

CE 380

Highway and Traffic Engineering

Lec-1

Introduction

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Course Content

- Highway Geometric Design**
- Components of Traffic system.**
- Highway Materials**
- Traffic- stream characteristics.**
- Traffic studies.**
- Traffic safety.**
- Traffic signals, Signs and Markings.**
- Capacity of urban streets and Intersections.**
- Parking.**

Module Aims

To enable students to plan and design all components of highways that are safe and economical for traffic operation and can sustain traffic loads and satisfy their intended function and specification.

Outcomes

- Plan and design highway geometrics .**
- Know pavement materials characteristics and methods of pavement design.**
- Design elements of roads to satisfy their intended function and sustain traffic loads.**
- Design Parking Facilities**

Textbooks and References

- Bent Thagesen, “Highway and Traffic Engineering in Developing Countries”, Chapman & Hall, (Latest edition).
- Martin Rogers, “Highway Engineering”, Blackwell Science, (Latest edition).
- Robinson & Thagesen, “Road Engineering for Development”, 2nd. Edition.
- L.R. Kadiyali, “Principles and Practice of Highway Engineering”, Khanna. Publications, (Latest edition).
- Khanna S.K. and Justo C.E.G., “Highway engineering”, Nem Chand, (Latest edition).

INTRODUCTION

History of highway engineering

Ancient Roads

By foot

These human pathways would have been developed for specific purposes leading to camp sites, food, streams for drinking water etc.

The next major mode of transport was the use of animals

for transporting both men and materials. Since these loaded animals required more horizontal and vertical clearances than the walking man, track ways emerged.

The invention of wheel

That led to the development of animal drawn vehicles. Then it became necessary that the road surface should be capable of carrying greater loads.

History of highway engineering

Roman roads

- The earliest large scale road construction is attributed to Romans who constructed an extensive system of roads radiating in many directions from Rome



French roads

- The next major development in the road construction occurred during the regime of Napoleon.
- The significant contributions were given by Tresaguet in 1764.
- The pavement used 200 mm pieces of quarried stone of a more compact form and shaped such that they had at least one at side which was placed on a compact formation. Smaller pieces of broken stones were then compacted into the spaces between larger stones to provide a level surface
- Finally the running layer was made with a layer of 25 mm sized broken stone.

British roads

- The British engineer John Macadam introduced what can be considered as the first scientific road construction method.
- Stone size was an important element of Macadam recipe. By empirical observation of many roads, he came to realize that 250 mm layers of well compacted broken angular stone would provide the same strength and stiffness and a better running surface than an expensive pavement founded on large stone blocks. Thus he introduced an economical method of road construction.

Modern roads

- The modern roads by and large follow Macadam's construction method. Use of bituminous concrete and cement
- Various advanced and cost-effective construction technologies are used.
- Development of new equipment's help in the faster construction of roads.
- Many easily and locally available materials are tested in the laboratories and then implemented on roads for making economical and durable pavements.

