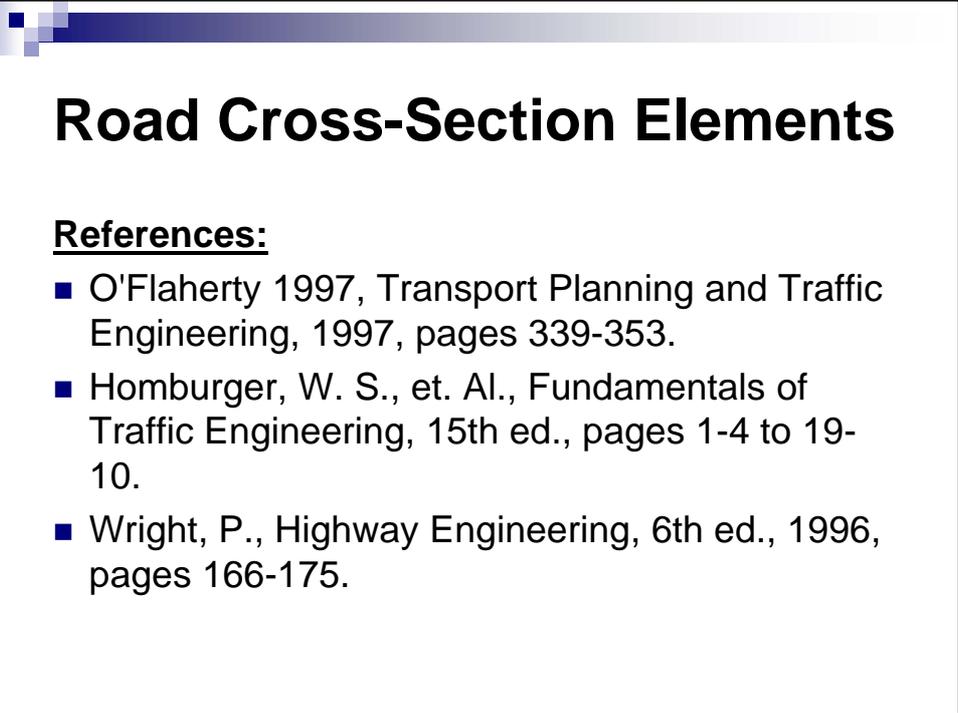


Road Cross-Section Elements

Dr. Yahya Sarraj



Road Cross-Section Elements

References:

- O'Flaherty 1997, Transport Planning and Traffic Engineering, 1997, pages 339-353.
- Homburger, W. S., et. Al., Fundamentals of Traffic Engineering, 15th ed., pages 1-4 to 19-10.
- Wright, P., Highway Engineering, 6th ed., 1996, pages 166-175.

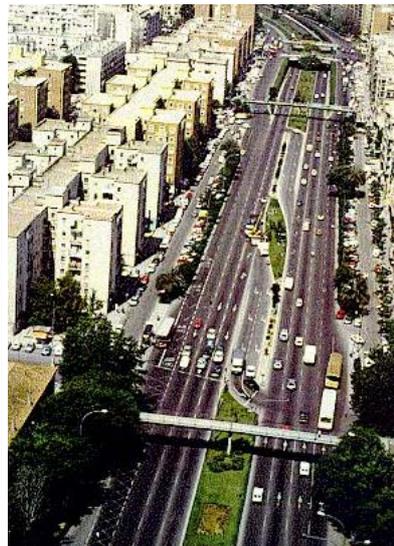
Road Cross-Section Elements

Urban Roads



Road Cross-Section Elements

Urban Roads



Road Cross-Section Elements

Urban Roads



Road Cross-Section Elements

Rural Roads



Road Cross-Section Elements

Rural Roads



Road Cross-Section Elements

Rural Roads



Right of Way

- **The right of way is the total land area acquired for the construction of the roadway.**
- **Its width should be enough to accommodate all the elements of the roadway cross section, any planned widening of the roadway, and any public utility facilities that will be installed along the roadway.**

Road Cross-Section Elements

Two types:

