

# Road Safety

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COURSE CODE: 18CV562

OPEN ELECTIVE

# Course Learning Objectives (CLO's)

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1.	To acquire knowledge and understanding of the road environment.
2.	To inculcate decision making and behavioural skills necessary to survive in the road environment.
3.	To impart knowledge and understanding of the causes and consequences of accidents.
4.	To understand the roles and responsibilities in ensuring road safety.

# Unit 1 (8 hours)

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**Introduction:** Importance of Transportation Engineering- Jayakar Committee Recommendations & Implementations- Road Alignment & factors Affecting the Road Alignment- Road classification. Importance and Factors Controlling The Design of Geometric Elements- Highway Cross Sectional Elements-Camber, Width of Carriage Way, Shoulder Width, Formation Width, Right of Way, Typical Cross Sections of the Roads -Pavement Surface Characteristics- Types of Pavements.

Introduction to Road Safety: Road traffic accidents scenario in India and in the world. Road Safety and its importance. Traffic Rules and Driving Behaviour. Characteristics of accidents, accidents vs. crashes.

Specifications for Road Humps.

# Unit 2 (8 hours)

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**Management of Traffic and Traffic Rules:** Vehicle And Human Characteristics, PIEV Theory, Traffic characteristics, vehicular characteristics, Traffic regulation and control ( Traffic signals, Traffic signs and Road Markings), Pedestrian Facilities (zebra crossings, bus stops, use of road by physically disadvantaged persons, elderly persons, women and children)

**Salient features of Motor Vehicles Act, 1988 and 2019 amendment.**

(Registration and Licensing Authorities in India: Their powers and duties, Legal requirements to be met for driving various classes of vehicles. classification of traffic offences. Penalties and appeals)

# Unit 3 (8 hours)

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## **Accidents studies and Analysis**

Importance of accident studies, causes, accident studies and records, Accident investigation, Road and its effect on accidents, parking and its influence on accidents.

Collection of Accident Data, requirement of accident records, Traffic management measures and their influence on accident prevention, cost of road accidents.

**Management of Road Mishaps and Accidents:** First aid to accident victims- First aid techniques, coordination with hospitals and other health centres for emergency treatment of accident victims, role of Insurance companies in providing relief to accident victims, Management of Ambulance Services, Importance of voluntary blood donation in saving accident victims, Rehabilitation of persons affected by accidents.

# Unit 4 (8 hours)

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## **Traffic regulations and Management of road Safety**

Regulation of Speed, vehicles, regulation concerning driver and traffic

Promotion of Road Safety in India: Coordination between various local and Government Authorities for better management of road safety, compulsory safety training for drivers of all classes of vehicles. widening and improvement of quality of roads in India, role of NGOs, media and voluntary organizations in promoting road safety.

**Management of Road Safety:** Meaning and interpretation of various road signs, management of speed limits and enforcement of safety rules, fundamentals of vehicle maintenance for better safety on the road. Vehicle parking rules, overtaking rules, stringent penalties for repeated violations, participation of the public in ensuring safe driving conditions on the road, prevention of driving under the influence of alcohol, drugs and intoxicants. counseling and its role in accident prevention.

# Unit 5 (8 hours)

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**People responsible for accident prevention**, 4 E's of Accidents Prevention, Celebration of Road Safety week or Workshop

## **Road safety audit**

Road Safety Audits and Tools for Safety Management Systems, Road Safety Audit Process, Approach to Safety, Road Safety Improvement Strategies, ITS and Safety

# Reference Books:

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- |   |   |
|---|---|
| 1 | Dr. S. K. Khanna, Dr. C. E. G. Justo and Dr. Veeraragavan, “Highway Engineering”, Nem Chand and Bros., Revised tenth edition, 2015, Roorkee, India. |
| 2 | Dr. L. R. Kadiyali, “Traffic Engineering & Transport Planning”, Khanna Publishers, Seventh edition, 2007, New Delhi, India.                         |
| 3 | Indian Roads Congress, Highway Safety Code, IRC: SP-44:1996   |
| 4 | Indian Roads Congress, Road Safety Audit Manual, IRC: SP-88-2010  |
| 5 | Highway Safety Manual, 1st Edition, AASHTO  |
| 6 | IRC 103-1988 Guidelines for Pedestrian facilities   |



