29.02.2016

Hasib Sir

Transportation Planning & Traffic Engineering

- Syllabus ⇒
  - Transport planning
  - Geometric design of highways
- Textbooks –
  1. Highway engineering (7th and 5th edition)
     - Wright & Paquette
  2. Traffic Engg. & Traffic Planning
     - Kadiyali, Khanna
  3. Intro. to transport engg & planning
     - Edward K. Morlok
  4. Principles, Practice & design of Highway Engg.
     - Sharma, Chand
  5. Traffic Engg
     - Louis J. Pignataro, Prentice, Hall, Inc.

Transportation Planning :

- Planning is undertaken for four main reasons—

1. to ensure that resources are efficiently allocated
2. - - - - - - - - - are equitably allocated
3. to widen community choice by offering alternatives and options
4. to make the best possible prediction of future needs & of consequences of proposed schemes.

- Transportation is the movement of people & goods.
  ⇓
  moving.
  - resources — all the usable things
  - allocation — to distribute
  - equity → demand wise
    → contribution wise
  - CIP — Commercially Important Person
    ⇓
    how much he can employ people and contribute in the economy.

V. Imp.

- community — general people

- captive users — those who have no alternatives economically and also have no facilities.

- The goals of road transport planning are to produce a ⇒
  - safe
  - efficient
  - convenient system

which will meet the current and future needs and preferences (V. Imp.) of the community and also promote social and economic development.

7.03.16

Transport Planning :-

- 4টা steps –

1. Inventory : তালিকা তৈরী করা। v.v.imp. phase & work.

- Survey phase-এ তিন ধরনের জিনিস বের করা –

(a) মোহাম্মদ কিভাবে travel করে

– origin & destination of travel জানা দরকার

– demand মোহাম্মদ কেমন – Buet Bus

– representative sample নিব – i.e. peak demand এর কিছু জায়গার বাসায় survey, city size, population density এর উপর demand করে

(b) উঠবা যেতে কি facility, bus service যদি ভাল থাকে সেখানে Buet bus দেয়ার দরকার নেই।

(c) রাস্তার আশেপাশে land কি কাজে used? residential, academic, corporate, attract করে না, productive & socio-economic activity – population, family size, income কত, income ↑, গাড়ি থাকবে, no need to provide bus.

– data collect – purpose: to understand the travel pattern → through survey.

— data collect - এর পর-

2. Analysis and model building phase:

- travel pattern, socio-economic activity, land use
  ⇓
  এদের মধ্যে relation ?

- economy ↑ ,, car আছে, bus দিলে use করবে না
  economy ↓ , ,, নাই, bus না দিলে problem

- Model = যে data পাচ্ছি / relation পাচ্ছি তা eqn দিয়ে express করা
  → কতগুলি point থেকে best fit curve (relationship) বের করা, represented mathematically.

a) trip generation
b) ,, distribution
c) ,, assignment
d) model split

→ 4 step transport model without considering land use here

⇓

Land use ধরলে ভুল ∴

Model থেকে pattern বের করে future-এ কি হবে তা predict করে নিতে পারব।

3) Forecast -

- পূর্বাভাস নিব — Model (existing behaviour দেখায়)
- but government এর future policy আমার consideration - এ নিয়ে কাজ করব। এলাকা থেকে population পূর্বাচলে চলে যাবে কিনা

4: Evaluation - consequences - bus service চালু করলাম, সেটা কতটুকু effictively কাজ করছে, congestion কেমন হচ্ছে ⇓ with respect to view of users.

a) Operational
b) economic
c) financial

transport ভাল, economy ভাল, বাস চালু, cost ↓, economy ↑ → view is community

Operator's viewpoint

⇓

তার লাভ হচ্ছে কিনা সেটা দেখে সে এই service দিবে

এর থেকে একটা flow dia –

Planning –

i. Data base তৈরী করা survey করে → main task of transport planning

ii. Data use করে, কি কাজে, কার জন্য ব্যবহার করব।

iii. এটা কি, model – building
⇓
SWOT Analysis করে বের করা defficiencdy, opportunity বের করব।

iv. Then alternative – ও ঠিক্ করা

v. Then finally implementation করব

vi. 20/25 year এর জন্য তৈরী করে থাকি so continuously maintain করতে হবে performance.
5 yrs পর দেখব – congestion কমেছে কিনা
⇓
with time change কিভাবে আসছে এটা continuously maintain করতে হবে।
⇓
So dynamic process — non government based যে 5 yr পর বন্ধ হয়ে যাবে

Planning এর জন্য কি কি ধরনের data needed?

