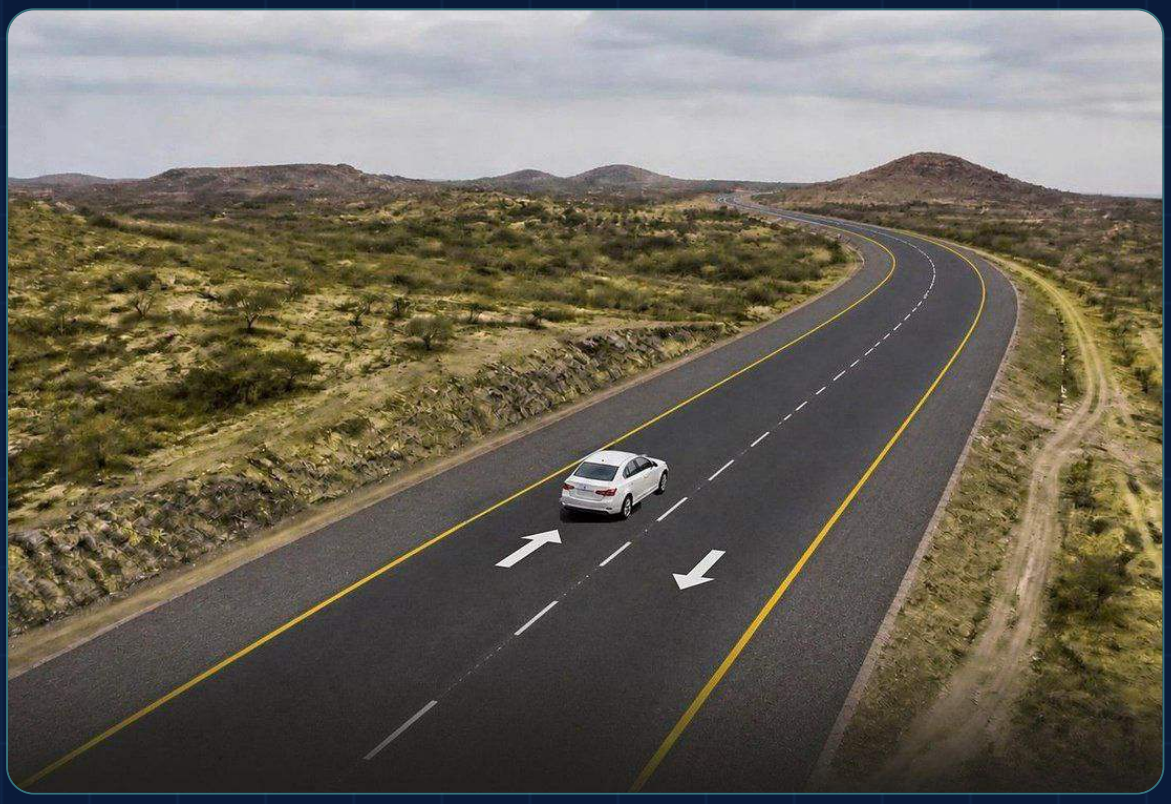
ENGINEERING REPORT

Flexible Pavement Design Report

Based on Road Note 31 (5th Edition): A Guide to the Structural Design of Surfaced Roads in Tropical and Sub-Tropical Regions



Sample Project

PREPARED & SUBMITTED BY

SP Consultant

shahidpervaiz.net

ISSUE

November 2026

Sample report: illustrative data, not for design use

DOCUMENTS CONTROL SHEET

Report Name	Flexible Pavement Design Report
Project Name	Sample Project
Project Number	
Report for	
Prepared by	SP Consultant
Design standard	Road Note 31 (5th Edition): A Guide to the Structural Design of Surfaced Roads in Tropical and Sub-Tropical Regions
Report date	5 November 2026

Originators Record

Date / Prepared by / Reviewed by / Approved for Issue by — to be completed per your organization's document control procedure.

Distribution

Organization / Contact / Hard copies / Soft copies — to be completed before issue.

TABLE OF CONTENTS

Executive Summary 1

1. Introduction 2

1.1 General 2

1.2 Design Philosophy 2

2. Design Traffic 5

2.1 Traffic Data 5

2.2 Direction and Lane Distribution 5

2.3 Design Traffic 5

2.4 Axle Loads and Their Effect on the Pavement 5

3. Pavement Design Parameters 7

3.1 Design Period 7

3.2 Subgrade Design CBR and Class 7

3.3 Foundation Class and Capping 7

3.4 Road Type and Surfacing 7

4. Pavement Thickness from the Catalogue 8

4.1 Catalogue Options 8

4.2 Recommended Pavement 8

4.3 Construction Layers and Aggregate Size 8

Annexure – A (Key Plan and Location Map) 9

Annexure – B (Design Calculations by Road Note 31 (5th Edition)) 10

Annexure – C (Typical Cross Sections) 19

Annexure – D (Soil Investigation Results of CBR) 22

Annexure – E (Applicable Road Note 31 Design Charts) 23

Sample report: illustrative data, not for design use

EXECUTIVE SUMMARY

The proposed Sample Project (Road 1) will form an important regional transport link within and around the project area. The road traverses predominantly rural and sparsely developed areas, providing connectivity between local communities and supporting the movement of people, goods and commercial traffic. The project corridor forms part of the wider regional road network that connects inland areas with the national highway system and with important trade and economic centres.

The pavement has been designed in accordance with Road Note 31 (5th Edition): A Guide to the Structural Design of Surfaced Roads in Tropical and Sub-Tropical Regions. The design of the pavement structure includes selecting materials of adequate strength and placing them at the proper thickness, so that the pavement carries the anticipated traffic loading over its design period without structural distress.

Design basis. Road Note 31 is a catalogue method: it gives pavement structures of proven performance for roads in tropical and sub-tropical regions, so that the layer thicknesses are read from the design charts rather than calculated. The design traffic is expressed in million equivalent standard axles (MESA), using the damage exponent of each pavement type (Table 2-3); the design CBR gives the subgrade class S1 to S6 (Table 3-9) and, with any capping, the foundation class F1 to F4 (Keys 2 and 3); the structures are read from the catalogue charts (Chapter 9) at the traffic and foundation class. Every option that suits the traffic and subgrade is compared on cost and life-cycle cost (Chapter 12).

For the design traffic of 33.78 MESA (n = 3), 42.50 MESA (n = 4), 48.14 MESA (n = 4.5) and a subgrade design CBR of 20% (class S5), the Road Note 31 catalogue offers the following pavement options:

- **Option 1 — Chart C1** (traffic class T9, 42.50 MESA; No capping (S5 = F3)): AC 50 / DBM 125 / GB1 225 / GS2 150 — 550 mm total.
- **Option 2 — Chart C2** (traffic class T9, 33.78 MESA; No capping (S5 = F3)): AC 75 / GB1 150 / CB1 200 — 425 mm total, ranked first.
- **Option 3 — Chart D** (traffic class T9, 33.78 MESA; No capping (S5 = F3)): AC 40 / DBM 60 / GB1 275 / CB1 200 — 575 mm total.

The preferred option is set out below; part 4 of this report compares the options in detail.

Based on the design traffic and subgrade parameters set out in this report, the following pavement structure (Option 2 — Chart C2) is recommended:

Pavement layer	Thickness (mm)
AC — Asphalt concrete / hot rolled asphalt (AC/HRA)	75
GB1 — Granular base 1 / bitumen stabilised material (GB1/BSM)	150
CB1 — Hydraulically bound material (CB1)	200
Total	**425**

Design traffic 33.78 MESA (traffic class T9, damage exponent n = 3); subgrade design CBR 20% (class S5); foundation No capping (S5 = F3). The structure is read from Chart C2 of the Road Note 31 catalogue (Annexure E).

The key plan and location map are included as Annexure A, the design calculations by Road Note 31 (5th Edition) in Annexure B, typical cross sections in Annexure C, applicable Road Note 31 design charts in Annexure E and the soil investigation results of CBR in Annexure D of this report.

1. INTRODUCTION

1.1 General

The proposed Sample Project (Road 1) will form an important regional transport link within and around the project area. The road traverses predominantly rural and sparsely developed areas, providing connectivity between local communities and supporting the movement of people, goods and commercial traffic. The project corridor forms part of the wider regional road network that connects inland areas with the national highway system and with important trade and economic centres.

The development of the Sample Project is expected to improve regional accessibility, reduce travel times and vehicle operating costs, and enhance the movement of goods and passengers, contributing to the socio-economic development of the surrounding areas. The project also forms part of the wider improvement of road infrastructure, supporting connectivity with major routes and access to markets, services and other economic centres.

The proposed road generally follows the existing transport corridor, with improvements and realignments introduced where required to meet the applicable highway standards, improve road geometry, enhance safety and provide an appropriate level of service for the anticipated traffic. The road is expected to carry a significant share of heavy commercial vehicles, many of them loaded close to or above the legal axle load limits, so the axle loads of the heavy vehicles govern the pavement design.

The pavement design has been developed in accordance with Road Note 31 (5th Edition): A Guide to the Structural Design of Surfaced Roads in Tropical and Sub-Tropical Regions, considering the projected traffic and its axle loads, the strength and moisture condition of the subgrade, the locally available construction materials, the climate and drainage of the project area, and the construction and maintenance capability expected for the project. The objective is a pavement that carries the design traffic over its design period with an acceptable level of serviceability, at the lowest whole-of-life cost.

The key plan and location map of the project road are provided as Annexure A.

1.2 Design Philosophy

The pavement has been designed with the catalogue of Road Note 31 (5th Edition). Road Note 31 is a catalogue method: it gives pavement structures of proven performance for roads in tropical and sub-tropical regions, so that no structural calculation of the layers is needed once the design traffic, the subgrade strength and the materials are known.

