

Republic of Iraq

Ministry of Higher Education & Scientific Research

Al-Mustaqbal University College

Department of Building & Construction Engineering



## HIGHWAY ENGINEERING” 3<sup>rd</sup> Stage”

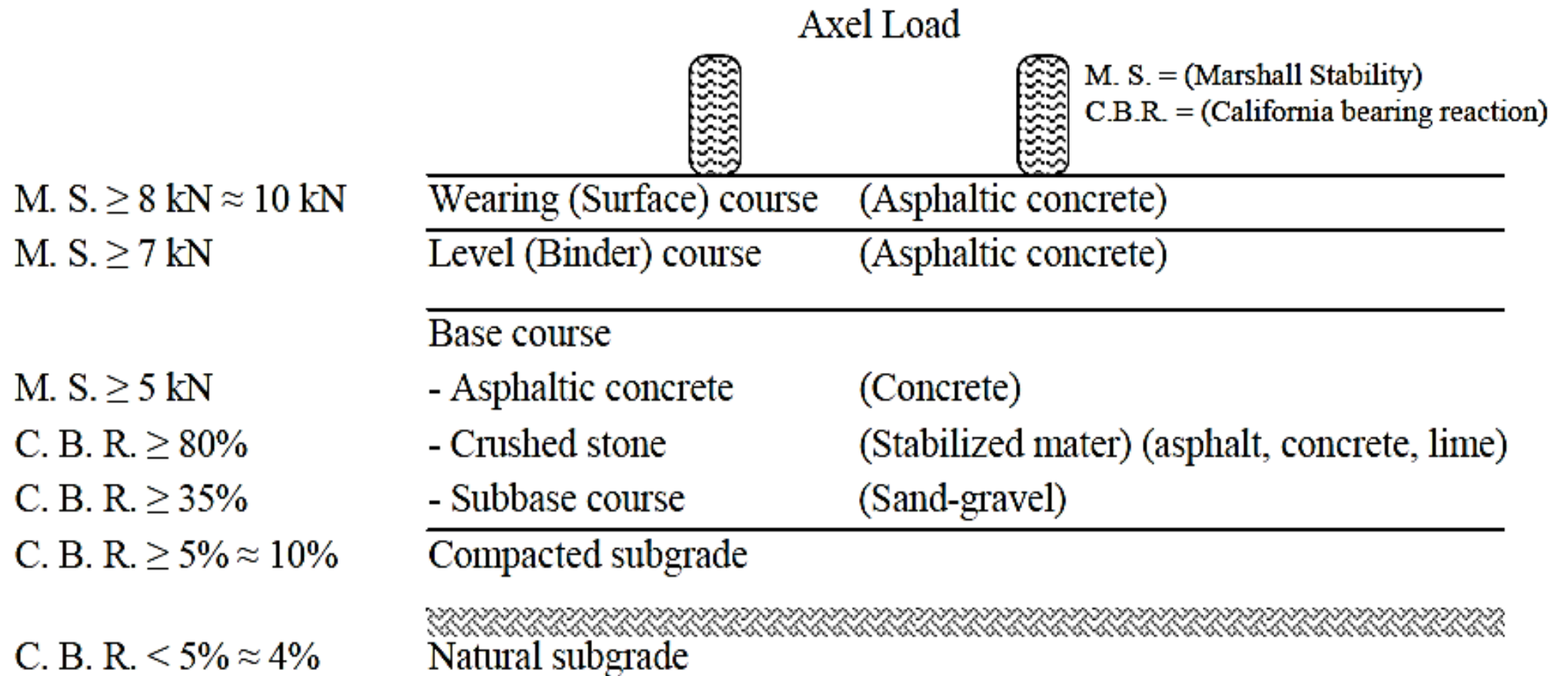
((المواد الاسفلتية Asphaltic Materials))



