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1 : Introduction

1.1 NATURAL STONES AND THEIR IMPORTANCE

The use of natural stones down the centuries in raising monuments and memorials is well-known and needs no elaboration. Natural stone represents one of the oldest building materials and its availability and durability have led to its wide and successful use for building purposes through the ages. Few building materials have so great a tradition as natural stone for "it was in stone that man created many early inspiring works of art that are still in existence for us to admire. Because of its immense variety, the unlimited possibilities as regards to shape, surface finish, size and adaptability of the material, building in stone was and still is a means of expressing architectural features of the finest quality".

Stones are cut to different shapes and sizes i.e. to different dimensions and hence these are called dimension stones. With the increase in the construction of buildings and monuments all over the world, the importance of dimension stones has increased in spite of the ever-increasing use of building materials like cement, mortar, asbestos sheets, etc. Most of the important forts, temples, palaces and other buildings in southern India are built of granite stones of various colours whereas similar buildings in northern India are built of marble and sandstone. Ancient forts like the Tanjore Fort in Tamil Nadu, the Golconda Fort near Hyderabad, and Mysore, Chitradurga and Bellary Forts in Karnataka, are but a few examples of granite utility. When we look at the big temples all over southern India, we wonder whether such shrines could have been built by our ancestors, had there been no granite. There are thousands of temples spread over Kerala, Karnataka, Tamil Nadu, Andhra Pradesh and Orissa. The tallest monolith statue in the world, that of Shri Gommateswara (Bahubali), of the twelfth century, at Shravanabelagola in Karnataka is an outstanding example of granite stone statuary. In the relics of the twelfth century Vijayanagar Empire at Hampi, lies a treasure of granite artistry.

In Maharashtra, Gujarat and parts of Madhya Pradesh, Deccan Trap basalt stone takes the place of granite in the construction of historical forts as well as in important shrines and buildings. The world famous carvings in Ajanta and Ellora caves are in the Deccan Trap. The monuments have stood the ravages of time and weather as prominent witnesses of Indian culture, heritage and artistry.

Some famous granite monuments built in the recent past are given below:

1. The Vidhan Soudha at Bangalore, housing the Karnataka State Legislature and Secretariat (frontpiece).
2. The Vivekananda Rock Memorial at Kanyakumari
3. The Vietnam War Memorial monuments in Washington D.C. U.S.A.
4. Gita Mandir, Wardha where full Bhagwat Gita is engraved on polished stones.

5. A huge polished granite stone is used for a column of a Buddhist temple in Japan.
6. The Atomic Bomb Victims' Memorial at Hiroshima, Japan.
7. International First prize-winning building of "DONG BANG BUILDING" in Seoul, South Korea where polished granite stones from India are used for interior and exterior.
8. Our Late Prime Minister Mrs. Indira Gandhi's Memorial at No. 1, Safdarjang Road, New Delhi.

Blocks of granite and marble exported from India to a number of countries, for building purposes, interior decoration, for use as tombstones, etc. Granite blocks and slabs of different shapes and sizes, specially polished, are in great demand in many countries. The polished black granites in the form of tombstones, curbstones, etc. are much sought after. In India too, the utility of these stones is on the increase and the mining, cutting and polishing of granite and marble has come to stay as an important industry.

The Bulletin emphasises the aspects like the nature and quality of granite accepted by the industry, its geological and geographical distribution, methods of mining and processing, machinery employed and problems faced in mining and processing.

For the benefits of the readers it is clarified that in this bulletin some of the dimension stones of igneous and metamorphic origin traded as granites have been covered and described as granite, irrespective of their geological classification.

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2 : Composition And Physical Properties

2.1 WHAT IS GRANITE

Granite is an important structural and ornamental stone and because of its high compressive strength and durability, it is used extensively for massive structural work. Fine-grained granite that takes and preserves good polish is employed for ornamental and monumental works and also for inscription purposes². The term granite is derived from the Latin word 'granum', a grain.

Granite, a light-coloured acid igneous granular rock of plutonic origin, generally, grey, mottled grey, red or pink and white or green in colour, is characterised mainly by the presence of quartz, felspar and minor amounts of mica and ferro-magnesian minerals like biotite, amphibole and pyroxene. It is generally of three types: (a) alkali granite containing alkali felspar, (b) cal-alkali granite mainly known as granodiorite containing plagioclase felspar, and (c) adamellite granite, an intermediate variety, containing an equal proportion of calc and alkali felspars. Colour is usually imparted to the granite by its felspar constituents and may vary according to the degree of its assemblage. Calc-alkali granites are usually grey or white. Many potash varieties are pink or red, because of the colour of orthoclase felspar. In grey granite, the proportion of quartz is more than in pink granite. Felspars are generally white in grey granite, and pink in pink granite. When hornblende or biotite is abundant, granite may be dark green or almost black. The minerals of granite are directly crystallised from magma melt, resulting in a strong cohesive bond that contributes to its compactness and durability. The magma in the deep-seated condition does not leave any air cavities rendering the rock thoroughly massive².

Dimension granite includes not only true granite but other types of igneous and metamorphic rocks³, such as dolerites, syenites, diorites, granitic schists and gneisses, quartz porphyrites, rhyolites, diabases, basalts, gabbros, charnockites and khondalites, used as sources of building material. In popular usage, the term granite is applied to almost any crystalline rock, irrespective of its composition or origin. Black granites or diabases are actually gabbro or dolerite rocks generally occurring in the form of dykes, mainly of volcanic origin. These are black and fine to medium-grained rocks. The exact composition of granite varies from place to place and even from specimen to specimen. The diabase or dolerite has a low to negligible percentage of quartz. Diabasic, gabbroic and dolerite rocks are not as abundant as pink or grey granite.

2.2 COMPOSITION AND PHYSICAL PROPERTIES OF GRANITES

Granites have a broad range of physical and chemical properties. The suitability of a granite for any purpose is decided by its properties which meet the specification established for the purpose. Granites are mostly used because of their pleasing appearance and physical strength; and the chemical properties are less important than the physical properties. However, the chemical composition determines many physical properties of granites, particularly its resistance to weathering. The chemical composition of a few important granites is given in Tables 1.1 (A, B, C and D)

The physical properties of granites, dolerites and gabbros are given in Table 1.1 (E).

TABLE 1.1 (A)
AVERAGE COMPOSITION OF GRANITE AND DOLERITE
(IN %)

CONSTITUENT (oxide)	GRANITE	DOLERITE
SiO ₂	75.01	50.61
Al ₂ O ₃	12.27	13.58
Fe ₂ O ₃	0.80	3.19
FeO	2.78	9.92
MgO	0.08	5.46
CaO	1.87	9.45
Na ₂ O	3.36	2.60
K ₂ O	2.80	0.72
H ₂ O	0.38	2.13
TiO ₂	0.33	1.91
P ₂ O ₅	0.02	0.39
MnO	0.06	0.21

TABLE 1.1 (A)
AVERAGE COMPOSITION OF GRANITE AND DOLERITE
(IN %)

CONSTITUENT (mineral)	GRANITE	DOLERITE
Quartz	38.8	4.14
Orthoclase	16.7	4.45
Albite	28.3	22.01
Anorthite	9.2	23.07
Diopside	-	17.41
Hypersthene	4.3	17.78
Corundum	0.3	-
Ilmenite	0.6	3.65
Magnetite	-	4.64
Apatite	-	1.01

54	49.5
35.2	8.3
Iron Ore	

TABLE 1.1 (C)

CHEMICAL COMPOSITION OF A FEW GRANITES IN INDIA⁶
(IN %)

CONSTITUENT	GRANITE		
	St. Thomas Mount, Madras	Rajasthan	Chhote Nagpur
SiO ₂	77.47	65.90	75.87
Al ₂ O ₃	11.00	16.63	12.63
Fe ₂ O ₃	1.04	1.00	0.19
FeO	2.02	4.11	0.98
MgO	0.43	1.70	0.17
CaO	1.02	1.40	0.72
Na ₂ O	2.86	2.70	3.86
K ₂ O	4.14	4.38	5.22

TABLE 1.1 (D)

**CHEMICAL COMPOSITION OF A FEW GRANITES FROM
DIFFERENT PARTS OF THE WORLD⁶**
(IN %)

CONSTITUENT (Oxide)	GRANITE			
	California	Madagascar	Greenland	England
SiO ₂	66.65	70.40	71.24	68.55
Al ₂ O ₃	16.16	7.85	13.78	16.21
Fe ₂ O ₃	1.52	6.98	1.30	2.26
FeO	2.36	2.98	2.83	tr.
MgO	1.74	0.52	tr.	1.04
CaO	4.53	0.26	0.38	2.40
Na ₂ O	3.40	4.05	5.32	4.08
K ₂ O	2.65	4.45	5.10	4.14

TABLE 1.1 (E)

**PHYSICAL PROPERTIES OF GREY GRANITE, DOLERITE
AND GABBRO⁴**

Property	Grey granite	dolerite	Gabbro
1. Hardness			
a. "Moh's scale	5.8-6.6	6-6.7	4.8-6.2
b. Shore	85-110	85-105	-
2. Specific gravity	2.6-2.7	2.6-3.13	2.9-3.12
3. Compressive strength, kg/cm ²	1000-3000	2000-3500	1800-3000
4. Tensile strength, kg/cm ²	70-250	150-350	150-300
5. Shear strength, kg/cm ²	140-500	250-600	-
6. Modulus of elasticity, kg/cm ² x10 ⁵	2.5	8-11	7-11
7. Coefficient of linear expansion, x10 ⁶	4-6	2-4	-
8. Porosity, %	0.5-1.5	0.1-0.5	0.1-0.2

2.3 PHYSICAL PROPERTIES

The desirable physical properties of granite vary with the intended use. Generally strength, durability and appearance are considered the most important physical properties. Besides, a number of other properties influence the utility and value of granite. The salient physical properties are described in Table 1.1 (E).

Strength and deformation characteristics of granite and dolerites from Warangal District, Andhra Pradesh are given below :

Rock	Density M/V	Compression strength (SC) kg/cm ²	Tensile strength (St) kg/cm ²	Shear strength (SS) kg/cm ²	Young's Modulus (E) x10 ⁵ kg/cm ²
Pink granite	2.58 to	800 to	70 to	280 to	2.15 to
	2.63	1500	130	425	3.60
Grey granite	2.60 to	1300 to	100 to	300 to	2.80 to
	2.68	2200	150	540	5.04
Dolerite	3.00 to	1500 to	130 to	400 to	4.40 to
	3.10	3200	220	680	7.42

Source : Deva Pratap, Granite Seminar, Institution of Engineers, 1988 Hyderabad.

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3 : Geological And Geographical Distribution

3.1 GEOLOGICAL DISTRIBUTION

Granites are widespread throughout the Archaean terrain. The Archaeans which are the oldest rocks of the earth's crust occur at the bottom of the stratified formations of the Cambrian upwards in all countries of the world. These exhibit everywhere with similar characteristics regarding their structure and composition. Granites form the core of all the mountain chains in the world and the foundation of all the great ancient plains.

The following general succession of the Archaeans of India as adopted by Sir Lewis Fermor in 1919². In this succession granites are distributed as under :

- a) The oldest basement gneisses representing, in part at least, the primitive crust of earth.
- b) Dharwar sediments and contemporaneous lavas; also khondalities.
- c) Remelted masses of basement gneiss, now consisting much of schistose and garnetiferous rocks in Bengal and Peninsular gneisses and schists.
- d) Charnokites and Bundelkhand gneisses with intrusions such as peridotites, granites and syenites.

The Dharwar formations of the Archaean System in India in which granite occurs are shown in Table 3.1. Dolerite and gabbros which occur as dykes in the Archaean gneisses and are of a later age, are also called black granite in the trade centre.

3.2 GEOGRAPHICAL DISTRIBUTION

The rocks of the Archaean System covers several hundred thousand square kilometers in India. By far the largest part of the peninsular India is occupied by this ancient crystalline complex. The Archaean System includes Dharwars, Charnokites, Bundelkhand Gneisses, Banded Gneiss Complex, Older Metamorphics and Basement Complex¹. These rocks cover wide areas in Assam, Bihar, West Bengal, Madhya Pradesh, Rajasthan, Gujrat, Maharashtra and Orissa, besides, the southern States viz., Karnataka, Goa, Andhra Pradesh, Kerala, Tamil Nadu and Pondicherry. The important occurrences of granite in some of the States is discussed below:

3.2.1 Andhra Pradesh

Andhra Pradesh is endowed with very good quality of granites. These mainly occur in Chittoor, Hyderabad, Khammam, Warangal and Prakasam districts.

Chittoor District

Kuppam and Palamner are the well-known areas for granite production. The Pre-Cambrian granite gneiss of Kuppam taluk exhibits a clear gneissic banding. The commercial granite,

Table 3.1

DHARWAR FORMATIONS OF INDIA IN WHICH GRANITE OCCURS

Mysores	Singbhum	Rajasthan	Eastern Ghats	Madhya Pradesh	Assam	NW Himalayas
Close-pet granite	Granite and Dome gneiss	Alkali granite and syenites	Bellary, Hosur and Arcot granite	Granite	Granite intrusions	Kazi Nag and Chor granite
Charnockite	-	-	Charnockite	Granite gneiss	-	-
Peninsular gneiss	Bengal gneiss	-	Granite gneiss	-	-	Chail series
Sedimentary Dharwars	Iron ore series, Gangpur series	Raialo series, Aravalli series, Champaner series	Baster iron ore series, Khondalites and Kodurites	Sakoli, Saugar & Chilpi series, Gondites	Shillong series, calc gneiss	Salkhale series, Jutogh series
Older gneiss	Older gneiss	Bundlekhand gneiss, Banded gneiss	-	Older gneiss & schist	-	Archaean schists

i.e. black granite, is actually a gabbroic intrusive in granite. In Chittoor District, dolerite dykes intrude schists and gneisses of Archeans. These basic dykes are extensively seen at Chandragiri, Chittoor, Puttur, Bangampalli, Chinnapottigally, Pungawuru, Vayalpadu, and Madampalli of the erstwhile taluk of Chittoor district. These basic dykes form remarkable pattern of cross-cutting, coalescing and ramifying systems. These may be classified into two groups: Those running in an E.W. direction and those running in N.S. direction. The majority of the dykes belong to the former group. These basic dykes range from 3.5 to 100 m. in width. The texture of these rocks ranges from very fine-grained or almost glassy to very coarse-grained with distinct ophitic structure and xenocryst of basic plagioclase.

The dykes partly outcrop in the form of small hillocks in a succession and are partly concealed below the soil cover. The thickness of the dykes varies between 30 and 36 meters. The dyke rocks are also identified in the Koneru-Kuppam, Mallur, Krishnapuram, Ramakuppam, Thuminda, Gudipala, Pasumanda, Naragallur, Peddasethipalle and Cheuchugidi villages³.

Hyderabad District

Granite and gneisses are extensively worked, especially around Hyderabad city. Grey and pink varieties are common. Dolerite dykes are also worked here. The stones take good polish and hence are used for decorative purposes⁴.

Khammam District

Export quality black granites occur in Polepalli and Edulapuram areas in Khammam district⁵. Deposits of pink granites have also been reported in the district.

Prakasam District

Black granites are found in and around Kukutapalli and Gokunkonda villages and north of Narasaraopet-Addanki Road in Shankarlinga and Gudipadu villages. In the later area, a gabbroic sill stretches in NW-SE direction. The rock is medium-grained and is brownish-black. This is an extension of the Chimakurthi igneous complex of Warangal district.

Warangal District

Granites of good quality occur around Kazipet town and Chowtapally area in Warangal district. Grey and black varieties which take good polish occur around Kazipet. Black granite is recorded in Chowtapally area. A good variety of charnockite extending over a square km. occurs near Chimakurthi village. Although two varieties of black granites are available here, however, these are not marketable due to presence of bronzite flakes⁶.

Nizamabad District

Pink granite spread over an area of 50 sq. km. occur near Bhimgal town. Preliminary studies have indicated that this pink granite is amenable to polishing and can be used as decorative stone because of its pleasing colour and absence of deleterious constituent.

The other areas in Andhra Pradesh where good quality granites of black, grey and pink varieties occur are as follows:

- a) Jagtial and Metupalli areas in Karimnagar district.
- b) Areas of Dhone taluk in Kurnool district.
- c) Ellapalem and Gullapalem areas in Guntur district.
- d) Udarapikonda area in Anantpur district.
- e) Granitoid gneiss of pinkish variety in a number of places in Nellore district.
- f) Black granites or charnockites and pyroxenites of good export quality in Kondapalli area in Krishna district

3.2.2 Assam

There are extensive deposits of dimensional and ornamental stone in the central and lower part of Assam. Some of the deposits are of very high grade. Most of the deposits are mica free, pink coloured granite. Grey and light coloured granite are also abundant. Such type of granite deposits occur along the National Highway 36 and National Highway 37 in Central Assam at places like Mahamaya Hill (93° 4' 29" E 26° 12' 15" N), Central Bazar (93° 9' 30" E to 93° 10' 40" E; 26° 7' 15" N to 26° 8' 00" N) and Bura Pahar Amguri area (93° 0' 00" E to 93° 5' 00" E; 26° 32' 00" N to 26° 30' 00" N). All these above mentioned deposits are easily accessible. In lower Assam there are huge deposits of such rocks at easily accessible places and by the side of railway track.

Besides pink and grey coloured granite there are also large deposits of basic rocks (Dolerite, Meta dolerite, etc.) or "Black Granites" in the state.

From the point of location, accessibility, availability of labour and other facilities the pink granite deposits of Mahamaya hillock and Central Bazar areas appear suitable for setting up of a building and decorative stone processing plant. The State Directorate of Geology and Mining, Assam has estimated that about 43 million cubic metre of best quality pink granite is available at Mahamaya Hill and Central Bazar area.

3.2.3 Bihar

Granites and gneisses of good variety occur in many districts of Bihar. They are geologically known Chhota Nagpur gneiss, Dome gneiss and Singbhum gneiss. Some gneisses of Chota Nagpur area take good polish and are used for ornamental purposes^{7, 8}.

So far eight deposits of granite have been identified, which include dolerites of different generation, light pink granite, gneiss, porphyritic granite, etc. Samples collected from these deposits were found suitable as black or in multicolour after polishing. The area-wise description of these deposits is given below¹⁹.

a. *Newar dolerites of Hatia :*

A number of dykes were identified in and around Hatia (Lat. 22°37'0": Long. 86°9'45") in Singbhum district. Their general trend is NE - SW with few smaller cross-cut dykes of limited dimension. While dykes extend over considerable length of more than a km., their

width varies from 15 to 40 meters. The rocks are fine to medium-grained, hard and compact and are greenish black. The marginal parts of dykes have finer grain size due to sudden chilling effect of magma. After cutting and polishing, rocks show greenish tinge on a black background. Because of its strength, uniform grain size and pleasing colour after polishing, the material can be used as decorative stone. Detailed geological exploration for individual dyke is yet to be carried out.

b. Porphyritic granite of Balasiring :

It is located at a distance of 5 km. South West of Hatia (La. 23°16'0": Long. 85°12'0") in Ranchi district. The deposit occurs in the form of a small batholith having a length of 700 m. and a maximum width of 200 m. It occurs as small hillock rising above ground by 35 meters. Well-defined two sets of vertical joints, almost at right angle to each other, have been identified.

The rock is hard and compact and is grey with well-defined porphyries of soda-feldspar. The material takes good polish and can be marketed as decorative stone in combination with pink granite.

c. Pink granite of Hatia :

Deposit is located at a distance of 23 km North of Daltonganj in Palamau district (Lat. 24°13'0": Long. 84°13'0") and extends EW for a strike off about 10 kilometers with more than 300 width. It occurs as a ridge with an average elevation of 30 m and exhibits a set of master joints. Geologically, the rock can be termed as granite gneiss with well-defined gneissic structure. The rock is medium to coarse-grained and is easy to cut to form sizable dimension stones. The pink colour is due to presence of potash feldspar. It takes good polish.

d. Blackgranite of Arapur :

The deposit is located about 3 km. north of Hatia deposit as described above. The deposit occurs in form of two isolated ridges elongated in E-W direction for a strike length of about 800 metres. The rock is very hard and compact. It produces metallic sound on hammering. On cutting and polishing, it assumes good commercial value because of its dark colour and shining polish.

e. Black granite of Khori :

The deposit is located at a distance of 35 km north of Daltonganj in Palamau district. This deposit is similar in look and character to that of Arapur. However, it is more extensive. It is also hard and compact but is finer-grained and darker in colour. There are two sets of joints, one vertical and another horizontal, causing better recovery of blocks.

f. Black granite of Salatua :

The deposit is located at a distance of about 25 km west of Daltonganj (Lat. 24°1'0": Long. 83°57'25"). It occurs in form of isolated patches with well defined alignment in E-W direction. On the basis of the data available so far, these appear to be the parts of a set of three parallel dykes, ranging in thickness from 30 to 50 metres. The rock is fine to medium-grained, hard and compact and jet-black in colour and takes good polish. It also gives metallic sound on hammering. On cutting and polishing these rock may fetch good price.

Other deposits of black granite are reported from Hansdiha area in Bhagalpur district, Domchanch

in Hazaribagh district and Jagdishpur in Giridih district. However, details of these deposits are awaited.

Except for a face development and trial mining in Salatua area, no regular mining for granite has been started in this State. The detailed geological exploration for few deposits described above has been taken up.

3.2.4 Gujarat

Granites and granodiorites of decorative/ornamental and building values are worked in Amreli, Banaskantha, Baroda, Mehsana, Panchmahal and Sabarkantha districts^{9, 10}.

a. Banaskantha District

Granite deposits occur in Jalwanthgadh, Vajasana and Navavas villages of Dant taluk, Jaspur, Pansval, Vagor, Dantivada and Pathavada villages of Dhanera taluk; Sodapur village of Disa taluk; and Goba, Tandiyavadi villages of Palanpur taluk.

b. Sabarkantha District

The deposits are in Idar, Mohanpur and Khuski villages in Idar taluk; Khalvad in Bhiloda taluk and Chhaniyan and Dhori villages of Vadagam taluk.

c. Other Districts

The other notable areas are Rupavati in Amreli district; Bulavam, Virpur and Bodeli in Baroda district; and Godhra and Ratanmahal in Panchmahal district. The porphyritic diorite of Rupavati area yields a handsome stone of blackish colour with felspathic grains of warm green tint. Granites of Baroda are pink and green and possess a high decorative value.

3.2.5 Karnataka

Grey, pink and black varieties of granite occur in a number of districts throughout the State. The important occurrences are distributed in Bangalore, Kolar, Mysore, Tumkur, Chickmagalur, Hassan, South Kanara, Bellary, Raichur, Gulbarga and Bijapur districts.