• **Design traffic** is the cumulative number of equivalent standard axles (80 kN) in the design lane over the design period, in millions (MESA), from the traffic count, the axle loads, the growth and the lane distribution (Chapter 2). The damage of an axle depends on the pavement type, so the relative damage exponent n of each chart is used (Table 2-3): the same traffic can fall in different traffic classes on different charts.

• **Subgrade strength** is the design CBR of each uniform section in its wettest likely condition, normally soaked (Chapter 3). The design CBR gives the subgrade class S1 to S6 (Table 3-9), and the subgrade with any capping gives the foundation class F1 to F4 (Keys 2 and 3).

• **Pavement structure** is read from the catalogue charts (Chapter 9) at the traffic class and foundation class. Each chart is one pavement type — granular, cemented or bituminous roadbase with a surface treatment or asphalt surfacing — so several options are available for the same traffic and subgrade; they are compared on cost and life-cycle cost (Chapter 12).

The catalogue thicknesses assume materials that meet the Road Note 31 specifications, adequate drainage and good construction quality. Layers may be replaced by other materials with the structural layer coefficients (Section 8.6). The chart philosophy is summarised below.

Chart	Traffic	Surfacing	Roadbase	Sub-base	Damage exponent n
Chart A1	0.3 to 10 MESA	DBST (or 40 mm AC/HRA)	Granular base / crushed rock / macadam / BSM / ETSB (min. 1.5% cement)	Granular material or hydraulically-modified material	4
Chart A2	0.3 to 17 MESA	DBST (or 40 mm AC/HRA)	Granular base / crushed rock / BSM / ETSB (min. 1.5% cement)	Hydraulically-bound material	3
Chart A3	0.3 to 17 MESA	DBST (or 40 mm AC/HRA)	Hydraulically-bound material	Granular material or hydraulically-modified material	4.5
Chart B	0.7 to 10 MESA	Asphalt	Granular base / crushed rock / macadam / BSM / ETSB (min. 1.5% cement)	Granular material or hydraulically-modified material	4
Chart C1	6 to 50 MESA	Asphalt	Crushed rock / macadam / BSM / ETSB (min. 1.5% cement)	Granular material or hydraulically-modified material	4
Chart C2	6 to 80 MESA	Asphalt	Crushed rock / macadam / BSM / ETSB (min. 1.5% cement)	Hydraulically-bound material	3
Chart D	30 to 80 MESA	Asphalt	Crushed rock / crushed stone / macadam	Hydraulically-bound material	3
Chart F	below 3 MESA	DBST / TBST	Natural gravel G80, G60 or GS1	GS2 and GC capping (S1–S4)	4

Damage exponent n (Table 2-3) converts real axle loads to standard axles in Equation 2-5, $EF = (P / SA)^n$: with n = 4 an axle twice the standard load does $2^4 = 16$ times the damage. RN31 sets n by the roadbase / sub-base type, so each chart has its own design traffic (Step 1).

Chart A1 – surface treatment on granular roadbase and granular sub-base (0.3 to 10 MESA). The classic unbound flexible pavement. The double bituminous surface treatment seals the pavement against water and gives the running surface; it has no thickness in the catalogue. The roadbase is the main load-spreading layer and the sub-base the secondary one, which also separates the roadbase from the subgrade and protects the subgrade from construction traffic (Section 1.7). The roadbase quality rises with traffic: natural gravel GB3 for T1–T3 (RN31 encourages local natural gravels for these classes, Section 4.4), macadam GB2 at T4 and crushed stone GB1 (or BSM) at T5–T6. It is usually the cheapest structure to build, but it depends on good drainage and on keeping the seal intact. Granular/granular damage exponent n = 4 (Table 2-3).

Chart A2 – surface treatment on granular roadbase and hydraulically bound sub-base (0.3 to 17 MESA). The same granular roadbase and surface treatment as Chart A1, but the sub-base is cement- or lime-treated: modified CB2 at lower traffic, with a CB1 bound layer added above it at T6–T7 (the bound sub-base alone on the strong F3/F4 foundations). Stabilisation is worth it where suitable granular sub-base is scarce and stabilising a local material costs less than importing one (Section 5.1). The treated layer is stiffer and less sensitive to water, but RN31 lists its risks: traffic, thermal and shrinkage cracking, cracks working up through the surfacing, erosion at low binder contents, loss of strength by carbonation, and the need for more construction skill and control (Section 5.1, remedies in Section 5.10). Granular/cemented damage exponent n = 3 (Table 2-3).

Chart A3 – surface treatment on hydraulically bound roadbase (0.3 to 17 MESA). A cement- or lime-bound CB1 roadbase directly under the surface treatment, on a granular sub-base (with a CB2 layer added on F1 at T6–T7). It suits areas without good crushed stone or gravel for a granular roadbase. Because of the risk of cemented bases failing, RN31 limits them to 17 MESA (Section 2.3.2). Cracks in the bound base can reflect through the thin surfacing, so the guide sets upper limits on strength to reduce reflection cracking (Section 5.1), stresses proper curing (Section 5.10) and notes that stress-alleviating membranes and geogrids lengthen the life of bound bases (chart note). The tool uses n = 4.5 (cemented/cemented, Table 2-3) for this chart.

Chart B – thin asphalt surfacing on granular roadbase and granular sub-base (0.7 to 10 MESA). Like Chart A1, but with a 40–50 mm premixed asphalt wearing course (flexible HMA such as HRA or flexible AC) instead of a surface treatment, giving a smoother, more durable surface for busier roads. The roadbase types follow the same pattern as A1 (GB3, GB2, then GB1/BSM as traffic rises), while the catalogue gives a thicker granular sub-base than A1 for the same traffic and foundation (for example 325 mm against 250 mm at F1, T5). The chart asks for flexible mixes on the granular base. For climate resilience, GS1 or HBM replaces GS2 and a surface treatment goes on the asphalt (chart note). Granular/granular n = 4.

Chart C1 – asphalt wearing and DBM binder course on GB1/BSM roadbase and granular sub-base (6 to 50 MESA). For heavier traffic the bituminous layers become structural: a wearing course (AC, HRA or SMA) on a dense bitumen macadam binder course, both designed for rut resistance and durability (Chapter 6). As traffic rises from T6 to T9 the catalogue mainly thickens the bituminous layers (DBM 60 to 125 mm); on foundations F1 and F2 the crushed stone / BSM roadbase stays at 200 mm while the sub-base thickens. The granular sub-base keeps the structure fully flexible, with no cemented layer to crack. GS1 or HBM in place of GS2 and a surface treatment on the asphalt for climate resilience (chart note). Granular/granular n = 4.

Chart C2 – asphalt on GB1/BSM roadbase and hydraulically bound sub-base (6 to 80 MESA). A structural asphalt surfacing (AC or SMA; on a DBM binder course at T10) over a crushed stone / BSM roadbase on a thick CB1 cement-bound sub-base. The bound sub-base gives a stiff platform, and the unbound roadbase between it and the asphalt separates the two. Its T10 designs suit 80 MESA and are long-life pavements: RN31 reports that above about 80 MESA there is no structural benefit in more thickness, cracking starts at the top, and rehabilitation is milling off the top 30–50 mm and replacing it (Section 8.3). The Section 5.1 cautions on hydraulically bound layers apply to the sub-base. Granular/cemented n = 3.

Chart D – asphalt and DBM on thick crushed stone roadbase and hydraulically bound sub-base (30 to 80 MESA). RN31's climate-resilient alternative to Chart C2, and the chart for roads where super-single (wide-base) tyres are expected to be common. The crushed stone / macadam roadbase is much thicker than in C2 (250–300 mm against 100–175 mm), on a CB1 sub-base, under a wearing course and DBM binder course; the binder course can be EME2 for extra resilience or reliability, with a surface treatment on the asphalt (chart note). RN31 recommends the Table 2-4 axle-group standard loads where more than 25% of trucks run on super-singles (Key point 6). Granular/cemented n = 3; T10 designs are long-life (Section 8.3).

Chart F – low volume sealed roads (below 3 MESA). For tertiary and secondary roads carrying under 3 MESA, RN31 uses separate catalogues that do not use the foundation class system (Section 8.5). They come from Gourley & Greening (1999), made to be less conservative than the earlier Road Note 31 and to use locally available materials, and were updated by Otto et al. (2020) for three things that govern low-volume sealed road performance: adequate drainage, a robust bituminous seal resealed in time, and an allowance for occasional overloaded axles. LVR1 is for axles mostly over 8 t and LVR2 for axles mostly under 8 t. Natural gravels (G80, G60, G45/GS1, G30/GS2, G15/GC) are specified by soaked or OMC CBR depending on the climate (Key 5 and chart note).

Common to all charts. The structures come from full-scale experiments and performance studies of existing road networks, filled in with performance models and mechanistic analysis where direct evidence was missing (Section 8.4). Each structure covers a range of traffic and subgrade strength, so the charts are easy to use, but the notes of each chart must be followed. A stronger foundation (capping) reduces the thickness of the more expensive upper layers (Section 8.1). Among the structures that fit, RN31 chooses by economic comparison (Chapter 12) and the materials available (Section 8.4).

2. DESIGN TRAFFIC

The traffic loading is expressed as the cumulative equivalent standard axles (MESA) in the design lane over the design period, in accordance with Chapter 2 of Road Note 31.

2.1 Traffic Data

#	Vehicle	Dir. 1 / day	Dir. 2 / day	Axle groups (t)
1	Semi-trailer (6 axles) AASHTO Truck Type 1 (Composite), counted 2026	150	150	SAST 5.44 TADT 19.05 TRDT 33.57
2	Semi-trailer (5 axles) AASHTO Truck Type 2, counted 2026	125	125	SAST 5.9 TADT 21.77 TADT 21.77
3	Semi-trailer (5 axles) AASHTO Truck Type 3, counted 2026	125	125	SAST 5.9 TADT 11.79 TADT 11.79

Parameter	Value
Growth periods	20 years at 3%
Years from traffic count to opening	3
Equivalence factors (Equation 2-5)	each axle against the 80 kN standard axle
Seasonal factor	1

2.2 Direction and Lane Distribution

Carriageway: Single carriageway, 6 m or wider — Total ESAs in the heaviest loaded direction.

