6
PAVEMENT DESIGN

Pavement Design

- **Primary Function**
  - To provide:
    - Safe, Comfortable, Economic, Durable Riding Surface which is "Fit for purpose"
- **Serviceability** – Measure of pavement condition
  - Roughness Levels, profilometer (laser), - QCI or PSI or IRI
  - Rutting Straight edge, line, profilometer
  - Cracking Visual (not remote!)
  - Texture Scrim, profilometer

Present Serviceability Index (PSI) or IRI

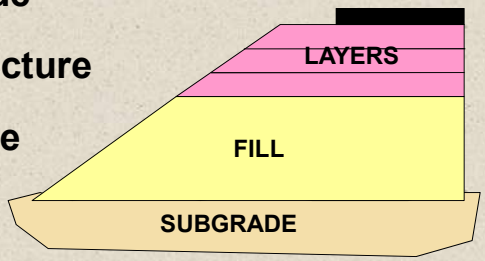
Pavement Design

- **Design Elements**

Protect **subgrade**

Stable layer **structure**

Wearing **Surface**



Durability - **Needs to last for a set period**

Pavement Types

Concrete

Block-pave

Flexible

Pavement Design

PAVEMENT TYPES

Rigid

Concrete

Semi-Rigid

Blocks & cemented layers

Flexible

Granular ‘unbound’ layers

Pavement Design

Flexible

Design Input

- Traffic
- Environment
- Materials
- Construction capabilities
- Maintenance

Often more than one design option

Pavement Design

- DESIGN
  - Empirical (CBR curves)
  - Analytical (Mechanistic)
- Economic Analysis
  - Present Worth of Cost (PWOC)

$$PWOC = C + M_1(1 + r)^{-x1} + M_2(1 + r)^{-x2} .... S(1 + r)^{-z}$$

Construction Maintenance Salvage

r = rate of return (say 8%)

x = year of action

Pavement Design

- What does the damage?

TRAFFIC

- Wheel Loads → Fatigue
  - Bearing capacity ↓
- Tyre Forces (Horiz) Breaking & turning

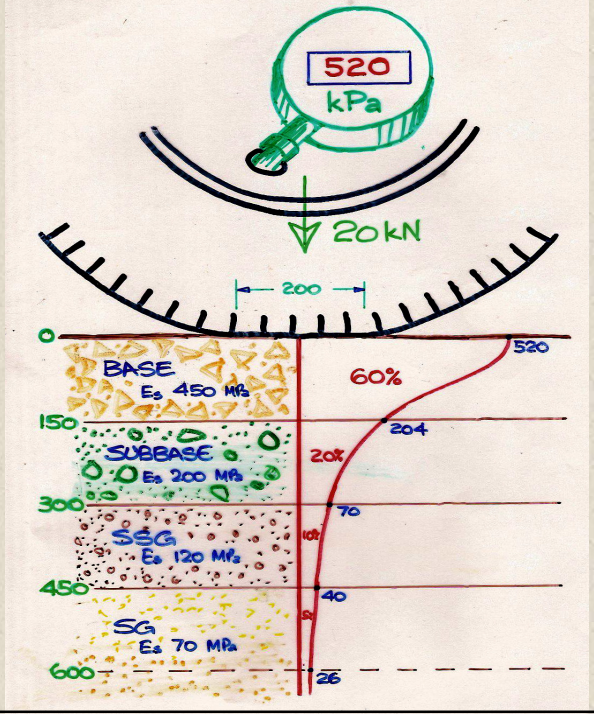
ENVIRONMENT

- Water Run-off & seepage
- Temperature degradation

Other Tree roots, Moles

Collapsing soils

Heaving materials



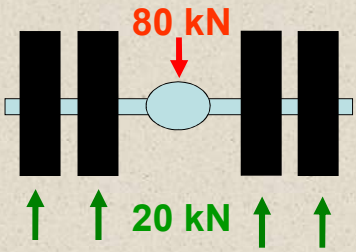
Pavement Design

Traffic

- **Simple Approach (CBR)** just looks at wheel-load {Bearing capacity}
- **Most modern designs look at:-**
  - **Spectrum of wheel-loads**
    - **Split into: Passenger Vehicles**
      - **Light Heavies < 3 t**
      - **Medium Heavies 3 t to 8 t**
      - **Heavy heavies > 8 t**
  - **–Cumulative number of loads**

Pavement Design

Rationalise damage caused by various loads equating to the effect of a standard axle (not legal axle!)