- ***Basic elements***

- Width of carriageway (including no. of lanes)
- Central reservation (or median strip)
- Shoulders
- Laybys
- Camber of the carriageway (cross slope)
- Side-slopes of cuttings and embankments

Road Cross-Section Elements

Two types:

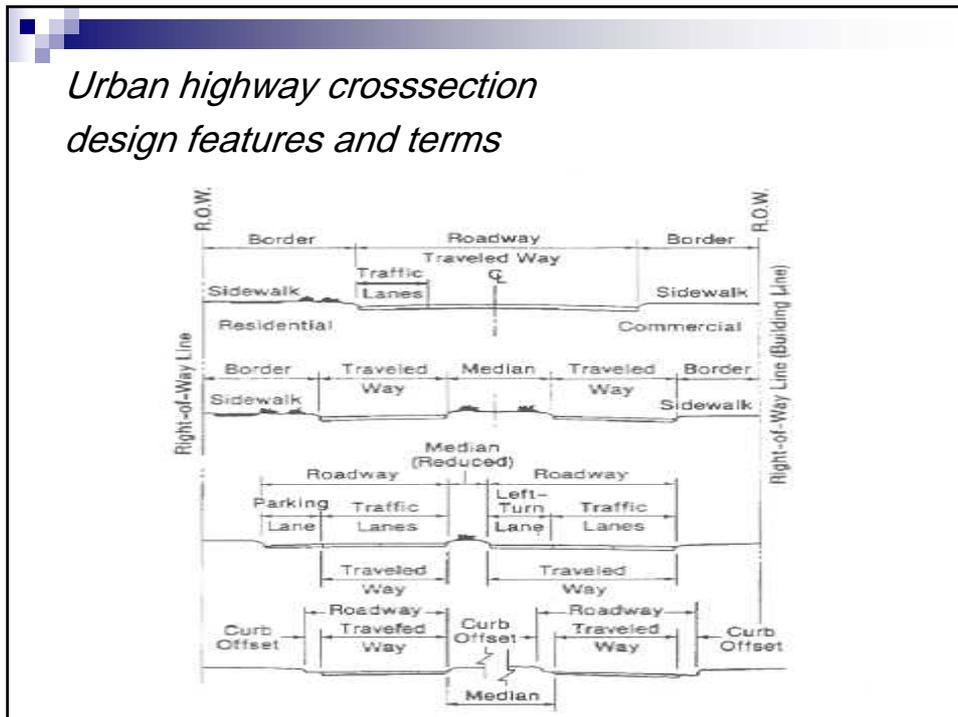
- ***Ancillary elements***
 - Safety fences
 - Crash attenuation devices
 - Anti-dazzle screen
 - Noise barriers

Road Cross-Section Elements

See figure 19-10 page 340 (O' Flaherty)

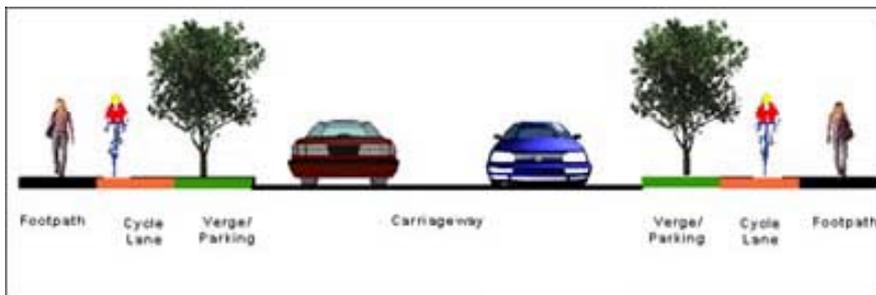
- ***Figure a) 2-lane street***
- ***Figure b) urban motorway***
- ***Figure c) 2 or 3 – lane rural highway***
- ***Figure d) rural motorway***