The traffic of each direction has been counted separately, and the design traffic follows the cross-section rule of Table 2-5 for the carriageway type.

The lane distribution follows Table 2-5 of Road Note 31 for the carriageway type and width (Single carriageway, 6 m or wider).

2.3 Design Traffic

Damage exponent n (Table 2-3)	Charts	Design traffic (MESA)	Traffic class
3	A2, C2, D	33.78	T9
4	A1, B, C1, F	42.50	T9
4.5	A3	48.14	T9

2.4 Axle Loads and Their Effect on the Pavement

The axle group loads of the heavy vehicles are compared below with the legal axle load limits of the National Highway Authority (NHA, NHSO 2000 regime: front single axle 5.5 t, single axle 12 t, tandem 22 t, tridem 31 t). The last two columns give the equivalent standard axles (ESA, n = 4, each axle against 80 kN) of each axle group with the load as entered and with the load capped at the legal limit.

Vehicle	Axle group	Load (t)	Legal limit (t)	Load / limit	Status	ESA as entered	ESA at the legal limit
Semi-trailer (6 axles) (AASHTO Truck Type 1 (Composite), counted 2026)	SAST — single axle, single tyres	5.4	5.5	99%	within	0.198	0.198
Semi-trailer (6 axles) (AASHTO Truck Type 1 (Composite), counted 2026)	TADT — tandem axle, dual tyres	19.1	22.0	87%	within	3.713	3.713
Semi-trailer (6 axles) (AASHTO Truck Type 1 (Composite), counted 2026)	TRDT — triaxle, dual tyres	33.6	31.0	108%	over by 8%	10.609	7.715
Semi-trailer (5 axles) (AASHTO Truck Type 2, counted 2026)	SAST — single axle, single tyres	5.9	5.5	107%	over by 7%	0.273	0.206
Semi-trailer (5 axles) (AASHTO Truck Type 2, counted 2026)	TADT — tandem axle, dual tyres	21.8	22.0	99%	within	6.333	6.333
Semi-trailer (5 axles) (AASHTO Truck Type 2, counted 2026)	TADT — tandem axle, dual tyres	21.8	22.0	99%	within	6.333	6.333
Semi-trailer (5 axles) (AASHTO Truck Type 3, counted 2026)	SAST — single axle, single tyres	5.9	5.5	107%	over by 7%	0.273	0.206
Semi-trailer (5 axles) (AASHTO Truck Type 3, counted 2026)	TADT — tandem axle, dual tyres	11.8	22.0	54%	within	0.545	0.545
Semi-trailer (5 axles) (AASHTO Truck Type 3, counted 2026)	TADT — tandem axle, dual tyres	11.8	22.0	54%	within	0.545	0.545

The heaviest axle group is the TRDT of the Semi-trailer (6 axles) at **33.6 t**, 8% above the legal limit of 31.0 t. **33% of the axle group passes are above the legal limits.**

The damage of an axle group rises with about the fourth power of its load (Equation 2-5 with n = 4): a group 10% over the limit does about 1.46 times the damage of a legal one, and 20% over about 2.07 times. With the loads as entered the traffic gives **7,931.3 ESA per day** (two-way), against 7,029.5 ESA per day if every axle group carried no more than its legal limit: **overloading increases the design traffic by 13%**. Road Note 31 uses a damage exponent for each pavement type (Table 2-3): with n = 4.5 for the cemented roadbase and sub-base of Chart A3 the effect of overloading is larger, and with n = 3 (Charts A2, C2 and D) smaller.

Share of the ESA by vehicle: Semi-trailer (6 axles) (AASHTO Truck Type 1 (Composite), counted 2026) 55%, Semi-trailer (5 axles) (AASHTO Truck Type 2, counted 2026) 41%, Semi-trailer (5 axles) (AASHTO Truck Type 3, counted 2026) 4%.

Axle load survey data should be used where available, and enforcement of the legal limits protects the pavement.

3. PAVEMENT DESIGN PARAMETERS

The design parameters adopted for the project road are presented in the following sub-sections.

3.1 Design Period

A design period of **20 years** has been adopted. Road Note 31 typically uses 20–30 years for new roads (Section 12.1).

3.2 Subgrade Design CBR and Class

A subgrade design CBR of **20%** has been adopted, giving subgrade class **S5**. The soil investigation results are given in Annexure D.

3.3 Foundation Class and Capping

The foundation class follows from the subgrade class and any capping layer (Keys 2 and 3). The foundation routes used by the options are listed in part 4.1 of this report.

3.4 Road Type and Surfacing

Road type: Automatic (low volume Chart F too when < 3 MESA). Surfacing on the Chart A options: double bituminous surface treatment.

4. PAVEMENT THICKNESS FROM THE CATALOGUE

The pavement structures are read from the Road Note 31 catalogue charts (Chapter 9) at the traffic class and foundation class of the project. The applicable charts are reproduced in Annexure E and the full calculation printout is in Annexure B.

4.1 Catalogue Options

Option / foundation route	Traffic class	Layers top to bottom (mm)	Total (mm)	Cost / km	Rank
Option 1 — Chart C1 No capping (S5 = F3)	T9	AC 50 / DBM 125 / GB1 225 / GS2 150	550	–	2
Option 2 — Chart C2 No capping (S5 = F3)	T9	AC 75 / GB1 150 / CB1 200	425	–	★ 1
Option 3 — Chart D No capping (S5 = F3)	T9	AC 40 / DBM 60 / GB1 275 / CB1 200	575	–	3

Rank by total thickness. The rank is a screening; the choice also considers materials, construction and maintenance.

4.2 Recommended Pavement

Based on the design traffic and subgrade parameters set out in this report, the following pavement structure (Option 2 — Chart C2) is recommended:

Pavement layer	Thickness (mm)
AC — Asphalt concrete / hot rolled asphalt (AC/HRA)	75
GB1 — Granular base 1 / bitumen stabilised material (GB1/BSM)	150
CB1 — Hydraulically bound material (CB1)	200
Total	**425**

Design traffic 33.78 MESA (traffic class T9, damage exponent n = 3); subgrade design CBR 20% (class S5); foundation No capping (S5 = F3). The structure is read from Chart C2 of the Road Note 31 catalogue (Annexure E).

The pavement layers are drawn to scale in Annexure C (Typical Cross Sections), and the detailed design calculations are given in Annexure B.

4.3 Construction Layers and Aggregate Size

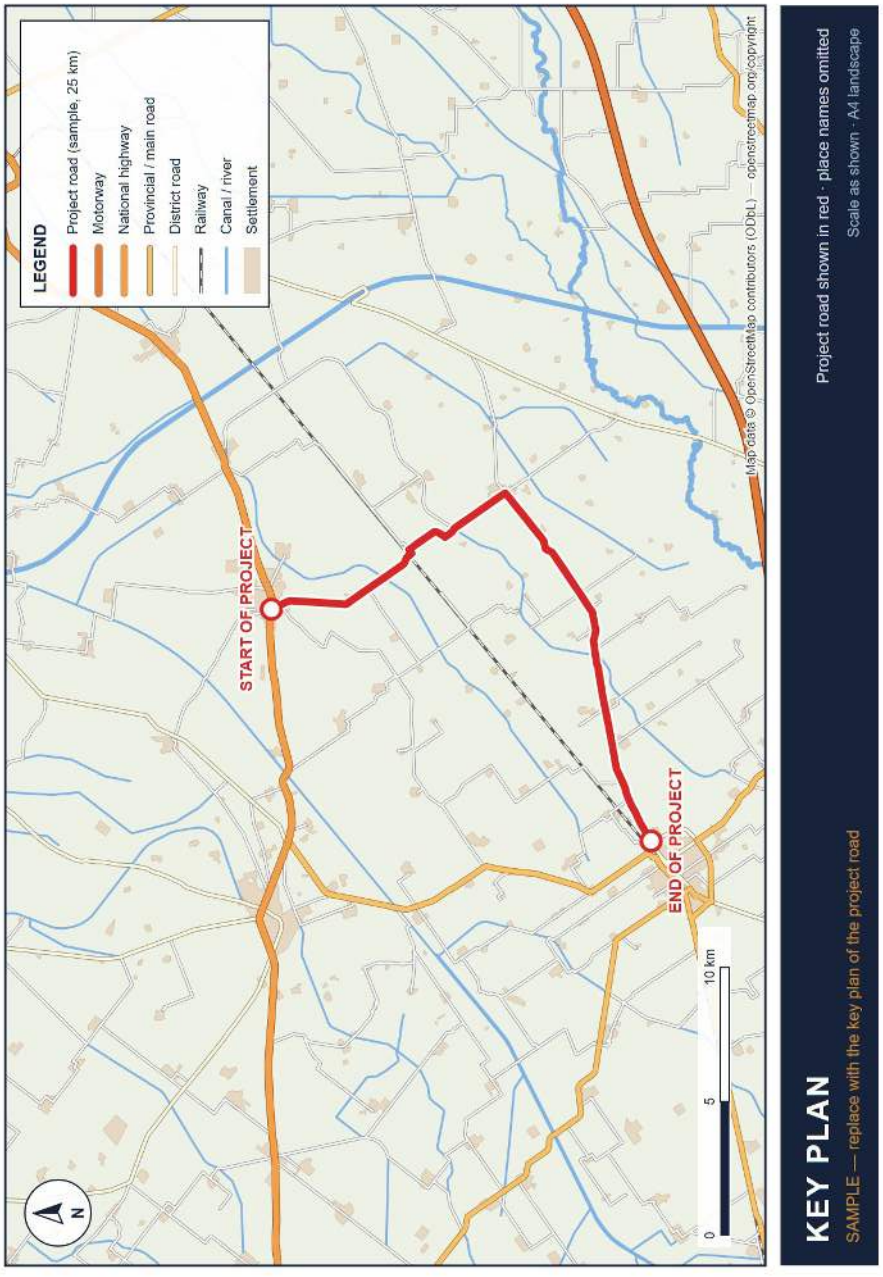
Layer	Thickness (mm)	Construction	Road Note 31 rule	Check
AC	75	laid in one layer	asphalt concrete WC1, 20 mm maximum aggregate: 40–50 mm (Table 6-4; the upper limit has been exceeded by 20% in practice)	too thick
GB1	150	one layer	graded crushed stone: each compacted layer not over 200 mm (Section 4.4.1)	OK
CB1	200	one layer	stabilised layer: lifts of 100–200 mm (Section 5.10.1)	OK

***AC 75 mm**: outside the thickness range of the chosen mix — choose another mix in Step 4.*

The catalogue gives the total thickness of each layer; it is built in the compaction layers shown, so that each layer can be compacted to the specified density. Asphalt mix: asphalt concrete WC1, 20 mm maximum aggregate; GB2 stone: 50 mm; other granular layers: at most 200 mm (Step 4).