1. Engg type – topography
2. Env. " – air, noise pollution

university area তে highway হওয়া ঠিক না।

- Project Power Plant @ Sundarban

⇓

পরিবেশ খারাপ হয়ে গেলে আটা ঠিক করতে আবার ১০ টা project লাগবে। তবে impact না ফেলে কিছু prevention নিয়ে কাজ করা যায়।

3. Social data – Bd তে public service (more expected)

USA → public service ⇒ less expected

4. Economic data – fund আছে কি নাই
- Agriculture – road বেশি করলে Agri. land ↓, food crisis হবে
- Dhaka – Chittagong highway – 4 lane railway

So extra project not needed.

14.03.2016

The Study Area – কোন জায়গা develop করব ?

- External Cordon Line – total যে area study করব
- Internal " " – অনেক বড় area হলে ছোট ছোট area তে ভাগ ভাগ হয়। Cordon lines never meets. like Contour.
- Zones –

Travel Data Surveys

- Internal trips
- External trips

Land Use/Transport interaction

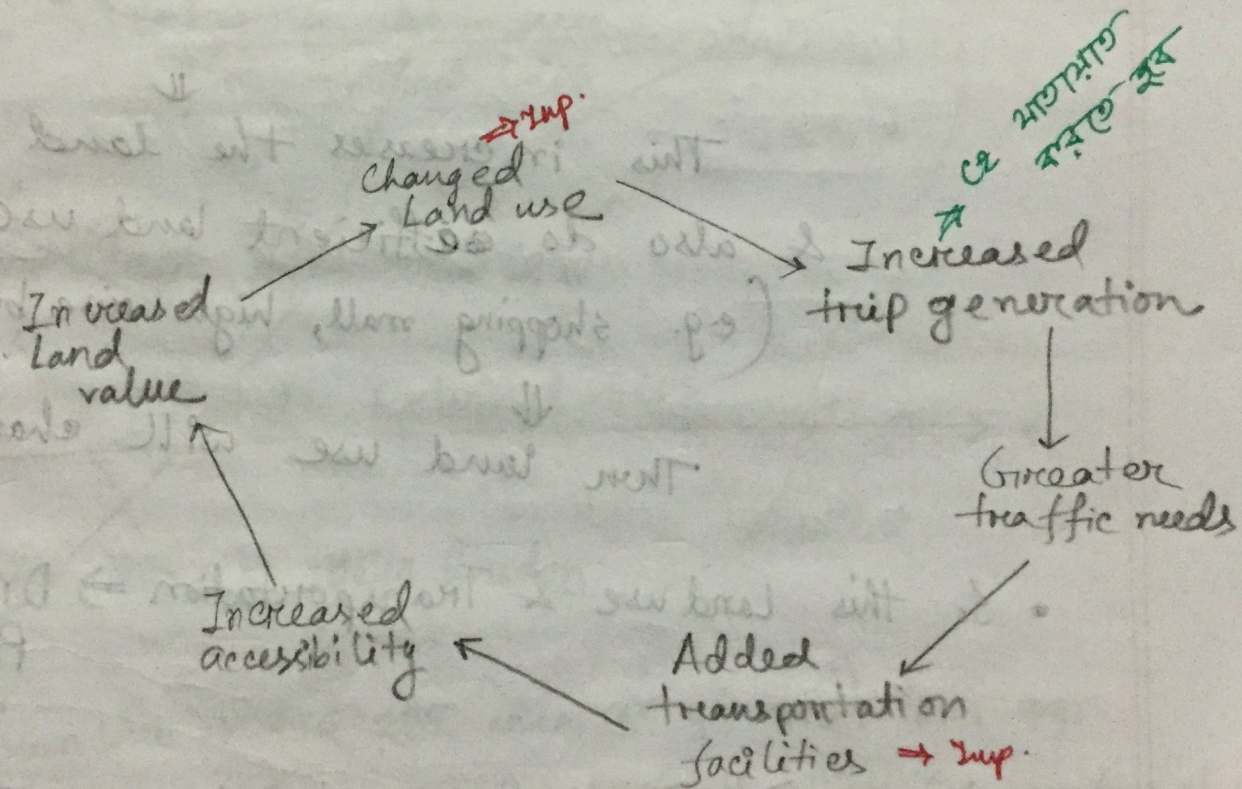


Fig: The land use transportation cycle.