Prepared by The senior Lecturer: Mr. Tameem Mohammed Al Musawi

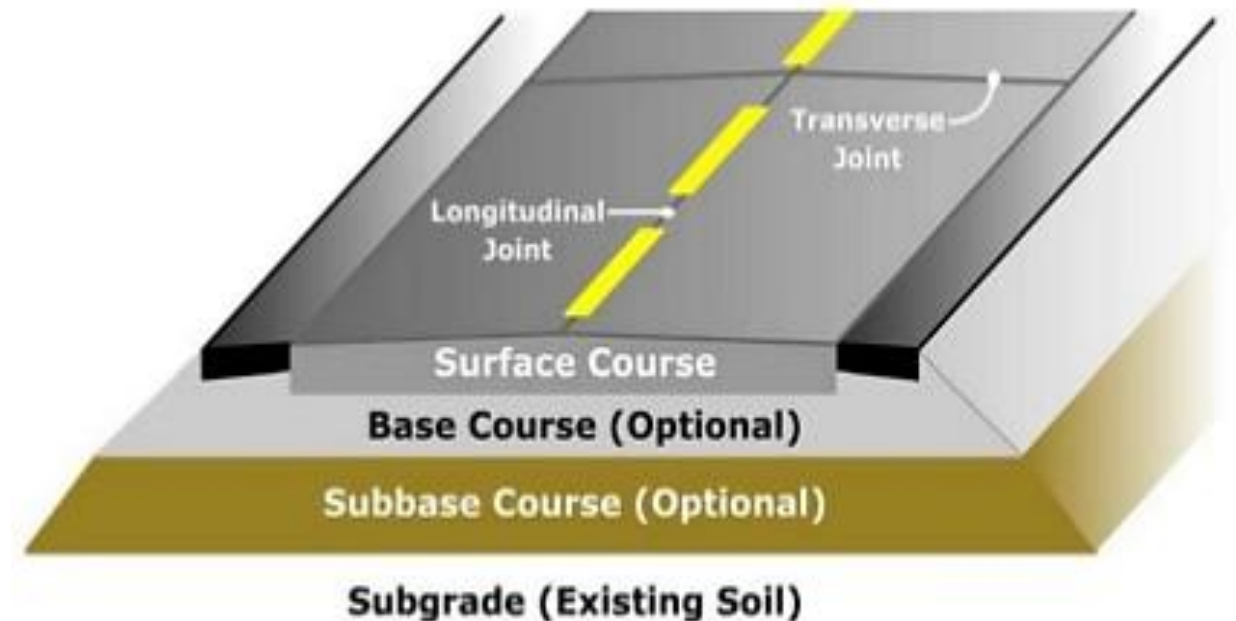
## Asphaltic Materials

### Flexible Pavement Layers:



## Asphaltic Concrete:

- Asphalt cement
- Coarse aggregate (crushed gravel) [1" – No.4 (No.10)]
- Fine aggregate (sand) [No.4 (No.10) – No.200]
- Mineral filler (cement or lime) [ $\leq$  No.200]
- Additives

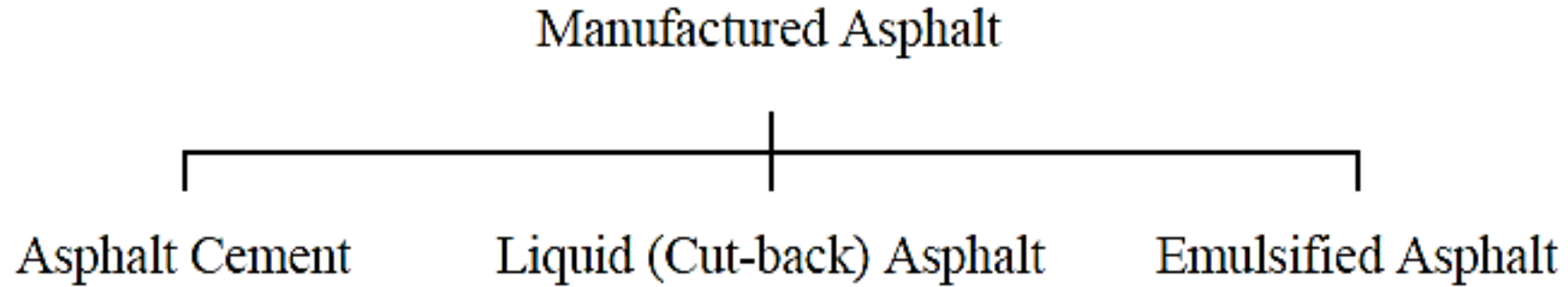


## Bituminous materials:

Mixture of hydrocarbons (C, H), liquid or semisolid in consistency, soluble in CS<sub>2</sub> & CCl<sub>4</sub>

