Pavement Materials

Lecture 10 & 11

Pavement Unbound Layers

Granular (Physical) Stabilization

Lecture 09

- **IDENTIFICATION**
- **EVALUATION**
- **SELECTION**
- **CONSTRCUTION**

Aggregate Identification

- **Aggregate** is the major component of materials used in road making.
- It is used in
- **Granular Bases and Sub-Bases**
- **Bituminous Courses**
- **Cement Concrete Pavements**
- A study of the Types of Aggregates, Their Properties and Tests is of great importance to a highway engineer.
- Aggregates can be obtained from two sources,
- (1) Naturally Occurring Deposits
  - **(1a) Processed Material**
  - **(1b) Blends of Natural or Processed Materials** .
  - **(1c) Stabilized Materials**
- (2) Artificially or Industrially Prepared Deposits *(synthetic)*

Aggregate Identification

- **Aggregates** can be identified on the basis of

- (1) Origin (*Composition*)
- (2) Mode of Formation & Deposition
- (3) Density (*Intra-particle voids*)
- (4) Shape
- (5) Surface Texture

Aggregate Identification

- **Naturally Occurring Materials**
- The majority of aggregates used in road construction are obtained from naturally occurring deposits.
- Natural aggregates for road-making are obtained from rock of the following geological groups :
- **Igneous Rocks (95% of Earth's Crust)**
  - which are formed by the cooling of molten material
- **Sedimentary Rocks (5% of Earth's Crust & 75% of Earth's Surface)**
  - which are formed by deposition of granular material
- **Metamorphic Rocks**
  - which are igneous or sedimentary rocks that have undergone transformations due to heat and pressure
- The weathering product may be of two general types:
- **Residual Materials** which may be either weathered or unweathered, generally occur in large deposits and are obtained by quarrying.
- **Transported Deposits** are found, for example, in stream beds, sand and gravel bars, and alluvial fans.