- এই transport & land use change
  ⇓
  may be huge or little ⇒ it can't be said surely.

- for all demands ⇒ some transport facilities must be added

⇓

Added Transport Facilities

⇓

It increases ACCESSIBILITY or MOBILITY

⇓

how fast it can move.

⇓

This increases the land value & also do efficient land use (e.g. shopping mall, high rise building etc.)

⇓

Then land use will change

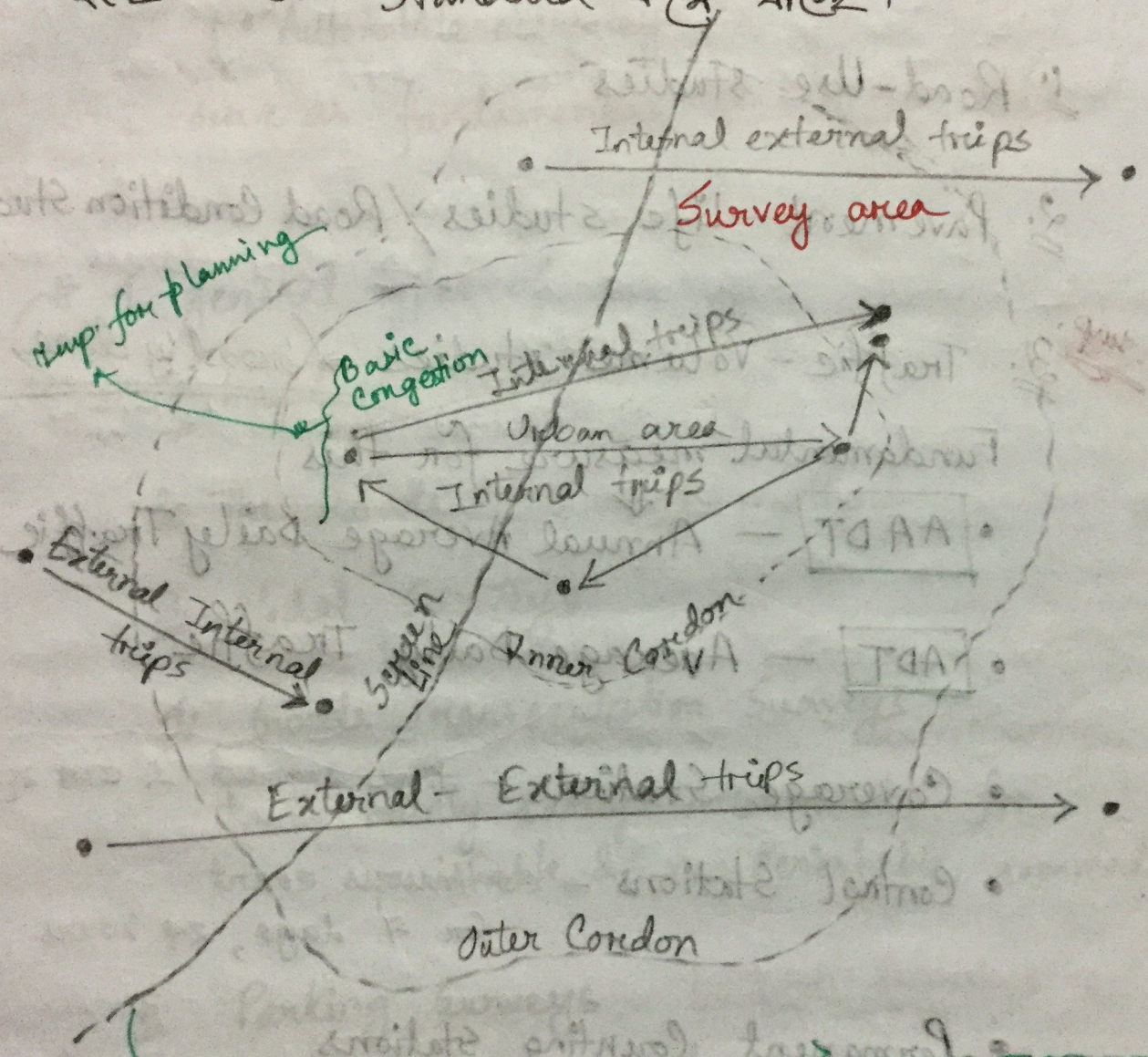
- So this Land use & Transportation ⇒ DYNAMIC PROCESS

- দুটোর একটাই দুটো change হত ⇒ change হতেই থাকবে until SATURATION.