The important occurrences of black granite are as follows¹¹:

- a) Dodakallahalli and Ityandanahalli in Kolar district. These are the extension of the deposit in Chittoor district Andhra Pradesh.
- b) Banaswadi, Jathigondampura, Yadepura, Shirpura, Punjamur, Devarahalli, Kagalipura and Masakpura villages in Bangalore district.
- c) Kundlur, Malemala, etc. villages in Chamrajnagar taluk; Gumhalli village in Yelandur taluk; and Kengadi, Ponnachi, etc. villages in Kollegal taluk in Mysore district.
- d) Gundlagantal, Bachapalli, Madkamballi, etc. villages in Sira and Tiptur taluks in Tumkur district.
- e) Kadur, Ammandahalli, Bogibyle villages in Karwar district and Ankola taluk in North Kanara district.

- f) Maroulu villages in Hassan taluk; Gangur, Konanur, Harlahalli, etc. villages in Arakalagud taluk in Hassan district.
- g) Areas in Mangalore district.

The important occurrences of grey and pink granites are as follows¹¹:

1. Alahalli in Bangalore South taluk and some villages in Megadi, Nelamangala, Hoskote and Ramnagar taluks of Bangalore district.
2. Quarries of red multi-coloured granite located near Hosadurga, Kebbhally, Yadamaranahally, Mahimanahally, Nidagally, Maralebekuppe and Nallahally villages in Kanakapura taluks of Bangalore district.
3. Quarries of black multi-coloured granite located near Hosadurga and Kebbehalli villages in Kanakapura taluk of Bangalore district.
4. Bachappanahalli, Kallahalli villages in Chintamani taluka; and Soddakere and Narnehalli villages in Bangarpet taluk of Kolar district.
5. Sivigera and Dasapura villages in Sirguppa taluk and some villages in Bellary taluk of Bellary district.
6. Chikkadagalli, Balkundi, Hungund, etc. villages in Hungund taluk of Bijapur district. Pink granites of Ilkal village are famous in the world. The colour of the granite varies from deep red, deep pink to pinkish brown and the variety produced include the imperial red, ruby red and sentinel red.
6. Chingalli, Midewadi, etc. villages in Hassan taluk; Kudlapura, Maltigudi, Rudrapatna, etc. villages in Arakalagud taluk of Hassan district.
7. Salagenudu and Samalpur villages in Sindhur taluk of Raichur district.

3.2.6 Orissa

Khondalities which provide ornamental building stones are quarried at Kakuri Hill, Sunajheli, Jagannathpur, Thiragaunju, Kamalapur and Satyanarayanpur in Ganjam district. Pink garnet gneisses, granitic gneisses and charnokites satisfy the local demand for building stone in Ganjam district. The pink colour and easy splitting quality of partially decomposed gneiss made them a favourite building stone.

3.2.7 Rajasthan

Granite and gneisses of decorative and ornamental quality occur in a number of districts. Though granite occur in considerable quality, these are generally not used for construction purposes due to easy availability of other building stones like sandstone, limestone, marble, phyllites and schists.

Granite of good quality is mainly found in Ajmer, Barmer, Bhilwara, Jalore, Sirohi, Pali districts. In Ajmer district, granite and granite gneisses are quarried near Vijaynagar, Deoli, Baghera, Kekri and Para. In Barmer district, pink granite associated with Malani rhyolites has been worked near Jasori. In Bhilwara district, fine-grained varieties of biotite gneiss are quarried extensively near Ajitpura. In Jalore district, three types of granites, pink, red and black, are quarried but only red and black granites are exported. Pink granite is mined in Thanskhana and Kalkaji temple areas. Black granite is mined in Kolar-ki-ghati and Kalaghata and red granites in Nuan and Keshwana areas. In addition to above, large deposits of black granites have been located at Bidiar and Talera in Jalore district. Porphyritic granite which takes good polish occurs south of Jalore resthouse. The other occurrences of granite porphyry which is suitable as building material are located near Desu, Modras and Kolar areas in Jalore district^{13, 14}.

There are huge resources of granite in Rajasthan, suitable for large block-making and for tile preparation. The important locations are listed below²⁰:

1. Jalore : Erinpura granite/Siwana granite, basic intrusive rocks in Thaskhana, Kalkaji Naun, Keshwana, Kolar-ki-ghati, Kalaghata.
2. Sirohi : Abu granite, Mundwara Sodalite-Syenite, Sirohi border granite, Koteswar granite, Veerwada.
3. Chittorgarh : Bundelkhand granite, Berach granite and dolerite/gabbro in Gangrar, Soniana, Khuntia, Nimbahera and Chhoti Sadri area.
4. Jodhpur : Granitic rocks near Jasai, Bisala, Taralana, Mongris.
5. Barmer : Siwana, Mokalsar, Viratra, Bhachbhar, Dhorimana and around Barmer.
6. Jaipur : Dudu-Ladera area.
7. Sikar : Ajitgarh granite.
8. Ajmer : Kishangarh syenite, Harmada, Bijaynagar, Piplad, Pilua, Rupnagar, Bhimpura (Sewaria) Botholith, Bandanwara Bhinai charnokites.
9. Pali : Sendra complex, Chitar, Manihari, Paldi-Sumerpur.
10. Udaipur : Bhimkarea-Gyanganarh, Gingla-granite, Unthala granite, Padrada-Saira granite/gneisses, Salumber granite.
11. Banswara : Bijanwas granite, dolerite dykes and intrusive, NW of Banswara on district border; Surwania, Khunta and Barbarada.

12. Nagaur : Basic intrusives near Talera, Bidiyar, Morad, Kinaria and Kishorpura of Parbatsar taluka.
13. Dungarpur : Ramgarh granite/gneisses.
14. Alwar : Hazipur granite, Dadikar, Bairath, Holsora.
15. Jhun-jhunu : Moto Pahar and Raizani areas.
16. Sawai Madhopur : Baunli area.

3.2.8 Tamil Nadu

A number of areas of granite, black granite and granitoid gneisses have been identified in Tamil Nadu. Granite and granitoid gneisses of very good quality occur at many places like Dindigal, Tirupathur, Vaniambadi, Walajah, Chengam and Vellore areas in North Arcot district; Tirusulai, Puliarpatti, Arupkottai, Tiruparal, Kundaram, Shalpatti areas in Ramanathapuram district, Nagarvalli, Vakkanadu and Tolassmpatti areas in Salem district; Tirkonum, Pudukkottai, Kunamalla, Virallimalai, etc. areas in Tiruchirapalli district; and in many areas in Tanjore and Nilgiri districts.

Black granite, i. e. gabbros and dolerites of good quality, occurs at a number of places like Tindivanam, Kunnam, Kallakurichi, Villupuram, and Thirukollur areas in South Arcot district; Bevanur R. F., Ajjanahalli, Badrahalli, Gopinathpatti, Chintalpatti, Pannagaram, Eriyur, Harur, Donnakuttahalli, Chendrapatti, Devarabatta, etc. areas in Charnapuri district; Thirumalaipatti, paithur, Kalipattai, Yellakaradu, Namakkal and Mettur areas in Salem district; and Bhavani area in Coimbatore and Kancheepuram and Chingleput areas in Chingleput district ^{1, 7, 10, 15}.

Charnockites and leptinites which take good polish occur at Tiruvattur in Kanyakumari district; Puddur, Chelampatti, Sedamangalem, Variyappamalai and on the east bank of Cauvery at Metur in Salem district; and Tambaram and Pallavaram areas of Chingleput district.

3.2.9 Uttar Pradesh

The porphyritoid grey granite which could be used for ornamental work has been reported in Almora district. Pink granites occur in Bundelkhand region¹⁶.

3.2.10 West Bengal

The Porphyroblastic granites which are very hard, durable and suitable for building material, occur in Purulia district. Medium-grained granites occur in two hillocks of Dubrajpur near Rambhal, Avadarpur and other places in Birbhum district.

Black granites of good variety are reported from Ramkrishnapura, Nandanpur, etc. areas in Bankura districts; Purulia district^{17, 18}.

3.2.11 Other States

Black granite and granite occurrences are reported from Kerala and Maharashtra. Black Granites occur in Calicut district of Kerala. In Maharashtra, black, granites of gabbroic composition are identified in Ratnagiri district¹⁵.

3.3 RESERVES OF GRANITE DEPOSITS

Granite deposits of grey, pink, red and black varieties are widely distributed in India as could be seen from the above discussion. The various State Directorates of Geology & Mining and one State Govt. undertakings dealing with granite have made independent efforts to assess the reserves of granite in their areas.

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4 : Uses And Specifications

4.1 USES

Granite is an important structural and ornamental stone and because of its high compressive strength and durability, it is used extensively for massive structural work. Fine-grained granite that takes and preserves good polish is used for ornamental and monumental work, for inscription purposes and cladding of buildings.

The recommended grade of granite stones for building and constructional purposes as per IS:3316-1974 is given below :

TABLE 2.1

RECOMMENDED GRADES OF GRANITE STONES FOR VARIOUS USES^{1, 2}

Sl. No.	Specific Use	Grade of Stone	Compression Strength Kg/Cm ² , minimum
1.	Bridge piers, sea and river walls, dams and related structures, bridge superstructures, grade separations and retaining walls	A	2,200
2.	Traffic controls, curbs, land-scaping and parks	C	1,400
3.	Pavement	B	1,800
4.	Flexural members (see Note 1)	A	2,200
5.	Monumental buildings (see Note 2)	A	
6.	Institutional and commercial buildings	C	
7.	Residential buildings	D	
8.	Gradewise Abrasion Value :		
	Grade of Stone	Abrasion Value % . Maximum.	
	A	32	
	B	36	
	C	40	
	D	45	

Note 1: The stones selected for the purpose shall, in addition, have a transverse strength not less than 140 Kg/Cm² determined in accordance with the method laid down in IS:1121-1957 with Amendment No.1, July 1964.

Note 2 : Additional requirements for thermal properties and polishing characteristics of the stone may be specified if considered necessary.

4.1.1 Granite for Memorials⁴

Granites of different varieties are in demand for preparing monuments which are used as memorials in India and abroad. Most granites exported from India are in the form of finished memorial sets.

There are four types of memorial sets :(i) head stone set, (ii) lawn set, (iii) Kerb set and (iv) Mouse trap set.

Only the visible and not all the faces of these sets are polished. The unpolished visible faces carry fine punching which is done by fine and uniform chiselling. Special articles like books, scrolls and posts also form parts of memorial sets (sets made out of black granites are preferred, sets made out of grey and pink varieties come next in importance).

4.1.2 Utility of Granites as Metrological Aids^{5, 6}

Granites are used in various metrological instruments as surface plates, straight edges, parallels, cubes, V-blocks and work mounting tables of co-ordinates measuring machines. Due to their superior wear resistant quality and particularly due to non-denting property granite could be conveniently used as a bearing material in aerostatic guide-ways for large and small machines, radar movements, etc. The surface plates are used as a flat datum surface whenever precise measurement of dimensions and geometrical relationships are to be carried out. With the special advantages attributed to granites, cast iron plates are being replaced by granites. Till recently, granite surface plates were being imported. At present, manufacturing technology has been developed by the Central Machine Tools Institute, Bangalore (CMTI) for certain metrological aids.

Cast iron and steel surface produce a large bulge due to impact of other tools on them, the resulting defect remains unnoticeable to the naked eye. On the other hand a granite surface when subjected to similar impact localises crushing or scratching giving away pieces or powder but the accuracy of the surface remains unaffected. The CMTI has carried out research on a dolerite surface plate of 1 x 1m size, which during constant workshop use for over four years displayed deterioration in accuracy by less than 5 microns, amply proving its wear resistant quality. In a similar experiment, the CMTI found that granite surface is not affected at all by aging. Small stress is developed immediately after quarrying and its lapping is usually sufficient for stabilization and no appreciable effect is noticed. Measurements carried out on a 1.6 x 1.0m granite surface immediately after lapping and over a period of four years when it was used sparingly, have indicated that the variation in shape and accuracy of the surface was negligible. In another experiment, it was found that fine-grained granitic rocks possess higher density, hardness, and resistance to scratch, and are less porous. Thus, granite has proved its usefulness for providing an accurate surface to serve as a reference.

Granites to be used for metrological purposes should have a close-grain size, homogeneity, high density and hardness, uniform colour and low moisture absorption. The granites should be free from flaws. The stone processed in the normal manner constitutes the semi-finished raw material for metrological use. It is further processed to obtain necessary surface accuracies with the aid of machines and abrasive materials. The process involved is lapping in stages. After each lapping, the contour of the surface is assessed by the grid method with sophisticated instruments like high precision spirit levels, electronic levels and laser interferometer. Large surfaces are evaluated by computers.

4.1.3 Granite for Decorative Pieces

Many decorative domestic articles are made out granites. These are different types of blocks and slabs, kitchen platforms, bathing platforms, name boards, ash trays, pen stands, paperweights, grinders and flower vases, etc

The plaques in polished granite with inscriptions on it for use as ceremonial foundation stones, corner stone of any construction work, or plaques signifying the opening ceremonies are so elegant that they have become a part of tradition.

4.2 SPECIFICATIONS

To be a good building ornamental stone, the rock should be hard and compact, should not crumble under heavy superincumbent pressure and should withstand the ravages of time and weather. Further, it should be possible to quarry the stone and dress it into blocks of desired sizes and shapes. This depends upon the inherent properties of the rock such as its texture and incidence of joints which help in rock fracturing along certain directions. A pleasing appearance and colour blend together with composition and grain size are prerequisites for ornamental stones⁶. The texture of the rock is specially important for inscription.

4.2.1 Suitability of Indian Granite for Building and Ornamental Purposes

Indian granites represent much desirable and durable building stones, due to their ornamental nature. These rocks because of their massive nature and homogeneous grain size are preferentially used in monumental and architectural works, as well as in massive masonaries. The wide range of appearance and colour, i.e. white, pink, red, grey and black, renders the stone highly ornamental and effective for a variety of decorative purposes. The charnockite of Madras, Arcot gneiss, Bangalore gneiss, porphyries of Srirangapatnam and many other varieties of granite obtained from different districts of the peninsular India are indeed very attractive. The charnockites of Tamil Nadu, Karnataka and Andhra Pradesh are amongst the strongest and the most durable stones found anywhere in the world. Granites of the southern India have been tested and found superior to certain famous granites of the British Isles³. The durability is such that the numerous ancient temples and monuments built of granite stones in the southern India stand almost intact even today after centuries of weathering and yet will continue to hold well for centuries to come⁷.

4.2.2 Indian Standard Specification (IS:3316-1965) for grading structural granite¹

Granite should be free from cracks and other imperfections that would impair its structural integrity and adversely affect its strength and appearance. The designer has to specify the colour desired and the permissible natural variations in colour and texture in detail or name

the granite having the required characteristics. Granite containing deleterious minerals like pyrites and marcasite which upon exposure rust rapidly and cause objectionable stains on the stone should be excluded.

Granites are classified under four grades depending upon the compression strength and abrasion resistance as specified below:

Designation/Grade	Compression strength (kg/cm ² minimum)	Abrasion value (% max.)
A	2,200	32
B	1,800	36
C	1,400	40
D	1,000	45

4.2.3 Selection, Dimension and Marking of Granite²

The Indian standard specification IS:3316-1974 (First Revision)² was evolved for selection, dimensions, marking, sampling, grading and strength requirement of the Indian structural granites for various constructional purposes.

As regards dimensions of slabs and their marking, it lays down that the slabs should be rectangular or square and of specified dimensions (tolerance of length and breadth ± 2 mm thickness ± 1 mm). The bottom face may be rough but the top surface should be fine-dressed and joint faces should be dressed back square with the top surface for at least 50mm without hollowness or spalling. The dimensions of blocks should be ± 5 mm. The edges of blocks should be dressed according to IS:1129-1972 (First Revision - Recommendations for Dressing of Stones). Each type of blocks and slabs may be marked in a suitable manner with the manufacturer's name or initials and/or with the IS specification mark.

4.2.4 Properties entering Specifications

Adequate testing is not always possible or feasible and the reputation of the stone producer is often a deciding factor in choosing the granite stone for dressing and polishing purposes to be used either as dimension ornamental or ornamental dimension stone⁹.

Generally, the understanding between the purchaser and the producer is important. The traders have their own specifications for stones depending mainly on the following properties¹⁰.

- a) Uniformity of grain size
- b) Colour
- c) Colour base
- d) Flow structure
- e) Hair cracks
- f) White lines
- g) Flowers
- h) Moles
- i) Size of blocks
- j) Shape of blocks

A brief description of these properties as prevalent in one of the important producing centres is given below¹⁰.

a. Uniformity of Grain Size

The best quality stones are usually of uniform fine-grained texture. Such stones take good polish. Carving and inscribing of letters can be done uniformly on fine-grained varieties. Fine-grained black granite stone can be cut to the thickness of a post-card and letters engraved on it.

b. Colour

The colour of black granite should be jet-black. Dolerite and gabbros of jet-black colour fetch high prices. Colour variation is a drawback. In grey and pink stones also, generally only one fast colour is preferred to although a few buyers like variegated stones.

c. Colour Base

In case of jet-black granite, a stone with a brownish tinge fetches a better price than one with other shades. Depending upon the colour base, black granites are classified as follows:

1. Brownish tinge
2. Brownish-blue tinge
3. Blue tinge

Black stones with brownish tinge show the effect of polish, much better than stones with other tinges.

d. Flow Structure

These are genetically related inherent characters of stones. Flow structures are generally indicative of the presence of thin bands of different minerals having varying compositions. Stones having flow structures generally do not take good polish due to variations in hardness of minerals and they may chip while dressing. Hence, blocks without flow structures are preferred of as these fetch better prices.

e. Hair Cracks

The presence of hair cracks which impairs the value of the stone may be micro-structures like thin hair-line joints, due to original structural deformity or due to the effect of blasting and quarrying. These cracks may extend deep into the stone and may carry an iron oxide tinge. Such stones do not take good polish and while dressing chips may come off or a block may split. Sometimes, the finished statues have to be abandoned at the final stages due to the presence of hair-line cracks which would not disappear in the final chiselling and polishing.

f. White Lines

These lines are formed for two reasons:

1. presence of thin silica or calcite veins in blocks, and
2. chloritisation or sericitisation of basic minerals in black granite

Both these are genetically related phenomena and blocks having such lines are not preferred to as these do not take good polish and chips come off while cutting and dressing.

g. Flowers

In black granite, patches of white colour called flowers are formed by concentration of light-coloured mineral at different places. Such flowers are undesirable in black granite.

h. Moles

Patches of black and other dark colours are called moles and are formed by concentration of coloured minerals. These are also undesirable in the polished blocks. Cutting and dressing pose a problem due to differential hardness of various minerals.

i. Size of Blocks

Size is one of the most important factors in valuation of stones by purchasers. Generally, sizes are classified into two categories:

1. Random size without any specific size, depending upon the customer's requirement. The export of raw stones is generally in random sizes.
2. Monumental size is specific.

Generally, polished blocks are exported in monumental sizes. The maximum size is generally 1.5 to 2.0 cubic meters. Tamil Nadu Mineral Industries Ltd., for example, produces 100x90x70 cm monumental stones each weighing about two tonnes.

j. Shape of Blocks

Dressed rectangular blocks are always preferred. There should not be any protrusions and depressions on the dressed faces. Protrusions increase freight while depressions impairs the value of blocks as the blocks will have to be again dressed before polishing. Hence, a high degree of skill in dressing is needed. The blocks are also shaped to various designs as required.

4.2.5 Commercial Grading

From the above it is evident that the specifications to be prescribed are invariably subjective and it is almost impossible to have any standard except for size and shape. The types of specifications adopted in the industry can be better understood from the following examples of the type of requirements set down in few cases by Japanese buyers for black granite.

Grades of Black Granite acceptable in Japanese market¹¹

	Colour	Texture	Appearance
Grade I	Dark black with a brown tinge	Nice grains with black dots	Free from black moles or black patches, white patches or flowers. Free from cracks and lines, such as black and white lines

	Colour	Texture	Appearance
Grade II	Same as Grade I	Coarse grains having a brown tinge and large even black dots	Same as Grade I
Grade III	A little bit of light black with a brown tinge	Coarse, nice grains with a brown tinge	Same as Grade I.

The supply order indicates the specification, quality, quantity, size, etc. The supply order can be as follows''.

Material

"Genuine Black" granite in random sizes as per your sample 'X' quarried at and in 'Z' area. All blocks should be hexahedral, free from cuts, veins, flow, green and brown surfaces, and other visible faults.

Quantity

About 15 cu m per shipment

Block size: 0.3-0.5cu.m per block - 30%
over 0.5 to 1.0cu.m per block - 70%

An excess 6 to 7 cm allowance on width, length and thickness to be supplied free of charge.

With this there will be the other trading terms such as price (per cu.m), shipment schedule, shipment marks, distribution payment procedure, inspections, etc.

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SHRI GOMMATESWARA : A twelfth century granite statue of the Bhagwan Bahubali at Shravana Belagola

*(Courtesy - Department of Information & Publicity,
Government of Karnataka)*



VIVEKANANDA ROCK MEMORIAL, KANYAKUMARI : A memorial built of granite over natural granite rock in the sea

(Courtesy - Vivekananda Kendra, Madras)

5 : Geological Appraisal of Granite Deposit

The study of granite deposit requires a distinct approach and method because, unlike most mineral deposits rock masses to be quarried are quite large and bulky. Moreover, compared to the chemical composition, physical properties of the granite blocks play a more important role in their marketability. Granite having a uniform even-grained texture and attractive colour is desirable as dimension stone. Even if the colour appears pleasing at the surface, it should be persistent throughout the deposit. Because when a particular colour is liked by the customers they expect that all the slabs would be of that colour.

Colour of the granite is characterised by the prominent feldspars present in it. Granites should be free from flaws like cracks or weakness planes and regressions of dark-coloured minerals. Generally, granites are intersected by joints. Joints occurring in two parallel sets approximately at right angles to each other and spaced several feet apart, facilitate removal of big blocks of granite. However, if joints are closely spaced or irregular in direction, blocks of adequate size may not be obtained and there may be excessive waste. Thus, in evaluating a granite deposit, every set of joints and fractures should be mapped and further confirmed by core drilling, preferably in two intersecting directions. One of the directions, of core drilling may be parallel to the direction of sawing. Granites typically show two directions of easy splitting or breakage called as grain or rift. Since directions of natural splitting determine the direction in which the quarry can be developed, these directions should be confirmed. Rocks subjected to heavy stress are strained and develop new fractures and cracks after the blocks are quarried. The presence of excessive overburden material is not much desirable. However, at times, presence of overburden soil of 1.5 to 3.0 mts. is found to be advantageous as it often preserves the underlying deposit from weathering.