Urban highway crosssection design features and terms

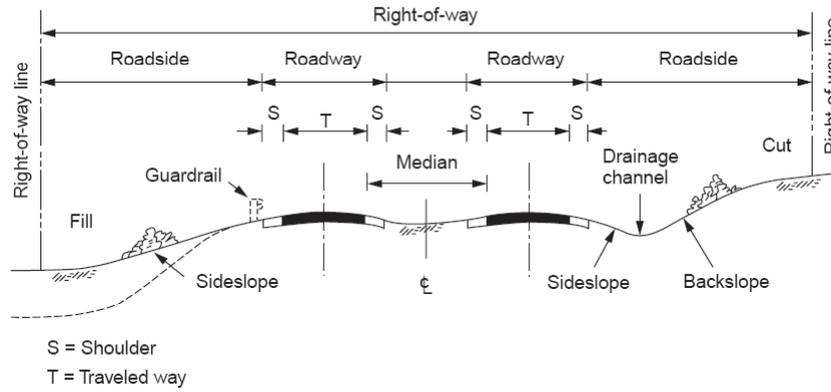


Road Cross-Section Elements

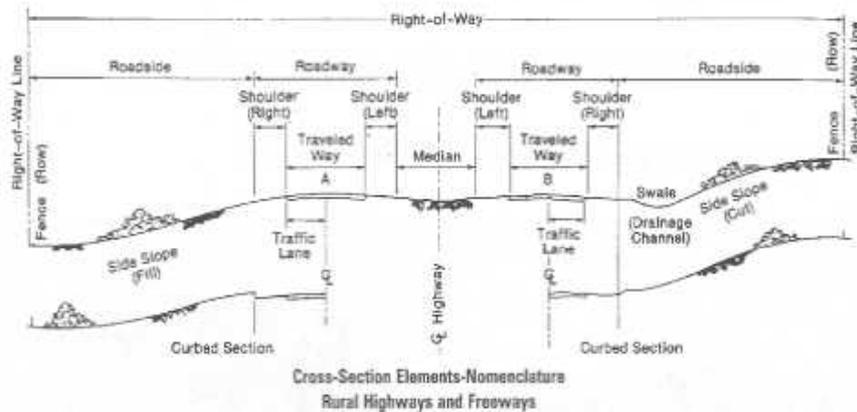
- Road Cross-Section Elements are those features of a roadway which forms its effective width.



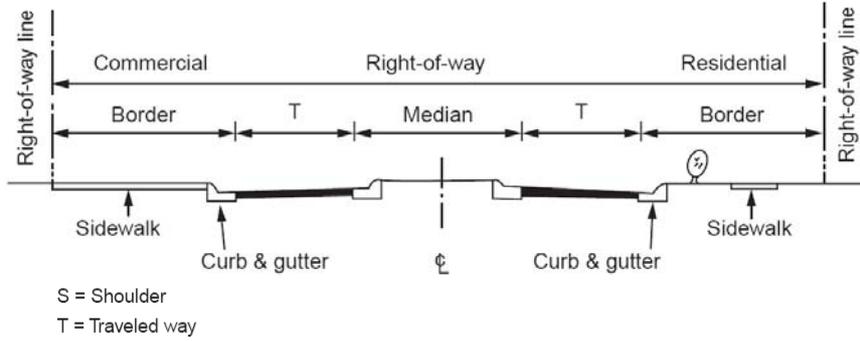
Cross Section (rural highway)



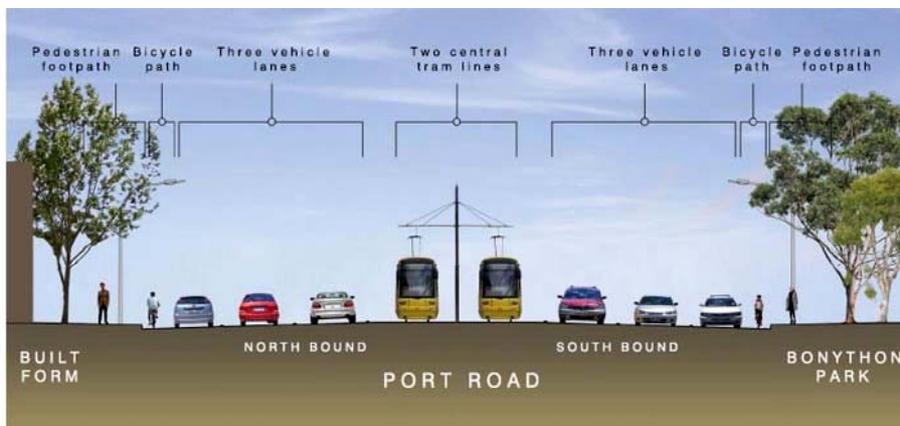
Twolane rural highway cross section design features and terms.



