Fiji Roads Authority

SUPPLEMENT TO THE AUSTROADS GUIDE TO STRUCTURAL DESIGN OF ROAD PAVEMENTS

July, 2018

FRA's Supplement to the Austroads Guide to Structural Design of Road Pavements

Updates Record

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Acknowledgement: FRA gratefully acknowledges the generosity of the Association of Australian and New Zealand Transport and Traffic Authorities(Austroads) in allowing FRA, to use and reference much of the material used in this *Guide.*

Unless specifically identified in the *Guide*, all diagrams and tables have been sourced from the various VicRoads, NZTA and Austroads Design Guides and relevant Australian Standards.

CHAPTER TITLES

1.0 Introduction

1.1 Scope of the Supplement

The purpose of this Supplement is to provide procedures for the design of pavements for the Fiji Roads Authority (FRA).

This Supplement is intended to act as an addition to the AUSTROADS "Guide to the Structural Design of Road Pavements" (2017). There are some differences in design methods between this Supplement and the AUSTROADS Guide which reflect current knowledge and experience of the performance of Fijian road pavements.

Future modifications to the procedures given in this Supplement will be necessary from time to time due to;

- Improved knowledge on pavement performance
- Changes in technology which enable better methods of determining design input parameters, and
- Improved methods of characterising pavement material properties.

The section numbers and figures in this Supplement refer to the section and figure numbers in the AUSTROADS Guide to Pavement Technology Part 2: Pavement Structural Design (2017). Where extra sections or figures are used in this Supplement they are numbered sequentially from the last numbered section/figure in the particular section of the AUSTROADS Guide.

The use of the term " AR Guide" in this document refers to the AUSTROADS Guide, while the term "Supplement" refers to this FRA Supplement.

2.0 Pavement Design Systems

2.2 Common Pavement Types

- Unsealed Road pavements
- Unbound granular with sprayed seal (chip seal) /thin bituminous surfacing (Sealed Pavements)
- Thick asphalt on granular material
- Concrete Pavement with Lean Mix Concrete/crushed rock subbase

2.3 Overview of Pavement Design Systems

2.3.1 Input Variables

Table 2.3.1 Project Reliability Levels

Road Type / Classification#	Project Reliability (%)
M1 – Roads and highways connecting major cities and major provincial centres	95
M2 – Roads are serve the same role as M1 roads but carry less traffic and connect to large town and provincial centres	95
S – Roads provide the primary link between towns and villages and also support tourism areas	90
C – Roads provide access for abutting properties to towns and villages	90
R – Roads connect properties to the network	90

- Road classification as defined in Austroads Design Guide Parts 1 to 8

3.0 Construction and Maintenance Considerations

3.2.3 Use of a Drainage Blanket

Generally, road construction specifications nominate material gradings, source rock durability requirements and possibly permeability requirements. This is to ensure appropriate materials are to be used. However, alternative pavement materials can be considered. Key requirements of the drainage blanket include the need for free draining, durable rock source. The source rock must not be moisture sensitive. The blanket must be effective in the removal of water from the pavement and/or prevention of water entering the pavement.

When placed on material which passes a test roll and unless otherwise specified, a drainage blanket may be considered as forming a lower subbase of the pavement or as a separate structural layer beneath the pavement or embankment.

In the absence of a project specific hydrological assessment, the minimum depth of the drainage blanket shall be 300 mm and outlets must be provided to ensure drainage of the blanket. If sufficient geotechnical/hydrology data is available, the minimum drainage blanket thickness must be reviewed by an appropriately qualified geotechnical engineer. Where required drainage blanket thickness of greater than 300 mm can be designed to ensure adequate drainage is provided. Information must be provided to the FRA to support drainage blanket thicknesses other than 300 mm.

Where drainage blankets are placed on fine-grained subgrades a geotextile must be used as a separation layer between the drainage blanket and the subgrade to limit contamination of the drainage blanket. Refer FRA Roadworks Standards and Specifications Specification Section (SS) – 202 for further detail.

4.0 Environment

4.3 Temperature Environment

The effects of temperature on the performance of asphalt pavements can be assessed by the use of Weighted Mean Annual Pavement Temperature (WMAPT). The WMAPT for Fiji is 38^0 C unless otherwise specified or calculated based on relevant Fiji climate data. Where a WMAPT other than 38^0 C is used, data supporting its calculation shall be provided to the FRA.

