Highway & Traffic Engineering

RIGID PAVEMENT

by

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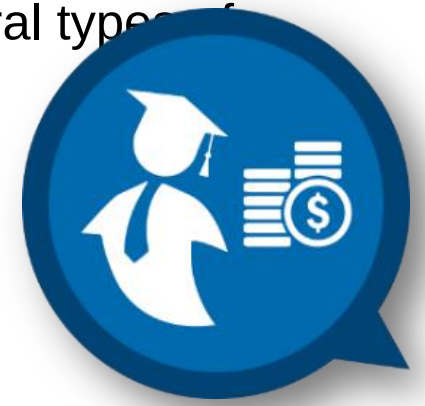
Chapter Description

- Aims
  - Understand basic terminology, types and important criteria in the construction of rigid pavements.
- Expected Outcomes
  - Students should be able to differentiate between flexible and rigid pavements.
  - Students should be able to explain important features in rigid pavement.
  - Students will understand the difference between several types of rigid pavements.
- References
  - Highway Engineering, Paul H. Wright / Karen K. Dixon
  - Images are taken from other related websites



Concrete Pavements

- Compose of aggregate bonded with cement, PCC and water.
- Capable of carrying almost all types of loads
- Surface are smooth, dust free, good skid resistance, low maintenance cost.
- Classified as high type pavements, used in constructions of heavily traveled road.
- Old concrete pavements normally used as base course for new bituminous wearing surface.

http://transportationengineering2012onwards.blogspot.my/2013/03/expansion-and-contraction-joints-in.html