ANNEXURE – A (KEY PLAN AND LOCATION MAP)

Referred to in: Executive Summary, 1.1 General.



Sample key plan — insert the actual key plan and location map of the project road to replace this sample (upload it in the report form under Annexure A; use + Add plan for more). Map data © OpenStreetMap contributors (ODbL).

ANNEXURE – B (DESIGN CALCULATIONS BY ROAD NOTE 31 (5TH EDITION))

Referred to in: Executive Summary, 4. Pavement Thickness from the Catalogue, 4.2 Recommended Pavement.

Full printout of the Road Note 31 Flexible Pavement Design tool, corresponding to the design summarised above.

1. Design traffic (Chapter 2)

Traffic input	Vehicle mix and axle loads
Growth periods	20 years at 3%; 3 years from count to opening
Seasonal factor F	1
Cross-section (Table 2-5)	Single carriageway, 6 m or wider — Total ESAs in the heaviest loaded direction
Equivalence factors	Each axle vs 80 kN standard axle (Equation 2-5), loads in t
Damage exponent	Table 2-3 value of each chart

#	Vehicle	Description	Dir. 1 / day	Dir. 2 / day	Axle groups (t)	ESA / vehicle (n = 4)
1	Semi-trailer (6 axles)	AASHTO Truck Type 1 (Composite), counted 2026	150	150	SAST 5.44, TADT 19.05, TRDT 33.57	14.520
2	Semi-trailer (5 axles)	AASHTO Truck Type 2, counted 2026	125	125	SAST 5.9, TADT 21.77, TADT 21.77	12.939
3	Semi-trailer (5 axles)	AASHTO Truck Type 3, counted 2026	125	125	SAST 5.9, TADT 11.79, TADT 11.79	1.363

ESA/day dir. 1 (n = 4)	ESA/day dir. 2 (n = 4)	Design lane a, ESA/day	Design traffic (n = 4)	Traffic class
3,966	**3,966**	**3,966**	**42.50 MESA**	**T9**

Low volume class (Chart F)
Not applicable

```
Table 2-5: Single carriageway, 6 m or wider → Total ESAs in the heaviest loaded direction
a = 1 × max(3,966, 3,966) = 3,966 ESA/day
Equation 2-6: ESA = a × 365 × 100/b × [(1 + b/100)^(c+d) − (1 + b/100)^d] = 3,966 × 365 × 100/3 × [1.030^23 − 1.030^3] = 42,500,137 ESA
```

Design traffic by damage exponent (Table 2-3)

Damage exp. n	Pavement type (Table 2-3)	Charts	Design traffic (MESA)	Traffic class
3	Granular roadbase / cemented (hydraulically bound) sub-base	A2, C2, D	33.78	T9
4	Granular / granular (also bituminous / granular and bituminous / cemented)	A1, B, C1, F	42.50	T9
4.5	Cemented / cemented (used for Chart A3: cemented roadbase on a granular or modified sub-base, which Table 2-3 does not list)	A3	48.14	T9

Why three values? *The same trucks are converted to standard axles with EF = (P / SA)^n. RN31 Table 2-3 gives n by pavement type: 3 for a granular roadbase on a cemented sub-base, 4 for granular / granular, 4.5 for cemented / cemented. With n = 4 an axle twice the standard load counts as 2^4 = 16 standard axles, with n = 3 as 8. Each chart is therefore entered with its own design traffic.*

2. Subgrade (Chapter 3)

Design CBR	Subgrade class (Table 3-9)	Foundation as it is
20%	**S5**	**F3**

3. Foundation classes and capping (Keys 2 and 3)

Route	Capping layers (bottom → top)	Capping (mm)	Foundation class	Surface modulus (MPa)	Equivalent min. CBR
1	None — subgrade S5 as it is	0	**F3** (S5)	125	15%
2	Granular sub-base 2 (GS2) 150 mm	150	**F4** (S6)	250	30%

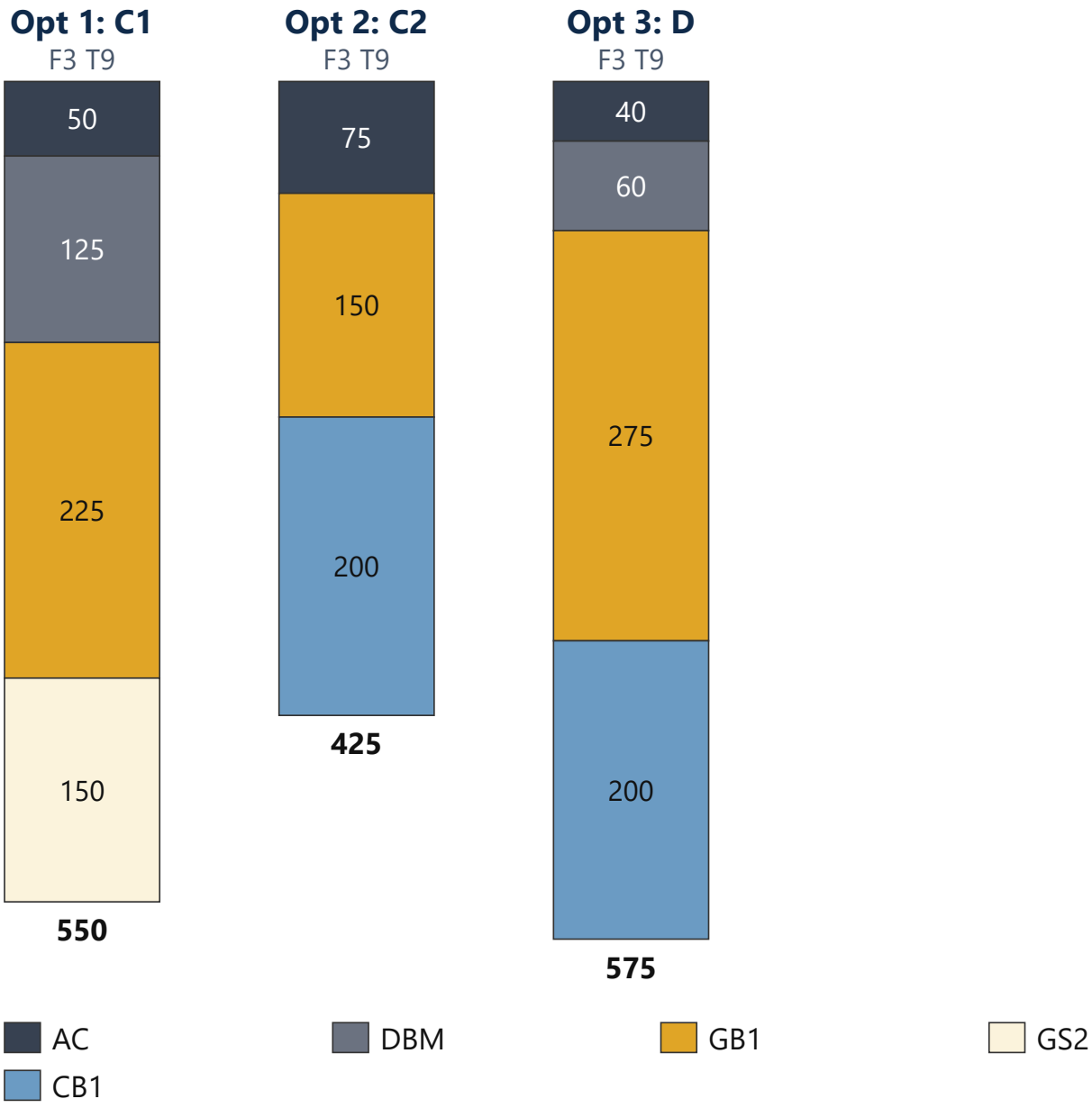
Any combination of capping may be used if the foundation surface modulus is achieved; a 50 m trial section tested with FWD/LWD can verify it (Key 3, Note 1). Capping materials: Table 4-1 (G8, GC, GS2).