Surface examination of outcrops reveals many properties of granite deposits. A fresh surface of granite will reveal the degree of hardness, colour, texture, nature and intensity of joints, dykes, veins and the presence or absence of rift or grain. Topography, nature and thickness of overburden, and drainage are also studied during preliminary examination. If surface examination indicates the possibility of locating a favourable deposit, topographic surveying, geological mapping and exploration by core drilling are undertaken.

A competent geologist can undertake detailed study of the structural, lithological and textural fractures of a granite deposit and estimate the reserves. Currier has given a very detailed account of the points that must be covered in a report on prospecting and exploration of building stone deposit¹. The basic principles of mineral exploration are explained in detail in the publications 'Elements of Mineral Exploration' published by the Indian Bureau of Mines in 1980.

A schedule for the examination of building stone deposits as given by Currier is as follows:

a) General Features :

1. Location of deposit or quarry, name of owner, name of district
2. Size of quarry (if any)
3. Formation name, trade name (if any)
4. History of past operations

b) Geological Features :

1. Distribution of formation
2. Stratigraphic position
3. Thickness of formation and workable portion
4. Lithological classification and description, notable variations
5. Petrographic description and classification
6. Mode of origin and occurrence, and form
7. Major structural elements and attitudes, folds, etc.
8. Contact relations to other formations
9. Texture and fabric: variation and relation to other features
10. Fractures and fracture system
 - i) Joints : attitude, distribution and spacing
 - ii) Faults : attitude, displacement width of shattered or gaugy zones
11. Rock cleavage: natural planes of parting, relation to other features
12. Inclusions and segregations: distribution, nature
13. Overburden: nature, thickness
14. Weathering: depth, nature and relation to other features
15. Surface water: amount and direction of drainage

c) Industrial Features :

1. Classification: points of similarity or difference with other commercial stones of its class
2. Use of stone, specific structures as example
3. Topography
4. Accessibility
5. Working facility, structural elements
6. Workability of stone, production and milling into finished blocks or other architectural and monumental units
7. Colour, texture and finish
8. Reserves, proven and inferred areas available for development by potential competitors

A systematic appraisal on the above lines is very essential as it takes care of not only the immediate prospects but also a long-term outlook for the deposit. However, a very few areas have adopted such systematic approach.

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6 : Mining

Granite generally occurs in large masses in the form of hillocks and mounds and is worked by opencast mining. Production of blocks or slabs of considerable size and weight is a peculiar feature of granite mining. The mining process as well as the equipment used, differs considerably from normal methods of mining¹. Mining is mostly manual where drilling and wedge splitting is done manually. At few places, mining is semi-mechanised, where drilling, wedge splitting, loading and transport operations are mechanised at one stage or the other. Like for other minerals, granite mining is not free from mine hazards and problems.

It is important to delineate the areas containing good building, ornamental stone of uniform quality and desirable properties for successful mining of blocks. Zones of deep weathering and jointing are to be avoided for mining for obvious reasons². The exposed granite is examined for its suitability for forming blocks or slabs. It is also examined for textural uniformity, colour, strength, durability, presence of cracks, joint planes, etc. and their frequency before the blocks are marked or channelled.

Well spaced joints at right angles enable the quarrying of large rectangular blocks which require only limited dressing before use³. For decorative work as monuments, stones must be artistically attractive, capable of taking good polish and easily workable with chisels and cutting tools.

6.1 MINING METHODS

In dimension stone quarrying, the principal method used consists of drilling and wedge splitting carried manually or usually with airpowered tools and gunpowder blasting. Jet piercing is a relatively modern technique in granite mining. The need to hoist and handle large size stone calls for the use of cranes¹.

After removing the overburden, if any, fresh surface is visually checked for its suitability. The hard overburden is removed by drilling 30 to 60 cm deep holes of 5 cm diameter and blasting it with gunpowder. Usually, vertical face is developed and the granite is quarried in rectangular blocks of standard sizes as well as in the form of slabs. Generally, only selected portions are cleared and quarried. Granite quarries are opened as trenches taking advantage of joint systems. As far as possible, rectangular blocks of standard lengths and width are marked either by hand channelling in manual mining, or by channelling machines in semi-mechanised/mechanised mining. After developing a vertical face, block is separated from the parent ledge by putting closely spaced linear drill holes and gunpowder charging; or deep-channel cutting by close drilling for making large blocks². Joint planes in granite parallel to the surface are called sheeting planes which are useful for horizontal splitting. The direction of easy splitting is called 'rift' and the angles to the former is called 'grain'³. The advantage of rift and grain arrangement is taken during mining granite in blocks. Generally, a very little blasting is done in quarry; with the shattering effect of a mild charge, the blocks are separated.



Wire Saw (Diamond studded)

: Courtesy – Pellegrini, Italy



Mining of Pink Granite, Karnataka

: Courtesy – Mysore Minerals Ltd.

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Initially, a key block is removed by drilling a hole in the centre down to the depth of the desired vertical cuts. An explosive charge in this hole frees the block with or without damaging the block. Once the key block is removed, a series of closely spaced holes are drilled underneath the remaining blocks which are broken free with the use of feathers and wedges. (Feathers are pieces of semi-circular steel wedges that are inserted into the hole). Steel wedges are driven among feathers to produce the break to free a block from stone. The blocks may be further cut by the same technique³. Granite blocks so broken and separated are lifted manually with levers or by cranes and loaded into trucks for despatch to the dressing yards.

6.2 MANUAL MINING

This is a common mode of granite mining in India. Drilling and channelling are done by hand, using chisels and hammers. Slabs as well as rectangular blocks are quarried. For making slabs, the stone should be splittable and, therefore it should have prominent joint planes.

The overburden consisting of soil or weathered zone is removed. The fresh surface so exposed is examined to check its suitability and only clear rectangular portions available are marked. As far as possible, rectangular portions are marked in such a way as to get a maximum number of blocks of standard length and width. For dislodging the block, one or two free faces are created with hammer and chisel. In the remaining two or three sides, small holes (recesses) of 3x2x2 cm are put along the lines marked at an interval of 10 to 15 cm., depending on the hardness of the stone. The wedges are inserted in these holes and hammered in a calculated sequence so that the block splits along the line. Any crack parallel to the joint plane helps in separating the block. Horizontal joint planes specially help in dislodging the blocks at their base. Blocks are brought up by levering, using crow bars, and further split into standard-size blocks in a similar manner.

The standard-size blocks are split into slabs by trained workers. The big block is laid on the ground in such a way that bedding planes of the block are perpendicular to the ground. A sharp-edged chisel is hammered at a chosen point which is generally located at the geometrical centre of the thickness of the block to develop cracks in the block along the bedding planes from this point. This crack is then filled on either side of the central point at 10 to 15 cm by inserting chisel and hammered, so that it further enlarges the cracks. Following this method, the block is split into two slabs. Sometimes, these cracks are followed along the side, when the bedding plane is not clear and smooth. The bigger slab is further split into slabs of required thickness by repeating the above process.

At times, when quarrying grey granite slabs, the rock is heated by burning wood, charcoal or grass along a particular line. The heat splits the slab. This is done on the surface as well as on the sides^{3, 4, 5}.

The mined material is removed to the pit-head manually by using crow bar as a lever and wooden logs to serve as rollers for transporting big blocks. Smaller blocks are lifted and carried tied to slings.

The recovery of marketable grade block from a quarry is about 30-40 percent depending upon the nature of deposit.

6.3 MECHANISED MINING

In this method, most of the mining operations are carried out with the help of machines. Besides, the mechanised methods for removing overburden, channeling machines are used for marking, and drilling is done with the help of compressors and drilling machines. Gunpowder is used for blasting and cranes for removal of blocks to surface.

In a stone quarry, it is usual to drill a set of peripheral uncharged holes to prevent cracks in the stone on blasting, although the practice may be more labourous and time-consuming¹. Sometimes, inclined holes are drilled in the desired alignment for better results. Endless braided steel wires are also used for cutting blocks. Jet-channeling or jet-piercing which is an improved technique is common in granite cutting. In certain countries, flame-cutting is adopted. In flame-cutting the stone breaks along the desired line due to intense heat generated by combustion of fuel oil and oxygen. The thermal shock causes the rock to spall and small fragments blow off from the channel². In this method, a jet blow pipe mounted on a simple frame or hand feed is moved back and forth along the channel. It cuts a 40-cm wide channel in one-eighth the time required to cut similar channel by drilling and broaching.

6.4 MINING MACHINERY

In India, a very few quarries are equipped fully with mining machinery. The mining machinery generally used are compressors and drilling machines for drilling and blasting, cranes for lifting big blocks, and dumpers and trucks for transport. Some mines in Dharmapuri and South Arcot districts in Tamil Nadu and at Chamrajnagar in Mysore district, Karnataka are partially mechanised with compressors, jackhammer drills, cranes, chain pulley, etc. Wire saws fitted with diesel motors of 55 to 100 H.P. are also being introduced in some quarries.

6.5 MINING IN OTHER COUNTRIES

Granite mining method ranges from the primitive to the modern, utilising the latest techniques like jet-channelling and flame-cutting. In the USA, quarrying methods include the use of various combinations of diamond saws, wire saws, channelling machines, drilling machines, wedges and broaching tools. Wire saw has been used successfully in granite quarries of the USA and Italy for primary cuts. It consists of single strand or three-strand wire forming a closed loop which is loaded for tension to augment cutting action. Specially made hellicoidal wires are commonly used for the saw. The wire of the saw passes over and through the granite block and cuts a channel of about 7 mm in width. Granular aluminium oxide (60 to 120 mesh) or silicon carbide is used as cutting media. The cutting medium is carried in water stream to facilitate a smooth and uniform cut. Besides carrying the cutting medium, water also acts as an agent for cooling and flushing.

The choice of machinery depends on the nature of the stone, its reserves, production capacity of the mine, shapes and sizes in which blocks and slabs are required, labour cost, management policies, etc. Generally, a very little blasting is done for mining or quarrying⁶. Handling and transport of blocks are both manual and/or mechanical.

Before opening up a quarry for systematic and continued production of building and ornamental stones, a preliminary geological examination of the area is made. In the Western Countries where stones are quarried or mined on a large-scale, initial exploration is usually done by drilling. In most cases, drill hole spacing of 50 to 100 m is considered sufficient. For stones which are not uniform, closer spacing may be necessary⁷.

6.6 GUIDELINES FOR WORKING

In view of the peculiar nature of granite mining and different mining equipment utilised, it is necessary to follow certain guidelines during dimension stone quarrying and processing, which differ somewhat from those used in normal mining practice for efficient working. These are as follows:

- a) The layout of faces and working benches must meet the fundamental safety requirements of opencast mines. Where large blocks are cut by stone cutting machines or by drilling and splitting, faces and sub-faces should be vertical as far as possible.
- b) The use of wedges for splitting the blocks may cause injury to the worker due to the wedge jumping while hammering. The wedges should be tied to each other with a wire or the coefficient of friction between the wedge and the granite should be increased by sifting sand or drill dust into recesses. The wedges stuck in the block should be released by driving another wedge into the same recess and not by hammering.
- c) The workers driving in the wedge should never stand on the block being split. If a large block is being reduced to a number of small size blocks, care must be taken to stabilize the block before a worker mounts on it.
- d) While driving in the wedges, the worker should be careful of flying rock splinters. Neighbouring workers should maintain a safe distance. Provisions for goggles with shatterproof glass and a safety shield between the adjacent workers is recommended to minimise the danger.
- e) No worker should be allowed to push the separated block away from the parent rock by foot.
- f) Most of the blasting in granite quarries is done by a light charge of gunpowder. Owing to its sensitivity to flames and sparks, all safety rules should be strictly followed.
- g) The handling method in a dimension stone quarry is to bring the block to the floor and load it into the haulage units by cranes. The cranes and all other machinery employed at quarry must be operated in accordance with the relevant safety requirements. For safe hoisting and handling large blocks, the crane should never be loaded in excess of its rated capacity or its stability limit.
- h) Stone cutting machines should be equipped with adequate shields for protecting operators from flying splinters which are a source of danger.

6.7 PROBLEMS IN GRANITE MINING^{1, 2, 3}.

Granite mining is not very different from that of other mineral deposits in so far as mining hazards and problems are concerned. These could be grouped as follows:

- a) Environmental problems
- b) Geological problems
- c) Transport problems

6.7.1 a) Environmental Problems

In granite mining, environmental problems are similar to those encountered in the mining of other mineral deposits. These are noise, vibration, dust and deforestation¹.

6.7.2 b) Geological Problems

These problems arise generally out of the need to find a suitable quality of granite in sufficient quantity. Presently, there is no technology to make a precise or reliable assessment of granite deposits both qualitatively and quantitatively. Presently it is also difficult to detect the presence of fine cracks in the mined block. As mentioned before, it is important to delineate the areas containing good building and ornamental stone of uniform quality and desirable properties for mining blocks and slabs. A geological examination of the area before opening a quarry or new face may resolve this problem. The rock properties that need to be studied are strength, durability, presence and distribution of cracks and joints, colour and texture. A geological appraisal of the area is useful for assessing the potentiality of the area⁷. Some mine owners experience difficulty in locating a suitable quality of granite in their leaseholds. For proper qualitative and quantitative assessment of granite in a given property, its geological appraisal is therefore, necessary. The aspects to be looked into while carrying out geological appraisal are briefly discussed below:

6.7.3 Nature of the Deposit

It should be ascertained whether the deposit is massive, bouldery or in a dyke form. Pink and grey granite deposits occur as small hillocks and are massive. Dolerites and gabbros which are known as black granites are intrusives into granite and occur as dykes. In a bouldery deposit, boulder size and amount of weathering sustained are important factors to obtain blocks of the desired size. The type of over-burden such as hard or soft and its extent should be known in advance for evolving the quarry layout. An examination of the fresh surface in initial stages is necessary to confirm the suitability of the stone for desired purpose.

6.7.4 Joints and Cracks

The granite deposit is usually jointed and it enables easy splitting during quarrying. Large rectangular blocks with well-spaced joints at right angles are possible. Types of joints such as vertical, horizontal, oblique, their frequency, extent, width, nature such as tight or gaping, and their tendency to persist in depth or otherwise need to be studied. Sheeting planes as well as rift and grain arrangement need to be identified so as to use them advantageously while mining granite blocks.

The presence of hair cracks in granite is a micro-structural phenomenon which is either due to original structural deformity or the effect of blasting and quarrying. At times, such cracks

may be deep and bear infillings of iron oxide. Some times, secondary quartz or calcite veins occupy such cracks. Along the cracks in black granites, alteration is pronounced due to chloritisation or sericitisation. The overall effect of alteration causes unwarranted chipping during cutting and dressing and impairs polishing.

6.8 IMPORTANT MINING CENTRES IN INDIA

The important granite mining centres are located in Andhra Pradesh, Gujarat, Karnataka, Rajasthan and Tamil Nadu. In West Bengal, a few leases are worked for granite. Maharashtra is planning to go into granite production shortly. The state-wise position of mining centres for granite is discussed below:

6.8.1 Andhra Pradesh

The mining/quarrying activity is reported from:

- a) Kuppam and Palamner areas of Chittoor district for basic rocks
- b) Near and around Hyderabad for pink and grey granites
- c) Kazipet area in Warangal district for both grey and black granites
- d) Choutapally and Edulapuram areas in Khammam district for black granites
- e) Udarpikonda area in Anantpur district for pink granites, and
- f) Chimakurthi and Kukutapally areas in Prakasham district for black granites

About 333 quarry leases have been granted for black and multi-colour granites of which 124 leases are in Chittoor district and 41 in Warangal district (see Table 6.1).

Table 6.1
NUMBER OF BLACK AND MULTI-COLOURED GRANITE QUARRY LEASES IN
DIFFERENT DISTRICTS OF ANDHRA PRADESH

District	No. of leases granted	No. of working mines	No. of non-working mines
Anantpur	46	6	40
Chittoor	124	48	76
Cuddapah	4	-	4
Kurnool	39	7	32
Nellore	16	1	15
Prakasam	6	6	-
Guntur	4	4	-
Warangal	41	25	16
Karimnagar	20	6	14
Ranga Reddy	2	-	2
Nizamabad	2	-	2
Vizianagram	9	-	9
Mahaboobnagar	2	-	2
Khammam	13	3	10
Adilabad	2	-	2
Nalgoda	3	-	3
Total	333	106	227

Note: The data (subject to verification) in the Table were gathered from the Director of Mines and Geology, Government of Andhra Pradesh.

During 1986-87, total 8,060 Cu. meters polished granite was produced (Table 6.2)

TABLE 6.2

PRODUCTION AND DESPATCHES OF POLISHED GRANITES IN ANDHRA PRADESH

	1983-84		1984-85		1985-86		1986-87	
	Production (in cu.m)	Despatch	Production (in cu.m)	Despatch	Production (in cu.m)	Despatch	Production (in cu.m)	Despatch
Khammam	540	578	638	593	757.5	845.5	600	486
Chittoor	1770	1661	4005	3564	3226	3287	3550	3547
Anantpur	1130	1006	1370	1130	1164	788	951	1227
Warangal	1689	517	2258	2507	-	2292	-	1422
Karimnagar	254	282	689	240	392	127	-	116
Kurnool	1147	884	1484	1132	2782	2153	2959	2447
Guntur &								
Prakasam	100	-	151	-	-	730	-	669
Ranga Reddy	-	-	-	-	51	-	-	-
Total	6630	4928	10595	9166	8336	10231	8060	9914

Source: Directorate of Mining and Geology, Andhra Pradesh, 1987.

6.8.2 Gujarat

The important mining centres are located in Sabarkantha, Banaskantha, Vadodara, Mehsana, Kheda and Panchmahal districts. There are about 65 leases for granite in Gujarat, of which 30 leases are located in Banaskantha district and 21 leases in Sabarkantha district¹⁰. A list of granite leases in Gujarat is given in Annexure I.

6.8.3 Karnataka

A number of mining centres for granite of different varieties are located in many districts. The important districts in which mining centres are located are Bangalore, Bijapur, Kolar, Mandya, Mysore, Tumkur, Hassan, Chickmagalur, North Kanara, Bellary and Raichur. For Dera Temple of Japan, about 750 tonnes dressed granite was supplied from Mangalapada quarry near Karkala in South Kanara district. The stones upto 30m length were quarried using Japanese power-cutting machine. Granite mining in other districts, is not of much importance. Granite producers in the State exceed a hundred with a substantial annual production of about 1.0 lakh cu.m. raw stone¹¹. The finished products manufactured include mainly memorials of different

types, blocks, slabs and kitchen platforms. Mysore Minerals Limited (MML), a State Enterprise, is the major producer of granite in Karnataka. MML's granite processing plants are located at Hassan.

The quarries are mostly operated by contractors who supply raw granite to polishing units. Mining is mostly manual by using crowbars, hammers and chisels. In a few mechanised mines, air-compressors, pneumatic drills, cranes and winches are used. The recovery of marketable grade block from a quarry is about 32 to 40 percent. A list showing quarry licences granted for black, grey and pink coloured granite in Karnataka is given in Annexure IIA, IIB, IIC¹.

6.8.4 Rajasthan

In the northern part of the country, Rajasthan is a major producer of granite, particularly of pink or red colour. Granites of good quality are worked in Ajmer, Barmer, Bhilwara, Sirohi, Pali and Jalore districts. Jalore is the most important mining centre in Rajasthan where pink, black and red granites are mined. Mining is carried out by the State Undertaking. The finished products include blocks, slabs, decorative and domestic articles like paper weights, pen stands, ash trays and grinders.

Granite is quarried manually. Holes are drilled and charged with gunpowder and blocks are dislodged with the help of hammers and chisels. The recovery of marketable block from quarries varies from 25 to 75 percent. A list of Granite leases in Rajasthan is given in ANNEXURE III.

6.8.5 Tamil Nadu

A number of mining centres are located in Tamil Nadu. Different varieties of granite mined in the state include grey granite, charnockites, leptinites, gabbros and dolerites. The jet-black granites of South Arcot district are the best available in the state and area considered equivalent to 'Ebony black' of Sweden. The important mining centres in Tamil Nadu are as follows:

- a) Kunnam in South Arcot district
- b) Pennagaram and Harur in Dharmapuri district
- c) Thirumalai and Paithur in Salem district
- d) Bhavani in Coimbatore district, and
- e) Osur, Siyalam, Thandampatti, Sorkatham and Kundril in North Arcot district

About 25 important producers including the state agencies produce granite in Tamil Nadu. Important producers of Granite in Tamil Nadu include i) Tamil Nadu Minerals Limited (TAMIN) Madras, ii) Gem Granites, Madras and iii) Enterprising Enterprises, Madras. TAMIN is a state enterprise established in 1978. TAMIN's granite processing plant is located at Manali-Ponneri Road, Madras. Gem granites have been awarded the Highest Export Award by Chemicals & Allied Products Export Promotion Council in the year 1987-88. Their granite processing plant is located at Injambakkam, Madras.

Mining is mostly manual, usually, minor blasting is done. Holes are made by chisels and hammers and the blocks separated. A few mines are partially mechanised. The operations include drilling and blasting, haulage of blocks by cranes and winches to the dressing yard

and loading into trucks for despatching to cutting and polishing units. The recovery of marketable block is between 20 and 40 per cent. A list of important producers of granite in Tamil Nadu is given in ANNEXURE IV.

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7 : Processing

Processing is an integral part of granite industry. Mined block of granite are cut, splitted and polished into various sizes, shapes, and thickness as per the buyers requirement. With the advent of diamond saw it has now been possible to cut thinner slabs and tiles of granite used in cladding. Quality of polishing has also improved considerably. With modern technology it is now possible to give mirror like polished surface even to large blocks and slabs.

There are over hundred granite processing units in the country, almost all of them are located in Andhra Pradesh, Karnataka, Tamil Nadu and Rajasthan.

A number of modern processing plants having some of the most sophisticated automatic machines have also been set up in India.

7.1 GRANITE PROCESSING

The processing of raw granite involves following four operations¹ :

- a) dressing
- b) cutting/sawing
- c) surface grinding and polishing, and
- d) edge cutting/trimming.

Processing can be done manually or with machine or with the combination of both. With the passage of time requirement for thinner slabs/tiles of superior polish has increased and thus more and more entrepreneurs are now adopting mechanical methods of processing.

7.2 MANUAL DRESSING, CUTTING AND POLISHING²

A block of requisite size is cut at the quarry site by channelling and splitting. The crude block received from the quarry site is dressed with chisels and hammers. Such a block is generally 2 to 5 cms oversize of the contemplated polished block to take care of further losses, if any, when subjected to chiselling, grinding and polishing in the factory. Polishing is done either for any of the six faces or all the faces according to the requirements of the consumer. In the former case, only the face to be polished is first dressed and subjected to polishing. In the later case, all the faces are finely-dressed before polishing.

