

A photograph of a dirt road in a rural setting, lined with large trees. Several people are visible on the road, some walking and some on bicycles. The scene is captured in a slightly hazy, overcast light. A semi-transparent blue rectangular box is overlaid on the center of the image, containing the title text in white, bold, sans-serif font.

# CONSTRUCTION OF CEMENT CONCRETE PAVEMENT

# PUBLIC WORKS DEPARTMENT- AN OVERVIEW

- ❑ Public Works Department (PWD), under the Ministry of Public Works department, is the pioneer in construction arena of Uttar Pradesh.
- ❑ It plays a pivotal role in the implementation of government construction projects
- ❑ To accelerate the construction of bridges in the state, Uttar Pradesh State Bridge Corporation was founded in 1973.
- ❑ In year 2004-05, Uttar Pradesh state highways authority was established to overcome with problem of pavements in state.

# INTRODUCTION

- ❑ Development of a country depends on the connectivity of various places with adequate road network.
- ❑ Roads constitute the most important mode of communication in areas where railways have not developed much.
- ❑ India has one of the largest road networks in the world (over 3 million km at present). For the purpose of management and administration, roads in India are divided into the following five categories:
  - National Highways (NH)
  - State Highways (SH)
  - Major District Roads (MDR)
  - Other District Roads (ODR)
  - Village Roads (VR)

## Status of Indian Road Network

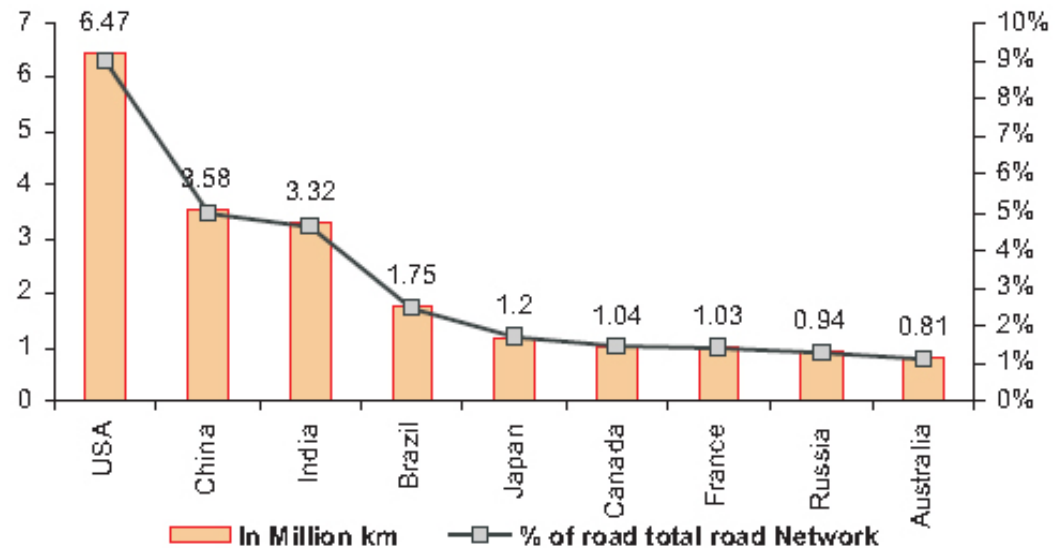
Expressways	200 km
NHs	66,590 km
State highways	131,899 km
Major district roads	467,763 km
Rural and other roads	2,650,000 km
<b>Total length (approx.)</b>	<b>3.3 million km</b>

Source: NHAI

**Fig. Showing status of Road Network In India**

## Position of India In World Road Network

**World roads networks**



Source: CIA world fact book, Keynote Institutional Research

# WHAT IS ROAD AND PAVEMENT ?

- ❑ Road is an open, generally public way for the passage of vehicles, people, and animals.
- ❑ Pavement is finished with a hard smooth surface. It helped make them durable and able to withstand traffic and the environment. They have a life span of between 20 – 30 years.

## FUNCTIONS

One of the primary functions of pavement is load distribution. It can be characterized by the tire loads, tire configurations, repetition of loads, and distribution of traffic across the pavement, and vehicle speed

# TYPES OF PAVEMENTS

There are various types of pavements depending upon the materials used; a brief description of all types is given here-

## FLEXIBLE PAVEMENT

Bitumen has been widely used in the construction of flexible pavements for a long time. This is the most convenient and simple type of construction. The cost of construction of single lane bituminous pavement varies from 20 to 30 lakhs per km in plain area.

