29.08.15

Hasib Sir

- Teacher: Prof. Dr. Moazzem Hossain : Transportation Engineering
  Prof. Dr. Hasib Mohammed Ahsan : Transport Planning, Geometric Design of Highways
  Prof. Dr. Md. Shamsul Hoque : Traffic Engineering, Transportation in Bangladesh.

- Sir won't take class from Sept 15 to Oct 16.

Transport ~~Board~~ → movement of goods & people.

We need a mode for Transportation.
Walking is also a mode.
Waterways → path which is navigable, is followed.
We also need infrastructure.

Not following rules is the main problem of jam.

Have to design considering demand & supply.

Books:

(1) Highway Engineering (7th & 5th edition).
Paul H. Wright & Rodnor J. Paquatte;
John Wiley & sons

(2) Traffic Engineering & Traffic Planning.
L.R. Kadiyali; Khanna Publishers

(3) Introduction to Transportation Engineering & Planning: Edward K. Mordak;
Mc Graw Hill

(4) Principles, Practice & design of Highway Engineering -
S.K. Sharma, S. Chand & Company Ltd.

(5) Traffic Engineering - theory & practice
- Louis. J. Pignataro, Prentice Hall Inc. Englewood Cliffs NJ

Transportation Planning

Introduction

To understand the meaning of term transportation planning, we need to understant
— transportation & planning.

Resources: raw materials, humans, technology, fund,
→ needed for any development
→ have to use efficiently & allocate equitably.

Allocation: Distribution,
→ See '5 year Plan' from Library
পঞ্চবার্ষিকী পরিকল্পনা
→ to decide priority.

Equity: → how much is the necessity.
→ Allocate resource equitably & efficiently.

Community: User
→ need to know their need.

Widen : Have to increase the choice.

So, to stop Rickshaw in VIP road is a wrong decesion.

i) Not following rules
ii) Traffic Police don't manage efficiently.

Options : Can't stop options. Have to increase options.

Captive users : Using a mode since there is no other options.

~~Proposed | Achieved~~ } Very difficult to say about future. What will be the trend of development after 10 years.

Prediction : ↗ This is done on the basis of some information.

Consequences : Have to understand the result of taking the steps.

Have to decide on a goal.

Rickshaw was removed from VIP road with the goal to increase speed & decrease jam. But this goal wasn't achieved.
This caused the loss of one community who use rickshaw.

Criteria → have to decide on criteria.

Ultimately we want safe, efficient & convenient transport.

Have to meet current & future needs.

Sustainable → will sustain if community wants it.

Social Development: Social values may decide the design or development.

Transportation Planning

Basic Elements of Transportation Planning:

Flowchart: Figure 3-1

Planning process is a dynamic & continuous process.

The Planning Process (4 phases)

1. Survey Phase (Inventory)
2. Analysis & Model building Phase
3. Forecasting phase
4. Evaluation phase

Inventory → making a list.
→ facilities, transport pattern & land use.
→ we'll get a database.

Model → to understand the future using the info collected.

Forecasting → most difficult

Evaluation → operational, economic & financial.

Operational → whether people are sitting in bus or standing → (eg)

Have to consider Economic Benefit.
Have to evaluate if toll collection is feasible or not for community.

For Padma Bridge → in point of view of financial evaluation, not feasible as can't operate it using toll.

But ~~it~~ from the point of view of economical evaluation, it is feasible.

So, we give most importance to economical evaluation.

1.08.15

(2)

Hasib Sir

- For 2 weeks sir will take 3 classes in a week.

Possible Data Sources for Desk Study of Highway locations

- Project → eg:- making road, starting bus service etc.
- To understand project, we need data.

Data Group

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

- Have to ensure safety
- Should not make highway through forest as it will destroy resources.

(Q) • Why Registration Records is a Social Data

⇒ Car ownership depends on social status & registration record represents car ownership.
Economic disparity is more in our country. Social classes have huge differences in social & economic status.

⇒ More car ownership indicates less use of public transport

⇒ Have to analyze these data while working in a project.

- Dhaka - Chittagong road → 4 lanes upto Daudkandi.
- Most highways in Bangladesh are 2 lane highway.
- Agricultural land might be destroyed if we want to increase lanes on ground. We may also make lanes at elevated level.
- Have to analyze the data & assess which option will be beneficial → increasing lane or protecting agricultural lands.

Surveys & Plans:

Fig - 13-1 : The Rural Highway Location & Design Process (flowchart)

→ not much important

→ we'll memorize the chart shown in 1st class

Data Collection:

- Data (Reliable ; Quality data) is the basis of Planning

Road-Use Studies:

- To what extent or for how long or why a road is being used ?.

Pavement Life Studies

- Also called remaining life or residual life
- Distributed load → less damage
  Concentrated load → more damage
- If trucks with more load moves on road, crack may occur as design load was less → that's why crack developed at Padma bridge
- Hardinge bridge → already 100 years old
  → expected life is 125 years
  → if frequency of train is increased, then life will be less.

Traffic Volume Studies:

VMT → Vehicle-miles of travel

AADT → Annual Average Daily Traffic

We want average one for design

ADT → Average daily traffic

We need Counting Stations

i) Coverage Stations

ii) Control Stations

Sampling is very important for Transportation Engineering

Sample should always be Representative

✱ Control Station → continuously taken but not for long

✱ Coverage Station → taken for a long time
→ 2 to 5 miles for rural
→ 1.6 km for urban

• Ultimate target is preparing a map

Have to draw each link in map.

(*) These are from book → 1 page skipped
→ won't give this sheet.

In sessional we'll do manual counting. But there is also automatic counting by camera or weight measurement (from wt. can understand whether bus or motor-cycle)

GPS → tells position of receiver
→ can track vehicle
→ may be used in forest areas to know if any accident happened

These are components based on volume.

Travel Surveys:

→ to know origin, destination

→ choice depends on trip purpose

→ to design a parking lot we have to assess whether driver will be driving (parking lot can be far away as driver can drop owner & have enough time to park).
or owner will be driving (parking lot has to be near as owner have to go to work immediately without wasting time in parking).

→ To reduce congestion, one person can't travel alone in some countries (have to give fee if travels alone). Many people (4 or 5 at least) needs to travel together.

Household Travel Surveys:

→ most comprehensive & more expensive surveys

→ can't do sampling for population census; have to go to each house.