5.0 Subgrade Evaluation

5.3 Lime-stabilised Subgrades

Lime stabilisation may be used to improve the strength and/or reduce the plasticity of clay at or below subgrade level.

Where the lime stabilised layer is considered in the determination of pavement thickness, an additional 30 mm construction tolerance must be added to the design thickness of the lime stabilised layer. Hence, the minimum construction layer thickness for a lime stabilised layer is 180 mm (150

mm + 30 mm). The maximum design thickness for lime stabilised materials is 220 mm i.e. 250 mm construction thickness unless otherwise specified.
Design thickness of up to 270 mm can be considered where it can be demonstrated that the full lime stabilised layer depth has been compacted to specification requirements.

Lime stabilised material shall be sub layered in accordance with AR Guide Part 2 – Sections 5 and 8. The modulus values determined for the lime stabilised material sublayers shall be no greater than 10 times the Assigned CBR of the material.

The lime stabilised material can only be considered a structural layer where the design distribution rate of Available Lime to be added to the material to be stabilised and the CBR of the lime stabilised material have been determined in accordance with FRA SS 290.

5.4 Methods for Determining Design CBR

The Design CBR is the CBR value given to an imported earthworks layer in fills or to prepared in situ material in cuts, at or below subgrade level, which is used to determine the structural thickness of a pavement

The subgrade level is the level of the prepared subgrade defined as follows:

- On Fills – subgrade level is the level of the top of Type A material or where no Type A material is to be placed, the top of Type B material.
- In Cuts – subgrade level is the level of the top of Type A material or where no Type A material is to be placed, the cut floor level and the underside of pavement.

The Cut Floor Level is the theoretical level of the formation in a cut after completion of excavation to the underside of any selected material. Where Type A is required, the cut floor level is subgrade level and the underside of pavement.

Type A and B materials (formerly typically referred to as Selected Subgrade and Common Fill, respectively), are as defined in FRA Roadworks Standards and Specifications Earthworks SS 202. For Type A and B materials the Design CBR must not exceed the materials Assigned CBR. Hence the Design CBR for these materials can be determined through laboratory based CBR testing.

The basis of pavement design is typically the Design CBR of the in situ material at or below subgrade level which is the material present after stripping but prior to earthworks commencing.

Several procedures are available for estimating the Design CBR of the in situ material, including laboratory and field based testing and previous experience.

For new pavements with traffic loading greater than 1×10^4 ESA, the Design CBR shall be heavily biased towards laboratory soaked CBR test results for representative samples taken from the in situ material.

Dynamic Cone Penetrometer (DCP) testing may be undertaken to assess the relative CBR of the in situ material however as DCP test results are significantly influenced by the materials moisture content at the time of testing they must not be used as the basis for determining the Design CBR.
DCP testing should be restricted to fine-grained subgrades to avoid obtaining misleading results as a result of the influence of large particles.

In determining the Design CBR of the in situ material, consideration can be given to the effect of improvements to drainage, in service material moisture content changes, fill depth and levels etc. arising from the works.

Pavement designs undertaken for FRA must provide supporting information justifying the selection of the Design CBR. The supporting information includes test results, alignment investigations, references to other supporting documentation, interpretation etc.

For new pavements with traffic loading less than or equal to 1 x 10^4 ESA, Design CBR shall be based (as a minimum) on insitu CBR (using DCP) and presumptive CBR based on localised or general experience. Pavement designs undertaken for FRA must provide supporting information justifying the selection of the Design CBR.

5.6.2 Determination of Moisture Conditions for Laboratory Testing

As the median annual Rainfall of Fiji is greater than 1000 mm, a laboratory soaking period of 4 days for the CBR test shall be used in the determination of Design CBR.

6.0 Pavement Materials

6.2.3 Determination of Modulus of Unbound Granular Materials

The modulus of granular materials, sourced from quarries, which meet the material requirements of FRA Roadworks Standards and Specifications SS 301 Materials for Pavement Construction for Crushed Rock Base and Subbase shall be 350 MPa.
All other naturally occurring marginal or non-standard material placed as “Base” or “Subbase” material may be inferior to the crushed rock with respect to the long-term performance of the pavement. Design modulus values of 300 MPa or less are likely.

