ANNEXURE – II

Dimension Stone

Dimension Stone is a convenient term applied to stone sold in blocks or slabs of specified shapes and usually of specified sizes, as contrasted with crushed, broken and pulverised stone. According to Bowles (1949) dimension stone includes cut stone, rough building stone, ashlar and rubble, paving blocks, kerbing and flagging. Riprap (large irregular blocks used for shore and embankment protection) is classed with crushed and broken stone.

Specifications of a Dimension Stone

Stones used as blocks or slabs are of many kinds. The principal varieties are granite and granitic rocks, sandstone, quartize limestone and marble. Granite, as mentioned earlier, is visibly a granular crystalline rock composed essentially of quartz, feldspar and mica or hornblende. Although rock occurrences are numerous and widespread, the required quality of material for specific use condemn most of the rock mass except a small fraction of them for our commercial use as dimension stone. No deposit that has closely spaced cracks or joints or any kind of lines of weakness can be so used because sound blocks of moderate to large size are in demand. Uniform texture and grain size, constant and attractive colour, and freedom from impurities that may cause stains or deterioration is required. Hardness is a variable-property of rocks. Granites are very hard. The workability depends to a considerable extent on hardness and freshness of the rock. The degree of hardness has little influence on use except when stones are subjected to severe abrasion, as on steps or floors. Texture as applied to stone relates to the arrangement, uniformity, and size of the constituent grains.
Stones are of many colours and thus satisfy a variety of tastes of customers. According to M/s. Tile Italia of Bangalore, there are 160 natural shades. For monumental stone, a marked contrast between polished and tooled surfaces is preferred in order that inscriptions may be read easily. Some of the trade varieties and shades of granite produced and marketed in India are given below:

Strength requirement usually are disregarded because any sound structural stone suitable in other respects is almost invariably many times as strong as would be required for any ordinary use. High-grade granite will sustain a crushing load of about 1758 kgs/sq.cm. A structure made of stone with a crushing strength of 1054 kgs/sq.cm. (15,000 pounds/sq.in) would have to be nearly four kilometres high before crushing of the lower courses would occur (Bowles, 1934). However, stones disintegrate more readily under severe stress. Therefore a safety factor of 20 is demanded usually. For all ordinary uses, a crushing strength of 350 kgs/sq.cm. (5000 psi) is considered satisfactory.

Porosity (expressed as the percentage of pore space to total rock volume) for granites may be lower than 0.1 percent. The specific gravity of common rocks ranges from 2.23 to 2.8; and the weight per cubic centimetre from 2.4 to 2.9 grams (150 to 180 lbs. per cubic foot).

**Structural Features of Granite and Granitic Rocks**

Innumerable granite deposits occur in several States of India, including Bihar, but only relatively a small number of deposits are actually found to provide suitable colour or texture or are available in sound blocks large enough for use as dimension stone. Most granite deposits are characterised by joints or seams. Such natural fractures which cut the rock mass usually in a nearly vertical direction. They tend to occur in more or less parallel arrangement, frequently in two major systems suitable for use as dimension stone, but if they are regularly spaced 3 to 10 meters apart, they are of great advantage in quarrying.
Horizontal partings which separate the granite into sheets or layers are known as sheeting planes. Most granites and granitic granular igneous or metamorphic rocks split in some direction with greater ease than in others. The direction of easiest is known as the “rift”. A second less strongly marked tendency to split, usually at right angles to the rift, is known as the “grain” or the “run”. Rift and grain structures consist of fine cracks varying from 0.09 – 1.30 mm apart (Dale, 1923), crossing the quartz particles and extending into the feldspars. Such cracks determine the crude feasibility in two rectangular directions of which the usually horizontal rift is the more pronounced (Yadav, 1992). The direction at right angles to both rift and grain is called the “head grain”. These splitting directions are obscure and can be identified only by skilled stonecutters or an experienced geologist, but these splitting are of utmost importance in processes of quarrying and shaping blocks of granite. Dykes in granites are to be avoided in quarrying and if they are numerous, the deposit may be abandoned. “Knots” consisting of dark spots, lenses or patches, and “hair lines”, fine cracks with lines of discoloration which may be either veins or dykes, are also undesirable, particularly on granite to be polished.