→ but in our case, we'll do sampling

→ 2 days to 2 weeks: ask people

→ this sampling is not done at road; it is done at home (because at road people are busy & may not talk or may not remember about last 14 days but at home they may have a schedule)

→ More sample size, less %.

Roadside Survey Method:

→ very difficult

→ cordon

→ Screen line

→ Definite area: Condone line is used to specify an area

Modal Surveys:

Mode → walk, bus, train etc.

Goods & Transportation Surveys:

→ more important than human transportation.

Parking Surveys:

(Will be taught in other class)

* On street & Off-street parking
  ↓
  outside roads, field, park etc

* 4 types of data needed.

1.09.15

(3)
Haris Sir

Use of Data for Origin Destination Analysis

O-D → Origin - Destination

eg - If OD is Dhaka Narayanganj → can give direct service. But if stops at middle, then can't give direct service.

Have to form a Matrix of OD.

TAZ ⇒ Traffic Analysis Zone

eg - BUET, DU → educational area → has specific pattern
New Market area → has different pattern

⟶ Pattern is based on Land Use.

We try to form small unit.

Census boundary

In Dhaka there are 90 words

1st we try to coincide our boundary with census boundary

Interzonal → going from one zone to other zone

Intrazonal → Within a single zone.

⇒ We want Interzonal trips.
Intrazonal → 10 - 15%.

Fig 3-4 Example of TAZ

- Internal Traffic → who travel within the study area but moves from one zone to other.
- External Traffic → Who moves from outside study area to inside.

Comprehensive O-D studies
→ external survey
→ internal survey (home interview)

From Questionnaire we get volume.
We transfer small sample to bigger survey.
We need to check sampling → 3 types
1) Use of control points for comparison
2) A screen-line comparison
3) a cordon-line comparison

- Screen line → open
→ divides study area into two
→ to check whether moves from one side to other.

For East-West road, we draw N-S screen line. If demand more, than we need road at east-west direction.

Figure 3-5 Comparison of Traffic passing ....

Fig-3 Diagramatic representation of basic movements.

1st → outer cordon
We may form many inner cordon.

3 movements in study are
i) Internal Trips
ii) Internal-External Trips
iii) External-External Trips.

We want to improve transport facilities; so we are studying Transportation
need to know internal trips to improve internal traffic.
us terminal is designed for inter- or Internal-External Trips. (Dhaka Chittagong)

External - External → Khulna to Chittagong trip (but has to go through Dhaka)
→ To lessen congestion within city, by-pass road is constructed.

Fig. 3-6 A Desire Line Map

→ Origin Destination corridor is formed.
→ It is very important to know OD.
→ We need to give service for lowest time.

Plan & Project Evaluation

Criterias: (No need to memorize)

Table 3-2 Measures of Effectiveness used in Evaluation.

→ Using these parameters we understand condition of system.
→ Public Participation is important.
→ Need to know whether public wants or not
→ Public hearing, comments, meetings, ...

For East-West road, we draw N-S screen line. If demand more, than we need road at east-west direction.

Figure 3.5 Comparison of Traffic passing - - -

Fig-3 Diagramatic representation of basic movements.

1st → outer cordon

We may form many inner cordon.

3 movements in study are

i) Internal Trips

ii) Internal - External Trips

iii) External - External Trips

- We want to improve transport facilities; so we are studying Transportation

We need to know internal trips to improve internal traffic.

Bus terminal is designed for inter-city or Internal - External Trips. (Dhaka-Chittagong)

Transportation System Modelling

Fig : 3-7

Land-Use/Transportation Interaction

→ Transport & land use are inter-related

↓

Chicken - Egg

→ Fig-1 : The Land Use Transportation Cycle

The Recognized Components of Future Travel Demand

→ Natural growth occurs for existing traffic

→ For diverted traffic, mode is not changed

→ Converted traffic : mode changes

→ Change of destination traffic is for transport development.
OD will change

→ Development traffic is due to land use

→ Induced traffic had no form
People are being attracted by giving service
eg - ladies bus.
It is special kind of service.

Behaviour of the component is to be known.

Basic Concepts in Transportation Systems Modeling

↳ Trip making is a fn of land use.
↳ Should use Time Staggering
↳ have to consider the options while modeling.
↳ We don't usually want comfort maximization but we want minimization of inconvenience.

Transportation networks & Traffic Analysis Zones are the basis of Systems modeling.

→ Any intersection is node
→ We divide whole system into node & link
→ Centroid is also a node.

Fig 3-8 : Representation of a transportation network.

→ We have to identify and name from which node, movement is going on which link.

7.09.15

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- 4 step modeling process: To forecast demand
  - i) Trip Generation (T_i) or (Trip Attraction)
  - ii) Trip Distribution (T_{ij})
  - iii) Mode Split (T_{ijm})
  - iv) Trip assignment (T_{ijmr})

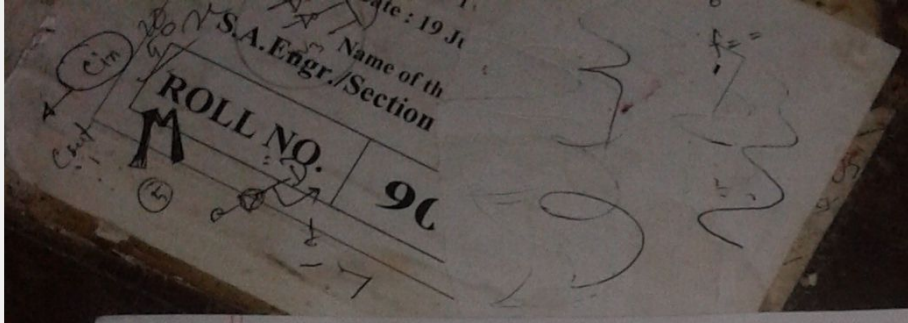
* Land use → as an external variable
  → considering it will be 5 step transport model

* Trip attraction → as if goes to office, then returns home, office becomes source & home becomes destination.

* Zone i to zone j
* Trip ~~&~~ Distribution is done for preparing O D matrix so that we can know demand.
* Need to know which route will be followed.

