

**Thi\_ Qar University**  
**College of Engineering/Civil Engineering**  
**Department**

**Highway Lectures**

*Fourth Class*

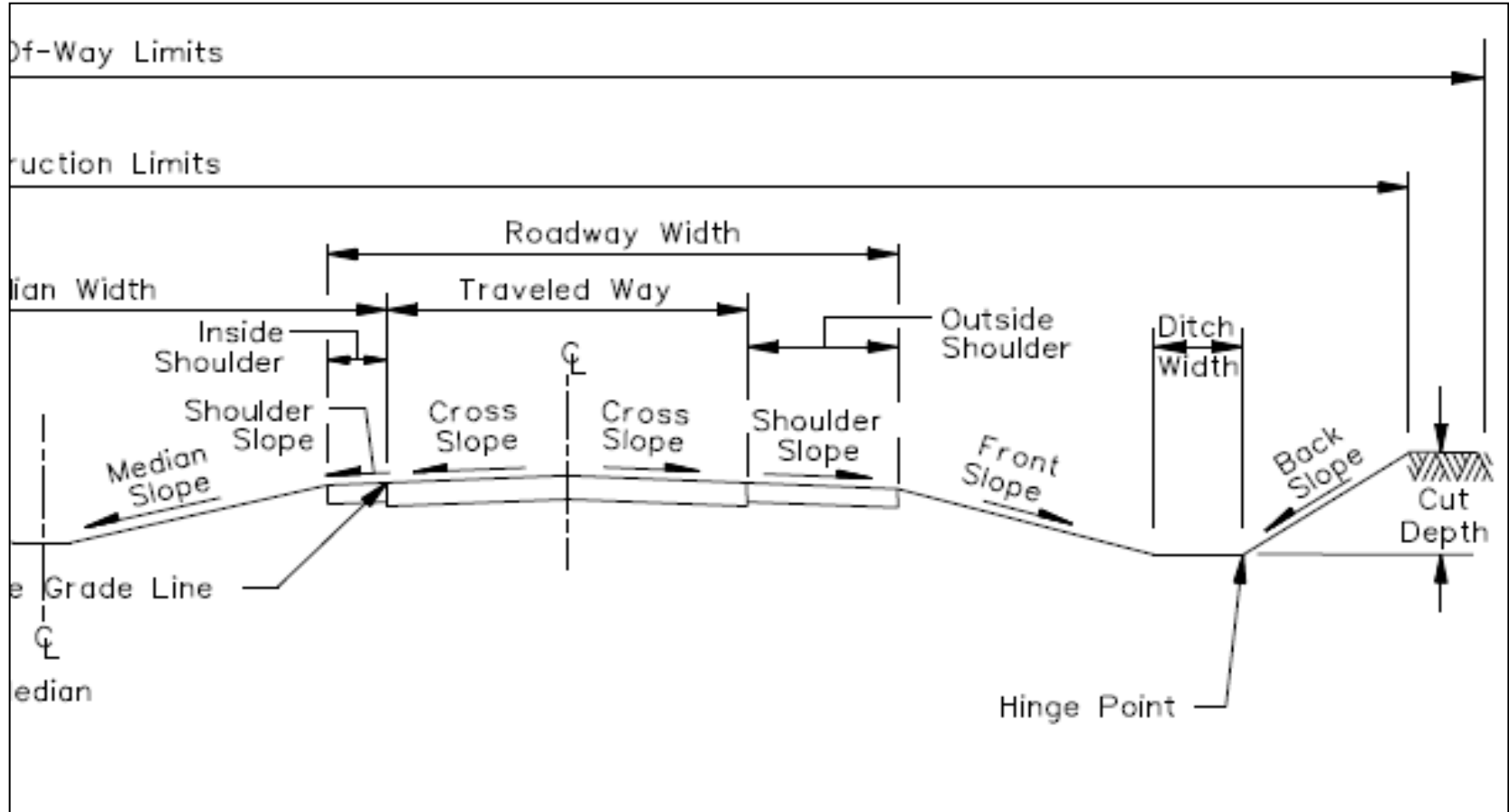
*Part #1: - Cross Section Elements*

**Lecture #1**  
**Cross Section Elements**

*Prepared By*  
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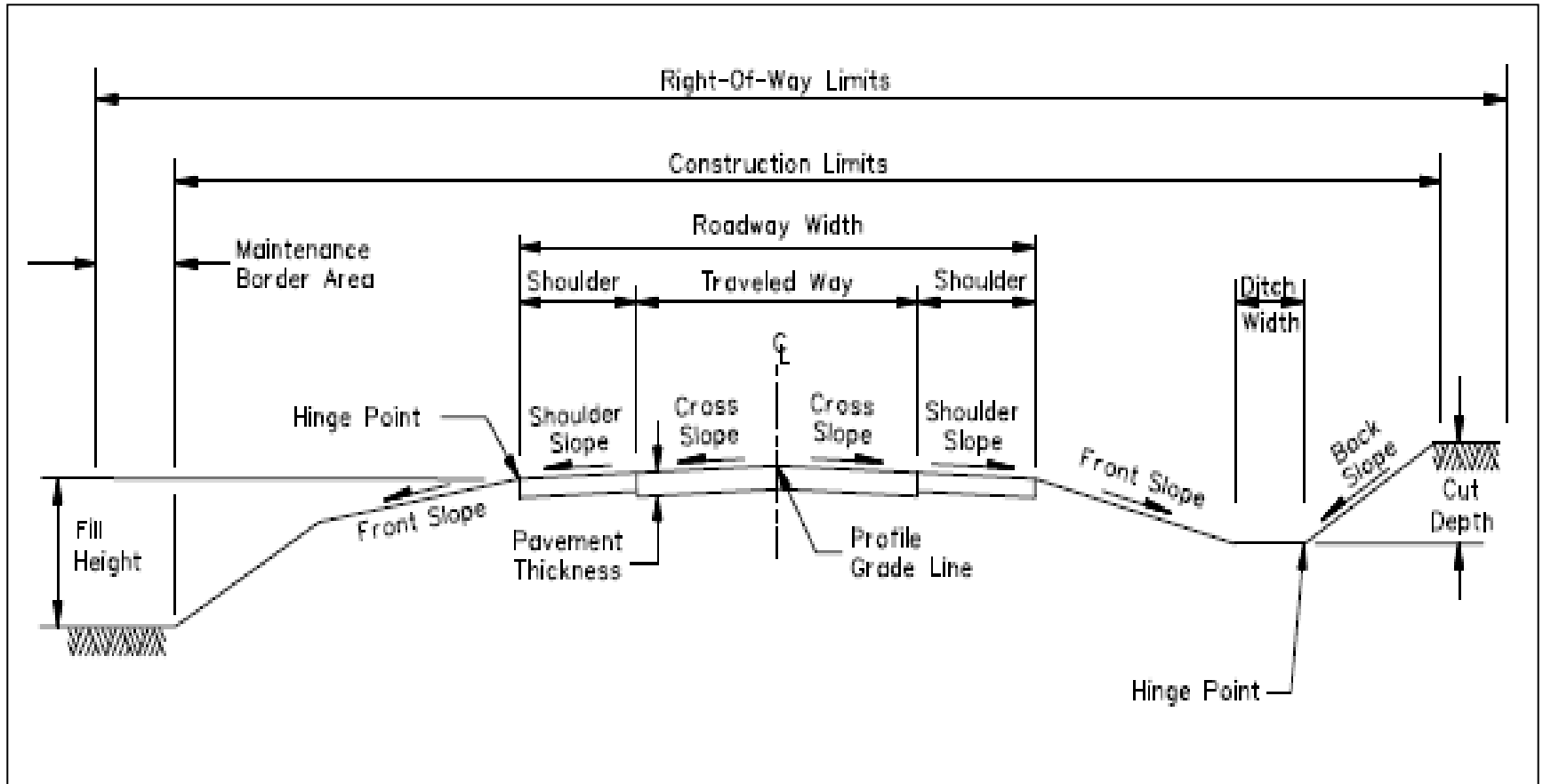


# Introduction



**FREEWAY AND EXPRESSWAY (Reference #3)**

# Introduction



Rural Highway (Reference #3)

# 1) Travel Lanes (Carriageways), (Pavement)

- The type of pavement usually is determined by analysis of the volume and composition of traffic, the soil conditions, the availability of materials, the initial cost, the desired service life and the estimated cost of maintenance.
- There are different types of surfacing such as:-
  - i. Flexible pavement type (Asphalt mix).
  - ii. Rigid pavement (Portland cement concrete).
  - iii. Concrete pavement bricks (Interlock)
  - iv. surface treatment on prepared subbase material.
  - v. Others.

# 1) Travel Lanes (Carriageways), (Pavement)

- Width of the carriage way or the width of the pavement depends on:-
  - i. Design volume
  - ii. Vehicle dimensions
  - iii. Design speed
  - iv. Road classification
  
- The width of the carriage way vary between (3.0 m to 3.75 m). For single lane, the desirable carriage way width recommended is 3.75 m and 3.5 m for multilane.

