Catalogue of Standard Pavement Profiles for Local Government Roads in Western Australia

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Draft

About LG TRRIP

The Local Government Roads and Research and Innovation Program (LG TRRIP) is an initiative between Main Roads Western Australia and the Western Australian Local Government Association.

LG TRRIP has a strategic commitment to the delivery of collaborative research and development that positively contributes to the design, construction and maintenance of safe, sustainable transport infrastructure in Western Australia.

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Version Control

Report version no.	Date	Released to client by	Nature of revision
1	14/05/2025	Negin Zhalehjoo	Final Catalogue for publication.

Contents

1 Overview

1.1 Purpose and Scope

This guideline consolidates current resources providing pavement profiles for flexible pavements, covering a range of traffic volumes and subgrade California Bearing Ratio (CBR) values suitable for local government (LG) roads in WA.

The guideline presents a catalogue of pavement profiles, organised into design tables, for different pavement configurations, including:

- granular basecourse with sprayed seal surfacing
- granular basecourse with thin asphalt surfacing
- asphalt basecourse.

Design processes were used to establish minimum pavement thickness requirements for typical LG pavement configurations. The tables were developed using a range of subgrade design CBR values and design traffic inputs. Furthermore, the guideline provides additional background information on pavement design principles and a concise overview of key factors influencing pavement design.

1.2 Limitations

This guideline may not be applicable in the following cases:

When designing a pavement not covered by the configurations provided in Section 3.1

If the selected subgrade CBR and design traffic volume fall outside the parameters presented in the design tables in Section 3.1

For roads with very high traffic volumes, equal to or greater than 1×10^7 ESAs

In the above instances, detailed pavement design procedures that account for local materials, traffic and conditions, as outlined in the Austroads *Guide to Pavement Technology Part 2* (2017), should be followed

Additionally, this guideline should not be applied if the selected materials do not comply with the relevant minimum standard specifications as outlined in Section 2.3

1.3 Anticipated Benefits

This guideline assists LGs in WA in selecting appropriate pavement profiles relevant to the desired application.

The overall anticipated benefits of this guideline are as follows:

Reduction in the likelihood of inappropriate pavement profile selections and associated failures.

Savings in time and cost:

- of the design and construction process by reducing the time required to assess and select suitable pavement options
- for road managers to check designs provided by consultants and other external parties
- to provide a reference for investigating road failures and designing rehabilitation treatments.

Possible shared cost and time savings for consulting agencies/contractors to prepare designs during road construction/maintenance projects. Note that this depends on the specific responsibilities of LG and industry in a road construction project.

Potential reduction in road closures due to reduced pavement failure following application of the guideline.

Potential environmental benefits from reduced road maintenance requirements following application of the guideline.

1.4 Catalogue Structure

This guideline includes 3 main sections as below:

- Section 1 provides the project overview.
- Section 2 presents an overview of pavement design principles and design inputs.
- Section 3 provides practitioner's guidance and a catalogue of pavement profiles, in the form of tables.

Appendices are used to expand points and provide relevant supporting information.

1.5 Acronyms

Definitions of the acronyms used in this guideline are provided in Table 1.

Table 1: Acronym

Acronym	Definition
AADT	Annual average daily traffic
AFPA	Australian Flexible Pavement Association
CBR	California Bearing Ratio
CGF	Cumulative growth factor
DCP	Dynamic cone penetrometer
DG asphalt	Dense graded asphalt
ESA(s)	Equivalent standard axle(s)
HVAG	Heavy vehicle axle groups
IPWEA	Institute of Public Works Engineering Australia
LG(s)	Local government(s)
LG TRRIP	Local Government Transport and Roads Research and Innovation Program

Acronym	Definition
MRWA	Main Roads Western Australia
NTRO	National Transport Research Organisation
SMA	Stone mastic asphalt
WA	Western Australia
WALGA	Western Australian Local Government Association

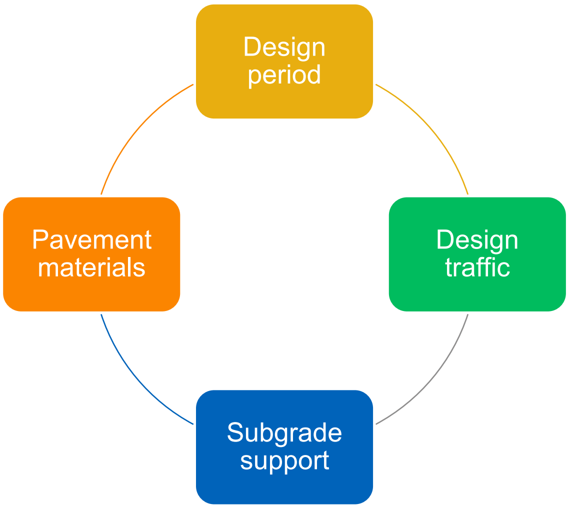
2 Determination of Pavement Design Inputs

The aim of pavement design is to select the most economical pavement thickness and composition that will provide a satisfactory level of service for the anticipated traffic. A correctly designed pavement should be capable of serving its intended design life without requiring significant rehabilitation.

