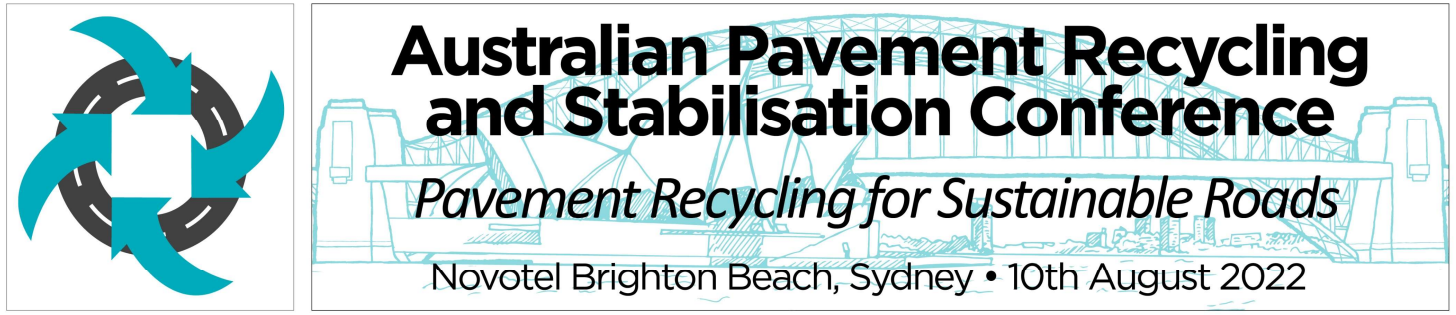
Design of foamed bitumen stabilised pavements for local government engineers

George Vorobieff

BE (Civil), MEngSc, MBA, FIEAust CPEng NER APEC Engineer IntPE (Aus)

Subject matter expert on flexible and concrete pavements

Head to Head International



AustStab
Pavement Recycling and Stabilisation Association

A great example of insitu foamed bitumen stabilisation rehabilitated pavement on the Pacific Highway, Port Macquarie

Content

- Selecting a design modulus for CIRCLY analysis
- Is FBS more applicable for base or subbase layers for local roads?
- Design considerations for multiple layers
- What options should be considered for a wearing course?
- Getting the best from pavement drawings, profiles and edge details
- Pavement specifications for local roads to meet the design intent
- Summary

Selecting a design modulus for CIRCLY analysis

- FBS is a bound material (but not asphalt)
- Typical material failure is from fatigue cracking
- Strength/modulus (stiffness) increases over time
- Design modulus selected from mix design
- Adjust modulus for traffic speed and temperature (WAMPT)
- Deformation distress is likely a result of material issues or early trafficking by heavy vehicles

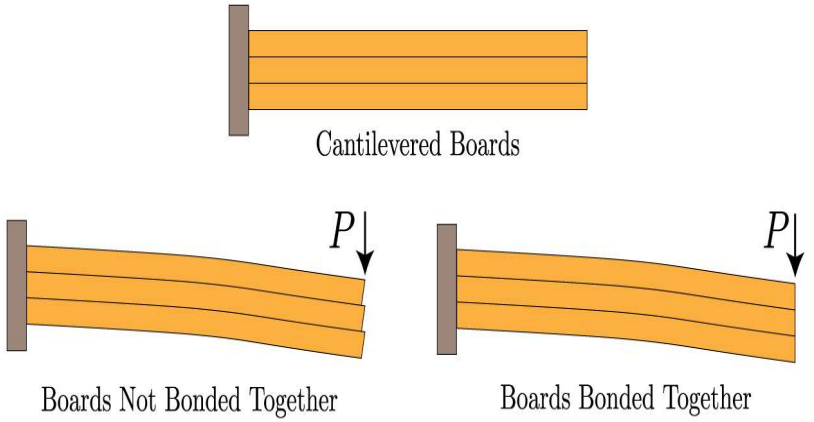
(For further FBS mix design information, refer to each State Roads agency websites)

Selecting a design modulus for CIRCLY analysis (Cont'd)

- Typical design range is 1,500 to 2,500 MPa
- A higher modulus gives a thinner layer thickness (keeping other properties constant)
- Given that the FBS layer is the lowest layer, to maximise the design period, maximise layer thickness rather than design modulus