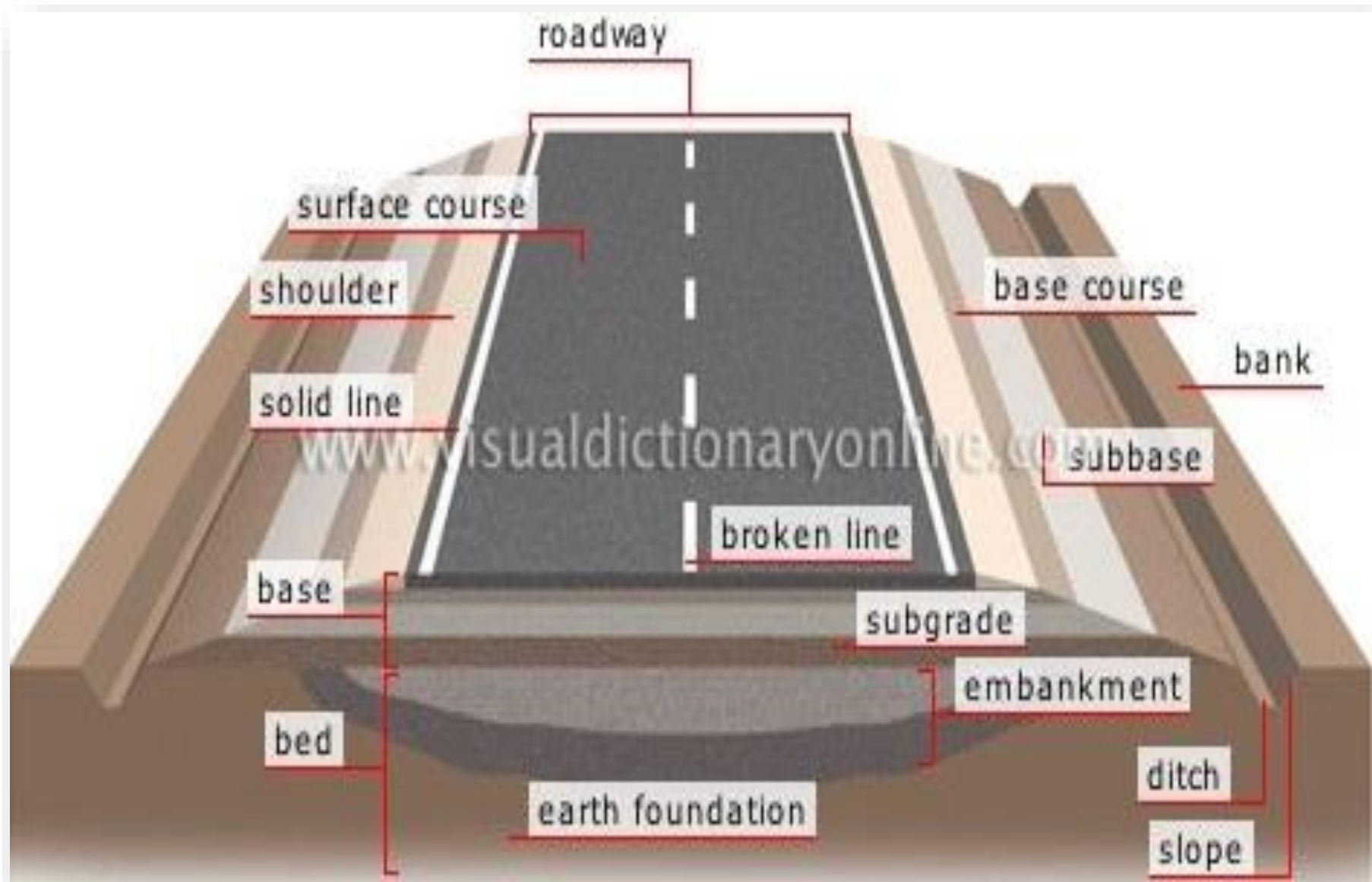
Road locations

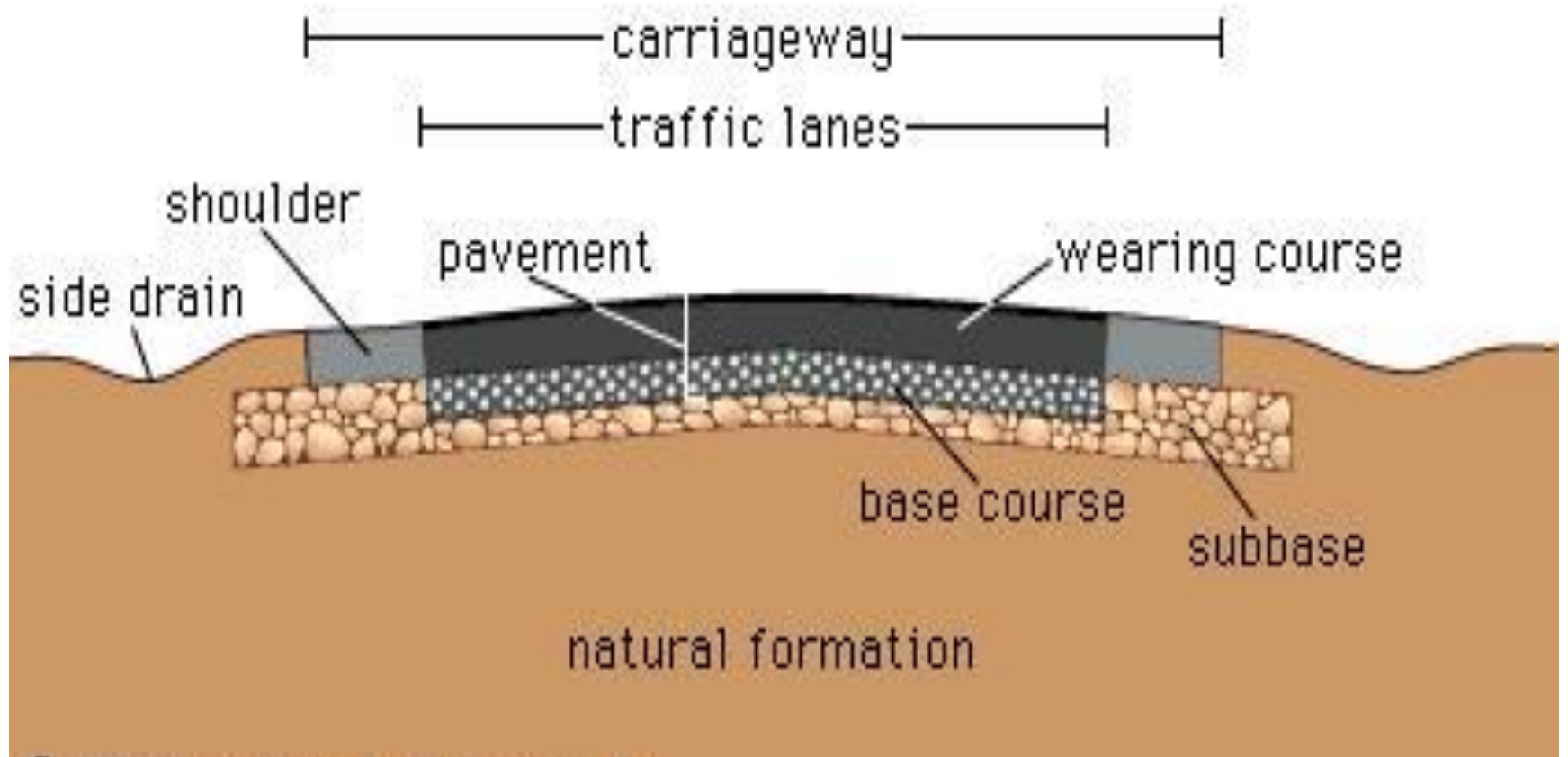
- Urban Roads
- Rural Roads

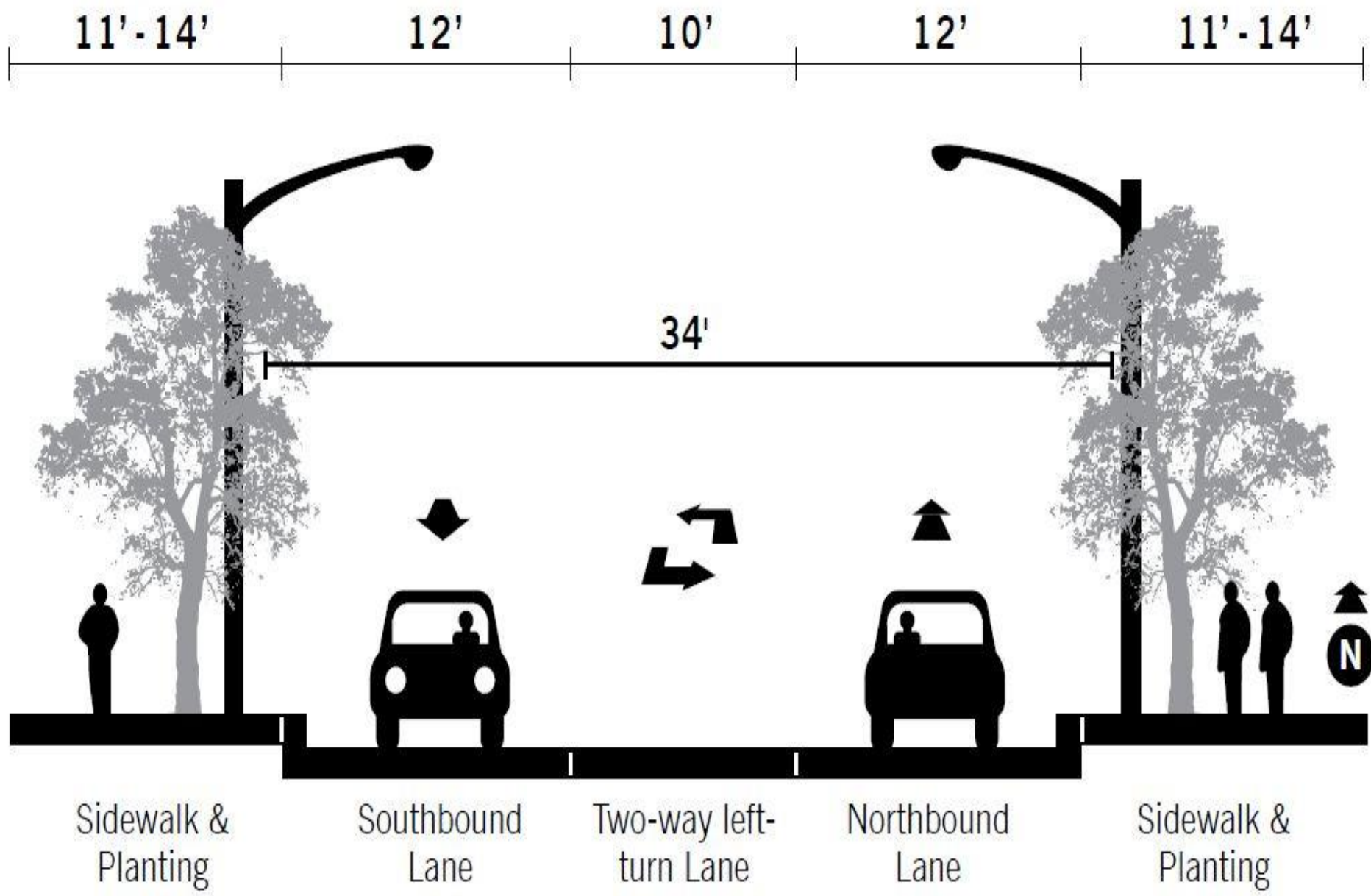












Carriageway

It is the travel way which is used for movement of vehicle, it takes the vehicular loading . It may be cement concrete road or bituminous pavement.

Shoulder

It is provided along the road edge to serve as an emergency lane for vehicle. It act as a service lane for vehicles that have broken down. The minimum shoulder width of 4.6 m so that a truck stationed at the side of the shoulder would have a clearance of 1.85m from the pavement edge.