# 1) Travel Lanes (Carriageways), (Pavement)



## 2) Cross Slop (Camber)

- Camber or cant is the cross slope provided to raise middle of the road surface in the transverse direction to enable surface water to drain from traffic lanes and shoulders as quickly as possible .The objectives of providing camber are:
  - ✓ Surface protection especially for gravel and bituminous roads;
  - ✓ Sub-grade protection by proper drainage;
  - ✓ Quick drying of pavement which in turn increases safety.
- Accumulations of water cause hazards by reducing surface friction and vehicle stability. Good drainage minimizes moisture



## 2) Cross Slop (Camber)

- **Crown** is the point which having maximum height on the carriageway
- Cross slope (camber) values for different type of pavement according to Iraqi Highway Design Manual is given below:-

No.	Surface type	Cross slop, %
1	Gravel surface, stabilizes surface	3
2	Bituminous surface treatment	2.5-3
3	Stone block pavement	2.5
4	Asphaltic concrete	1.5-2
5	Concrete road	1.5

### 3) Shoulders

➤ Shoulder widths will vary according to functional classification, traffic volumes, urban/rural location, curbed/uncurbed, and the project scope of work. So, shoulder widths can vary between 1.25 to 3.0 m. The paved shoulder part has the same slope as the carriageway, but unpaved shoulder has a cross slope 8% . The following are some of the important functions of shoulders:

- ✓ provides structural support for the traveled way;
- ✓ increases highway capacity;
- ✓ encourages uniform travel speeds;
- ✓ enhances highway aesthetics;

## 3) Shoulders

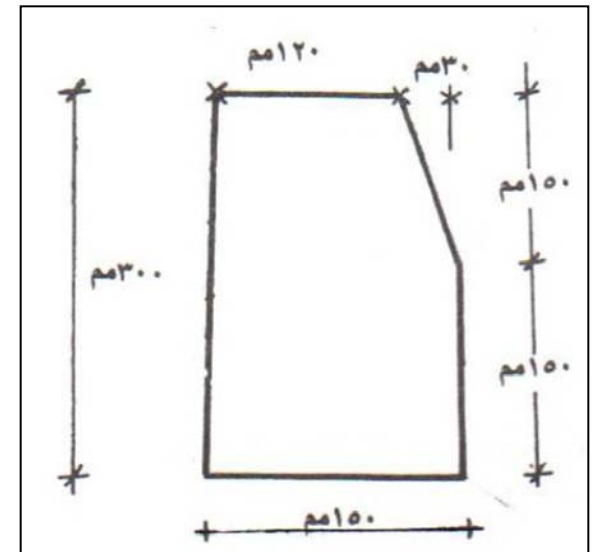
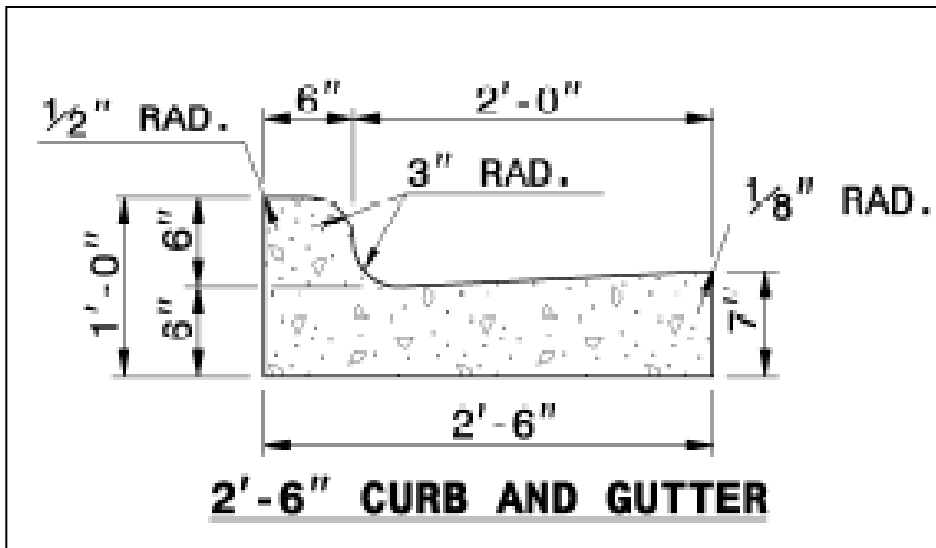
- ✓ provides structural support for the traveled way;
- ✓ provides space for emergency stops;
- ✓ improves sight distance around horizontal curves;
- ✓ facilitates maintenance operations;
- ✓ provides space for pedestrian and bicycle use.
- ✓ provides support for guardrail and prevents erosion around guardrail posts;
- ✓ prevents or minimizes pavement edge dropoffs;

## 4) Medians

- Medians are provided on divided multi-lane highways to provide a separation of opposing traffic lanes, a recovery area for out-of-control vehicles and an area for emergency stops. Besides these safety benefits, medians also can provide space for:
  - ✓ Collecting surface drainage,
  - ✓ Refuge for pedestrians at crosswalks,
  - ✓ Reduce light glare,
  - ✓ Reduce accidents,
  - ✓ Installation of traffic control devices and
  - ✓ Adding future lanes
- The Medians width suggested by Iraqi standard is vary from **3.0 m to 10.5 m** according to highway type and classification.