⇓

from different point of view, saturation can be assessed.

• e.g. Dhaka তে যেভাবে population বাড়ছে তবুও saturation হচ্ছে না তে standard কমে যাচ্ছে।



Screen line ⇒ কাজ হচ্ছে area কে দুই ভাগে ভাগ করা

e.g. in Bd ⇒ North & South City Corporation of Dhaka

• Cordon Line এ কোন survey station থাকলে easy হয়।

Data Collection—

Different methods are there—

1. Road-Use studies

2. Pavement - Life studies / Road Condition Studies

v. imp. 3. Traffic - Volume studies → (broadly done)

Fundamental measure for this

⇓

- AADT — Annual Average Daily Traffic
- ADT — Average Daily Traffic
- Coverage Stations — time segment - 2 count
- Control Stations → continuous count for 7 days, 24 hours.
- Permanent Counting stations
- ITS — Intelligent Transport System

⇓

GPS is used primarily for tracking system

1. Travel Survey ⇒ directly trip makers' information.

- Automobile occupancy

serve as fundamental source of data

4 general types of surveys –

1. Household travel surveys
2. The Roadside survey method
3. Modal Surveys
4. Goods Transportation Surveys

⇓

mainly survey in terminals for perishable & non-perishable commodities

5. Parking Surveys

⇒ 4 data are needed

- Location & kind & capacity of existing parking facilities
- Amount of parking needed to serve the present demand
-
-

21.03.2016

Use of data for origin destination analysis:

TAZ = Traffic Analysis Zone. For selecting TAZ we have to follow some instructions—

1. Uniformity
2. The boundaries of this zones should, whenever feasible coincide with census tract boundaries and with jurisdictional boundaries
3. The zone should be small enough so that there are a large number of

Interzonal trips ⇒ zone to zone trip
Intrazonal " ⇒ within the zone

Fig-3.4

1. External survey
2. Internal survey ⇒ may be checked by 3 methods
   1. use of control points for comparison
   2.
   3.

Fig - 3.5

Transportation Systems Modelling:

Fig - 3.7

The recognized components of future travel Demand:

1. Existing traffic
2. Normal traffic growth
3. Diverted traffic ⇒ using the same mode / included that the traffic will use the same mode in a improved way.
4. Converted traffic ⇒ change of mode of transport
5. Change of destination traffic ⇒ only due to attractive transport facility include, the destination is changed
6. Development traffic ⇒ for land use change, the change of destination.
7. Induced traffic ⇒ This means additional service. So it may also cause additional pressure on traffic

Basic Concepts in transportation systems Modellings

1. Tripmaking is a function of Land Use

Most imp. 2. Trips are made of different purposes

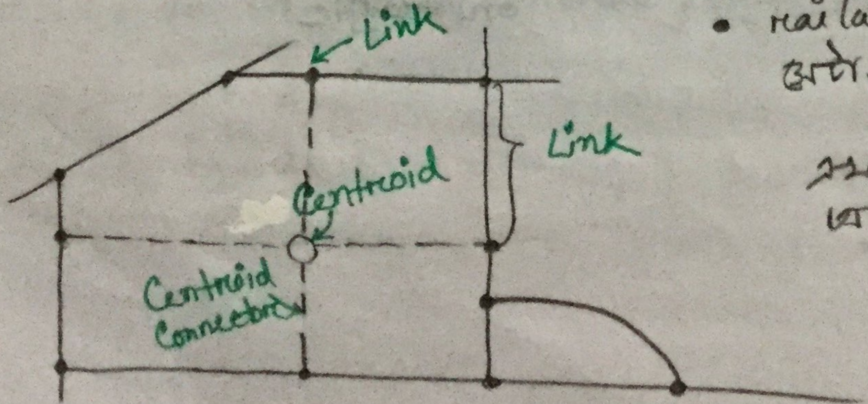
3. " " " at different times of the day

4. Travelers often have different options available to them

Imp. 5. Trips (and thus the characteristics of travel) are made to minimize the level of inconvenience associated with reaching a destination

- derived demand ⇒ travel করে for some purpose ⇒ only travel করা main উদ্দেশ্য নয়
  ⇓
  So fully convenient না হলেও চলে

