



Subgrade Classification

Subgrade Definition

- The “Subgrade” may be defined as the supporting structure on which pavement structure rest. Generally, Subgrade can be defined as the soil prepared and compacted to support a pavement system.
- In cuts, the subgrade consists of the original soil of the ground having been removed in order to obtain the necessary gradient of the road.

In fills, the subgrade is constructed by importing suitable soil and laying it on the native ground in form of embankment.

Subgrade performance

- A subgrade's performance generally depends on two interrelated characteristics:
 1. **Load bearing capacity:** The subgrade must be able to support loads transmitted from the pavement structure. This load bearing capacity is often affected by degree of compaction, moisture content, and soil type. A subgrade that can support a high amount of loading without excessive deformation is considered good.
 2. **Volume changes:** Most soils undergo some amount of volume change when exposed to excessive moisture or freezing conditions. Some clay soils shrink and swell depending upon their moisture content.

Soil Classification Definition

- Classification of soil simply means grouping of individual units of soils to identify their common properties. It gives the impression that a specific class of soils behaves as a whole group.
- Classifying soils into groups with similar behavior, in terms of simple indices, can provide geotechnical engineers a general guidance about engineering properties of the soils through the accumulated experience.
- The objective behind the use of any soil classification system for highway purpose is to be able to predict the subgrade performance on which the highway will be constructed.

Soil Classification Systems

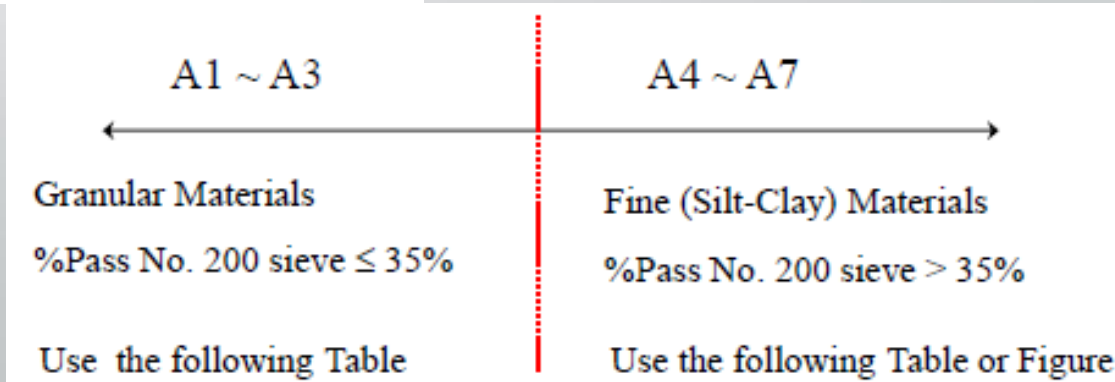
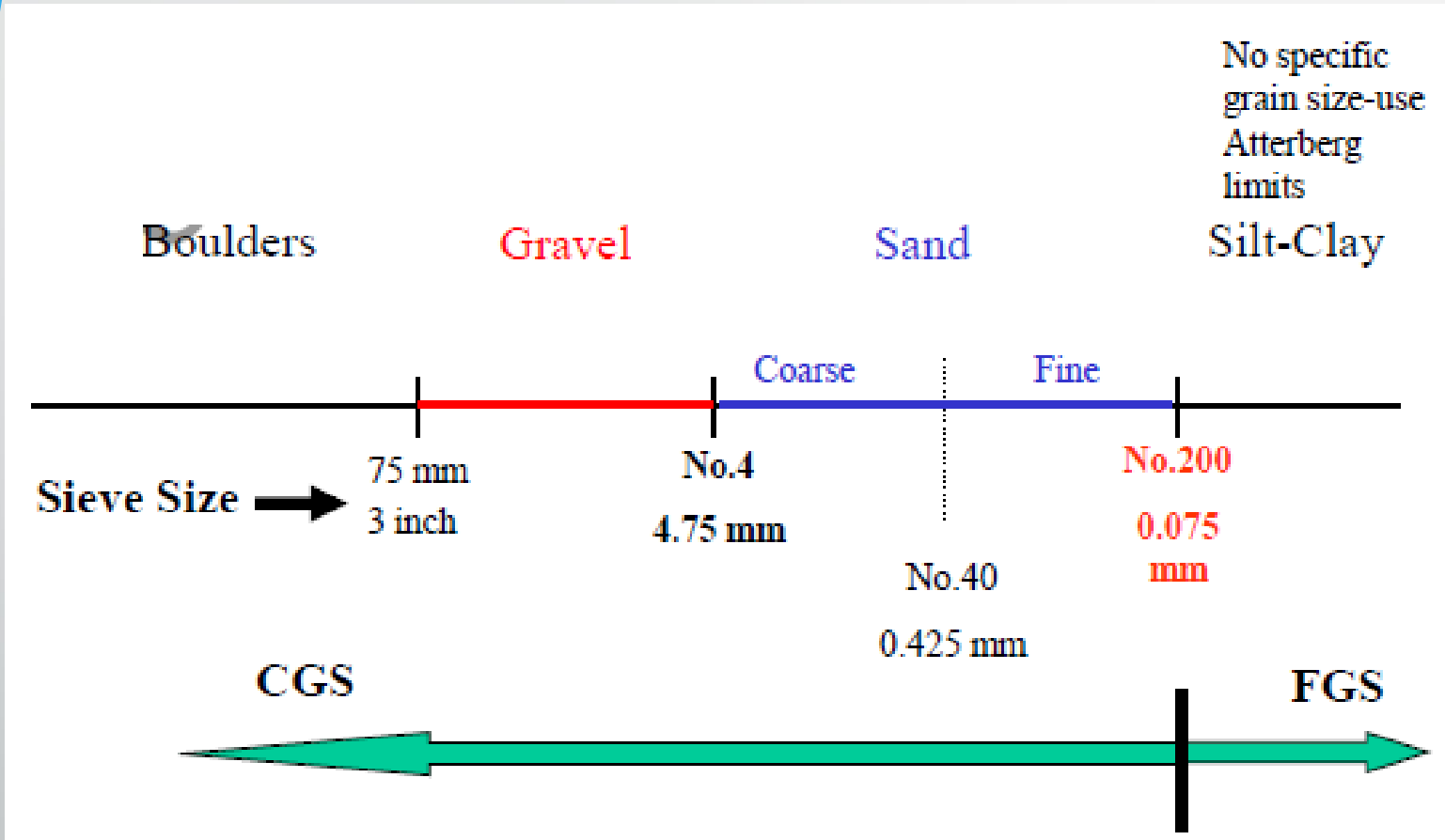
Two commonly used systems