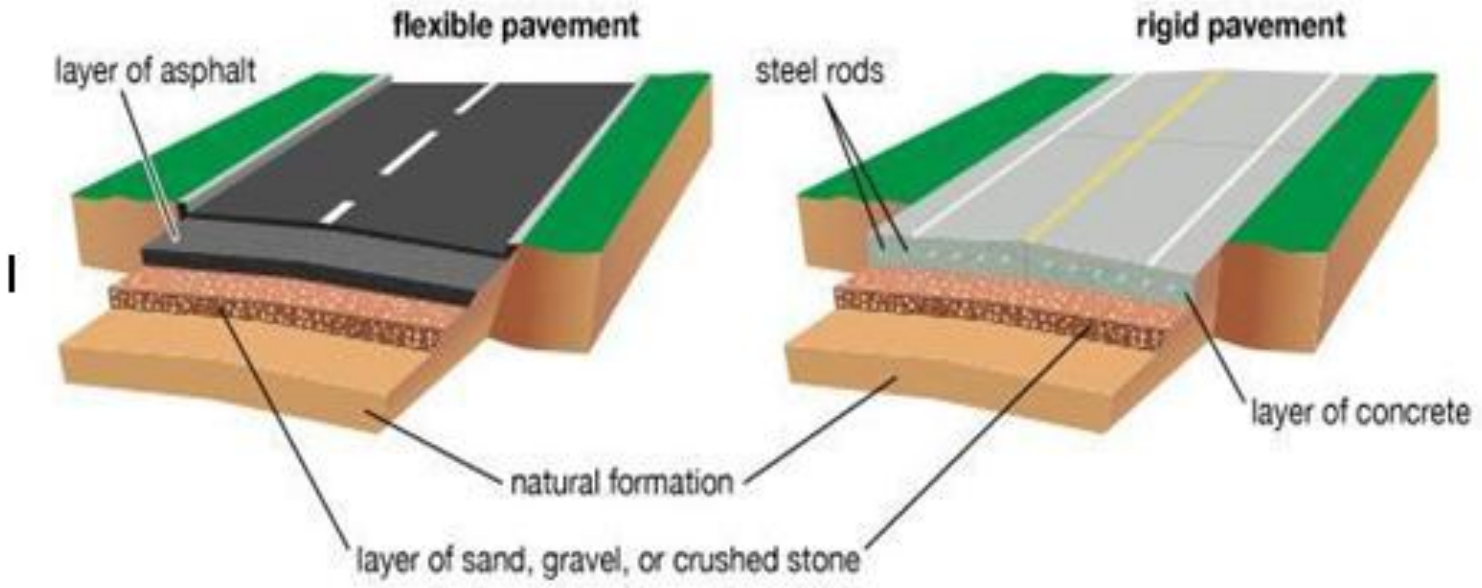
Rigid Pavement

- Have two different construction method:-
  - Applied directly on prepared subgrade
  - Applied on a single layer of granular or stabilized material / base course
- These types of pavements are called "rigid" because they are substantially stiffer than flexible pavements due to PCC's high stiffness.
- It possess certain degree of beam strength that can span.
- This PCC layer will protect weak sub base and base.
- Rigid pavements are the pavement structure deflects very little under loading due to the high modulus of elasticity of their surface course.

Characteristics of Rigid Pavements

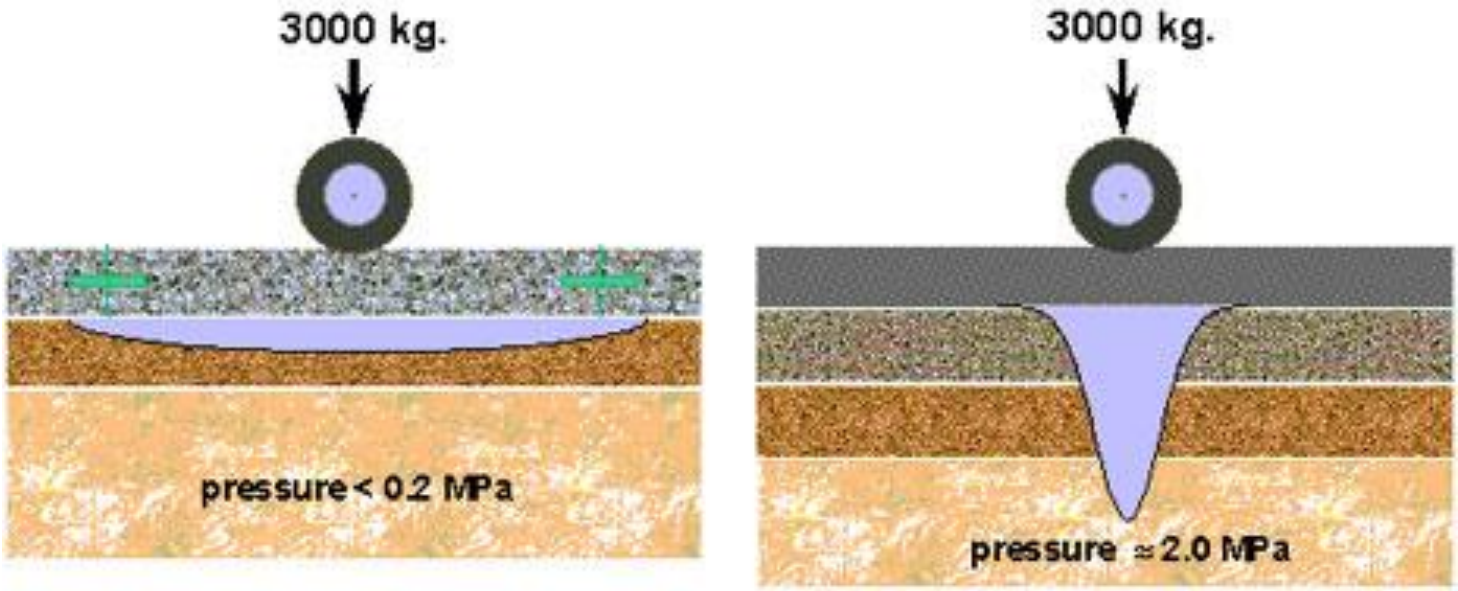
- A rigid pavement structure is typically composed of two layer:
  - the subgrade
  - an underlying base course.
- The pavement structure distributes loads over a wide area with only one, or at most two, structural layers.