Cross Section (urban highway)



Cross Section (urban highway)



Road Cross-Section Elements

Basic elements:

1. Carriageway width p. 340

Factors which influence the width of a carriageway are:

- Design volume*
- Vehicle dimensions*
- Design speed*
- Road classification*

Road Cross-Section Elements

Basic elements

Lane width:

In urban areas

Lane width is normally not less than 3.5m

Narrower lanes are used for economic or environmental reasons

Road Cross-Section Elements

Basic elements

Lane width:

In rural roads

recommended lane width is 3.65m to:

reduce accidents and increase capacity.

Road Cross-Section Elements

Basic elements

- Three-lane single carriageway is not recommended. **Why?**
- Two-lane single carriageway roads constitute the predominant type.
- A road of 10m width is preferred to have 2-lanes and not 3.

Road Cross-Section Elements

Basic elements

Definition:

Motorways are:

- Dual carriageway roads with 3 or more lanes in each direction
- With full control of access
- With grade-separated intersections and no at-grade crossings.

Road Cross-Section Elements

Basic elements

In urban areas:

- Width of the nearside lane is often increased to:
- Improve conditions for cyclists
- Allow more space for commercial vehicles.

Road Cross-Section Elements

Basic elements

In urban areas:

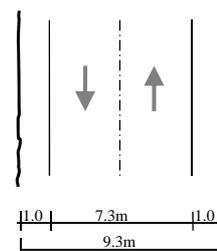
- Two-way local distributor route can be:
- As narrow as 6.1m in carriageway width;
- Provided that kerb (curb) parking is restricted.

Road Cross-Section Elements

Basic elements

In rural areas

- Standard edge treatment on normal two-lane single carriageways consists of a 1m strip of the same construction as the carriageway on both sides with a solid white line.
- ⇒ Total width becomes 9.3m



Travel Lanes

- **Travel lanes facilitate the movement of vehicles. Lane widths usually vary from 3.0m to 3.6m.**
- **Most arterials have 3.6m travel lanes since the extra cost for constructing 3.6m lanes over 3.0m**

Basic elements

Shoulders

- **Shoulders are contiguous with the travel lanes providing space along the roadway for vehicles to stop especially during emergencies.**
- **Shoulders also function to laterally support the pavement structure.**

Road Cross-Section Elements

Basic elements

Shoulders (p343)

Definition:

A surfaced clear portion of the roadway cross-section immediately adjacent to the carriageway edge.

Road Cross-Section Elements

Basic elements

■ **Advantages:**

- Refuge for vehicles in case of emergency stops
- Recovery space for vehicles
- Temporary extra traffic lanes
- Assist in horizontal sight distance
- Structural support to the road pavement
- Decrease accident risk

Road Cross-Section Elements

Basic elements

■ **Shoulder width:**

- A shoulder width of 3 to 3.35m is internationally considered adequate for most high-speed high-volume roads (motorways).
- However, to reduce cost of dual carriageways and single carriageways in rural roads, only 1m wide hard strips are used in addition to 2.5m wide grass verges.

Basic elements

Sidewalks

- **Sidewalks are usually provided on roads in urban areas, but very seldom they are provided in rural areas.**
- **Generally, sidewalks should be provided when pedestrian traffic is high along main or high-speed roads in either rural or urban areas**

Road Cross-Section Elements

Basic elements

Medians

- **A median is the element of a divided roadway that separates the lanes in opposing directions.**

Road Cross-Section Elements

Basic elements

Central reservation (or median strip) (p342)

Dual carriageways are normally divided by a central reservation of median strip.