6. Transportation networks & traffic analysis zones for ...



- railway থাকলে সেটাও দেখাব
  ⇓
  এখানে only road আছে তাই road দেখানো

1. Trip Generation (T_i) — The no of trips produced in traffic analysis zone i.

2. Trip distribution (T_{ij}) — The no. of trips produced in zone i & attracted to...

3. Mode Split (T_{ijm}) —

4. Trip Assignment (T_{ijmrs}) —

- **Trip generation (T_i) :**

* CBD — Central Business District
* There are 3 methods

⇒ Trip rates from national / Local sources —

⇒ Cross classification analysis

Household size ↑ ⇒ trip ↑

Car ownership ↑ ⇒ trip ↑

trip কমলেও fraction হয় না ⇒ but 2nd chart-এ fraction কমছে ৫২ data থেকে এসেছে।

↓

(But finally last-এ গিয়ে whole number করতে হবে।)

⇒ Regression Analysis

$$T_i = 0.34 P_i + 0.21 DU_i + 0.12 A_i$$

where, P_i = total population for zone i

DU_i = " no. of dwelling units for zone i

A_i = " no of automobiles " " "

$$A_i = 57.2 + 0.87 E_i$$

- For purpose P, we will write $\underline{\underline{T_i^P}}$

04.04.2016

- **Trip distribution :**
  - trip table.
  - Calibration ⇒ to establish relationship bet^{n} the model and the actual.
    i.e. WRE lab ocf এর model এর সাথে actual river-এর relationship establishment.
    - Another purpose is to minimize the error i.e. to check whether there is error or not.

— trip generation / production / attraction calculate করে বের করার জন্য TAZ (Traffic Analysis Zone) create করা হয়। Then this is OD (Origin-Destination)

— এভাবে এটা calculate করে calibration করে then distribute করব।

This produces OD Matrix ⇒ To determine this matrix is the main aim of trip distribution.

⇓

Diagonal elements of this Matrix are Intrazonal Trips ($A_{11}, A_{22}, A_{33}, A_{44}, \ldots$)

— The OD Matrix is divided into two -
- Attraction
- Generation

— The Gravity Model ⇒ The original version of the model was of the form ⇒

$$T_{ij} = \left[\frac{\frac{A_j}{(D_{ij})^n}}{\frac{A_1}{(D_{i1})^n} + \frac{A_2}{(D_{i2})^n} + \frac{A_3}{(D_{i3})^n} + \cdots + \frac{A_m}{(D_{im})^n}} \right] P_i$$

where, T_{ij} = trips from zone i to zone j for a specific purpose

P_i = total trips produced at zone i for the specific purpose

A_j = A measure of attraction of the jth zone for trips of this purpose

D_{ij} = Distance from zone i to zone j for m zones

n = some exponent that varies with purpose

— This model is an aggregate type of model ।

⇓

আবার opinion/activities একসাথে নিয়ে কাজ করা হয়।

— Non-aggregate type model ⇒ আলাদাভাবে হিসাব করা হয়।

- Example (from book):

Trip should always be rounded in whole numbers.

বিভু বলল না আবদুল $\boxed{n = 2}$

this $\underline{\underline{n}}$ comes from Calibration.

— To generalize the model, some factors are there -

1. $F_t = \frac{c}{t^n}$

2. So the gravity model is -

$$T_{ij} = \frac{A_j F_{tij} K_{ij}}{\sum_{\text{allzones}} A F_{tij} K} \times P_i$$

K_{ij} = socio-economic adjustment factor between zones i and j.

- **Mode Split Models :**

⇒ factors influence mode choice-

1. Type of trip (trip purpose, +
2. Characteristic of trip maker
3. Characteristic of transportation System

— We use Individual Choice Modal.

⇓

One type is LOGIT MODEL

⇓ depends on probability

$$P_{it} = \frac{e^{U_{it}}}{\sum_{\text{All } j} e^{U_{jt}}}$$

P_{it} = probability of individual t choosing mode i

U_{it} = utility of mode i to individual t

U_{jt} = utility of mode j to individual t.

↓

means the characteristics & availability of the particular transportation mode.

— Example (Book).

U_{auto}, U_{bus}, U_{walk} ⇒ all factors are found by calibrating the real data.