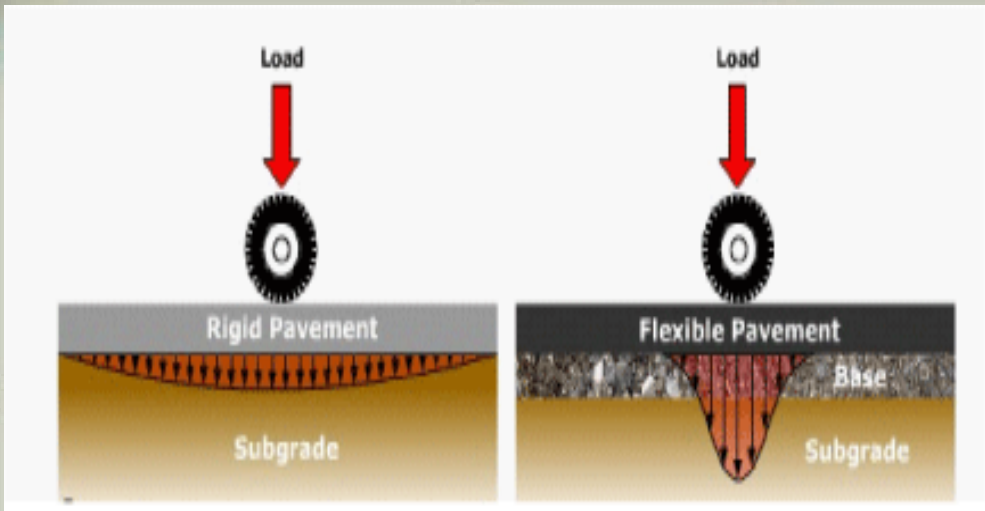
Flexible pavement have-

- Have low flexural strength
- Load is transferred by grain to grain contact
- Have low completion cost but repairing cost is high
- Have low life span (High Maintenance Cost)

# RIGID PAVEMENT

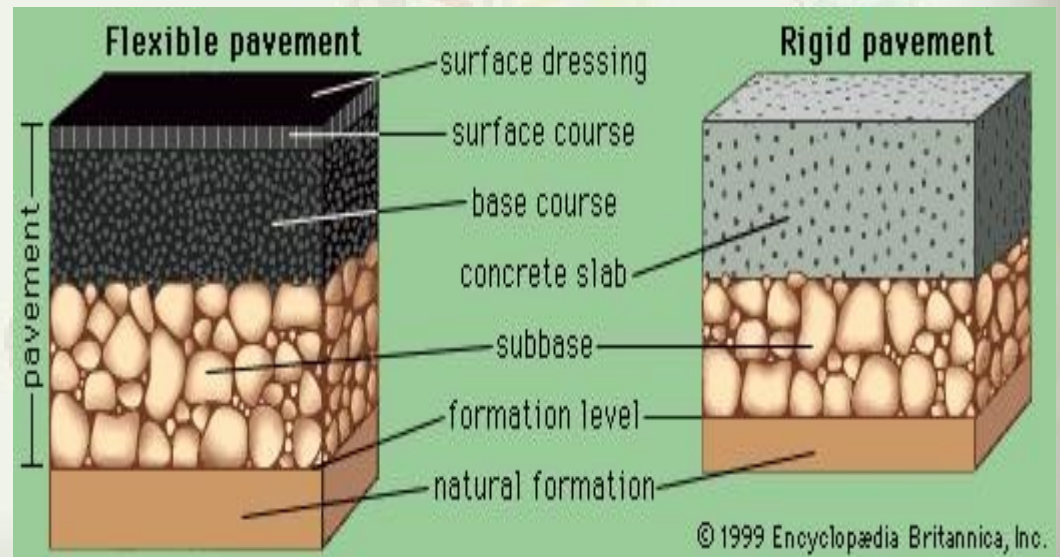
Rigid pavements, though costly in initial investment, are cheap in long run because of low maintenance costs, The cost of construction of single lane rigid pavement varies from 35 to 50 lakhs per km in plain area, Rigid pavement have-