- Trip Generation

↳ have to know land use.
  - i) intensity
  - ii) Characteristics
  - iii) location related to economic activities



☐ Trip rates from National / local Sources:

Those who want to study TE, must have idea about these
↳ see 5 year Plan from Library
↳ see Statistical year book of Bangladesh

☐ Cross Classification Analysis: (comparison)

1) Tabular Format 2) Graphical Format

↑ From survey

(*) In our country we don't use graphical form. Lots of data are needed for generating Graphical form.

(*) The graphs in sheet are for American Society.

(*) Because of freedom, private ownership increases with increasing income.

(*) More private ownership → more unnecessary trips.

(*) Home, Work, Shop → these 3 elements are very necessary

(*) Home based Trip → either origin or destination is home

(*) Office to shop → non-home based trip (NHB)

(*) Majority of trips in one day are home based trip.

(*) HB Work ⟹ more income → less work trip
less income → more work trip

because of work pattern
less income → official job
more income → managerial job
More income → more home based trip.

(*) Ultimately we get trip production purpose.

- Regression Analysis :

Car → independent variable
trip → dependent "

(*) The coefficients are from Calibration (0.34, 0.21, 0.12)

(*) Which parameters we select, depend on Correlation

(*) • Trip Distribution

Measure of Attraction (Newton's law concept is used)

→ $n = 2$ if not given.

→ a ratio or proportion

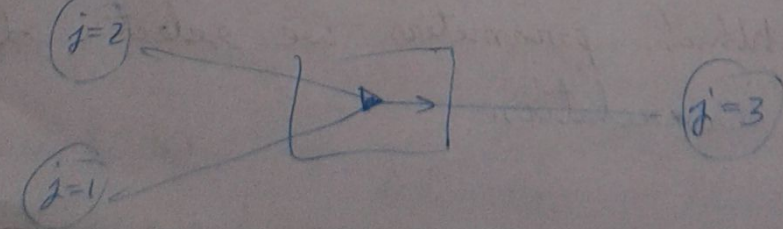
→ From previous step we got forecast which we will divide in ratio for different zones. Thus we get O-D matrix.

→ In Transport we don't work with distance.
Travel time is more important than distance.

→ $F_t = \frac{C}{t^n}$ travel time is converted

→ K → socioeconomic adjustment factor
→ without it trip distribution won't be accurate.

Math → from book



Mode Split Models

→ Individual Choice ~~method~~ Model : Mode Split Models
→ Previous 2 models were Aggregate Type of model
→ Mode choice is more individual choice than aggregate choice.
→ Which mode we shall choose depends on Utility function

Math on utility fun^n (from book)

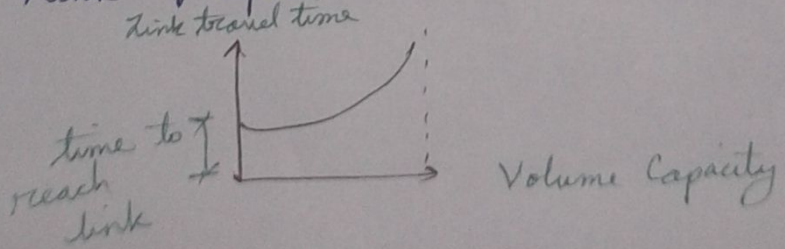
(*) 1000 trips : auto, bus, walk.
(*) Parameter : travel time , cost (these are primary parameters ; could add comfort)

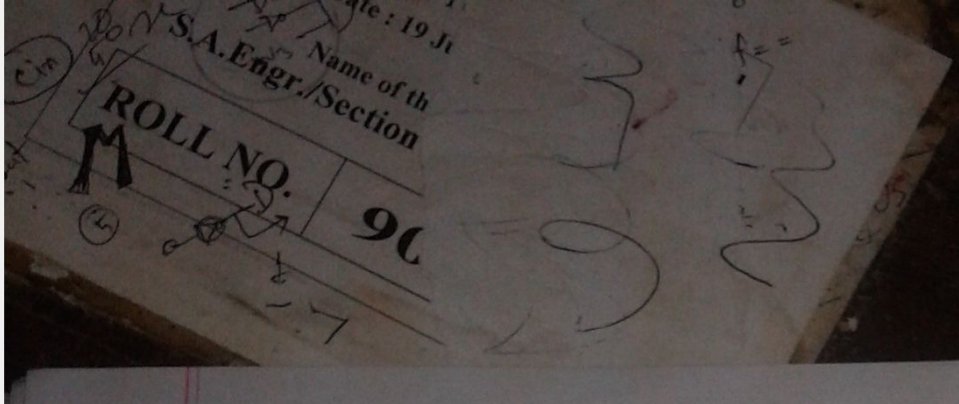
Trip Assignment

(*) Link is the biggest element

Link Performance Fu^n : for each link

#





Using this fⁿ we can do 3 types of assignment.

i) All or nothing assignment

ii) Capacity Restraint Assignment

iii) Stochastic Equilibrium Assignment.
dynamic process, moves up & down if there are two parallel roads.

ITS → Intedligent Transport System.

CT → only Today's class → next week Monday or Tuesday (will inform later)
→ Saturday normal class.
→ ~~from~~ from book.

14.09.15

(5) Habib Sir

Geometric Design of Highways

(*) Planning is for standard solution or ideal solution; budget is not considered here.

↳ Proportionate : very important

↳ We'll proportionate the visible elements.

↳ Which we can see, are included in Geometry; which we can't see, are not included.

↳ Controls & Criterias for proportioning for evaluation.

↳ Controls & Criterias are only Guidelines (not mandatory)

↳ As an Engineer, have to apply judgement.

↳ Have to know for which purpose road will be used.

↳ Have to know volume.
If more rickshaw moves then one type of design and if more less moves, then another type.

↳ If speed more, have to give more facilities.

↳ Topography is very important from the point of economy & nature
Natural Topography should be followed, only then drainage will be good.