Aggregate Identification

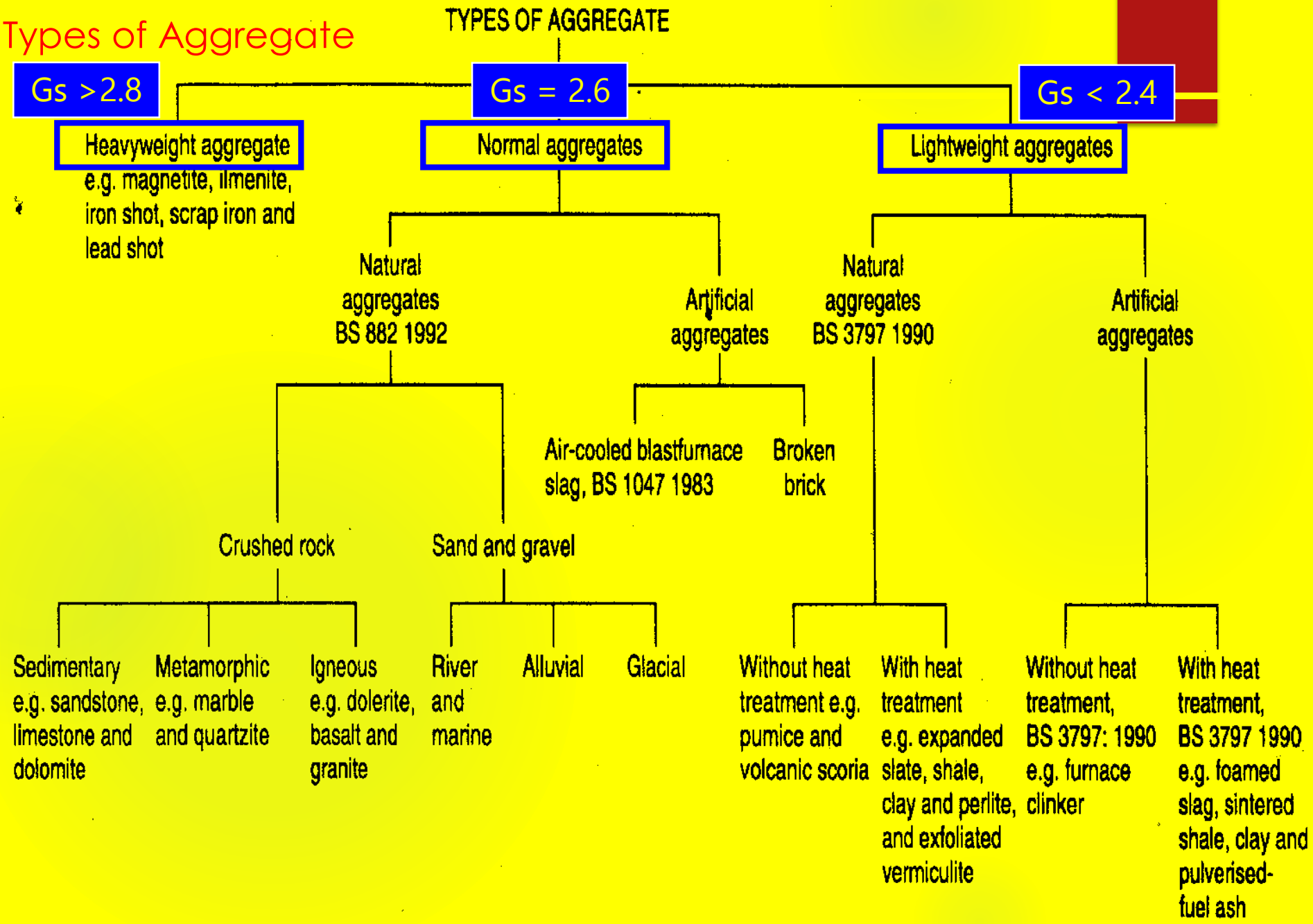
- **Naturally Occurring Materials**

- Mineral aggregates may be classified in a number of different ways. Each classification technique is useful in developing an understanding of the type of material to be used in the pavement.
- **Pedological**
- It is extremely helpful if the rock can be classified with respect to its general geologic type.
- It is not necessary that the person involved with highway materials be a geologist to make this classification.
- An understanding of geology and mineralogy are, however, extremely helpful, particularly in interpreting and predicting the performance of aggregates produced from the various available deposits.