Road Right of way

It is the total area of land acquired for the road along its alignment. It depends on the importance of the road and possible future development.

Traffic separators or median

The main function is to prevent head on collision between the vehicle moving in opposite direction. Channelize traffic into streams at intersection. Segregate slow traffic and to protect pedestrians

Cross slope or camber

It is the slope provided to the road surface in the transverse direction to drain off the rain water from the road surface.

Guard rail

It is provided at the edge of the shoulder when the road is constructed on a fill exceeds 3 m. It is also provided on horizontal curve so as to provide a better night visibility of the curves under the head light of the vehicle.



Highways Design Process / Steps

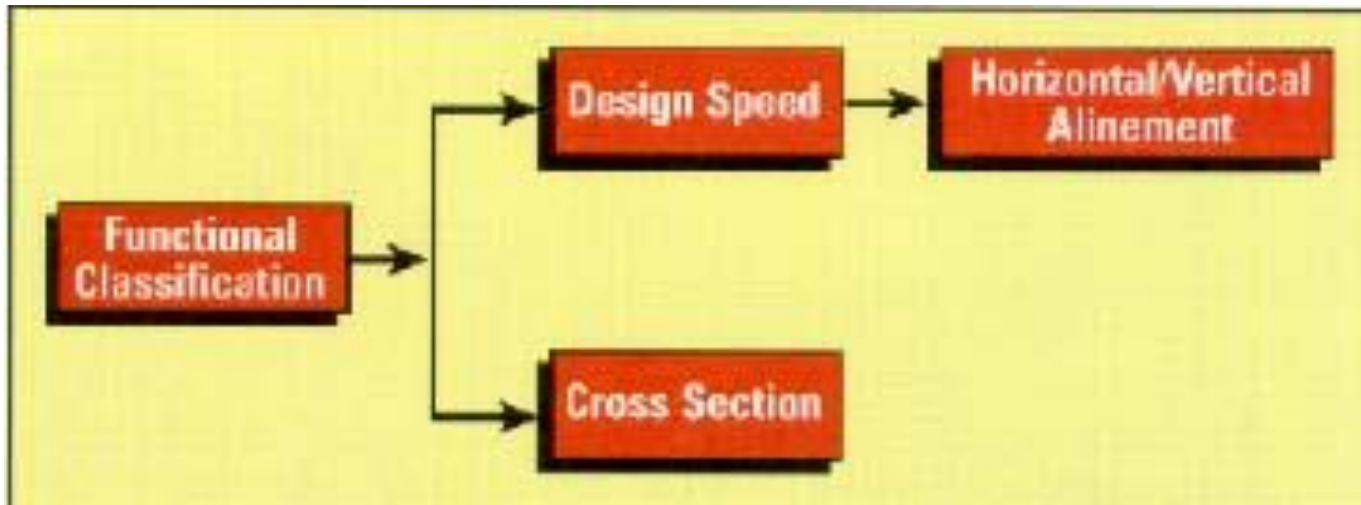
1. Geometric Design.
2. Structural Design.

Geometric Design

1. Determine road's start and end
2. Classify the road according its function.
3. Design the road capacity (cross section width)
4. Draw the road layout on the map (contour map).
5. Design the horizontal curves and vertical curves.
6. Design the intersections if found.

