NEW SOUTH WALES

DEVELOPMENT DESIGN SPECIFICATION

D2

PAVEMENT DESIGN

Amendment Record for this Specification Part

This Specification is Council's edition of the AUS-SPEC generic specification part and includes Council's primary amendments.

Details are provided below outlining the clauses amended from the Council edition of this AUS-SPEC Specification Part. The clause numbering and context of each clause are preserved. New clauses are added towards the rear of the specification part as special requirements clauses. Project specific additional script is shown in the specification as italic font.

The amendment code indicated below is 'A' for additional script 'M' for modification to script and 'O' for omission of script. An additional code 'P' is included when the amendment is project specific.

Amendment Sequence No.	Key Topic addressed in amendment	Clause No.	Amendment Code	Author Initials	Amendment Date
1.	Add new reference –AUSTROADS – "A guide to the design of new pavements for light traffic" APRG Report No. 21, 1998	D2.03	A	GA	Sep 2000
2.	Add new reference – ARRB – "Unsealed Roads Manual – A Guide to Good Practice",1998	D2.03	A	GA	Sep 2000
3.	In subclause 1 modify pavement design life from 25 years to 20 years	D2.05	M	GA	Sep 2000
4.	Remove subclause 4 – Design Traffic Volumes	D2.05	O	GA	Sep 2000
5.	Remove subclause 5 – Guide to Design ESAs	D2.05	O	GA	Sep 2000
6.	Add new subclause 6 – Design traffic Volumes	D2.05	A	GA	Sep 2000
7.	Add new subclause 7 – Design Traffic Volumes	D2.05	A	GA	Sep 2000
8.	Change from reference ARRB SR41,fig.7 to Austroads APRG R21, fig.13.8.2 (A)	D2.11, D2.12	M	GA	Sep 2000
9.	Replace type of seal specified from asphalt to spray seals	D2.16 (a),(b),(c)	M	GA	Sep 2000
10.	Add new subclause 3 – Seal Design	D2.21	A	GA	Sep 2000
11.	Add new subclause 4 – Spray Sheets, Seal Records	D2.21	A	GA	Sep 2000
12.	Add new Clause – Wearing Course (Rural Roads)	D2.22	A	GA	Sep 2000
13.	Add new Clause – Unsealed Road Pavements	D2.23	A	GA	Sep 2000

PAVEMENT DESIGN

GENERAL

D2.01 SCOPE

1. The work to be executed under this Specification consists of the design of the road pavement to meet the required design life, based on the subgrade strength, traffic loading and environmental factors, and including the selection of appropriate materials for select subgrade, subbase, base and wearing surface. ***Design Criteria***

2. The Specification contains procedures for the design of the following forms of surfaced road pavement construction: ***Surfaced Pavement Types***

   (a) flexible pavements consisting of unbound granular materials;

   (b) flexible pavements that contain one or more bound layers, including pavements containing asphalt layers other than thin asphalt wearing surfaces;

   (c) rigid pavements (ie. cement concrete pavements);

   (d) concrete or clay segmental pavements.

3. Consideration to the design of unsealed (gravel) pavements will only be given for minor rural subdivisions/developments in isolated rural areas where the access to the subdivision is via an existing unsealed road. (Refer to Clause 2.22 and Clause 2.23). ***Unsealed Pavements***

D2.02 OBJECTIVES

1. The objective in the design of the road pavement is to select appropriate pavement and surfacing materials, types, layer thicknesses and configurations to ensure that the pavement performs adequately and requires minimal maintenance under the anticipated traffic loading for the design life adopted. ***Pavement Performance***

D2.03 REFERENCE AND SOURCE DOCUMENTS

(a) Council Specifications

D1	-	Geometric Road Design [1]
D4	-	Subsurface Drainage Design [2]
C242	-	Flexible Pavements [3]
C244	-	Sprayed Bituminous Surfacing [4]
C245	-	Asphaltic Concrete [5]
C247	-	Mass Concrete Subbase [6]
C248	-	Plain or Reinforced Concrete Base [7]
C254	-	Segmental Paving [8]
C255	-	Bituminous Microsurfacing [9]

(b) State Authorities

Roads and Traffic Authority, NSW - Sprayed Sealing Guide, 1992 [10].