1. The American Association of State Highway and Transportation Officials (AASHTO) Classification.
2. The Federal Aviation Agency (FAA) Classification.

➤ The American Association of State Highway and Transportation Officials (AASHTO) Classification

- 8 major groups: A1~ A7 (with several subgroups) and organic soils A8
- the lower in the numerical operator of the group, the better in the performance. (i.e. A-2 is better than A-4)
- The required tests are sieve analysis and Atterberg limits.
- The criterion for separation of fine materials is based on 35% passing sieve No. 200
- The group index, an empirical formula, is used to further evaluate soils within a group (subgroups).
- The original purpose of this classification system is used for road construction (subgrade rating).

➤ AASHTO: General Guidance



➤ AASHTO: Classification Table

Table 1. American Association of State Highway Officials classification of soils and soil-aggregate mixtures with suggested subgroups

General Classification	Granular Materials [35% or less passing 0.075 mm (#200)]							Silt-clay materials [more than 35% passing 0.075 mm (#200)]			
	A - 1		A - 3	A - 2				A - 4	A - 5	A - 6	A - 7 A-7-5 A-7-6
Group Classification	A-1-a	A-1-b		A-2-4	A-2-5	A-2-6	A-2-7				
Sieve Analysis, % Pass - 2.00 mm (# 10) - 0.425 mm (# 40) - 0.075 mm (# 200)	50 Max 30 Max 15 Max	50 Max 25 Max	51 Min 10 Max	35 Max	35 max	35 Max	35 Max	36 Min	36 Min	36 Min	36 Min
Characteristics of Fraction Passing # 40 - Liquid Limit - Plasticity Index	6 Max.		NP	40 Max 10 Max	41 Min 10 Max	40 Max 11 Min	41 Min 11 Min	40 Max 10 Max	41 Min 10 Max	40 Max 11 Min	41 Min 11 Min
- Group index	0		0	0		4 Max		8 Max.	12 Max	16 Max	20 Max
Usual Types of Significant Constituent Materials	Stone fragment gravel & sand		Fine sand	Silty or clayey gravel and sand				Silty soils		Clayey soils	
General Rating as Subgrade	Excellent to good						Fair to poor				

Classification procedure: With required test data available., proceed from left to right on above chart and correct group will be found by process of elimination.

The first group from the left into which the test data will fit is the correct classification.

Plasticity index of A-7-5 subgroup is equal to or less than LL minus 30. Plasticity index of A-7-6 subgroup is greater than LL minus 30.

Group index should be shown in parentheses after group symbol as: A-2-6(3), A-4(5), . . etc.