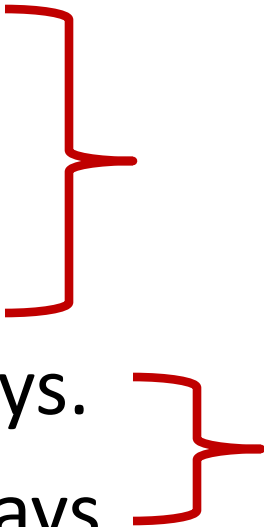
Functional Classification

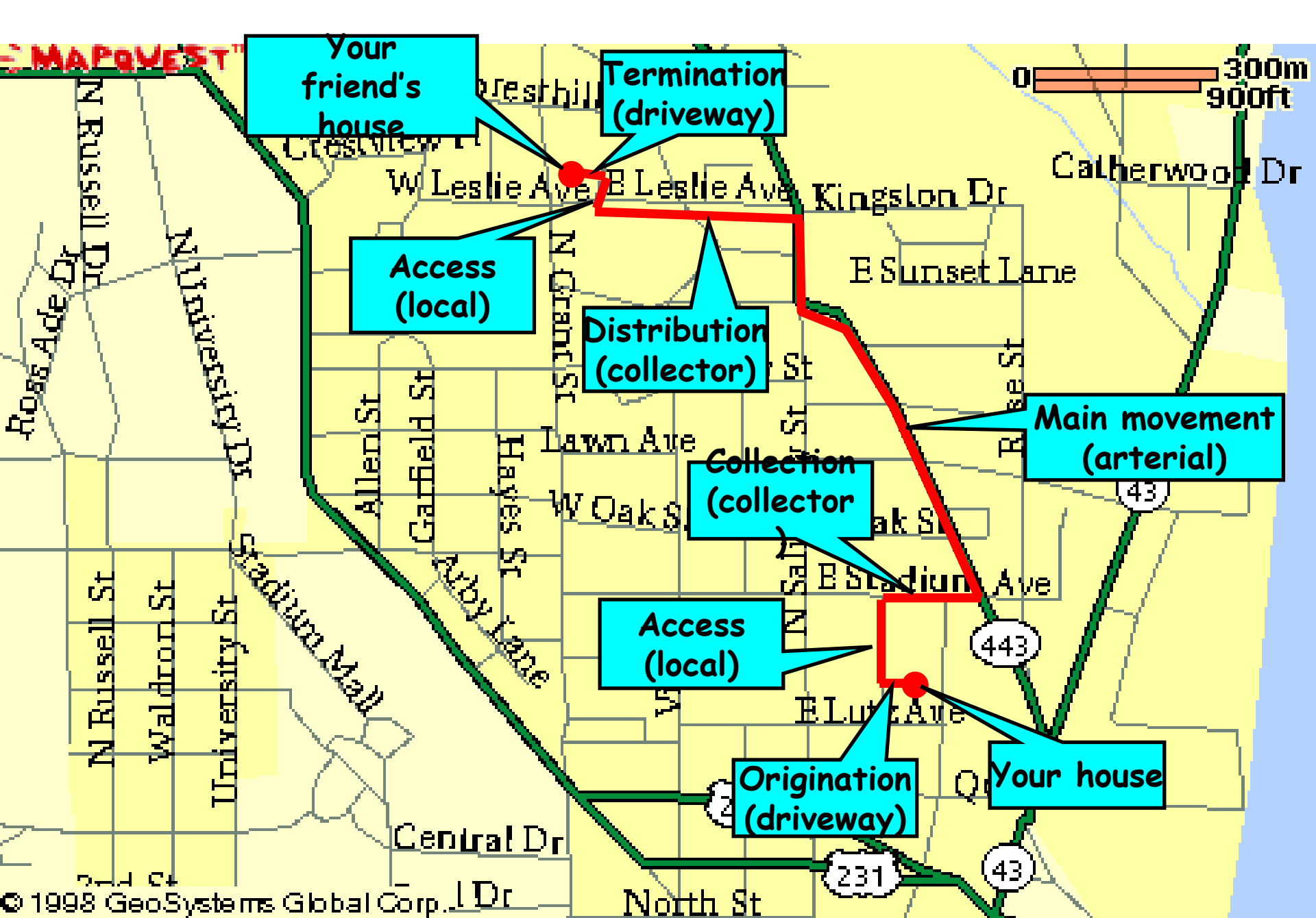
- Much is decided in **early stages**
- Involves generating **full range of alternatives** and technically evaluating
- One of the most important parts of the design process is determining what **purpose** (or **who**) a roadway serves?