The following stages are involved in dressing a face:

- a) Marking to align a perfect plane at which dressing should stop.
- b) Cutting two grooves diagonal to the face and intersecting at the centre and reaching from the plane of ultimate dressing. Chiselling is done from the centre outward to cut those grooves.
- c) After a roughly chiselled but flat surface is obtained, the face is made more

even and uniform by fine chiselling. It is called 'fine-punching', which is a concentration of minute, equi-spaced and dense depressions of equal size caused by light strokes from a chisel point. The face is now ready for grinding. Fine-punching still leaves an unevenness in the form of 2.5 to 3 mm. deep depressions which are removed in grinding. One worker takes 10-12 hours to dress 0.09 sq. m. (one square foot) area.

Manual polishing is done by rubbing the stone on a rough surface of iron plates with polishing media like steel shots, carborundum powder and tin oxide. Fragmented steel shots are employed in initial stages followed by carborundum powder of diminishing grit sizes, starting from 60 mesh. It is estimated that manual polishing of 0.83 sq. m. (9 sq. ft.) granite requires about 14 hours to obtain glazed surface. Now a days, machine polishing is done everywhere. Only the sides of slabs are polished manually after polishing, edge cutting of final dressing or trimming is done manually by chisel and hammer by skilled workers.

Engraving of pictures or inscribing letters could also be done at this stage by skilled craftsman by using pneumatic cutting tools or by applying sand blasting techniques. Sand blasting is done by covering the stone with a rubber-like elastic film, cutting out the required pattern on the film and then exposing the pattern to the sand blast³.

7.3 CUTTING, POLISHING AND EDGE CUTTING BY MACHINE

Cutting and sawing by machine

Various types of cutting or sawing machines used to prepare granite blocks of the required size are :

- (i) Wire Saw
- (ii) Frame Saw
- (iii) Circular Saw

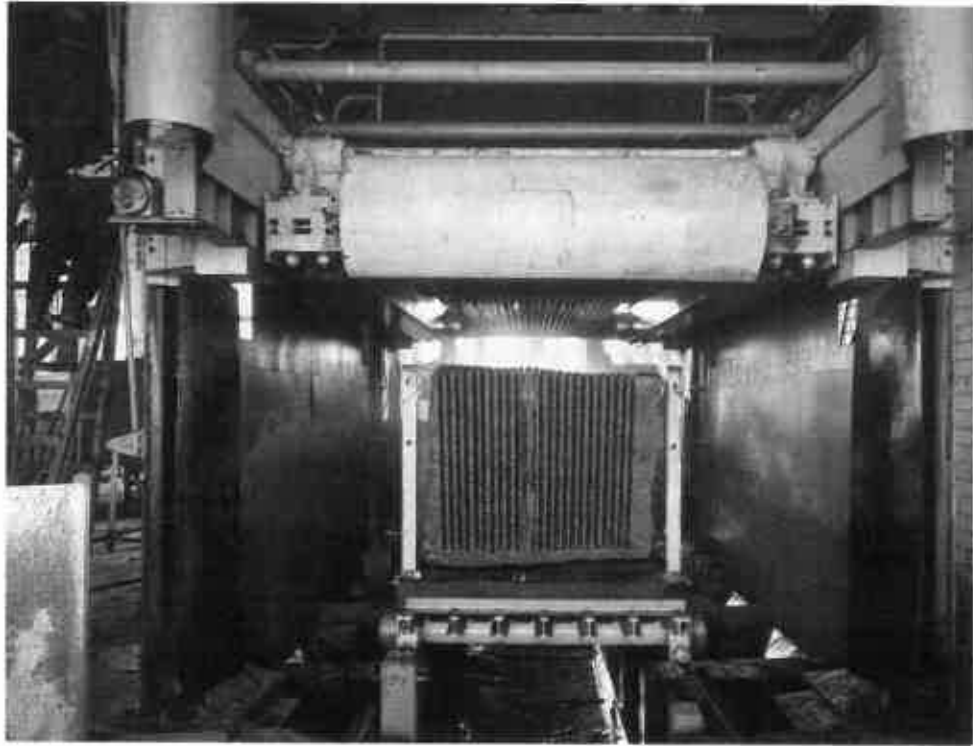
The use of a cutting machine obviates the use of further dressing of the surface which otherwise is necessary when splitting is done manually.

The operational techniques of each type of cutting/sawing machine are discussed below.

7.3.1 Wire Saw Machine⁴

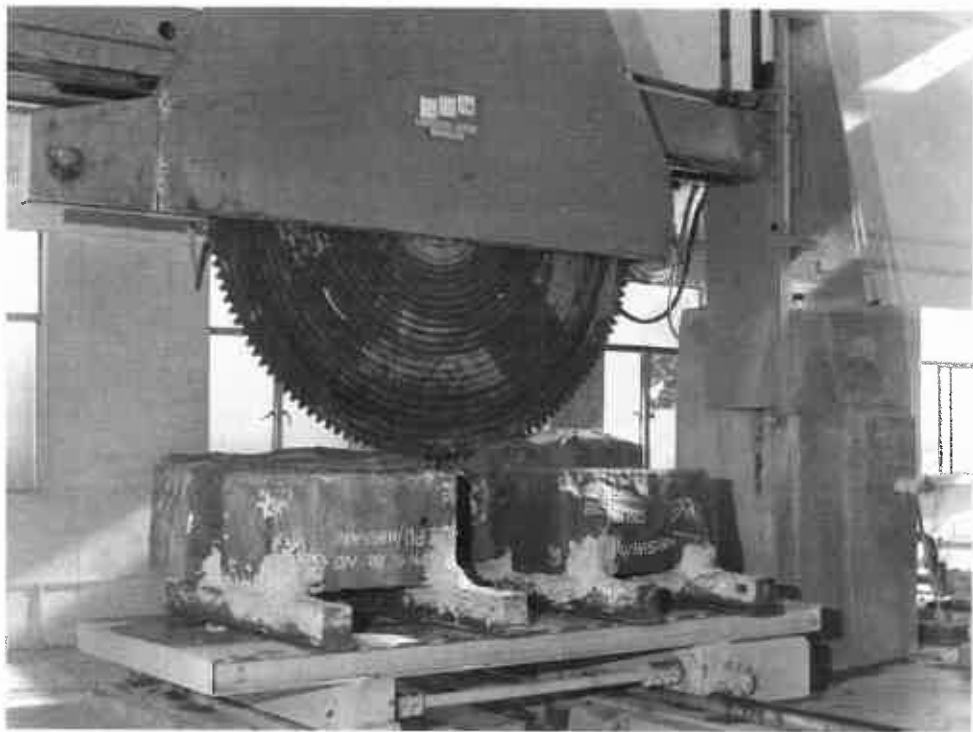
In this type of machinery, a continuous length of wire running over pullays is used as a cutting tool. The long and short conventional wire saws using silicon carbide or steel shots are being used for many years in the stone industry. Wire saw machines are no doubt less expensive but they are not capable of yielding a high rate of production compared to the other sawing machines. An advantage of wire sawing is that it produces a smooth cut which minimises the subsequent finishing operation. Low rate of production, increasing cost of loose abrasives and frequent changing of wire are some of the disadvantages of this type of machine.

Diamond wire saw is an improved version of the usual wire saw machine, simulating the cutting action of a single cutting element. All the segments fitted to the wires are electroplated. A diamond wire saw with 15.9 m. long stainless steel wire of 4 mm. diameter, and 7 leads each consisting of 133 wires is found suitable for granite cutting without causing vibrations.



Gang Saw

: Courtesy – Carl Meyer, W. Germany



Block Saw (Circular Saw)

: Courtesy – Mysore Minerals Ltd.



7.3.2 Frame Saw Machine¹

A perfectly linear reciprocating movement is possible in a frame saw machine. Depending on the movement of the cutting tool which may be either vertical or horizontal, frame saw machines are placed into two groups, namely vertical and horizontal saws.

1. A vertical saw has a lesser number of blades, 8 to 15, and it has the advantage of cutting a block of any width and to make continuous feeding easy. It is generally used in cutting low-quartz granites.
2. A horizontal saw machine has a large production capacity and is designed to operate in two ways. In the conventional method, the blades cut downward into the stone. In another design, the frame operates at a constant horizontal plane and the block is cut by a rising movement of the table on which the block is mounted. A high linear speed is achieved in the latter technique. For cutting 20 mm. slabs, a 40 blade unit is suitable. A 60-70 blade unit works satisfactorily for cutting 10-15 mm. slabs.

In both the machines, there are diamond blades made of a brazed steel body on which diamonds are impregnated. The steel used for the purpose should have high elastic limit and resistance to wear and tear. The standard sizes of blades are:

- i) 180 mm. x 3 mm.
- ii) 180 mm. x 3.5 mm. and
- iii) 200 mm. x 3 mm.

For hard marbles and granites a 3.5 mm thick blade is used. The shortest blades have a better resistance to deviation. However, the blade length depends on the size of the block to be cut and the stroke of the machine.

The diamond segments set in the steel body either have a regular spacing or are randomly spaced. The number of segments set is proportional to the cutting pressure of the machine. Although a wider spacing limits deviations, the segments wear rapidly. Random spacing improves the surface condition of slabs by eliminating some vibrations due to resonance between the frequency of passage of the segments and the vibration frequency of the blade itself. Positioning of the block and the blade has a bearing on the efficiency of the cutting machine. The proper fixing of the stone block eliminates vibrations and reduces the wear of the segments. The wear may be three to four times more in case of poorly fixed blades. Proper wedging of the blocks enables a higher downward speed without risk of accidents. With regularly-shaped blocks, the blades are in full contact and their efficiency is maximum. The blades are not in full contact when irregularly shaped blocks are cut. In that case, the blades have a tendency to vibrate causing rapid wear. Moreover, this reduces the downward speed and hence productivity. Care should be taken to cut blocks of constant length as far as possible, corresponding to the working length of the blades so that the wear of the diamond segments is uniform.

Proper positioning of the blade lengthens its life and improves the quality of cutting. Hence, proper fixing of the blade with particular preference to its verticality, parallelism and horizontality needs to be ascertained. Poor adjustment of the verticality of blade causes deviation which

may be harmful for the working of the machine itself. It is estimated that blades are drawn across a block for about two lakh times for cutting a 20 mm. thick block. Deviation under such circumstances would create fatigue and deformations in the steel, sometimes to an extent that the blade goes beyond repair.

The parallelism of the plane of the blade with the cutting movement should be checked with a comparator at two points on the blade, while operating the frame slowly. The blades must be horizontal to the cutting movement. Any fault in this positioning of the blade causes irregular wear which can be checked with a comparator.

The general technique of cutting with diamond saw blades in a frame saw is as follows:

1. In a harder stone, the blades of the cutting machine should operate at a high speed to avoid polishing of the segments and consequent deviation. The machine is adjusted to the desired speed which is maintained when each type of stone is to be cut. In case of accidental polishing, reconditioning of the blade by cutting the abrasive stone is preferable to increasing the downward speed for achieving the optimum performance. A simple increase of speed may weaken the resistance of the steel.
2. Usually the blade starts cutting a particular stone at 3/4th of the speed. After 5 to 10 cm. deep cut is made, the speed is increased progressively to reach the optimum speed.
3. It is also necessary to prepare a cutting plan taking into consideration the type of stone and also the extent of cutting required. A proper selection of the blade not only eliminates its frequent replacement but also saves time. Besides, replacement by new blades at the point of cutting is not possible. As such, frequent replacement of blade causes rapid wear and tear of the cutting machines.
4. Generally, for cutting various types of stones on the same machine, the same blades are used, although ideally there should be two or three different sets of blades. However, the use of a single set is also possible provided the different types of stones have been properly classified for their hardness and abrasiveness and the downward speed is determined in advance. In such an event, hard or compact stones and soft or crystalline stones are cut alternatively.
5. In the event of deviation of a cutting plane, it is essential to analyse the cause. For example, if it is found that after a deviation restoring of evenness is not possible, it means that the cutting edge is deformed. The blade should then be dismantled and reconditioned.
6. Strict supervision is necessary to locate faults, if any, as and when they develop and to set them right for efficient functioning of the cutting machines.

The water used as a coolant should be soft and well filtered, particularly when the cutting waste tends to stick to the blade.

7.3.3 Circular Block Cutting Saw ^{4, 7}

Circular block cutting saws fitted with diamond tipped circular blades are used in a number of processing units in India. Circular saws manufactured in India as well as those manufactured abroad are in use. A typical circular saw machine consists of a stable heavy machine gantry which moves vertically on two robust machine columns. On the gantry guide, the circular saw is fixed vertically so as to slide from the one end to the other. The machine is fitted with computerised control panel which helps automatic monitoring of the various stages of sawing. Depending on the hardness of rock, required thickness of the slabs/tiles, and the size of the block, various parameters of sawing like speed of horizontal movement of the saw, the RPM of the circular blade, and the down feed etc. are to be adjusted. All these parameters can be fed to the system in advance, through the control panel, for automatic control and execution of sawing. Lifting of the blade and positioning the block for the next cut is also achieved by programming through the control panel. Water of required pressure is used as coolant and is supplied to the machine with a pump.

The granite blocks are placed on the block carriage, cemented firmly to the stage of the trolley, moved on rails underneath the blade and positioned suitably. For ensuring prolonged life of the blade periferial RPM of the blade and the rate of down feed are very crucial. Rate of cutting is maintained at an optimum level. Higher rate of cutting may be had at the expence of the useful life of the blade. Circular block cutting saws are mainly used for cutting monument blocks, whereas the gang saws are used for slab cutting. Depending on the nature of the rock, the rate of cutting ranges from 0.9 to 1.5 sq. meters per hour. Block of 3.5 x 1.5m. size could be cut by the circular saw.

7.3.4 Cutting and Sawing Practice in India

Granite cutting in India is done both manually and by machine. Sawing is mostly manual in Kuppam area in Andhra Pradesh and in Krishnagiri area in Tamil Nadu. The incidence of the use of sawing machines is comparatively high in Bangalore area. Manual cutting is done by chisels and hammers. For mechanical sawing, the types of machines used are usually diamond circular saw, wire saw, and gang saw. Manual cutting takes usually 16 to 20 hours for a 0.55 sq. m. (6 sq. ft.) block whereas the rate of cutting by machines varies from one to five sq. m. (10 to 50 sq. ft.) per hour.

An automatic slicing machine is made indigeneously and consists of a circular diamond impregnated wheel for sawing granite blocks. The machine has a total power requirement of 110 HP. The blocks are sawn horizontally, with half of the block sawn from one side and the other half from the other side. It is possible to saw a 3.0 x 0.9m. x 0.9m. size block by a 1.2 m. diameter circular saw with an accuracy of 1.0 to 1.5 mm. The thickness of slabs that could be sawn ranges from 12 to 200 mm. The production capacity of this machine is about 45 sq. m. of granite per day of 20 mm. slab thickness. Another diamond saw machine produced in the country has 20 blades and is also automatic with a stepless speed control for vertical sink. The maximum size of the stone that can be cut is 3.2 x 1.7 m. with an unlimited width. The machine is useful for small but very wide stone blocks. Another indigenous circular sawing and sizing machine cuts a granite block of 3.5 x 2.1 x 0.25m. size with the help of special fixtures.

7.4 Edge Cutting by Machine

In modern processing units, granites are subjected to polishing before edge cutting or final dressing. A vast range of edge cutting machines is used in the stone industry depending upon the size and shape of the work piece. A variety of machines like special purpose profiling machines, automatic edge surface grinding and polishing machines, and universal machines are available. All these machines employ diamond grinding wheels which have a very low wearing rate and as such last longer when compared to conventional abrasives.

The special purpose profile machine is developed for producing firm edges for tables and lintels. It involves the use of an electroplated diamond grinding wheel with grits, saving many labour-hours of hand finishing. It ensures a consistent form, superior to hand finishing. In the automatic edge surface grinding and polishing machine, the work piece and table remain stationary while the headstock moves across the work table by means of a rail carriage system. The advantage of this type of machine is that the length of operation can be adjusted simply by lengthening the rails and work piece table. The application of diamond tooling for this type of machine is, however limited. An attachment by fitting a metal bounded rim diamond wheel in the initial stage of operation to get perfect flat edge is also tried. This is followed by resin bond segmented wheels containing diamond grits. The grit size of the diamond wheel is reduced at each polishing stage to achieve the desired surface finish. The universal machine which is designed for edging window sills and steps is fully automatic with size control. There are six front side grinding wheels for the face and four for chamfering. Grinding wheels are made of silicon carbide initially which can be changed to metalbonded wheels. The remaining eight wheels are resinbonded wheels.

7.4.1 Edge-Cutting or Dressing

Bridge Sawing Machine: These machines are used for tomb stones (top parts, base linings and cover plates) or buildings (steps, window sills, floor or wall slabs). In large plants, it is chiefly used as an edge cutting machine to dress up thin slabs by cutting irregular edges and bringing up to the desired size.

This machine consists of a bridge across two parallel rails mounted on a concrete wall of suitable height. The bridge carries the saw carriage which slides on the bridge. The bridge itself moves on the parallel rails. The slabs of the material to be cut is placed on the table below. The table can be rotated to 360° for suitably orienting the material to be cut. The length of the cut could be 3,000 to 3,500 mm. The vertical adjustment of the carriage could be up to 500 mm which governs the height of the material to be cut. Diamond-tipped blade of diameter 600 to 800 mm. can be fixed and the depth cut achieved from 200 to 300 mm. The cutting rate is 20 to 26 mm. a second (i.e. for 600mm. diameter), 27 to 35 mm. a second (i.e. for 800 mm diameter). Automatic sequence cutting is also possible. The operation is controlled by pendant-type control box. Stationary bridge-type machine is also available which could accommodate more than one saw carriage.

7.4.2 Edge Cutting Practice in India

In Indian units edge cutting is done both by machine and manual methods. Time required for a 0.55 sq. m. (6 sq. ft.) block is 12 to 16 hours. A few units apply mechanical edge cutting. A 2 edge machine in one of the units does 9.1 running metre of edge cutting in one hour. The single edge machine does 10 running ft. of edge cutting in one hour.

One automatic edge cutting machine has a slab carrying capacity of 2.4 m. x 1.0 m. x 7.5 cm. In this machine, the beam is stationary and the slide has a simple longitudinal motion imparted by a 2 HP motor for variable speed control. The machine cuts one edge at a time and then the slab shifted by 90° to cut the next edge. It is used for light cutting strips of granite of 20 mm. thickness. However, by means of raising and lowering slides of thickness up to 100 mm. can be cut. Its capacity is to cut 10 sq. m. granite of 20 mm. thickness per shift of 8 hours. The other edge cutting machine with a slab carrying capacity of 2.5 x 1.2 x 0.2 m. (8ft. x 4ft. x 8ft.) and with an automatic cycle is used for dressing granite. It is fitted with raise lower timers for exact location and with a mitre cutting facility. The main cutter is mounted on the saddle which, in turn, slides on a beam. The beam with the cutter can again be transported on rails. The capacity of this machine is to cut 40 to 50 sq. m. granite of 20 mm. thickness in 8 hours.

Bridge saws with diamond tipped circular blades of 600 to 800 mm. are also used for edge cutting. Depth of cut is about 200 to 300 mm. Rate of cutting is 20 to 26 m. per second for 600 mm. diameter blade and 27 to 35 m. per second for a 800. mm diameter saw blade.

7.5 Polishing

Polishing of granite is done in stages, from rough grinding to smooth grinding followed by rough, medium and smooth polishing. About 5 to 8 stages are involved in the whole polishing process. Depending on the hardness of the rocks, the polishing stage and the quality of polishing required, various types of polishing media are used. In the first stage, generally steel is used as polishing medium. In the second stage, steel grit or carborundum rough powder is used. Generally, carborundum powder is used in stages 2 to 4. Silicon carbide is also used in place of carborundum powder. In the next stage, emery powder is used. Tin oxide is used in the final stage or polishing or buffing. Polishing discs made of mild steel, copper or lead are common. Segments of abrasive material or bricks of abrasive material are often used in sophisticated machines.

7.5.1 Polishing Machines

Following three types of polishing machines are most commonly used for granite polishing.

- a) Single head polishing machine
- b) Line polishing machine
- c) Hand polishing machine

7.5.1.1 Single Head Polishing Machine

This is generally used for slab polishing and monument polishing in small plants. In big plant, it is mostly used for monument polishing. The machine consists of a crossbar which moves horizontally on two parallel toothed rails on side walls. The crossbar carries the spindle which could slide perpendicularly to and simultaneously with the horizontal movement of the crossbar. Depending on the stages of grinding or polishing different types of grinding or polishing heads could be fixed to the head of the spindle, to achieve desired results. All the movements of the crossbar and the spindle are pre-adjustable with the help of electric meters provided for the purpose. The system can work in automatic or semi-automatic mode. Electronic switches and sensors monitor and control various activities of the system.

Water is provided to achieve even polishing of surface and to minimise the wear and tear of the polishing head.

Slabs or blocks of granite to be polished are placed on the concrete floor of the machine, with the surface to be polished facing the spindle. Polishing is achieved in number of stages --- rough grinding to final mirror finish. Generally, the length of the tract is about 5,000mm. Effective polishing width is about 2,000 mm. and the rate of grinding or polishing varies between 1.5 and 1.75 sq. m. an hour depending on the nature of rock.

7.5.1.2 Line Polishing Machine

This is generally used for cut-slab polishing in a big plant. It consists of 6 to 8 spindles arranged in a line; it is possible to add additional spindles. The spindles are mounted in pairs on separate crossbars and slide along the crossbars in opposite direction from side to side. Unlike the single head automatic polishing, the crossbars carrying spindles do not move. Slabs to be polished are placed on a continuous conveyor belt which moves below the row of the spindles. Thus, instead of the spindle moving over the slabs, the slabs move themselves below the spindle. The movement rate of the conveyor belt is about 0.1 to 0.5 m. a minute. Different stages of grinding or polishing are achieved by successive pairs of spindles, i.e. the first pair of spindles perform rough grinding, next smooth grinding, the third pair rough polishing and the fourth pair fine polishing. Every pair of spindles is controlled by a separate control board, and the entire process, i.e. feeding the slabs to final polishing is fully automatic and computer can be programmed. Roller conveyors are provided at input and output ends to facilitate proper loading and unloading of slabs. The grinding width ranges from 1600 to 1800 mm. The thickness of slab that could be processed ranges from minimum 20 mm. to maximum 250 mm. The production capacity is about 20 sq m an hour.⁷

7.5.1.3 Hand Polishing Machine

In hand polishing machine, polishing arm, having the spindle carriage and the grinding wheel attached to it, is moved manually over the material to be polished and hence the name. The spindle head rotates by means of electric power. It is generally used for polishing odd size blocks which cannot be polished in the single head automatic machines. In single head polishing machine, grinding head could be raised to a certain maximum height, and thus blocks of more than that height cannot be polished. Such blocks can be polished by hand polishing machine. The hand polishing machine can generally accommodate slabs or blocks of thickness upto 5.5 meters with length, and width of 2.5 and 3 meters respectively. Hand polishing with planetary grinding heads are also available.