➤ AASHTO: Classification Table

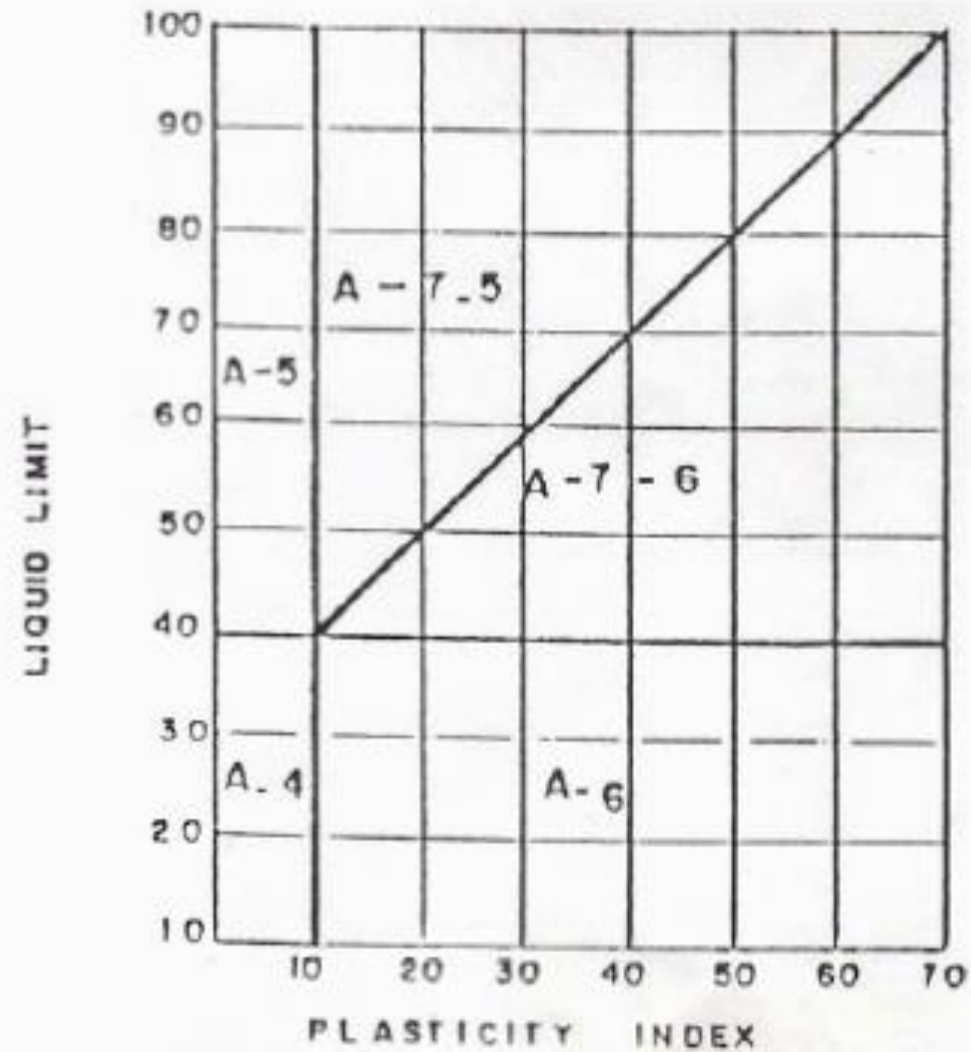


Figure 2 AASHTO classification chart for fine grained soils

➤ AASHTO: Group Index

- The Group Index (G.I.) is a supplement of the AASHTO system, which permits more precise prediction of the expected performance of the subgrade material.
- The rating for a pavement subgrade is inversely proportional to the group index.

G.I.	0	1	2	3-4	5-9	10-20
Rating	Excellent	Very Good	Good	Fair	Poor	Very Poor

$$GI = a[0.2 + 0.005c] + 0.01bd$$

Where,

$a = \% \text{ Passing \#200} - 35$ (0-40)

$b = \% \text{ Passing \#200} - 15$ (0-40)

$c = \text{L.L.} - 40$ (0-20)

$d = \text{P.I.} - 10$ (0-20)

➤ The Federal Aviation Agency (FAA) Classification

Soil group		MECHANICAL ANALYSIS			L.L	P.I
		Material retained on No. 10 sieve percent	Material finer than No. 10 sieve, percent			
			Coarse sand passing No. 10 retained on No. 40 ⁶⁰	Fine sand passing No. 40 retained on No. 200		
Granular	E - 1	0 - 45	40 +	60 -	15 -	25 - 6 -
	E - 2	0 - 45	15 +	85 -	25 -	25 - 6 -
	E - 3	0 - 45	—	—	25 -	25 - 6 -
	E - 4	0 - 45	—	—	35 -	35 - 10 -
	E - 5	0 - 45	—	—	45 -	40 - 15 -
Fine Sand	E - 6	0 - 55	—	—	45 +	40 - 10 -
	E - 7	0 - 55	—	—	45 +	50 - 10 - 30
	E - 8	0 - 55	—	—	45 +	60 - 15 - 40
	E - 9	0 - 55	—	—	45 +	40 + 30 -
	E - 10	0 - 55	—	—	45 +	70 - 20 - 50
	E - 11	0 - 55	—	—	45 +	80 - 30 +
	E - 12	0 - 55	—	—	45 +	80 + —
E - 13	Muck and peat - field examination					

if percentage of material retained on the No. 10 sieve exceeds that shown, the classification may be raised, provided such material is sound and fairly well graded