Functional Classification

- Road types according to their function :

1. Local Road.
 2. Collector Road
 3. Arterial Road
 4. Express Highways.
 5. National Highways
- Urban Roads
- Rural Roads
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







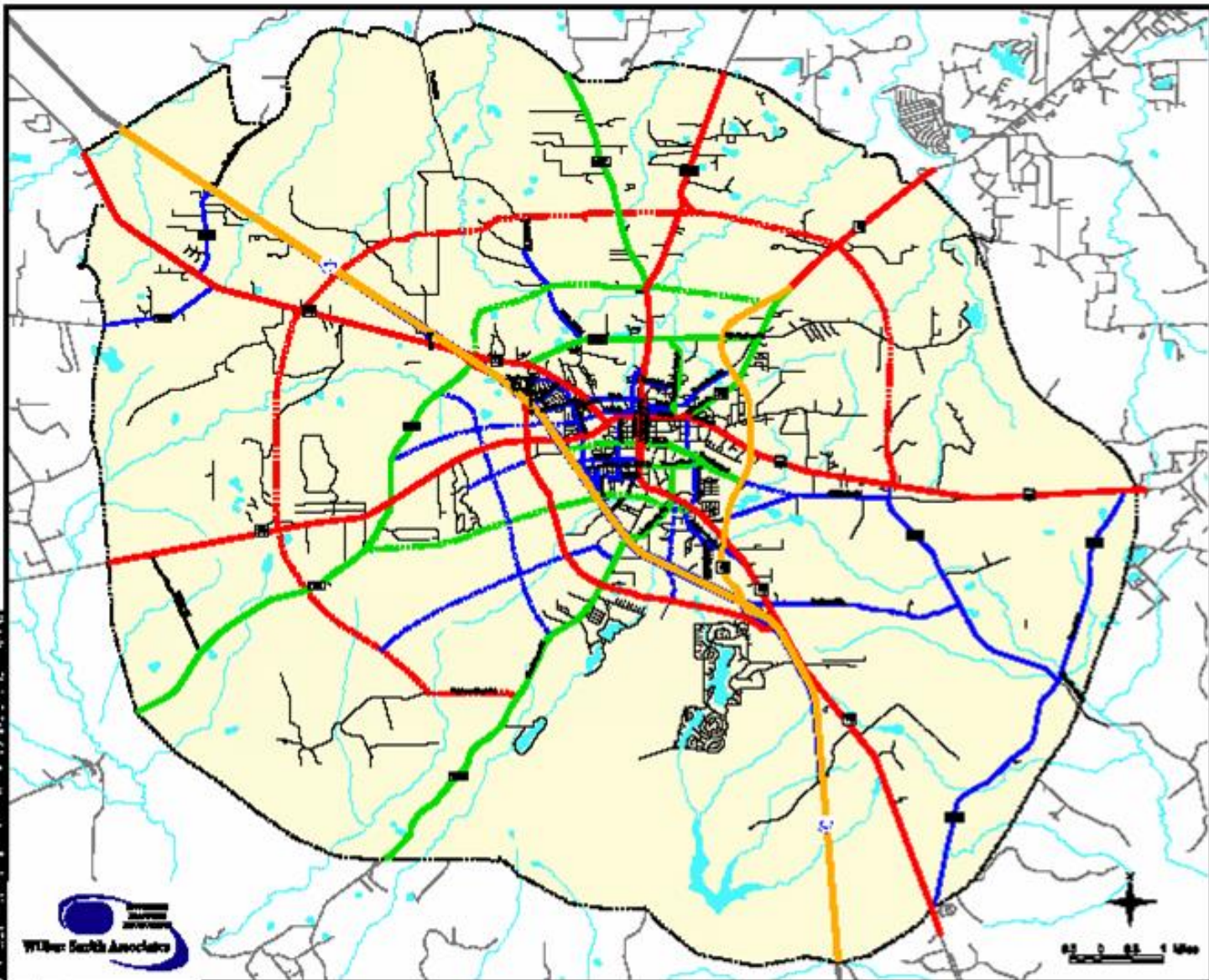
Hierarchy of Movements and Roads



Figure 5-3

**Proposed Functional
Classifications**
Huntsville
Transportation Plan
Huntsville, Texas

-  Study Area
- Roadway Functional Class:**
-  Expressway/Bypass
 -  Primary Arterial
 -  Secondary Arterial
 -  Collector
 -  Local



0 0.5 1 Mile

Developed by Transportation Planners or Transportation Planning Engineers

Urban Locals

- Functions: Provide **direct access to land**, connect properties to higher class streets (i.e., collectors)