7.5.2 Polishing Practice in India

Indigenously manufactured polishing machines as well as imported machines are used in India. Most of the State Enterprises and 100% E.O.U. use imported polishing machine. The commonly used machine has a horizontal disc rotating at high speed and rubbing the granite surface to be polished. The granite block is mounted under the machine on a polishing platform. To hold the polishing block in position, wooden props are wedged between the block and the polishing platform. Further, the gaps, if any, are packed with plaster of paris to get a composite plan surface. At a time, a number of blocks can be taken together for polishing a common surface. The disc offers free horizontal movement. The position of the disc in the required horizontal plane can be clamped. The vertical movement is fixed manually.

Discs of cast iron, copper, lead and/or felt discs are used for polishing. The operation of a disc fitted to an electric motor is simple and is managed by one operator. Both imported and domestic discs are easily available. The table polishing machine with the rapid planetary head manufactured in the country consists of a main spindle driven by a 5 HP motor. The polishing capacity of this machine is 4 to 5 sq. m. of granite per shift of 8 hours. The other automatic grinding and polishing machine is capable of polishing a slab of 3.80 x 2.0m. size with 15 mm. minimum thickness.

An examination of the practices followed at nine different units located in Kuppam, Bangalore, Madras and Krishnagiri with particular reference to the number of stages involved in polishing, polishing media used, their consumption, types of discs used, their size and time required for polishing brings out the following picture:

Generally, 5 to 8 stages are involved in the polishing of granites. In one case, there are as many as 10 stages. The number of polishing stages, polishing media used, and time taken for polishing depend mainly on the type of stone to be polished and also on the quality of polishing required. The polishing media used are steel shots, steel grit, carborundum powder, silicon carbide powder, emery powder, and tin oxide.

The sizes of block polishing ranged from 0.09 to 0.55 sq. m. (one to six sq. ft.). In one case, it was as much as 1.8 x 1.2 m. Steel shots are invariably utilised as a polishing medium in the first stage. Its consumption for a 6 sq. ft. block ranged from 2.5 to 6 kg. and the time taken for polishing was 4 to 8 hours. For 0.09 sq. m. (one square foot) of block, the consumption of steel shot was about 1 kg with 4 to 8 hours polishing time.

In the second stage of polishing, the medium used is either steel shot, steel grit or carborundum, rough powder. For a 0.55 sq. m. (6 sq. ft.) size block the consumption of steel shot/steel grit is 1 kg. and the time taken for polishing 1 to 2 hours. About 50 to 250 gm. of carborundum rough powder (60 mesh size) was required for one sq. ft. size block and it involved 3 hours of polishing. For a 1.8 x 1.2 m. (6 x 4 ft.) size block about 4 kg. carborundum powder was used with 6 hours of polishing time.

Carborundum powder is generally used in 2 to 4 stages. The powder size and quantity, of course, decrease with every stage from rough, medium to fine. In one of the units the corresponding consumption of powder in three sizes in 500, 250 and 150 gm. with polishing times of 2, 1.5 and 1 hour for stage No. 3, 4 and 5, respectively, for a 0.55 sq. m. (6 sq. ft.) size block. At places, silicon carbide is used in place of carborundum powder. In one unit silicon carbide medium is used from the third to ninth stages with increasing consumption of powder from 50 to 1000 gm. at each stage. The time required for polishing varied between 30 minutes for stages 3 and 4 and 20 minutes for the remaining stages. Carborundum or silicon carbide powder is followed by emery powder which is generally used in one or two stages. The fine powder is used in a later stage. The consumption of emery powder varied between 100 and 200 gm. The corresponding polishing time ranged from one to two hours.

Tin oxide is the medium in the final stage of polishing (buffing). Its consumption varies from 25 to 250 gm, depending on the size of the block to be polished. For 0.09 sq. m.

(1 sq. ft.) size block, the polishing time is 1 to 2 hours. In case of a 1.8 x 1.2 m (6 x 4 ft.) size block, the polishing time is as high as 6 hours. The total time taken for polishing in all the stages ranges from 10 to 36 hours.

Different types of polishing discs made of cast iron, mild steel, copper and lead are used. Cast iron and mild steel discs of 15 to 30 cm. (6 to 12 inches) (maximum 45 cms) diameter are used in the initial stages. The size of the discs decreases to 10 cms. to 12.5 cms. (4 to 5 inches) diameter in the latter stages. Copper discs 1.25 to 2.5 cms. thick and 7.5 to 20 cms. diameter follow cast iron mild steel discs for fine polishing. Lead discs 3 to 6 mm. thick and 7.5 to 12.5 cms. diameter are used in the final stage of polishing.

The stagewise details of media, their consumption, time required for polishing and plates used in units A, B, and C are given in Table 7.1.

The rate of consumption of polishing media given in Table 7.1 should be considered only as a guide. The norms practised in a unit are based on trial and error to suit the particular type of dimension stone with utmost economy and efficiency. On an average, 5 to 6 polishing machines are installed in each unit. 0.37 to 0.92 sq. m. (4 to 10 sq. ft.) of granite is usually polished by one machine in 24 hours.

7.6 STATUS OF GRANITE PROCESSING IN INDIA

A list of granite processing units in Andhra Pradesh, Gujarat, Karnataka, Rajasthan and Tamil Nadu is given in Annexure V.

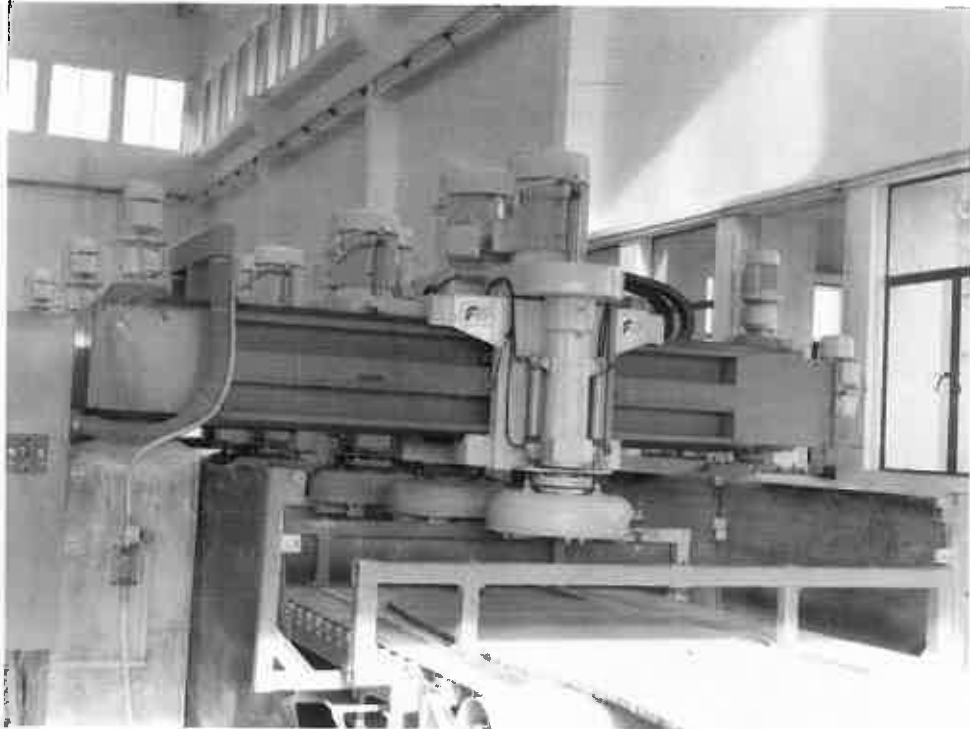
In order to assess the status of granite processing in medium to small Indian units, data collected in respect of 36 working units were analysed with particular reference to the type of raw stone used, sources of supply, and the cutting processes employed in various units. These cutting and polishing units are located in Andhra Pradesh, Karnataka, Tamil Nadu and Rajasthan. These are discussed below:

7.6.1 Type of Raw Stone and Its Supply

Raw stones subjected to processing are usually black, grey and pink granites. In a few units, red and rose varieties are also treated. Sixteen units have their own captive quarries which supply the raw stone. Only five units meet their requirement through supplies from other quarries. The remaining units share their requirement from their own as well as from other quarries. The stone is usually in the form of blocks or slabs of various sizes.

7.6.2 Processing of Granite

The granite processing employed involves sawing or cutting, polishing and edge cutting. While polishing is done by machine, sawing and edge cutting are manual as well as mechanical. The manual method of cutting is done in 22 units. In five units, both the methods have been employed as required. Mechanical cutting is adopted in the remaining units. Manual cutting requires 16 to 20 hours for a standard size block of 0.55 sq. m. (6 sq. ft.). In the mechanical units, the sawing machine used include gang saw, circular saw and wire saw. The rate of cutting varies from machine to machine and unit to unit. In one case, a wire saw machine cut 0.09 sq. m. (1 sq. ft.) of stone in an hour. In respect of other machines, the rate of cutting varied between one to five sq. m. (10 to 50 sq. ft.) per hour. Machine



Autoline Polishing Machine
: Courtesy – Mysore Minerals Ltd.



Multi Disk Sawing Machine
: Courtesy – Mordenti, Italy



TABLE 7.1
STAGEWISE DETAILS OF POLISHING PROCESS IN SOME GRANITE CUTTING AND POLISHING UNITS IN INDIA

Sl. No.	Item	Polishing								Remarks
		I	II	III	IV	V	VI	VII	VIII	
1. Polishing Medium										
Unit A	Steel shot	Steel grit	Carborundum rough	Carborundum smooth	Carborundum very fine	Emery powder rough	Emery powder smooth	Tin oxide	In unit A polishing is in 8 stages	
Unit B	-do-	Carborundum rough	Carborundum smooth	Emery	Tin oxide	-	-	-		
Unit C	-do-	Carborundum rough (60 mesh)	Carborundum (120 mesh)	Emery	Tin oxide	-	-	-		
2. Consumption of polishing medium in kg.										
Unit A (for 0.55 sq. m. surface)	2.50	1.00	0.50	0.25	0.15	0.20	0.20	0.25	In unit A time required for polishing is about 20 hrs.	
Unit B (for 0.09 sq. m. surface)	1.25	0.25	0.25	0.10	0.10	-	-	-	The products made are kerbstone, tombstone, memorials and books.	
Unit C (for 2.2 sq. m. surface)										

Sl. No.	Item	Polishing								Remarks				
		I	II	III	IV	V	VI	VII	VIII					
3.	Type of polishing and its size (diameter in inches)													
	Unit A	MS cast iron 30 cm.	MS Cast iron -20 cm.	MS Cast iron 15 cm.	MS Cast iron 15 cm.	MS Cast iron 15 cm.	MS Cast iron 15 cm.	MS Cast iron 15 cm.	MS Cast iron 15 cm.	MS Cast iron 15 cm.	MS Cast iron 10 cm.	MS Cast iron 10 cm.	Lead 11.25 cm.	In the unit B polishing is in 5 stages. Time required for polishing is 12 to 14 hours. The products made are kitchen plat- forms, flower vases, memorial slabs for interior decoration.
	Unit B	MS Cast iron 30 cm.	MS cast iron 22.5 cm.	MS cast iron 12.5 cm.	MS cast iron 7.5 cm.	Copper 7.5 cm.	Lead 7.5 cm.							
	Unit C	MS cast iron 45 cm.	MS cast iron 30 cm.	MS cast iron 22.5 cm.	Copper 20 cm.	Lead 15 cm.								
4.	Time required for polishing													
	Unit A	8 hrs.	2 hrs.	2 hrs.	1 hr. 30 min	1 hr.	1 hr.	1 hr.	1 hr.	1 hr.	1 hr.	2 hrs.		In unit C, polishing is in 5 stages. Time required for polishing is about 36 hrs. The products include memorials, bookstones kitchen platforms and other stones used for interior decoration.
	Unit B	4 hrs.	3 hrs.	2 hrs.	2 hrs.	2 hrs.	1 hr.							
	Unit C	8 hrs.	6 hrs.	6 hrs.	10 hrs.	6 hrs.	6 hrs.							

cutting although costly is very fast and obviates further dressing before polishing. Polishing is done invariably by machine. The number of polishing stages varies from 5 to 10 stage using steel shots, grits, carborundum, emery and tin oxide powder. Edge cutting, i. e. final dressing, is mostly done manually by using chisels and hammers. Only in a few cases edge cutting is mechanical.

An idea of the structure and status of cutting and polishing units in various states can be had from the following discussion.

7.7 Andhra Pradesh

Data from 10 working units was analyzed out of these ten working units two have captive quarries supplying raw stone. Six units meet their requirements from their own quarries as well as from other quarries while two units purchase all their requirements. All but one unit employed manual method of cutting. In all the 10 units, there are 68 roughing and polishing machine with a motive power of 3 to 5 HP each. Polishing is done in 5 to 8 stages according to the requirement. In one unit, edge cutting is done by machine but else where it is manual. The following is the status of three of the units :

One group has two sawing machines, 36 polishing and edge cutting maching the particulars of which are as follows:

- a) **Sawing Machine**
 - i) Diamond circular saw (Italian make, 1980), one No. Dia. 180 cms. motive Power Electrical, 40 HP.
Rate of cutting 0.09 sq.m. in 5 minutes with water as coolant. Life of blade - 180 sq. m.
 - ii) Wire, saw, 2 Nos. (Korean Brand, 1973) Motive power electrical 20 HP and 7.5 HP, High-carbon steel wire. Life of wire 1.100 sq.m. with water as coolant. It is slower than the diamond saw machine.
- b) **Polishing Machine** : 36 Nos. locally fabricated. Motive power electrical 3 to 5 HP. Polishing in 7 stages using steel shots, steel grits, carborundum, emery and tin powder. Time taken for polishing about 14 hours.
- c) **Edge cutting Machine** : 1 No. (German Make) Blade dia. 50 cm. Motive power electrical, 15 HP.

Preparation of memorials, markers and monuments of 6 mm. thickness is a speciality of this group.

In the second unit, cutting and dressing(edge cutting) of granite is done manually. Polishing is done mechanically with six polishing machines locally fabricated. polishing is done in eight stages using steel shots, carborundum, emery and tin oxide powder.

Interior decoration articles are the product speciality. This unit has plans to set up a new unit with cutting, polishing and edge cutting machines.

In the third unit, cutting and edge cutting of granite is done manually. Polishing is done mechanically with five polishing machines locally fabricated. It has plans to import horizontal diamond saw machine (20 HP) of Japanese make and to acquire one indigenous edge cutting machine.

7.8 KARNATAKA

Bangalore is one of the most important cutting and polishing centres for granite. A study of the structure and status of 14 polishing units in Bangalore indicated that most of units have their captive sources supplying raw stone. Only three units meet their raw stone requirement from other quarries besides their own quarries, while two units purchase all their requirements. In all units, the method of cutting is manual. The remaining three units employ mechanical means of cutting by a diamond circular saw and gang saw machines. A total number of 77 roughing polishing machines are being used. The machines are in the range of 3 to 5 HP with electrical motive power. Six to seven polishing stages are generally involved. In one case, however, as many as 10 stages are involved. Edge cutting is mostly manual. Only four units are equipped with edge cutting machines.

The machinery deployed for granite processing in five of the units are as follows :

- a) In one unit, the cutting machines include one horizontal circular saw and one gang saw. There are four polishing machines of which two are automatic, one with 4 discs and another with one spindle. Polishing is done in six stages using steel shots, carborundum powder of various sizes and tin oxide powder. There is one edge cutting machine fabricated indigenously.

Monuments, memorials, blocks and books are the product specialities of this unit.

- b) In the second unit, cutting is done with a wire saw machine, locally fabricated. The rate of cutting is 6 hours for every 0.09 sq.m. (sq.ft.) of stone. There are seven polishing machines locally fabricated. Polishing is done in 7 stages.
- c) The third unit has one sawing machine and ten polishing machines. Polishing is done in six stages. There is only one edge cutting machine.

Products like memorials, kerbstones and step stones are made in this unit

- d) In the fourth unit, cutting and edge cutting are manual while polishing is mechanical. There are seven polishing machines with electrical motive power of 3 to 5 HP, involving 10 stages of polishing with steel shots, carborundum and tin oxide powder.

Monuments and surface plates are the product specialities of this unit.

- e) The fifth unit employs mechanical cutting, polishing and edge cutting machines both for granite and marble. The cutting machines include one diamond circular

saw (Vertical) of 1.25 m dia meter with electrical motive power, and one old gang saw machine of 5 HP which cuts 20 slices of 2.4 x 1.0 m size. There are seven polishing machines locally fabricated. Polishing is in seven stages. There is one edge cutting machine.

Kitchen platforms and elevated bath platforms are the specialised products of this unit.

7.8.1 Granite Processing Plant of Mysore Minerals Ltd.

Granite processing plant of Mysore Minerals Ltd. (MML) a Government of Karnataka Enterprise, is located at the Industrial Estate, Hassan, Karnataka. This is an 100% export oriented unit. The production from this unit mainly consists of polished slabs of Ilkal pink granite, black multi-coloured granite, and the black granite. Production of black granite monuments is also made in the plant. Annual production capacity of the various types of granites is as follows:

- i) Black granite 7000 cubic meters.
- ii) Ilkal pink granite 1200 cubic meters.
- iii) Red multi-coloured granite 4200 cubic meters.
- iv) Black multicoloured 1200 cubic meters.

Granite blocks are mostly quarried from the captive quarries of Mysore Minerals Ltd. So far they have exported more than 9000 cubic meters of granite. The processed granite is exported through Mangalore port.

There are two automatic gang saws of Carl Meyer (LVG/S) W. Germany and one circular block saw of Hensel Bayreuth with diamond segments. The gang saws can take 30 to 60 blades. Cutting media in the form of steel grit is circulated with a slurry of lime water. Rate of down feed is 4 cm/hr.

Polishing is done on autoline polishing units of Fickert Winterling and also on Single Head Polishing machine manufactured by Hensel Bayreuth, W. Germany. Both the polishing units are fully automatic. The autoline grinding unit is used for line polishing of building slabs and also for monumental stones. The single head grinder is mainly used for monumental stones. Polishing media is silicon carbide. Similarly magnesite bonded polishing bricks are also used.

Edge cutting & chamfering is also done on fully automatic machines of Fickert Winterling. There are two side polishing units and one miling unit. Bridge saws are also used for edge cutting.

Cranes and trollies are used for loading - unloading and movement of quarry blocks.

Monument blocks produced here are mostly exported to Japan.

7.8.2 100% Export Oriented Granite Units in Karnataka

A list of 100% Export Oriented Granite processing units in Karnataka is given in ANNEXURE VI.

7.9 TAMILNADU

A study of 12 working units with respect to their structure and status indicated that, in respect of 10 units, raw stone is obtained from their own quarries or by purchases from other quarries. Two units meet their requirements by purchase. Most of the units employ manual method of cutting. Mechanical means of cutting are used only in two cases. There are in all 38 polishing machines, of 3 to 5 HP electrical motive power. The polishing stages involved are six or seven. Edge cutting is manual except in one case.

The details of machinery deployed in some of the units are as follows

In one unit Granite cutting and edge cutting are done manually and polishing mechanically. There are three polishing machines and polishing is in six stages with steel shots and grits, carborundum, emery, and tin oxide powder.

Tombstones, kitchen sets and engraved name plaques are the product specialities. The party has immediate plans to install two cutting and polishing machines.

In another unit also cutting and edge cutting are done manually and polishing mechanically.

There are three polishing machines and polishing is done in seven stages with steel shots and grit and Carborundum, emery and tin oxide powder.

A third unit has only one polishing machine with polishing done in six stages. The unit produces mainly Kerbstone, memorials and kitchen sets.

In the fourth unit, cutting and edge cutting are done manually and polishing mechanically. There are five polishing machines with polishing done in six stages.

The unit produces mainly blocks, slabs and tombstones exclusively for export to Japan.

7.9.1 Granite Processing Plant of Tamil Nadu Minerals Ltd. (TAMIN)

Tamil Nadu Minerals Limited was established in 1978 as a State Government Enterprise. TAMIN has a number of quarries of black and multi-coloured granite in Tamil Nadu. Its granite processing unit is located at Manali, Madras - 68. This unit, known as TAMIN GRANITES, is 100% Export Oriented Unit. It is located in the proximity of Madras Harbour and has been allotted 23 acres of land in Manali.

The techno-economic feasibility report, encompassing the details of project capacity, identification of machinery technical evaluation of granite processing machinery manufactured all over the world and recommending the suitable ones to match the proposed capacity, was prepared by Industrial and Technical Consultancy Organisation of Tamil Nadu (ITCOT).

As recommended by ITCOT granite processing machinery have been bought from Hensel Bayreuth, West Germany. The production capacity of the plant is 50,000 sq. m. of cut and polished wall panel slabs of 2-3 cms. thickness, and 10,000 sq. m. of cut and polished monuments of 10-15 cms. thickness.

This plant has all the automatic machinery. It has a grinding and polishing line with 4 double heads to polish 15 sq. m. per hour. Block circular saws (monoblock type) capable of cutting monument blocks continuously for 24 hours are also installed.

7.9.2 Establishment of New 100% Export Oriented Unit

Government of Tamil Nadu has received a number of applications for establishment of 100% EOU for granite processing in the state. More than 40 parties have submitted their projects. A list of granite processing units who have approached Department of Industries, Government of Tamil Nadu for establishing 100% E.O.U. in the state is given ANNEXURE VII.

7.10 RAJASTHAN

Data from three units were studied. Of these, two units owned by M/s. Rajasthana State Granite and Marble Ltd. located at Jalore and Jodhpur, respectively. Two gang saws, two polishing machines and one edge cutting machine, all imported from SPA Gregory, Italy, installed in these units have an annual capacity to produce 20,000 sq. m. stone. Granites are of light grey to pink and red in colour and extracted in sizes of 0.2 to 1.3 cu. m. Another unit owned by a private party is located at Jodhpur. The Jodhpur unit of M/s.RSGM Ltd. has one gang saw machine, two polishing machines and one edge cutting machine. The steel blade gang saw machine is of A/B model. The blades are of C60 type and 100 in number. The size of the blade is 3590 x 1.20 x 3.5 mm. The machine has slab-carrying capacity of 3.0 x 2.5 x 2 m. The sawing rate varies from 6 to 25 mm. per hour depending on the variety of granite. The unit has two automatic polishing machines (Levistar 1G and 2G type) of 4 x 4 m size and fitted with a 25 HP motor. Against the rate of polishing of 1.5 sq. m. per hour per spindle prescribed, the rate achieved was 0.5 sq. m./hour/spindle. The edge cutting machine is New Star Bridge type with a cutter diameter of 500 to 900 mm. The rate of edge cutting machine varies from 70 to 100 cm. per minute in thickness of 2 cm. depending on the variety of the granite. The actual rate achieved is 50 cm./minute in thickness of 2 cm.