Road Cross-Section Elements

Basic elements

- Central reservation has a number of uses:
 - Separating
 - Vehicles to recover
 - Safe waiting place
 - Left turning
 - Space for road furniture
 - Storage lanes

Road Cross-Section Elements

Basic elements

- Ideal width of central reservation

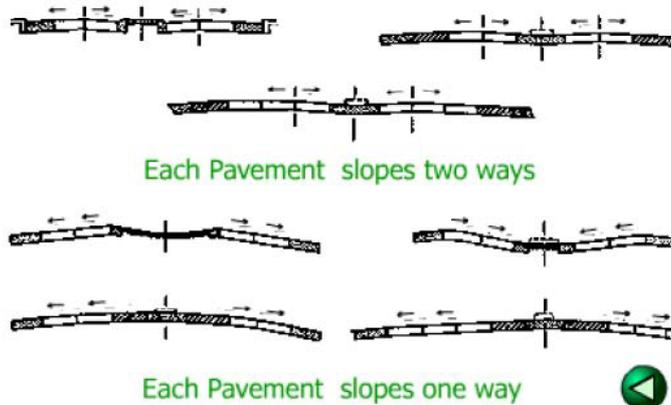
Rural	Urban
10-15m	5.5 – 9m
Can be 30m (USA)	Can be 1m but 3m preferred

Basic elements

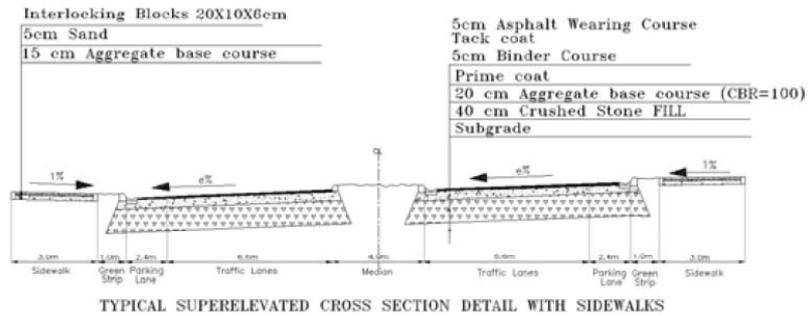
Cross Slopes (Camber)

- Pavements on straight sections of two-lane and multilane roadways without medians are sloped from the middle downward to both sides of the roadway.
- This provides a cross slope, whose cross section can be either curved or plane or a combination of the two.

