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METHOD OF IDENTIFICATION OF NATURAL BUILDING STONES

(First Revision)

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(*Continued on page 2*)

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Indian Standard

METHOD OF IDENTIFICATION OF NATURAL BUILDING STONES

(First Revision)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 19 July 1975, after the draft finalized by the Stones Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 Building stones are available in large quantity in various parts of the country and to select and utilize them for their satisfactory performance it is necessary to know the various strength properties determined according to the standard procedure. The strength of the rocks depends on its mineral constituents which form the basis of classification and identification of rocks and thus before ascertaining the strength properties it is also necessary to identify the types of rock. This standard had therefore been formulated to cover standard methods for identification of natural building stones. This standard was first published in 1957 which covered the aspects of petrographical examination of building stones. While revising the standard its scope is limited to only identification of natural building stones which is in fact needed by the various research laboratories of stones using departments.

1. SCOPE

1.1 This standard lays down the procedure for identification of some of common types of natural building stones.

2. SELECTION OF SAMPLE

2.1 The sample shall be selected to represent the type of grade of stone under consideration. The samples shall be from the fresh rock and not weathered.

2.2 The sample shall be selected by the purchaser or his authorised representative from the quarried stone or taken from the natural rock, as described in **2.2.1** and **2.2.2** and shall be of adequate size to permit the preparation of the requisite number of test pieces.

2.2.1 *Stones from Ledges or Quarries* — The ledge or quarry face of the stone shall be inspected to determine any variation in different strata. Differences in colour, texture and structure shall be observed. Separate samples of stone weighing at least 25 kg each of the specimens shall be obtained from all strata that appear to vary in colour, texture and structure. Pieces that have been damaged by blasting, driving wedges, heating, etc, shall not be included in the sample.

2.2.2 *Field Stone and Boulders* — A detailed inspection of the stone and boulders over the area where the supply is to be obtained shall be made. The different kinds of stone and their condition at various quarry sites shall be recorded. Separate samples for each class of stone that would be considered for use in construction as indicated by visual inspection shall be selected.

3. PROCEDURE

3.1 The sample shall be examined macroscopically for its colour, structure, texture and mineral constituents.

3.2 The type of rocks shall be identified according to characteristics given in Table 1. In case of doubt guidance can be obtained from engineering properties of the rock given in Table 1.

4. REPORTING

4.1 Date of sample taken, identification of sample and the type of stone shall be reported.

TABLE 1 CHARACTERISTICS OF BUILDING STONES

(*Clause* 3.2)

Sl No.	Type	Physical Properties			Uses	Availability	Average Engineering Properties (*See* Note)						
		Colour	Texture & Structure	Mineralogical Composition			Specific Gravity	Compressive Strength	Shear Strength	Tensile Strength	Porosity	Resistance to Abrasion	Modulus of Elasticity
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
								kg/cm²	kg/cm²	kg/cm²	Percent	Percent	kg/cm²
					Class: Igneous Rocks								
1.	Granite*	White to light grey and pink.	Crystalline, fine to coarse grained, massive sometimes sheeted and banded; joints common.	Essentially quartz and feldspar with mica, amphiboles and pyroxenes as accessories.	Used primarily for bridge piers, river walls, dams and related structures, pavements, kerbs, pedestal, monumental buildings, institutional and commercial buildings, table top, coarse aggregate, road metal, etc. Polished granite looks more elegant than marble with a very long lasting lustre. Good foreign market.	Granites occur throughout the country. Only a relatively small number of suitable colour or texture are available. Most granites are characterised by joints and fractures. It is desired that granites shall be free from flaws, etc. Granites may be graded by their compressive strength.	2·63-2·75	1 000-2 500	140-500	70-250	0·4-4	43·9-87·9	2×10^5 to 6×10^5
2.	Granodiorite*	Light grey.	Crystalline, medium to coarse grained; massive; joints common.	Essential minerals are quartz and plagioclase feldspar with accessories like biotite and hornblende.	Same use as granites.	Less abundant in occurrence.	2·8-3·0	—	—	—	0·50	—	—
3.	Syenite*	Light coloured to dark green, grey and bluish grey.	Crystalline, medium to coarse grained; massive; joints common.	Essential minerals are alkali feldspar sometimes with nepheline (nepheline syenite). Common accessories are hornblende, biotite and augite.	Same use as granites.	Syenites are less abundant than granites.	2·60-2·80	350-500	—	—	1·38-1·54	—	6×10^5 to 8×10^5
4.	Diorite*	Grey to dark grey.	Crystalline, medium to coarse grained; massive; joints common.	Essential minerals are plagioclase feldspar and dark minerals.	Used as a good aggregate material and road metal, etc.	Found in a number of places in India.	2·8-3·0	1 800-3 000	—	150-300	0·25	—	7×10^5 to 10×10^5
5.	Gabbro*	Dark grey to black.	Crystalline, medium to coarse grained; banded and often jointed.	Consists of lime-feldspar and pyroxene (augite); accessories may be olivine, biotite, hornblende and rarely quartz.	May be used where available for bridge piers, river walls dam and related structures; it may also be used for pavements, kerbs and in buildings (same as granite).	It's high strength value and low porosity, makes it suitable for heavy structures.	2·90-3·2	1 800-3 000	—	150-300	0·1-0·2	—	7×10^5 to 11×10^5