(c) Other

AUSTROADS Pavement Design, A Guide to the Structural Design of Road Pavements, 1992. [11]
AUSTROADS A guide to the design of new pavements for light traffic, 1998 (APRG Report No. 21)[12]
AUSTROADS Guide to Control of Moisture in Roads. [13]
ARRB-SR41 Australian Road Research Board, Special Report No. 41 - A Structural Design Guide for Flexible Residential Street Pavements, 1989. [14]
ARRB Unsealed Roads Manual –Guidelines to Good Practice, 1993 [15]

Cement and Concrete Association of Australia.
CACA - T51 Concrete Pavement Design for Residential Streets, 1997 [16].

Concrete Masonry Association of Australia.
CMAA - T44 Concrete Segmental Pavements - Guide to Specifying, 1997 [17]
CMAA - T45 Concrete Segmental Pavements - Design Guide for Residential Access Ways and Roads, 1997.[18]
CMAA - T46 Concrete Segmental Pavements - Detailing Guide, 1997 [19].

Clay Brick and Paver Institute
Design Manual 1 – Clay Segmental Pavements, A Design and Construction Guide for Sites Subjected to Vehicular and Pedestrian Traffic, 1989. [20]

PAVEMENT DESIGN CRITERIA

D2.04 DESIGN VARIABLES

1. Regardless of the type of road pavement proposed, the design of the pavement shall involve consideration of the following five input variables:

(a) Design Traffic

(b) Subgrade Evaluation

(c) Environment

(d) Pavement and Surfacing Materials

(e) Construction and Maintenance Considerations

D2.05 DESIGN TRAFFIC

1. The design traffic shall be calculated based on the following minimum design lives of pavement:-

Minimum Pavement Design Life

(a) Flexible, Unbound Granular – 20 years

(b) Flexible, Containing one or more bound layers – 20 years

(c) Rigid (Concrete) - 40 years

(d) Segmental Block – 20 years

2. Design traffic shall be calculated in equivalent standard axles (ESAs) for the applicable design life of the pavement, taking into account present and predicted commercial traffic volumes, axle loadings and configurations, commercial traffic growth and street capacity. For new subdivisions, the design traffic shall take account of both the construction traffic associated with the subdivision development and the in-service traffic for the subdivision and any future developments linked to that subdivision. For interlocking concrete segmental pavements, the simplification of replacing ESA's with the number of commercial vehicles exceeding 3 tonne gross contained in CMAA - T45 is acceptable up to a design traffic of 10^6. Beyond this, ESAs should be calculated. ***Equivalent Standard Axles***

3. The pavement design shall include all traffic data and/or assumptions made in the calculation of the design traffic. ***Traffic Data***

4. (Deleted).

5. For design traffic in the range of 10^3 to $5x\ 10^5$ ESAs reference should be made to the Austroads Guide to the Design of new pavements for light traffic - Ref.[12]. For design traffic volumes exceeding 10^6 ESAs, the Austroads Pavement design – Guide to the Structural Design of Road Pavements should be used - Ref.[11]. ***Design Traffic Voluimes***

6. In the absence of traffic data, the design traffic (in ESAs) given below may be taken as a guide, but shall be subject to variation depending on the circumstances for the particular development. ***Guide to design ESAs***

Street Type		**Design ESA**	**Design Life**
Urban Residential	Access Street	2×10^4	20 years
	Local Street	5×10^4	20 years
	Collector Street	3.5×10^5	20 years
	Local Sub –Arterial	2×10^6	20 years
Rural Residential		1×10^4	20 years
Commercial and Industrial		7.5×10^4	20 years

'For minor and local access streets to be constructed in new residential subdivisions, a suitable addition to design traffic to cover traffic generated by housing construction in the subdivision is given by the following:

TOTAL ESAs associated with construction traffic = 3 x AADT." Ref [12]

D2.06 SUBGRADE EVALUATION

1. Except where a mechanistic design approach is employed using AUSTROADS Pavement Design, the measure of subgrade support shall be the California Bearing Ratio (CBR). Where a mechanistic design approach using linear elastic theory is employed for flexible pavements, the measure of subgrade support shall be in terms of the elastic parameters (modulus, Poisson's ratio). ***California Bearing Ratio***

2. The following factors must be considered in determining the design strength/stiffness of the subgrade: ***Design Considerations***

(a) Sequence of earthworks construction

(b) The compaction moisture content and field density specified for construction

(c) Moisture changes during service life

(d) Subgrade variability

(e) The presence or otherwise of weak layers below the design subgrade level.

Design CBR Considerations

3. The subgrade Design CBR adopted for the pavement design must consider the effect of moisture changes in the pavement and subgrade during the service life, and hence consideration must be given to the provision of subsurface drainage in the estimation of equilibrium in-situ CBRs, and hence in the design of the pavement structure. Warrants for the provision of subsurface drainage are given in Specification for SUBSURFACE DRAINAGE DESIGN. If subsurface drainage is not provided, then the Design CBR adopted must allow for a greater variability in subgrade moisture content during the service life of the pavement, and hence a Design Moisture Content above the Optimum Moisture Content.

Calculation of Design CBR

4. The calculation of the Design CBR shall be based on a minimum of three 4 day soaked CBR laboratory samples for each subgrade area, compacted to the relative density specified for construction, and corrected to allow for the effects of subsurface drainage (or lack of), climatic zone, and soil type if appropriate (as per the guidelines in ARRB SR41) to give an estimated equilibrium in-situ CBR. The Design CBR for each subgrade area is computed by using the appropriate formulae as follows:

Design CBR = Least of estimated CBRs, for less than five results

Design CBR = 10th percentile of all estimated CBRs, for five or more results

= C - 1.3S

Where C is the mean of all estimated CBRs, and
S is the standard deviation of all values.

Field Confirmation

5. Where practicable, the Design CBR obtained from laboratory testing should be confirmed by testing performed on existing road pavements near to the job site under equivalent conditions and displaying similar subgrades.

Summary of Results

6. The pavement design shall include a summary of all laboratory and field test results and assumptions and/or calculations made in the assessment of Design CBR.

D2.07 ENVIRONMENT

Moisture and Temperature

1. The environmental factors, which significantly affect pavement performance, are moisture and temperature. Both of these factors must be considered at the design stage of the pavement. Reference should be made to AUSTROADS Pavement Design, ARRB-SR41, Austroads, APRG R21, and to NAASRA (Now AUSTROADS) – Guide to Control of Moisture in Roads.

Moisture Considerations

2. The following factors relating to moisture environment must be considered in determining the design subgrade strength/stiffness and in the choice of pavement and surfacing materials:

(a) Rainfall/evaporation pattern

(b) Permeability of wearing surface

(c) Depth of water table

(d) Relative permeability of pavement layers

(e) Whether shoulders are sealed or not

(f) Pavement type (boxed or full width)

Evaluate Design CBR

3. The effect of changes in moisture content on the strength/stiffness of the subgrade shall be taken into account by evaluating the design subgrade strength

parameters (ie. CBR or modulus) at the highest moisture content likely to occur during the design life, ie the Design Moisture Content. The provision of subsurface drainage may, under certain circumstances, allow a lower Design Moisture Content, and hence generally higher Design CBR.

Temperature Change

4. The effect of changes in temperature environment must be considered in the design of pavements with asphalt wearing surfaces, particularly if traffic loading occurs at night when temperatures are low, thus causing a potential reduction in the fatigue life of thin asphalt surfacing. The effect of changes in temperature environment should also be considered for bound or concrete layers.

5. The pavement design shall include all considerations for environmental factors, and any assumptions made that would reduce or increase design subgrade strength, or affect the choice of pavement and surfacing materials.