The designer must have sufficient knowledge of the materials, traffic conditions and local environment to estimate the performance of any pavement composition. Furthermore, the designer should understand the expected performance levels and the pavement conditions that will be deemed satisfactory for the specific circumstances for which the pavement structure is being designed.

An overview of pavement design principles is provided in Appendix A (Section A.1).

This section provides a brief overview on some of the major factors affecting pavement design, including:



2.1 Design Period and Design Traffic

The design period chosen by the pavement designer represents the specified time span during which the road pavement should operate effectively without requiring major rehabilitation or reconstruction. This period is a fundamental factor in the pavement management process. It has a direct role in estimating the amount of design traffic for the pavement design and sets the expectations for the constructed pavement's performance.

It is important to emphasise that, although a pavement is intended to provide satisfactory service throughout the specified design period, this is contingent upon the actual cumulative traffic not surpassing the estimated cumulative traffic. Therefore, the anticipated duration of satisfactory service is controlled by the adopted design traffic value rather than the design period value (Austroads 2017).

The typical pavement design period adopted for the new granular pavement with sprayed seals or asphalt surfacing is 20–25 years (Lyons et al. 2020). But it may be as long as 40 years.

Selection of the pavement configuration is on the basis that the pavement will provide adequate service (i.e. no need for major rehabilitation) for the cumulative traffic expected over the design period. This expected cumulative traffic to load the pavement during the design period is known as design traffic.

Design traffic is defined as the cumulative traffic in ESAs over the design period. An overview of the procedure for determining the design traffic is provided in Appendix A (Section A.2).

2.2 Subgrade

The subgrade is typically the in situ material which has been prepared to make a formation above the natural surface. The formation is subsequently shaped and compacted before the placement of the overlying layers. The subgrade may also include selected subgrade materials or lime stabilised subgrade which are placed above the in situ subgrade material.

The subgrade support is generally considered a primary factor in determining the required pavement design thickness, composition and performance. The level of support, as characterised by the subgrade strength or modulus, is dependent on the soil type, density and moisture conditions at construction and during service (Austroads 2017).

Note that subgrades are naturally variable due to differences in topography, soil type and drainage conditions along an existing or proposed road alignment. Therefore, choosing subgrade design values requires thorough consideration of the degree of variability within specific project sections and careful evaluation of the quantity and quality of data on subgrade properties.

One of the main goals of subgrade evaluation is to determine a subgrade California Bearing Ratio (CBR) value for design purposes. This value represents the CBR at the density and moisture conditions anticipated to exist in-service over the long term.

Appendix A (Section A.3) provides a summary of methods for determining subgrade design CBR value.

2.3 Pavement Materials

The choice of the pavement profile that the practitioner considers depends largely on the availability of materials. Once an appropriate pavement profile is selected from the design tables in Section 3, the practitioner must ensure that the correct materials are sourced to meet the required properties for basecourse and subbase specifications.

Pavement materials must be carefully selected to comply with the relevant minimum standard specifications at the time of construction. Ensuring that these material properties are satisfied during construction is essential to ensure that the chosen design profile will perform as forecast.

The relevant specifications are as follows:

- WALGA specification, Granular Pavement Materials (WALGA 2022a)
- WALGA specification, Sprayed Bituminous Surfacing (WALGA 2022b)
- IPWEA/AfPA Technical Specification for Supply and Laying of Asphalt Surfacing (IPWEA/AfPA 2023)
- IPWEA/WALGA Specification for the Supply of Recycled Road Base (IPWEA/WALGA 2016)
- Other recognised material specifications.

3 Pavement Design Catalogue

This section provides a catalogue of pavement profiles for granular basecourse with sprayed seal surfacing, granular basecourse with thin asphalt surfacing and asphalt basecourse pavements. It aims to assist LGs in WA in selecting appropriate pavement profiles relevant to the desired application.

The basis of the design catalogue is detailed in Appendix B.

3.1 Design Catalogue for Typical Pavement Configurations

Figure 1 to Figure 3 illustrate the 3 pavement types for which typical design catalogues, in the form of design tables, have been developed for a range of subgrade design CBR and design traffic inputs.

Note for Design Catalogue Application

Additional Considerations

- The minimum thicknesses for unbound granular base layers assume a 100 mm minimum thickness for construction purposes. Allowances for construction tolerances have not been included. Therefore, construction tolerances deemed appropriate for the specific project conditions can be applied.
- Additionally, for construction purposes, a total minimum thickness of 150 mm for combined base and subbase layers are assumed.
- It is worth noting that this guideline primarily focuses on pavement profiles and the determination of pavement layer thicknesses. It assumes that users will select appropriate materials with suitable properties based on relevant specification requirements, as well as local knowledge and experience. References to the material specification documents are provided in Section 2.3.
- For granular basecourse with sprayed seal or thin asphalt surfacing, higher quality materials are required near the pavement surface, with material having a CBR value of 80% or better being required for at least the top 100 mm of the pavement. This aligns with well-established practices.