- Characteristics: Short in length, dead end – terminate at collectors, low speeds, no bus routes

Urban Collectors

- Functions: Provide traffic circulation within residential neighborhoods and industrial/commercial areas, collect traffic from locals and channel to arterials, carry local buses, provide some direct land access
- Characteristics: Shorter than minor arterials, moderate speeds, spacing intermediate to arterials, **penetrates residential neighborhoods**
- Subclasses: major and minor

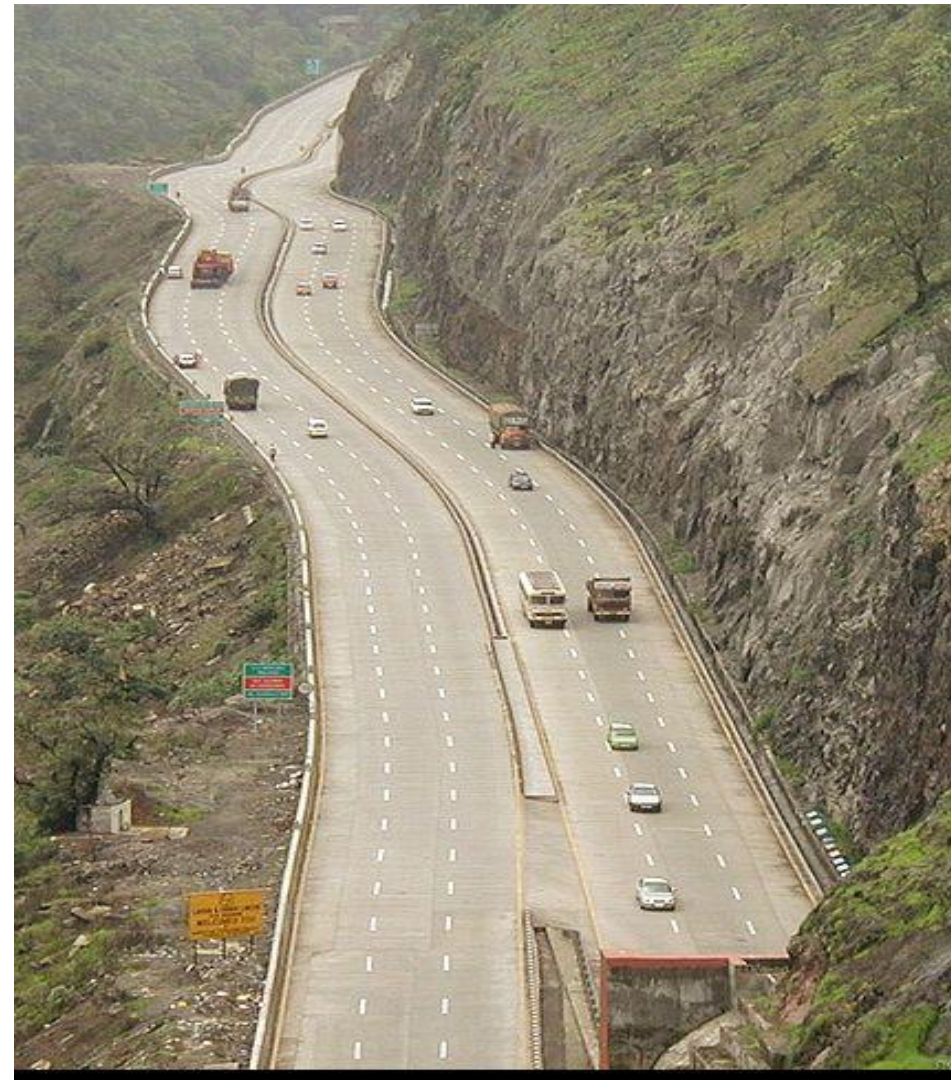
Urban Arterials

- Functions: carry most trips entering/leaving urban area, serve intra-urban trips, carry intra-urban and intercity bus routes, provide continuity to rural arterials
- Characteristics: longest distance routes and highest volume, high speed, spacing is less than 1 km in CBD and greater than 8 km in urban fringe, full/partial access control.