Difference of Flexible and Rigid Pavement Layers



http://www.basiccivilengineering.com/2015/04/comparison-between-flexible-pavement.html

Load Distributions of Rigid Pavement vs. Flexible Pavement



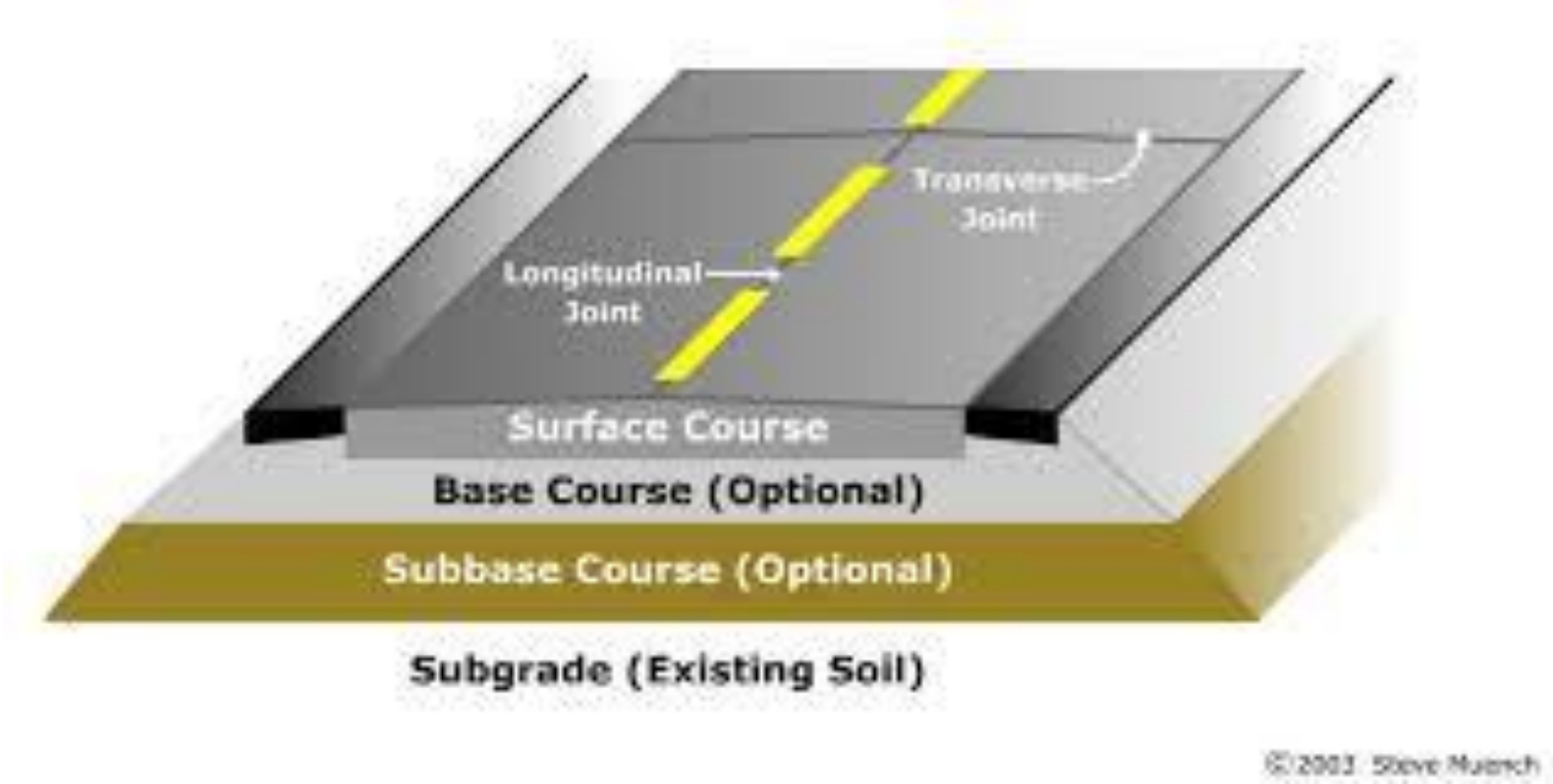
Rigid Pavement Structure

Flexible Pavement Structure

http://designarchitectureart.com/2016/12/difference-between-flexible-pavement-and-rigid-pavement/

Rigid Pavement Layers

- This rigid pavement structure consists of:
  - *Surface course*. This is the top layer, which consist of the PCC slab.
  - *Base course*. This is the layer directly below the PCC layer and generally consists of aggregate or stabilized subgrade.
  - *Sub-base course*. This is the layer (or layers) under the base layer. A sub-base is not always needed and therefore may often be omitted.