↳ If we think about funds - can't plan First have to know the necessity and then assess fund and modify the plan accordingly.
Stage construction → very important for poor countries

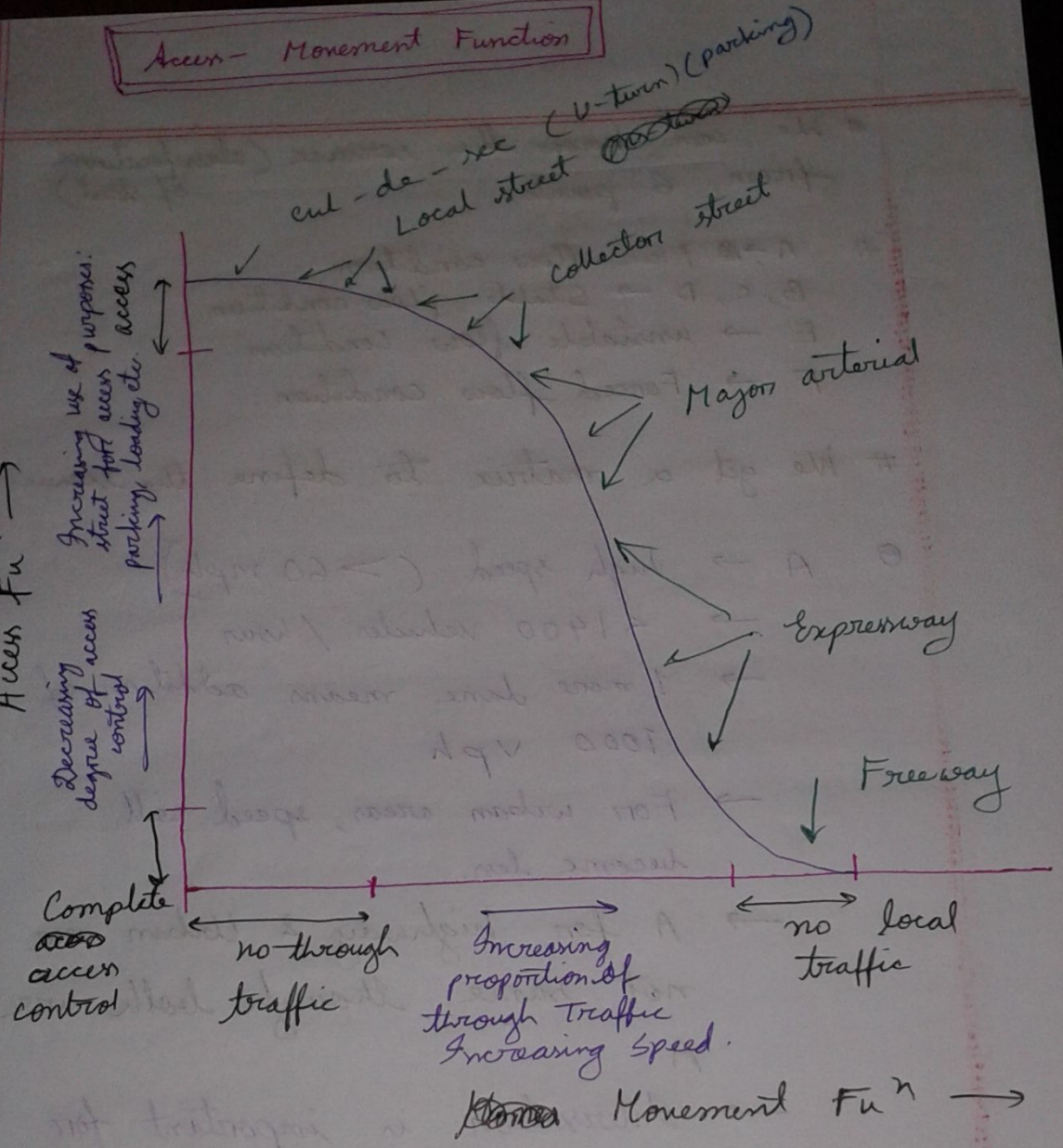
↳ Have to understand human psychology
Then wastage will be less.
In road, high speed vehicles moves along mid-lane
and low speed vehicles move along foot path

↳ Need to know size of vehicles

↳ We'll get safety if all criterias are satisfied.

↳ pollution should not be present.

Access - Movement Function



(*) We can define level of service → according to AASHTO.

A, B, C, D, E, F

We can know the service (classification of street) from 6 points

A → Free flow condition
B, C, D → Stable flow condition
E → unstable flow condition
F → Forced flow condition.

We get a matrix to define the service

- A → high speed (>60 mph)
  - → <1400 vehicles / hour
  - → 1 more lane means addition of 1000 vph
  - → For urban areas, speed will become less.
  - → A for highway & Urban are not same though both are A
  - → Intersection is important for Urban ; not for highway
  - → Load Factor
  - → Level of service is different depending on classification of street.

- Forced Flow → stop & go
  → looks like parking space (storage).

7.11.15

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Design Speed

Design Speed Def^n → "the max^m safe speed that can be maintained over a specified section of highway when conditions are so favorable that the design features govern."

footpath, lane width etc.

Design speed & allowable speed are not same.

To ensure safety, 'speed limit' in road is less than design speed.

Generally, there is a common speed for a city.

Design Designation:

↳ for which purpose, design is done.

↳ In map, there are scales, North line, (mandatory)

↳ DHV = Design hour volume (need to know hourly variation).

↳ Hour variation can't be understood from average one. So, we don't design using average variation.

↳ We don't design using highest value

as it will not be economical.
We consider 85 th value if there are 100 values.

↳ D = direction of flow.
(one lane free, one congested)

↳ T = truck volume, truck percentage

↳ ADT = Average

- Design Vehicle :

↳ We design for largest vehicle that is expected in significant ~~in~~ no. in the design year.

↳ After a road is constructed, it is not readily opened for traffic. May be opened after 5 years; have to consider that year.

- Table 8.3
Design Vehicle Dimensions

↳ no need to memorize; just for understanding

↳ Overhang, wheel base (in between axles)
↓
how much is open from base.

↳ Motor home: Foreign consultants bring these in our country for working in field condition.

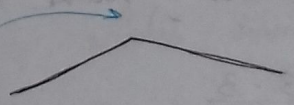
8-4 The highway cross section
8-6 Limited-access highways.
8-7 Pavement crowns
8-8 Shoulders
8-9 Guardrails
8-12 Right of way
Curb

↳ along with volume, level of ~~sp~~ service should be maintained.

↳ Limited-access: access is controlled. In our country, no example of this level. "Fly over" can be taken as an example. Should be present.