4. Catalogue options (Chapter 9)

***Material codes: DBST** = Double bituminous surface treatment; **TBST** = Triple bituminous surface treatment; **AC** = Asphalt concrete / hot rolled asphalt (AC/HRA); **DBM** = Dense bitumen macadam (DBM); **GB1** = Granular base 1 / bitumen stabilised material (GB1/BSM); **GB2** = Granular base 2 (GB2); **GB3** = Granular base 3 (GB3); **CB1** = Hydraulically bound material (CB1); **CB2** = Hydraulically modified material (CB2); **GS1** = Granular sub-base 1 (GS1); **GS2** = Granular sub-base 2 (GS2); **GC** = Granular capping (GC); **G8** = Soil capping (G8); **G80** = Natural gravel G80; **G60** = Natural gravel G60. **Classes:** T1–T10 = traffic classes by design traffic in MESA (million equivalent standard axles of 80 kN); S1–S6 = subgrade strength classes by CBR (Table 3-9); F1–F4 = foundation classes (Table 8-1); CBR = California bearing ratio. **Axle groups:** SAST / SADT = single axle with single / dual tyres; TAST / TADT = tandem axle; TRST / TRDT = tridem axle; QAST / QADT = quad axle.*

Road type: Automatic (low volume Chart F too when < 3 MESA) · surfacing on Charts A: DBST · climate-resilient variant: no · width 7.3 m · costs in PKR

Rank	Option / chart	Foundation	Traffic	Layers top → bottom (mm)	Total (mm)	Cost / km
2	Option 1 — Chart C1 Chart range 6 to 50 MESA	F3	T9 (42.50 MESA, n = 4)	AC 50 / DBM 125 / GB1 225 / GS2 150	550	–
★ 1	Option 2 — Chart C2 Chart range 6 to 80 MESA	F3	T9 (33.78 MESA, n = 3)	AC 75 / GB1 150 / CB1 200	425	–
3	Option 3 — Chart D Chart range 30 to 80 MESA	F3	T9 (33.78 MESA, n = 3)	AC 40 / DBM 60 / GB1 275 / CB1 200	575	–



Same scale, thicknesses in mm; hatched = capping. Header: foundation class and traffic

Life-cycle cost of the options (Chapter 12)

Option	Construction (PKR)	Periodic treatments	Treatments, PV (PKR)	Routine, PV (PKR)	Residual value, PV (PKR)	Life-cycle cost, PV (PKR)
Option 1 — Chart C1 F3, 550 mm	–	missing: construction rates, 40 mm AC overlay	–	0	0	**–**
Option 2 — Chart C2 F3, 425 mm	–	missing: construction rates, 40 mm AC overlay	–	0	0	**–**
Option 3 — Chart D F3, 575 mm	–	missing: construction rates, 40 mm AC overlay	–	0	0	**–**

Present value over 25 years at 6% (Equation 12-1, PV = FV / (1 + r)^n); treatments due in the final year are not counted; residual value is a negative cost discounted from the end of the period (Section 12.2.5). Costs per km of carriageway at your rates. Not included: land, design fees, road user costs, environmental mitigation, contingencies and taxes / conversion to economic prices (Sections 12.2.1–12.2.3) — add them where they differ between options.

Choosing between the options (Road Note 31 Section 8.4 and Chapter 12)

Every option listed is a valid catalogue design for this traffic and foundation. The ranking is a screening by life-cycle cost, construction cost or thickness — not a recommendation on its own. Decide the option to adopt by considering:

1. **Materials available**: quality and haul distance of crushed stone, natural gravel and sub-base materials; supply of cement, lime and bitumen (Chapters 4–6). Structure options are selected from the catalogues on the basis of the materials available (Section 8.4).
2. **Climate and drainage**: rainfall, flooding and the moisture regime. The chart notes give climate-resilient variants (e.g. GS1 or a hydraulically bound sub-base instead of GS2, a triple or extra surface treatment on the asphalt).
3. **Construction capability**: an asphalt plant and paver for DBM and AC; mix design, compaction and curing control for cement- or lime-treated layers. Cement-treated layers shrink and crack: binder content, compaction and curing need close control (Chapter 5).
4. **Traffic certainty and overloading**: where the forecast or the axle loads are uncertain, prefer the more robust structure or consider stage construction, e.g. a thinner asphalt now and an overlay later (Section 12.1). The options here carry different design traffic because their damage exponent differs (Table 2-3).
5. **Life-cycle cost** (Chapter 12): construction plus maintenance, periodic treatments and rehabilitation over 20–30 years, discounted to present value (about 6% for countries growing at about 3% a year, Section 12.2.4), with residual value where relevant — see the comparison above.
6. **Other criteria**: safety, embodied carbon (Chapter 13) and community preferences — score them with a multi-criteria analysis where they cannot be priced (Section 12.5).

Design philosophy of the charts

Chart	Traffic	Surfacing	Roadbase	Sub-base	Damage exponent n
Chart A1	0.3 to 10 MESA	DBST (or 40 mm AC/HRA)	Granular base / crushed rock / macadam / BSM / ETSB (min. 1.5% cement)	Granular material or hydraulically-modified material	4
Chart A2	0.3 to 17 MESA	DBST (or 40 mm AC/HRA)	Granular base / crushed rock / BSM / ETSB (min. 1.5% cement)	Hydraulically-bound material	3
Chart A3	0.3 to 17 MESA	DBST (or 40 mm AC/HRA)	Hydraulically-bound material	Granular material or hydraulically-modified material	4.5
Chart B	0.7 to 10 MESA	Asphalt	Granular base / crushed rock / macadam / BSM / ETSB (min. 1.5% cement)	Granular material or hydraulically-modified material	4
Chart C1	6 to 50 MESA	Asphalt	Crushed rock / macadam / BSM / ETSB (min. 1.5% cement)	Granular material or hydraulically-modified material	4
Chart C2	6 to 80 MESA	Asphalt	Crushed rock / macadam / BSM / ETSB (min. 1.5% cement)	Hydraulically-bound material	3
Chart D	30 to 80 MESA	Asphalt	Crushed rock / crushed stone / macadam	Hydraulically-bound material	3
Chart F	below 3 MESA	DBST / TBST	Natural gravel G80, G60 or GS1	GS2 and GC capping (S1–S4)	4

Damage exponent n *(Table 2-3) converts real axle loads to standard axles in Equation 2-5, $EF = (P / SA)^n$: with n = 4 an axle twice the standard load does $2^4 = 16$ times the damage. RN31 sets n by the roadbase / sub-base type, so each chart has its own design traffic (Step 1).*

Chart A1 – surface treatment on granular roadbase and granular sub-base (0.3 to 10 MESA). *The classic unbound flexible pavement. The double bituminous surface treatment seals the pavement against water and gives the running surface; it has no thickness in the catalogue. The roadbase is the main load-spreading layer and the sub-base the secondary one, which also separates the roadbase from the subgrade and protects the subgrade from construction traffic (Section 1.7). The roadbase quality rises with traffic: natural gravel GB3 for T1–T3 (RN31 encourages local natural gravels for these classes, Section 4.4), macadam GB2 at T4 and crushed stone GB1 (or BSM) at T5–T6. It is usually the cheapest structure to build, but it depends on good drainage and on keeping the seal intact. Granular/granular damage exponent n = 4 (Table 2-3).*

Chart A2 – surface treatment on granular roadbase and hydraulically bound sub-base (0.3 to 17 MESA). *The same granular roadbase and surface treatment as Chart A1, but the sub-base is cement- or lime-treated: modified CB2 at lower traffic, with a CB1 bound layer added above it at T6–T7 (the bound sub-base alone on the strong F3/F4 foundations). Stabilisation is worth it where suitable granular sub-base is scarce and stabilising a local material costs less than importing one (Section 5.1). The treated layer is stiffer and less sensitive to water, but RN31 lists its risks: traffic, thermal and shrinkage cracking, cracks working up through the surfacing, erosion at low binder contents, loss of strength by carbonation, and the need for more construction skill and control (Section 5.1, remedies in Section 5.10). Granular/cemented damage exponent n = 3 (Table 2-3).*

Chart A3 – surface treatment on hydraulically bound roadbase (0.3 to 17 MESA). *A cement- or lime-bound CB1 roadbase directly under the surface treatment, on a granular sub-base (with a CB2 layer added on F1 at T6–T7). It suits areas without good crushed stone or gravel for a granular roadbase. Because of the risk of cemented bases failing, RN31 limits them to 17 MESA (Section 2.3.2). Cracks in the bound base can reflect through the thin surfacing, so the guide sets upper limits on strength to reduce reflection cracking (Section 5.1), stresses proper curing (Section 5.10) and notes that*

stress-alleviating membranes and geogrids lengthen the life of bound bases (chart note). The tool uses n = 4.5 (cemented/cemented, Table 2-3) for this chart.

Chart B – thin asphalt surfacing on granular roadbase and granular sub-base (0.7 to 10 MESA). *Like Chart A1, but with a 40–50 mm premixed asphalt wearing course (flexible HMA such as HRA or flexible AC) instead of a surface treatment, giving a smoother, more durable surface for busier roads. The roadbase types follow the same pattern as A1 (GB3, GB2, then GB1/BSM as traffic rises), while the catalogue gives a thicker granular sub-base than A1 for the same traffic and foundation (for example 325 mm against 250 mm at F1, T5). The chart asks for flexible mixes on the granular base. For climate resilience, GS1 or HBM replaces GS2 and a surface treatment goes on the asphalt (chart note). Granular/granular n = 4.*

Chart C1 – asphalt wearing and DBM binder course on GB1/BSM roadbase and granular sub-base (6 to 50 MESA). *For heavier traffic the bituminous layers become structural: a wearing course (AC, HRA or SMA) on a dense bitumen macadam binder course, both designed for rut resistance and durability (Chapter 6). As traffic rises from T6 to T9 the catalogue mainly thickens the bituminous layers (DBM 60 to 125 mm); on foundations F1 and F2 the crushed stone / BSM roadbase stays at 200 mm while the sub-base thickens. The granular sub-base keeps the structure fully flexible, with no cemented layer to crack. GS1 or HBM in place of GS2 and a surface treatment on the asphalt for climate resilience (chart note). Granular/granular n = 4.*

Chart C2 – asphalt on GB1/BSM roadbase and hydraulically bound sub-base (6 to 80 MESA). *A structural asphalt surfacing (AC or SMA; on a DBM binder course at T10) over a crushed stone / BSM roadbase on a thick CB1 cement-bound sub-base. The bound sub-base gives a stiff platform, and the unbound roadbase between it and the asphalt separates the two. Its T10 designs suit 80 MESA and are long-life pavements: RN31 reports that above about 80 MESA there is no structural benefit in more thickness, cracking starts at the top, and rehabilitation is milling off the top 30–50 mm and replacing it (Section 8.3). The Section 5.1 cautions on hydraulically bound layers apply to the sub-base. Granular/cemented n = 3.*