- Tar: produced by destructive distillation of coal (chemical change), cannot found in nature, more susceptible to temp. & more toxic.
- Asphalt: produced by fractional distillation of petroleum (physical change), natural (lakes, rocks) or manufactured, less susceptible to temp. & less toxic.





## A) Asphalt Cement:

### a. Penetration grade:

انتاج قليل	40-50	[	Less durable (قليل الديمومة)	(Thermal Cracking)
	50-60		Less flexible (لدونة قليلة)	
	60-70			
	85-100	[	More temperature susceptible	(Rutting)
	120-150		(permanent deformation)	
	200-300			

## b. Viscosity grade:

Absolute viscosity (Dynamic): By Poise  $\left(\frac{\text{dyne} \cdot \text{sec.}}{\text{cm}^2}\right)$

$$\tau_{(\text{shear stress})} \left(\frac{\text{dyne}}{\text{cm}^2}\right) = \eta (\text{Abs. Vis. (Poise)}) \cdot \left[ \frac{d\gamma (\text{shear strain})}{dt (\text{time (sec.)})} \right] \leftarrow \text{rate of shear strain} \left(\frac{1}{\text{sec.}}\right)$$

	<u>Viscosity grade</u>		<u>Penetration grade</u>
قليل الانتاج	AC-40	Abs. Vis. @60°C = 40*100=4000 poise	> 20
مهم	AC-20	2000 poise	> 40
	AC-10	1000 poise	> 70
	AC-5	500 poise	> 120
	AC-2.5	250 poise	> 200

Asphalt cement requirements (AC-20 [40-70]):

1. Basis of grading (Consistency) (القوام)

- Abs. Viscosity @60°C = (1600 – 2400) poise  
(Gs = 1.01 – 1.05)

2. Temperature susceptibility (حساسيتها للحرارة):

- Penetration (فحص الغرز): (ST. condition – min. 40 (40-70) 1/10mm

Penetration after thin film oven test, retained pen. > 55% & (mass loss < 0.75%)

- Kinematics viscosity @135°C → Min. (210) Centistokes

(Stokes = 100 Centistokes) (Stoke = Poise/Density)



3. Oxidative hardening (التصلب بسبب الاكسدة):

- Abs. viscosity @60°C after thin film oven test → Min. (10000) Poise

4. Homogeneity (التجانس):

- Ductility after thin film oven test → Min. (20cm)

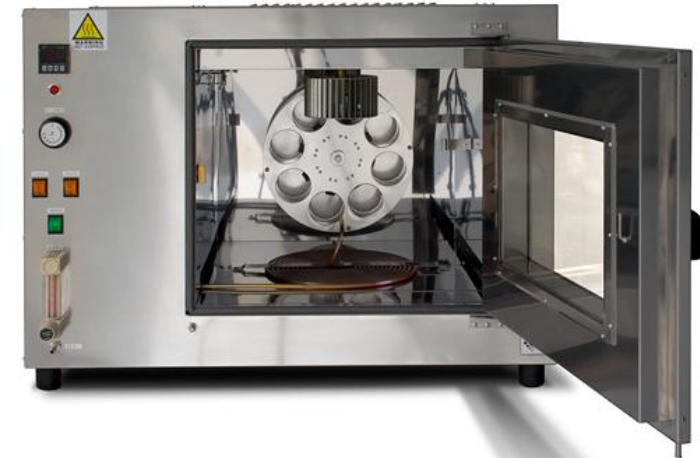
Ductility before thin film oven test → ( $\geq 100\text{cm}$ )

@25°C (5cm/min.)

