



WARRIP

WESTERN AUSTRALIAN ROAD RESEARCH
AND INNOVATION PROGRAM



Engineering Road Note 9

Western Australian Supplement to the
Austroads Guide to Pavement Technology
Part 2: Pavement Structural Design

AN INITIATIVE BY:



mainroads
WESTERN AUSTRALIA



Why?

- Engineering Road Note 9 (ERN9) (2018) is WA's supplement to Austroads Guide to Pavement Technology Part 2: Pavement Structural Design – AGPT02 (2017)
- ERN9 (2018) takes precedence over AGPT02 (2017)
- Address industry comments previously received on ERN9 (2013)
- ERN9 (2018) is intended as a stand-alone guide for empirical design, but otherwise does not repeat information already supplied in AGPT02 (2017)
- Section numbers in ERN9 (2018) align with the section numbers in AGPT02 (2017)
- ERN9 (2018) contains additional clauses over and above AGPT02 (2017), which are identified as e.g. “3.17 [MRWA] Pavement Joints”

What changed in AGPT02 (2017)?

AGPT02 (2017)	ERN9 (2018)
<p>Flexible pavements</p> <ul style="list-style-type: none">• Lime stabilised subgrades• Cemented materials• Lean-mix concrete• Asphalt characterisation• Design traffic<ul style="list-style-type: none">• Lane capacity limit• Axle-strain method - Removal of Standard Axle Repetitions (SARs)	<ul style="list-style-type: none">• Content not repeated in ERN9• Added to ERN9 with WA context• Added to ERN9 with WA context• Added to ERN9 with WA context• Added to ERN9 with WA context• Added to ERN9 with WA context<ul style="list-style-type: none">• Not adopted in ERN9• Added to ERN9 with WA context

Changes - Lime stabilised subgrades

Section	AGPT02	ERN9
Section 5.3.8	<ul style="list-style-type: none">• AGPT02 (2012) - Lime stabilised subgrades not structural• AP-R435-13 (2013) - Proposed procedures for design as selected subgrade NOT subbase• AGPT02 (2017) - Adopted	Refer to AGPT02

Changes - Cemented materials

Section	AGPT02	ERN9
Section 2.2.3	Cemented Granular Bases with Sprayed Seal Surfacing	This pavement type not used in WA
Section 6.1.1	Not applicable	Added section for verification of design assumptions
Section 6.4.3	Determination of Design Modulus	Adopted with additions for WA context
Section 6.4.6 - 6.4.8	Fatigue performance - 3 methods	Refer to AGPT02

Changes - Lean-mix concrete

Section	AGPT02	ERN9
Section 6.6.2	Discussed as separate material type for subbase concrete	Refer AGPT02
Section 6.6.3	Discussed as separate material type for subbase concrete for flexible pavements	This pavement type not used in WA

Changes - Asphalt characterisation

Section	AGPT02	ERN9
Section 6.5.3	Definition of asphalt design modulus - 4 methods	Guidance provided for WA context
Section 6.5.4	Determination of Design Modulus from Direct Measurement of Flexural Modulus	Applies to EME2 only

Changes - Asphalt characterisation (continued)

Section	AGPT02	ERN9
Section 6.5.5	Determination of Design Modulus from Measurement of ITT Modulus	Guidance provided for WA context
Section 6.5.6	Design Modulus from Bitumen Properties and Mix Volumetric Properties	<i>“Unless specified otherwise by the Principal, asphalt design modulus shall not be obtained using the Shell nomographs”</i>

Changes - Asphalt characterisation (continued)

Section	AGPT02	ERN9
Section 6.5.10	Fatigue criteria - $\frac{SF}{RF}$ SF presumptive value = 6	SF=6 <u>unless</u> for thin asphalt surfacing over granular (clause 1.2(c) 2013), then SF = 23
Section 6.5.11	Means of Determining Asphalt Fatigue Characteristics - laboratory measurement guidance	<i>“Unless specified otherwise by the Principal, mix specific fatigue models should not be used.”</i>

Asphalt characterisation (Clause 1.2(c) 2013)

- ERN9 (2013) allows the use of a **5-years asphalt fatigue design life** when the asphalt thickness is 60 mm or less and the following conditions are satisfied:
 - the design traffic loading for 40 years is less than or equal to 3×10^7 ESAs
 - the pavement is well drained
 - the subgrade is Perth sand
 - the sub-base is crushed limestone
 - the basecourse material is either crushed rock base or bitumen stabilised limestone.

Asphalt characterisation (Clause 6.5.10 2018)

- “Based on empirical observations and analysis of in-service asphalt life of thin asphalt surfacing over granular pavements in Perth, compared to modelled asphalt fatigue life, **a shift factor (SF) of up to 23 may be used when:**
 - the asphalt nominal total thickness is 60 mm or less,
 - the design traffic loading for 40 years is less than or equal to 3×10^7 ESA,
 - the pavement is well drained,
 - the subgrade is Perth sand,
 - the subbase is crushed limestone and
 - the basecourse material is either high standard crushed rock base or bitumen stabilised limestone.”

