

Q.1

Gradients: It is the rate of rise or fall along the length of the road with respect to the horizontal. It is expressed as a ratio (1 vertical unit for horizontal unit). Sometimes the gradient is also expressed as a percentage i.e. $n\%$ (n in 100).

Types of Gradients:-

A. Ruling Gradient:

- 1) This depends on the terrain, length of the grade, speed, pulling power of the vehicle & the presence of the horizontal curve.
- 2) The IRC has recommended ruling gradient value of 1 in 30 on plain & rolling terrain, 1 in 200 on mountainous terrain and 1 in 16.7 on step terrain.

B. Limiting Gradient:-

- 1) It is steeper than the ruling gradient.
- 2) This gradient is adopted when the ruling gradient results in enormous increase in cost of construction.
- 3) It may be frequently necessary to limiting gradient.

C Exception Gradient:-

- 1) Exceptional gradient are very steep or gradients given at unavoidable situations
- 2. They should be limited for short stretches not exceeding about 100m at stretch

D Minimum Gradient:-

- 1) It depends on the main fall, type of soil and other site conditions.
- 2) A minimum of 1 in 500 may be sufficient for concrete drain & 1 in 200 for open soil drains are found to give satisfactory performance.