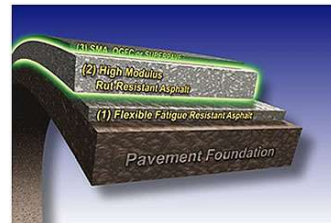


Introduction to Road Materials Engineering

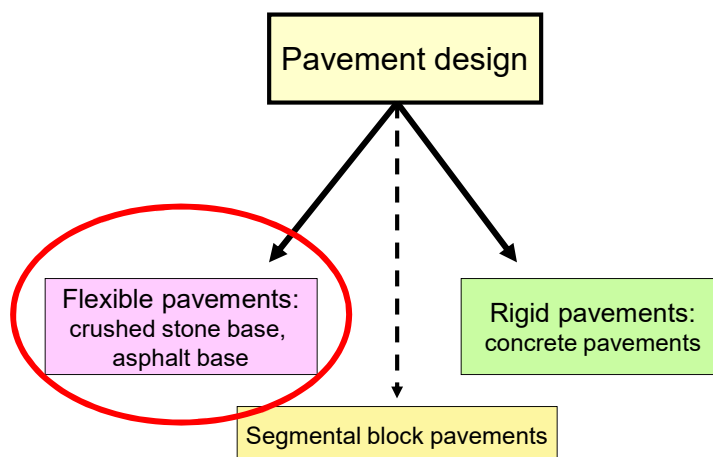
Part 8: Introduction to Pavement Design

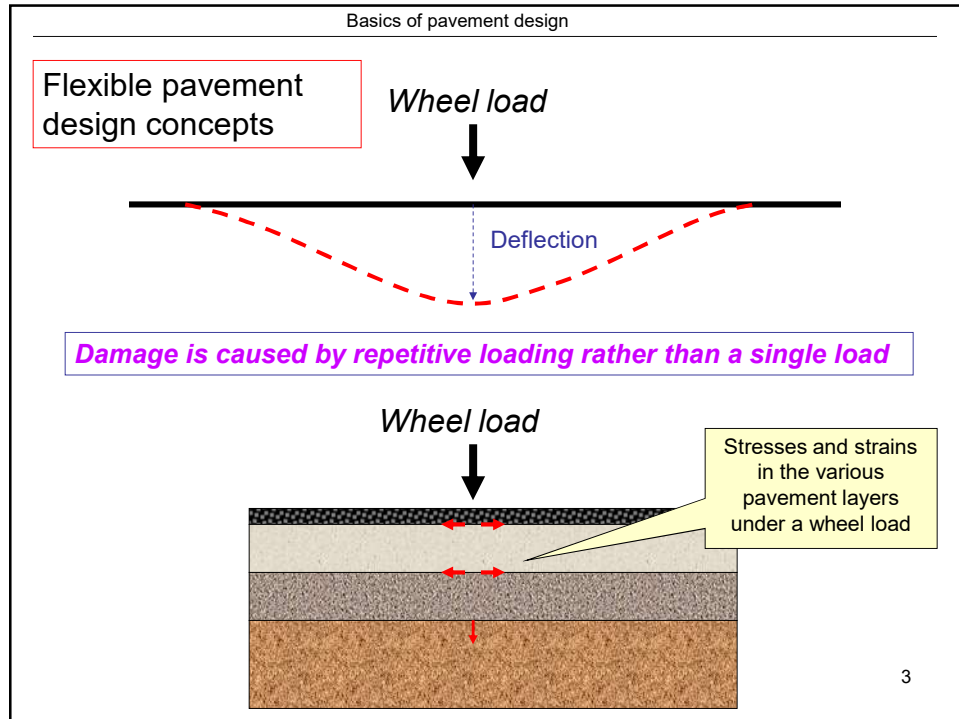
Presented by SARF

Presenter:
Ron Berkers



Basics of pavement design





Basics of pavement design

What is the basis for the design of flexible road pavements ?

"The pavement must be capable of carrying the traffic in an acceptable condition for the required number of years without major strengthening being necessary"

Structural Design Period (SDP)

Structural design periods vary, depending upon the importance of the road:

Typically:

- Major roads 25 years
- Minor roads 15 years

4

What is the basis for the design of flexible road pavements ?