- Deformation in the sub grade is not transferred to subsequent layers
- Design is based on flexural strength or slab action
- Have high flexural strength
- No such phenomenon of grain to grain load transfer exists
- Have low repairing cost but completion cost is high
- Life span is more as compare to flexible (Low Maintenance Cost)



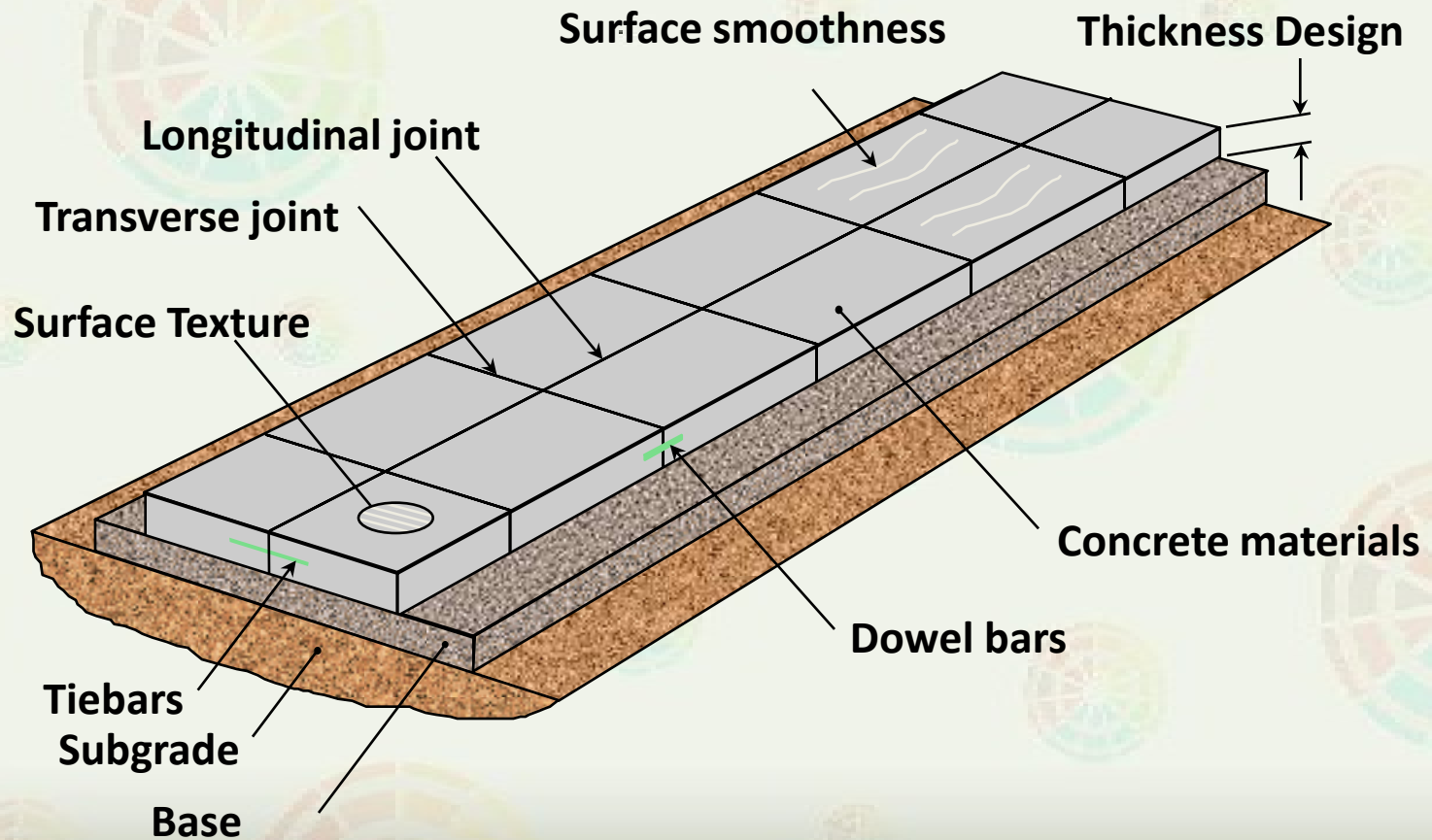
**Difference b/w Flexible and Rigid Pavement in terms of load distribution In different layers**

**Different layers in Flexible and Rigid Pavement**





# Basic Components of a Concrete Pavement



# Types of Rigid Pavements

## **Jointed Plain Concrete Pavement (JPCP)**

- does not use any reinforcing steel

## **Jointed Reinforced Concrete Pavement (JRCP)**

- Reinforcing steel placed at mid height and discontinued at the joints.

