Stone

Lecture -2

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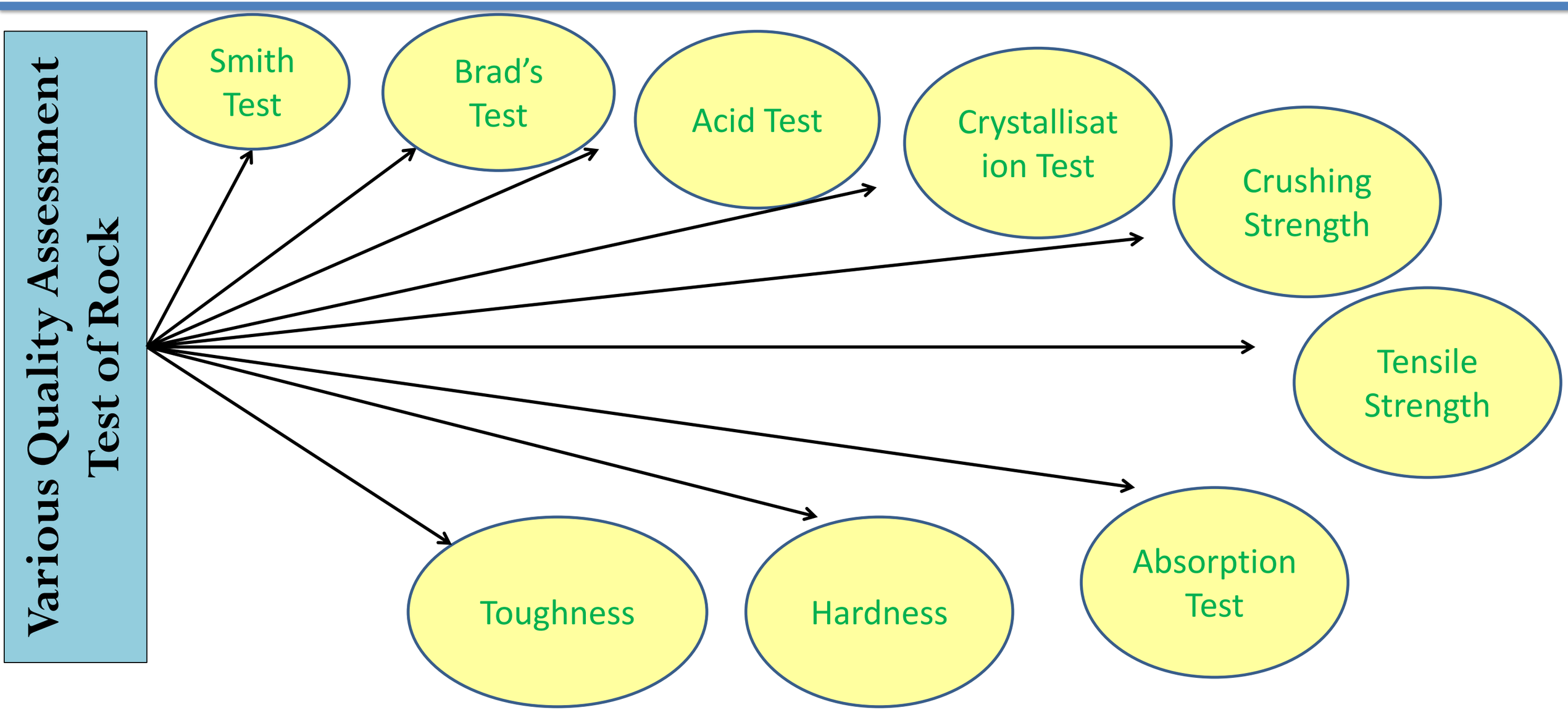
Testing of Stone



Testing of Stone

Smith Test

- This test conducted to find the presence of earthy matter or the deterioration of stones when immersed in water. Break off the freshly quarried stone hipping to about the size of a rupee coin and put them in a glass of clean water, one- third full. If the water becomes lightly cloudy, the stone is good and durable

Brad's Test

For Frost resistance

- Few small pieces of freshly quarried stone are immersed in boiling solution of sulphate of soda (Glauber's salt) and are weighed. These are then removed and kept suspended for few days and weighed again. The loss in weight indicates the probable effect of frost.