Expressways

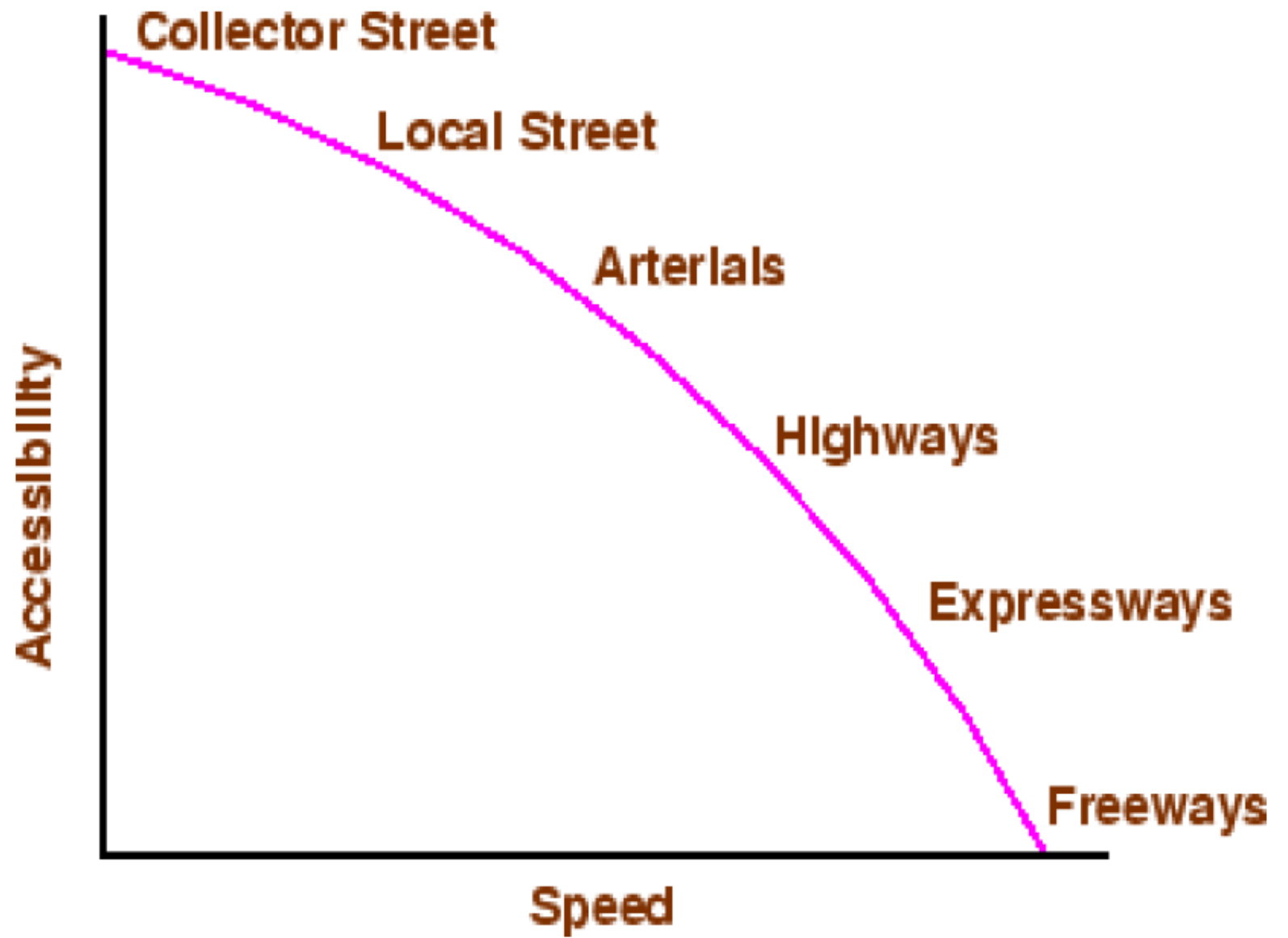
- Heavy traffic at high speed (120km/hr)
- Full access control
- Connects major points of traffic generation
- No slow moving traffic allowed
- No loading, unloading, parking.



Road Criteria

1. Acceptable Road Speed

Functional Classification	20 mph	30 mph	40 mph	50 mph	60 mph	70 mph
Rural Principal Arterial				X	X	X
Rural Minor Arterial				X	X	X
Rural Collector	X	X	X			
Rural Local Road	X	X	X			



Speed vs accessibility

2. Number of Lanes Range

Functional Class	Design Class	Design Type
Arterial	Freeway	8-Lane 6-Lane 4-Lane
	Major Arterial	6-Lane Divided 4-Lane Divided
	Minor Arterial	5-Lane 4-Lane
Collector	Major Collector	5-Lane 4-Lane 3-Lane
	Minor Collector	2-Lane
Local	Local	Loop Cul-de-Sac

Typical distribution of rural functional systems.

Systems	Range	
	Travel Volume (%)	Length (%)
Principal arterial system	40-65	5-10
Principal arterial plus minor arterial street systems	65-80	15-25
Collector street system	5-10	5-10
Local street system	10-30	65-80