Base Course

- The base course is immediately beneath the surface course.
- It provides
  - additional load distribution.
  - contributes to drainage and frost resistance.
  - uniform support to the pavement.
  - a stable platform for construction equipment.
- Bases also help prevent subgrade soil movement due to slab pumping.

Surface Course

- The surface course is the layer in contact with traffic loads and is made of PCC.
- It provides characteristics such as friction, smoothness, noise control and drainage.
- It serves as a waterproofing layer to the underlying base, sub-base and subgrade.
- The surface course can vary in thickness but is usually between :-
  - 150 mm (6 inches) (for light loading)
  - 300 mm (12 inches) (for heavy loads and high traffic).

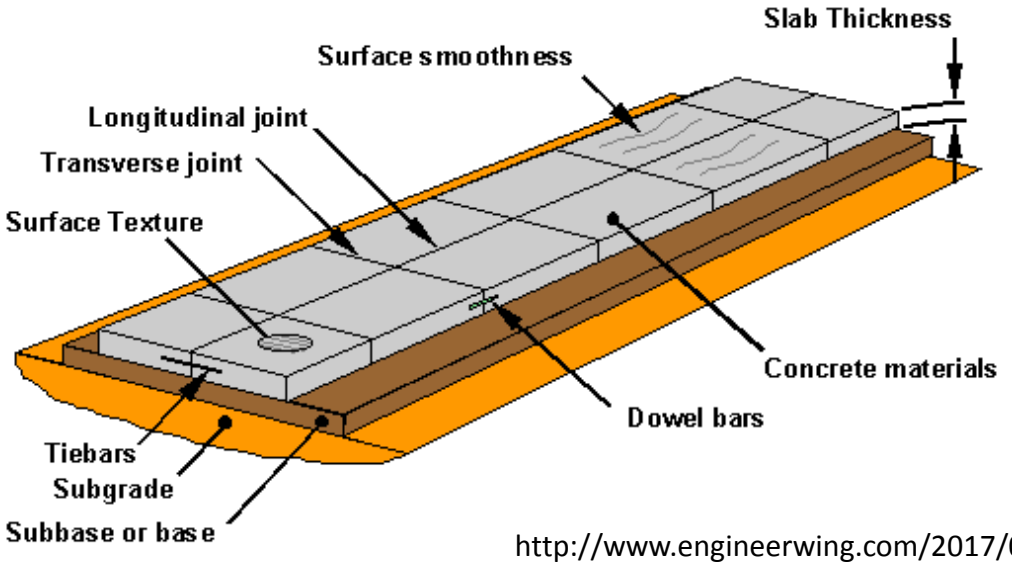
Joints and Joints Spacing

- Joints are installed to control stresses induced by volume changes in concrete.
- Stress is caused by :-
  - Contraction due to uniform temperature drop/decrease in temperature
  - Expansion due to uniform temperature increase
  - Warping effects due to vertical temperature or daily moisture differential in slab

Joints in Rigid Pavements

- Joints are the discontinuities in the concrete pavement slab, and help to release stresses due to temperature variation, subgrade moisture variation, shrinkage of concrete etc.
- These discontinuities (joints) could be extended to the **full or partial depth** of the slab.
- Sometimes iron bars are provided across the joints, the iron bars along the longitudinal joints are called **tie bars** and along the transverse joints are called **dowel bars**