How to Use Design Tables

- ➢ Select the indicative design traffic volume (ESAs) for the project – Refer to Appendix A.2.
- ➢ Select subgrade CBR – Refer to Appendix A.3.
- ➢ Choose the desired pavement type.
- ➢ Refer to Table 2 or Table 3 or Table 4 depending on the chosen pavement type.
- ➢ Based on the selected subgrade CBR and design traffic volume, determine the general material thickness requirements and the minimum required depth of pavements for their specific application.

Figure 1: Example pavement structures – Granular basecourse with sprayed seal surfacing (see Section 3.1.1)

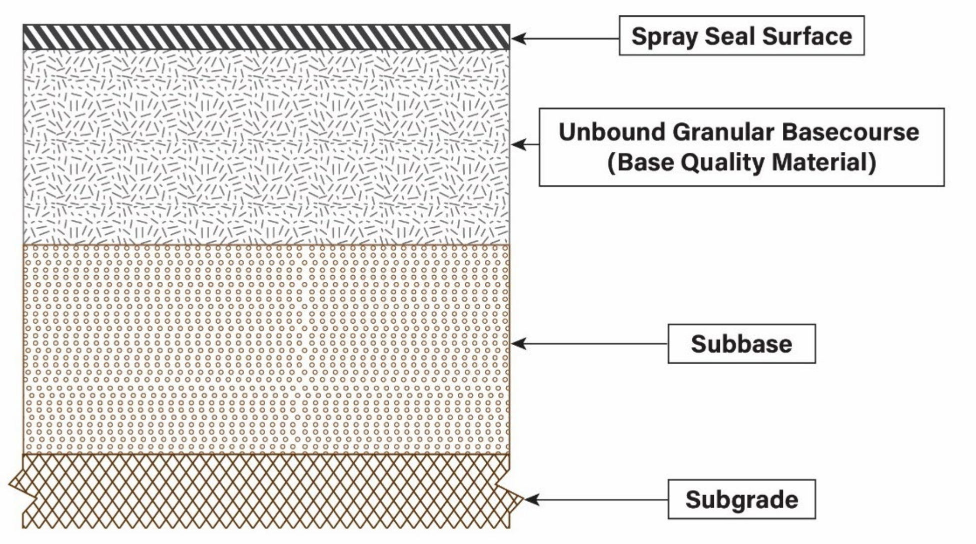


Figure 2: Example pavement structures – granular basecourse with thin asphalt surfacing (see Section 3.1.2)

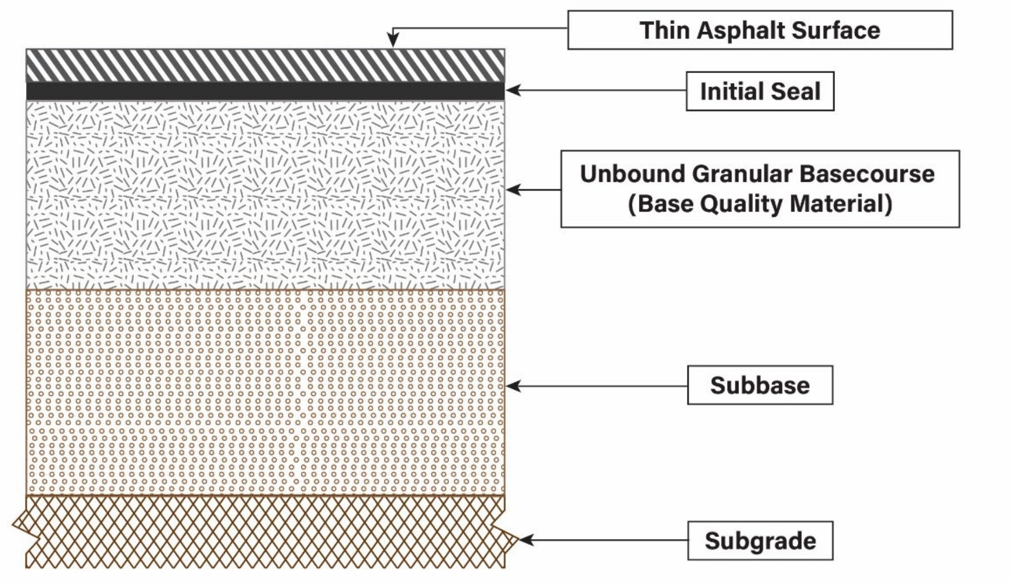
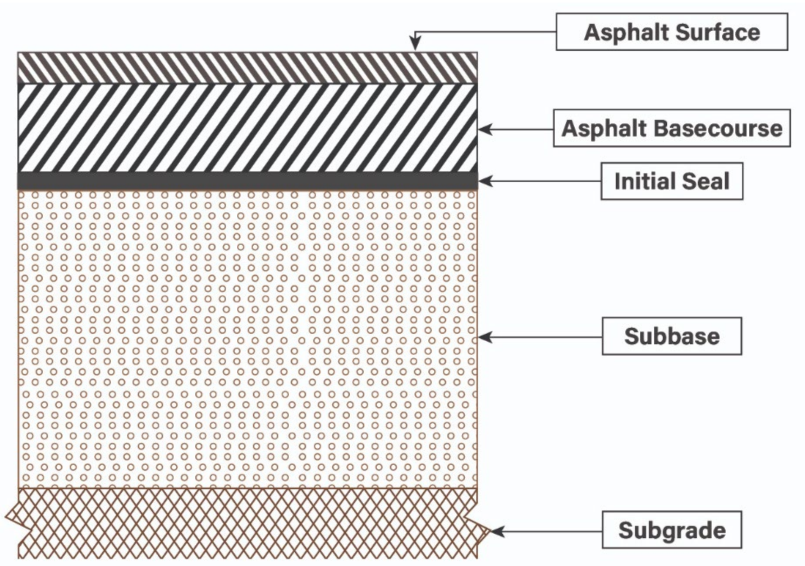