D2.08 PAVEMENT AND SURFACING MATERIALS

Pavement Classification

1. Pavement materials can be classified into essentially four categories according to their fundamental behaviour under the effects of applied loadings:

(a) Unbound granular materials, including modified granular materials

(b) Bound (cemented) granular materials

(c) Asphaltic Concrete

(d) Cement Concrete

Surfacing Classification

2. Surfacing materials can also be classified into essentially five categories or types:-

(a) Sprayed bituminous seals (flush seals)

(b) Asphaltic concrete and bituminous microsurfacing (cold overlay)

(c) Cement Concrete

(d) Concrete Segmental Pavers

(e) Clay Segmental Pavers

3. Unbound granular materials, including modified granular materials, shall satisfy the requirements of the Construction Specification for FLEXIBLE PAVEMENTS – C242 Ref[3].

4. Bound (cemented) granular materials shall satisfy the requirements of the Construction Specification for FLEXIBLE PAVEMENTS – C242 Ref[3]...

5. Asphaltic concrete shall satisfy the requirements of the Construction Specification for ASPHALTIC CONCRETE C245 Ref. [5]

6. Cement concrete shall satisfy the requirements of the Construction Specifications for MASS CONCRETE SUBBASE, PLAIN OR REINFORCED CONCRETE BASE, or FIBRE REINFORCED CONCRETE, as appropriate.

7. Sprayed bituminous seals shall satisfy the requirements of the Construction Specification for SPRAYED BITUMINOUS SURFACING C244 Ref.[4].

8. Concrete and clay segmental pavers shall satisfy the requirements of the Construction Specification for SEGMENTAL PAVING C254 Ref.[8].

9. Bituminous microsurfacing (cold overlay) shall satisfy the requirements of the Construction Specification for BITUMINOUS MICROSURFACING C255 Ref.[9].

D2.09 CONSTRUCTION AND MAINTENANCE CONSIDERATIONS

1. The type of pavement, choice of base and subbase materials, and the type of surfacing adopted should involve consideration of various construction and maintenance factors as follows:

(a) Extent and type of drainage

(b) Use of boxed or full width construction

(c) Available equipment of the Contractor

(d) Use of stabilisation

(e) Aesthetic, environmental and safety requirements

(f) Social considerations

(g) Construction under traffic

(h) Use of staged construction

(i) Ongoing and long-term maintenance costs

These factors are further discussed in AUSTROADS Pavement Design.

PAVEMENT THICKNESS DESIGN

D2.10 PAVEMENT STRUCTURE - GENERAL

1. The pavement thickness, including the thickness of surfacings, shall not be less than 250mm for roads in which kerb and guttering is to be constructed, 200mm for unkerbed roads and 150mm for carparks. ***Minimum Pavement Thickness***

5. Notwithstanding subgrade testing and subsequent pavement thickness design, the thickness of subbase and base layers shall not be less than the following:-

(a) Flexible pavement: Subbase 100mm, Base 100mm
(b) Rigid pavement: Subbase 100mm, Base 150mm

3. The subbase layer shall extend a minimum of 150mm behind the rear face of any kerbing and/or guttering. ***Subbase Extent***

4. The base and surfacing shall extend to the face of any kerbing and/or guttering. Where the top surface of the subbase layer is below the level of the underside of the kerbing and/or guttering, the base layer shall also extend a minimum of 150mm behind the rear face of the kerbing and/or guttering. ***Base Extent***

5. For unkerbed roads, the subbase and base layers shall extend at least to the nominated width of shoulder. ***Unkerbed Roads***

6. The pavement designer shall make specific allowance for traffic load concentrations within carpark areas (eg entrances/exits). ***Carparks***

7. The pavement designer shall make provision for pavement layer drainage on the assumption that during the service life of the pavement ingress of water will occur. ***Drainage***

D2.11 UNBOUND GRANULAR FLEXIBLE PAVEMENTS (BITUMINOUS SURFACED)