6.	Basalt (Deccan Trap)†	Dark grey to black.	Medium to fine grained, dense and compact and also at times vesicular with flow bands. Often occurring in columns and prismatic structures. Fractures and joints common.	Plagioclase feldspar and pyroxene with or without interstitial glass; olivine, sometimes common. Vesicles filled by quartz, calcite and zeolite.	Used primarily for bridge piers, river walls, dams and related structures, in masonry works and is used also for pavements, kerbs, monumental buildings; etc.	Basalts occur as "trap" rocks in western India, and in Rajmahal. It is cut into slabs and blocks. The presence of void, infilling of calcite, zeolite and quartz are undesirable. Fractures, joints also decrease its importance. Basalt generally have a dark brown appearance.	2·6-3·0	1 500-3 000	200-600	100-300	0·1-1·0	14·86-18·92	6×10^5 to 10×10^5
7.	Dole rite†	Dark grey to black	Crystalline, fine to coarse grained; joints and fractures common.	Consists of plagioclase feldspar and pyroxene; olivine, hornblende and biotite are common accessories.	Same as Gabbro.	It's high strength values and low porosity makes it suitable for heavy structures. But joints may not allow large homogeneous block and slabs to be cut from quarries. Makes a very high quality aggregate material.	3·0-3·05	2 000-3 500	250-600	150-350	0·1-0·5	—	8×10^5 to 11×10^5
8.	Rhyolite†	White to light, grey, pink and greyish black; black when extremely glassy (obsidian and pitchstone).	Glassy to cryptocrystalline with few embedded crystals of quartz and feldspars; flowbands, and fractures quite common.	A volcanic equivalent of granite.	Though not used on large scale; rhyolite may be used as blocks if easily available; in buildings, paving blocks, ornamental and decorative works, etc.	Rhyolites are less abundant than granites. The rock may be characterised by cracks and fractures which render the blocks unsuitable for the purpose of building stone.	2·40-2·60	—	—	—	4-6	—	—
9.	Trachyte†	Grey to bluish grey.	Glassy, aphanitic; flowbands and fractures common.	A volcanic equivalent of syenite.	Used as a building stone — dimension stone, grinding stone (same as granite).	Fairly abundant in occurrence.	2·60-2·35	820	—	—	—	19·5	—
10.	Andesite†	Dark grey to black.	Glassy, aphanitic.	A volcanic rock with plagioclase feldspar and one or more minerals like biotite pyroxene and hornblende.	Not generally in use, but may be used, if easily available, as blocks and slabs in buildings paving blocks ornamental and decorative works, etc.	It is not abundant in India. May possess cooling cracks, joints and fractures which may render it unsuitable as a building stone.	2·20-2·60	1 300-2 500	—	—	0·10-11	—	—
					Class: Sedimentary Rocks								
1.	Sandstone	Depends on the colour of matrix and cement; generally white, grey, red, buff, brown, yellow and even dark grey.	Stratified (bedded) fine to coarse grained; cross-bedding flute-cast and sole-markings, etc, common.	Consists mainly of quartz with feldspar and dark minerals in a siliceous, calcareous, argillaceous and ferruginous cement.	Used for masonry work, for dams, bridge piers, river walls, buildings, pavements, kerbs, monumental stones, etc.	Famous building stone, ornamental stone. Weathering of the rock renders it unsuitable as building stone. Kaolinisation of feldspars and leaching effect of matrix and cement make the rock porous. It is desirable to use sandstone with silica cement for heavy structures if necessary.	1·85-2·7	200-1 700	80-400	40-250	5-25	1·6-29·0	0.5×10^5 to 8.0×10^5

* These fall under 'Granite Group'.
† These fall under 'Basalt Group'.

(*Continued*)