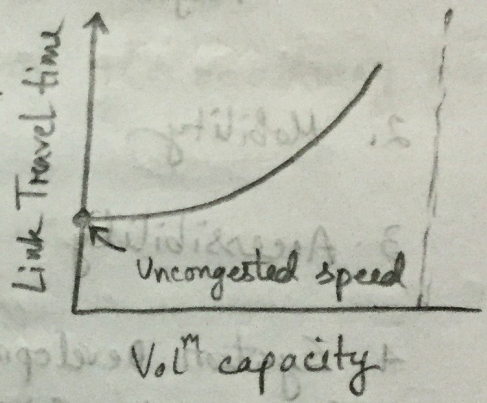
- Trip Assignment :

— Tijmp ie: route of the trip

— Basically route is consisted with a number of Links. So the smallest part of Route is **LINK**

— 1. Shortes Path

2. Link Performance ⇒



• first → 0 থেকে start হয়নি ৫২ কোন congestion না থাকলে ও min^m TT লাগবে।

— 3 methods for assignment :

1. All-Or-Nothing Assignment

assumption is সবাই shortest path use করবে & so অন্য সকল path → zero vol^m ⇒ This is not practical.

2. Capacity Restraint Assignment

সকল path → সবাই যেতে থাকলে একসময় highest vol^m হলে আবার অন্য path → যাবে ⇒ this is capacity restraint.

3. Stochastic Equillibrium Assignment

— dynamic system.

Class test ⇒ upto this class ⇒ Monday (25.04.2016)

11.04.16

Plan and Project Evaluation :-

Tab - 3.2 Measures of Effectiveness used in Evaluation

General Category	Typical Criteria
1. Transportation System Performance	
2. Mobility	
3. Accessibility	
4. System Development, Coordination & integration	
5.	
⋮	
16. Other	

Geometric Design of Highways :

This topic concerns the "Geometric Design" or the proportioning of the visible elements of highway or street.

- Design Controls and Criteria —

The elements of highway design are influenced by a wide variety of design controls & criteria. Such factors include :

1. Functional classification of the roadway being designed.
2. Traffic volume and composition
3. Design speed
4. Topography

P.T.O.

- Visible elements of roads are –
  1. Pavement Way (travel way)
  2. Divider / Median
  3. Footpath
  4. Lane
  5. Foot over bridge (overpass)
  6. Foot under bridge (underpass)
  7. Lamppost
  8. Postbox
  9. Telephone exchange Pole.

  etc.. all are related to the road

→ এই visible element এর proportioning করাকে design বলে।

⇓ This is called geometric design.

Criteria

Contd. ⇒ 5. Cost and available funds ⇒ very very imp. but after planning.

6. Human sensory capacities of drivers, bikers, and pedestrians

7. Size and performance characteristics of the vehicles that will use the facility

8. Safety considerations

9. Social & environmental concerns.

- Most economic design is to follow the topography.
- First - 1 ideal / optimum solution reach করতে হবে according to demand.
- After finishing the design, the we will look into the costs and fundings available.
- These considerations are not, of course, independent.
- These considerations are not all. These are the majors.

Functional Classification of the roadway being designed:

→ Mobility ⇒ speed
Accessibility ⇒ Connectivity

- Through traffic ⇒ যারা ঐ road-এর আশেপাশের land-এ কাজ নেই। অন্য দিকে or অন্য area তে যাওয়ার জন্য road use করে।

- Access যত বাড়বে, speed তত কমবে।
- Freeway ⇒ highest speed.
- Level of Service —
- Level of service Given by AASHTO.

1. Free — A
2. Stable — B, C, D (C: medium)
3. Unstable-E (Higher / lower)
4. Restricted-F

- A → Freeflow - - -
  F → - - - - -
- Load Factor ⇒ In signal design, this is needed.

Design Speed —

The maximum safe speed that can be maintained over a specified section of highway when conditions are so favorable that the design speed features govern. ⇒ Defⁿ of Design speed.

Page 28 of 36

09.05.2016

* Design Designation :

Imp. for traffic engg.