# Course Outcomes (COs)

	At the end of the course, students will be able to:	Bloom's Level
1.	Describe the importance of transportation and road safety.	L2
2.	Explain the vehicle and human characteristics affecting road accidents.	L2
3.	Outline the salient features of motor vehicle acts and Summarize accident studies and investigations.	L2
4.	Make use of traffic regulations to manage road safety.	L3
5.	Demonstrate the importance of a multidisciplinary approach to planning for traffic safety and rehabilitation.	L2

# Program Outcome (POs)

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	Program Outcome (POs)	PO No.
1.	Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.	1
2.	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	6
3.	Individual and team work: Function effectively as an individual and as a member or leader in diverse teams, and in multidisciplinary settings.	9

# Unit 1

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- **Transportation engineering** is the application of technology and scientific principles to the planning, functional design, operation and management of facilities for any mode of transportation in order to provide for the safe, efficient, rapid, comfortable, convenient, economical, and environmentally compatible movement of people and goods from one place to other.

# Characteristics of road transport

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- Roads are used by various types of road vehicles, like passenger cars, buses, trucks, pedal cycle and animal drawn vehicle.
- It requires a relatively small investment for the government.
- It offers a complete freedom to road users to transfer the vehicle from one lane to another and from one road to another according to need and convenience.
- Speed and movement is directly related with the severity of accident.
- Road transport is the only means of transport that offers itself to the whole community alike.

# Highway Development in India

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- Jayakar Committee (1927)
- Central Road Fund (1929)
- Indian Roads Congress (IRC), 1934
- Central Road Research Institute (CRRI), 1950
- Motor vehicle act (1936)
- National Highway Authority of India (NHAI), 1995
- First twenty year road plan ( 1943-61 )
- Second twenty year road plan ( 1961-81 )
- Highway Research board ( 1973 )
- National Transport Policy committee ( 1978 )
- Third twenty year road plan ( 1981-2001 )

# JayakarCommittee,1927

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- After the first World War, motor vehicle using the roads increases, this demanded a better road network.
- In 1927, Indian road development committee was appointed by the government with M.R. Jaykar as chairman.
- Road development in the country should be made as a national interest since local govt. do not have financial and technical capacity for road development.
- An extra tax should be levied on petrol from road users to create the road development fund.
- To establish a semi-official ,technical institution to pool technical knowledge, sharing of ideas and to act as an advisory body.
- To create a national level institution to carry research , development works and consultation.

# Central Road Fund

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- It was formed on 1<sup>st</sup> March 1929
- The consumers of petrol were charged an extra levy of 2.64 paisa per litre of petrol to built up this road development fund.
- From this 20% of annual revenue is to be retain as a central revenue for research and experimental work expenses..etc
- Balance 80% is allowed by central govt. to various states based on actual petrol consumption or revenue collected.

# Central Road Fund , 1929 CRF Act , 2000

Distribution of 100% cess on petrol as follows:

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- 57.5% for NH
- 30% for SH
- 12.5% for safety works on rail-Road crossing.

50% cess on diesel for Rural Road development

1. <http://transport.bih.nic.in/Acts/The-Central-Road-Fund-Act-2000.pdf>
2. <https://www.prsindia.org/billtrack/central-road-fund-amendment-bill-2017>
3. <http://164.100.47.193/Refinput/New Reference Notes/English/The%20Central%20Road%20Fund%20amd%20bill%20-%20Main.pdf>



# IRC

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The Indian Roads Congress (IRC) is the Apex Body of Highway Engineers in the country.

The IRC was set up in December, 1934 on the recommendations of the Indian Road Development Committee best known as Jayakar Committee set up by the Govt. of India with the objective of Road Development

<http://www.irc.nic.in/index1.aspx?lsid=28&lev=1&lid=31&langid=1>  
[t in India.](#)

# Indian Roads Congress, 1934

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- Central semi official technical body known as IRC was formed in 1934.
- To provide national forum for regular pooling of experience and ideas on matters related to construction and maintenance of highways.
- It is a active body controlling the specification, standardization and recommendations on materials, design of roads and bridges.
- It publishes journals, research publications and standard specifications guide lines.
- To provide a platform for expression of professional opinion on matters relating to roads and road transport.

# Motor vehicle act

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- It was formed in 1939
- To regulate the road traffic in the form of traffic laws, ordinances and regulations.
- Three phases primarily covered are control of driver, vehicle ownership and vehicle operation
- It was revised on 1988



# CRRI in New Delhi

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# Central Road Research Institute (1950)

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- Engaged in carrying out research and development projects.
- Design, construction and maintenance of roads and runways, traffic and transportation planning of mega and medium cities, management of roads in different terrains
- Improvement of marginal materials.
- Utilization of industrial waste in road construction. Land slide control. Ground improvements, environmental pollution.
- Road traffic safety.

