




2011 STUDY TOUR

Brief Introduction of Australian Pavement Design

AAPA 2011 Pre-CAPSA'11 Study Tour - Topic www.aapa.asn.au



Design Philosophy

- Distribute the loads to the subgrade
- Provide for smooth, safe and efficient movement of vehicles


AAPA 2011 Pre-CAPSA'11 Study Tour - Topic www.aapa.asn.au



Design Philosophy

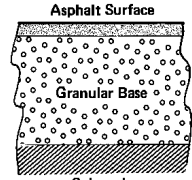
- Pavement design
 - most economical pavement composition to provide reliable service for expected traffic loading and environmental conditions

AAPA 2011 Pre-CAPSA'11 Study Tour - Topic www.aapa.asn.au

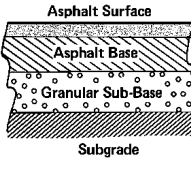


Types of Pavements

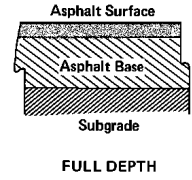
- Flexible pavements



CONVENTIONAL



DEEP STRENGTH



FULL DEPTH

AAPA 2011 Pre-CAPSA'11 Study Tour - Topic www.aapa.asn.au



Types of Pavements

- Rigid pavements
 - Continuously Reinforced
 - Plain Jointed
 - Dowel Jointed
 - Jointed Reinforced
 - Etc...

AAPA 2011 Pre-CAPSA'11 Study Tour - Topic www.aapa.asn.au



AUSTROADS



AAPA 2011 Pre-CAPSA'11 Study Tour - Topic www.aapa.asn.au

Subgrade

- Classified in terms of CBR
 - Poor: ≤ 3
 - Fair: 4 – 9
 - Good: ≥ 10
- Need to consider swell (can exceed 7%)

AAPA 2011 Pre-CAPSA'11 Study Tour - Topic www.aapa.asn.au

Subgrade

- Soaking requirements
 - Based on environment (1 – 10 day)
 - 4 day most common
 - 10 day where wet
- Generally subgrades very poor
 - Require careful attention
 - Fills

AAPA 2011 Pre-CAPSA'11 Study Tour - Topic www.aapa.asn.au

Subgrade

- Drainage very important
 - Maintain moisture regime in pavement

AAPA 2011 Pre-CAPSA'11 Study Tour - Topic www.aapa.asn.au

Pavement materials

Material type	Properties
Granular	CBR, grading, atterberg
Modified granular	CBR/UCS
Stabilised granular	UCS
Asphalt	Binder type, grading
Concrete	Flexural strength
Surfacing seals	Binder type, aggregate size

AAPA 2011 Pre-CAPSA'11 Study Tour - Topic www.aapa.asn.au



Traffic loading

- Concept of ESA (E80)
- Developed further
 - HVAG
- Parameters for design
 - $W_{18.5} \neq W_{18}$
 - ESA/HVAG
 - Determine damage "coefficient" for each material type
- < 100 000 ESA to more than 700 million ESA

AAPA 2011 Pre-CAPSA'11 Study Tour - Topic www.aapa.asn.au

Damage "coefficient"

AAPA 2011 Pre-CAPSA'11 Study Tour - Topic www.aapa.asn.au

Design: Subgrade

AAPA 2011 Pre-CAPSA'11 Study Tour - Topic www.aapa.asn.au

Design: Thickness

- Empirical design method (< 10 million ESA)
- Mechanistic-Empirical design method (> 10 million ESA)

AAPA 2011 Pre-CAPSA'11 Study Tour - Topic www.aapa.asn.au

Empirical design method

AAPA 2011 Pre-CAPSA'11 Study Tour - Topic www.aapa.asn.au

Mechanistic-Empirical design method

- Assign stiffness to pavement layers
 - Asphalt: 3000MPa depending on:
 - Traffic speed
 - temperature
 - Cemented: 2000 – 5000 Mpa
 - Granular: 150 to 500 Mpa
 - Subgrade: E=10.CBR
- Sublayering of granular layers

AAPA 2011 Pre-CAPSA'11 Study Tour - Topic www.aapa.asn.au



Mechanistic-Empirical design method

- Calculation of critical stresses and strains (LE software) (750kPa, 4 circular loads)
- Using transfer functions to predict performance
 - Subgrade rutting: Vertical strain at top
 - Cemented fatigue: Horizontal strain at bottom
 - Asphalt fatigue: Horizontal strain at bottom
 - Granular: currently none

