BASE MATERIAL SPECIFICATIONS

Tentative specifications considered in designing, subject to modification for betterment. This will provide starter for designer.

Most of the specifications are based on IRC, MORT&H and Ministry of transport specifications.

The most important difference to be observed in these specifications is the absence of the commonly used methods of Rubble Soling and Water Bound Macadam (WBM), the practice of which, has been prevalent for many many years in our country, but the application of which has been discontinued by most of the relevant regulatory bodies recently, in favour of newer options.

Minimum recommended strength requirements for unbound aggregate base should be CBR= 80% and CBR=30% for Sub Bases

The specifications in detail should aim at minimizing field quality control at remote sites and economize cost.

Specifications:

1) Grading for Aggregates in Base & Sub-base Layer:

I. S. Sieve	Base Layer		Sub-base Layer	
	% Passing	Adoptable Variation	% Passing	Adoptable Variation
50.00 mm	100	(- 2)	100	(- 3)
37.50 mm	95 – 100	(± 5)	90 – 100	(± 5)
19.00 mm	70 – 89	(± 8)	-	-
9.50 mm	50 – 75	(± 8)	-	-
4.75 mm	35 – 55	(± 8)	30 – 60	(± 10)
600 μ	12 – 55	(± 5)	-	-
75 μ	0 – 8	(± 3)	1-12	(± 5)

2) Grading for Bedding Sand for Pavers:

I. S. Sieve	% Passing
10.00 mm	100
4.75 mm	95 – 100
2.36 mm	80 – 100
1.18 mm	50 – 85
600 μ	25 – 60
150 μ	2 – 10

3) Geo-filter:

UV Stable, Polypropylene Woven Geo-filter

Type: 1, For Soil CBR > 5
Having 90 ± 2 g / m^2 wt, k = 25 or more liter / m^2 / sec

Type: 2, For Soil CBR < 5
Having 140 ± 2 g / m^2 wt, k = 25 or more liter / m^2 / sec

4) Cement Treated Base:

With 7 days compressive strength 4.5 Mpa
M10 or more grade of Concrete (As per IRC: 60 for Lime-Fly ash concrete as Pavement Base/Sub-Base & IRC: 74 for Lean Cement Concrete and Lean Cement–Fly Ash Concrete as Pavement base or Sub-base.)

5) Asphalt Treated Base:

The material should conform to dense graded, asphalt concrete specifications i.e. Marshall stability of at least 8000 N.

6) Wet Mix Macadam for Sub-base.

The Aggregate for Wet Mix Macadam shall confirm to following Physical Properties & Grading

Physical requirements of Coarse Aggregates for Wet Mix Macadam for Sub-base / Base Course:

1. Los Angeles Abrasion Value: 40 % (Maximum) or
   Aggregate Impact Value: 30 % (Maximum)
2. Combined Flakiness and Elongation Indices (Total): 30 % (Maximum)

Grading Requirements of Aggregates For Wet Mix Macadam:

I. S. Sieve Designation	% By Wt. Passing the I. S. Sieve
53.00 mm	100
45.00 mm	95-100
26.50 mm	-
22.40 mm	60-80
11.20 mm	40-60
4.75 mm	25-40
2.36 mm	15-30
600.00 micron	8-22
75.00 micron	0-8

The material finer than 425 micron shall have Plasticity Index (PI) not exceeding 6.

5.0 ECONOMICS:

The cost aspect is governed by Cost of materials – Aggregates, Bitumen, Cement, Fly ash, Sand, etc. The design given is a typical pattern.

For site where good stone is easily available the unbound aggregate base and sub-base could be planned using economical thickness of each by proper designing.

The modern material byproducts like Fly ash could prove economical & eco-friendly as explained latter.

6.0 SCOPE FOR NEW MATERIALS:

The future trend and development which will be adopted in design will be, use of Fly ash with some 10 to 20 % clay as fill materials for the embankment or raising of existing low level ground to road formation level for petrol pumps. (Refer IRC: SP – 20, 2002, Pg – 222). The layers of properly mixed fly ash, 15 – 20 % soil and water in pan mixture, placed and rolled in 200 mm layers may provide CBR value more than 50. It will provide cheapest, Eco-friendly material for sub-base and base for some sites.

Similarly lime - fly ash stabilized soil could provide attractive alternative materials for sub-base and base in some locations. Use of waste fly ash and prevention of exploitation of topsoil layer would be demand of environment in future. The laboratory design mix of fly ash – soil - lime for strength will be specified with OMC and density (Heavy Compaction Test). Both mix in place or control-mixing techniques can be adopted (Refer IRC: SP– 20, 2002, Pg – 232).

Lime – Fly ash bound macadam (LFBM, Article 9.5 of IRC – 20), Lime fly ash concrete (suitable as replacement of WBM in heavy rainfall expansive soil areas (Article 9.6 of IRC – 20), Roller compacted Fly ash concrete pavement are alternative materials for Sub-base.