CSIR-Central Road Research Institute (CRRI), a premier national laboratory established in 1952, a constituent of Council of Scientific and Industrial Research (CSIR) is engaged in carrying out research and development projects on design, construction and maintenance of roads and runways, traffic and transportation planning of mega and medium cities, management of roads in different terrains, improvement of marginal materials, utilization of industrial waste in road construction, landslide control, ground improvements environmental pollution, road traffic safety and analysis & design, wind, fatigue, corrosion studies, performance monitoring/evaluation, service life assessment and rehabilitation of highway & railway bridges.

The institute provides technical and consultancy services to various user organizations in India and abroad. For capacity building of human resources in the area of highway Engineering to undertake and execute roads and runway projects, Institute has the competence to organize National & International Training Programmes continuing education courses since 1962 to disseminate the R&D finding to the masses.

# Ministry of Road Transport & Highways

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- Planning, development and maintenance of National Highways in the country.
- Extends technical and financial support to State Governments for the development of state roads and the roads of inter-state connectivity and economic importance.
- Evolves standard specifications for roads and bridges in the country.
- It stores the data related to technical knowledge on roads and bridges.



# Highway Research Board

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- To ascertain the nature and extent of research required
- To correlate research information from various organization in India and abroad.
- To collect and correlation services.
- To collect result on research
- To channelize consultative services



# Classification of Highways

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National highway act ( 1956 ) Depending on weather

- All weather roads
- Fair weather roads

Depending the type of Carriage way

- Paved roads(WBM)
- Unpaved roads(earth road or gravel road)

Depending upon the pavement surface

- Surfaced roads(bituminous or cement concrete road)
- Un surfaced roads

# Classification of Highways

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## Based on the Traffic Volume

- Heavy
- Medium
- Light

## Based on Load or Tonnage

- Class 1 or Class 2 etc or Class A , B etc Tonnes per day

# Classification of Highways

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Based on location and function ( Nagpur road plan )

- National highway (NH)
- State highway (SH)
- Major district road (MDR)
- Other district road (ODR)
- Village road (VR)

# Based on modified system of Highways classification

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- Primary**

- Expressways
- National Highways

- Secondary**

- SH State Highways
- MDR Major District Roads

- Tertiary**

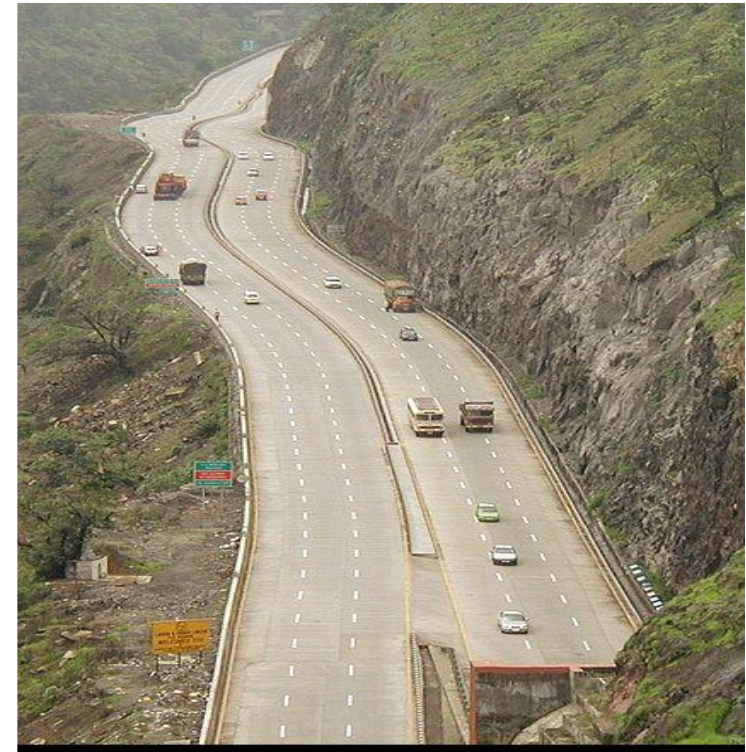
- ODR Other District Roads
- VR Village Roads