Changes - Design traffic (Lane capacity limit)

Section	AGPT02	ERN9
Section 7.4.6	Capacity check Annual number of Heavy Vehicles \leq lane capacity	<i>“Unless advised by the Principal no allowance should be made for limiting the design traffic due to saturation. This is to allow for greater future flexibility of the road fleet”</i>

Axle Strain Method (ME Bound Materials) - Removal of SARs

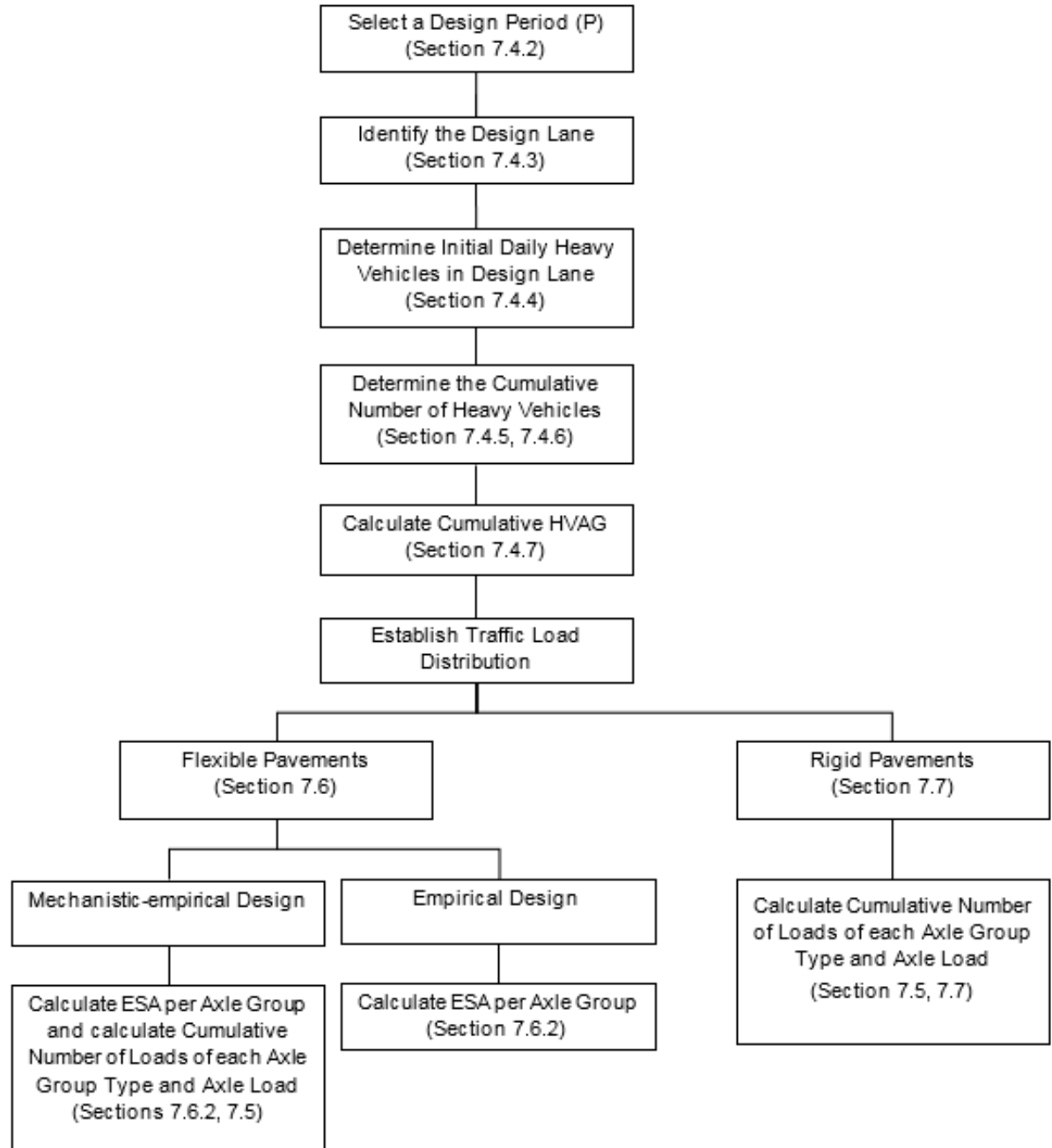
- AGPT02 (2012)

$$SAR = \sum_{i=1}^m \left(\frac{L_i}{SL_i} \right)^{LDE}$$

Axle type	Standard group load [kN]
Single Axle - Single Tyres	53
Single Axle - Dual Tyres	80
Tandem Axle - Dual Tyres	135
Triaxle Axle - Dual Tyres	181
Quad Axle - Dual Tyres	221

Distress type	LDE
Asphalt fatigue	5
Cemented material/LMC fatigue	12
Rutting and shape loss	7

- AGPT02 (2017)



• ERN9 (2018)

Determine the annual average number of heavy vehicles daily in one direction in the first year, the proportion of heavy vehicles using the design lane (Section 7.4.3) and the compound cumulative growth factor (Section 7.4.5).