Selecting a design modulus for CIRCLY analysis
(Cont'd)

- CIRCLY 7 assumes all interface layers are 'rough':
  - Ensure a bonded interface when plant-mix is in two layers
  - Ensure bond where AC wearing course is ≤ 100mm



(Source: Boston University, Mechanical Engineering)

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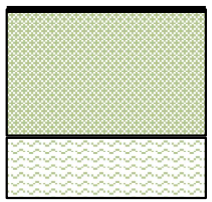
Is FBS more applicable for base or subbase layers for local roads?

- FBS is applicable for both base and subbase layers
- Avoid sprayed seal wearing course where:
  - Ride quality limits are in place
  - HV turning traffic is expected

Design considerations for multiple layers

- Insitu stabilisation is one layer
- Plant mix production & placement may be in 1 or 2 layers
- The thicker the layer, the harder it is to compact the bottom half of the layer – need to consider if the formation is strong enough to support the compactive effort

Design considerations for multiple layers
- Pav't thickness versus design subgrade strength



Sprayed seal WC

FBS (M_r = 2000 MPa)

Design subgrade (CBR %)

Pavement Profile

Thickness of FBS from CIRCLY 7 analysis

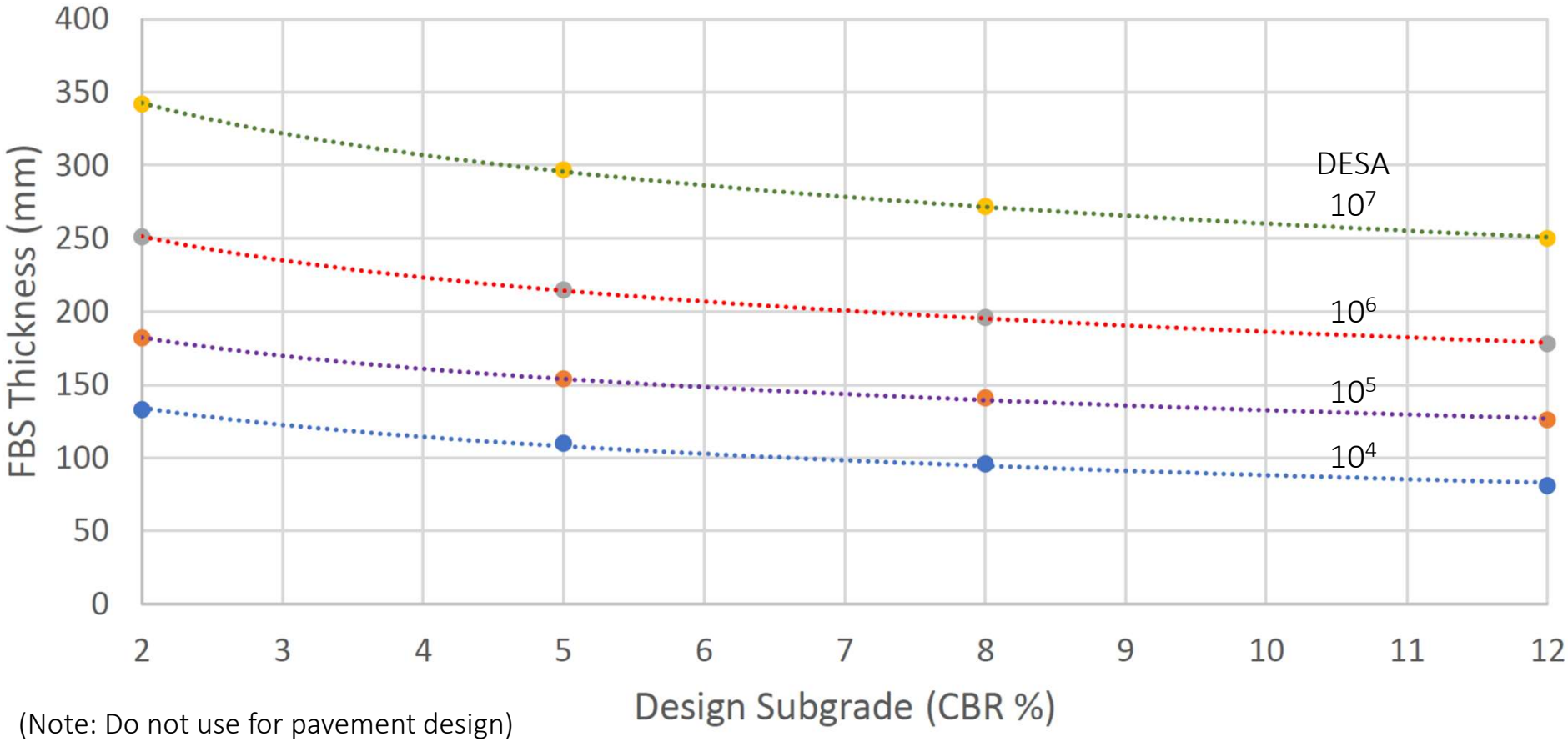
	DESA			
CBR (%)	10^4	10^5	10^6	10^7
2	133	182	251	342
5	110	154	215	297
8	96	141	196	272
12	81	126	178	250