7.11 Manufacture Of Granite Processing Machinery In India

Some of the indigenous agencies manufacturing processing machinery suited to handle granite are listed in Annexure VIII. Some of them manufacture processing machinery in technical collaboration with leading stone processing machinery manufacturers of the world. Important manufacturers outside India are listed in Annexure IX.

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8 : Leasing Procedures and Policies in Major Producing States

Granite being a building stone is considered as a minor mineral. Grant of leases for minor minerals is governed by the Minor Mineral Concession Rules made by the respective State Governments. Leasing procedures and policies for granting granite leases in the important producing States of India, viz. Andhra Pradesh, Karnataka, Tamil Nadu and Rajasthan are summarised below :

8.1 ANDHRA PRADESH

The Andhra Pradesh Minor Mineral Concession (APMMC) Rules, 1966 govern the grant of leases for minor minerals, including granite, in the State. These rules came into force with effect from the 7th December, 1967.

Competent Authority

The APMMC Rules, 1966 stipulates that the Deputy Director of Mines and Geology is the competent authority for granting quarry leases. Even if the granite deposit is located in the Reserved Forest land, the Deputy Director of Mines and Geology is the competent authority for granting leases. He may grant leases in Reserved Forest land in consultation with the Divisional or the District Forest Officer concerned. The Conservator of Forests is also empowered under the Rule 22 to allow quarrying in the Reserved Forest areas. However, in view of the recent Forest Act, granting of quarry leases in forest lands is restricted.

Procedures for Granting a Lease

Under Rule 12(1) of the APMMC Rules, 1966, a quarry lease can be granted on an application made for the purpose and accompanied by a Treasury or Bank Challan for Rupees one hundred as fees. If more than one application is received for grant of the same areas, the Deputy Director shall dispose of the application in order of preference as specified in Sub Rule 12(2). The order of preference followed for this purpose is as below :

- a) Applications of the Government departments and Government Corporations and Companies.
- b) Applications of Labour Contract Co-operative Societies.
- c) Applications of unemployed persons who possess any recognised qualification in Geology, Geophysics or Mining Engineering or any other allied subjects.
- d) Other applications.

The quarry leases are granted with the condition that the lessee shall work the quarry directly and shall not hand it over to any other party for working. Further, the Deputy Director may refuse to accord preference to the application of a Labour Contract Co-operative Societies if he finds that the particular society does not work properly in the interest of the workers concerned.

Whenever more than one application falling under any of the categories (a) to (c) above are received for granting a quarry lease and have to be considered under the order of preference prescribed above, the Deputy Director shall refer the matter to the Government with his recommendation for a direction.

Disposal of Application

The application for granting quarry lease shall be disposed of within ninety days from the date of its receipt and if it is not disposed of within that period, the application shall be deemed to have been refused. The lease deed shall be executed within ninety days from the date of grant of lease or within such further period as the Director may allow in this behalf and if no such lease deed is executed within the said period due to any default on the part of the applicant, the Deputy Director may revoke the order granting the lease.

Renewal of Quarry Lease

The application for renewal of a quarry lease shall be made at least ninety days before the expiry of the period of lease to the Deputy Director and it shall be disposed of before the expiry of the lease period. If the application is not so disposed of within that period, it shall be deemed to have been renewed.

Period of Lease

Quarry lease for granite may be granted by the Deputy Director of Mines and Geology for a period of five years. If the period required for the lease exceeds five years for the proper development of quarry, prior approval of the State Government is necessary under the sub-rule (2) of the Rule 15. If the State Government is satisfied that for proper and systematic development of the quarry, a period longer than five years is necessary and the applicant or the lessee is capable, financially and technically, of developing the quarry on a large-scale, a quarry lease may be granted for ten years. Such lease may be renewed from time to time.

Renewal of Leases

Under Rule 31 the Deputy Director may grant renewals not more than two times the period of quarry lease, subject to the following criteria:

1st Renewal

- a) Systematic development of the quarry.
- b) Development of good communication facilities and their maintenance.
- c) Investment on transport
- d) Training of skilled labour and commitments on labour retention and inducement.
- e) Preliminary work and investment for establishing a processing (dressing or upgrading) plant utilising the product from the quarry/quarries in question.

- f) Establishment of market for the product, either in raw form or in processed or semi-processed form.

2nd Renewal

- a) Establishment of processing plant, either individually or in partnership.
- b) Development of market in the country or abroad (efforts in this direction are very important).
- c) Any long-term contracts with the established industries for supplying granite.

Policy of the Government

The State Government may by notification in the official gazette reserve any area for exploitation by the Government, a corporation established by the Central or State Government, or a Government company. Presently much area has been reserved in Andhra Pradesh. However, Government has decided to permit exploitation of black and coloured granite in private sector by 100% EOU only in G.O.M.s No: 317, Ind. Com. dt. 10.7.85 and G.O.M.s No: 409, Ind. Com. dt. 30.9.85. The exploitation of black and coloured granite by the private sector within Andhra Pradesh who are registered as SSI unit for internal consumption and marketing is also permitted by the Government vide G.O.M.s No: 209, Ind. Com. (MIV) Deptt. dt. 7.4.86 and G.O.M.s No: 266, Ind. Com. Deptt. dt. 20.5.86 subject to the following conditions:

- a) The plant and equipment shall be erected at the pithead or near any one of the quarries according to convenience, if the lessee has more than one quarry in the State.
- b) Erection and commissioning of the plant, etc. shall be completed within a period of two years from the date of grant of quarry lease, failing which the quarry lease shall be cancelled without notice.

The party shall not export raw blocks but utilise the same in his industry, as per the instructions of the Government vide the Government Memo No: 2173/MIV/87-1 dt. 4.9.87.

The renewal of quarry leases for those who are not having 100% export-oriented units or local units registered as SSI units are not being considered to avoid trading of leases and also preserve such areas for genuine entrepreneurs. However, renewal of quarry leases for black and coloured granites shall be granted to the lessees who are the sister concerns of the companies possessing 100% export-oriented licences or SSI registrations with a condition that the lease so renewed shall be transferred in favour of the company holding the licence, soon after the renewals are executed. This is only to ensure the supply of raw material to the unit.

Lease for 100% EOU or SSI Unit

The Director of Mines and Geology has been recognised as a nodal agency for granting a certificate relating to the availability of raw material to Government of India for considering application for 100% export-oriented licences. For this, one set of applications received under

100% EOUs is marked to the Department of Mines and Geology for granting quarry lease. The certificate is issued on the basis of the application for grant of quarry lease. On the strength of the certificate issued by the Director of Mines and Geology, an 100% export oriented licence is issued by the Deptt. of Industrial Development, Government of India. The leases are granted only after the licence either from the Government of India for 100% export-oriented units or small-scale industries registrations granted by Distt. Industries Centres are produced.

Seigniorage Fee

When quarrying is carried out in an area, the following seigniorage fee shall be charged on all the material despatched or consumed from the land as specified in Schedules I & II.

Cut or dressed blocks of black granite is Rs. 500/- per cubic meter and for other granites Rs. 300/- per cubic meter (vide G.O. Ms. No. 606 dt. 27.11.86 w.e.f. 30.11.86 as published in Andhra Pradesh Gazette No. 52 Ext.

8.2 KARNATAKA

The Karnataka Minor Mineral Concession Rules, 1969 govern the grant of granite leases in the State.

Grant of a Lease

Presently, leases for granite are not granted to the private parties. All the deposits of pink and black granite are reserved for exploitation by the Government Corporation vide Ministry of Commerce and Industries Notification No: CI 441 EMO 77 dated the 23rd June, 1981 and the Notification No: CI 444, EMO 77 dated 5th September, 1979.

Mysore Minerals Ltd., a State Government Undertaking, is the only Government organisation at present who can get the fresh leases for granite.

Competent Authority

The Director of Mines & Geology is the Controlling Authority and Deputy Director, Mines and Geology is the Competent Authority for the purpose of the Karnataka Minor mineral Concession Rules, 1969.

Rates of Royalty

As per the Government Notification No: CI 240 MRC 85 dated the 15th July, 1986, a new schedule for the royalty on various minor minerals has been implemented. Accordingly, royalty on ornamental and decorative stones has been fixed at Rs. 400/- per tonne.

8.3 RAJASTHAN

The Rajasthan Minor Mineral Concession Rules, 1986 (RMMCR) govern the grant of leases for minor minerals including granite in the State. Repealing the Rajasthan Minor Mineral Concession Rules, 1977, the RMMCR-1986 were first published in Rajasthan Gazette, part IV (C), (I) Extra-Ordinary, on the 4th March, 1986.

The application for the grant of a mining lease for granite (used for slabs or tiles) is made to the Mining Engineer/Assistant Mining Engineer, Department of Mines and Geology, Rajasthan. The mining lease is granted for an area of 100 sq. m. and for a period of ten years. Renewal of mining lease may be granted for a further period of ten years, if the competent authority is satisfied that mines have been worked properly. A total of five renewals may be granted, each for a period of ten years.

8.4 TAMIL NADU

The Tamil Nadu Minor Mineral Concession Rules, 1966 govern the grant of quarry leases for granite in Tamil Nadu. As per Rule 8-C (dt. the 7th Dec. 1977), no quarry lease for granite was to be granted to private parties. However, in August, 1989, the Government of Tamil Nadu made a special announcement on granite quarry leases in the State. The text of this announcement, as published in the Economic Times, Bombay dt. the 23rd August, 1989 is given below:

"The liberalised policy initiated during the President's Rule in 1988 in respect of granite Mining Leases will be continued, to promote further development of granite-based industry in this State.

Grant of quarry leases in poramboke lands will be restricted to existing cutting and polishing units and to those applicants who give a definite and time-bound programme of putting up cutting and polishing units within a period of two years.

Letters of Commitment will be issued to the successful tenderers having an industrial programme either with Letters of Indent issued by the Government of India or Small-Scale Industries, Registration Certificates issued by the Directorate of Industries. Mining leases will be issued in the name of such units only after the technical officers nominated by the Government inspect and certify the units set up and the machinery erected.

In pursuance of the policy of the government on value addition for the quarried granite, besides creating more employment opportunities, permission for quarrying has to be obtained from the Government in respect of "Patta" lands also subject to the conditions laid down by the Government.

Granite quarries will henceforth be leased to granite cutting and polishing industries on the basis of sealed tenders, where there are more than one application. Where there is only one application, the case will be processed through a committee constituted by the Government.

Unit holders/individuals with a definite granite industrial programme will be permitted to take on lease only such extents as are required for full production as per their industrial licence.

The tender will be only for the right to exploit the reserves in the specified granite quarries. The tender amount will be collected in one lump-sum on the date of opening of the tender. In addition, seigniorage, Local Cess and Local Cess Surcharge will be payable at rates fixed from time to time, on each cubic metre of granite quarried.

A tender once confirmed, the Mining Lease will be for a period of ten years and can be renewed for a further period of ten years only without further tenders, on payment of an amount equal to 150% of the bid amount at the initial tender before the end of the tenth year.

The continuance of the mining lease and its renewal will be subject to the unit continuing the granite processing industry as such mining lease grantees will not have the right to export rough blocks of granite.

The leasees will be insisted upon to do scientific mining as advised by the officers of the State Department of Geology and Mining for conserving this valuable mineral.

The tender of Mining Leases of granite mentioned above will apply only to the areas other than those reserved for TAMIN, a Government of Tamil Nadu Undertaking.

No decision in respect of areas and cases which are covered under Court Stay will be taken at present".

9 : Banking Services And Financial Incentives

9.1 BANKING SERVICES

Important services offered by the various banks in the country include:

- a) Financing
- b) Merchant banking assistance
- c) Export promotion

9.1.1 Financing

Financing of granite processing industry may be in the form of the following:

- a) **Term Loans** : To meet in part the cost of land, building, plant and machinery, other fixed assets, and preliminary and pre-operative expenses.
- b) **Working Capital Loans - Cash Credit Loans** : For making advance payment for raw material, or purchase of raw material. It can also cover the bills receivable.
- c) **Packing Credit Facilities** : Pre-shipment credit and post-shipment credit are provided at concessional rates of interest to meet the confirmed export orders. The pre-shipment credit is meant for making the expenditure on raw material and for meeting the cost of stone processing. The post-shipment credit is offered to meet the bills receivable and export-licence dues.
- d) **Letter of Credit** : Helps to import equipment or raw material, and
- e) **Bank guarantee**

9.1.2 Merchant Banking Assistance

A merchant banker offer to the entrepreneurs a range of financial and project related advisory services. A Number of merchant banking services are offered to granite industry. Many a nationalised banks have now established their subsidiaries for this purpose in the capital market of the country e.g. The State Bank of India (SBI) has now established the SBI capital market (SBI CAP) in August 1986. Services offered by the merchant bankers include the following:

- a) **Corporate Finance Services** : Banks undertake the management of Capital Issues. This covers the issue of shares, debentures and bonds, etc. to the public and other investment organisation. Recently, John Meyers Granite Limited has made a public Issue of Rs 8,70,000; equity share of Rs. 10/- each. Syndicate Bank, Hyderabad was one of the managers of the issue. In addition to banks, a number of financial organisations in the country offer such services.

Credit Syndication : For term loans and bridge finance from institution banks,

working capital is also arranged, Similarly, equity support is offered to new promoters.

- b) **Advisory Services** : Advisory services in the form of project counselling, corporate counselling, and investment guidance are offered to new entrepreneurs. It may also guide entrepreneurs in compliance of various legislative provisions like those required for obtaining the consent or license from the government agencies.
- c) **Investment Management Services to Non-Resident Indians** : Non-Resident Indian having good savings are often in search of lucrative investment opportunities. The banking organisations advises them in selection of investments. Presently, trading in granite block and polished granite has been identified as a business of guaranteed and quick returns on investments. So, banks act as intermediaries between the parties who have their quarries but who cannot establish a granite processing factory for want of finance, and the non-resident Indians who are in search of investment opportunities in the country. Banks also help them in securing approval from the Reserve Bank of India for purchase or sale of shares or debentures and other financial instruments.

9.1.3 Export Promotion

Indian Banks, through their commercial and marketing intelligence, undertake market-specific and product-specific studies, to establish new export markets for Indian granites. If Indian Granite products lose their share in specific foreign market, banks also try to identify reasons for the same.

Banks offer Pre-shipment finance or packing credit to the exporters in the form of working capital required between the receipt of the export order and the time of shipment. It is given at concessional rates of interest and is provided for a period up to 6 months. Packing credit is generally sanctioned if the exporter has received a firm order from an overseas buyer or if the exporter has an irrevocable letter of credit opened by a prime overseas bank. Post-shipment financing by way of discounting or negotiation of bills, advances against cash incentives and duty drawbacks, and forward (exchange) contract is also provided to exporters. Bills drawn as non-credit bills are often purchased by banks on ascertaining the means and standing of the exporter, nature of shipment and the price situation abroad, and the commercial situation and political stability of importing countries.

In addition to the advances against shipping documents, advances against claims of duty drawbacks and incentives can also pay to the exporters by the bank. These advances are of great help to exporters because the settlement of such claims often take a very long time. Advances against duty drawbacks are interest free and are available up to 90 days. For this purpose, exporters have get themselves registered with the bank. The shipping bills against which the drawback amount is to be paid are scrutinized by custom authorities and an endorsement made to that effect on shipping bills. The exporter, after shipment, submits his copy of shipping bill duly endorsed by the customs to the bank for availing of the advance.

Forward exchange contract are agreements between the bank and the exporter in terms of which the bank agrees to purchase from the exporter foreign exchange at a future date at a rate fixed on the date of booking the contract. The rate of exchange, the amount of currency and the date of delivery of export documents are agreed in advance by the bank and the exporter. Such contract provide a protective cover to the exporter against the risks arising from fluctuations in currency rates. Forward contracts are looked by the banks on receipt of the full detail regarding description, quantity, unit price and probable date of shipment and copy of the cable or telex confirming the transaction, and the opening of irrevocable letter of credit. Delivery of goods has to be made within three months for shipment to Pakistan and Afghanistan and 6 months to other countries from the date of shipment. One consolidated contract can be made for different export order if all the payments are routed through the same bank, all the transactions are in the same currency, and the Reserve Bank's provisions regarding delivery period are adhered to.

9.2 FINANCIAL INCENTIVES AND CONCESSIONS FOR SETTING UP GRANITE PROCESSING UNITS

A number of financial incentives and concessions are granted both by the State and the Central Governments to the granite industry on the pattern of small-scale industries and processing industry. These incentives and concessions are mainly in the form of investment subsidy, sales tax concessions, special concessions for SC or ST, physically handicapped and women entrepreneurs; exemption of stamp duty and concessional registration charges, concessions for establishing an industry in backward area, and exemption from custom duty on imported machinery by 100% export oriented units.

9.2.1 Central Government's Assistance

The Central Government assists granite stone industry in a number of ways. Certain important measures adopted by the Central Govt. for encouraging the growth of the stone industry are as follows

- a) Allowing the export of granite stones through the Export Policy.
- b) Import of Capital goods, equipment, tools, consumables and spares.
- c) Development of stone industry under the liberalised licensed procedure, of the 100% export oriented units scheme.
- d) Encouragement for setting up medium-scale industries in backward areas and providing cash subsidies to those industries.
- e) Providing export finance at concessional interest to achieve better exports. Financial assistance for Term Loan is also provided.
- f) Liberalised foreign collaboration and foreign loan borrowal.
- g) Excise duties on indigenous equipment has been waived for the purchases made by the 100% Export-oriented units.

10 : Future Outlook

Individual units are available. Modular construction helps in expanding or updating the machines for higher productivity and sophistication as per the requirements. Computerized controls assure superior finish of required precision thereby eliminating need for manual manipulation. These machines are very useful for increasing productivity and reducing cost besides giving superior finish. Granite occurs very widely in India but the occurrences of good quality granite which could be used for monumental and architectural work are limited. Earlier only the grey, pink and red colour granite, were used for ornamental purposes. In recent days, ornamental granite, gabbros, and schists which would take good polish and look aesthetically beautiful are also gaining popularity. The availability of delicate gabbros and schists etc. as a dimension stone is not significant. It is not only the appearance but the quantitative and qualitative evaluation of such materials along with the skill of granite finisher evaluation will go a long way in obtaining a steady supply of blocks of definite quality and quantity to the country in their job.

10.1 NEED FOR MODERNISING MINING METHODS

In the existing method of mining which is carried out mostly by skilled labour the average recovery of blocks of size of 30-40% of the total excavation. Blocks are obtained through manual mining by use of small size tools. In recent days blocks of larger size are preferred because of larger surface area of slabs of uniform design and pattern can be obtained in grinding of polished slabs. A larger surface area looks more attractive than the cladding through slabs of smaller size. In order to improve the recovery and also to obtain larger size blocks it is advisable to modernise the mining methods by using high speed diamond saws, wire saws, grinders, drills and other tools etc. With the adoption of mechanisation it is also necessary to use high capacity cranes.

10.2 IMPROVEMENT IN TRANSPORT

Presently only 10-12 tonnes blocks can be lifted from the mines and transported to the processing plants. From the marketing point of view it is desirable to have blocks of larger size weighing upto 30 tonnes so that the slabs of bigger surface area can be obtained from the single block. For transporting bigger blocks it is necessary to have large capacity trucks. This would also require improvement of roads and bridges from the mines to the processing plants and from processing plants to ports.

10.3 NEED FOR MODERNISING PROCESSING METHODS

Though recently some modern units have been installed both in public and private sector, there is a need for more and more sophisticated processing units. Manual methods of processing are both time consuming and labour intensive. Moreover the processing by manual method may not have the superior finish achieved by modern sawing & polishing machines. Further, it is very difficult for manual processing to maintain the superior quality of finish over a large number of pieces. As a result the manually processed blocks may not even meet the rigid export requirement, far from their being suitable for metrological purpose. The modern processing machines not only give superior finish but they also are capable of doing it very quickly and with the required precision over a large number of blocks or slabs.

In advance countries a number of manufacturers have developed highly sophisticated equipment. Manufacturers from Italy and West Germany have developed modular and fully automatic computer controllable machines. Lines or batteries of such machines containing a chain of

individual units are available. Modular construction helps in expanding or updating the machines for higher productivity and sophistication as per the requirements. Computerised controls assure superior finish of required precision thereby eliminating need for manual manipulation. These machines are very useful for increasing productivity and reducing cost besides gives superior finish. There is much scope for deploying these machines in our country.

10.4 TRAINING OF PERSONNEL

As mining and processing granite is highly skilled job it is necessary to create facilities for training of workers at different levels, in modern method of mining and processing. For the operations of some of the sophisticated machines a specialised training to the operators is very much necessary to fully utilise all the capabilities of the system. Training outside of the country should also be encouraged to a selected group of persons to acquire the required skill in their job.

10.5 MARKET

Indian granites have not been property standardised and catalogued for international markets. Leading international producers have standardised the colour, texture and design of their granites. Therefore a prospective consumer can easily decide the particular type of granite he will like to buy. Efforts for standardising our granites will help in attracting more buyers.

