APPENDIX VI.1

Formulae used for calculations of index and Engineering properties of openpit soil samples

1. Specific Gravity:

$$\text{Specific Gravity} = \frac{\text{Wt. of oven dry soil}}{\text{Wt. of Kerosene displaced} \;/\; \text{Sp. gr. of Kerosene}}$$

2. Atterberg Limits:

(a) Liquid limit at 25 blow

$$W_L(\%) = \text{Water Content} \left(\frac{\text{No. of blows}}{25}\right)^{0.120}$$

(Ref: IS:2720 Part V - 1970)

(b) Plastic limit at 3 mm thread just breaking -

$W_p(\%)$ = Percentage of moisture content in soil.

(c) Plasticity Index -

$$I_p = W_L - W_P$$

3. Grain Size Analysis:

Percentages of Gravel, sand, silt and clay fractions in Soil determined by dry Sieving and Sedimentation analysis (hydrometer method)

(Ref: IS:2720 P.IV - 1965)

contd...

APPENDIX VI.1 (contd.)

4. Dry Density - Moisture relationship (Standard Compaction Test)

(a) Wet Density (lb/cft) = $\frac{\text{Weight of compacted soil}}{\text{Volume of the mould}}$

(Vol. of mould = $\frac{1}{30}$ cft = 943 cc)

(b) Dry Density (lb/cft) = $\frac{\text{Wet density}}{1 + \frac{\text{Moisture content \%}}{100}}$

(c) Moisture content (%) = $\frac{\text{Wt. of water in Soil}}{\text{Wt. of dry soil}} \times 100$

Maximum Dry Density (MDD) and Optimum moisture content (OMC) are obtained from graph in which dry density is plotted against per cent of moisture content.

5. Permeability -

$$K_{27°C} = \frac{QLU}{AH}$$

in which $K_{27°C}$ - Permeability coefficient at 27°C (cm/sec)

L - Thickness of Soil sample (cm)

U - Viscosity of water at room temp.

H - Hydrostatic (constant) head (cm)

A - Cross-sectional area of soil sample (cm^2)

t - Time in second

Q - Constant discharge cc/sec. (quantity of water)

contd...

APPENDIX VI.1 (contd.)

6. Shear Strength (Direct Shear Test)

Load equivalent (lb) = Dial reading x Prooving ring factor

$$\text{Shear Stress } (lb/inch^2) = \frac{\text{Load equivalent}}{\text{Area of Cake}}$$

Cohesion (lb/sq.in) and internal friction (degree) obtained from graph in which normal stress (lb/sq.in) is drawn against shear stress (lb/sq.in)

7. California Bearing Ratio (Penitration Resistance)

Load on plunger = Dial reading x Prooving ring factor

$$\text{CBR Value \% (0.1 inch penetration)} = \frac{\text{Plunger load}}{\text{Standard load (3000)}} \times 100$$

$$\text{CBR value \% (0.2 inch penetration)} = \frac{\text{Load on plunger}}{\text{Standard load (4500)}} \times 100$$

(Standard load at 100% CBR)

APPENDIX VI.2

BASIC SOIL COMPONENTS

(Ref: IS:1498 - 1970,p.14)

Sr. No.	Soil	Soil Component	Symbol	Particle Size Range and description
1	Coarse grained components	Boulder	None	Rounded to angular hard rock particle,average diameter more than 300 mm.
		Cobble	None	Rounded to angular hard rock particles, average diameter smaller than 300 mm but retained on 80 mm IS Sieve.
		Gravel	G	Rounded to angular hard rock particles, Passing 80 mm IS Sieve but retained on 4.75 mm IS Sieve.
		Sand	S	Rounded to angular, hard rock particle, Passing 4.75 mm IS Sieve but retained on 75 micron IS Sieve
2	Fine grained component	Silt	M	Particles smaller than 75 micron IS Sieve, Slightly plastic or non plastic.
		Clay	C	Particles smaller than 75 micron IS Sieve, Plastic.
		Organic matter	O	Organic matter in various sizes and stages of decomposition.

APPENDIX VI.5

SPECIFICATIONS FOR CRUSHED AGGREGATES

(Ref: IS:383 - 1970)

Specifications for	Crushing Value	Abrasion Value
For concrete other than wearing surface	Not greater than 45% by weight	Not greater than 50% by weight
For concrete for wearing surfaces of runways, roads and pavements	Not greater than 30% by weight	Not greater than 30% by weight

APPENDIX VI.6

CLASSIFICATION OF BUILDINGSTONES

Rock type	Sandstone	Basalt
Physical Properties		
Colour	Depend on colour of matrix and cement - White, grey, red, brown yellow etc.	Dark grey to black
Texture and Structure	Stratified, Fine to coarse grained, cross -beeding	Medium to fine grained, compact, Vesicular, prismatic, fractures, joints.
Mineral Composition	Quartz with felspar and dark minerals in all cements	Plagioclase, Pyroxene, Olivine, Magnetite, Vesicles filled by quartz, Zeolite, Calcite.
Engineering Properties		
Specific Gravity	1.85 to 2.7	2.6 to 3.0
Compressive strength	200 to 1700 kg/cm^2	1500 - 3000 kg/cm^2
Shear strength	80 - 400 kg/cm^2	200 - 600 kg/cm^2
Tensile strength	40 - 250 kg/cm^2	100 - 300 kg/cm^2
Porosity	5 - 25 %	0.1 - 1.0 %
Use	For masnory works, building, Pavements	Piers, dams, masnory works, building, pavements.

(Ref: IS: 1123- 1975: Methods of identification of buldingstones)