## 5) Curbs

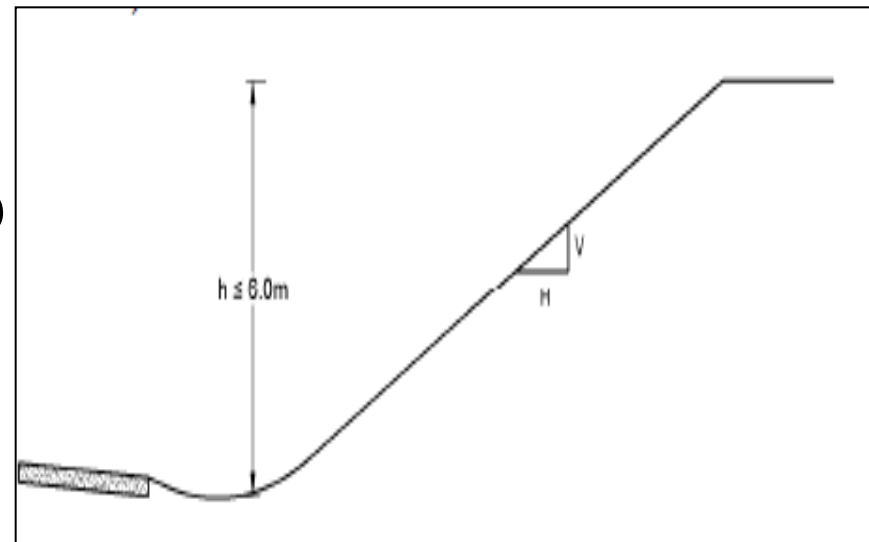
- Curbs are used on urban and suburban facilities due to
  - ✓ control drainage
  - ✓ delineate pavement edges
  - ✓ prevent the vehicles from leaving the pavement at hazardous point
  - ✓ channelize vehicular movements
  - ✓ manage access
  - ✓ provide separation between vehicles and pedestrians



## 6) Side Slopes

- Side slopes are important in maintaining the stability of the roadbed and pavement structure as well as providing an area for the safety of errant vehicles. Side slopes are constructed in both fill (embankment) areas (those falling above the natural ground level) and cut areas (those falling below the natural ground level).

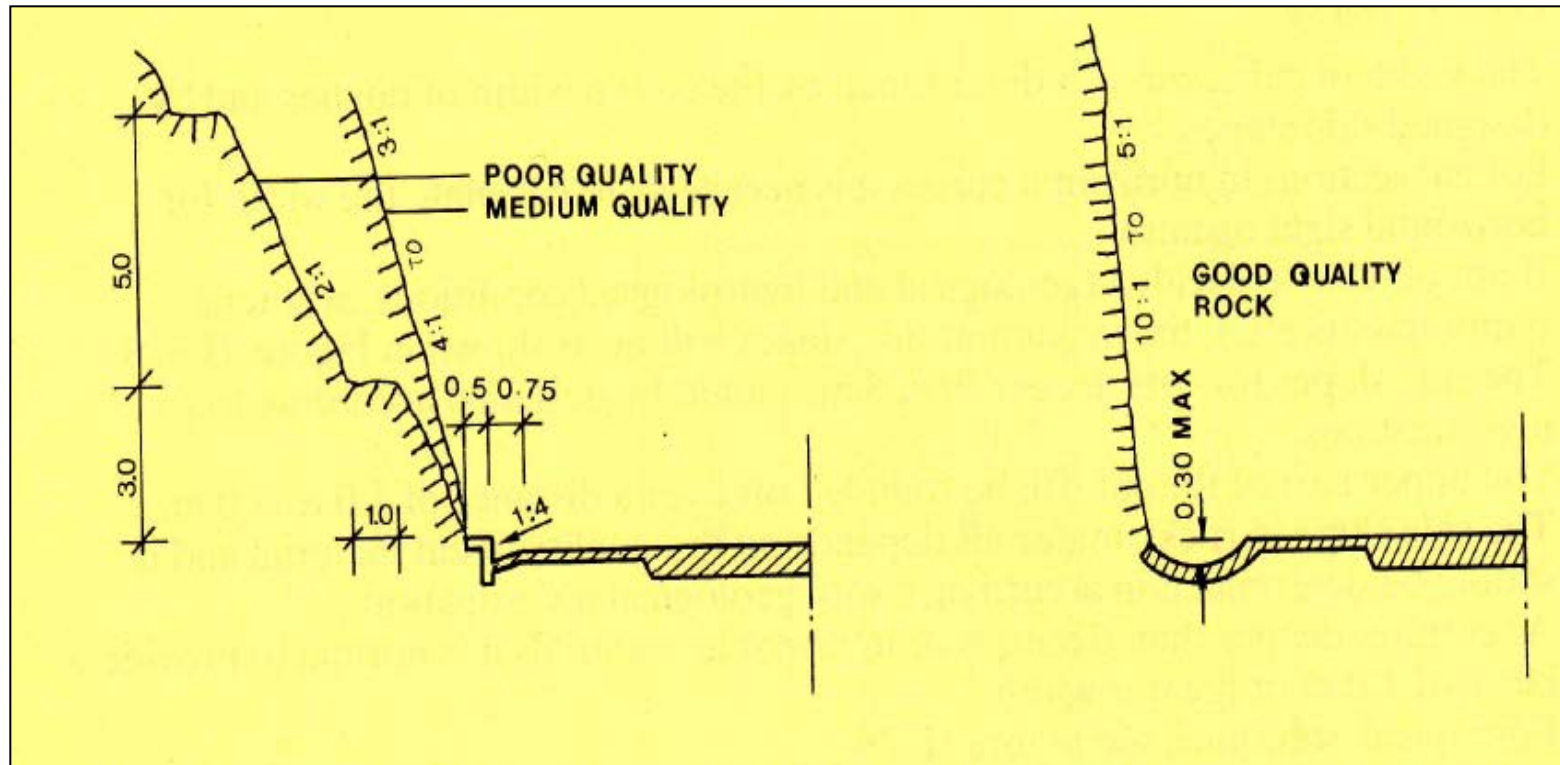
- Cut slop For earth materials  
(gravel soil, silt, sand or clay,  $H \leq 6.0$  M)  
Side slop equal {H:V = 2:1 to 4:1  
(For safety taken 4:1)}