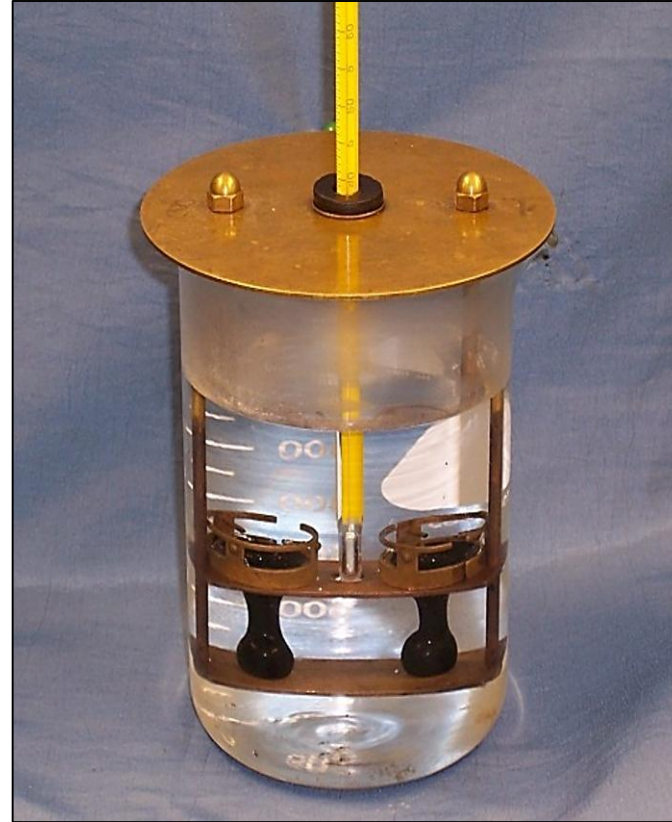
- Solubility in Trichloro-Ethelin → Min. (99%)

5. Safety:

- Flash point → Min. (232°C)
- Softening point → (52 – 60°C)







Fractional component of asphalt cement:

		Fractional Components of AC	Role	(Durability) Reactivity to O <sub>2</sub>
Asphaltene	1	Asphaltene	Bonding agent (القوام)	Low
Maltenes	2	Nitrogen bases	Peptizing agent (يساعد على اندماج الاسفلتين بالاجزاء الاخرى)	High
	3	First acidaffines	Solvent (مواد مذيبيية تساعد على احتواء المواد الاخرى)	High
	4	Second acidaffines	Solvent (مواد مذيبيية تساعد على احتواء المواد الاخرى)	Low
	5	Paraffin	Gelling agent (عامل مخثر)	Very low

**B) Liquid (cut-back) Asphalt:**

Asphalt cement + solvent (for temporary liquefaction)

a. Rapid Curing (R.C):

**AC (85-100) + Gasoline**



RC-70 (الأكثر شيوعاً)	للمناطق الحارة	Kinamatic Vis. @60°C = 70-2*70 centestok
RC-250	للمناطق الباردة	
RC-800		
RC-3000		

Used as **Tack Coat**: Thin film of asphalt applied (immediately before paving)

between 2-paved layers (0.2-0.5 liter/m<sup>2</sup>)

b. Medium Curing (M.C):

**AC (120-150) + Kerosene**

MC-30	
MC-70 (الاکثر شیوعاً)	Tight Surface (مساحات صغيرة)
MC-270 (الاکثر شیوعاً)	Open Surface (مساحات كبيرة)
MC-800	
MC-3000	

Used as **Prime Coat**: Film of asphalt applied (before 24hr of paving) between unpaved & paved layers (1.0-0.5 liter/m<sup>2</sup>)



c. Slow Curing (S.C):

**AC (200-300) + Oils**

SC-70	For stabilizing earth works (لتثبيت الأعمال الترابية)
SC-250	
SC-800	
SC-3000	