TYPE OF ROCKS

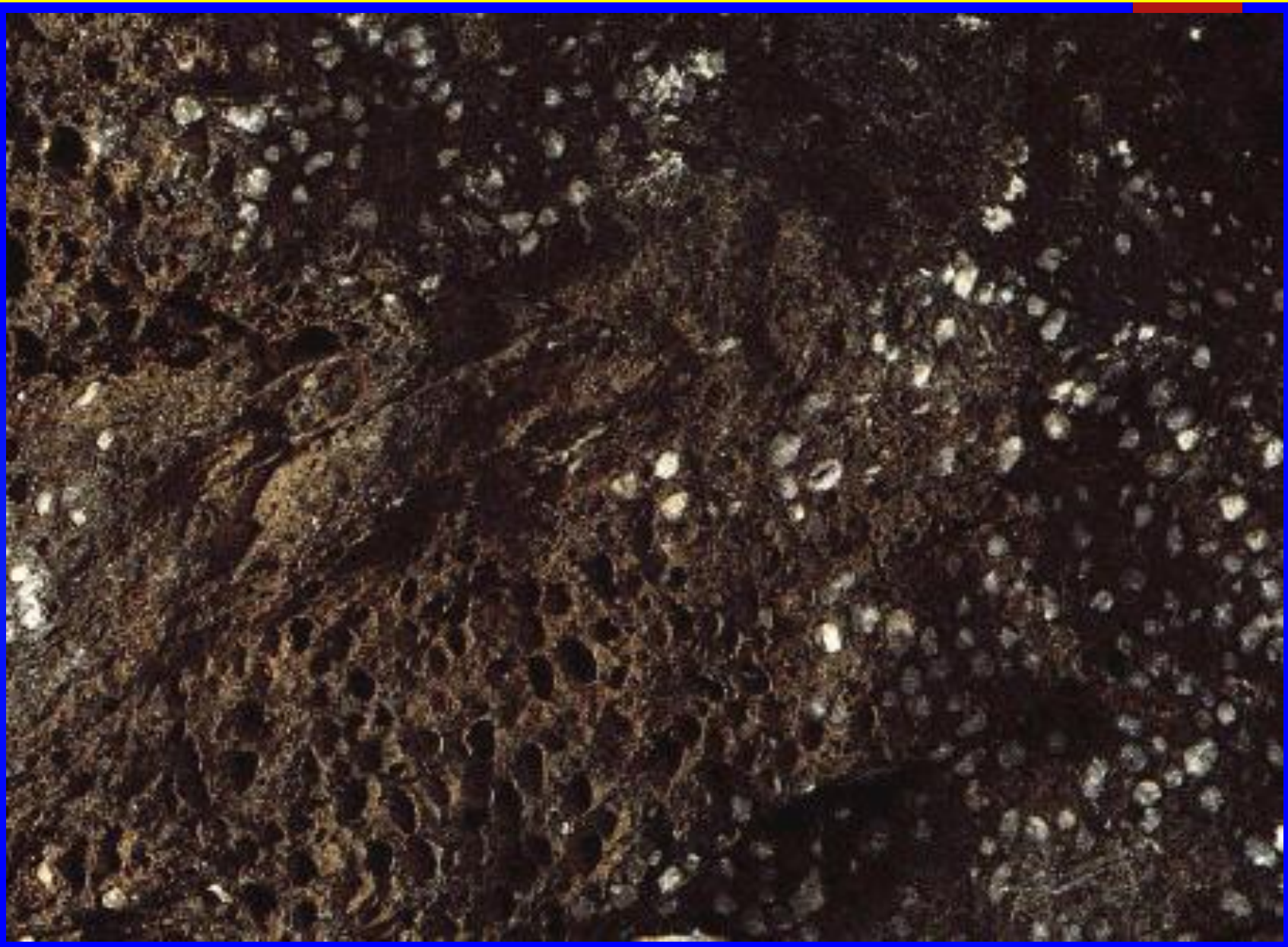
- TABLE OF ROCKS

Types of Aggregate

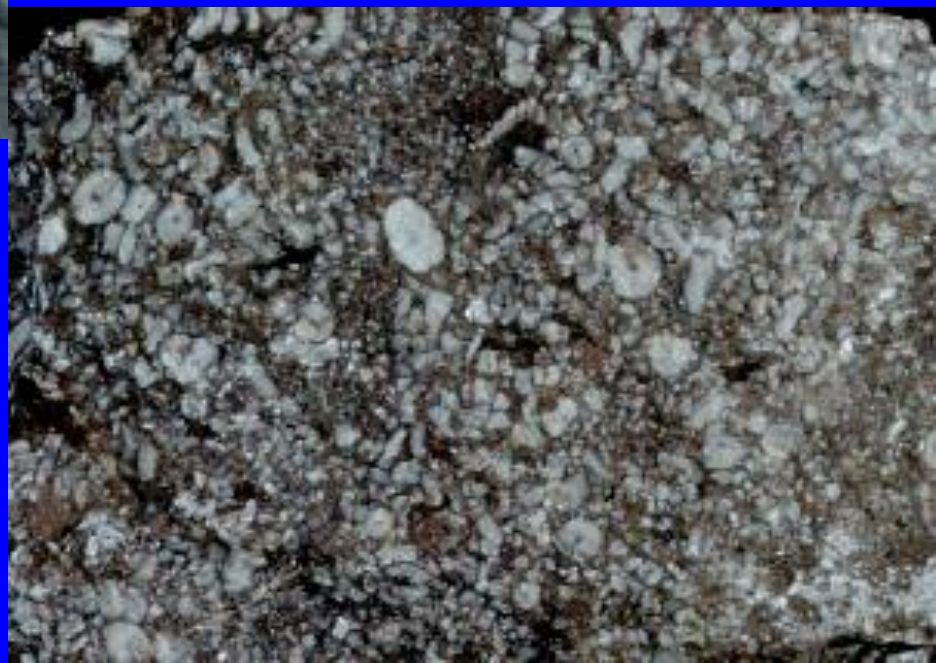


Granite

Basalt

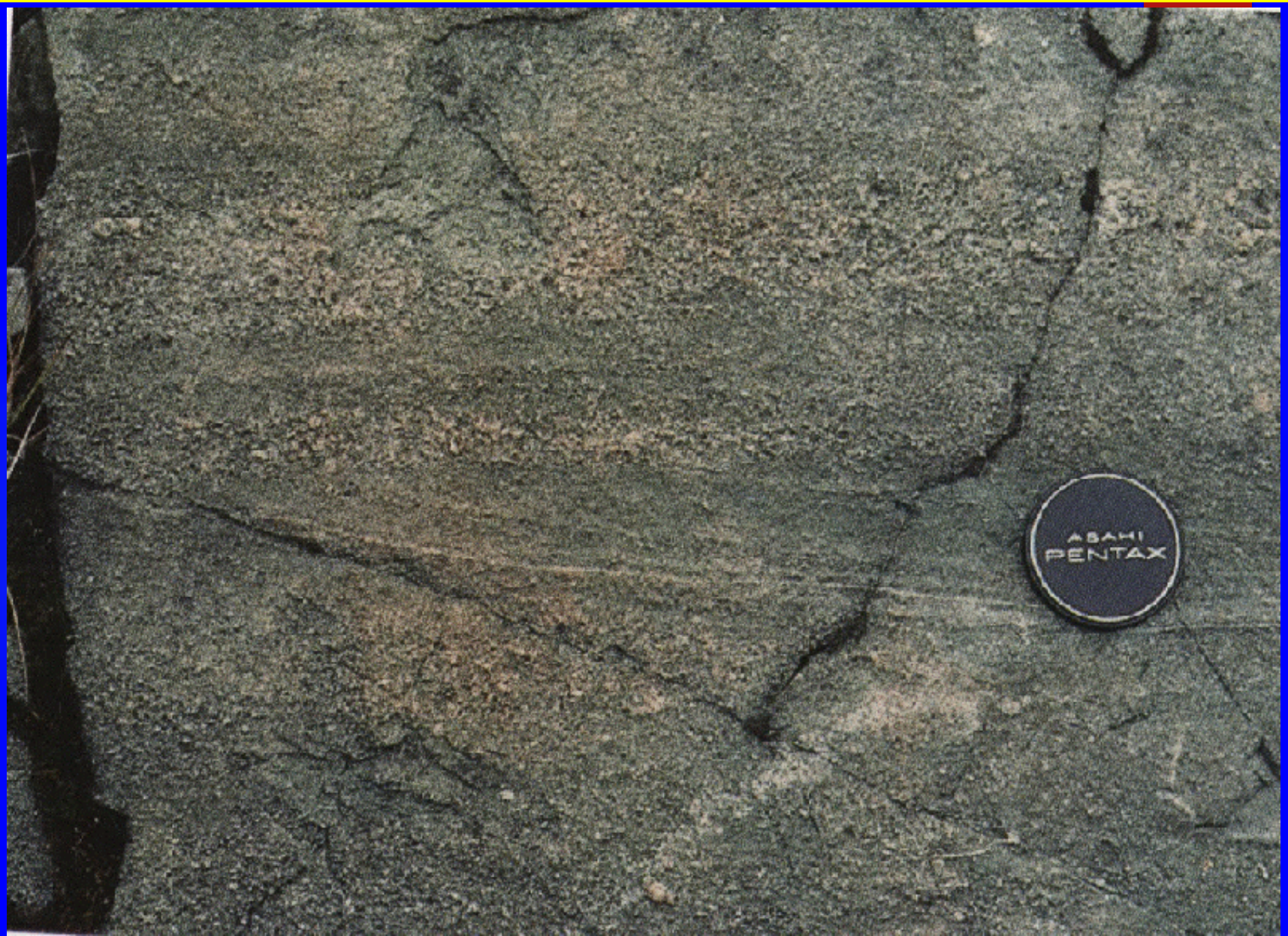


Limestone



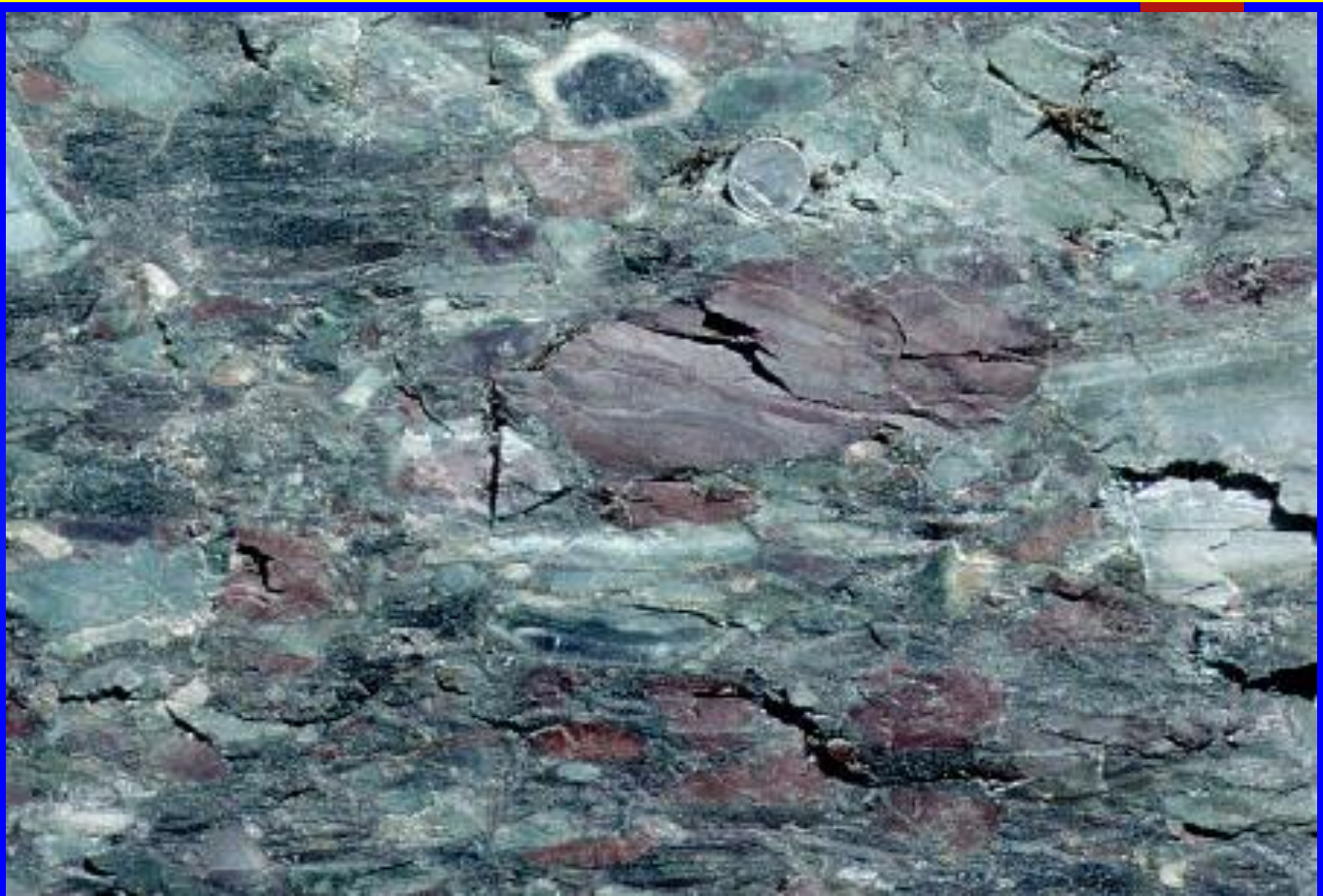
Dolomite

Sandstone



Conglomerate

Breccia



Shale

Marble

Slate

Quartzite

Gneiss

Aggregate from Rock

- ***Any single rock type could be***

- **porous or dense**
- **strong or weak**
- **hard or soft**
- **decayed or unweathered**
- **durable or unsound**
- **fine or coarse-grained**

- ***Type of Rock does not determine the type of required aggregate***

Aggregate Identification

- A summary of various types of deposits based on their mode of deposition is as follows.

- **Colluvium Deposits (*Talus*)**
- a. formed by gravity and weathering action of a steeply sloping rock face
- b. crushing usually necessary
- c. large angular chunks
- **Glacial Deposits**
- a. true glacial deposits - transported by glacial ice and have not been subjected to river transportation