1. Unbound granular flexible pavements with thin bituminous surfacings, including those with cement or lime modified granular materials, with design traffic up to 10^6 ESAs shall be designed in accordance with Austroads Guide to the Design of New Pavements for Light Traffic, using Fig. 13.8.2(A) (95% confidence level curves) for urban streets and Fig 13.8.2 (B) (90% confidence level curves) for rural roads

2. For design traffic above 10^6 ESAs, the design shall be in accordance with AUSTROADS Pavement Design.

D2.12 FLEXIBLE PAVEMENTS CONTAINING BOUND LAYERS (BITUMINOUS SURFACED)

1. Flexible pavements containing one or more bound layers, including cement stabilised layers or asphaltic concrete layers other than thin asphalt surfacings, shall be designed in accordance with AUSTROADS Pavement Design.

2. As an alternative to AUSTROADS Pavement Design for design traffic up to 10^6 ESAs, bound layers may be assumed to be equivalent to unbound layers of the same thickness, and the pavement designed in accordance with Austroads Guide to the design of new pavements for light traffic, using Fig. 13.8.2(A) (95% confidence level curves) for urban streets and Fig 13.8.2 (B) (90% confidence level curves) for rural roads

D2.13 RIGID PAVEMENTS

1. Rigid (concrete) pavements, with design traffic up to 10^6 ESAs shall be designed in accordance with either CACA -T51 or AUSTROADS Pavement Design.

2. Rigid (concrete) pavements for design traffic above 10^6 ESAs, the design shall be in accordance with AUSTROADS Pavement Design.

D2.14 CONCRETE SEGMENTAL PAVEMENTS

1. Concrete segmental pavements with design traffic up to 10^6 estimated commercial vehicles exceeding 3T gross shall be designed in accordance with CMAA-T45.

2. For design traffic above 10^6 estimated commercial vehicles exceeding 3T gross the design shall be in accordance with AUSTROADS Pavement Design, with the calculation of design traffic in terms of ESAs.

D2.15 CLAY SEGMENTAL PAVEMENTS

1. Clay segmental pavements with design traffic up to 10^6 ESAs shall be designed in accordance with Design Manual 1 – Clay Segmental Pavements.

2. For design traffic above 10^6 ESAs and up to 10^7 ESAs the design shall involve consideration of both Design Manual 1 – Clay Segmental Pavements and AUSTROADS Pavement Design, with the thicker and more conservative design of each of the two methods adopted.

3. For design traffic above 10^7 ESAs, the pavement shall be designed in accordance with AUSTROADS Pavement Design.

SURFACING DESIGN

D2.16 CHOICE OF SURFACE TYPE

1. Except where the pavement is designed for concrete or segmental block surfacing, the wearing surface shall be a bituminous wearing surface as follows:- ***Bitumen Wearing Surface***

(a) Urban Residential streets – Access Street and Local Street, and Rural Residential streets:

- (deleted)
- 7 mm primer seal first coat, 14mm seal second coat OR
- 14mm seal first coat, 7mm seal second coat (Double /Double Seal)

NOTE: A minimum of 2 weeks must be provided between the primer seal and second coat

(b) Urban Residential streets – Collector and Local Sub-Arterial:

- 10mm primer seal, plus 14mm flush seal, or
- 20mm seal first coat, 10mm seal second coat (Double / Double Seal)

(c) Commercial and Industrial streets:

- 7mm primer seal, plus 20mm/10mm Double / Double Seal

2. At intersection approaches and cul-de-sac turning circles on residential streets with flush seals, either bituminous microsurfacing or asphalt surfacing shall be provided within the vehicle braking and turning zones. ***Braking and Turning Zones***

3. Variations to these requirements may be approved by Council in special circumstances. ***Approval***

D2.17 SPRAYED BITUMINOUS SEALS (FLUSH SEALS)

1. The design of sprayed bituminous (flush) seals, including primer seals, shall be in accordance with the RTA Sprayed Sealing Guide. ***Seal Design***