**Endurance of Building Stones**

Stone is one of the most enduring of all building materials. Quite a few of the stone structures and monuments built as early as Third Century B.C. are still in good condition. Most of the forts and palaces are built around a 1000 years ago are still standing in excellent condition. There is great variation in the endurance of stones. Some of them though decay comparatively rapidly. The conditions of rock outcrops which have been exposed for millions of years are the best evidence as to their resistance to weathering, through observations made on stone buildings are helpful.
Now endurance tests are conducted in laboratories. By repeated freezing and thawing of wet samples, the results of exposure from many winters and summers may be achieved within weeks. Many of the stones are not recommended for the exterior use unless they are approved after the most rigid tests for endurance. It is not possible to make any generalised statements as to which kind of rock is the most enduring, because anyone particular kind may be susceptible to certain agencies of weathering and quite resistant to other decaying forces. Granites, syenite and other granular igneous rocks suffer most from physical agents such as repeated expansion and contraction as a result of sudden and excessive changes in temperature. Limestone and marbles are altered primarily by chemical action and to a much smaller degree by physical agents. Sandstones with calcareous cement are affected in much the same way as a carbonate rock. Firmly cemented siliceous sandstones have great endurance. Slates are affected very little by solution, expansion or contraction, but high calcium carbonate content may lead to rapid disintegration if the slates are exposed to acid fumes or solutions.

Thus, it may be inferred that limestone and marble have less endurance than granite in an acidic atmosphere, but granite may disintegrate more rapidly than a marble or limestone under extreme temperature changes. However, under any adverse conditions, disintegration and deterioration is an extremely slow process and any standard stone marketed is so enduring that the question of performance be scarcely given. The performance of stone masonry depends not only upon the quality of the stone itself but on the quality of the accessories used and the workmanship. Roofs, gutters, flashing and window casements should be so constructed that water cannot run behind the stone facing blocks. Masonry mortars of only the highest quality should be used. All bedded stones should invariably be placed in the wall with the bedding plane horizontal.

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Miscellaneous Stone and Boulders

Basalt, gabbro and other basic igneous rocks are often used for building purposes. Tuffs, rhyolites and other porous volcanic rocks sparingly used as light weight building material. Mica schists are used as abrasive stones, for linking kilns and furnaces. They are also used for building purposes. Diatomite, Tripoli and pumice are cut and shaped into refractory bricks. They are also used as mineral filters.

Boulders of granite or any other rock are formed as “rolling stones”. Masses of rocks are loosened from their parent bodies by natural processes. Usually they are plentiful where the bed rock is close to the surface. In Bihar, large boulders are obtained in the foothills in northern part of the State, especially between Bagaha and Raxaul in the beds of the Gandak River and its tributaries flowing down from the north. Large pink granite boulders have been seen by the author in Gulbarga District of Karnataka, and Deccan Trap boulders around Lonavala and Lattur in Maharashtra. In glaciated territory, the ice sheet might have carried them for many kilometres, and in any locality, boulders of granite and other older igneous rocks may be found from widely scattered sources.

Boulders are known to have been used by the most ancient tribes for building their primitive dwellings. They are still important construction materials. Local boulders are used extensively in building rustic houses. Around Lattur village in Maharashtra State and its neighbourhood even today the houses are constructed with boulders of Deccan Trap and mud mortar. Locally boulders are used in Western Countries in the construction of chimneys, and basements. Many large architectural mansions, Club-houses and hill resorts are often built of boulders. Because these boulders are obtained locally in the areas of their consumption and are not a product of quarry, there is seldom any systematic record of the extent of their production and use. In Ladakh region, nearly every house, farm and monastery has its fence made of boulders.
Because of the abundance of boulders in that region, one can see many kilo metres of boulder fences which are characteristic feature of the country side usually around Buddhist monasteries. About 80 per cent of the world production of Natural Stone goes to construction, followed by funeral art, urban design and equipment and others. Until recently, all the activities of the Natural Stone Sector were concentrated in only few countries, basically European – Italy, Spain, Portugal and Greece.

<table>
<thead>
<tr>
<th>Use of Natural Stone</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal coverings of pavements</td>
<td>36</td>
</tr>
<tr>
<td>Extensive vertical coverings</td>
<td>22</td>
</tr>
<tr>
<td>Funeral art</td>
<td>15</td>
</tr>
<tr>
<td>Interior vertical coverings</td>
<td>14</td>
</tr>
<tr>
<td>Structural elements</td>
<td>7</td>
</tr>
<tr>
<td>Special works</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

*Source: India Stone, 2007*

Indian Decorative Stones are mostly exported as Slabs, Tiles, Monumental stones and Dimensional Blocks to Argentina, Australia, Belgium, Canada, China Peoples Republic, China Republic (Taiwan), Czechoslovakia, France, Germany, Hong Kong, Indonesia, Ireland, Italy, Japan, South Korea, Kuwait, Malaysia, Netherlands, New Zealand, Nigeria, Singapore, Spain, Switzerland, Thailand, U.A.E., U.K., U.S.A. and some others.