Min. thickness 150mm

(Note: Do not use for pavement design)

Design considerations for multiple layers

- Pav't thickness versus design subgrade strength (Cont'd)



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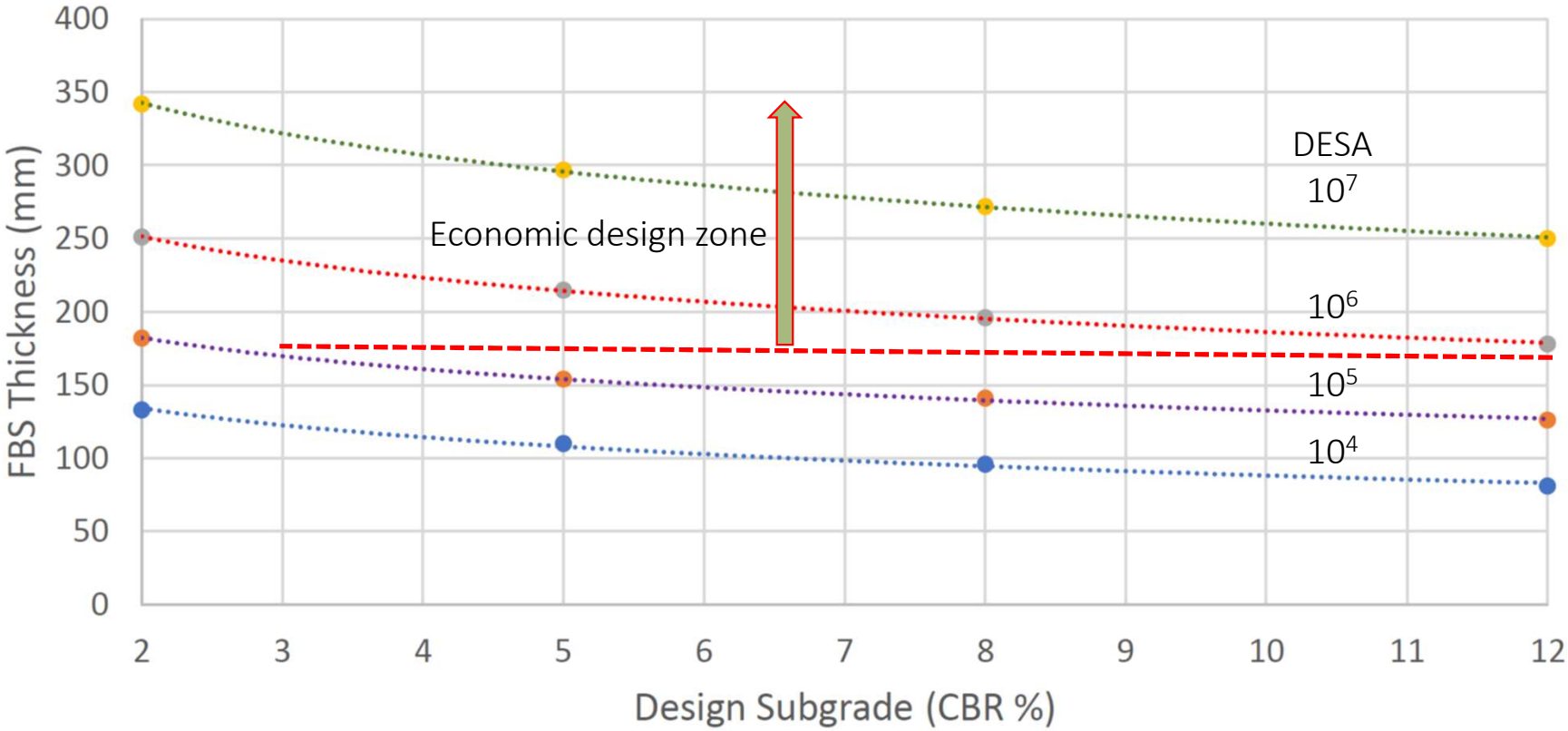
Design considerations for multiple layers