6.5 Asphalt

6.5.2 Factors Affecting Modulus of Asphalt

The Weighted Mean Average Pavement Temperature (WMAPT) shall be calculated as per the AR Guide Appendix B of Part 2 unless otherwise specified (refer Section 4.3).

6.5.5 Determination of Design Modulus from Measurement of ITT Modulus

FRA Roadworks Standards and Specifications SS 404 Asphalt provides mix design criteria for Size 10, 14 and 20 mm asphalt mixes. Size 10 and 14 mm mixes are generally used for wearing course whereas Size 20 mm mixes are used for intermediate and base course.

SS 404 allows alternative binder types to be used. The most commonly used bitumen in Fiji is Multigrade (M1000/320). The supply of alternative bitumens is limited. For size 10, 14 and 20 mm mixes Table 6.5.5 provides presumptive modulus values for pavement design purposes based on indirect tensile testing (undertaken in accordance with Australian Standards).

Where alternative binders are proposed, ITT (Indirect Tensile Test) testing in accordance with Austroads Guide for Pavement Technology - Part 2 is to be undertaken to determine pavement design modulus values. Test values must be adjusted for temperature, loading and air voids in accordance with the AR Guide Chapter 6.

Table 6.5.5 Asphalt Design Moduli

Size	Binder	Modulus (MPa) at WMAPT of 38^0C			Fatigue (K) Value		
		10 km/h	40 km/h	60 km/h	10 km/h	40 km/h	60 km/h
10 HG	Multigrade	1000	1100	1200	6140	5820	5610
14 HG	Multigrade	1000	1200	1300	5810	5510	5300
20 SG	Multigrade	1100	1300	1500	5450	5160	4970

7.0 Design Traffic

7.2 Traffic Data

The following methods in descending order of preference can be used in the determination of design traffic:

(i) Weigh in Motion (WIM) data to obtain the following parameters;
- Number of Heavy Vehicles
- Axle Groups / configuration
- Load on individual axle/group

(ii) Traffic Surveys / Classification Counts

(iii) Local data (site specific) supplemented by data from other sources

(iv) Presumptive traffic load distributions based on roads carrying similar distribution of heavy vehicle type and loading

The design traffic may be based on the traffic predictions in the case of new road alignments and/or on actual traffic and/or a vehicle classification count at or near the site.

Detail of any traffic related surveys and/or modelling justifying the determination of traffic loading is to be included in an appendix to the pavement design report.

If Weigh in Motion/traffic survey data is not available or specified, data as provided in Appendix B of this supplement for the appropriate road class shall be used.

7.4.2 Selection of Design Period

Where the Design Traffic has not been specified or stated, Table 7.4.2 shall be used to define the pavement design period for determination of the Design Traffic for new pavements.

Table 7.4.2 Pavement Design Period

Road Type / Classification	Design Period (Years)
M1 – Roads and highways connecting major cities and major provincial centres	30
M2 – Roads are serve the same role as M1 roads but carry less traffic and connect to large town and provincial centres	30
S – Roads provide the primary link between towns and villages and also support tourism areas	25
C – Roads provide access for abutting properties to towns and villages	20
R – Roads connect properties to the network	20

8.0 Design of Flexible Pavements

8.3 Determination of Base and Subbase Thickness

If accurate/reliable traffic data is not available for any road type, the calculated Design Traffic Loading (DTL) shall be increased by 50% to account for overloaded vehicles. However, the 50% increase shall not be applicable if the FRA confirms that overloaded vehicles are not a concern for the anticipated design period for the specific project site.

8.3.1 Unbound Granular Pavements with Sprayed Seal Surfacing/Asphalt Wearing Course

Design of unbound granular pavements with sprayed seal surfacing shall be in accordance with Appendix A of this Supplement. Guidance on using the empirical design chart is given in Section 8.3 Chapter 8 of the AR Guide Part 2. Appendix M of the AR Guide provides worked examples.

Design of unbound granular pavements with total asphalt thickness ≥ 50 mm shall be in accordance with the mechanistic approach specified in AR Guide Part 2.