(+) We have 8 national highways (considering Jamuna bridge, can be 9)

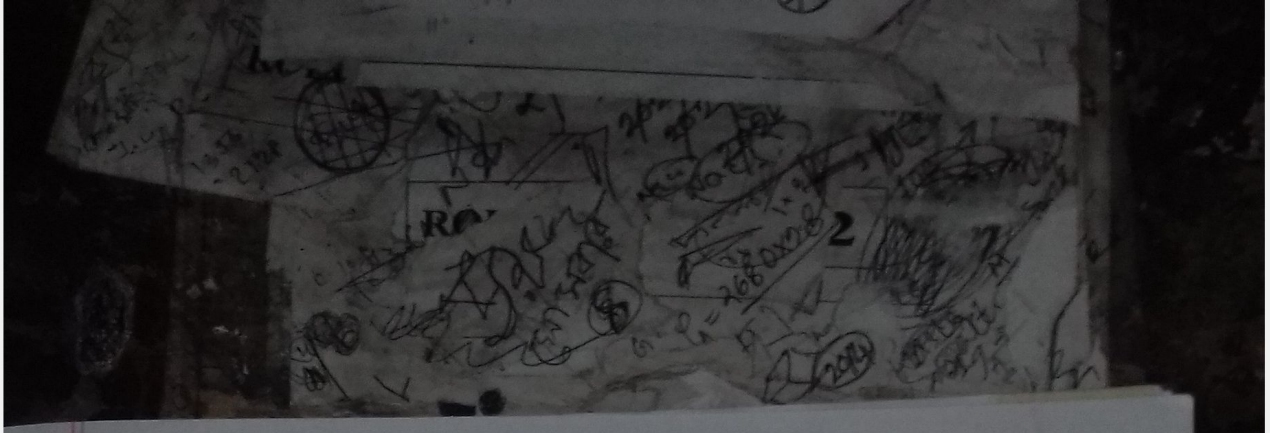
↳ Pavement Crown:



Centerline is raised with respect to outer edge. This is for drainage facility; not for traffic.

$\frac{1}{8}$ → 1 vertical, 8 horizontal.

Now, $\frac{1}{16}$ → as material & construction process has improved.



↳ Shoulders: → unpaved portion for lateral stability (from structural point of view)

→ it is not travelway as vehicles don't move above it.

→ safe operation: if vehicle ~~can~~ gets damaged, can't keep on travel way; then can be kept on shoulders.

→ ~~o~~ sidewalk / footpath (whatever term we use, have to understand meaning)

→ during flood, shoulder can be damaged.

→ full traffic capacity is ensured by it.
If everyone move along centerline, then capacity will be reduced.

↳ Guardrails: → Usually in hilly areas or bridge, it is used to indicate limit.

→ we don't give too much strength for guardrails.

→ it indicates edge of bridge.

↳ Right of way: → For city, property line to property line ~~is~~ space

→ it means this space is only for traffic movement. Can't do other works in this space.

→ For highway, property line isn't visible

↳ Curb: → Shows pavement edge

→ We usually use it for city

→ Raised footpath.

→ Barrier curbs (footpath)

→ Mountainable curbs (Parking lot)

→ In some European countries, as less space, for certain period, car is allowed to stay on footpath and hence in these cases, Mountable curb is uses.

Figure 8-4

ROW → right of way.

If we can't ensure safety of pedestrian, how can we ensure safety of bicycle lane.

Figure 8-5

For rural areas, a bit more area needed.

For highway, slope is a must; sharp slope is very harmful. If steel slope, then an uncontrolled car may overturn. But if mild slope, then it may drive downwards.

- 1 on 2 → steepest slope for highway; must not exceed it.

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(7)

Hasib Sir

Alignment:

We use circular curve if variation in horizontal direction. For vertical distribution, we use grade or slope.

8-14

Circular Curves:

100 ft Arc
100 ft Chord

Degree of curvature & radius represents a curve.

Geometric Design of Highways.

Superelevation of Curves:

↳ Centrifugal force is to be balanced by weight & for this outward ~~dir~~ edge is elevated.

↳ F = side friction factor (road surface friction)

↳ So, in curve, surface is kept rough texture to develop friction so that along with slope, it can also balance centrifugal for (balanced by 2 elements)

↳ $e + f = \frac{v^2}{gR} = \frac{V^2}{15R}$

Fig 8-7

Can find superelevation from curves also. In practical life, different handbooks are used.

Table 8-5

max^m Degree of curvature → lower rounding

min^m Radius → upper rounding

Length required for Superelevation Runoff - Two Lane pavements :

↳ for superelevation, distance is required.

↳ To place a circular curve, two transition curves is to be used.

↳ Spiral is variable

↳ R radius is at connecting portion of circular curve & transition curve.

↳ Circular curve has same superelevatio

↳ Superelevation Runoff : Transition runoff.

(*) We'll take bigger of transition runn off and length of transition curve.

(Chart not needed :)

8-16 Spirals or Transition curves

● Attainment of Superelevation:

3 methods

↳ 2 fig : line diagram and pavement surface
  ↳ A position is the crown for all the figures. (centerline)
↳ In line diagram, variation of elevation of inside edge, outside edge etc are shown.
↳ In pavement surface diagram, physical properties are shown.
↳ Outer edge, inner edge depend on curve.
↳ Center line (A) → straight line → as always in same elevation.
↳ Outer edge → varies.

↳ W.r.to center line, as much inner edge is below, that much outer edge is above at the point bet^{n} B & C.

Have to raise outer edge upto superelevation is attained.

Have to use cut-fill.

If cut = fill for a road, then it is most economical.

Outer edge movement w.r.t. inner edge (B)
↳ inner edge is always in same elevation.
↳ raising the road up means filling.

(C) → Cutting → as crown is taken below.

(Q) In exam, have to draw line diagram by understanding properly.

Fig 11 Camber → British notation for superelevation.

8-18 Widening of curve:

↳ needed from safety point of view also.
↳ widening is done because sometimes friction does not work and vehicle may

slip due to centrifugal force. So, widening prevents it.

A vehicle moving in curve is a bit slanted / projected because rear ~~wheel~~ wheel & front wheel don't follow same path. So, the impact area of ~~curve~~ vehicle increases. For this widening is done.

Grades & Grade Control

For vertical alignment

8.20 Vertical curve

↳ x & y measurement.

↳ vertical offset.

↳ one method shown as example.

Example B-1 → Do it.

↳ in this method 2 times x, y measurement for 2 portions; can't have continuous measurement.

↳ Vertical curve needed on bridge, in undulation (should not change undulation, rather use vertical curve because natural topography ~~is prescribed~~ should be maintained. For less variation, grade can be used.