2. 7mm primer seals shall be indicated on the Drawings below all flush seals, bituminous microsurfacing, and asphalt surfacings. Where a 7mm primer seal is impractical, a 10mm primer seal shall be indicated in lieu. ***Primer Seal***

3. Two-coat flush seals shall be double-double seals, comprising a minimum of two coats binder and two coats of aggregate. The preferred seal types are: ***Two- Coat Flush Seals***

1st coat	14mm
2nd coat	7mm

4. Single coat flush seals shall be allowable if bituminous microsurfacing (or asphaltic concrete) is to be applied as the finished surface. The preferred seal type is either 14mm or 10mm. ***Single Coat Flush Seal***

D2.18 BITUMINOUS MICROSURFACING (COLD OVERLAY)

1. Bituminous microsurfacing, also referred to as 'cold overlay', shall be designed to provide a nominal compacted thickness of not less than 8mm. ***Minimum Thickness***

2. As a minimum, a 7mm primer seal and a single coat flush seal shall be indicated on the Drawings below the bituminous microsurfacing. ***Primer Seal and Single Coat Seal***

D2.19 ASPHALTIC CONCRETE

1. In urban residential access and local streets, rural or light trafficked commercial streets (design traffic up to approximately 3 x 10^5 ESAs), the asphalt mix design shall be either a 'high-bitumen content' mix or the ARRB Gap-graded mix in accordance with ARRB-SR41 and the Construction Specification for ASPHALTIC CONCRETE. ***Light to Medium Traffic***

2. In urban residential collector and sub-arterial roads, medium to heavily trafficked commercial streets and in all industrial roads, the asphalt mix design shall be a dense graded mix in accordance with the Construction Specification for ASPHALTIC CONCRETE. ***Medium to Heavy Traffic***

3. Asphaltic concrete surfacings shall be designed to provide a nominal compacted layer thickness of not less than 25mm on light to medium trafficked residential, rural and commercial streets, and 40mm on medium to heavily trafficked residential, rural or commercial roads and on all industrial and classified roads. ***Minimum Thickness***

4. As a minimum, a 7mm or 10mm primer seal shall be indicated on the Drawings below the asphalt surfacing. ***Primer Seal***

D2.20 SEGMENTAL PAVERS

1. Concrete segmental pavers shall be 80mm thick, shape Type A, and designed to be paved in a herringbone pattern. ***Size and Shape***

2. Clay segmental pavers shall be 65mm thick, Class 4, and designed to be paved in a herringbone pattern.

3. The edges of all paving shall be designed to be constrained by either kerbing and/or guttering, or by concrete edge strips. ***Edge Constraint***

DOCUMENTATION

D2.21 DESIGN CRITERIA AND CALCULATIONS

1. All considerations, assumptions, subgrade test results, and calculations shall be submitted with the pavement design for approval by Council's Engineer. ***Submission Details***

2. The Drawings shall clearly indicate the structure, material types and layer thicknesses of the proposed pavement and surfacing. ***Drawings***

3. Design forms recording the design of the selected seal treatment must be submitted to Council's Engineer for approval. ***Seal Design***

4. The contractors spray sheets / record must be submitted to the Council Engineer following completion of work. ***Spray Sheets, Seal Records***

SPECIAL REQUIREMENTS

D2.22 WEARING COURSE (RURAL ROADS)

Sealing of the road system will be required on all new roads and existing roads which will be an extension of existing sealed roads. ***Minimum Requirements***

For roads which are created in new subdivisions off an existing unsealed road, sealing of the road system will be required under the following conditions:

1. Where traffic volumes are likely to exceed 100 vehicles per day.
2. Where longitudinal grades exceed 10% or the road pavement will otherwise exhibit a high scouring potential in any section of the road.
3. Where there are causeways, floodways and approaches which may be subject to regular flooding on any section of the road.
4. Where pavement base courses are chemically stabilised on any section of the road.
5. On superelevated pavements, which are likely, to be subject to scouring from undesirable cross pavement water flows.