"The pavement must be capable of carrying the traffic in an acceptable condition for the required number of years without major strengthening being necessary"

Design Traffic

Obtain traffic data which should include:

Average daily traffic counts

Percentage of heavies (estimate E80s per heavy)

Growth rate

Design traffic = ADT x 365 x %heavies x E80s per heavy x growth rate x SDP

5

The standard axle load in South Africa is 80kN

Pavement bearing capacity is expressed in standard (80kN) axle repetitions – known as E80s

The pavement 's design bearing capacity is expressed as the number of E80s it is capable of carrying

TRH4(1996)
pavement
classification

Pavement class*	Pavement design bearing capacity (million 80 kN axles/lane)	Volume and type of traffic**	
		Approximate v.p.d. per lane***	Description
ES0.003	< 0,003	< 3	Very lightly trafficked roads; very few heavy vehicles. These roads could include the transition from gravel to paved roads and may incorporate semi-permanent and / or all weather surfacings.
ES0.01	0,003 - 0,01	3 - 10	
ES0.03	0,01 - 0,03	10 - 20	
ES0.1	0,03 - 0,10	20 - 75	
ES0.3	0,10 - 0,30	75 - 220	
ES1	0,3 - 1	220 - 700	Lightly trafficked roads, mainly cars, light delivery and agriculture vehicles; very few heavy vehicles.
ES3	1 - 3	> 700	Medium volume of traffic; few heavy vehicles.
ES10	3 - 10	> 700****	High volume of traffic and / or many heavy vehicles.
ES30	10 - 30	> 2200****	Very high volume of traffic and / or a high proportion of fully laden heavy vehicles.
ES100	30 - 100	> 6500****	




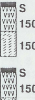



















6

TABLE 1
Definition of the road categories

ROAD CATEGORY				
	A	B	C	D
Description	Major interurban freeways and major rural roads	Interurban collectors and rural roads	Lightly trafficked rural roads, strategic roads	Rural access roads
Importance	Very important	Important	Less important	Less important
Service level	Very high level of service	High level of service	Moderate level of service	Moderate to low level of service
TYPICAL PAVEMENT CHARACTERISTICS				
RISK	Very low	Low	Medium	High
Approximate Design Reliability (%) *	95	90	80	50
Total Equivalent Traffic Loading (E80/lane) **	3 - 100 x 10 ⁶ over 20 years	0,3 - 10 x 10 ⁶ Depending on design strategy	< 3 x 10 ⁶ Depending on design strategy	< 1 x 10 ⁶ Depending on design strategy
Typical Pavement Class ***	ES10 - ES100	ES1 - ES10	ES0.003 - ES3	ES0.003 - ES1
Daily Traffic: (e.v.u) ****	> 4000	600 - 10 000	< 600	< 500

7

Typical TRH4 catalogue design sheet

PAVEMENT CLASS AND DESIGN BEARING CAPACITY (80 kN AXLES/LANE)										Foundation	
ROAD CAT.	ES1 < 3000	ES2 0,3-1,0x10 ⁴	ES3 1,0-3,0x10 ⁴	ES4 3,0-10x10 ⁴	ES5 0,1-0,3x10 ⁶	ES6 0,3-1,0x10 ⁶	ES7 1,0-3,0x10 ⁶	ES8 3,0-10x10 ⁶	ES9 10-30x10 ⁶	ES10 30-100x10 ⁶	
A											
B											 150 G7 150 G9 G10
C											
											
D											 150 G9 G10 8

What about non-standard pavement design, such as when designing pavements for rehabilitation?

Resort to using the South African Mechanistic Pavement Design Method

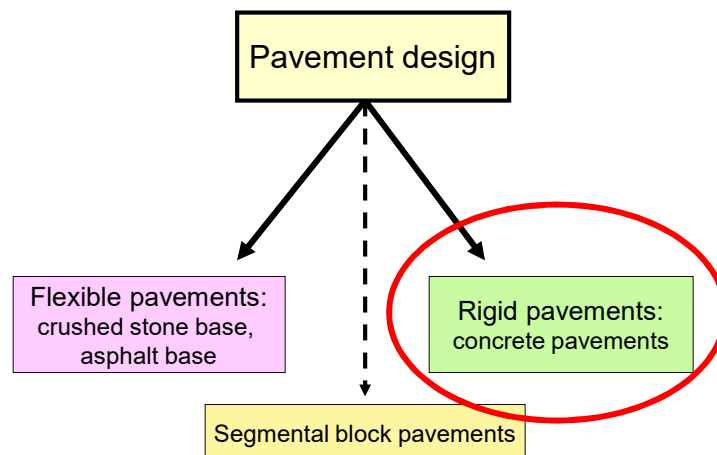
Use software such as Rubicon to carry out the various options to achieve the required structural capacity of the pavement