ANNEXURE I

GUJARAT Quarry Leases For Granite

Sl. No.	Name & Address of Lessee	Location of lease Village	Taluka	Lease Area in Hect.
1	2	3	4	5
Dist. Kheda				
1.	Babubhai Chhotabhai Patel, At Kapadwanj.	Balasinor	Balasinor	4.00
2.	Mayur Stone Industries, 350/7 Ashis Calander Compund, Dani Linda, Ahmedabad	Jetholi	-do-	2.69
3.	-do-	Saliawadi	-do-	1.36
4.	-do-	Saroda	-do-	2.00
5.	Gujarat Granite Industries (as above)	Karanpur	-do-	2.00
6.	-do-	-do-	-do-	2.84
7.	-do-	-do-	-do-	2.00
Dist. Panchmahal				
1.	Champaklal Nanjibhai Dhamnani, Sathria Bazar, Godhra	Paravadi	Godhra	0.6764
2.	Mahmad Yusuf Ismail, At & Post Aalipor, Tq. Sankheda, Dist. Vadodara	Dhusar	Kalol	8.2027
3.	Laxman A. Chawda, Nava Tahkor Vas, Devgadbaria Dist. Panchmahals	Bhadbha	Devgadh barid	2.00

ANNEXURE I

1	2	3	4	5
Banaskantha				
1.	Ashok Kumar Amarabhai Dabhi, At & Post Chhaniyal, Tq. Vadgam	Chhaniyal	Vadgam	2.00
2.	Manilal Kasturchand Barot, At & Post Dantiwad, Tq. Dhanera	Dantiwad	Dhanera	2.00
3.	Kasar Savabhai Parmar, At & Post Juni Sendhani, Tq. Vadgam	Juni Sendhani Village	Vadgam	1.00
4.	Sariffbhai Vajirbhai Sunasara, At Post Islampura, Tq. Vadgam	Bhankhri	-do-	1.00
5.	Chaturbhai Maganbhai Solanki, At. & Post Kodaram, Tq. Vadgam	-do-	-do-	1.00
6.	Ganeshbhai Bhikabhai Chauhan, At & Post Chhaniyala, Tq. Vadgam	Chhaniyala	-do-	1.00
7.	-do-	-do-	-do-	1.00
8.	Virsang Galabhai, (as above)	-do-	-do-	0.94
9.	Virjibhai Ujambhai Patel, (as above)	-do-	-do-	0.94
10.	Smt. Dalijit Kaur H., At & Post Deesa, Tq. Deesa	Dantiwada	Dhanera	1.00
11.	Juthsing Virsing Devda, At & Post Vadirad, Kotda, Tq. Dhanera	Vagor	Dhanera	0.4576
12.	Swarnsing H., (as above)	Dantiwada	-do-	2.00
13.	Laxmanbhai Parthibhai Patel, At & Post Vadgam, Tq. Palanpur	Karnala	Vadgam	1.00
14.	Galabbhai Manjibhai Patel, At & Post Chhaniyala, Tq. Vadgam	Chhaniyala	-do-	2.00

1	2	3	4	5
15.	Kaushik Const. Co., Vadi Road, Deesa, Tq. Deesa	Dantiwada	Dhanera	1.00
16.	Premji Muljibhai Patel, At & Post. Chhanjiyala, Tq. Vadgam	Chhaaniyala	Vadgam	1.00
17.	Sitaram Khemaji Oad, At & Post Bhankhri, Tq. Vadgam	Bhankhri	Vadgam	1.00
18.	Pruthviraj Sardarsing Vaghela, At & Post Dantiwada, Tq. Dhanera	Dhantiwada	Dhanera	1.00
19.	Remeshwar Ramkrishan & Co., At & Post Dessa, Tq. Dessa.	Dhantiwada	Dhanera	1.00
20.	Prabatsing M. Vaghela, At & Post Dantiwada, Tq. Dhanera	Dhantiwada	Dhanera	1.00
21.	Shamalbhai Parthibhai Patel, At & Post Chhaniyala, Tq. Vadgam	Chhaniyala	Vadgam	2.00
22.	Shamalbhai Ramjibhai Patel At & Post. Vagda, Tq. Palanpur	Bhankrj	Vadgam	4.00
23.	Parthiji Ratnaji Thakor, At & Post. Dantapura, Tq. Vadgam	Bhankhri	Vadgam	1.00
24.	Mukeshkumar Bhogilal Patel, At & Post Chitrasani, Tq. Palanpur	Dhanpura	Palanpur	2.00
25.	Executive Engineer, Aay: Vojna Vibhag, At & Post Dantiwada, Tq. Dhanera	Dantiwada	Dhanera	1.24
26.	Sonjaykumar B. Modi, Bhagryodaya Society, Tq. Palanpur	Rabaran	Palanpur	5.00
27.	Shamalsha Girdhari Co., 65, Mahatma Gandhi Road, Bombay	Malan	Palanpur	1.40

1	2	3	4	5
28.	Arbuda Granite & Marble Co., 65 Mahatma Gandhi Road, Bombay.	Hasanpur	Palanpur	4.85
29.	-do-	-do-	-do-	4.00
30.	Dilip S. Vyas, Near Kalupur Police Station, Gandhi Road, Ahmedabad	Manpuria	Palanpur	4.7753
Dist. Mehsana				
1.	Stone Granite Pvt. Ltd., C/o. 4593/7 Imperial Bldg., Kalupur Police Chowky, Ahmedabad	Vasai	Kheralu	6.00
2.	Harish Mineral, At & Post Gavada, Jantral, Vijapur, Dist. Mehsana	Deriya	Vijapur	3.6129
Dist. Vadodara				
1.	Ganesh Stone Supply Co., C/o. Bharat Laxmi Mining Industry, At & Post Chhotaudepur, Dist. Baroda	Surkheda	Chhotaudepur	4.00
2.	Indian Construction Co. At & Post Bhadarpur, Tq. Sankheda, Dist. Vadodara	Bhulvan Noorpur	Sankheda	2.00
Dist. Sabarkantha				
1.	Punjiram Khemram Panchal, Govindnagar, At & Post Bhiloda, Dist. Sabarkantha	Khalwada	Bhiloda	0.8098
2.	Shaymlal Ravataji Oad, Station Road, At & Post Idar	Idar	Idar	0.4047
3.	Chinubhai Mafatlal Shah, Maincrupa, Near Swaminarayan Mandir, Himatnagar.	Nadri	Idar	5.40
4.	Nathabha Devjibhai Patel, 43-B, Kachchhi Patidar Society, Himatnagar	-do-	-do-	2.00

1	2	3	4	5
5.	Arvindbhai I. Patel, C/o. Patel Quarry Works, Sevalia, Near Rly. Station.	Nadri	Idar	10.00
6.	Ajijbhai Hakimbhai Hasanji, Moti Vorvad, Himatnagar	Mordungra	Himatnagar	10.00
7.	Arvindbhai Shankerlal Joshi, Pusp kunj Society, Khedbrahma	Vasni	-do-	2.00
8.	Uniyashankar Manilal Pandya; At & Post Radhiwad, Khedbrahma	Kawa	Idar	2.48
9.	Smt. Jayaben Kashandas, Rahmehal, Tq. Idar	-do-	-do-	2.88
10.	Kiritkumar Punjiram Panchal, At & Post Bhiloda, Tq. Bhiloda	Khalwad	Bhiloda	0.24
11.	Khalwad Gram Vikas Mandal At & Post Khalwad, Tq. Bhiloda	-do-	-do-	0.24
12.	Stona Granite Pvt. Ltd., 70/16, Bijo Main Road, Vyani Canal, Bangalore, Karnataka	Madri	Idar	4.00
13.	Navkar Feen Stocks Pvt. Ltd., 17, Dhaval Society, Near St. Xavier's High School, Navarangpura, Ahmedabad.	Nadri	-do-	25.92
14.	-do-	-do-	-do-	18.72
15.	Narendrasinh Survirsinh Chauhan, At & Post Nadri, Tq. Idar, Dist. Sabarkantha	-do-	-do-	5.00
16.	Survirsinh Laxmansinh Chauhan, (as above)	-do-	-do-	5.00
17.	Ibrahimbhai Mohmadhusen Sheth, Himatnagar, Tq. Himatnagar	-do-	-do-	5.00
18.	Mahendrabhai Jasbhai Patel, Khedbrahma, Dist. Sabarkantha	-do-	-do-	4.00

1	2	3	4	5
19.	Govabhai Jivabhai Patel, At & Post Bhadar, Tq. Idar	-do-	-do-	5.00
20.	Pradhumansinh S. Chauhan & Gajendrasinh H. Chauhan, At & Post Nadri, Tq. Idar	-do-	-do-	5.00
21.	V. J. Mineral Pvt. Ltd., Ajanta Ellora Theatre, Ashram Road, Ahmedabad	-do-	-do-	15.00

ANNEXURE IIA

KARNATAKA Quarry Leases Sanctioned For Pink Granite

Sl. No.	Name & Address of Lessee	Survey No.	Village & Taluk	Extent acres (Hectares)
[1 Acre=0.405 Hectare]				
1.	Gem Granites, Ilkal tq., Bijapur District.	296/A 12	Balkundi Village	47.00 (19.04)
2.	Surya Enterprises, No.980, 5th cross, K. R. Puram, Hassan.	42	Danayakanapura Tq. Tumkur District - Tumkur	23.00 (9.32)
3.	Muddeereswara Mining Industries, 147/2, Vth Main, Chamrajpet, Bangalore-19	778	Tekkalakatte, Tq. Siraguppa District - Bellary	2.00 (0.81)
4.	Muddeereswara Mining Industries, 147/2, Vth Main, Chamrajpet, Bangalore-19	26	Sugudevanahalli, Tq. Bellary	5.00 (2.03)
5.	Gurudev Exporting Co., 18-28, Guruprasad, behind Keerthi Mahal, Bangalore-1	114 (76)	Kangal, Tq. Nelamangala Dist - Bangalore	15.00 (6.08)
6.	Gomtesh Granites, Deddannavar Bros, Compound Near Fort, P.B. Road, Belgaum	100& 101	Hirekodagali, Hungund Tq.	6.36 (2.58)
7.	Master Minerals, No. 37/1, Aga Abbas Ali Road, Bangalore-42	71to75 &86	Sripathihalli Magadi Tq. District - Bangalore	22.32 (9.04)
8.	Sridevi Enterprises, Nettakallappa Building, No.66 D.V.G. Road, Bangalore-4	27	Madagondanhlli Tq. Tumkur District - Tumkur	10.28 (4.17)

Sl. No.	Name & Address of Lessee	Survey No.	Village & Taluk	Extent acres (Hectares)
9.	G. S. Basavaraj, No. 4-27, 1st Main Road, Maruthi Extension, Bangalore-21	63	Shivagnage, Tq. -Nelamangala District - Bangalore	24.08 (9.76)
10.	Shri R. Rangappa Naik, Uppar Mohalla, P.O. Sorapur, District. - Gulbarga	133	Jalibenchi, Shora District. - Gulbarga	32.00 (12.96)
11.	Shri Lakshmappa Naik Uppar Mohalla, P.O. Sorapur, District. - Gulbarga	133	Jalibenchi, Shore District. - Gulbarga	54.00 (21.87)
12.	Navaneeth Exporters (P) Ltd., 10/2, J.C.Road Cross, Bangalore-2,	II Part	Bommanal, Linga Tq. Sugur District - Raichur	5.00 (2.03)
13.	Gem Granites, 58,Cathedral Road, Madras	29,32	Bhogirammanagudda, Tq. Deodurg District - Raichur	30.00 (12.15)
14.	L. Lingaswamy, Silk Waste Merchant, Old Bus-Start Road, Chamarajnagar	136,416 419	Vikkalageri T., Tq. Narasipur District. - Mysore	60.00 (24.30)
15.	Gem Granites Tq. Ilkal District - Bijapur	793 13/1	Balkundi, Tq. Hungund	50.00 (20.25)
16.	Gem Granites Tq. Ilkal District - Bijapur	296/1 1A 2	Balkundi Tq. Hungund	63.00 (25.52)
17.	Lal Singh and Co., No. 1655, 40th Cross, 18th Main, 4th T Block, Jayanagar.	78(part)	Varadanahalli Tq. Tumkur District - Tumkur	5.28 (2.14)
18.	Gomtesh Granites & Exporters, Near port, Belgaum	7,8,91,92 93 & 2/40	Gudur and Hirekoda gali Villages, Tq. Hungund	20.00 (8.10)
19.	Shri S. L. Gopal, S/o Late Lakkaiah Krishnapur P.O.Dabaspeta, Tq. Nelamangala	84,86 to 88 Agalaguppa	Tq.Nelamangala District - Bangalore	4.20 (1.71)

Sl. No.	Name & Address of Lessee	Survey No.	Village & Taluk	Extent acres (Hectares)
20.	P. S. Raju. 100/C 1st 'N' Block Rajajinagar, Bangalore	82	Kalamangala, Tq. Magadi District - Bangalore	44.00 (17.82)
21.	South India Granite Co. Pvt. Ltd., No. 100/C, 1st 'N' Block Rajajinagar, Bangalore	54,62	Kacharanahalli and Thotahalli, Tq. Kanakapura District - Bangalore	31.00 (12.56)
22.	K. Madhava Rao, No. 37, 7th Main, 5th Cross, Srirampuram, Bangalore - 21	260	Gudibande, District - Kolar	6.00 (2.43)
23.	Excel Traders, Prop : Shri Saifullakhan, No. 901, Nanagerpeth, Kolar		Harishchandra Tq. Ramanagaram District - Bangalore	5.00 (2.03)
24.	Vijaya Granites, No. 197, Cavalry Road, Bangalore - 1	1 to 4 13 to 15 18,38,39, 48,60 etc.	Begiramangudda Tq. Deodurg District - Raichur	36.00 (14.58)
25.	Kalpagaum Granites, No. 12, Sungar Building, IInd Floor, M. G. Road, Bangalore - 1	21	Bachanhatti Tq. Magadi District - Bangalore	3.00 (1.22)
26.	Shri Surendrababu, Kapalgai Road, Gandhinagar, Bellary	8,19	Tekkalkote, Tq. Siruguappa District - Bellary	2.00 (0.81)
27.	Smt. S. Padman, No. 177, West of Chord Road, II nd Stage, Rajajinagar, Bangalore - 10	85 to 87	Kanavanahally, Tq. Pavagada District - Tumkur	7.00 (2.84)
28.	Smt. S. Indira No. 177, West of Chord Road, II nd Stage, Rajajinagar, Bangalore-10	63	Bhantrakuppa, Tq. Magadi District - Bangalore	4.32 (1.75)
29.	Alankar Granite Industries, Cambridge Raod, Bangalore-8	86	Archikerihalli, Tq. Ramanagaram District - Bangalore	3.00 (1.22)

Sl. No.	Name & Address of Lessee	Survey No.	Village & Taluk	Extent acres (Hectares)
30.	Stone Craft Enterprises, 120, IIIrd Phase, J. P. Nagar Bangalore - 69	24	Belappanahally, Tq. Ramnagaram District - Bangalore	13.00 (5.27)
31.	B. N. Ravindranath, No. 51, BD Lane, Cottonpeth, Bangalore-53	1,2,4, to 7 10,32,33	Nagalpura Tq. Deodurga District - Raichur	90.00 (36.45)
32.	Srishyla Granite No. 37/1, Aga Abbas Ali Road, Bangalore - 42	109	Annigere Tq. Channapatna District - Bangalore	36.00 (14.58)
33.	Anand Granites, No. 37/1, Aga Abbas Ali Road, Bangalore - 42	308	Gajjagerekuppa, Tq. Magadi District - Bangalore	24.00 (9.72)
34.	Muddeereswara Mining Industries 147, V Main Road, Chamarajpet, Bangalore-18	67	Kannali Village, Tq. Khanapur	78.00 (31.59)
35.	Muddeereswara Mining Industries -do-	48	Hosadurga and Kanakpur Villages	45.00 (18.23)
36.	Bhovi Janangada Labour Contract S.S. Ltd., Yellammanapalya Tq. Anekal District - Bangalore	21	Veelagal Village Tq. Ron. District - Dharwar	25.00 (10.13)
37.	Bhovi Janangada Labour Contract S.S. Ltd., Yellammanapalya Tq. Anekal District - Bangalore	47	Veelagal Village Tq. Ron. District - Dharwar	25.00 (10.13)
38.	Bhovi Janangada Labour Contract S.S. Ltd., Yellammanapalya Tq. Anekal District - Bangalore	37	Veelagal Village Tq. Ron. District - Dharwar	15.00 (6.08)
39.	International Granite, No. 103, CHB Layout, Vijayanagar, District - Bangalore	94	Doddagulikere, Tq. Ramanagaram District - Bangalore	23.00 (9.32)
40.	Gomtesh Granites, Near Fort, O. B. Road, District - Belguam	48/7 and 8	Halageri Tq. Kustagi District - Raichur	100.00 (40.50)

Sl. No.	Name & Address of Lessee	Survey No.	Village & Taluk	Extent acres (Hectares)
41.	Brindavan Granites		Ganehal Tq. Ramanagram District - Bangalore	3.00 (1.22)
42.	Muniswamappa, 294, Rama Iyengar Road V. V. Puram, Bangalore-4	52	Gallaragalli Tq. Magadi District - Bangalore	2.20 (0.90)
43.	Muniswama, 99a 294, Rama Iyengar Road, V. V. Puram, Bangalore - 4	45 & 48	Gellaragalli Tq. Magadi District - Bangalore	15.30 (6.20)
44.	Galaxy Granites, No. 37/1, Åga Abbas Ali Road, Bangalore - 42	21 & 25	Maraladevarapur Tq. Magadi District - Bangalore	29.00 (11.75)
45.	K. L. Poddar & Sons (P) Ltd., No.2, Ali Askar Road, Bangalore - 51	82	Dammur Tq. Bellary	2.82 (1.15)
46.	Brindavan Granite, No. 37/1 Aga Abbas Ali Road, Bangalore - 42	220	Kolipura Tq. Ramanagaram	2.03 (0.83)
47.	Pratab Reddy, 3rd Cross, Gandhinagar, Bellary, District - Bangalore	919	Tekkalakatti Tq. Siruguppa District - Bangalore	10.00 (4.05)
48.	Mysore Minerals Limited, Mahatma Gandhi Road, Bangalore	45	Hosadurga, Tq. K. K. Pura District - Bangalore	41.21 (16.69)
49.	Hindu Hippen Rural Industries(P) Ltd., No.2 Ali Asker Road, Bangalore- 52	19	Maddarahalli, Tq. Ramanagaram, District - Bangalore	15.00 (6.08)
50.	Muddeereswara Mining Industries, No. 147, V th Main Road, Chamarajpet, Bangalore-18.	41	Hanumanal Village Tq. Hungund	3.00 (1.22)
51.	Muddeereswara Mining Industries, No. 147, V th Main Road, Chamarajpet, Bangalore-18.	41	Chikkodagali Tq. Hungund	5.00 (2.03)

Sl. No.	Name & Address of Lessee	Survey No.	Village & Taluk	Extent acres (Hectares)
52.	Muddeereswara Mining Industries, No. 147, V th Main Road, Chamarajpet, Bangalore-18.	204	Nittur Tq. Siruguppa	2.00 (0.81)
53.	N. S. Sasnur, Guddur, P. O. Hirekodahalli, Tq. Hungund District - Bijapur	80	Arasikere, Tq. Kappal District Raichur	47.20 (19.12)
54.	Mysore Minerals Limited, 39, Mahtma Gandhi Road, Bangalore	67,112 and 95	Kebballi Tq. V. V. Pura	26.00 (10.53)
55.	Shilpa Granite Prop: Shri S.S. Naina Galli. Indian Oil Dealers, Muddenhal	48/7&8	Huligeri Tq. Kustagi District Raichur	14.50 (5.88)
56.	International Granite India Ltd., No. 103, CHB Layout Vijaynagar, Bangalore	87	Arisandra, Tq. Ramanagar District - Bangalore	30.00 (12.15)
57.	Brindavan Granites, No. 37/B, Aga Abbas Ali Road, Bangalore - 42	36	Kempanahally, Tq. Ramanagaram District - Bangalore	24.00 (9.72)
58.	Kalpagam Granites	49	Dubbagattiga Tq. Magadi	8.00 (3.24)
59.	Bharat Timber & Construction Co.	296/1A	Balkundi, Tq. Hungund District - Bijapur	38.00 (15.39)
60.	Shivakrishna Enterprises, House of Lads, Sandur- 583119, District - Bellary	248 & 264 Tonasigere	Tq. Sandur District - Sandur	50.00 (20.25)
61.	Mysore Minerals Limited, Mahatma Gandhi Road, Bangalore	50 & 166	Yadawaranahalli & Malimanahalli Village Tq. Kanakapura	32.00 (12.96)
62.	Mysore Minerals Limited, Mahatma Gandhi Road, Bangalore	109	Malimanahalli Tq. Kanakapura	33.20 (13.45)

Sl. No.	Name & Address of Lessee	Survey No.	Village & Taluk	Extent acres (Hectares)
63.	Mysore Minerals Limited, Mahatma Gandhi Road, Bangalore	283 & 329	Malimanahalli Tq. Kanakapura	14.30 (5.80)
64.	Mysore Minerals Limited, Mahatma Gandhi Road, Bangalore	42&67	Nidagal, Kebbehally, Tq. Kanakapura	25.20 (10.21)
65.	Mysore Minerals Limited, Mahatma Gandhi Road, Bangalore	15	Sankalapur Tq. Hungund	20.16 (8.17)
66.	Mysore Minerals Limited, Mahatma Gandhi Road, Bangalore	63	Ilakal Tq. Hungund	33.10 (13.41)
67.	K. S. Jithendra Swamy	108 & 74	Balekatte Tq. Magadi	1.10 (0.45)
68.	Maheswari Enterprises	27	Mata, Tq. Magadi	8.00 (3.24)

ANNEXURE II B

KARNATAKA Quarry Leases Sanctioned For Black Granite

Sl. No.	Name & Address of Lessee	Survey No.	Village & Taluk	Extent acres (Hectares)
1.	Sri Krishna Murthy Rao, No.4267 Shastrinivas,Subramanyanagar,Bangalore-21	1 of Pannachi, Kollegal -	District Mysore	7.20 (2.92)
2.	Mysore Minerals Ltd., Mahatma Gandhi Road, Bangalore	53,55 57& 49 Kagalipura.	Tq. Chamarajnagar District Mysore	4.10 (1.66)
3.	-do-	248.148 of Melamalaand Jothi Gundanapura	Tq. C.R. Nagat District Mysore	28.20 (11.43)
4.	-do-	465,467. 455,466 part of Kotanawad.	-do-	9.20 (3.73)
5.	-do-	Part of 501,504, 584& 586 of Kotalawadi.	-do-	3.20 (1.3)
6.	-do-	Part of 238,247,245,248, 249 of Kotalawadi.	-do-	10.30 (4.18)
7.	-do-	86 of Jyothi-Gundanapura	-do-	6.00 (2.43)
8.	-do-	88 and 83 Jyothi Gundanapura	-do-	5.30 (2.15)
9.	-do-	117 & 118 Yadapura	-do-	15.00 (6.08)
10.	-do-	173,39 of Kadahalli & Kiragesur	-do-	4.00 (1.62)
11.	-do-	Kadahalli & Masagapura	-do-	15.00 (6.08)