## **Continuously Reinforced Concrete Pavement (CRCP)**

- This method is very costly and generally not used in India.

## **Pre-stressed Concrete Pavement (PCP)**

- Comprises new and innovative construction methods
- Precast pavement components are fabricated and installed on a prepared foundation (existing pavement or re-graded foundation).

# MINERALS USED

## Cement

### □ Ordinary Portland cement (OPC)

Ordinary Portland cement and High Strength Ordinary Portland Cement are most widely used for concrete pavements.

### □ Rapid hardening Portland cement

In general, this cement would be used only where time is a critical factor and the road is required to be opened to traffic at an earlier date than would be possible if Ordinary Portland Cement or High Strength Ordinary Portland Cement is used.

# Mineral used( cont.)

## Aggregates

- There are two types of Aggregates are used during construction of road i.e. Fine and Coarse Aggregate depending on requirements.
- Maximum size of aggregate should not exceed  $\frac{1}{4}$ th of the pavement slab thickness.

## Water

- Water used in mixing or curing of concrete shall be clean and free from injurious amounts of oil, salt, acid, vegetable matter or other substances harmful to the finished concrete.
- Potable waters are generally considered satisfactory for mixing or curing.

# Equipments used

A list of tools, equipment and appliances required for the different phases of concrete road construction is given below

- Three wheeled or vibratory roller for compaction purpose
- Shovels, spades and Sieving screens
- Concrete mixer for mixing of concrete
- Formwork and iron stakes
- Watering devices - Water Lorries, water carriers or watering cans
- Wooden hand tampers for concrete compaction
- Cycle pump/pneumatic air blower for cleaning of joint
- Mild steel sections and blocks for making joint grooves for finishing purpose

# Site Preparation

Before construction begins, the construction site must be carefully prepared, This includes preparing the grade or road base, sub grade and sub base-

- First the site is graded to cut high points and fill low areas to the desired roadway profile elevations.
- Generally, cut material can be used as embankment fill.
- A course of material is placed on the sub grade to provide drainage and stability.
- A course of fairly rigid material, sometimes cement- or asphalt-treated, that is placed on the sub base to provide a stable platform for the concrete pavement slab.



# Construction Process

After site preparation, Construction process consists of various steps, which are described below-

## FORM WORK

Wooden sheets, battens, plywood, fibre hard board, steel plates, angles, rope etc are generally use for form work.

- before using form work, it should free from all type material like as dust ,cement.
- To placing the concrete in appropriate depth used 2.5-5cm thick and 3mtr long wooden sheeting
- The depth of wooden block must be same as level of slab thick.
- After 24hrs, form work displaced next length of road.



## Watering of base

If the base of the road is dry or construction is taken place during summer seasons Then watering is done using the sprinkling process, after this concrete should be Placed.

## Construction of Joints

- There are three basic joint types used in concrete pavement: contraction, construction and isolation.
- Except for some isolation joints, all joints provide a means to mechanically connect slabs. The connection helps to spread a load applied on one slab onto slabs along its perimeter.
- Where it is necessary to provide transverse and Longitudinal joints; there wedge of woods, metals fix on level of concrete.
- After setting of concrete it should be pull out.