Design Traffic Loading Method 1 ***(Section 7.6.2)***

- Determine the proportion of each heavy vehicle class and the number of ESAs per each heavy vehicle class (MRWA Table 7.3 and 7.4)
- Calculate DESA

Design Traffic Loading Method 2 ***(Section 7.6.2)***

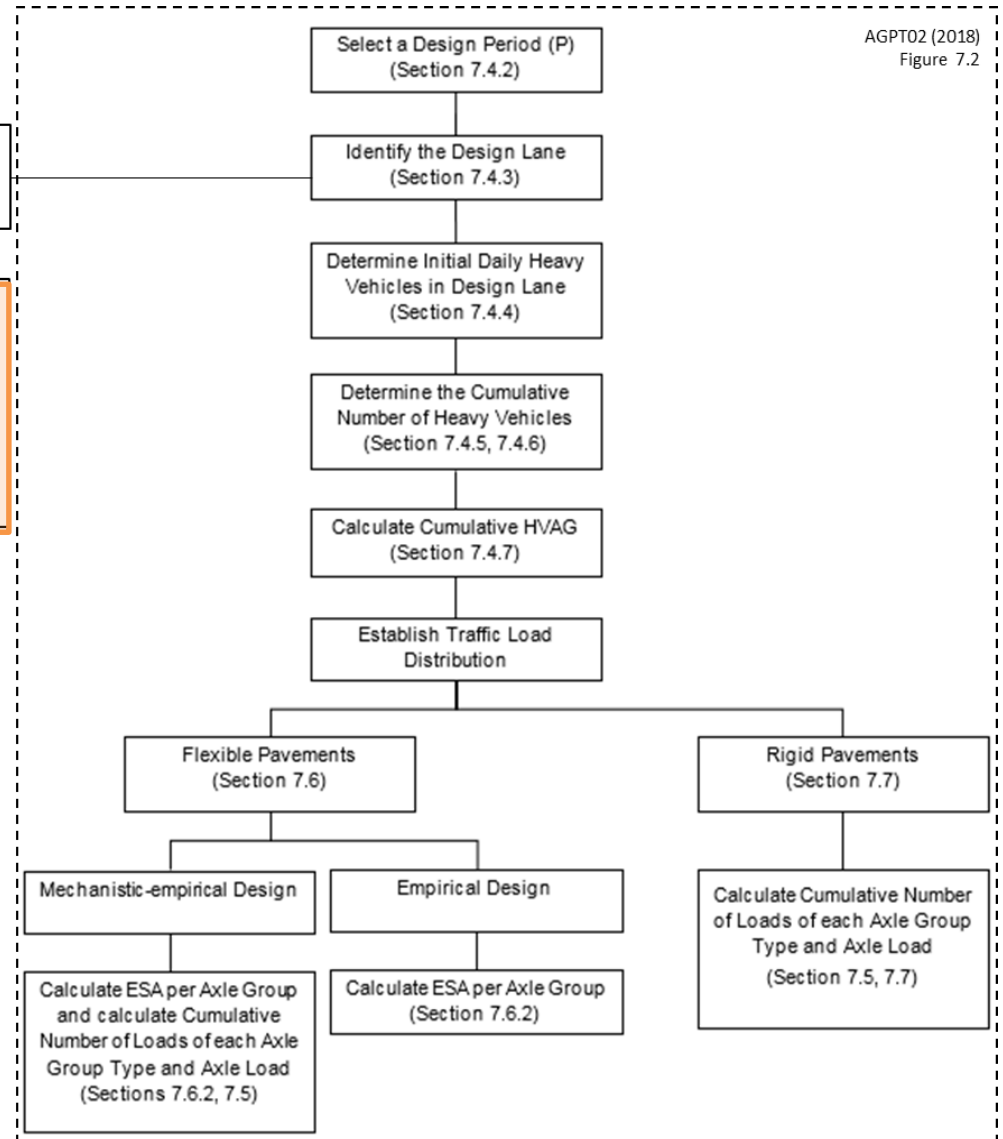
- Determine the proportion of heavy vehicle and the number of ESAs per each heavy vehicle (MRWA Table 7.5)
- Calculate DESA

Flexible pavements that include a bound layer or rigid pavements

Unbound flexible pavements

- Generate TLD from available traffic data or select appropriate TLD from Appendix A (Section 7.5)
- Calculate HVAG
- Calculate Cumulative Number of Loads of each Axle Group Type and Axle Load

No more action required. The traffic is calculated in terms of DESA



Where to from here?

- Two or three volunteers for independent review
- Main Roads working towards producing TLDs later this year
- WARRIP workshop to launch ERN9 (2018) with industry – half day?

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QUESTIONS?