Base course of Dry Lean Fly ash concrete (cement binder) designed for zero slump can be an alternative. Dry lean fly ash concrete replacing 50 % sand (by wt) in conventional mix by equal absolute volume of fly ash (e.g. 1 Cement : 2.5 Sand : 2.5 n Fly ash : 10 Aggregates, n = ratio of sp. Gravity of ash / sp. Gravity of sand) may give 28 days strength 13 MPa. This may replace the sub-base economically at some of the sites where aggregates are not good in quality.

The best results are reported by using 45° Herringbone structure illustrated in Fig: 3. The side friction is controlled by friction between block and sluiced sand. The horizontal movements are checked by friction of bedding sand & end restrains by Curb wall.

7.0 GLOSSARY OF TERMS:

Base Course:
A material of a designed thickness placed on a sub-base or a subgrade to support a surface course. A base course can be compacted aggregate, cement or asphalt stabilized aggregate, asphalt or concrete.

Bedding sand:
A layer of coarse, clean sand that is screeded smooth for bedding the pavers. The sand can be natural or manufactured i.e. crushed from large rocks and should conform to the grading requirements of ASTM C 33. The layer is 1 to 1/1/2 in. (25 to 40mm) thick.

Bitumen:
A class of asphalts combined with neoprene and used as an adhesive under unit paving.

CBR:
The ratio of: (1) the force per unit area required to penetrate a soil mass with a 3 in.sq. (19 cm.sq.) circular piston (approx. 2 in.(51mm) dia at the rate of 0.05 in.(1.3mm).min, to (2) that required for corresponding penetration of a standard material. The ratio is usually determined at 0.1in. (2.5mm)penetration, although other penetrations are sometimes used.

Clay :
Fine-grained soil or the fine-grained portion of soil that can be made to exhibit plasticity (putty like properties)within a rage of water contents and that exhibits considerable strength when air dry . The term can designate soil particle finer than 0.002mm (0.005 mm in some case).

EALs :
Summation of equivalent 18,000 pound-force (80 kN) single axle loads used to combine mixed traffic to a design traffic load for the design period.

Failure :
The point at which a pavement does not adequately service its intended use. For flexible pavements, rut depth is often a criteria for failure.

Flexible Pavements :
A pavement structure which maintains intimate contact with and distributes loads to the sub-grade. The base course materials rely on agg. Interlock, particle friction and cohesion for stability.

Geo Grid :
Geogrids are two dimensional or three dimensional. The two dimensional type are flat and have small “TV Screen” shaped openings. The materials is generally placed between the soil and the base to reduce rutting. Three dimensional geogrids are 4 to 8 in. (100 to 200mm) high and provide stability under loads for cohesionless soils.

Geo Textile :
Woven or on-woven fabrics made from plastic fibers used for separation, reinforcement or drainage between pavement layers.

Optimum Moisture Content:
The water content at which a soil can be compacted to a maximum dry unit weight by a given compactive effort.

Plastic Limit:
(1) The water content corresponding to an arbitrary limit between the plastic and the semisolid states of consistency of a soil. (2) Water
content at which a soil will just begin to crumble when rolled into a thread approximately 1/8 in. (3.2 mm) in diameter.

Rutting:
Permanent deformation from repetitive traffic loading that exceeds the ability of the pavement structure to maintain its original profile.

Structural Number (SN):
The basis of the flexible pavement design method developed by the American Association of State Highway and Transportation Officials (AASHTO). It is a dimensionless number expressing the relative strength of a pavement structure. The SN is calculated from an analysis of traffic, roadbed soil conditions, and environment. The SN equals the sum of layer coefficients, with each coefficient quantifying the material strength and thickness of each pavement layer.

Sub-base:
The layer or layers of specified or selected material of designed thickness placed on a subgrade to support a base course.

Subgrade:
The soil upon which the pavement structure and shoulders are constructed.

Sand:
Granular material passing the 3/8 in. (5 mm) and retained on the No. 200 (0.075 mm) sieve, made from the natural erosion of rocks, and consisting of sub-angular or rounded particles. Sands made by crushing of coarse aggregates are called *manufactured sands*.

Screenings:
A residual product not suitable for bedding sand. It is a by-product from the crushing of rock, boulders, cobble, gravel, blast-furnace slag or concrete. Most of the aggregate passes the No. 4 (4.75 mm) sieve.

Silt:
Soil finer than 0.02 mm and coarser than 0.002 mm (0.5 mm and 0.005 mm in some cases)

Soil Separation Fabric:
A layer of fabric typically placed between the subgrade and the base reduce rutting, also called a geotextile.

Soil Stabilization:
Chemical or mechanical treatment designed to increase or maintain the stability of a mass of soil or otherwise to improve its engineering properties. Lime, flyash or cement are typical chemical stabilization materials. Geotextiles and geogrids are typical mechanical materials for soil stabilization.

Stabilized Base:
An aggregate base where either cement, asphalt or other material is added to increase its structural capacity. The soil subgrade can be stabilized with cement, lime, flyash or other materials.

Topsoil:
Surface soil, usually containing organic matter.