- b. fluvial-glacial - glacial deposits subjected to stream action
- glacial deposits may be unsuitable as aggregate sources since they are heterogeneous and require a great deal of processing before they can be used.
- c. fluvial-glacial deposits - are more suitable

Aggregate Identification

- **Fluvial Deposits**
- materials which have been transported and deposited by running water:
- a. stream-bed - from beds and banks of existing rivers
- b. terrace deposits - older stream bed deposits laid down as a stream bed, earlier age
- c. alluvial deposits - fans or cones deposited at the mouth of ravines, gullies, or canyons, arid and semiarid regions
- d. Flood-plain - deposited outside normal stream channels during flood periods
- **Eolian Deposits**
- a. deposits laid down by the wind
- b. finer sands of narrow size range
- c. well rounded and hard and durable
- **Marine Deposits**
- a. usually contain hard, durable particles as a result of weathering
- b. particles are normally very well rounded
- c. usually narrow size range
- d. wash to remove salts

Aggregate Identification

Classification	Description
Rounded	Fully water-worn or completely shaped by attrition
Irregular	Naturally irregular, or partly shaped by attrition and having rounded edges
Angular	Possessing well-defined edges formed at the intersection of roughly planar faces
Flaky	Material of which the thickness is small relative to the other two dimensions
Elongated	Material, usually angular, in which the length is considerably larger than the other two dimensions
Flaky and elongated	Material having the length considerably larger than the width, and the width considerably larger than the thickness

TABLE 2 Criteria for Describing Particle Shape (see Fig. 4)

The particle shape shall be described as follows where length, width, and thickness refer to the greatest, intermediate, and least dimensions of a particle, respectively.