DHV = Design Hour Volume (85th percentile value)

⇓

100 hr এর মধ্যে 15 hrs congestion allow করব cz max^m হলে uneconomic হয়ে যাবে

D = Direction of flow

T = truck %. (for our country, % of heavy vehicle)

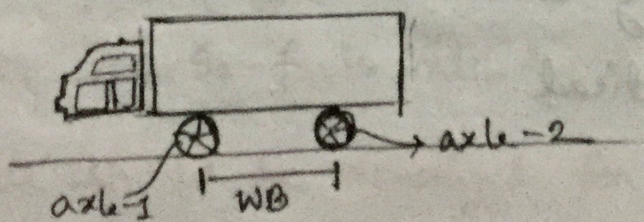
V = Design Speed

* Design vehicle:

the design engineer will select for design the largest vehicle - - - - - - - in significant number - - - -.

- Table 8-3 : (মুখস্থ করা লাগবে না)

wheel base → axle to axle distance



The highway cross-section

* Limited access highways

Pavement crowns → given only for drainage

Shoulders → 4' shoulder is a must

Guardrails

Right of way

Fig - 8.3

Fig - 8.4 (urban context)

Fig - 8.5 (rural context)

Alignment

2 types —

1) Horizontal

2) Vertical.

16.05.2016.

Alignment :

8.14 Circular Curve

- Degree of curvature (D)
- Radius (R)
-

8-15 Superelevation

- Transition curve

  2 changes

  1. Radius (∞ to R)
  2. superelevation (0 to S)

  ⇓

  used for balancing ~~superelevati~~ centrifugal force by using the component of the weight of car.

  ⇓

  ইচ্ছামত দেয়া যাবে না। এটা কমানোর একটা way হচ্ছে road + vehicle tire friction use করা

  ⇓

  So f is introduced in the formula.

- Formula should be memorized for xm.

- Transition Run off
- length of the transition curve

→ যেটা বেশি সেটা use করব।

- 3 ways of giving super elevation —
  - outer edge
  - inner "
  - center line

1. Revolve about center line (both cut & fill)
2. " " outer edge (cut only)
3. " " inner " (Fill only)

Imp.
Widening of curves:
only for safety reasons.
(min^m 2'~4')

Vertical Curves —

direction of movement ऊपरिमुख ⇒ +ve
opposite to " " " " ⇒ -ve.

Imp. Math ⇒ Fig 8.10.

30.05.2016

Sight Distance :

Min^m Stopping Sight Distance :

⇓

Combination of two distances—

Imp. 1. Perception-reaction distance ⇒ Normally 2.5 sec লাগে

2. Breaking distance

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

Effect of grade on stopping distance :

Measuring stopping sight distance :

H_1 = রাস্তা থেকে driver-এর sight এর distance = 3.5′
H_2 = object height = 0.5′ (min^n)

(এগুলো রাখব for formula use)

V.V.Imp. # Min^m Passing Sight Distance —

Combination of 4 distances—

1. d_1 → the distance traveled during perception & reaction time & during the initial

accelaration to the point where the vehicle will turn into opposite side/lane.

Most critical position/ danger zone ⇐ 2. d_2 = the distance travelled while the passing vehicle occupies the left lane

3. d_3 = distance bet^n the passing vehicle at the end of its maneuver and the opposite vehicle.

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

Figure : First phase

⇓

not for our country

ez our country right hand driving keeping the vehicle left in the road

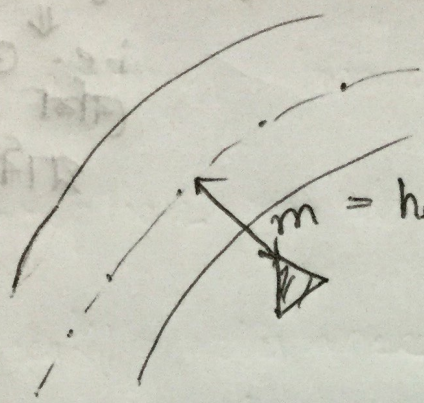
⇓

So overtaking will be at right.

⇓

~~xm~~ figure according to our convention.

* Measuring minimum Passing Sight distance: (8-25)



Imp. three types of distances are very imp.

1. Stopping Sight Distance
2. Passing " "
3. Horizontal " "

Planning and design of bicycle facilities —
↳ for our country, (similar is rickshaw)

- Warrants for bicycle facilities
  - — Automatic vol^m/ vol^m capacity ratio
  - — Vol^m of bicycle traffic
  - — Difference in auto and bicycle speeds.

- Bike Route (Class III) ⇒ officially designated & marked
  ⇓
  i.e. যেখানে যে vehicle বেশি সেখানে সেটার প্রাধান্য থাকবে

- Bike lane (Class II)

- Bike Path (Class I)