TABLE 1 CHARACTERISTICS OF BUILDING STONES — *Contd*

Sl No.	Type	Physical Properties			Uses	Availability	Average Engineering Properties (*See* Note)						
		Colour	Texture & Structure	Mineralogical Composition			Specific Gravity	Compressive Strength	Shear Strength	Tensile Strength	Porostiy	Resistance to Abrasion	Modulus of Elasticity
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
								kg/cm²	kg/cm²	kg/cm²	Percent	Percent	kg/cm²
2.	Limestone and dolomite	White, grey, pink, red, blue, buff brown, green yellow, black, etc. (Colour due to impurities in the form of silicates and carbonates).	Bedded, granular; fine grained.	Consists essentially of calcite (calcium carbonate) with varying amounts of magnesium carbonate.	Generally used as slabs and tiles in any type of construction used in buildings. Also large size blocks of Miliolite limestone (Porbandar stone) used as ornamental and building stone.	Limestone is found to occur throughout India. It should be devoid of any argillaceous band, softer vein, cracks	2·14-2·8 (limestone) 2·5-2·8 (dolomite).	300-2 500 (limestone) and (dolomite).	100-500	50-250	5-20	1·3-24·1	$1·0 \times 10^5$ to $8·0 \times 10^5$
3.	Laterite	Brownish red, yellow, brown, grey and mottled colours.	Porous, oolitic and pisolitic with cavities; at times bedded.	A mixture of hydrated oxides of iron and aluminium frequently with manganese dioxide, titanium oxide and free silica.	Generally used as blocks in the construction of buildings, institutional and commercial buildings.	Freshly quarried laterite is soft and porous, but when exposed to atmospheric conditions it hardens and makes a very tough material. When used in walls it should be plastered from outside.	1·85	19-23	—	—	—	—	—
					Class: Metamorphic Rocks								
1.	Charnnockite	Light grey to dark grey.	Fine to coarse grained, massive banded and sometimes foliated.	Consists of quartz, feldspar, hypersthene and garnet.	Generally used as slabs and block in the construction of building, monuments, pavements, kerbs, etc, form a source of aggregate material.	Occurs in association with Khondalites in the Eastern Ghats. Its strength is similar to granites and may be put to similar uses as granite.	2·7-3·0	—	—	—	—	—	$7·94 \times 10^5$ to $9·94 \times 10^5$
2.	Gneisses	Light grey, pink, purple, greenish grey and dark grey.	Fine to coarse grained; alternative dark and white bands (gneissose structure).	Composed of quartz, feldspar, biotite, hornblends, etc.	Not commonly used because of deliterious constitutes, but may be used in minor constructions if easily available. Hard gneisses may be used for construction of buildings and decorative works and also as riprap stone.	Varying composition of bands are likely to give low strength of the rocks. Widely found in India.	2·5-3·0	500-2 000	—	50-200	0·5-1·5	—	$2·01 \times 10^5$ to $4·9 \times 10^5$
3.	Quartzite	White, grey, yellowish & brownish grey, buff (colour is dependent on the impurities in the cement).	Fine to coarse grained often granular and banded.	Quartz is the chief constituent with feldspars and mica in small amounts.	Used as blocks and slabs for building stone and aggregate material.	Widely available in India.	2·55-2·65	1 500-3 000	200-600	100-300	0·2-0·6	—	$9·3 \times 10$

4.	Marble	White, rose, pink, red, green, yellow, black, etc. (Impurities impart different shades).	Fine to coarse grained, massive crystalline and granular.	Mainly calcite and dolomite or mixture of the two with some other impurities, e.g. wallastonite and serpentine as bands and veins.	Used as blocks, slabs and tiles in monuments, temples, commercial buildings. Coloured marbles are as ornamental stones.	Marbles may contain serpentine band, valuable for decorative works.	2·6-2·7	1 000-2 500	150-300	70-200	2-4	6·7-11·7	—
5.	Khondalite	Light grey to brown and light pink.	Medium to fine grained; often banded or schistose.	Composed of quartz feldspar, garnet and sillimanite, with biotite and muscovite.	Khondalite is widely used for building stones in commercial and institutional buildings in the form of blocks and slabs. In ancient times it was used in monuments and temples.	Khondalite may contain softer schistose bands and are found to weather easily on exposure to atmospheric condition. It is easily available all along the Eastern Ghats.	2·36-2·51	—	—	—	—	—	—
6.	Slate	Dark grey, black, greenish grey, purple grey, etc.	Fine grained, slaty cleavage, fissile along planes of original bedding.	Composed of quartz, mica and clay minerals.	Used as slabs and roofing tiles in the construction of buildings, pavements, etc.	Easily cut into slabs, of desired dimensions. It may contain softer bands. Slate is found in many parts of the country.	2·6-2·7	1 000-2 000	—	70-200	0·1-1·6	—	—
7.	Phyllite	Grey, greenish, buff, reddish. Rock characterised by a shinning silky lusture (phyllitic shean).	Fine grained, often characterised by foliation, cleavage and bedding.	Composed of micas (commonly sericite), quartz, garnet, and alusite, clay minerals and iron oxide.	Used as slabs roofing tiles for minor construction works and also caring statues in temples.	The rock is fissile. Harder phyllites (almost nearing to slates) are used commonly where their occurrence is abundant.	2·6-2·8	—	—	—	—	—	—
8.	Schists	Grey to black, brown, purple and greenish grey.	Fine to coarse grained, schistose.	Consists of quartz, feldspar, biotite, muscovite, chlorite, hornblende, garnet, etc.	Not generally used, because of its low strength, but if easily available may be used for minor construction. There are different types of schists, quartz-muscovite-quartz-sericite schists, horn blends-schists, etc.	do	2·31-3·04	400-950	—	—	—	—	$1·8 \times 10^5$ to $3·4 \times 10^5$

NOTE — These values are only for guidance. The exact data is being collected and these values will be revised.

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Amendments Issued Since Publication

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