8.3.1.1 DESA < 5.0 x 10^5 ESA

For sealed pavements, a minimum layer of 150 mm of crushed rock base shall be provided. Beneath this base layer, the lower strength requirements for subbase layers permit the use of alternative materials e.g. natural gravel.

Use of alternative natural gravel for base material should be subject to approval by the FRA and compliance with the requirements specified in FRA SS 301.

8.3.1.2 DESA ≥ 5.0 x 10^5 ESA

A minimum base thickness of 200 mm of crushed rock base is required. Subbase thickness shall be determined using Appendix A. The subbase shall consist of Crushed Rock Subbase as defined in FRA SS 301.The subbase shall be placed on select fill or subgrade material with a minimum Assigned CBR ≥ 8%.

Granular pavement layer design thickness shall be round up to the nearest 10 mm.

8.3.1.3 CBR of Alternative Natural Pavement Materials

Where it is proposed to use a naturally occurring gravel as pavement material in accordance with FRA SS 301, the proposal shall provide justification (data and/or lab results) to show that the CBR meets the specified requirements and the material has a proven history of satisfactory performance.

8.3.1.4 Sprayed Seal Surfacing – Selection and Design

If the type of surfacing is not specified, Austroads Guide to Pavement Technology Part 3: Pavement Surfacings shall be used to select a suitable road surfacing to meet the specification and project requirements.

Unless otherwise specified, sprayed seal treatments shall be designed in accordance with AR Guide – Part 4K Selection and Design of Sprayed Seals OR Chipsealing in New Zealand' - Chapter 9: Chipseal Design

8.3.1.5 Asphalt Wearing Course

An asphalt surfacing less than 50 mm thick over an unbound flexible pavement shall not be considered as providing any structural contribution to the pavement in terms of total thickness of the pavement material.

Asphalt thicknesses shall be rounded up to the nearest 5 mm.

A single coat size10 mm chipseal or primerseal (without cutters) shall be placed over the prepared crushed rock base layer prior to placing asphalt for total asphalt thicknesses of less than 60 mm.

8.3.3 Pavement Composition

The selection of materials depends on their cost, quality, availability and ease of compaction. As the traffic loading increases, the qualities and thickness of the base and subbase materials need to increase to inhibit rutting of these pavement materials.

Refer Appendix A for the design of granular pavements with sprayed seal surfacing using empirical procedures. Pavements with total asphalt thickness of 50 mm or greater shall be designed using the mechanistic procedure as specified in AR Guide – Part 2.

9.0 Design of Rigid Pavements

Rigid (concrete) pavement design is to be undertaken in accordance with the AR Guide.
The design of joint type and locations shall be undertaken to meet requirements of the following:

i. Roads and Maritime Services (RMS) – New South Wales (NSW) – Rigid Pavement Standard Details – Construction
   - Plain Concrete Pavement MD.R83.CP
   - Jointed Concrete Pavement MD. R83CJ
   - Continuously Reinforced Concrete Pavement MD.R83.CC

ii. RTA NSW* - Concrete Roundabout Pavements – A Guide to their Design and Construction (2004)

* Roads and Traffic Authority (RTA) NSW renamed Road and Maritime Services (RMS) NSW

The Standard Drawings for Rigid Pavement – Construction and Maintenance can be down loaded from RMS – NSW web site.

http://www.rms.nsw.gov.au/business-industry/partners-suppliers/document-types/standard-drawings/pavement.html