Chart D – asphalt and DBM on thick crushed stone roadbase and hydraulically bound sub-base (30 to 80 MESA). *RN31's climate-resilient alternative to Chart C2, and the chart for roads where super-single (wide-base) tyres are expected to be common. The crushed stone / macadam roadbase is much thicker than in C2 (250–300 mm against 100–175 mm), on a CB1 sub-base, under a wearing course and DBM binder course; the binder course can be EME2 for extra resilience or reliability, with a surface treatment on the asphalt (chart note). RN31 recommends the Table 2-4 axle-group standard loads where more than 25% of trucks run on super-singles (Key point 6). Granular/cemented n = 3; T10 designs are long-life (Section 8.3).*

Chart F – low volume sealed roads (below 3 MESA). *For tertiary and secondary roads carrying under 3 MESA, RN31 uses separate catalogues that do not use the foundation class system (Section 8.5). They come from Gourley & Greening (1999), made to be less conservative than the earlier Road Note 31 and to use locally available materials, and were updated by Otto et al. (2020) for three things that govern low-volume sealed road performance: adequate drainage, a robust bituminous seal resealed in time, and an allowance for occasional overloaded axles. LVR1 is for axles mostly over 8 t and LVR2 for axles mostly under 8 t. Natural gravels (G80, G60, G45/GS1, G30/GS2, G15/GC) are specified by soaked or OMC CBR depending on the climate (Key 5 and chart note).*

Common to all charts. *The structures come from full-scale experiments and performance studies of existing road networks, filled in with performance models and mechanistic analysis where direct evidence was missing (Section 8.4). Each structure covers a range of traffic and subgrade strength, so the charts are easy to use, but the notes of each chart must be followed. A stronger foundation (capping) reduces the thickness of the more expensive upper layers (Section 8.1). Among the structures that fit, RN31 chooses by economic comparison (Chapter 12) and the materials available (Section 8.4).*

5. Selected design

Selected	Foundation	Traffic class	Total thickness
Option 2 — Chart C2	**F3**	**T9 (33.78 MESA)**	**425 mm**

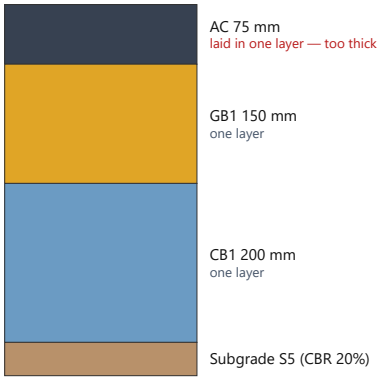


Chart C2, F3, T9. Surface treatments drawn with a nominal thickness.

Layer	Material	Thickness (mm)	Depth to bottom (mm)
Surfacing	Asphalt concrete / hot rolled asphalt (AC/HRA)	**75**	75
Roadbase	Granular base 1 / bitumen stabilised material (GB1/BSM)	**150**	225
Roadbase / sub-base	Hydraulically bound material (CB1)	**200**	425
Subgrade	S5, design CBR 20%		425

Chart notes

Surfacing: structural HMA / bitumen-bound materials, e.g. AC, SMA; on a binder course for T10. Design the surfacing layers for rut resistance and durability (Chapter 6). For climate resilience apply a surface treatment on the HMA surfacing. T10 designs suit 80 MESA and are long-life pavements (use for all higher traffic). Roadbase: Crushed rock / macadam / BSM / ETSB (min. 1.5% cement). Sub-base: Hydraulically-bound material.

Design philosophy

When to use: *Heavy traffic up to long-life T10, on a stiff cement-bound sub-base.*

A structural asphalt surfacing (AC or SMA; on a DBM binder course at T10) over a crushed stone / BSM roadbase on a thick CB1 cement-bound sub-base. The bound sub-base gives a stiff platform, and the unbound roadbase between it and the asphalt separates the two. Its T10 designs suit 80 MESA and are long-life pavements: RN31 reports that above about 80 MESA there is no structural benefit in more thickness, cracking starts at the top, and rehabilitation is milling off the top 30–50 mm and replacing it (Section 8.3). The Section 5.1 cautions on hydraulically bound layers apply to the sub-base. Granular/cemented n = 3.

Quantities and cost per km

Layer	Thickness (mm)	Quantity / km	Unit	Rate	Amount (PKR)
Asphalt concrete / hot rolled asphalt (AC/HRA)	75	548	m^3	–	–
Granular base 1 / bitumen stabilised material (GB1/BSM)	150	1,095	m^3	–	–
Hydraulically bound material (CB1)	200	1,460	m^3	–	–
Total per km, 7.3 m wide	425				rates missing

Material specifications

Code	Material	Specification summary (Road Note 31)
AC	Asphalt concrete / hot rolled asphalt (AC/HRA)	Asphalt concrete / hot rolled asphalt wearing course (Tables 6-4, 6-5, 6-10); design for rut resistance and durability (Chapter 6).
GB1	Granular base 1 / bitumen stabilised material (GB1/BSM)	GB1,A: high-quality fresh crushed rock - dense graded, unweathered crushed stone, non-plastic parent fines. GB1,B: crushed rock, gravel or boulders - dense grading, PI < 6, soil or parent fines (Table 4-1; gradings Table 4-6, aggregate strength Table 4-7). BSM alternative: Chapter 6.
CB1	Hydraulically bound material (CB1)	Cement/lime-stabilised roadbase, UCS 3.0-6.0 MPa. Material before stabilisation (Table 5-2): passing 53 mm 100%, 37.5 mm 85-100, 20 mm 60-90, 5 mm 30-65, 2 mm 20-50, 0.425 mm 10-30, 0.075 mm 5-15%; LL <= 25, PI <= 6, linear shrinkage <= 3.

Construction layers and aggregate size

Layer	Thickness (mm)	Construction	Road Note 31 rule	Check
AC	75	laid in one layer	asphalt concrete WC1, 20 mm maximum aggregate: 40–50 mm (Table 6-4; the upper limit has been exceeded by 20% in practice)	too thick
GB1	150	one layer	graded crushed stone: each compacted layer not over 200 mm (Section 4.4.1)	OK
CB1	200	one layer	stabilised layer: lifts of 100–200 mm (Section 5.10.1)	OK

***AC 75 mm**: outside the thickness range of the chosen mix — choose another mix in Step 4.*

The catalogue gives the total thickness of each layer; it is built in the compaction layers shown, so that each layer can be compacted to the specified density. Asphalt mix: asphalt concrete WC1, 20 mm maximum aggregate; GB2 stone: 50 mm; other granular layers: at most 200 mm (Step 4).

Catalogue chart (your cell highlighted)

Open Chart C2 as a full page with cross-sections

Chart C2	T6 6–10	T7 10–17	T8 17–30	T9 30–50	T10 50–80
F1 (S3)	AC 50 GB1 150 CB1 275	AC 50 GB1 150 CB1 300	AC 50 GB1 175 CB1 300	AC 75 GB1 175 CB1 300	AC 40 DBM 60 GB1 175 CB1 300
F2 (S4)	AC 50 GB1 150 CB1 200	AC 50 GB1 150 CB1 250	AC 50 GB1 175 CB1 250	AC 75 GB1 175 CB1 250	AC 40 DBM 60 GB1 175 CB1 250
F3 (S5)	AC 50 GB1 150 CB1 150	AC 50 GB1 150 CB1 225	AC 50 GB1 150 CB1 225	AC 75 GB1 150 CB1 200	AC 40 DBM 60 GB1 150 CB1 200
F4 (S6)	AC 50 GB1 100 CB1 150	AC 50 GB1 150 CB1 150	AC 50 GB1 150 CB1 150	AC 75 GB1 150 CB1 150	AC 40 DBM 60 GB1 150 CB1 150