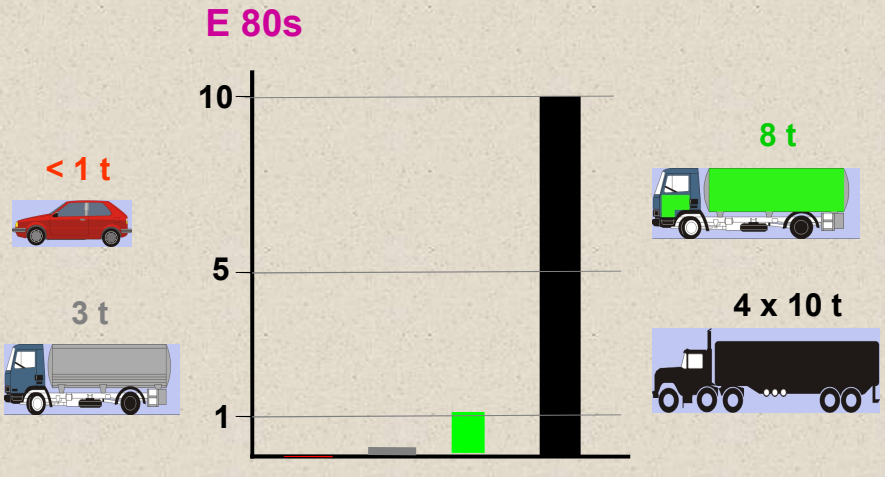


RSA - E80s

F = Damage factor = $\left[\frac{P}{80}\right]^n$

n = 4,2 (higher for thin/stiff – lower for deep)

Pavement Design



10 000 PVs = 1 E80

61,5 x 3 t = 1 E80

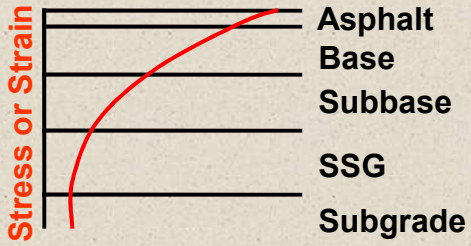
Pavement Design

- **SA Mechanistic Design (Rubicon)**

Forms the basis of SA design – multi-layered elastic analysis

- Looks @ full load spectrum using cum E80s over the selected design period to achieve a Design Structural Capacity E0 to E4 categories
- Multi-layers elastic

Calcs stresses & strains in each layer by assigning stiffness for each layer (M_R)

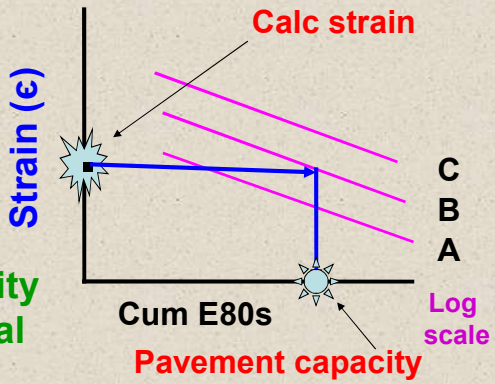


Pavement Design

Stress/strains are checked against semi-empirical performance curves for each layer

Transfer functions

Make the transfer from strain to cumulative E80s NB Traffic is on log scale



Check pavement capacity versus Design Structural Capacity for each layer

Pavement Design

SA Mechanistic design

For	Against
Uses elastic properties	Cumbersome
Multiple layer checks	Transfer Functions
Wide experience in SA	Does not handle cemented layers well
Useful for sensitivity studies – same Pavement type	Does not allow for permanent strain

Lot of work being done on upgrading 'Godzilla' – will have to see

It's the best we've got !!

Pavement Design

Catalogue Designs in TRH4

Based on SA Mechanistic Design

(see worked example in the notes)

Select:-

- ✓ Road Category
- ✓ Design Strategy
- ✓ Design Traffic
- ✓ Materials
- ✓ Environment
- ✓ Structural Design (Pavement type)
- ❖ Practical considerations

Drainage	Compaction
Subgrade	Constructability