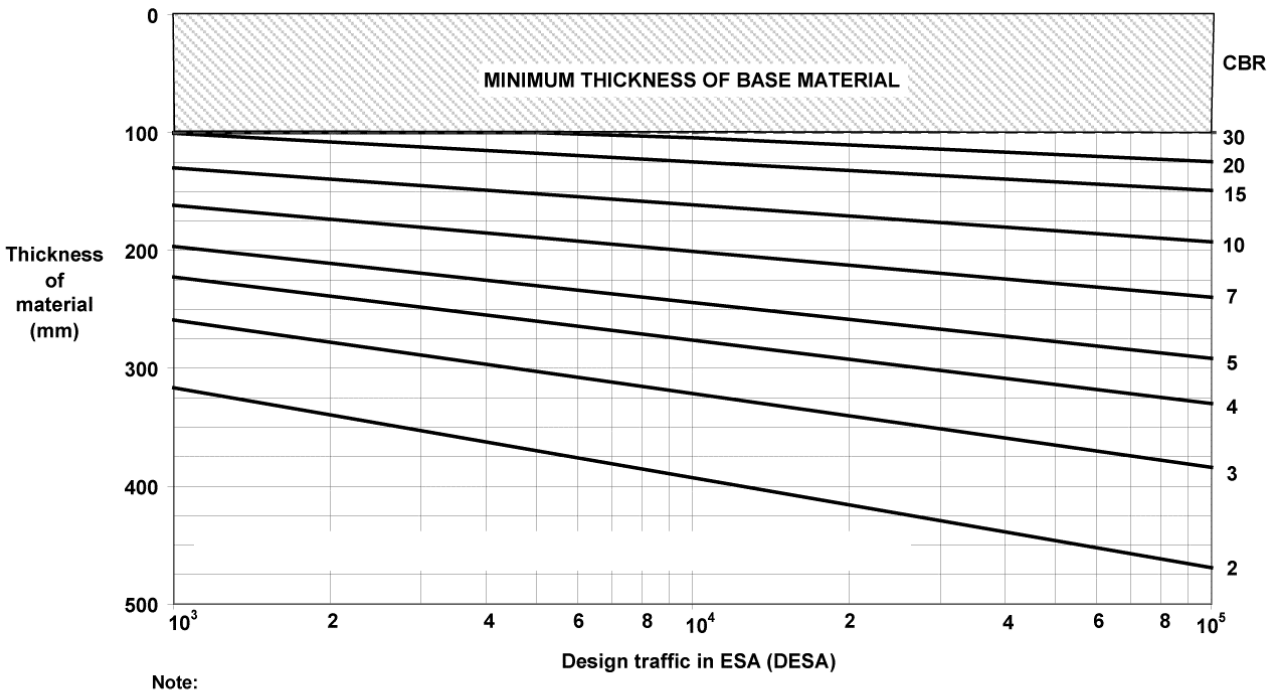
12.0 Design of Lightly – Trafficked Pavements

12.5 Subgrade evaluation

Refer to Section 5.4 Chapter 5 of the AR Guide Part 2 for determining subgrade Design CBR value.

8.2 Design of Granular Pavements with Thin Bituminous Surfacing

AR Guide Chapter 12 - Figure 12.8 is applicable where a minimum 100 mm thickness of base quality (CBR ≥ 30%) material is provided. However lower quality material may provide a fit-for-purpose alternative in some situations, subject to specific FRA approval.



Note:
1. Appropriate local conditions, environmental and drainage issues must be considered in using these design curves.
2. Thin asphalt surfacings may be included in total granular thickness. However, the minimum thickness of the granular base is 100 mm.

Refer Appendix A of this Supplement for the design of granular pavements with thin bituminous surfacing using empirical procedures.

13.3 Selection of Pavement Material

13.3.1 CBR values for Pavement Materials

The CBR values shall be determined from Table 13.3.1 unless otherwise specified or stated.