Figure 3: Example pavement structures – asphalt basecourse (see Section 3.1.3)



3.1.1 Design Tables: Granular Basecourse with Sprayed Seal Surfacing

Table 2 shows the catalogue of pavement profiles for granular basecourse pavements with sprayed seal surfacing.

Table 2: Pavement profiles – granular basecourse with sprayed seal surfacing

Design traffic (ESAs)	Subgrade design CBR (%)	Total pavement thickness (mm)[4]	Pavement composition		
			Subbase thickness (mm)[3]	Basecourse thickness (mm)	Sprayed seal surface[1]
1×10^4	5	250	150	100	Single/Single
	8	200	100	100	
	12	150	0	150	
3×10^4	5	270	170	100	Single/Single
	8	210	110	100	
	12	160	0	160	
1×10^5	5	300	200	100	Single/Single
	8	230	130	100	
	12	200	100	100	
3×10^5	5	340	220	120	Single/Single
	8	260	140	120	
	12	220	100	120	
1×10^6	5	400	260	140	Double/Double
	8	300	160	140	
	12	240	100	140	
3×10^6	5	440	290	150	Double/Double
	8	340	190	150	
	12	260	110	150	
1×10^7[2]	5	500	330	170	Double/Double
	8	380	210	170	
	12	290	120	170	

1. Specific sprayed seal designs should be adapted based on the materials and local conditions for each case.
2. For traffic volume equal to or greater than 1×10^7, a more considered pavement design reflecting the local materials, traffic and conditions is appropriate.
3. Thicknesses assume a minimum constructable layer thickness of 100 mm.
4. Total pavement thickness is the sum of subbase and basecourse thicknesses.

3.1.2 Design Tables: Granular Basecourse with Thin Asphalt Surfacing

The catalogue of pavement profiles for granular basecourse pavements with thin asphalt surfacing is shown in Table 3.

Table 3: Pavement profiles – granular basecourse with thin asphalt surfacing

Design traffic (ESAs)	Subgrade design CBR (%)	Total pavement thickness (mm)[4]	Pavement composition			
			Subbase thickness (mm)	Basecourse thickness (mm)	Initial seal	Asphalt surface thickness (mm) & type[1,2]
1 x 10^4	5	250	120	100	Single coat emulsion, 5–7 mm aggregate or equivalent	30 mm DG10
	8	230	100	100	Single coat emulsion, 5–7 mm aggregate or equivalent	30 mm DG10
	12	180	0	150	Single coat emulsion, 5–7 mm aggregate or equivalent	30 mm DG10
3 x 10^4	5	270	140	100	Single coat emulsion, 5–7 mm aggregate or equivalent	30 mm DG10
	8	230	100	100	Single coat emulsion, 5–7 mm aggregate or equivalent	30 mm DG10
	12	180	0	150	Single coat emulsion, 5–7 mm aggregate or equivalent	30 mm DG10
1 x 10^5	5	300	170	100	Single coat emulsion, 5–7 mm aggregate or equivalent	30 mm DG10
	8	230	100	100	Single coat emulsion, 5–7 mm aggregate or equivalent	30 mm DG10
	12	180	0	150	Single coat emulsion, 5–7 mm aggregate or equivalent	30 mm DG10
3 x 10^5	5	340	190	120	Single coat emulsion, 5–7 mm aggregate or equivalent	30 mm DG10
	8	260	110	120	Single coat emulsion, 5–7 mm aggregate or equivalent	30 mm DG10
	12	250	100	120	Single coat emulsion, 5–7 mm aggregate or equivalent	30 mm DG10
		200	0	170		30 mm DG10
1 x 10^6	5	400	220	140	Single coat emulsion, 5–7 mm aggregate or equivalent	40 mm DG14
	8	300	120	140	Single coat emulsion, 5–7 mm aggregate or equivalent	40 mm DG14
	12	280	100	140	Single coat emulsion, 5–7 mm aggregate or equivalent	40 mm DG14
		240	0	200		40 mm DG14
3 x 10^6	5	440	250	150	Single coat emulsion, 5–7 mm aggregate or equivalent	40 mm DG14
	8	340	150	150	Single coat emulsion, 5–7 mm aggregate or equivalent	40 mm DG14
	12	300	110	150	Single coat emulsion, 5–7 mm aggregate or equivalent	40 mm DG14
		260	0	220		40 mm DG14
1 x 10^7[3]	5	500	290	170	Single coat emulsion, 5–7 mm aggregate or equivalent	40 mm DG14
	8	380	170	170	Single coat emulsion, 5–7 mm aggregate or equivalent	40 mm DG14
	12	330	120	170	Single coat emulsion, 5–7 mm aggregate or equivalent	40 mm DG14
		290	0	250		40 mm DG14