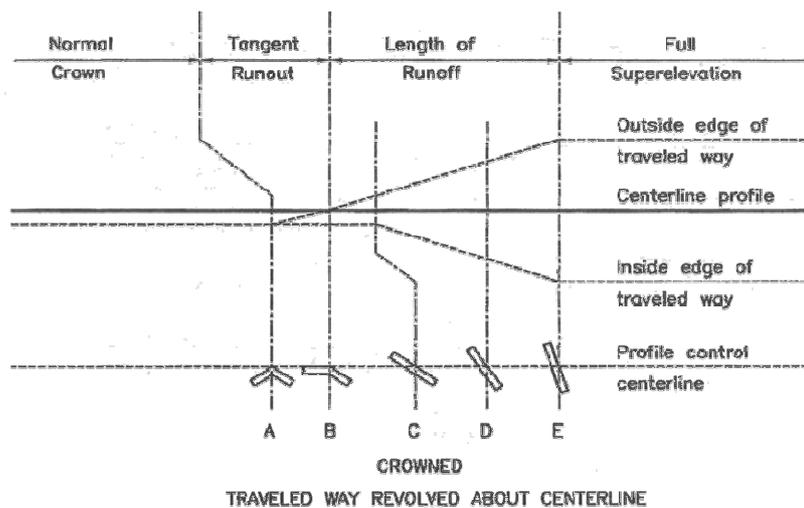
Cross slopes for multilane roadways



A cross section of a superelevated section of a roadway's curve



Superelevation Transition



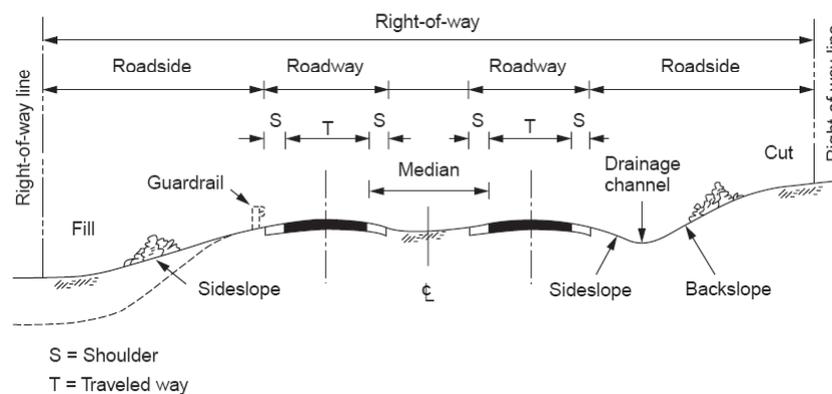
from AASHTO's *A Policy on Geometric Design of Highways and Streets*

Basic elements

Side Slopes

- Side slopes are provided on embankments and fills to provide stability for earthworks.
- They also serve as a safety feature by providing a recovery area for out-of-control vehicles.

Cross Section (rural highway)



Curbs and Gutters

- **Curbs are raised structures mainly made of Portland cement concrete that are used on urban roadways to delineate pavement edges and pedestrian walkways.**
- **Curbs are also used to control drainage, improve aesthetics, and reduce right of way.**

The likelihood of pedestrian and bicycle traffic is one factor to consider when designing the cross section of a facility



A landscaped median



Two-way left-turn lanes improve safety and efficiency for vehicular traffic but do not afford a safe refuge for pedestrians



Shoulders increase safety and highway capacity and provide a place for pedestrians and bicyclists when no sidewalks are provided.



Various shoulder treatments:

(a) Gravel (b) Paved (c) Concrete (d) Grass with sidewalk



(a)



(b)



(c)

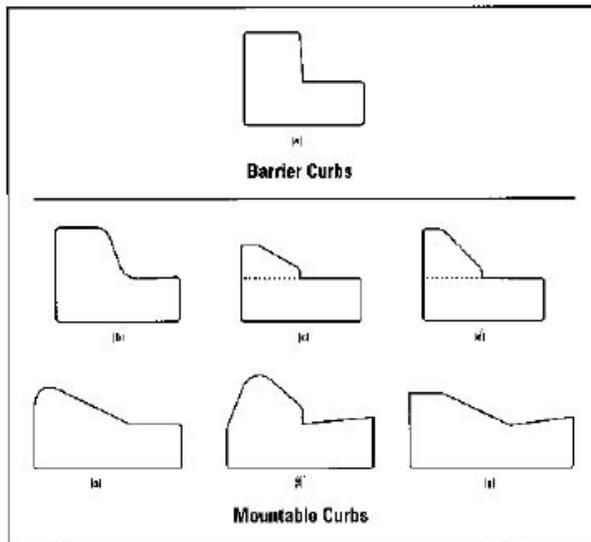


(d)

Use of paved shoulder, asphalt curbing, and closed drainage system along a rural minor arterial



Examples of barrier and mountable curbs



Sidewalks can be located next to a planted strip or flush with the roadside edge



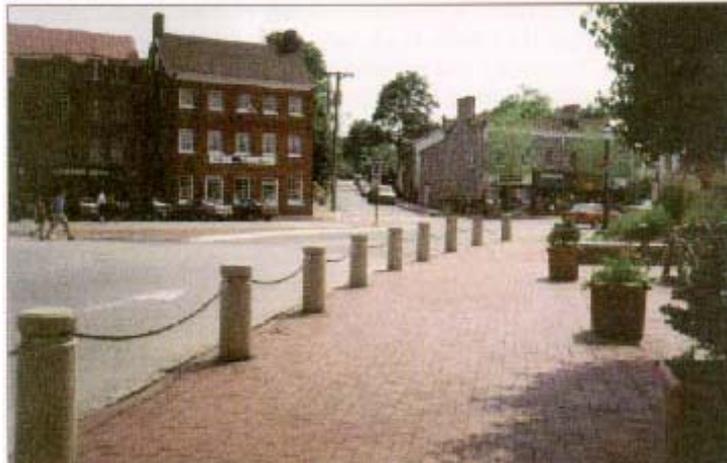
The wider the sidewalk, the more room there is for street furniture, trees, utilities, and pedestrians