- Pav't thickness versus design subgrade strength (Cont'd)



What options should be considered for a wearing course?

- Lowest cost – 2 coat sprayed seal with:
  - initial seal 7mm (C170)
  - final seal 14mm (C240 for NSW)
- AC14 wearing course – Thickness to allow for future mill & resheet
- SMA10 with underlying AC14 course
- Other options – Segmental pavers, flags, concrete etc

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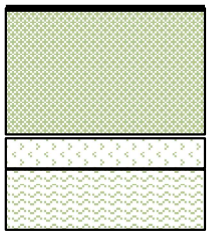
Pavement profile for drawings

- Key information for pavement profile (Cont'd)



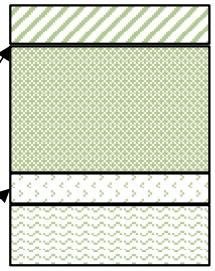
Two coat sprayed seal

FBS (Refer to Note x)

Existing granular material

Design subgrade CBR ≥5%

Profile A



AC base with AC wearing course

FBS (Refer to Note x)

Existing granular material

Design subgrade CBR ≥5%

Profile B

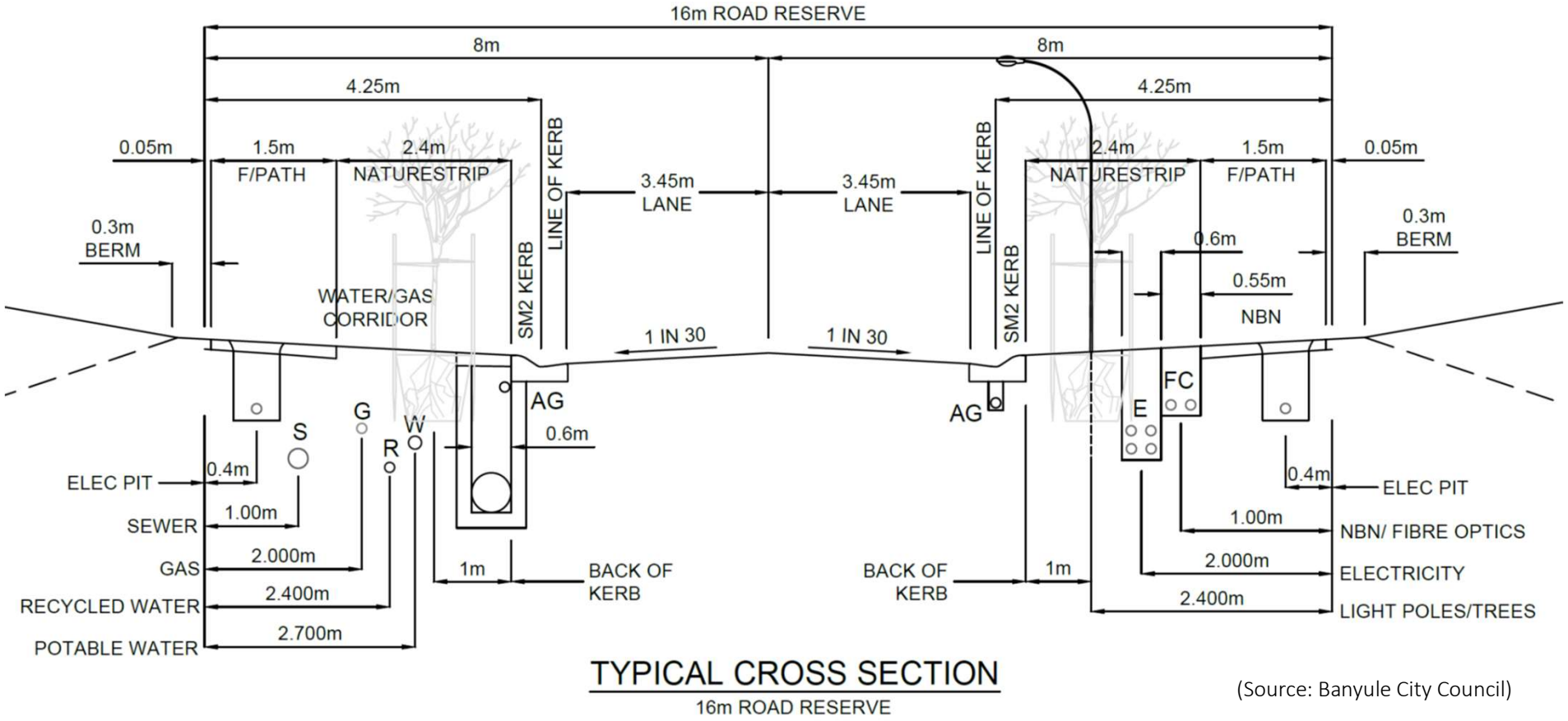
What are the treatments at these interfaces?