1. Stone mastic asphalt (SMA) mix can also be considered.
2. DG: Dense graded asphalt.
3. For traffic volume equal to or greater than 1 x 10^7, a more considered pavement design reflecting the local materials, traffic and conditions is appropriate.
4. Total pavement thickness is the sum of subbase, basecourse and thin asphalt surface thicknesses.

3.1.3 Design Tables: Asphalt Basecourse

Table 4 shows the catalogue of pavement profiles for asphalt basecourse pavement.

Table 4: Pavement profiles – asphalt basecourse

Design traffic (ESAs)(2)	Subgrade design CBR (%)	Total pavement thickness (mm)	Pavement composition			
			Subbase thickness (mm)	Initial seal	Asphalt basecourse thickness (mm) & type	Asphalt surface thickness (mm) & type
≤ 1×10^6	< 8	Undertake specific design				
	8	270	200	Single coat emulsion, 5–7 mm aggregate or equivalent	40 mm DG10 or DG14 basecourse	30 mm DG10(1)
		250		Single coat emulsion, 5–7 mm aggregate or equivalent	50 mm DG10 or DG14(1)	
	12	270	200	Single coat emulsion, 5–7 mm aggregate or equivalent	40 mm DG10 or DG14 basecourse	30 mm DG10(1)
		250		Single coat emulsion, 5–7 mm aggregate or equivalent	50 mm DG10 or DG14(1)	
> 1×10^6	Undertake specific designs based on subgrade conditions and specific asphalt materials selected					

(1) Designed to 35 Marshall blows for roads with design traffic ≤1×10^5, and 50 Marshall blows for roads with design traffic > 1×10^5 but ≤1×10^6 in accordance with the requirements in IPWEA/AfPA Technical Specification for Supply and Laying of Asphalt Surfacing (IPWEA/AfPA 2023)
(2) For traffic volume equal to 1×10^6, specific pavement design is appropriate, and the numbers in this table should be treated as indicative only.

References

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Western Australia Local Government Association 2022b, *Sprayed bituminous surfacing,* road building model specification, WALGA, Perth, WA.

Appendix A Additional Background Information

A.1 Pavement Design Principles

In designing a new pavement, one of the first tasks is to select the pavement types for detailed design. There are different pavement types that can vary notably based on the function of the road, traffic loading, the environment, the availability of materials and cost.

In rural Australia, unbound granular pavements with sprayed seal surfacing are the predominant pavement type. This type of pavement is extensively used due to its low initial cost, making it a common choice for lightly trafficked roads. Granular pavements can also be used for heavily trafficked applications when high quality materials and construction processes are used.

Unbound granular pavements with thin asphalt surfacings are structurally similar to unbound granular pavements with sprayed seal surfacing, except that the asphalt surfacing may fatigue crack. While the asphalt surface contributes little to the overall strength of the pavement, it provides greater resistance to minor traffic damage and offers a smoother, quieter and more durable surface. These attributes make it particularly suitable for residential streets and other light traffic urban applications where the risk of fatigue cracking is lower. On lightly trafficked roads, it is common for the thin asphalt surfacing to be 25–40 mm thick.

Additionally, thin asphalt surfacing can also be used on light to moderately trafficked rural road pavements where sprayed seals do not provide adequate serviceability and where the risk of fatigue cracking is acceptable. This is particularly relevant at intersections, in areas with turning traffic or where there is a need to improve ride quality.

Unbound granular pavements with thin asphalt surfacing typically have a primed or initial sealed (formerly known as primersealed) surface beneath the asphalt to enhance the bonding of the asphalt layer to the granular material. Applying a sprayed seal (following the application of a prime), or an initial seal before the asphalt layer, also improves the pavement's waterproofing (Austroads 2017). Thin asphalt layers are not waterproof.

The most commonly used asphalt surfacing types include dense graded (DG) asphalt with 7 mm or 10 mm aggregate size for lightly trafficked pavements or lower speed environments, and 10 or 14 mm aggregate for more heavily trafficked applications (Austroads 2017).