Table 13.3.1 – Suggested CBR value for Pavement Materials for Unsealed Roads

Pavement Layer	Typical CBR (4 day soaked)
Base	Min 50

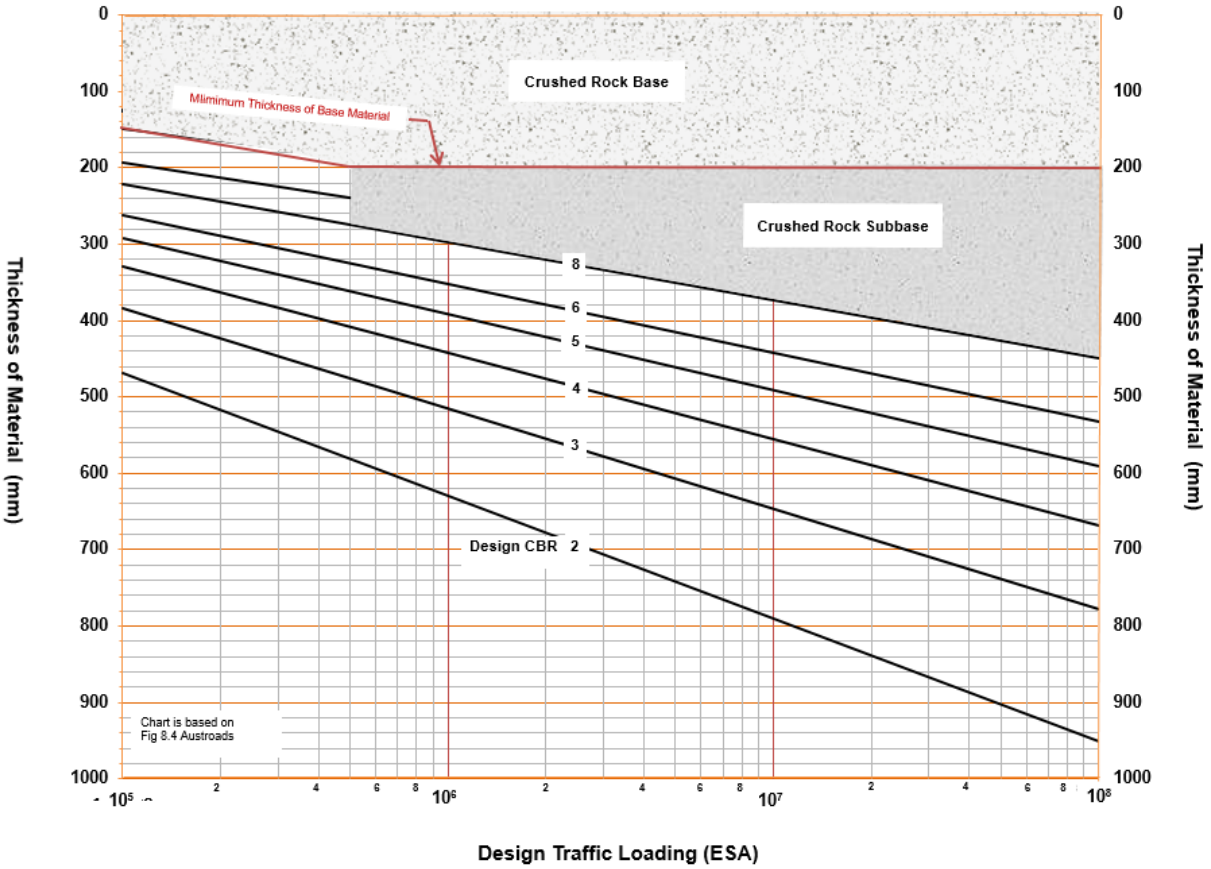
14.0 Pavement Structural Overlays

The design of pavement structural overlays for pavement rehabilitation shall be undertaken as specified in the Austroads Guide to Pavement Technology – Part 5 Pavement Evaluation and Treatment Design.

14.1 Foamed Bitumen Stabilisation

The "*Austroads Guide to Pavement Technology Part 5 – Pavement Evaluation and Treatment Design*" shall be used for the design of structural overlay designs and foamed bitumen stabilisations (FBS) treatments.
FBS is undertaken in accordance with FRA Roadworks Standards and Specifications In Situ Stabilisation Of Pavements With Foamed Bitumen Binder SS 305.

Appendix A - FRA Design Chart for Unbound Flexible Pavements



Refer to Section 8.3 Chapter 8 of the AR Guide Part 2 for layering requirements.

Appendix B - Traffic Characteristics Information

Appendix B shall be used where site specific design traffic parameters have not been specified or stated.

Table B1 - Number of Axle Groups per Heavy Vehicle by Road Class	
Road Class	**Axle Groups per Heavy Vehicles**
M1 – Roads and highways connecting major cities and major provincial centres	3.2
M2 – Roads are serve the same role as M1 roads but carry less traffic and connect to large town and provincial centres	2.8
S – Roads provide the primary link between towns and villages and support tourism areas	2.5

Table B2 - Average ESA per Heavy Vehicle Axle Group	
Road Class	**Average ESA per Heavy Vehicle Axle Group**
M1 – Roads and highways connecting major cities and major provincial centres	1.06
M2 – Roads are serve the same role as M1 roads but carry less traffic and connect to large town and provincial centres	0.85
S – Roads provide the primary link between towns and villages and support tourism areas	0.84