Longitudinal and Transverse Joint



http://www.engineerwing.com/2017/05/types-of-concrete-pavement-uses.html

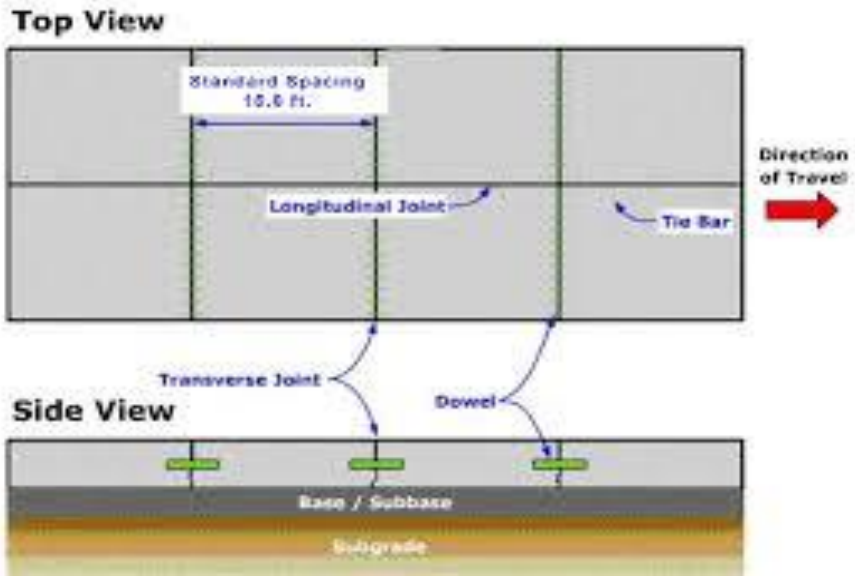
Transverse Joint :

- To control cracking of the slab because of contraction and to relieve stresses.
- Contraction joints and expansion joints were installed along transverse direction

Longitudinal joints :

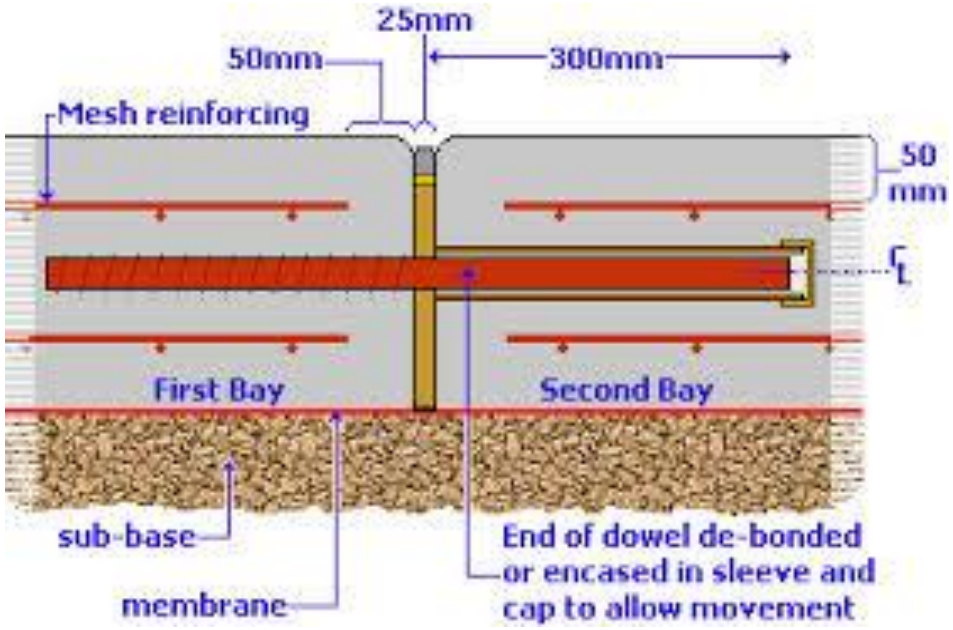
- Warping joints were installed along the longitudinal directions
- It separates a pavements according to number of lanes