Cut slop (Reference #2)

## 6) Side Slopes

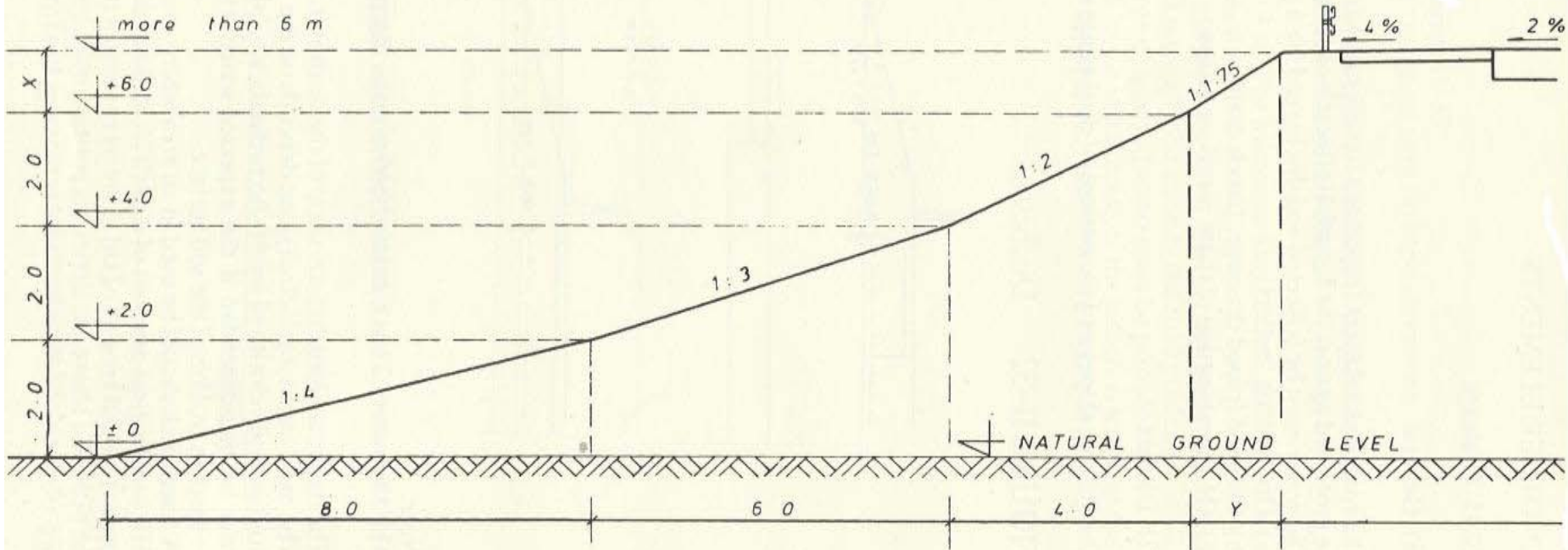
- For earth materials (gravel soil, silt, sand or clay,  $H > 6.0$  M) Side slope value should be designed according to analysis for slope stability theory and economic materials. For rocky materials side slope depend on the rock quality. See figure below;