Chapter 12 of *Austroads Guide to Pavement Technology Part 2* (2017) provides detailed procedures for undertaking pavement design for lightly trafficked roads.

It is crucial to recognise how the flexible pavement design process accounts for the various types of damage that can occur in flexible pavements. The Austroads *Guide to Pavement Technology Part 2* (2017) outlines 2 flexible pavement design methods:

- An empirical design process applicable to new flexible pavements with a thin bituminous surfacing (such as a sprayed seal or asphalt surfacing less than 40 mm thick) over granular material.
- A mechanistic-empirical design process intended for new flexible pavements that include one or more layers of bound material (such as asphalt, cemented material or lean concrete).

In the design of granular pavements with sprayed seal or thin asphalt surfacing, a single type of damage is considered, such as the overall deterioration of the pavement, reflecting increased roughness and rutting.

However, for pavements with one or more layers of bound material, up to 3 distinct types of damage are addressed, which are fatigue damage to asphalt, rutting and loss of surface shape, and fatigue damage to cemented material or lean-mix concrete (Austroads 2017).

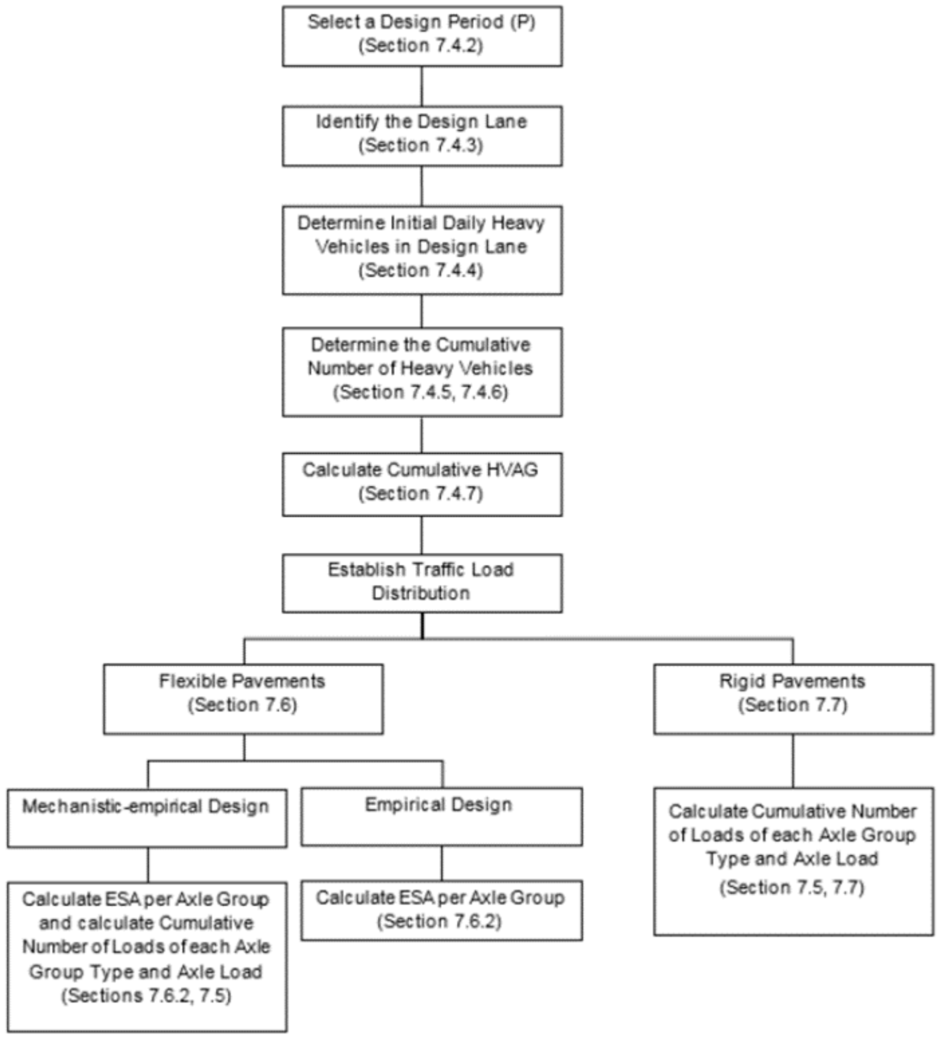
A.2 Determination of Design Traffic

Three methods for calculating design traffic are listed in this appendix. The detailed Austroads method is the most comprehensive. The other 2 methods are based on presumptive data.

A.2.1 Detailed Austroads Method

The procedure for determining the design traffic as outlined in Austroads *Guide to Pavement Technology Part 2* (2017) is summarised in Figure 4.

Figure 4: Procedure to determine design traffic



Source: Austroads (2017), refer to this reference for relevant sections.