# Expressways

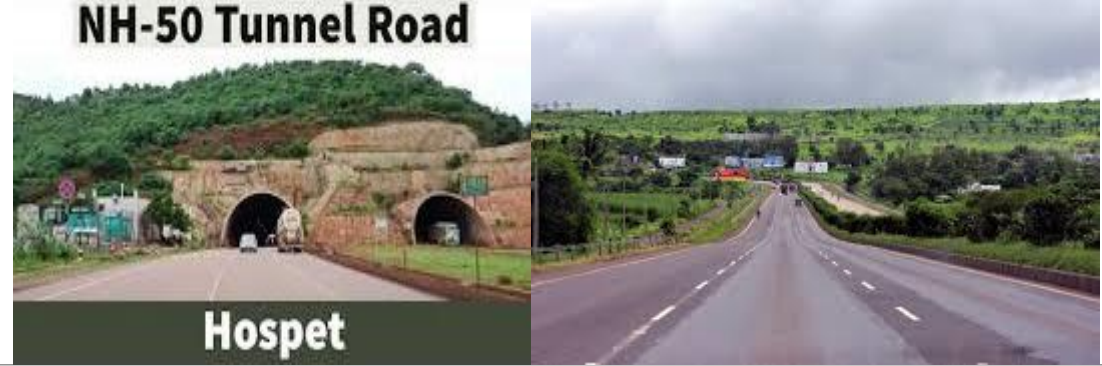
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- Heavy traffic at high speed (120km/hr)
- Land Width (90m)
- Full access control
- Connects major points of traffic generation
- No slow moving traffic allowed
- No loading, unloading,
- parking.

Mumbai Pune Expressway  
seen from Kandala



# National Highway



1. India has a huge network of national highways.
2. The national highways have a total length of 70,548 kms. Indian highways cover 2% of the total road network of India and carry 40% of the total traffic.
3. The entire highway network of India is managed by the National Highway Authority of India which is responsible for development and maintenance of highways.

The longest highway in India is NH7 which stretches from Varansi in Uttar Pradesh to Kanyakumari in the southern most point of Indian mainland.

4. The shortest highway is NH47A which stretches from Ernakulam to Kochi and covers total length of 6 Kms.

# State Highways

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They are the arterial roads of a state, connecting up with the national highways of adjacent states, district head quarters and important cities within the state.

**176,166 kilometres**

State Highways are designated with SH, followed by the highway number and preceded by state code. As of 31 March 2016, the total length of state highways was 176,166 **kilometres** (109,464 mi).

# Major District Roads and Other District Roads

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These are major roads within a district, connecting Taluka headquarters and major rural areas to district headquarters. They also connect with the **state highways** and **national highways**. District roads are sub-classified into "Major District Roads" (MDRs) and "Other District Roads" (ODRs).

Approximately 561,940 kilometres

As on 31 March 2016, the **total length** of **district roads** in India was approximately 561,940 kilometres (349,170 mi), of which 94.93% of the **total length** was surfaced.



# Village Roads

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Regardless of their impact, **rural roads** form the most important component of **India's road** network. Of **India's** 1.7 million km of **roads**, 73% are **rural roads**. A smaller but important component that the central government influences is national highways.

<https://www.worldbank.org/en/news/feature/2011/02/17/india-rural-roads>ponent that the central government influences is national highways.



# Arterial Road

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No frontage access, no standing vehicle, very little cross traffic.

Design Speed : 80km/hr

Land width : 50 – 60m

Spacing 1.5km in CBD & 8km or more in sparsely developed areas.

Divided roads with full or partial parking

Pedestrian allowed to walk only at intersection

# Sub Arterial Road

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Bus stops but no standing vehicle.

Less mobility than arterial.

Spacing for CBD : 0.5km

Sub-urban fringes : 3.5km

Design speed : 60 km/hr

Land width : 30 – 40 m

# Collector Street

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Collects and distributes traffic from local streets

Provides access to arterial roads

Located in residential, business and industrial areas.

Full access allowed.

Parking permitted.

Design speed : 50km/hr

Land Width : 20-30m

# Local Street

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Design Speed : 30km/hr.

Land Width : 10 – 20m.

Primary access to residence, business or other abutting property

Less volume of traffic at slow speed

Origin and termination of trips.

Unrestricted parking, pedestrian movements. (with frontage access, parked vehicle, bus stops and no waiting restrictions)

# CUL-DE- SAC

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Dead End Street with only one entry access for entry and exit.