↳ For change in vertical direction, have to adjust with grade on vertical curve.

8-21 Sight Distance

↳ vision of driver ahead is sight distance.
↳ Available & designed sight distance.
↳ Sight distances decreases with curve. For this buildings should not be erected at intersections. Should avoid blind spots.

↳ i) Stopping sight distance
ii) Passing sight distance (overtaking or passing)

↳ Stopping sight distance: i) Perception-reaction distance
ii) Braking distance

↳ A man takes 2.5 sec time to apply brake by understanding. Specific age limit for license because this perception - reaction is different at different age. This also depends on other things like education, etc.

↳ In this 2.5 sec, car will move a bit distance with the velocity it is moving and then another (d) distance for broking

↳ Driver needs a min^m distance for stopping a vehicle.

Table 8.7

* min^m sloping sight distance → upper rounding

Table 8.8

* If grade is present → (moving up or down).
* If moving down, stopping is difficult.
* If moving up, can consider less distance ~~by car~~ but while moving down more distance will be required.

8.23 Measuring Stopping Sight Distance

↳ Algebraic : have to consider sign.

↳ If height of eye of driver is more, can see more and can quickly stop car.

↳ Conservative assumption : $h_1 = 3.5'$, $h_2 = 0.5'$

↳ If less than 0.5', then car can move over it but if more, have to stop car.

↳ Must memorize upper value.

Graphs ⟶ for practical life ; not exam.

8.24 Minimum Passing Sight Distance :

↳ pass or overtake → for this have to increase speed.

→ have to see if our sight distance is clear or not as there is vehicle ahead of us.

(next class → 8.24 → this topic.

21.11.15

(8)

Hasib Sir

8.24 Minimum Passing Sight Distance

↳ Very important for our country as ~~more~~ most of our highways are 2 lane 2 way.

↳ If 4 lanes, then its importance becomes less.

↳ If 2 lane, then to go to another direction, vehicle moves to a lane where traffic is flowing opposite to it.

↳ d_1 → perception, reaction, initial acceleration.
→ the car is preparing to move to another lane.

↳ d_2 → longest distance
→ Initial acceleration ($\frac{1}{3} d_2$)
→ d_2 may get extended due to overtaking

↳ d_3 → $d_3 = 0$ means head on collission

↳ d_4 →

↳ $d_4 = \frac{2}{3} d_2$ → danger period

↳ After adding d_1, d_2, d_3, d_4 we can understand whether to overtake or not.

VVI

Empirical Formulas:

$$d_1 = 1.47\, t_1 \left(v - m + \frac{a \cdot t_1}{2} \right)$$

(remember units)

$$d_2 = 1.47 \, v \, t_2$$

- Min^m 10 mphs

$$d_3 = 110 \text{ to } 300 \text{ ft}$$

- There can be psychological impact if less than this

$$d_4 = \frac{2}{3} d_2$$

- In our country, vehicles are to be kept to the left.

  Right hand Drive Vehicle

(*) In book, American convention given

(#) In exam, can't draw the fig. of book. Draw the mirror image of the fig of book. ⟶ Other-wise no marks.

VVI

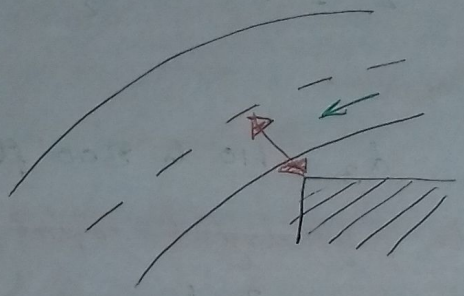
H.W.

- Fig 8-12 → curves (We don't need these)

Measuring Min^{m} passing Sight Distance:

We need to know main formula in case h_1, h_2 varies

Horizontal Sight Distance:



Eq^{n} 8-17, 8-18

3 sight distances:

Stopping, Passing, Horizontal

→ very important for our country as most accidents occurs ~~of~~ because of these

Table 8.11 → Summary

Planning & Design of Bicycle Facilities

↳ At a point of economy, motorcycle grows in number. It didn't happen in USA as their economy is very good.

↳ Bicycle → non-motorized vehicle
Rickshaw ↗

↳ Volume & Speed → whether we'll give facility or not, depends on these 2 factors.

Bicycle Facility Planning: 8-28

Data collection: Survey
Planning Principles:
Geometry: geometric standard of road.
Plan: there has to be continuity and rules about intersection
Access Control.

Warrants for bicycle Facilities

automobile volume is needed to know if there is capacity remaining for bicycle.

AASHTO criterias → compare bicycle & rickshaw

Greatest impact → if a rickshaw comes in front of vehicle, then speed will drop drastically.

So, we need to take measures for solving this.

Standard Facilities

1) Bike Route (Road shared) / (designated means the road will give priority to rickshaw)
2) Bike Lane (flexible → paint)
   (forcefully → use barrier)
3) Bike Path (best / desirable solution)
   (completely seperated roadway → when space is more).

Designated lane → other vehicles can move only when designated vehicle is not there.

Planning & Design for Pedestrians

(*) Non-motorized Traffic → pedestrian, rickshaw, bicycle

(*) Non-motorized vehicle → no pedestrian

Sidewalk

In whole world, pedestrians face accident

(*) Pedestrians are most vulnerable users of roadway

↳ 5′ wide sidewalks are recommended.

↳ min^{m} 4′ (in some books)

↳ 6′ min^{m} for commercial areas & school route

Math | Example 8.2 Sidewalk Flow Evaluation

Pedestrian flow also has a level of service.

7 level of services (Table 8-16)

Sol^{n} → we should do for non-motorized vehicle & pedestrian.