Table B3 - Average Number of ESA per Heavy Vehicle	
Road Class	**Average ESA per Heavy Vehicle**
M1 – Roads and highways connecting major cities and major provincial centres	3.4
M2 – Roads are serve the same role as M1 roads but carry less traffic and connect to large town and provincial centres	2.4
S – Roads provide the primary link between towns and villages and support tourism areas	2.1

Appendix C - Technical Basis for Supplement

TECHNICAL BASIS

for Supplement to the AUSTROADS Guide to Structural Design of Road Pavements

C1 Introduction

This technical basis provides a record of the main inputs that were considered in the development of key sections of the Fiji Roads Authority (FRA) Supplement to the Austroads Guide to the Structural Design of Road Pavements. It is not intended to provide a comprehensive overview of the development of the Supplement.

The development of the Supplement involved consideration of n the following key references:

- Austroads Guide to Pavement Technology – Parts 2 Pavement Structural Design
- Austroads Guide to Pavement Technology – Parts 5 Pavement Evaluation and Treatment Design
- VicRoads Code of Practice RC 500.22 – Selection and Design of Pavements and Surfacings
- Overseas Road Note 31(fourth edition) - A Guide to the Structural Design of Bitumen Surfaced Roads in Tropical and Sub-Tropical Countries

During the development of the Supplement feedback provided by the FRA and representatives of the Fiji roads industry was also considered.

C2 Pavement Design Systems

C2.3 Overview of Pavement Design Systems

C2.3.1 Input Variables

Table 2.3.1 Project Reliability Levels

Road Type / Classification	Project Reliability (%)
M1 – Roads and highways connecting major cities and major provincial centres	95
M2 – Roads are serve the same role as M1 roads but carry less traffic and connect to large town and provincial centres	95
S – Roads provide the primary link between towns and villages and also support tourism areas	90
C – Roads provide access for abutting properties to towns and villages	90
R – Roads connect properties to the network	90

The desired project reliability is the chance that the pavement being considered will outlast its design traffic, assuming that:

• the pavement is constructed in accordance with FRA specification standards
• the pavement is maintained appropriately
• the materials used meet FRA specification standard requirements

The values provided in the Table 2.3.1 are based on Austroads context and further detailed monitoring and/or historical data would assist in developing criteria specifically applicable to Fiji.

C3 Construction and Maintenance Considerations

C3.2.3 Use of a Drainage Blanket

Due to the intense rainfall and shallow ground water table expected in Fiji, a minimum drainage blanket thickness of 300 mm (in the absence of a proper hydrological assessment) was specified.

The proposed minimum thickness of 300 mm is based on local judgement. Ideally a detailed hydrological assessment for the project will provide a site specific drainage blanket thickness**.**

C4 Environment

C4.3 Temperature Environment

The effects of temperature on the performance of Asphalt pavements can be assessed by the use of Weighted Mean Annual Pavement Temperature (WMAPT). The WMAPT of 38^0 C for Fiji was calculated based on limited Fiji climate temperature data. More accurate detail would permit a site specific WMAPT to be determined.

The WMAPT is calculated as per the procedure presented in Appendix B of the Austroads Guide to Pavement technology – Part 2.

Air Temperatures used for the calculation were sourced from the "Fiji Climate Summary – March 2018" published in Fiji Meteorological Services official website.

C5 Subgrade Evaluation

C5.4 Methods for Determining Design CBR

The proposed limit of 1×10^4 ESA was adopted based on local judgment. Where more accurate data is available on anticipated heavy vehicle traffic volumes, the given value could be revised.

C5.6.2 Determination of Moisture Conditions for Laboratory Testing

A small-scale research undertaken in 2014 by VicRoads on high plasticity basaltic clay, indicated the laboratory soaked CBR results achieved are similar regardless for soaking times of 4 days and 10 days. The outcomes of this study were further supported by a 1980s VicRoads investigation which concluded that the results achieved from both these soaking period (4 day and 10 day) are very similar.

However, whilst the Fiji rainfall is high/intensive and with a shallow water table, the insitu subgrade may be at higher moisture contents for prolonged periods and therefore the use of 7 day soaking periods for the determination of CBR could be considered. However, as the FRA Roadworks Standards and Specifications require the determination CBR of materials based on a 4 day soak period, it was decided to maintain this period for site assessments. Nevertheless, designers may

request longer soaking periods for material assessment and use test results in determining a Design CBR.