Testing of Stone

Acid Test

To check the weather resistance

- confirms the power of stones to withstand the atmospheric conditions. 100 g of stone chips are kept in a 5 per cent solution of H2SO4 or HCI for 3 days. Then the chips are taken out and dried. The sharp and firm corners and edges are indication of sound stone. This test is used to test the cementing material of sand stone.

Crystallisation Test

As Per IS 1126

- Three pieces (50 mm dia. & 50 mm height) are dried for 24 hours and are weighed (W1). The specimens are suspended in 14% sodium sulphate solution for 16-18 hours at room temperature (20° to 30°C). The specimens are then taken out of the solution and kept in air for 4 hours. They are then oven dried at a temperature of 105° ± 5°C for 24 hours and then cooled at room temperature. This process is repeated for 30 cycles. The specimens are weighed (W2) and the difference in weight is found. This test is repeated thirty times and the loss in weight after every five cycles is obtained. The change in weight indicates the degree of decay of stone. Durability should be expressed in percentage as change in the weight. The average of three test results should be reported as durability value.

Testing of Stone

Crushing Strength Test

As Per IS 1121 part 1

- To test stone for compressive strength, specimen pieces in the form of cubes or cylinders are made from samples of rock. The lateral dimension or diameter of test piece should not be less than 50 mm and the ratio of height to diameter or lateral dimension should be 1:1. The load is applied gently at a rate of 14 N/mm^2 per minute until the resistance of the specimen piece to the increasing load breaks down and no greater load is sustained. The compressive strength of the specimen piece is the maximum load in Newtons supported by it before failure occurs divided by the area of the bearing face of the specimen in mm2. The average of the three results in each condition separately should be taken for the purpose of reporting the compressive strength of the sample. The crushing strength of stones varies in the range of 15–100 N/mm^2.

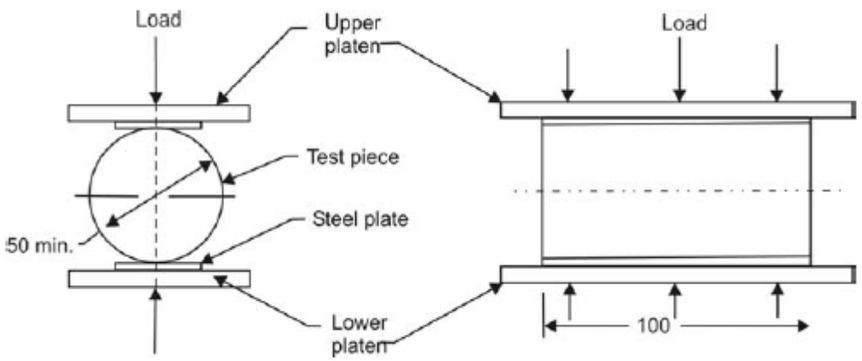
Testing of Stone

Tensile Strength

As Per IS 1121 part III

- Three cylindrical test pieces of dia. ≮ 50 mm and the ratio of diameter to height 1:2 are used to determine the tensile strength of the stone in each saturated (kept in water for 3 days at 20 to 30°C) and dry condition (dried in an oven at 105 ± 5°C for 24 hours and cooled at room temperature). Each test piece to be tested is sandwiched in between two steel plates of width 25 mm, thickness 10 mm and length equal to the length of test piece. The load is applied without shock and increased continuously at a uniform rate until the specimen splits and no greater load is sustained. The maximum load applied to the specimen is recorded.

- Split tensile strength $= \frac{2\,W}{pi \times d \times l}$



Testing of Stone

Absorption Test

- Weight of Oven Dry test piece –W1
- Cube is immersed in distilled water for 24 hours.
- Weight of saturated surface dry test piece - W2.
- Percentage absorption =(W2-W1)/W1)*100

Hardness

- This test is performed by scratching a stone with knife on Mohs scale.

Testing of Stone

Toughness Test

- This test is performed by breaking the stone with a hammer. Toughness is indicated by resistance to hammering.

Deterioration of Stone

- Following are the main climatic agencies bringing about deterioration of stones :
- Rain - Frequent wetting and drying of stones by rains and sun causes internal stresses thereby resulting in the disintegration of stones. Also while coming down rain water carries with it acids present in atmosphere particularly of industrial towns. This acidic rain water reacts with the constituents of stone causing its deterioration.