Unless otherwise mentioned in this specification, the wearing course is to be applied the full width of the gravel pavement, including widenings.

D2.23 UNSEALED ROAD PAVEMENTS

Design Criteria

"Unsealed road pavements are often constructed in development stages. Whether or not staged development of the pavement is employed, a pavement design method is required to determine the full thickness of pavement which takes into account the traffic, soil, and moisture conditions likely during its design life"(Unsealed Roads Manual Ref. 15)

Design life

Design charts from Austroads design of new pavements for light traffic based on an 80% confidence level (Ref. [12], fig. 13.8.2 (c)) can be used for determining pavement thickness. Design traffic is to be calculated for a design life of 10 years.

Staged Construction

If staged construction is proposed then 2 approaches can be adopted in deciding the first stage pavement thickness

1. Provide a nominal single course (100-150mm) of pavement when the following conditions apply:

- Dry climatic conditions and good drainage,
- Low traffic volumes
- Traffic consists predominantly of light vehicles
- the risk of overloaded vehicles is low; and
- the paving material is suitable

2. Provide a designed pavement thickness of 50 to 100mm less than that required for a sealed road, with a minimum of 100 – 150mm, when the following conditions prevail:

- Wet climatic conditions and or poor drainage
- Higher traffic volumes
- Traffic mix contains a significant number of heavy vehicles
- The road carries through truck traffic
- The road is likely to be used in times high subgrade moisture; and
- The risk of overloaded vehicles is high.

"Prior to sealing at a later stage, after initial construction, the residual pavement will be required to built up to full depth in accordance with the design standards". (ref,15)

If sealing is to be delayed then the minimum depth of wearing course should take into consideration the likely loss of material during the period of the regravelling cycle.

Wearing Course

"The desirable characteristics of the wearing course of an unsealed road are:

- Skid resisitance
- Smooth riding characteristics
- Resistance to ravelling and scouring
- Wet and dry stability
- Low permeability; and
- Load spreading ability

For ease of construction and maintenance, a surface material should also be easy to grade and compact" (Ref.15).

Selection of Materials

"A soil-aggregate consisting of a well-graded gravel-sand mixture with a small proportion of clayey fines will usually be the most desirable material for an unsealed surface. Gravels and sands, which are low in fines, will be porous, lack stability when dry and will ravel under traffic. However, fines in the form of a sand-clay may be incorporated into these materials to give added stability.

The least desirable materials are those with silty fines, lacking gravel sized particles, i.e. silts and silty-sands. These materials are likely to be porous and unstable and will ravel under traffic. They also tend to generate considerable dust.

Predominantly clay soils can provide a good dry-weather surface but will be slippery and/or will rut when wet. Sand-clay or sand-silt-clay mixtures can provide a satisfactory surface course for low-traffic volume roads.

In terms of the percentage passing the various sieve sizes, the requirements listed below are suggested as a guide in the selection of wearing course materials.

- For ease of grading and compaction and for the safety and comfort of traffic, it is desirable that 100% of stone should pass a 26.5mm sieve (or preferably 20mm if economical)
- For resistance to ravelling, the percentage of material retained on a 2.36mm sieve, should be between 20%and 60%.
- For stability and to reduce permeability, the fines to sand ratio should be in the range 0.20 – 0.60 i.e.

$$0.2 < \frac{\%\ \text{less than}\ 0.075\text{mm}}{\%\ \text{less than}\ 2.36\text{mm}} < 0.6$$

Either the Plasticity Index (PI) or the Linear Shrinkage (LS) can be used to evaluate whether the clay content of a material is appropriate. The PI or LS should desirably fall within minimum and maximum values, depending on climatic conditions, grading of the material and traffic conditions.

The overall range of PI, which might be considered, is 4 to15. The lower end of the range is appropriate for wetter climates, higher traffic and lower stone content materials, whereas the higher end of the range is appropriate for arid climates, lower traffic and higher stone content materials. The corresponding linear shrinkage range would be 2 to 8." (Ref 15).

D2.24 RESERVED

D2.25 RESERVED

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