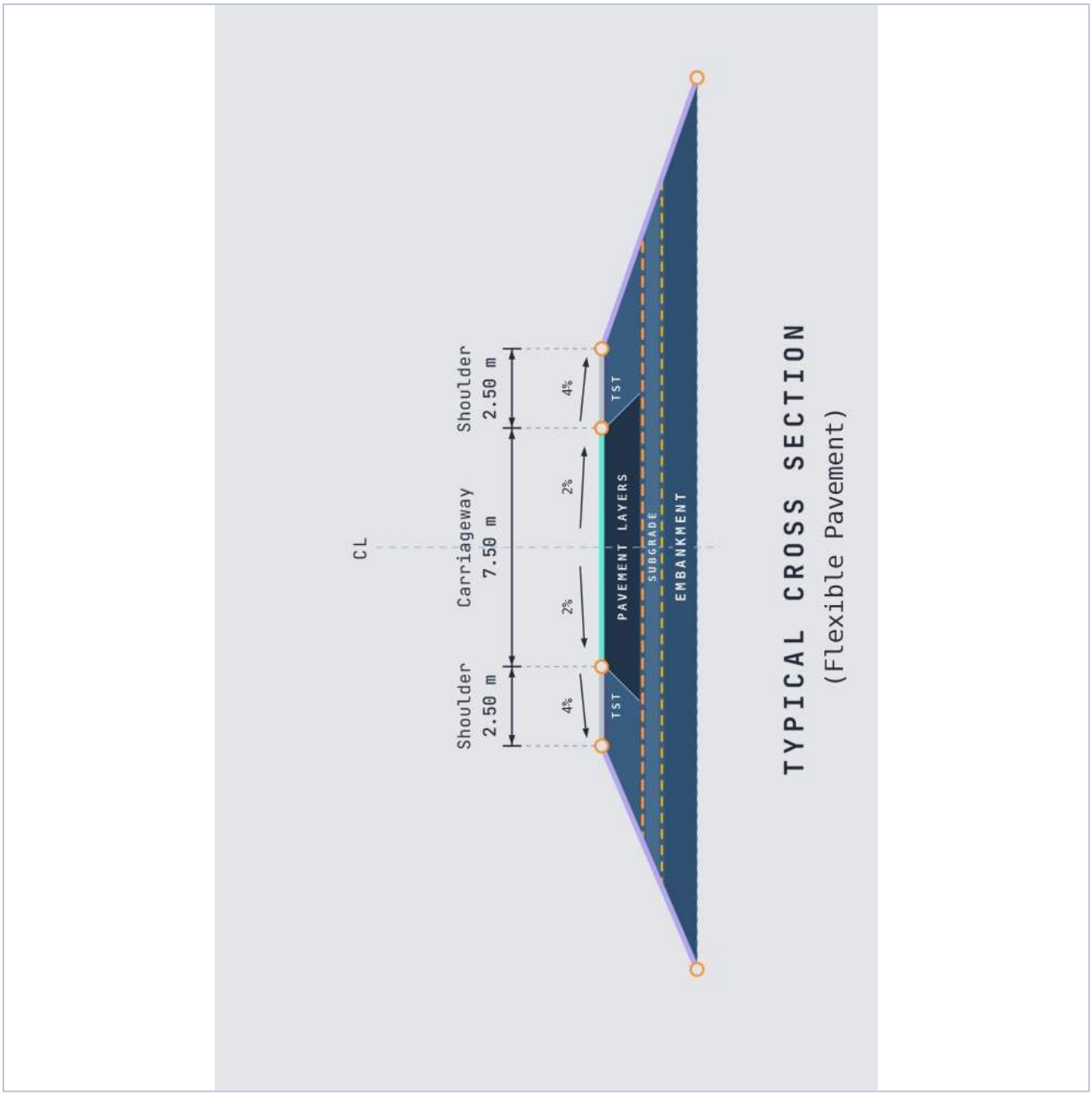
6. Method and references

- **Design traffic.** Equivalence factor EF = $(P/SA)^n$ (Equation 2-5) with the Table 2-3 exponent; ESA per day in each direction from the daily counts × seasonal factor F × mean EF per vehicle; the design-lane loading from Table 2-5; cumulative ESA by Equation 2-6, summed year by year when there are several growth periods. Traffic class from Key 1 (T1 < 0.3 … T10 50–80 MESA; T10 designs are long-life and used for all higher traffic). A value on a class boundary goes to the higher class.
- **Exponent per chart.** Table 2-3 gives n by roadbase/sub-base: granular/granular 4 (Charts A1, B, C1, F), granular/cemented 3 (Charts A2, C2, D), cemented/cemented 4.5 (used here for Chart A3, whose cemented roadbase sits on a granular or hydraulically-modified sub-base; Table 2-3 has no cemented/granular row), bituminous/granular and bituminous/cemented 4. Choose *one value for every chart* to override.
- **Subgrade.** Design CBR = lower 10th percentile of the soaked CBR results of a uniform section (5th percentile for trunk roads), PERCENTILE.INC method; at least 10 results; coefficient of variation below 30% (Section 3.3.6). Subgrade class from Table 3-9. Cover over reactive subgrades from Table 3-8.
- **Foundation.** Foundation classes F1–F4 (Key 2, Table 8-1) and the capping options of Key 3. Foundation class F5 is a performance design proved by trials and is not covered. Performance foundation designs (Section 8.2.3) are checked on site with FWD/LWD surface modulus.
- **Structures.** Thicknesses are read from the Chapter 9 catalogues (Charts A1, A2, A3, B, C1, C2, D for main roads; Chart F for low volume roads below 3 MESA, by LVR1/LVR2 and effective subgrade class). Chart cells are reproduced as printed; only the layer substitutions stated in the chart notes (40 mm AC/HRA for DBST, GS1 for GS2, triple surface treatment) are offered. Chart E (structural numbers) and rigid pavements (Chapter 10) are not included.
- **Costs.** Quantity per km = thickness × carriageway width × 1,000 m (surface treatments in m^2). Construction cost only, at your rates. RN31 Chapter 12 describes whole-of-life economic comparison.
- **Reference:** Road Note 31, *A guide to the structural design of surfaced roads in tropical and sub-tropical regions*, 5th edition, TRL, 2023 (FCDO / ReCAP). Always read the notes of the chart you use, and check the design against your road agency's requirements.

Generated with the free Road Note 31 Pavement Design tool at shahidpervaiz.net. Results must be checked by a qualified pavement engineer.

ANNEXURE – C (TYPICAL CROSS SECTIONS)

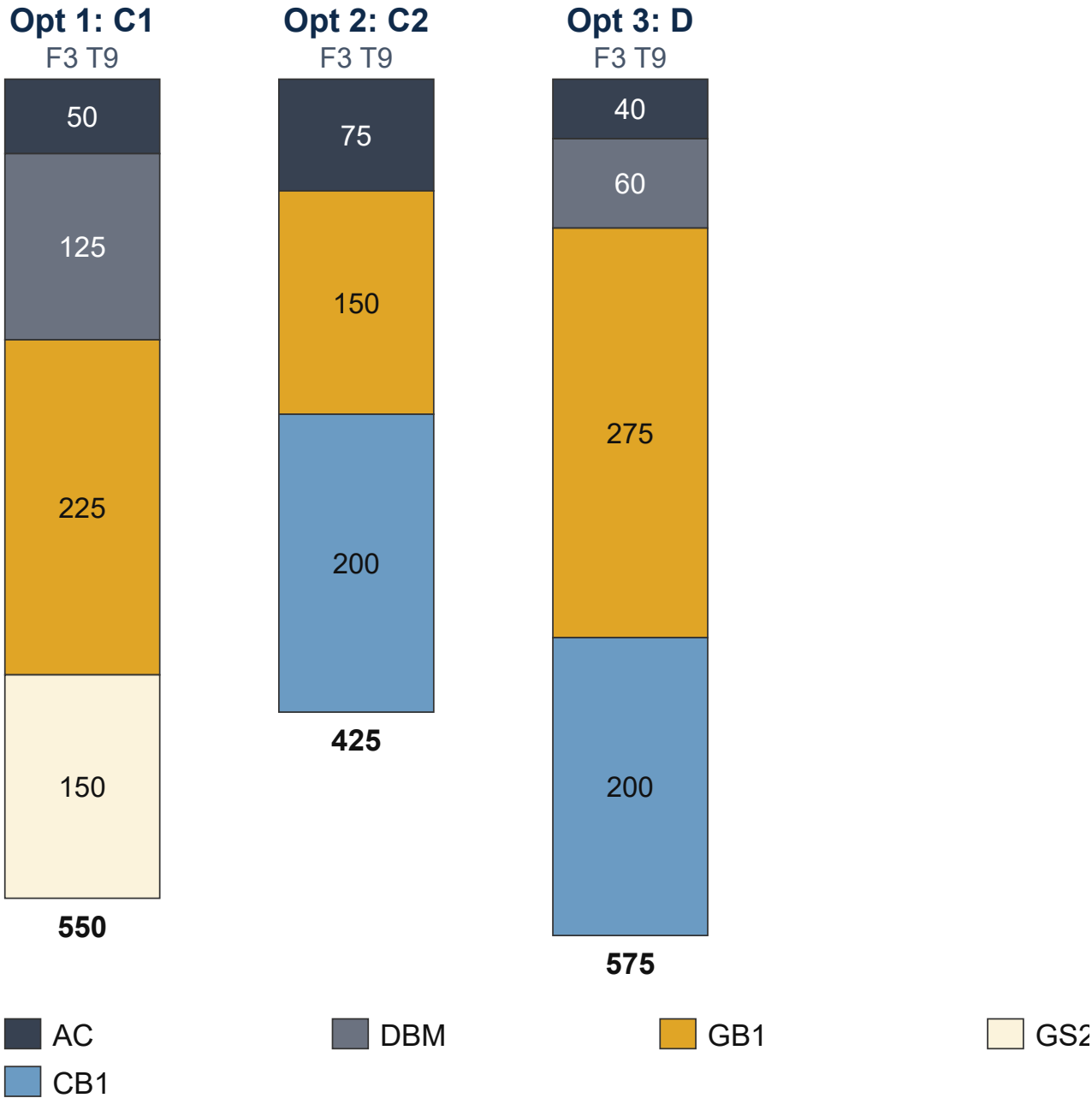
Referred to in: Executive Summary, 4.2 Recommended Pavement.



Sample drawing — insert the actual project cross section to replace this sample (upload it in the report form under Annexure C; use + Add cross section for more sections).