Flat	Particles with width/thickness > 3
Elongated	Particles with length/width > 3
Flat and elongated	Particles meet criteria for both flat and elongated

Aggregate Identification

- **SURFACE TEXTURE**

TABLE 12.10
Surface texture of aggregates

Surface texture	Characteristics
Glassy	Conchoidal fracture
Smooth	Water-worn, or smooth due to fracture of laminated or fine-grained rock
Granular	Fracture showing more or less uniform rounded grains
Rough	Rough fracture of fine or medium-grained rock containing no easily visible crystalline constituents
Crystalline	Containing easily visible crystalline constituents
Honeycombed	With visible pores and cavities

Aggregate Identification

- **DENSITY ?**

- **Porous**
- **Non-Porous**

Aggregate Identification

- **GENERAL USE**

S. No.	*Name of rock*	*Geological Group*	*Properties*	*Suitability for road-making*
1.	Granite	Igneous Rock	1. Hard, durable 2. Bulk Density below 2.80 3. Blue, pink in colour 4. Fine-grained to coarse grained texture . 5. Resistant to abrasion 6. Low absorption of water	1. Very good for bituminous courses and cement concrete pavements 2. Suitable for masonry work 3. Suitable for R.C.C. work
2.	Basalt (Also called Trap)	Igneous Rock	1. Hard, durable 2. Bulk Density about 2.8—3.0 3. Blue or dark blue in colour 4. Fine grained 5. Resistant to abrasion 6. Low absorption of water	1. Very good for bituminous courses and cement concrete pavements 2. Suitable for masonry work 3. Suitable for R.C.C. work

Aggregate Identification

S. No.	Name of rock	Geological Group	Properties	Suitability for road-making
3.	Quartzite **Kirana**	Metamorphic Rock	1. Reasonably hard and durable 2. Fine to medium grain size 3. Light brown or pink in colour 4. Resistant to abrasion 5. Low absorption of water 6. Reasonably high bulk density of 2.5—2.8	1. Good for base courses, bituminous courses and cement concrete pavements 2. Used for R.C.C. work 3. Suitable for masonry work
4.	Limestone **Margalla ??** ***(sandy in nature)***	Sedimentary Rock	1. Reasonably hard and durable 2. Liable to polish to a smooth surface under traffic 3. Fine grained 4. High water absorption 5. Bulk Density low in the range 1.9—2.2	1. Good for base courses 2. Unsuitable for wearing surfaces because of polishing characteristics
5.	Sandstone	Sedimentary Rock	1. Moderately hard and durable 2. Fine to medium grained 3. Bulk Density in the range 2.3—2.7	1. Good for road bases 2. Generally, unsuitable for wearing courses

Aggregate Identification

6.	Laterites	Decomposition of basalt and other rocks	1. Yellowish to reddish brown in colour 2. Spongy porous open texture 3. Bulk Density varies from 2.2—2.8. 4. Water absorption very high, 5—25 per cent. 5. Soft to medium hard, losing strength when it absorbs moisture.	1. Good for sub-base and base courses 2. Used as surface course in un-important roads
7.	Kankar	Sedimentary rock, impure form of lime stone	1. White to brown in colour 2. Soft to medium hard 3. Bulk Density in the range of 2.2—2.6 4. Water absorption high	1. Good for sub-base and base courses 2. Used as surface course in un-important roads.
8.	Dhandla	Gypsum	1. White in colour 2. Soft and highly abraded 3. Absorbs water to a high degree 4. Bulk Density varies from 2.2—2.5.	1. Used for sub-bases and bases 2. Used as a surfacing material in Rajasthan on unimportant roads

Aggregate Identification

- ***Artificial Aggregates***

- **Broken Brick Ballast**
- Broken brick ballast is soft, water-absorbent and gets powdered under traffic.
- Overburning of bricks increases the hardness.

- **Slag**
- is also used as an aggregate in countries abroad.

Aggregate Identification

- In PAKISTAN ??

- Crushed or Processed Aggregate
  - Margalla
  - Khairabad
  - Kirana
  - Others…….

- River Run Material
  - Gravels and Sand Mixtures

Thank You