Recommended in Residential areas



# Factors Influencing Highway Alignment

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## Requirements:

- Short
- Easy
- Safe
- Economical

# Factors controlling alignment :

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## 1) Obligatory points

A. Obligatory points through which alignment is to pass ( bridge site, intermediate town , Mountain pass etc

B. Obligatory points through which alignment should not pass.

## 2) Traffic

## 3) Geometric design

## 4) Economics

## 5) Other considerations



# Factors governing alignment

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## Obligatory points

- The location should avoid obstructions such as places of cemeteries, archeological, historical monument, public facilities like schools and hospitals, utility services.

## Geometric design features

- Facilitate easy grade and curvature
- Enable ruling gradient in most sections
- Void sudden changes in sight distance, especially near crossings
- Avoid sharp horizontal curves
- Avoid road intersections near bend or at the top or bottom of a hill

## Precautions at river and railway crossings

- Bridges should be preferably be located at right angles to the river flow, not located on a horizontal curve
  - Crossing railway lines should avoid intersections at gradient, frequent crossing and recrossing
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## Topographical control points

- The alignment, where possible should avoid passing through
  - Marshy and low lying land with poor drainage
  - Flood prone areas
  - Unstable hilly features
  - Avalanche prone areas
- Flat terrain-below 3%
- Rolling terrain -3 to 25%
- Mountainous terrain – above 25%
- A location on high ground should be preferred rather than valley to avoid cross drainage works

# Factors governing alignment

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## Materials and constructional features

- Deep cutting should be avoided
- Earth work is to be balanced; quantities for filling and excavation
- Alignment should preferably be through better soil area to minimize pavement thickness
- Location may be near sources of embankment and pavement materials

## Traffic

Trend, Direction and pattern of traffic are critical elements.

OD survey should be conducted.

Desire lines based on survey should be drawn to indicate the desired pattern of traffic flow.

# ECONOMIC FACTORS

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Capital cost

Maintenance Cost

Operational cost

Road User Cost

Embankment and deep cuttings cost.

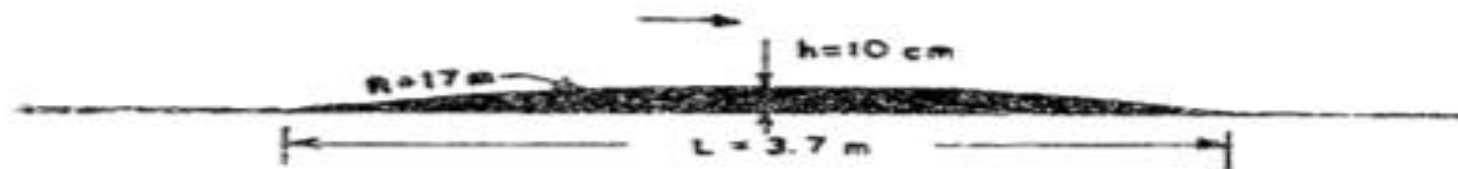
# Other Considerations

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1. Engineering feasibility
2. Environmental consideration
3. Social consideration
4. Political Acceptability
5. Monotony.

# Highway Cross Sectional Elements

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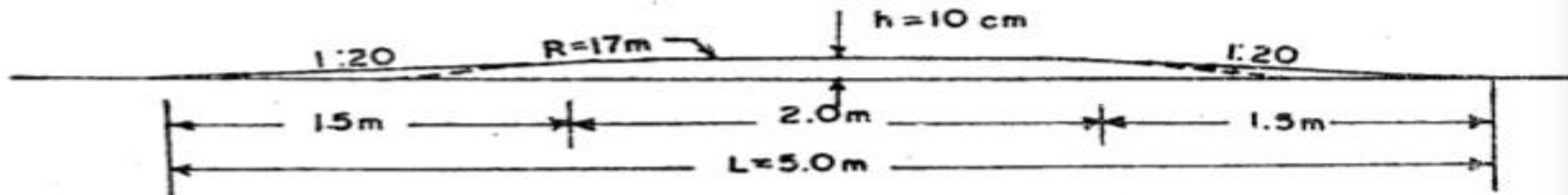


(a) LONGITUDINAL SECTION



(b) TRANSVERSE SECTION

Fig. 1. Recommended specification for rounded hump type of speed breaker for general traffic at preferred crossing speed 25 km/h



(a) LONGITUDINAL SECTION

(b) TRANSVERSE SECTION IS SAME AS GIVEN IN FIG. 1

Fig. 2. Recommended specification for hump type of speed breaker for heavy truck and bus traffic at preferred crossing speed 25 km/h