



# PAVEMENT MATERIALS

## LECTURE 13

# Pavement Unbound Layers

## ◆ Granular (Physical) Stabilization

- ▶ IDENTIFICATION
- ▶ EVALUATION
- ▶ SELECTION
- ▶ CONSTRUCTION

**Lectures  
09 to 12**

# CONSTRUCTION

## ▶ COMPACTION

▶ Roller Type, Number of Passes.....

## ▶ Controlled By ??

▶ PROCTOR Curve

▶ Minimum/Maximum Density

## ▶ TIPS

▶ *Granular material could be compacted very easily either perfect dry or fully saturated*

▶ *While Flooding, make sure that water may not damage the subgrade*

# Macadam Bases-*History*

- ▶ Mc Adam was a Scottish engineer who introduced, in the **early nineteenth century**, the idea of constructing roads composed of small size stones held together by means of a binding material.
- ▶ This concept had **revolutionized the road building** science then, aided as it was by the invention of the **stone crusher in 1858** by Blake, the **steam road roller by Aveling in 1867** and by the use of **bituminous materials early in the twentieth century**.

# Macadam Bases-Types

- ▶ Water Bound Macadam (WBM) if the stone materials are held together by the addition of water and filler
- ▶ Dry Bound Macadam if the aggregates are held together by mechanical interlock only
- ▶ Wet Mix Macadam if graded stones are mixed with water and compacted
- ▶ Penetration Macadam if a bituminous material is sprayed over the stones and allowed to penetrate into the course and by "premix" macadam if the bituminous material is mixed with the aggregates prior to laying.

# Macadam Bases

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## ▶ Sequence

- ▶ Concept
- ▶ Materials
- ▶ Construction

# Water Bound Macadam

## ▶ Concept

- ▶ Water bound macadam may be defined as a dense and compact course of a road pavement
- ▶ *composed of stone aggregates*
- ▶ *bound together by a thin film of cementing medium consisting of fine mineral filler (such as stone screenings or gravel) with cementitious properties and*
- ▶ *containing a minimum laden moisture to impart to the binder necessary cohesive and adhesive properties to enable it to bind the aggregates together.*
- ▶ The strength of a water-bound macadam course is thus
  - ▶ Primarily due to the thorough mechanical interlock in the aggregate particles.
  - ▶ Cohesion between the aggregate particles due to the cementitious film of soil-moisture binder.

# Water Bound Macadam

- ▶ Materials
- ▶ Coarse Aggregate
  - ▶ Broken Stone Aggregates
    - ▶ Hard varieties such as Granite, Basalt, Diorite, Quartzite, etc.
    - ▶ Softer varieties such as Sandstone, Limestone, Kankar, Laterite etc.
  - ▶ Over-burnt Bricks
- ▶ Screening (Choke)
  - ▶ Moorum, Other Mixtures
- ▶ Binding Material (Soil Binder)
  - ▶ Limestone Dust, PI => 6



# Water Bound Macadam

## ▶ Size and Grading Requirements of Coarse Aggregates

- ▶ The main source of strength of a water-bound macadam surface is due to the mechanical interlock in the aggregates and it is thus apparent that the aggregates should be well graded.
- ▶ Well graded aggregates can be obtained only by a crusher whereas hand breaking can yield single size aggregates.
- ▶ For soft aggregates such as kankar, laterite or brick ballast which get crushed excessively under roller, the grading is not very important.

## ▶ Requirements of Screenings and Binding Material

- ▶ The screenings, also known as "choke" materials, fill in the voids left in the coarse aggregates after they are consolidated and help to cement the stone aggregates together.
- ▶ To effectively perform these functions, the screenings should be properly graded and also should have some plastic material in them to impart cementitious properties.
- ▶ Excess of plasticity is harmful since, 'under the influence of moisture, the material may lose its stability.
- ▶ Screening materials may be dispensed with in case of soft aggregates such as kankar, laterite, brick ballast etc.

# Water Bound Macadam

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- ▶ Thickness of courses
- ▶ The water-bound macadam is constructed by spreading loose metal which gives a consolidated thickness of 75 mm-100 mm. A compacted layer less than 75 mm thickness is not desirable and a compacted layer more than 100 mm is equally undesirable.
- ▶ If the thickness of the base is more than the above value, the construction is done in multiple layers.

# Water Bound Macadam

- ▶ CONSTRUCTION
- ▶ Spreading metal
  - ▶ Manual Method
  - ▶ Mechanical Method
- ▶ Rolling of Aggregates
  - ▶ Dry Rolling
  - ▶ Wet Rolling
- ▶ Application of Screenings
- ▶ Application of Binding Material

# Wet Mix Macadam

## ▶ Concept

▶ Wet-Mix macadam is a specification in which a well-graded aggregate is mixed with water in a mechanical mixer and the resultant mixture is laid by pavers and compacted.

▶ The aggregate is generally crusher-run, and includes fines also. Because of the close grading, the course will have good interlock with excellent density.

## ▶ Grading

▶ Well-Graded

## ▶ Moisture content

▶ The optimum moisture content for mixing is determined by conducting suitable density tests. The moisture content during mixing is maintained at this optimum  $\pm 0.5$  per cent. The moisture content is usually in the range 2-5% by weight.

# Wet Mix Macadam

## ▶ Construction

- ▶ The mixing can be done in a suitable mechanical mixer. Specially designed mixers can be fabricated for this specification. Otherwise, a bituminous macadam plant can be used.
- ▶ Ordinary concrete mixers can also be used. Laying is done by paver-finishers and compaction by 8-10 ton smooth wheel rollers.

# Water Bound vs. Wet Mix Macadam

- ▶ The main advantage of wet-mix macadam over water-bound macadam is that it is composed of a well-graded mixture. This ensures good interlock and high stability.
- ▶ Addition of water while mixing facilitates the handling of the mixture. The operation of laying is much simpler than that of water-bound macadam, where the screenings and binding material have to be added in stages and forced into voids. If a crusher-run material is used, there is no possibility of plastic fines entering into the mixture.
- ▶ The compaction is greatly facilitated by the moisture added which lubricates the individual particles.
- ▶ One disadvantage of the wet-mix macadam is that it is slightly costlier than water-bound macadam. This is because the specification involves the use of mixing plant and paver. On the other hand, water-bound macadam has been traditionally a labour-oriented specification.
- ▶ The aggregates for wet mix macadam will have to be crusher-run, whereas the aggregates for water-bound macadam are generally hand-broken.



THANK YOU