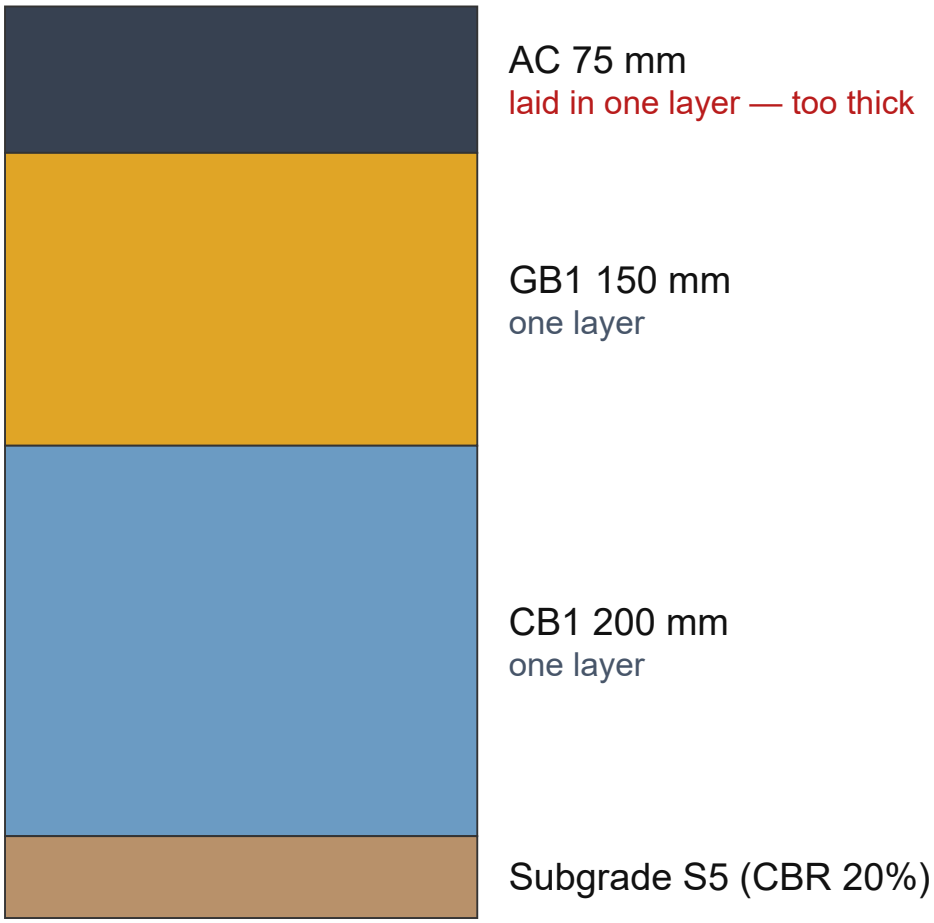
Pavement layers (to scale)

Pavement options drawn to scale by the tool (layer thicknesses in mm).



Same scale, thicknesses in mm; hatched = capping. Header: foundation class and traff

Recommended pavement



Total 425 mm above the subgrade

ANNEXURE – D (SOIL INVESTIGATION RESULTS OF CBR)

Referred to in: Executive Summary, 3.2 Subgrade Design CBR and Class.

A subgrade design CBR of **20%** (class S5) has been adopted in this design (see part 3.2 of this report).

Full soil and material investigation report, borehole logs and laboratory CBR test results to be attached separately by the design engineer (upload images or PDFs in the report form; + Add report / page for more).

ANNEXURE – E (APPLICABLE ROAD NOTE 31 DESIGN CHARTS)

Referred to in: Executive Summary, 4. Pavement Thickness from the Catalogue, 4.2 Recommended Pavement.

The catalogue charts of Road Note 31 that apply to the design traffic of this project are reproduced below as drawn by the tool from the guide (layer thicknesses in mm). The cell of the recommended pavement is highlighted; the cells used by the other options are listed under each chart.

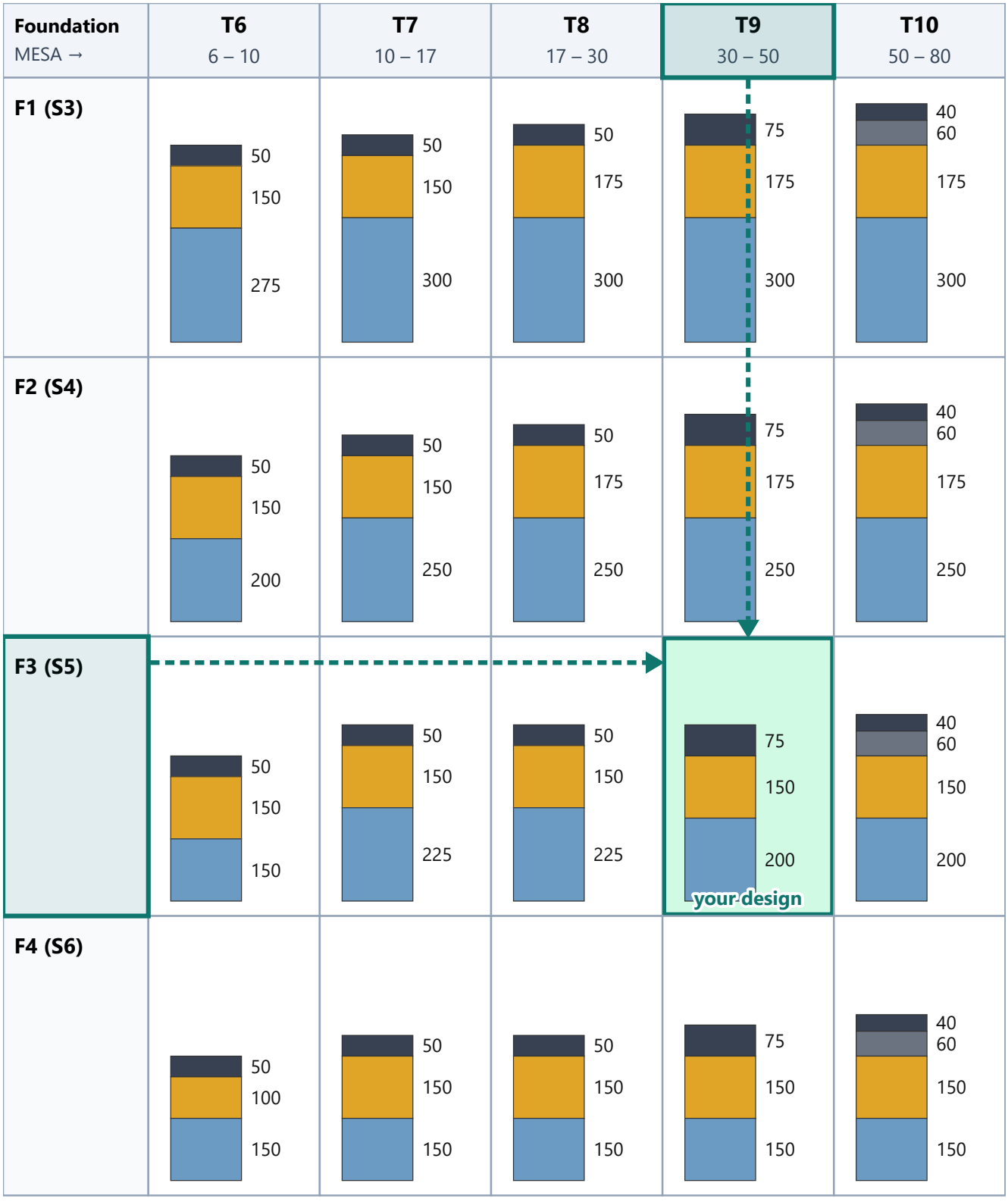
Chart C1 — Asphalt wearing + DBM binder course + GB1/BSM roadbase + granular sub-base (6 to 50 MESA)

Foundation MESA →	T6 6 – 10	T7 10 – 17	T8 17 – 30	T9 30 – 50
F1 (S3)	40 60 200 225	50 75 200 250	50 100 200 275	50 125 200 300
F2 (S4)	40 60 200 175	50 75 200 200	50 100 200 225	50 125 200 250
F3 (S5)	40 60 150 150	50 75 175 150	50 100 200 150	50 125 225 150
F4 (S6)	40 60 200	50 75 225	50 100 250	50 125 275

AC — Asphalt concrete / hot rolled asphalt (AC/HRA)
DBM — Dense bitumen macadam (DBM)
GB1 — Granular base 1 / bitumen stabilised material (GB1/BSM)
GS2 — Granular sub-base 2 (GS2)

Cells used: Option 1 — traffic class T9, No capping (S5 = F3), 42.50 MESA.

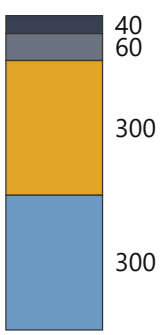
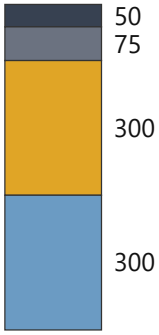
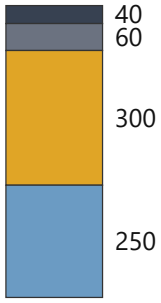
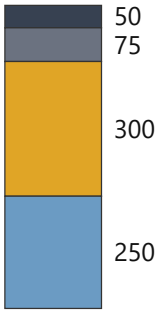
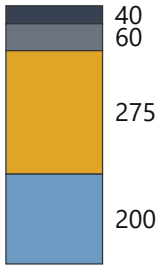
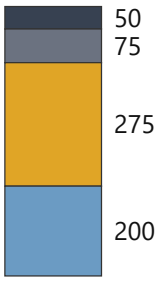
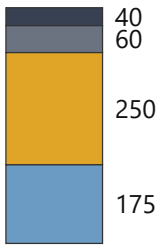
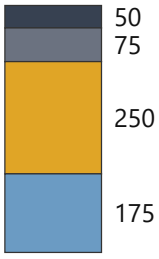
Chart C2 — Asphalt surfacing + GB1/BSM roadbase + hydraulically bound sub-base (6 to 80 MESA)



- AC — Asphalt concrete / hot rolled asphalt (AC/HRA)
- GB1 — Granular base 1 / bitumen stabilised material (GB1/BSM)
- CB1 — Hydraulically bound material (CB1)
- DBM — Dense bitumen macadam (DBM)

Cells used: Option 2 — traffic class T9, No capping (S5 = F3), 33.78 MESA.

Chart D — Asphalt wearing + DBM binder course + crushed stone roadbase + hydraulically bound sub-base (30 to 80 MESA)

Foundation MESA →	T9 30 – 50	T10 50 – 80
F1 (S3)		
F2 (S4)		
F3 (S5)		
F4 (S6)		

- AC — Asphalt concrete / hot rolled asphalt (AC/HRA)
- DBM — Dense bitumen macadam (DBM)
- GB1 — Granular base 1 / bitumen stabilised material (GB1/BSM)
- CB1 — Hydraulically bound material (CB1)

Cells used: Option 3 — traffic class T9, No capping (S5 = F3), 33.78 MESA.

Generated with the free Road Note 31 Flexible Pavement Design tool at shahidpervaiz.net. Results must be checked by a qualified pavement engineer before use.