- Flow rate → persons / min / feet
- Space / Person → ft^2

Provisions for Elderly & Handicapped Pedestrians:

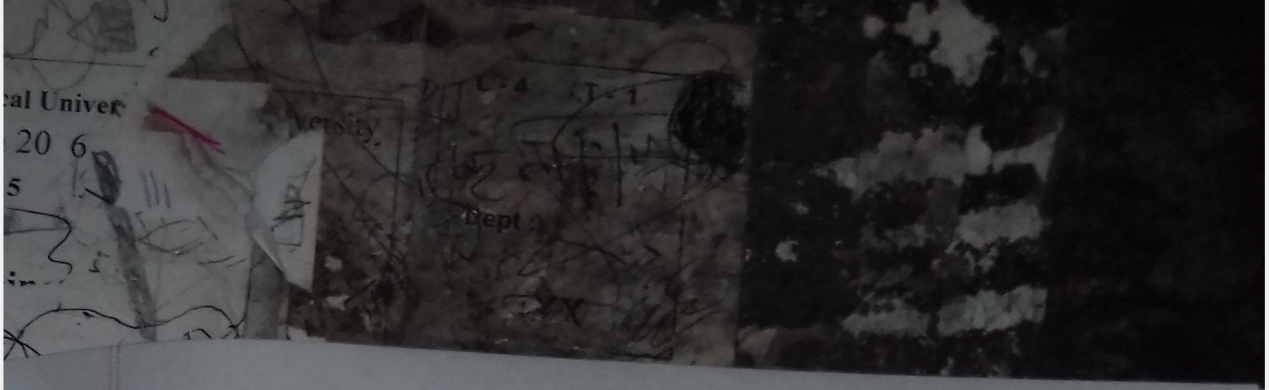
↳ Footpaths should not be made without slope.

↳ No slope is good in one sense that motor cycle can't move up on footpath.

↳ From the concept of Brail reading, footpath is made of special tiles. Using case, the blind people can understand the paths directed.

↳ We don't design for 1 person or 1 vehicle

↳ In present days, many handicapped people have started working & so have to keep provisions for them.



28.11.15

Habib Sir

Chapter Nine

Intersections, Interchanges, Terminals

- Conflict of movement is a big problem
- Vehicular conflict
- Straight, left, right → 3 movements.
- Interchange → link at grade seperation
- Bus or Truck terminal.

9.1 Intersection at Grade:

- Fig 9.1
- Volume & speed are important.
- In general, in our country → left turning lane is always free as no conflict.
- Left turning lane.
- Flare → one kind of turning lane.
  → some space kept at intersect.
- If still more volume, Islands are used to control, reduce conflict.

9.2 Islands & Channels:

↳ We give median to avoid head on collision

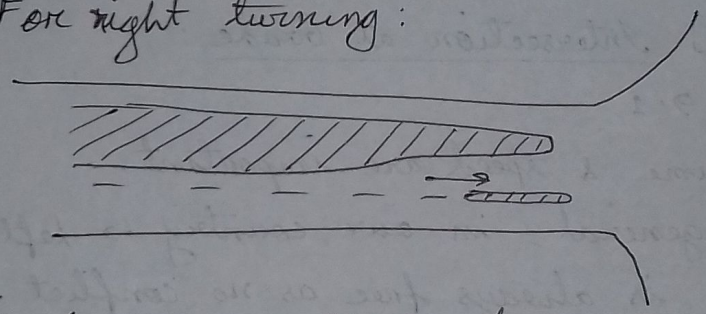
↳ Right angle is given to avoid accident

↳ There is difference between flare and excess area. Flare is control.

↳ Very important for pedestrian safety.

↳ Now we don't encourage giving island at the middle of road.

↳ For right turning:



↳ Islands are usually made as control device. Circular island for Police.

↳ 3 classes of islands.

(See the figures) → Figure 9.2

Directional Islands

Divisional "

A refuge "

- Islands should be large enough to command attention.
- Area : at least 75 ft^2, preferably 100 ft^2

Rotary Intersections / Roundabout

D-3

↳ Given, when island can't control ; it is large enough.
- Advantages (more ; though in book less points)
- Disadvantages

↳ See dimensions from net

↳ A circular flow is created ; otherwise we can't get benefit & it will be simply a traffic island, not rotary.

↳ Continuous flow.

↳ Accident happens but since no head on collision, so seriousness of accident will be less.

↳ In 'Sat Rasta', there is roundabout for easier movement.

↳ Disadvantage : volume & speed have to be less.

↳ Pedestrians try to cross at intersection. If there is roundabout, then can't cross.

Jamuna Bridge → there are 2 round about at the approach road of Jamuna Bridge
→ there used to be highest accidents of Bangladesh here

Roundabout doesn't work when speed is more.

Signalized Intersection

Signal design → in other class

9.4 Grade Seperations & Interchanges

↳ When Signalized Intersection doesn't work we use grade seperation & interchanges. (when volume is more)

↳ Two roads are not completely seperated.

↳ 3 dimensional flow from each lane.

↳ Express highway : huge volume comes from Highways

↳ Closely spaced intersection is also a problem.

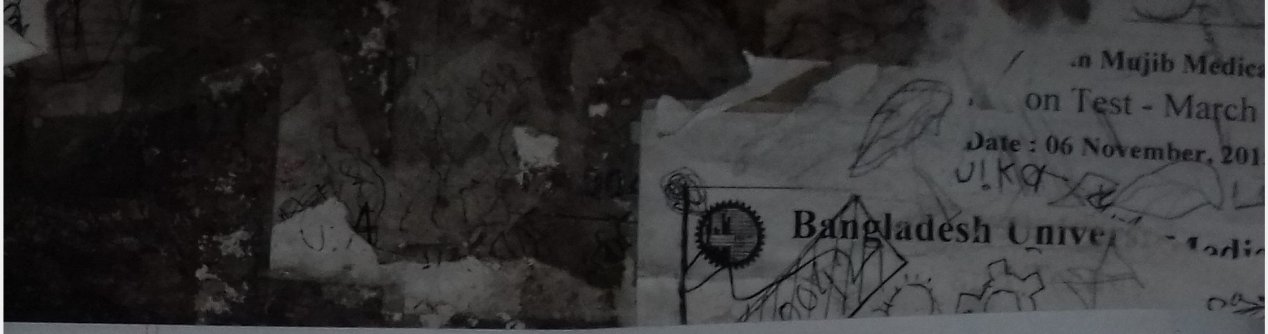
↳ If cost gets more, should do grade seperated instead of at-grade.

Figure 9.3, 9.4

Flyover → actually it is interchange (changing one roadway to other)

→ grade seperated interchange or intersection (actual name).