In any case, pavement design, whether using the TRH4 catalogues of other methods, requires consideration of a number of factors, some of which are:

- *local climatic conditions*
- *availability of materials in the vicinity of the project – crushed stone, asphalt*
- *local contractor's experience and capabilities*
- *Client's preferences*

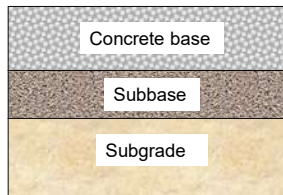
9

Basics of pavement design

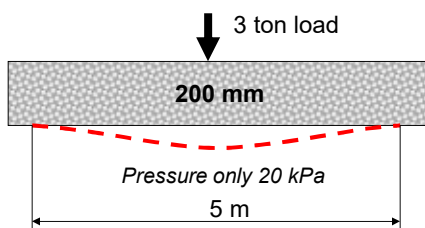


10

Concrete pavement design concepts



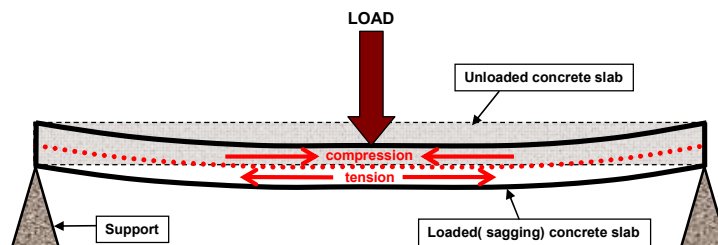
The concrete base can be un-reinforced, dowelled or reinforced



Concrete pavements do not require strong subgrades, but the support should be uniform

11

Concrete pavement design concepts



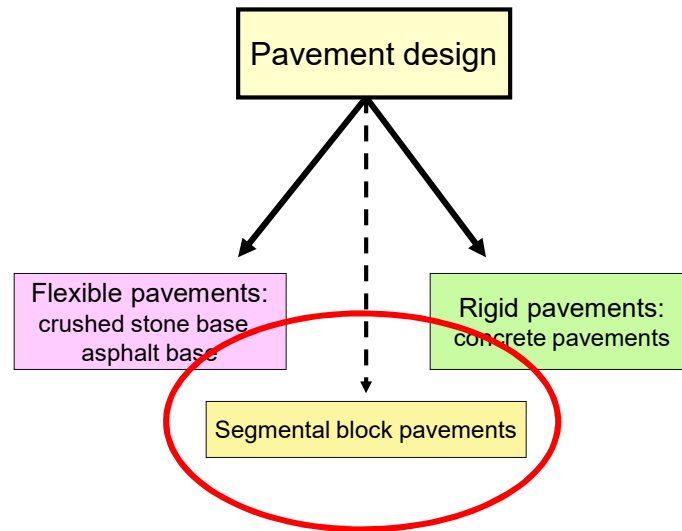
The flexural strength of the concrete becomes important in the design of a concrete pavement

cncPave is a useful pavement design program for concrete pavements

Typically a minimum 4.5 MPa flexural strength is required, while other requirements, such as minimum water/cement ratio and minimum cement content may be specified to ensure good durability as well as satisfactory strength

12

Basics of pavement design



13

Basics of pavement design

Segmental block pavement design concepts

May be divided into 3 categories:



← Architectural



← Roads

Industrial →



14

Segmental block pavement design concepts

The easy way:



15

Segmental block pavement design concepts

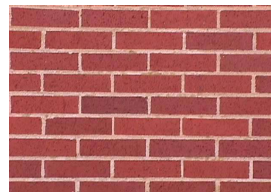
The design procedure is fairly similar to that for flexible pavements:

- *select structural design period*
- *estimate Design Traffic*
- *consider in situ material quality*
- *consider climatic region*
- *consider laying pattern – herringbone, stretcher bond*

Herringbone



Stretcher Bond



16

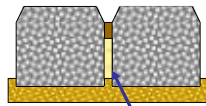
Segmental block pavement design concepts

Use guidelines in Draft UTG 2 1987 – somewhat dated but still useful

Lockpave is a user-friendly software program

Important practical aspects:

- block thickness – 60 mm or 80 mm
- block strength
- thickness and grading & quality of bedding sand
- grading and quality of filler sand



Filler sand

Edge restraints are important to prevent joints opening and blocks moving apart

Bedding sand 20 mm to 25 mm