# 6) Side Slopes

## ➤ Fill slop

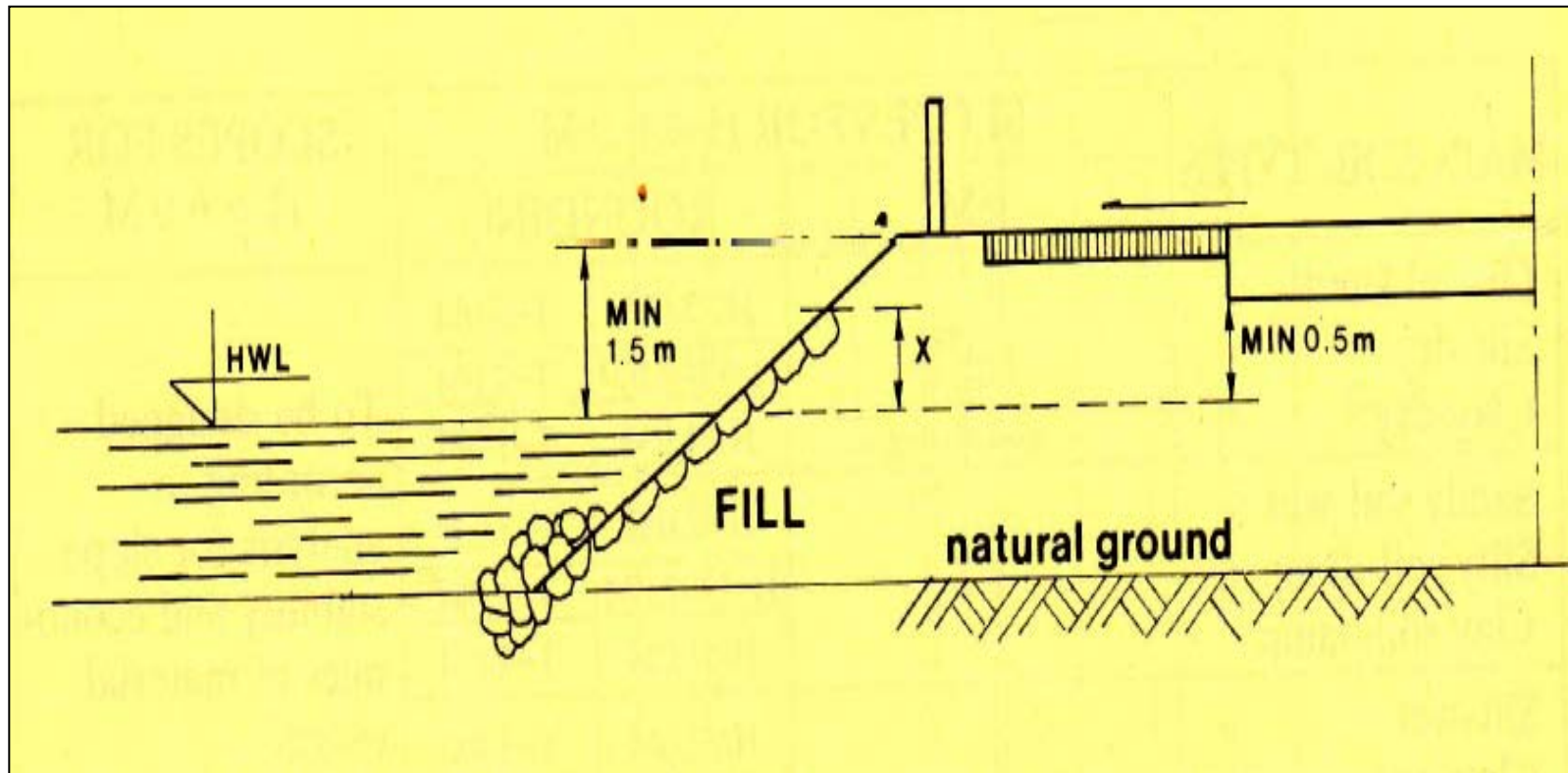
NOTE: These side slopes are valid for all road classes  
 X – height of upper part of the embankment  
 Y – will be determined by x





## 6) Side Slopes

- **Fill slop** :- Fills along waterway will be designed as figure below



## 7) Guard Rails

- They are provided at the edge of the shoulder usually when the road is on high an embankment especially when the height of the fill exceeds 3 m and at hazard locations:-