Longitudinal Joints and Transverse Joints



http://engineeringfeed.com/pavement-types

Expansion joints



http://www.pavingexpert.com/concjnt1.htm

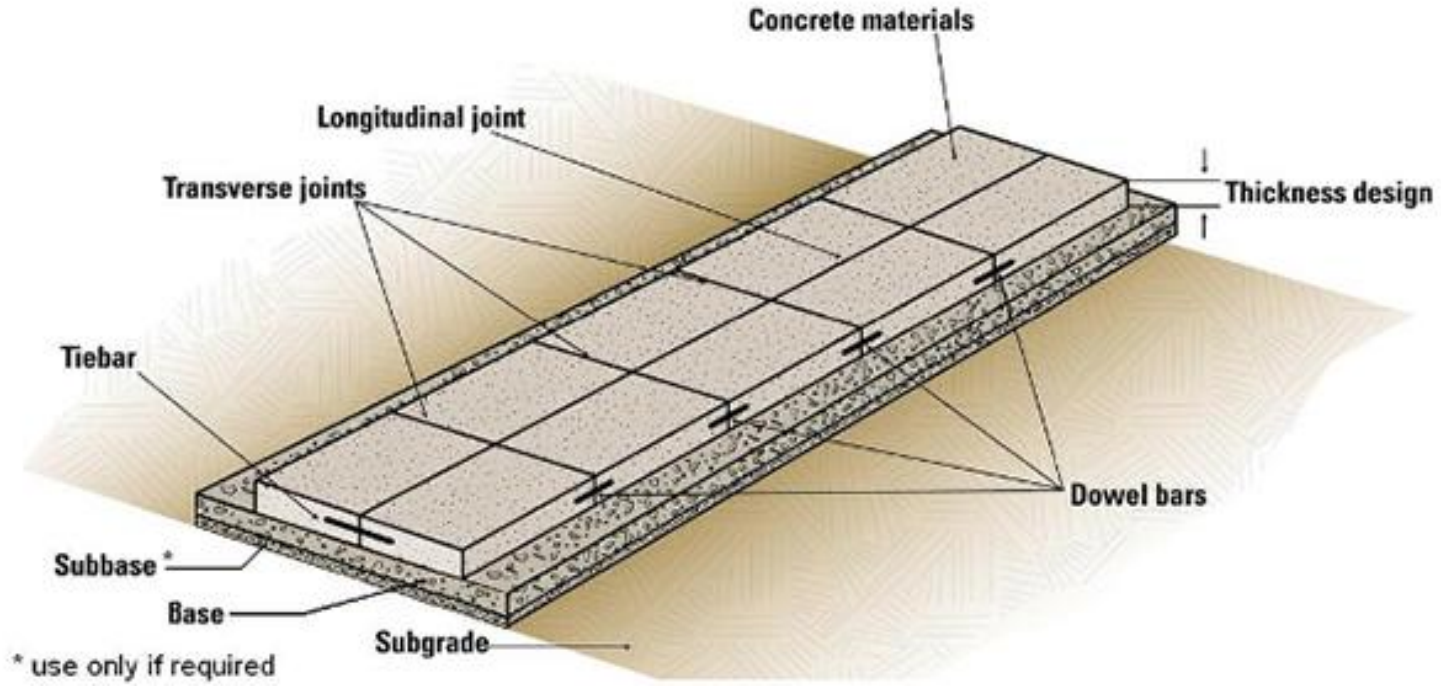
- Expansion joints are constructed to allow for movements of pavements due to rise in temperature in contrast with constructions temperature.
- Expansions joints will be provided along transverse directions.
- Dowel bar is located exactly in the middle of the slab (h/2)

Types of Rigid Pavements

1. Jointed Plain Concrete Pavements (JPCP)
2. Jointed Reinforced Concrete Pavements (JRCP)
3. Continuously Reinforced Concrete Pavements (CRCP)