Deterioration of Stone

- Frost - At very cold places frost on entering the pores of stones freezes and because of the consequent increase in volume cause its disintegration.
- Wind - Dusty winds cause deterioration of stones because of the abrasive effect of dust particles. Also winds force rain water and frost to enter the pores of stones deeper resulting in deterioration of stone as explained in point “Rain” above.
- Atmospheric impurities - Atmosphere, especially in big industrial towns, is generally polluted with smoke and acidic gases. These react readily with stones containing carbonate of lime resulting in their deterioration.

Deterioration of Stone

- Temperature variations - At places where temperature variations are too much or too frequent, stones, if used would crumble because of the setting up of internal stresses. Stones should not be used at such places.
- Vegetable growth - Roots of trees that penetrate the joints of stone masonry keep stones damp and secrete organic and acidic matters which cause deterioration of stones.
- Mutual decay - If materials having different physical characteristics are used together then they may cause mutual decay. For brought down from the lime stone by rain water will cause decay of the sand stone. Similarly granular lime stone may deteriorate due to the absorption of magnesium sulphate from magnesium lime stone when the two are used together.

Common Building Stone in India

S. NO.	Type of Work	Recommended Stone Type	Reasons
1	Heavy engineering works such as bridge, piers, and abutments, break waters, docks and light houses, retaining walls	Granite (of three verities, viz. biotite-granite, homblende-granite and tourmaline-granite; biotite-granite is most widely used Granite, fine grained sandstone	It is heavy strong, durable and is capable of reisisting large thrust
2	Building facing the sea	Granite, fine grained sand stone	These are not affected by the weathering action of sand particles blown by wind
3	Building in industrial areas	Granite, compact sandstone	These are restraint to acid fumes and smoke
4	Arches	Fine grained sandstone	Strong, durable
5	Building face work, carved works, ornamental works and statutes	Marble, close grained sandstone	These are light weight, soft and easy to work and have pleasing colour and appearance
6	Fire resisting structure	Compact sandstone	Fireproof
7	Road metal and aggregate for concrete	Granite, Basalt, Quartzite	Hard, tough and has high abrasion resistant
8	Railway Ballast	Coarse grained sandstone, quartzite	These are hard and compact
9	Electrical Seitch board	Slate, Marble	Poor conductor of electricity

S. NO.	Type	Classification	Characterstics	Reasons
1	Granite	Igneous	Sp. Gr. 2.63-2.75 Water absorption<1% Compressive Strength 77-130N/mm^2 Fine grained variety takes high polish Color depends upon colour of felspar Excess of felspar causes early decay	Most suitable for important engineering works such as bridges abutments, piers, dams, sea, walls light house
2	Trap and basalt (green stone, white stone, blue basalts)	Igneous	Sp. Gr. 2.6-3 Compressive Strength 150-190N/mm^2 Fine grained variety takes high polish Color depends upon colour of felspar Excess of felspar causes early decay	Suitable for road metal and concrete aggregate. Its red and yellow varieties are used in decorative features in structures.
3	Sandstone	Sedimentary	Sp. Gr. 2.65-2.95 Compressive Strength 65N/mm^2	In the form of flag stone for paving, tile stone for roofing, natural stone for ornamental work and grit for heavy engineering works.
4	Limestone	Sedimentary	Sp. Gr. 2.0-2.75 Compressive Strength 55N/mm^2 Affected by frost and atmosphere Tough but soft enough to be cute	Suitable for flooring, paving and roofing and in the manufacture of lime and cement.
5	Marble	Metamorphic	Sp. Gr. 2.65 Crushing Strength 70N/mm^2 Hard and compact Takes fine polish	Most suitable for monuments, statutes flooring, decorative and ornamental works.
6	Slate	Metamorphic	Sp. Gr. 2.89 Crushing Strength 77-210N/mm^2 Hard and tough Splits into thin slab	Most suitable for roof covering flooring, damp proofing and partitions

Duggal SK, Building Materials

Summary

- ✓ Various Quality Assessment Test of Stone
- ✓ Deterioration of Stone
- ✓ Common Building Stone in India

THANK YOU