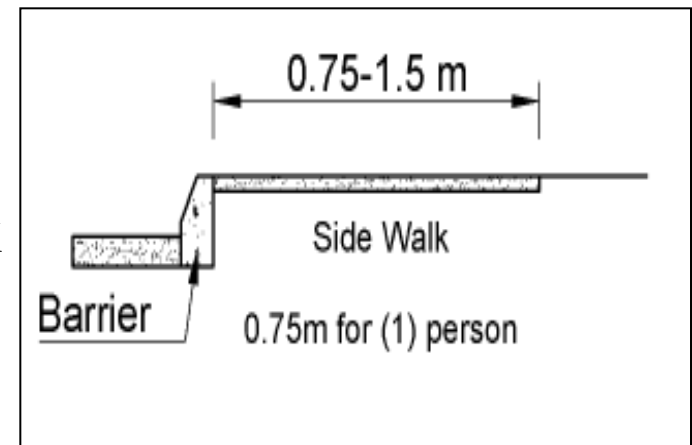
- ✓ High an embankment;
- ✓ Embankment on sharp curve;
- ✓ Water edge;
- ✓ sudden change in alignment;
- ✓ Deep ditch in cutting;
- ✓ Others dangerous place.



- They serve to prevent the vehicles from running off the embankment. Guard stones painted in alternate black and white are usually used. They also give better visibility of curves at night under headlights of vehicles.

## 8) Sidewalks

- That portion of the highway cross section separated from the roadway and constructed for the use of pedestrians.
- Sidewalks are an integral part of city roads, sometimes provided in rural areas.
- In residential areas the sidewalk width varies between **1.2 to 2.4 m**. The side walk should be separated from the traveled way with a curb and planted strip of minimum **0.6 m width**.



Side walk (Reference #5)

## 9) Gutter

- A street gutter is a depression running parallel to a road designed to collect rainwater flowing along the street and divert it into a storm drain.
- The **max. depth** of gutter is 0.3 m.
- The **min. longitudinal** grade is 0.5%.
- The **min. width** of gutter is 0.5 m.
- The **max. width** of gutter is 1.0 m.
- The surface cross full should be 10% .



Spin Screed at work on an Illinois highway  
building a type A gutter

## 10) Right of way

- Right of way is the width of land acquired for the road, along its alignment. It should be adequate to accommodate all the cross-sectional elements of the highway and may reasonably provide for future development
- The right of way width is depends on:-
  - ✓ The category of the highway and width of roadway
  - ✓ Height of embankment or depth of cutting.
  - ✓ Side slopes of embankment or cutting.
  - ✓ Sight distance considerations.
  - ✓ Drainage system and their size which depends on topography etc.
- Right of way is used for:- **Future expansion; Safety and Maintenance.**
- In general the right of way  $\geq 80$  m, for highway roads the right of way  $\approx 100$  m.