AAPA 2011 Pre-CAPSA'11 Study Tour - Topic www.aapa.asn.au

Mechanistic-Empirical design transfer functions

- **Asphalt fatigue**

$$N = RF \left[\frac{6918(0.865V_B) + 1.08}{S^{0.36} \epsilon} \right]^5$$
- **Cemented fatigue**

$$N = RF \left[\frac{113000 / E^{0.804} + 191}{\epsilon} \right]^{12}$$
- **Subgrade rutting**

$$N = \left[\frac{9300}{\epsilon} \right]^7$$

AAPA 2011 Pre-CAPSA'11 Study Tour - Topic www.aapa.asn.au

Typical examples (QLD)

- 450 million ESA with speed > 80 km/hr
- 85 million ESA with speed ≤ 80 km/hr
- 37 million ESA with speed > 80 km/hr
- 23 million ESA
- 10 million ESA with speed ≤ 30 km/hr

AAPA 2011 Pre-CAPSA'11 Study Tour - Topic www.aapa.asn.au

450 million ESA (v > 80km/h)

40 mm OG14(A5S) surfacing	40 mm OG14(A5S) surfacing
14 mm S4.5S PMB SAMI seal	14 mm S4.5S PMB SAMI seal
50 mm DG14HS binder layer	40 mm DG14HS binder layer
440 mm DG20 base	275 mm CRCP
10 mm C170 seal	10 mm C170 seal
150 mm cement modified Working Platform	150 mm Lean mix concrete subbase
CBR 3 subgrade	150 mm cement modified Working Platform
	CBR 3 subgrade

AAPA 2011 Pre-CAPSA'11 Study Tour - Topic www.aapa.asn.au

85 million ESA (v ≤ 80km/h)

50 mm DG14HS surfacing
14 mm S4.5S PMB SAMI seal
50 mm DG14HS binder layer
385 mm DG20 base
10 mm C170 seal
150 mm cement modified Working Platform
CBR 3 subgrade

AAPA 2011 Pre-CAPSA'11 Study Tour - Topic www.aapa.asn.au

37 million ESA (v > 80km/h)

50 mm SMA surfacing	50 mm SMA surfacing
14 mm S4.5S PMB SAMI seal	14 mm S4.5S PMB SAMI seal
180 mm DG20 base	330 mm DG20 base
200 mm CAT2 stabilised base	10 mm C170 seal
10 mm C170 seal	150 mm cement modified Working Platform
150 mm cement modified Working Platform	CBR 3 subgrade
CBR 3 subgrade	

AAPA 2011 Pre-CAPSA'11 Study Tour - Topic www.aapa.asn.au



23 million ESA

20/10 PMB double seal	20/10 PMB double seal
150 mm CBR80 base	175 mm CBR80 base
250 mm CBR45 subbase	300 mm CBR45 subbase
CBR10 subgrade	CBR7 subgrade



AAPA 2011 Pre-CAPSA'11 Study Tour - Topic

www.aapa.asn.au

10 million ESA ($v \leq 30\text{km/h}$) (ramp)

50 mm DG14HS surfacing	50 mm DG14HS surfacing
14 mm S4.5S PMB SAMI seal	14 mm S4.5S PMB SAMI seal
50 mm DG14HS binder layer	150 mm CBR80 base
230 mm DG20 base	150 mm CBR45 subbase
10 mm C170 seal	300 mm CBR15 selected layers
150 mm cement modified Working Platform	{150 mm cement modified Working Platform}
CBR 3 subgrade	CBR 3 subgrade



AAPA 2011 Pre-CAPSA'11 Study Tour - Topic

www.aapa.asn.au

Thank you



AAPA 2011 Pre-CAPSA'11 Study Tour - Topic

www.aapa.asn.au

3.5 million ESA (urban)

40 mm DG10(A5S)	40 mm DG10(A5S)
150 mm CBR80 base	150 mm CBR80 base
150 mm CBR45 subbase	150 mm CBR45 subbase
300 mm CBR15 selected	150 mm CBR15 selected
CBR3 subgrade	CBR7 subgrade



AAPA 2011 Pre-CAPSA'11 Study Tour - Topic

www.aapa.asn.au