Sidewalks can be built with a variety of shapes and materials



Pedestrian barriers can provide safety by separating pedestrian and vehicular traffic



Street trees and light fixtures are carefully lined to one side of the sidewalk to provide the widest possible space for pedestrians



A multiuse path



The shoulders on SR 313 were specifically designed to accommodate bicycle traffic



East Capitol Street accommodates two travel lanes, onstreet parking, and a designated bike lane in each direction



The highway landscape is an important part of its overall appearance



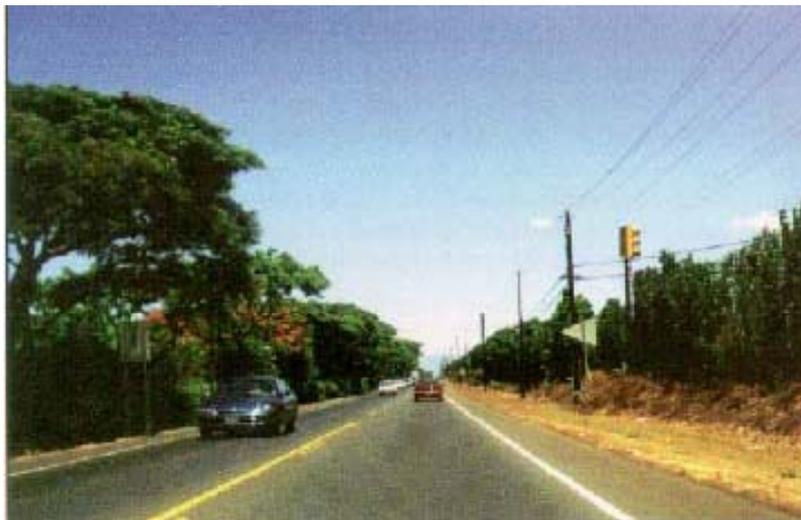
Landscape treatment is most successfully integrated into a project when considered early in the design



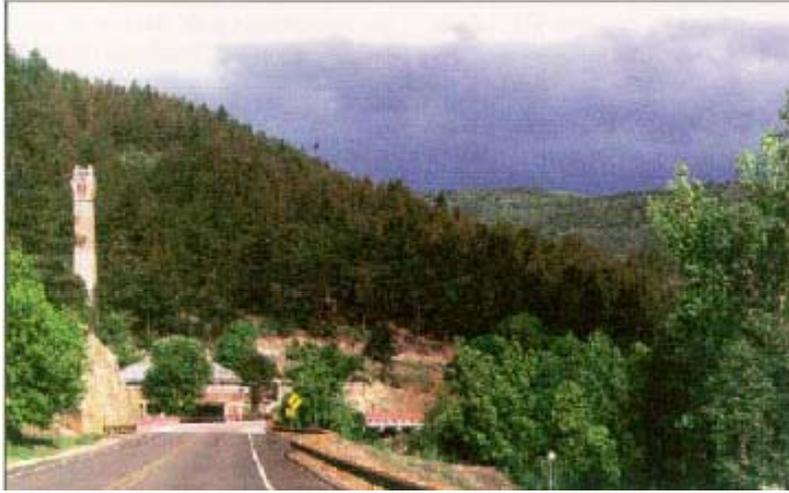
Trees add to the visual appeal of this urban street and can be placed in both medians and along roadway edges



Trees make a difference. Compare the left side of this roadway with the right side, where the trees have been removed



Weathering steel is a lowcost option for designers who are trying to "blend" a barrier into the surrounding environment



These HO V lanes are restricted to buses, vanpools, and carpools carrying three or more occupants



Computer visualization showing proposed design concepts of SH 23 in Rockville, MN



Existing conditions

Computer visualization showing proposed design concepts of SH 23 in Rockville, MN



Proposed continuous left turn lane design

Computer visualization showing proposed design concepts of SH 23 in Rockville, MN



Proposed continuous left and right turn lane design

Computer visualization showing proposed design concepts of SH 23 in Rockville, MN



Proposed channelized and raised median design

Road Cross-Section Elements

Basic elements

4. Laybys and bus bays (page 344)

Laybys are provided instead of shoulders for economic considerations.