## 10) Others

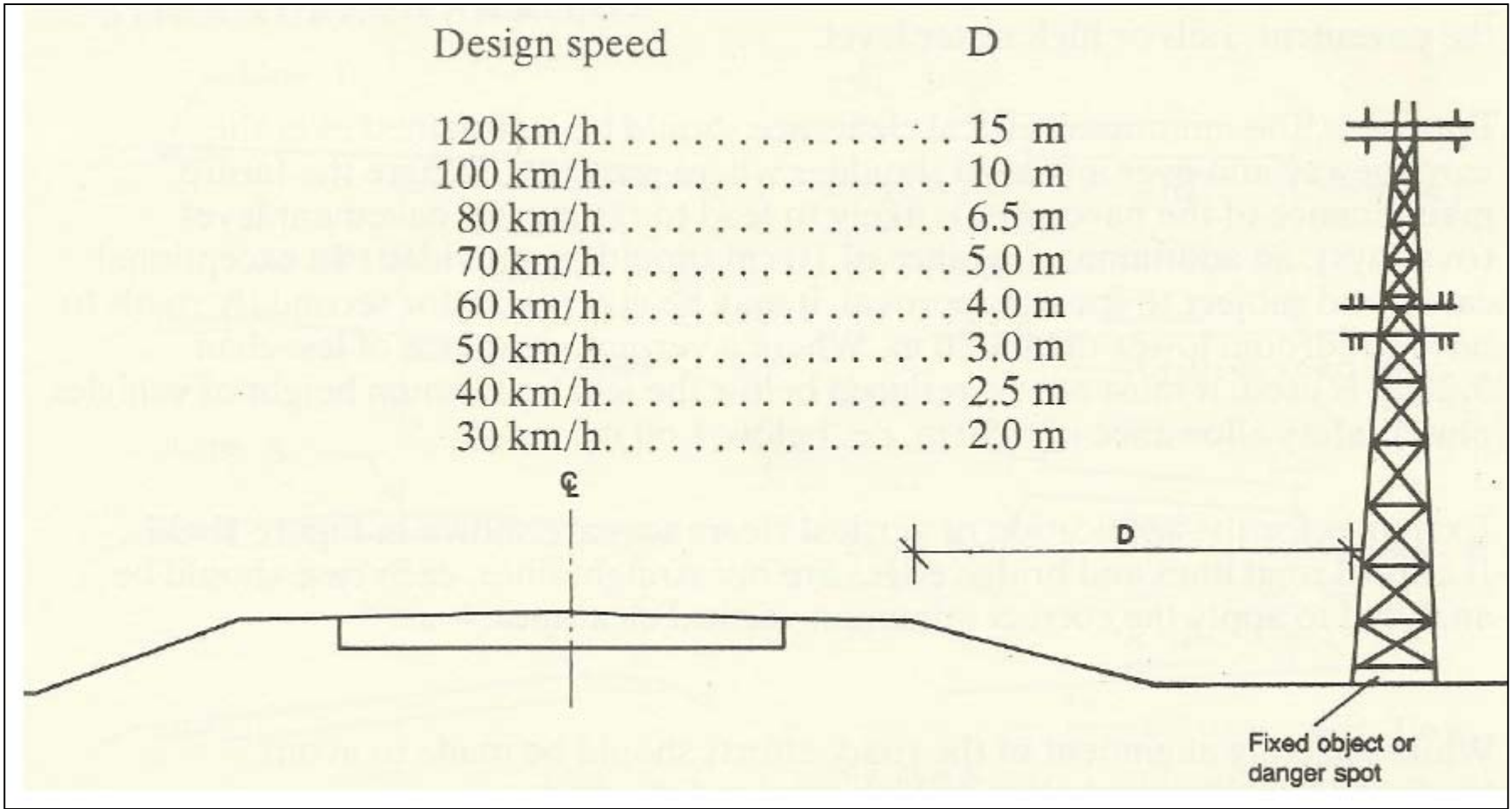
### ➤ Vertical Clearances

ت	عندما يكون العائق فوق ما يلي	الحد الأدنى لصافي المسافة العمودية ( م )
١-	طريق للمركبات	٥,٢٠
٢-	طريق للمشاة	٢,٥٠
٣-	سكة حديد	٦,٥٠
٤-	الانهر : المجموعة ١ : نهري دجلة والفرات	٦,٢٥
٥-	المجموعة ٢ : ديالى ، الغراف ، المجر الكبير ، شط الحلة ، الشامية ، الصويرة ، القادسية	٣,٥٠
٦-	المجموعة ٣ : الكحلاء ، المشرح ، البتيره ، البحيرة .	٢,٥٠
٧-	المنشآت الأخرى	١,٥٠

Vertical Clearance (Reference #2)

# 10) Others

## ➤ Horizontal Clearances



## 10) Others

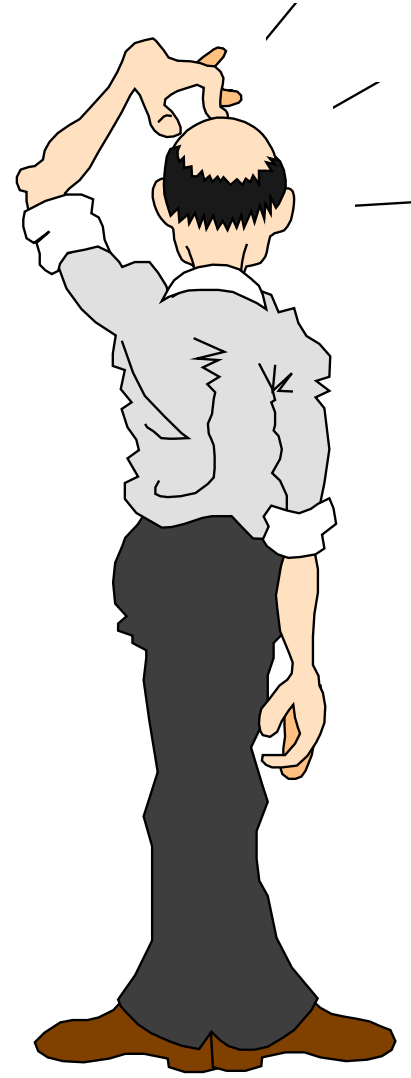
### ➤ Bus-bays

- Bus bays are provided by recessing the kerbs for bus stops. They are provided so that they do not obstruct the movement of vehicles in the carriage way. They should be at least 75 meters away from the intersection so that the traffic near the intersections is not affected by the bus-bay.





Questions - ?



# References

- 1) Delaware Department of Transportation, (2004), “Road Design Manual”, Delaware State. USA.
- 2) Ministry of Housing and Construction, (2004), “Highway Design Manual”, Republic of Iraq.
- 3) Bureau of Design and Environmental Manual, (2010), “Cross Section Elements”, Illinois, USA.
- 4) Tom V. Mathew and K V Krishna Rao, (2007), “Introduction to Transportation Engineering”, The Indian Institute of Technology Bombay, India.
- 5) Ali Alwash and Harith Ajam, (2010), “Lectures of Highway Engineering”, Babylon University, Iraq.