Axle numbers, load distribution, loading rate (speed) and tyre pressures can all significantly influence pavement performance. It is essential to consider not only the current traffic but also the estimated changes in volume, axle loads and composition over the design period. Detailed considerations of traffic and requirements for lightly trafficked pavements are presented in Chapter 12 of Austroads *Guide to Pavement Technology Part 2* (2017).

Design traffic loading is commonly expressed in terms of the number of equivalent standard axles (ESAs). Austroads *Guide to Pavement Technology Part 2* (2017) utilises the ESA concept for the empirical design of unbound granular pavements with sprayed seal or thin asphalt surfacing and lightly trafficked pavements. Furthermore, in the mechanistic-empirical design of pavements, design traffic is also considered in ESAs when considering rutting and loss of surface shape.

A standard axle is defined as a single axle with dual tyres applying a load of 80 kN to the pavement. To express design traffic in terms of ESAs, the designer must determine how many repetitions of the standard axle would cause the same pavement damage as the design traffic.

A.2.2 Indicative Design Traffic

For lightly trafficked roads, Table 5 provides indicative values for vehicle traffic volumes, presented on both a daily basis as well as for 20-year and 40-year design periods (Austroads 2017).

The annual growth rate adopted for each street type and given as the cumulative growth factor (CGF) is deemed to be representative. Given the significant variation in both AADT and per cent heavy vehicles for streets of a particular type, designers are encouraged to use all available data and information to estimate these quantities for the specific design situation.

Table 5: Indicative design traffic for lightly trafficked urban streets

Street type	AADT two-way	Heavy vehicles (%)	Initial daily heavy vehicles in design lane (single lane)	Design period (years)	Annual growth rate (%)	Cumulative growth factor[1]	Axle groups per heavy vehicle	Cumulative HVAG over design period	ESA/ HVAG	Indicative design traffic (ESA)
Minor with single lane traffic	30	3	0.9	20	0	20	2.0	13 140	0.2	3×10^3
				40	0	40	2.0	26 280	0.2	5×10^3
Minor with two lane traffic	90	3	1.35	20	0	20	2.0	19 710	0.2	4×10^3
				40	0	40	2.0	39 420	0.2	8×10^3
Local access with no buses	400	4	8	20	1	22.0	2.1	128 480	0.3	4×10^4
				40	1	48.9	2.1	285 576	0.3	9×10^4
Local access with buses	500	6	15	20	1	22.0	2.1	240 900	0.3	8×10^4
				40	1	48.9	2.1	535 455	0.3	1.5×10^5
Local access in industrial area	400	8	16	20	1	22.0	2.3	256 960	0.4	1.5×10^5
				40	1	48.9	2.3	571 152	0.4	3×10^5
Collector with no buses	1200	6	36	20	1.5	23.1	2.2	607 068	0.6	4×10^5
				40	1.5	54.3	2.2	1 427 004	0.6	10^6
Collector with buses	2000	7	70	20	1.5	23.1	2.2	1 180 410	0.6	8×10^5
				40	1.5	54.3	2.2	2 774 730	0.6	2×10^6

Note: Direction factor is 0.5, except for Minor Street with single lane traffic where DF = 1.0. Full indicative Traffic Load Distributions are listed in Appendix O.

Source: Austroads (2017).

A.2.3 WALGA User Guide Charts

Practitioners can also use the methods outlined in the WALGA User Guide (WALGA 2015) to estimate the ESA per year. The guide includes charts developed based on typical WA vehicle combinations and tare weights, offering reasonable estimates of ESA for most typical combinations.

A.3 Determination of Subgrade Design CBR Value

One of the main objectives of subgrade evaluation is to determine a subgrade California Bearing Ratio (CBR) value for design purposes.

There are primarily 2 modes of testing available for estimating subgrade support values: field testing and laboratory testing.

Field testing is typically used when the support values from the in situ subgrade soil conditions are anticipated to be similar to those of the proposed pavement. Laboratory testing is applicable in both this scenario and when subgrade support needs to be determined from first principles. It is important to carefully consider the sample density, moisture content and soaking conditions to accurately simulate the expected in-service pavement support (Austroads 2017).

When designing new pavement structures, subgrade design CBRs are typically determined by laboratory testing of recompacted subgrade material, with testing having been conducted after a number of days of soaking the material.

A.3.1 Field Determination of Subgrade CBR

The following field tests can be used to determine subgrade CBR.