C6 Pavement Materials

C6.2.3 Determination of Modulus of Unbound Granular Materials

The modulus of granular materials, sourced from quarries, which meet the material requirements of FRA Roadworks Standards and Specifications SS 301 for Crushed Rock Base and Crushed Rock Base Subbase shall be 350 MPa. The value is based on typical vertical moduli provided in Table 6.3 in chapter 6 of AR Guide Part 2

All other naturally occurring marginal or non-standard material placed as “Base” or “Subbase” material may be inferior to the SS 301 Crushed Rock Base and Crushed Rock Base Subbase with respect to material attributes and hence long-term material performance. Lower modulus values are likely and in the absence of test data a design modulus values of 300 MPa was assumed.

C6.5 Asphalt

Table 6.5.5 Design Moduli

Asphalt Mix	Binder	Modulus (MPa) at WMAPT of 38^0C			Fatigue (K) Value		
		10 km/h	40 km/h	60 km/h	10 km/h	40 km/h	60 km/h
10 HG	Multigrade	1000	1100	1200	6140	5820	5610
14 HG	Multigrade	1000	1200	1300	5810	5510	5300
20 SG	Multigrade	1100	1300	1500	5450	5160	4970

The asphalt moduli for different asphalt mixes are calculated based on the respective WMAPT. The asphalt moduli provided are based on VicRoads data available for Multigrade mixes for a WMAPT of 25^0C and were adjusted to the WMAPT of Fiji.

Based on advice provided by representatives of the Fiji roads industry including consultants noting the past performance of Fiji road surfacings, Multigrade bitumen is considered the preferred bitumen type. Hence Multigrade bitumen was assumed as the default bitumen for asphalt and asphalt modulus values derive accordingly. Design modulus may be developed based on actual testing of Fiji asphalt mixes and a more extensive list of design moduli values may be needed if various bitumen types are used.

C7 Design Traffic

C7.2 Traffic Data

As no detailed axle load and group distribution data was available for the various FRA road classes, presumptive data provided were taken from VicRoads Code of Practice RC 500.22 – Selection and Design of Pavements and Surfacings

C7.4.2 Selection of Design Period

The Table 7.4.2 shall be used to define the pavement design period for determination of the Design Traffic for new pavements.

Table 7.4.2 Pavement Design Periods

Road Type / Classification	Design Period (Years)
M1 – Roads and highways connecting major cities and major provincial centres	30
M2 – Roads are serve the same role as M1 roads but carry less traffic and connect to large town and provincial centres	30
S – Roads provide the primary link between towns and villages and also support tourism areas	25
C – Roads provide access for abutting properties to towns and villages	20
R – Roads connect properties to the network	20

The suggested values are mainly based on Austroads Guide and if required the FRA may alter the proposed values based on the road function.

C8 Design of Flexible Pavements

C8.3 Determination of Basic and Subbase Thickness

C Appendix A FRA – Design Chart for Unbound Flexible Pavements

The development of the empirical design chart was based on the following;

1. Figure 8.4 – Design Chart for Granular Pavements with Thin Bituminous Pavements in Chapter 8 of AR Guide Part 2
2. Appendix A – Design Chart for Unbound Flexible Pavements in VicRoads Code of Practice RC 500.22
3. Chart 1 – Granular Road base / Surface Dressing in Overseas Road Note 31 (fourth edition)
4. Feedback from the industry

The empirical design chart which has been developed by VicRoads based on decades of experience and judgement allows the designer to select the pavement material type and depth depending on the anticipated traffic loading and subgrade strength determined from laboratory soaked CBR values. The pavement depths proposed in chart 1 of the Overseas Road Note 31 - Fourth Edition (RN31) are marginally higher than VicRoads design chart. However, the depths given in RN 31 are based on field tested CBR values. Further, the traffic loading in RN 31 range between 3×10^5 and 3×10^7 ESAs, whilst the VicRoads design chart varies between 1×10^5 and 1×10^8 ESAs.

A 50% increase is suggested to the calculated Design Traffic Loading (DTL) as an allowance for over loaded vehicles. This increase would result an overall increase in pavement crushed rock depth by about 20 – 25 mm.

The suggested increase of 50% can be revised if accurate traffic data is available.