For single carriageways:

In the UK, laybys are provided with 2.5m to 3m width.

Intervals of providing laybys for single carriageways

at 1.5km for well trafficked roads

and at 5.8km for light trafficked roads

Road Cross-Section Elements

Basic elements

For dual carriageways:

Laybys are provided at 3m width and 100m long at 1km intervals.

They should be with good visibility and tapers of 16m.

Bus stops (bays)

Usually in urban areas

3.25m wide by $>$ or $=$ 12m + 20m end tapers

Road Cross-Section Elements

Basic elements

5. Camber of the carriageway (page 344)

Definition:

- Camber is a convexity of the carriageway cross-section.
- Its purpose is to drain surface water from the road and avoid ponding in surface deformations on the carriageway.
- Shapes:
- Parabolic or circular

Road Cross-Section Elements

Basic elements

Definition:

- Methods of application for single and dual carriageways
- In the UK 2.5% from the center of single carriageways
- And from the central reservation edge of each carriageway of dual carriageways to the outer drainage channels
- Application of camber at road intersections

Road Cross-Section Elements

Basic elements

Question:

- Describe the term camber.
- Explain the different ways of applying the camber to both single and dual carriageways.

Road Cross-Section Elements

Basic elements

6. Side-slopes of cuttings and embankments p(345)

Soil mechanics is used to determine the max. slope

Slope 1 in 2 is used

Slope 1 in 3 is preferred

See Figure 19.11

Road Cross-Section Elements

Ancillary elements

Road Cross-Section Elements

Ancillary elements

Safety fences p (346)

- Safety fences are used to reduce the severity of accidents resulting from vehicles leaving the carriageway.
- Two main groups:
 - edge barriers (guardrails) for both vehicles and pedestrians.
 - crash barriers; located within narrow central reservations.

Road Cross-Section Elements

Ancillary elements

- **Materials of safety fences can be:**
 - Steel beam (shape: C or S)
 - Rigid concrete
 - Flexible cable
- Read page 347 for more details
- and see figure 19.12 for dimension and shapes.

Ancillary elements

Guard Rails (Safety Fences)

- **Guard rails are longitudinal barriers placed on the outside of sharp curves and at sections with high fills.**
- **They are also used at the outside of rural roadway segments.**
- **Their main function is to prevent vehicles from leaving the roadbed.**

Different types of roadway guardrails



Road Cross-Section Elements

Ancillary elements

Median and Roadside Barriers

- **A median barrier is defined as a longitudinal system used to prevent an errant vehicle from crossing the portion of a divided roadway separating the traveled ways for traffic in opposite directions.**

Road Cross-Section Elements

Ancillary elements

7. **Anti-glare screens** p(346)

On unlit roads in particular

Anti-glare screens on the central reservation often used in conjunction with safety fences.

Open vision as much as possible

Plants can be used or metal mesh or vertical plastic vanes

Road Cross-Section Elements

Ancillary elements

9. **Noise and noise barriers** p (349)

In a survey in 1992 in the UK,

9% of the adult population in England was seriously bothered by traffic noise at home.

16% of them were bothered when out.

Noise barriers could be natural or manufactured

Road Cross-Section Elements

Ancillary elements

Noise level < 68 dB(A)L10 (18h) is accepted

See p 353

To alleviate the noise nuisance:

- Insulation of buildings (closed double-glazed windows
10cm cavity reduces noise by 25-38 dB(A))
- Constructing intervening barriers using
 - Dense timber fences
 - Concrete walls
 - Landscaped earth mounds

Height 1 – 3 m