# EFFECT OF DOWEL BARS ON CONCRETE PAVEMENT

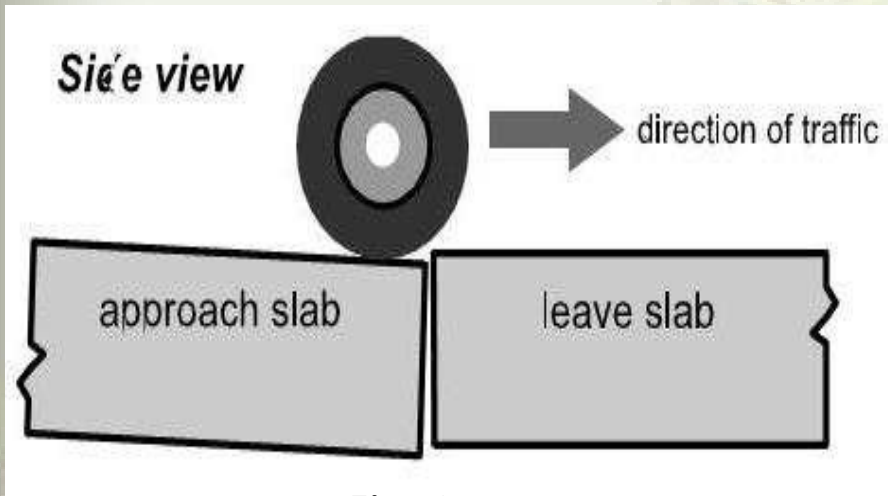


Fig.-1

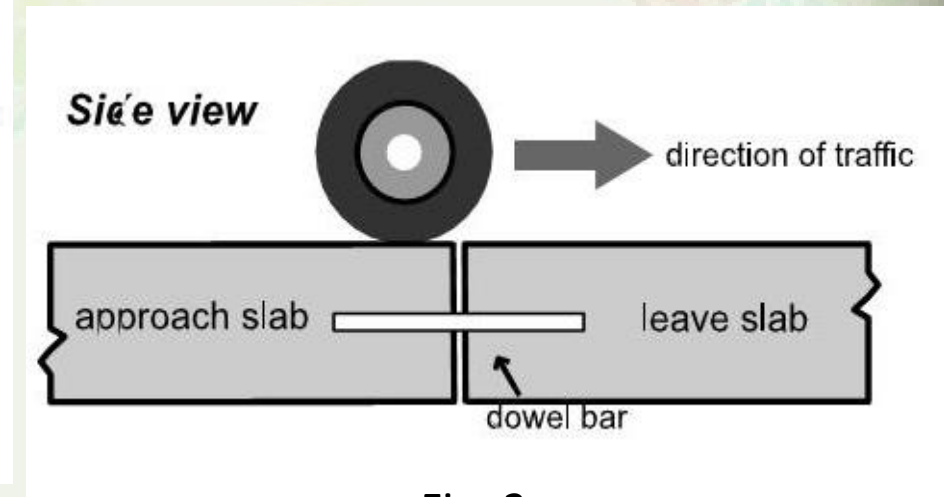


Fig.-2

## MATERIAL MIXING AND PLACING OF CONCRETE

Mixer is equipment that mix the concrete using distinct amount of cement , concrete, sand and water. There are two type of mixer generally used during construction,

**Batch mixer**- used for small road construction

**Continuous mixer**- used for large construction .

➤ If distance is more from site , mix concrete transported at site within setting time.

# PLACING OF CONCRETE

Two methods generally used in placing of concrete-

## 1- Alternate bay method-

Placed the concrete on both side of road alternatively like as 1,3,5... part at one side and 2,4,6... part other side, This method have slow process due to road traffic problems.

1 <sup>st</sup> side	1	2	3	4	5	6	7
2 <sup>nd</sup> side	1	2	3	4	5	6	7

## 2- Continuous bay method-

Construct one side of road regularly, and after construction of some part of first side than construct other side, this method have fast process without no obstruction of traffic

# COMPACTION OF CONCRETE

Purpose of compaction is that to pull out air from void and make concrete harden.

Compaction done by-

1. Mechanically surface vibrator

2. Manually hand tempers

➤ After this, **Floating, Belting, Screeding or strike off, Bull floating and Brooming** is done as per requirement for the finishing purpose of concrete pavement to smoothen the top surface.

## CURING

After completion of the finishing operations, the surface of the pavement shall be entirely covered with wet hessian cloth, burlap or jute mats

Curing is the process of increasing the hydration of cement, after setting the concrete curing process done till 14-28days.

# OPENING OF THE TRAFFIC

Generally after a month, road should be open to traffic, but If we used rapid hardening cement it take 7 days to open traffic.

## Advantages of Concrete Road

- Durability and maintenance free life
- Vehicles consume less fuel
- Resistant to automobile fuel spillage and extreme weather
- Greener process
- Saving of natural resources
- Eco friendly process