IN SITU CBR TEST

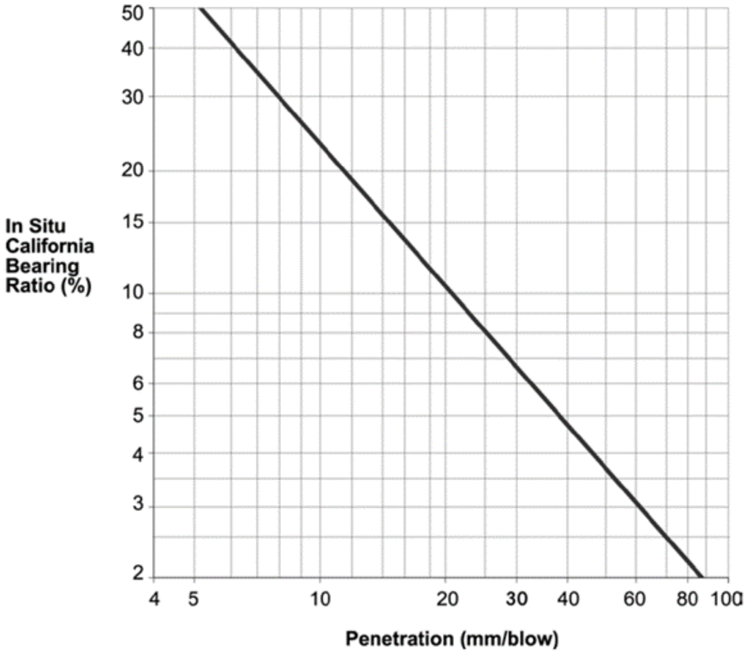
The CBR is a test that estimates the load carrying capacity of a material. For pavement applications, CBR is often carried out to evaluate the strength of subgrade materials and granular basecourse and subbase materials (Rice et al. 2020).

CONE PENETROMETERS

The dynamic cone penetrometer (DCP) test result can be used to determine the CBR of an in situ subgrade. There is a general relationship between DCP and CBR, as shown Figure 5. This is a simplified method, and once used for subgrade assessments, other CBR testing alternatives should be utilised to validate the DCP/CBR relationship adopted.

Austroads *Guide to Pavement Technology Part 2* (2017) indicates that the use of the DCP test should be restricted to fine-grained cohesive subgrades to avoid misleading results as a result of the influence of large particles.

Figure 5: Correlation between dynamic cone penetration and CBR for fine-grained cohesive soils



Source: Austroads (2017).

DEFLECTION TESTING

Back-calculation analysis of surface deflection bowl data can be utilised to estimate the elastic modulus of the subgrade using certain software packages.

However, considering the potential errors and uncertainties associated with the procedures of these back-calculation analyses, this method is often not suitable for determining a design CBR for new pavements or for verifying the constructed subgrade support conditions with a sufficient degree of confidence (Austroads 2017).

Austroads *Guide to Pavement Technology Part 2* (2017) indicates that results from this method should be approached with caution and supplemented with findings from other methods of investigation.

OTHER DEVICES

Other proprietary measuring devices, such as the Clegg Impact Hammer, may provide correlations for estimating in situ CBR. Refer to manufacturer guidance when considering these devices.

A.3.2 Laboratory Determination of Subgrade CBR and Elastic Parameters

Laboratory procedures can be employed to determine the design CBR or modulus when adequate samples of the subgrade material for the new pavement can be obtained for laboratory assessments and a reasonable estimate of the likely in-service subgrade density and moisture conditions can be made.

Subgrade materials are assumed to be elastic and cross-anisotropic, for thickness design using mechanistic-empirical procedures. The vertical modulus of subgrade materials can be estimated from an empirical relationship, which is 10 times the CBR value.

Austroads (2017) notes that this estimation is an approximation of the CBR value, with the modulus found to vary in the range of 5 × CBR to 20 × CBR (Sparks & Potter 1982). Additionally, this equation may overestimate the subgrade modulus for soils with relatively high CBR values.

A.3.3 Adoption of Presumptive CBR Values

Austroads *Guide to Pavement Technology Part* 2 (2017) provides typical presumptive subgrade design CBR values. This method can be used when no other relevant data is available. This approach is specifically useful for lightly trafficked roads where extensive field or laboratory assessments are not warranted and for undertaking preliminary designs across all roads. Local experience should be taken into account to complement these values.

Additional information regarding the description of the test methods for the above-mentioned approaches and additional details about the subgrade investigations can be found in the Austroads *Guide to Pavement Technology Part 2* (2017).

Appendix B Basis of Pavement Design Catalogue

This work collated and reviewed the available and relevant information from LGs in WA, with a specific focus on the pavement profiles for flexible pavements. Therefore, a request was sent out to WA LGs seeking their existing standards or guidelines for typical road pavement profiles or standard cross-sections/drawings.

Responses from 22 LGs were received. The responses were categorised based on their sources, essentially grouping similar pavement profiles together. This categorisation strategy enabled identifying differences as well as similarities across pavement profiles from different LGs. Notably, inconsistencies in the level of detail provided among the sources were observed, with some unavailable information such as subgrade CBR, design traffic or both.

Despite these variations, the pavement profiles were consolidated and grouped, incorporating associated details such as pavement compositions, subgrade conditions (CBR range), traffic characteristics (ESA range) and materials for base, subbase and wearing courses, where available. Two broad groupings of pavement profiles emerged, granular basecourse pavements and asphalt basecourse pavements.

Selection of the 3 typical profiles used in this guideline are based on these groupings and the standards recommended by IPWEA/WALGA (2020), IPWEA (2017) and IPWEA (2006).

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