Pavement profile for drawings

- Pavement notes

- Nominated the design modulus and bitumen & lime application rates
  - including Class of bitumen and type of lime
- Supply of granular material:
  - Supplied from quarry – What are the key properties?
  - Is RAP permitted and now much?
- Any specific requirements for:
  - Placement of longitudinal & transverse joints
  - Maximum working time
  - Interlayer for 2-layer of FBS
  - Maintenance (ie mill & resheet)
- Specification(s) for delivery of FBS and placing, compaction etc of layer(S), sealing, tackcoat

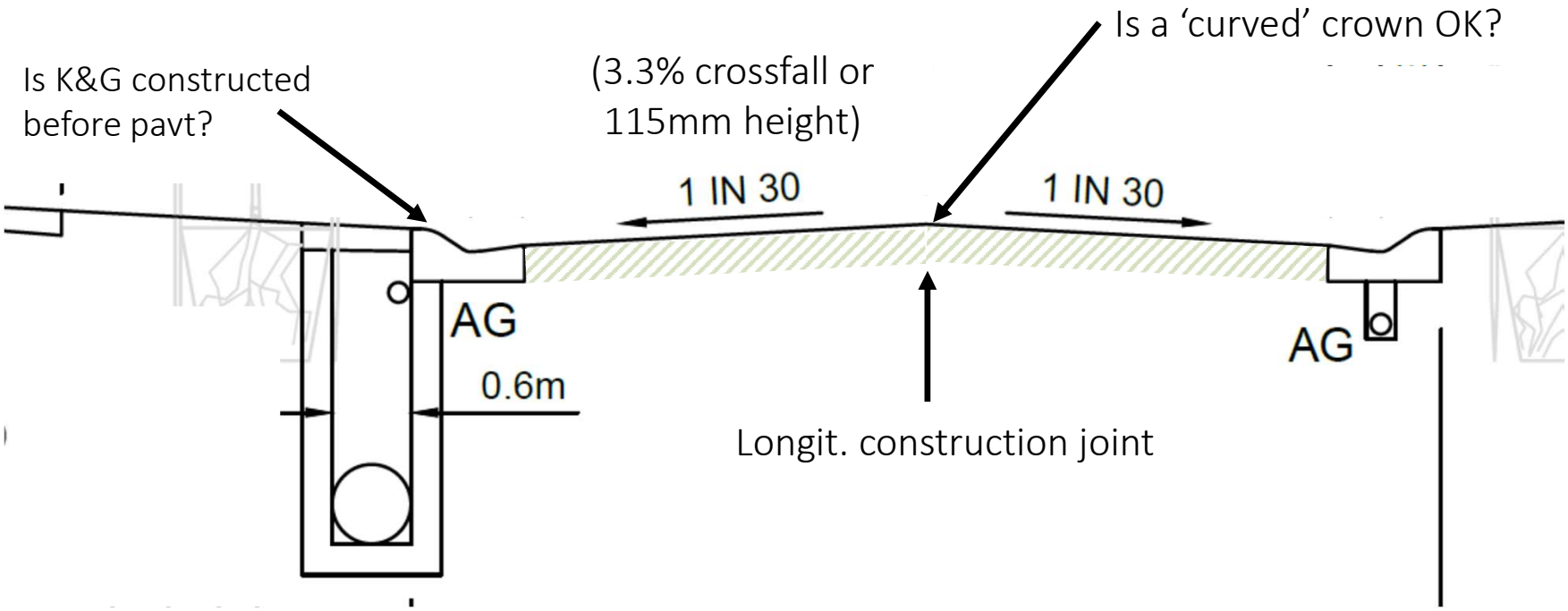
Pavement cross section



TYPICAL CROSS SECTION
16m ROAD RESERVE

(Source: Banyule City Council)

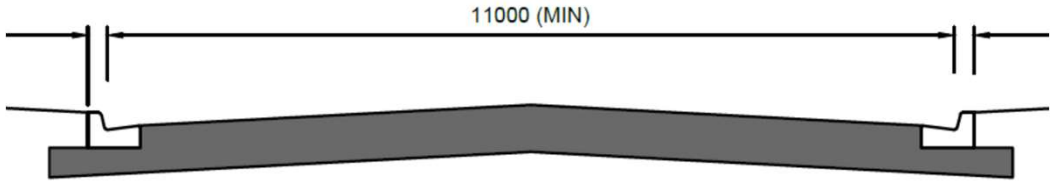
Pavement cross section (Cont'd)



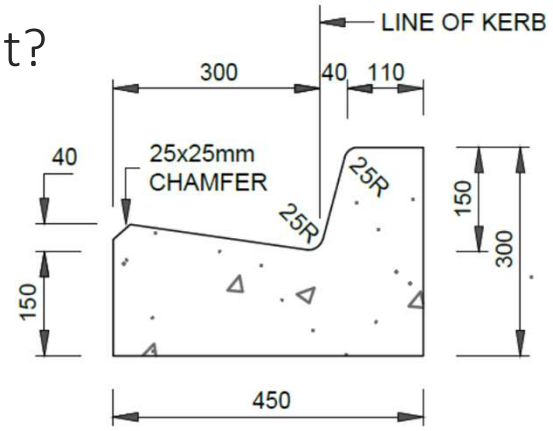
(Source: Banyule City Council)

Pavement edge details

- Need a minimum 500mm shoulder (Ref. RMS Pavement Design Supplement) – except where K&G
- Try to match K&G thickness to the combined FBS and wearing course thickness
- Which is constructed first – K&G or pavement?



COLLECTOR STREET - LEVEL 1



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Pavement specifications for local roads to meet the design intent

- Most road agencies have an insitu foamed bitumen stabilisation specification, and some have a plant-mix version
- AustStab has both an insitu and plant mix model specification that was last updated in 2006
- Aus-Spec has specification ‘1113 Stabilisation’ and many Council’s have modified the standard version
- Most specifications are aimed at rehabilitation of local roads and highways rather than new works

Road agency versus Aus-Spec specifications

- Road agency specs are more stringent that Aus-Spec but if traffic loads are high, why use a ‘lesser’ standard for delivery
- Mix design to be set by local govt designer (my preference)
- Avoid contractor conflicts & get independent test results for construction compliance

Summary

- Pavement design must match the mix design & profile details
- Mix design takes time – plan ahead
- Passing to the contractor to complete the mix design does not transfer all the risks to the contractor
- Economic thickness for FBS layer is ≥ 175mm
- How is the design assumptions going to be delivered by the contractor? (Need a robust /concise design report)
- Spend valuable time on pavement detailing to get best results
- Use road agency specification when DESA ≥ 10^6

Questions ….

- vorobieff@headtohead.com.au