CVL3211 : Civil Engineering Materials

Department of Civil Engineering

Abhipsa Kar
Pranjal Mandhaniya
Rashmisikha Behera

ITER, SoA University

November 15, 2016

Asphalt/Bitumen

This chapter will cover under given topics.

- Properties of asphalt
- Applications of asphalt
- Asphalt aggregate mix design
- Testing of asphalt/bitumen

Properties of Asphalt

- Asphalt/Bitumen is a viscoelastic material.
- It is defined by $\sigma - \epsilon - t$ (stress-strain-time) relationships i.e. creep and relaxation. Basic behavior of asphalt can be derived from models described in first chapter (lecture 2).
- Asphalt is classified based on its strength which is derived from viscosity.
- In laboratory, penetration, flash point, fire point etc properties are defined through experiments.
- Design of asphalt and aggregate mix is similar to concrete mix design which is discussed in chapter 3 (lecture 4).

Applications of Asphalt

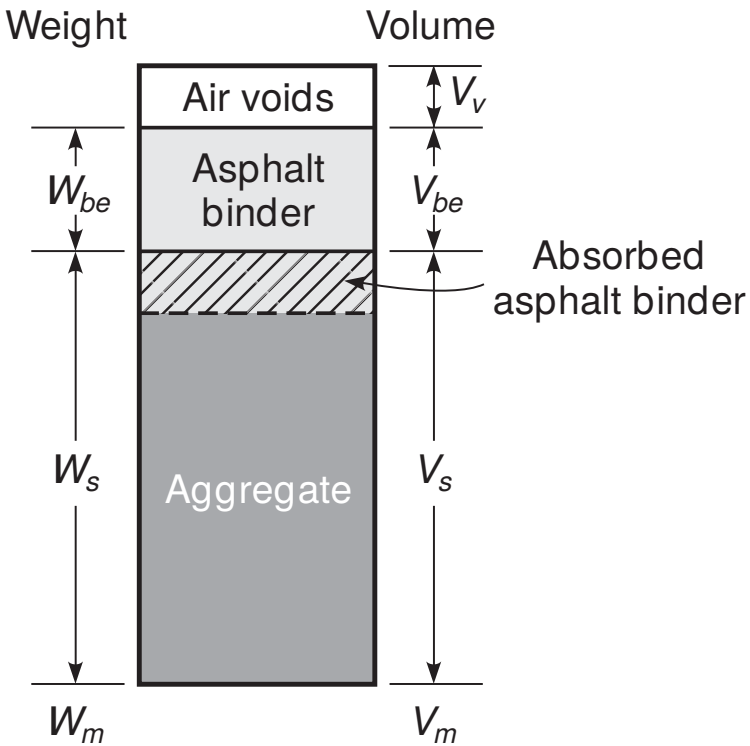
- Asphalt can be used in two major ways:
  - Asphalt emulsions: Mixture of asphalt and water, results in asphalt particles remaining dispersed/suspended in water.
  - Asphalt solutions: Mixture of asphalt with hydrocarbon or other petroleum liquids, results in a solution. These solutions can also be classified in two subcategories:
    - Asphalt cutbacks: mixing with lighter hydrocarbon.
    - Asphalt concrete: mixing with heavier hydrocarbon.
- From engineering aspects asphalt mixes can be classified as:
  - Concrete: Used to build a new pavement and needed to carry load and transfer it to subgrade (soil base).
  - Coat: Used to repair pavements and flexible pavements. It is designed to carry load.
  - Seal: Used for renovation and resurfacing. Seals off pavement from attack of water. It is not designed to carry loads.

Pavement application of asphalt

Term	Description	Application
Hot mix asphalt	Carefully designed mixture of asphalt cement and aggregates	Pavement surface, patching
Cold mix	Mixture of aggregates and liquid asphalt	Patching, low volume road surface, asphalt stabilized base
Fog seal	Spray of diluted asphalt emulsion on existing pavement surface	Seal existing pavement surface
Prime coat	Spray coat asphalt emulsion to bond aggregate base and asphalt concrete surface	Construction of flexible pavement
Tack coat	Spray coat asphalt emulsion between lifts of asphalt concrete	Construction of new pavements or between an existing pavement and an overlay
Chip seal	Spray coat of asphalt emulsion (or asphalt cement or cutback) followed with aggregate layer	Maintenance of existing pavement or low volume road surfaces
Slurry seal	Mixture of emulsion, well-graded fine aggregate and water	Resurface low volume roads
Microsurfacing	Mixture of polymer modified emulsion, well-graded crushed fine aggregate, mineral filler, water, and additives	Texturing, sealing, crack filling, rut filling, and minor leveling

Asphalt aggregate mix design

Asphalt for road construction is used as mixture with aggregates. When asphalt cement is mixed with aggregates, they absorb some asphalt on their surface which can't be extracted from it even after total recall. Schematic phase diagram for asphalt aggregate mix is given below.



- Here VTM (voids in total mix or air voids) $= V_v/V_m$, V_m is total volume.
- VFA (voids filled with asphalt) $= V_{be}/V_{be} + V_v$, its the ratio of voids filled by asphalt.
- Here the volume of asphalt absorbed on aggregate surface is considered as a part of aggregates.

Laboratory test of asphalt

Different laboratory tests which are performed on asphalt are given below:

- Penetration test: It is used to determine the viscosity indirectly from penetration of asphalt sample by a needle.
- Flash Point: The temperature at which asphalt subjected to heat shows the first spark.
- Fire Point: The temperature at which asphalt subjected to heat shows a flume for extended period (5-6 seconds).

Viscosity of asphalt is inversely proportional to grade value determined from penetration test. More the viscosity more will be the flash and fire point temperatures and less will be the penetration.
Other characteristics of asphalt concrete mix can be derived from concrete mix design.