Figure 9.7



5.12.15

(10)
Hasib Sir

Design of Parking Facilities

→ On Street Parking
→ Off Street Parking

9.7 Location of off street parking facility

9.8 Layout of Parking lots and garages

Parallel parking (it also has rules)

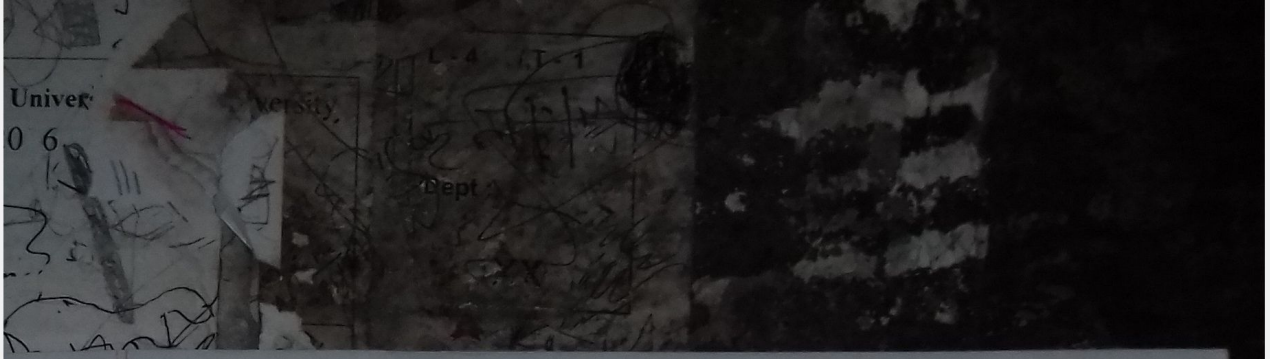
Parking lot Design :

90° on street parking is never allowed ;
But in parking design it is allowed.

It is a trial method → so there are variations

Curb Parking — × (not needed)

New Topic → Highway Safety (from handout ; won't get in Book).



Highway Safety

In no country traffic accident could be 100% prevented

3 impacts of Accident
- ↳ Property damage
- ↳ Injury
- ↳ Death

A kind of random incident

Crash is being emphasized as the term to replace the term accident because 'Crash' is preventable;
It is not proven but seems to be preventable.

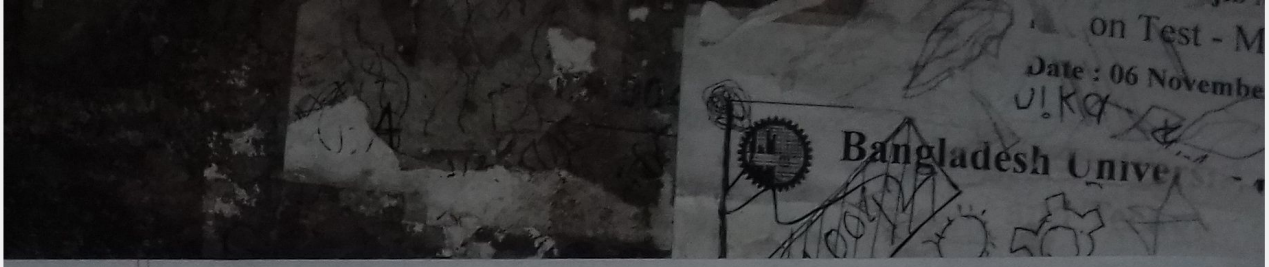
Causes:

Cause identification is a very difficult task

Truck driver, CNG drivers sleep
In CNG, there is sound which calms the nerve and driver sleeps; specially in highway

Factors:

4 categories



Vehicle, Driver, Roadway, Environmen
→ these are components.

In our country Truck drivers are most responsible for accidents.

Truck drivers spend money to get license as they are involved in commercial activities. In our country genuine license can be bought (This is more harmful than getting fake license)

{Sight distance & over speeding} are most important causes

Collecting & Maintaining Data

* Data is very important for research.
* Police record data in Bangladesh. ARI gets data from Police.
* Sketch is very important.

Storage & Retrieval of Crash Data

Collision diagram (VI)

In sketch —
- North line

Analysis of Crash Data:

- Methods of Summarizing Crash Data:
  - # Contributing Factors
- Identifying & Prioritizing Hazardous Locations & Elements.
  - # Determining Possible Causes of Crashes
    - Hazardous Location Identification → also called Black spot → the location were accident frequency is highest → This is very important
- Determining Possible Causes of Crashes

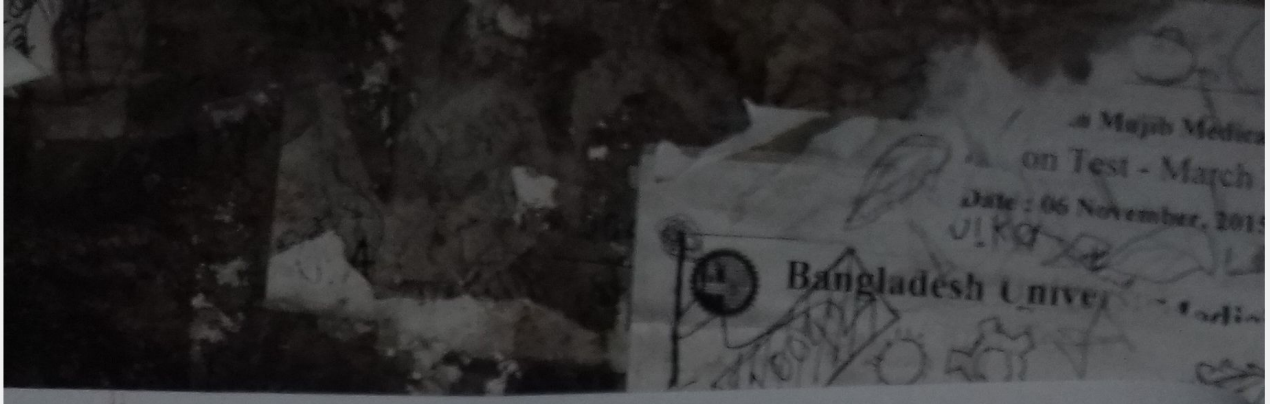
(*) VVI
The handout is American book → Here 'left turn' means our 'Right turn'

- Accident & geometry are related.
- In our country there is no signal for pedestrians (there should have been)

- Conducting Engineering Studies

▣ Countermeasures

➢ Project Cost of U-loop is very high (grade seperated)
Instead of constructing U-loop, blocks can be used to turn; this is possible by management



Implementation & Evaluation

without evaluation can't say that a system is effective ~~of~~ or if a project is successful. So, must do evaluation.