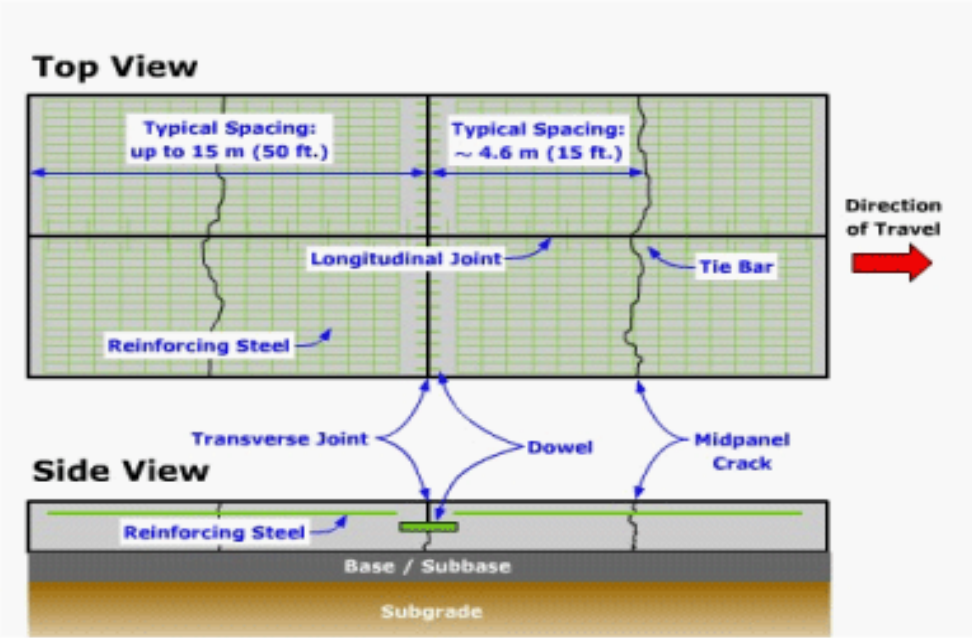
JPCP

- Short transverse joints spacing, between 15-20 feet long, **NO** reinforcing steel.



JRCP

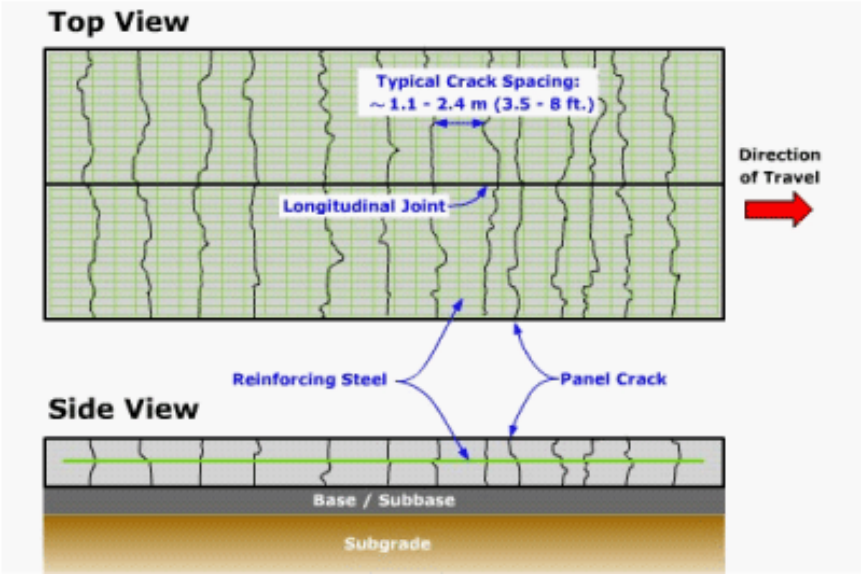
- Long joints spacing, between 30 – 100 feet long, reinforcement steel is embedded inside concrete slab to prevent cracking.



http://engineeringfeed.com/pavement-types

CRCP

- **NO** joints, contain greater percentage of steel to control cracking.



http://engineeringfeed.com/pavement-types

Constructions of Rigid Pavement

http://www.pavementinteractive.org/pcc-placement/

Exercise

- List out main differences between JPCP, JRCP and CRCP rigid pavements.

Solution

Conclusion of The Chapter

- Conclusion #1
  - Flexible and rigid pavements are made of different surface material that can withstand different load's types and distribution pattern.
- Conclusion #2
  - Joints are the most important aspect in the construction of rigid pavements.
- Conclusion #3
  - 3 types of rigid pavements i.e. JPCP, JRCP and CRCP are the most common types of rigid pavements used worldwide.

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