Sl. No.	Name & Address of Lessee	Survey No.	Village & Taluk	Extent acres (Hectares)
12.	Mysore Mineral Ltd.		-do-	6.00 (2.43)
13.	-do-	Koragasur Kodahalli Masakapura	-do-	8.00 (3.24)
14.	-do-	235,236,240, 272,271,251 of Terakabi	Tq. Gundulapet District Mysore	7.00 (2.84)
15.	-do-	96 Ponachi Kollegela	Tq. C.R.Nagar District Mysore	2.20 (0.90)
16.	-do-	96/B of Ponnachi	Tq. Kollegal Tq. District Mysore	11.32 (4.59)
17.	-do-	29 of Mallaianapura	Tq. C.R.Nagar District Mysore	8.00 (3.24)
18.	-do-	135 of Ponnachi	-do-	2.00 (0.81)
19.	-do-	96/A Ponnachi	-do-	2.00 (0.81)
20.	-do-	-do-	-do-	5.00 (2.03)
21.	-do-	104&112 Part Shivapura, Vadapura, Tq. Chamarajapura		28.20 (11.43)
22.	-do-	29 of Mallainapura.		2.20 (0.90)
23.	-do-	75 of Kolagundanahalli, Tq. Kanakapura		14.20 (5.76)
24.	Sri M. Subbanna, C/oPatel Madappa Aralikatte, Chamarajnagar, Mysore	124 & 127 of Tq. Heleyur Kollegal	District Mysore	8.05 (3.26)

ANNEXURE IIC

KARNATAKA Quarry Leases Sanctioned For Grey Granite

Sl. No.	Name & Address of Lessee	Survey No.	Village & Taluk	Extent in acres (Hectares)
1.	Sri D.S. Suryanarayana Managing Partner of Surya Enterprises, No.11, Venkateshwara Building, 7/D Sanki Road, Bangalore	Holakallu and Madakanahalli	Tq. Sira District Tumkur	51.20 (20.74)
2.	Deepaka Trading Co., No.2,Ist 'R' Block, Rajajinagar, Bangalore-10.	31 & 88 of Surappahalli Kallahalli	Tq. Chintamani District Kolar	2.36 (0.96)
3.	Evershine Granite, P.B.No.409, Kupam-517 425	81 of Alahalli	Bangalore, District South Bangalore	0.20 (0.09)
4.	Smt. Nirmala S. Acharya, 45,Out House, 5th Main, Ch.Pet, Bangalore-18.	49(part) Hosadurga	Tq. Kanakapura District Bangalore	53.00 (21.47)
5.	G. S. Basavaraja	50 of Hosadurga	K.K.Pura	62.00 (25.11)
6.	Satish Mines & Indusatries No. 45, Dr.Subramayanagar, Mettur Dam,Salem Dist.	31&53 of Gajarahalli	Tq. Sira District Tumkur	4.00 (1.62)
7.	P.R.Exports, No.648, Ist Main, Ist Stage, Indiranagar, Bangalore.	2 of Uttamahalli	Tq. Chinnapatna District Bangalore	8.00 (3.24)
8.	Galeny Enterprises, No.174, 5th Cross, Gandhinagar, Bangalore.	22 and 34 of Bachapanahalli	Tq. Chintamani District Kolar	7.00 (2.84)
9.	Granite India (P) Ltd., No. 32/60, II Main, Ist Stage, Indiranagar, Bangalore-38.	15 of Holakally	Tq. Sira District Tumkur	3.00 (1.22)

Sl. No.	Name & Address of Lessee	Survey No.	Village & Taluk	Extent in acres (Hectares)
34.	Vijaya Granite Ltd., 1-A (1), Nehru Street, Tirupur-622601.	31 and 188 of Surappanahalli and Kollahalli	Tq. Chintamani District Kolar	5.00 (2.03)
35.	Shri. Ramakrishna, No. 38, Pramananda Road, Frazer Town, Bangalore-5.	31 of Surappanahalli	Tq. Chintamani Kolar Dist.	1.20 (0.49)
36.	Trubo Shilpa Exports, 1st Cross Road, Gandhinagar, Bangalore-3.	395 of Varalupadi	Tq. Karkala District S. K.	1.00 (0.405)
37.	Agarwal Investment Co. (p) Ltd., No. 2 Ali Asker Rd, Bangalore-52.	12, Madakanahalli	Tq. Sira District Tumkur	12.00 (4.86)
38.	Madakanahalli Stone Cutters, Co. op. Society Ltd, Mudakanahalli, Tumkur.	12, Madakanahalli	Tq. Sira	9.00 (3.65)
39.	Agarwal Investment Co. Ltd., No. 2, Ali Asker Rd., Bangalore-2.	No. 18 (Part) Holakallu	Tq. Sira Tq. District Tumkur	4.24 (1.72)
40.	N. S. Sasnur, Gadag Road, Koppal-21, Tq. Koppal, District Raichur	94 (Part) Hirehenakal	Tq. Gungavathi District Raichur	4.00 (1.62)
41.	R. V. Prama, No. 10, South Avenue, Srinagar Colony, Saidapet, Madras-15.	89 of Kothapete	Tq. Srinivasapura District Kolar	2.00 (0.81)
42.	G. Rajana	186 Santhekalihalli	Tq. Chintamani District Kolar	0.30 (0.13)
43.	Balaji Granites	1, Kallahalli	Tq. Chintamani District Kolar	3.00 (1.22)
44.	Seema Enterprises, No. 14, Aga Abdulla Road, Richmond Town, Bangalore-25.	174 of Santhekallahalli	Tq. Chintamani District Kolar	0.20 (0.09)
45.	Vijaya Granites Ltd., No. 1A (I), Nehru Street, Tirupur-1	178 of Santhekallahalli	Tq. Chintamani District Kolar	1.24 (0.51)

Sl. No.	Name & Address of Lessee	Survey No.	Village & Taluk	Extent in acres (Hectares)
46.	Brindavan Granites, Prop: B. K. Chandrashekar Sing, No. 37/1, Aga Abbas Ali Road, Bangalore-42.	58 and 19 Bhimakanahalli	Tq. Hoskote District Bangalore	2.00 (0.89)
47.	Shamalasha Giridhari Minerals Co., Near Electrical Grid, Behind R.T.O. Weigh Bridge, Karwar Road, Hubli.	12, Madakanahalli	Tq. Sira District Tumkur	1.20 (0.49)
48.	Sabari Granite	15 of Holakallu	Tq. Sira District Tumkur	3.00 (1.22)
49.	Foremost Granite Exports	218	Tq. Chintamani, District Kolar	2.00 (0.81)
50.	S. B. Mathure No. 3555, 3rd Cross, Belgam.	20 of Tq. Kirubannakalli Chitradurga		1.00 (0.405)
51.	D. Tataji Rao, Ayodhya P. O., District Ranchi	1630 of Samaligpur Tq. Sindhamir		2.00 (0.81)
52.	Kathre Granite, Hakal -25, District Bijapur	402/2 of Mudgal Tq. Lingsor		5.00 (2.03)
53.	Kamith Granite, 3/681, Nilaya, Bidar.	50 Guddahalli Tq. Malakalmur		2.00 (0.81)
54.	Hanmthappa, Tq. Sira District Tumkur	24 of Holakalhr Tq. Sira		0.20 (0.09)
55.	K. B. Manjurathswamy, Zilla Parishad member, H. No. 1948/296, 3rd Main, 9th Cross, Davangara.	50 of Guddahalli Tq. Molakalamura		1.00 (0.405)
56.	Vajaya Granite, Penalri K. Sanumutta, District Kolar	31 Surappanahalli Tq. Chintamani		2.00 (0.81)
57.	B. Ganganna, S/o Dasegunda, Tq. Chinklamalanalli District Tumkur	26 of Maddakanahally Tq. Sira		3.20 (1.30)

ANNEXURE - III

List of Granite Lessees in Rajasthan

Sl. No.	Name & Address of Lessee	Village	Area (In sq. m.)
Ajmer District			
1.	Shri Govind Singh Thada/ Shri Mulchand Thada, Village - Kalegara Via Pisagaon, Dist. - Ajmer	Kanpura, Tah. Byawar	10,000
2.	Smt. Hazara Begum, wife of Shri Afdul Rehman Chowdhary, Garavati Road, Makrana, Nagaur	Harmada, Tah. Kishangarh	5,750
3.	Shri Hariprasad Soni/ Hanumanprasad Soni, Ringas Tah. Madhopur, Dist. Sikar	Buharu, Tah. Kishangarh	10,000
4.	Shri Mahendrakumar Mithal Shri Rameshwardayal, 30, Shri Rampura Colony, Civil Lines, Jaipur.	Kanpura, Tah. Byawar	10,000
5.	Nirmal Minerals Pvt. Ltd.; R-12, Sachdeva Road, C-Scheme, Jaipur	Kanpura, Tah. Baywar	10,000
6.	Shri Sureshchand Aggrawal Mohanlal Aggrawal Post Ninka Thana, Dist. Sikar	Harmada Tah. Kishangarh	10,000
Dungarpur District			
1.	Vinodkumar Sankhala/ Himmatlal Sankhala Prof. Gyan Granite(India) 68, Sankhala Bhavan, Bhilwara	Rangarh, Tah. Arasur	14,000

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Ajmer District			
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3.	Shri Hariprasad Soni/ Hanumanprasad Soni, Ringas Tah. Madhopur, Dist. Sikar	Buharu, Tah. Kishangarh	10,000
4.	Shri Mahendrakumar Mithal Shri Rameshwardayal, 30, Shri Rampura Colony, Civil Lines, Jaipur.	Kanpura, Tah. Byawar	10,000
5.	Nirmal Minerals Pvt. Ltd.; R-12, Sachdeva Road, C-Scheme, Jaipur	Kanpura, Tah. Baywar	10,000
6.	Shri Sureshchand Aggrawal Mohanlal Aggrawal Post Ninka Thana, Dist. Sikar	Harmada Tah. Kishangarh	10,000
Dungarpur District			
1.	Vinodkumar Sankhala/ Himmatlal Sankhala Prof. Gyan Granite(India) 68, Sankhala Bhavan, Bhilwara	Ramgarh, Tah. Arasur	14,000

Sl. No.	Name & Address of lessee	Village	Area (In sq. m.)
Bhilwara District			
1.	Shri Dinesh Kumar/ Shri Shivlal Maheshwari, Kota, Tah.-Raipur, Bhilwara	Kota, Tah. Raipur	10,000
Chittorgarh District			
1.	Shri Rakesh Kumar Kothari Shri Ranvir Singh, 32, Kanwarpada Marg, Ninigali, Udaipur, Present Address: Lucky Investment, Near Ladha Clinic, Miranagari, Chittorgarh.	Dhuwalia, Tah. Sangrar	5,000
Barmer District			
1.	Mineral Oriental Ltd. 2, R. N. Mukherjee Road, Calcutta	Makalsara	10,000
2.	Shri Vimalchand Jain, Khudala Tq. Bali, Dist. Pali	Makalsara	10,000
3.	Shri Vimalchand Jain, Khudala Tq. Bali, Dist. Pali	Makalsara	10,000
4.	Shri Ashok Kumar Singhwi/ S. M. Singhwi, 176, Bhupalpura, Udaipur	Ladaradi	10,000
5.	Shri Raikumar Babel/ S. M. Singhwi, A-36 Ind State Khalna, Pali	Mokalsar, Tah. Siwana	10,000
6.	Shri Indrachand Amnavat, Khudala, Tah. Bali, Dist. Pali	Ladaradi, Tah. Siwana	10,000
7.	Shri Bhoopat Ram Soni, Lalwanis Area, Siwana	Ramnia, Tah. Siwana	10,000
8.	Sanjeev Choudhari, Shri Ram Granite, Jallore	Ramnia, Tah. Siwana	10,000

(Source : Directorate of Mining & Geology, Udaipur, Rajasthan)

25. National Granite Industry,
3, Bederhalli, Magadi Road,
Bangalore.
26. Oriental Select Granite (P) Ltd.,
32/60, II Main Road, Vyalikaval,
Bangalore.
Phone: 365329, Gram: ESGRANITE
27. Prasad Granites,
7th Mile Stone, Magadi Road, Yashvanthpur,
Bangalore.
28. Radhakrishna Granites,
Sarakki,
Bangalore.
29. Royal Granite Art,
12-A, 9th Cross, I Phase, Sarakki,
J. P. Nagar,
Bangalore.
30. S. G. Ankolekar,
Kargil,
Ankola.
31. Shamalsha Girdhari,
P. B. No. 47, Bowle's Compound,
Karwar Road,
Hubli.
32. Sheela Stone Polishing Company,
12/7, Lalbag Road,
Bangalore.
33. Shilpakala Enterprises,
Magadi Road,
Bangalore.
34. Shipla Shree Enterprises,
9th Mile Stone, Magadi Road,
Bangalore.
35. Srinivasa Granite Works,
9th Main Road, 5th Block,
Bangalore.
36. Sowia Granite Enterprises,
Vijayanagar, Opp. Kempson Factory,
Bangalore.
37. Stone Polishing Co.,
Wadi, Taluk Chittapur,
Dist. Gulbarga.
38. S. V. Exports Corpn.,
Magadi Road,
Bangalore.
39. Technical Think Tank Company,
Plot No. 1812, II Phase, Peenya,
Dist. Bangalore North.
40. Vimal Concerns,
701, Udyambag,
Bangalore.
- Rajasthan**
1. Rajasthan State Granites and Marbles Ltd.,
E 17/18, Industrial Area, Phase II, Basni,
Jodhpur.
2. Rajasthan State Mineral Development
Corporation Ltd.,
At & Post Jalore.
3. Bhavana Stones,
Stone Cutting and Polishing Unit,
Industrial Area, Basni,
Jodhpur.
- Tamil Nadu**
1. Anand Blue Metal Works,
Madras Trunk Road,
Eriyur.
2. Chola Granite Industries,
68, Cathedral Road,
Madras.
3. Enterprising Enterprises,
Madras-Bangalore Road,
Madras.
Phone : 69436

3. Balaji Granite,
Bheemakkanahalli, Taluk Hoskote,
Dist. Bangalore.
4. Bharat Granites,
1815/1, Vinayaka Bulding, Sampige Road,
Malleswaram,
Bangalore.
5. Bluestone Polishing Co.,
Wadi,
Dist Gulbarga.
6. Diamond Mounments,
Kanakapura Road,
Bangalore.
7. Granitisers,
50/1, Sarakki Layout, Kanakapura Road,
Bangalore.
8. Hind Nippon Rural Industries (P) Ltd.,
No. 2, Ali Askar Road,
Bangalore.
9. Indian Granite Arts,
Devasthan Road, Chamrajnagar,
Dist. Mysore.
10. Indian Furniture works,
7th Main Road, Srirampuram,
Bangalore.
11. International Granite,
Magadi road,
Bangalore.
12. Janaji Industries,
10th Cross, Magadi Road,
Bangalore.
13. Karnataka Stone Polishing Company,
Halavahalli,
Sedam
14. Kohinoor Granite,
Bangarpet,
Dist. Kolar.
15. Lime and Monuments,
5th Mile Stone, Magadi Road,
Bangalore
16. Shri Manjunatha Granite and Marble Industries,
C-47, Industrial Estate, Baikampadi,
Dist. South Kanara.
17. Manjunatha Granite Works,
No. 10th Main, 4 Block, Jaynagar,
Bangalore.
18. Mohan Art and Granite Industries,
Swarnakuppa, Kolar Gold Fields,
Dist. Kolar.
19. Mohan Granites,
Bangarpet - KGF Road, Bangarpet,
Dist. Kolar.
20. Mysore Granite Works,
Soregowdannakote, Bangarpet,
Dist. Kolar.
21. Mysore Granite and Marble Works,
Cottonpet,
Bangalore.
22. Mysore Minerals Ltd.,
Granite Processing Plant,
Industrial Estate,
Hassan.
(Karnataka)
23. Nalwar Stone Polishing Factory,
Nalwar, Taluk Chittapur,
Dist. Gulbarga.
24. Narayan Swamy & Sons,
South End Road, Basvangudi,
Bangalore.

ANNEXURE - V

Granite Processing Units - By States

Andhra Pradesh

1. Andhra Granites,
Lakshmipuram,
Kuppam,
Dist. Chittoor.
2. Diamond Granites,
Lakshmipuram,
Kuppam,
Dist. Chittoor.
3. Evershine Granites,
Lakshmipuram,
Kuppam,
Dist. Chittoor.
4. Indian Granite Art Corporation,
Lakshmipuram,
Kuppam,
Dist. Chittoor.
5. Indian Granite Ltd.,
Bangarupalayam,
Dist. Chittoor.
6. Jupiter Granites,
Lakshmipuram,
Kuppam,
Dist. Chittoor.
7. Kwality Monuments,
Lakshmipuram,
Kuppam,
Dist. Chittoor.
8. Paradise Granite Art Corporation,
Lakshmipuram,
Kuppam,
Dist. Chittoor.
9. Radhakrishna Granite Works,
Kuppam,
Dist. Chittoor.

10. Royal Granites,
Lakshmipuram,
Kuppam,
Dist. Chittoor.
11. South India Granite,
Lakshmipuram,
Kuppam,
Dist. Chittoor.
12. Superfine Granite Art Corporation,
Kuppam,
Dist. Chittoor.
13. United Granites,
Lakshmipuram,
Kuppam,
Dist. Chittoor.
14. V. C. Gurappa Granites,
Lakshmipuram,
Kuppam,
Dist. Chittoor.

Gujarat

1. Tirupati Granite (P) Ltd.,
(Blockcutting- Polishing- Champering-
Machine)
Godhra - Halol Highway,
Village - Meghsar, Taluk - Halol,
Dist. Panch Mahals.

Karnataka

1. All India Granite Works,
223, III Block, Rajajinagar,
Bangalore.
2. Almin Rock Indescer Fabric,
11th Main Road, Malleswaram,
Bangalore.

43. Norton Granites (P) Ltd.,
72, Maddox Street,
Choolai,
Madras.
Phone : 32272/432731

West Bengal

1. West Bengal Mineral Development
Corpn. Ltd.
13, Lindsay Street (2nd Floor.),
Purulia (West Bengal).

4. Gem Granites,
146, Injambakkama,
Madras.
Phone: 47985
5. Golden Rock Granites,
64 Car Street, Anthigus,
Dist. Coimbatore.
6. Government Polishing Unit,
Department of Industries and Commerce,
Krishnagiri,
Dist. Dharmapuri.
7. Granite India (P) Ltd.,
Kalipettai, Taluk Harur,
Dist. Dharmapuri.
8. Hindusthan Monumental Works,
1-4, Industrial Estate, Krishnagiri,
Dist. Dharmapuri.
9. Kosar Mining & Polishing Industrial Company,
1-2, Industrial Estate,
Krishnagiri,
Dist. Dharmapuri.
10. Komedham Polishing Works
Mylandi,
Dist. Kanyakumari.
11. Lee Granite Polishing Unit,
Narayanswami Pillai Street, Uddyar Palayam,
Attur,
Dist. Salam.
12. Moon Rock & Marble Co.,
Industrial Estate,
Krishnagiri,
Dist. Dharmapuri.
13. Mylandi Stone Workers Co-operative Cottage
Industrial Society,
Mylandi,
Dist. Kanyakumari.
14. Pallava Granite Industries,
68, Cathedral Road,
Madras.
15. Premier Enterprises
'Thiruveragam', 19 (B 65/A), 48th st.reet,
Ashoknagar,
Madras.
16. Prince Polishing Industry,
Mylandi,
Dist. Kanyakumari.
17. Rainbow Granite Polishing Enterprises,
114, S. K. Road,
Ambur,
Dsit. North Arcot.
18. Regal Granite and Stone Works,
55, Mohammedpura, II Street,
Ambur,
Dist. North Arcot.
19. Samarth Industries,
124, Erivakkam, Kanchipuram,
Dist Chinglepet.
20. Shakli Enterprises,
Kamrajnagar Road, Attur,
Dist. Salem.
21. Shanmugham Industries,
73, Seda Street
Triuvannamalai.
22. Shri Balaji Minerals,
1-A Droupati Ammankoil, Valachery,
VI Street, Lakshmipuram,
Madras.
23. Srimeenambigai Industrial Works,
11, Veerappan Street,
Palur,
Dist. North Arcot.

24. Tamil Nadu Minerals Limited,
9, Habibullah Avenue, Anderson Road,
Madras.
25. Tamil Nadu Small Industries Ltd.,
No. 4, Whites Road,
Madras.
26. Thirumalai Granite Polishing Unit,
94/1. Thandrapet, Taluk Changam,
Dist. North Arcot.
27. Vijay Mines and Minerals,
Annupparpalayam, Nerinjipet, Post Tiruppur,
Taluk Bhavani,
Dist. Coimbatore.
28. V. S. Stone Crushing Industries,
63, Arcot Road, Rangapuram Sethuvachari,
Vellore.

ANNEXURE - VI

List of 100% Export Oriented Units of the Granites in Karnataka State

Sl No.	Name and Address of the Unit	Item of Manufacture	Location
1.	Prithvi Granite Export (P) Ltd., Industrial Suburb, Bangalore-22	Cut & Polished Granites	Bommasandra Industrial area, Bangalore.
2.	Mysore Minerals Ltd., MG Road, Bangalore.	- do -	Hassan
3.	Formost Granite Export (P) Ltd., No-23, Gopinivas Richmond Road, Bangalore-75.	- do -	Anekal Tq. Bangalore.
4.	Chamundi Granites (P) Ltd. Bommasandra Industrial area,	- do -	Bommasandra Industrial area, Bangalore.
5.	Sabari Granite (P) Ltd., No-55, 1st Cross, Residency Road, Bangalore-25.	- do -	Doddaballapur Industrial area,
6.	K. Subbaiah Shetty Skanda Granite (P) Ltd., Bangalore.	- do -	Anekal Bangalore.
7.	Kesar Marble Granites Limited, 403, Devatha Plaza, 4th Floor, 131/132, Residency Road, Bangalore.	- do -	Hebbal.
8.	Sudhir S. Gupta, MMV Continental Enterprises, Bangalore.		
9.	Bhuilal (P) Ltd., Bangalore.	Granite Tiles	Bangalore.
10.	Indian Furniture Works, 1175/32, 4th Cross, Srirampuram, Bangalore.	Polished Granite Slabs.	Bangalore.

Sl No.	Name and Address of the unit	Item of Manufacture	Location
11.	Mysore Rock Mill (P) Ltd., Basavanhalli, Mysore.	- do -	Mysore.
12.	Natural Stone Tiles (P) Ltd., 19th, 4th Cross Road, Malleswaram, Bangalore.	Granite Tiles, Monuments etc.,	Tamaka Industrial area, Kolar.
13.	Prasanth Alinrels Export (P) Ltd., 3C, Shah Jeevan Apartments, 219 RMV Extension, Bangalore.	Slabs Monuments of Granitres	Anekal, Bangalore.
14.	Orient Select Granite (P) Ltd., 32/60 II Main Road, Bangalore	Granites	Bangalore, Tq. North

ANNEXURE - VII

Proposed 100% Export Oriented Units for Manufacturing of Granites Polished Products In Tamilnadu

Sl. No (1)	Name, Address and Location (2)	Investment in Rs.	Power /Employment. (3)
1)	Vijay Granites (P) Ltd., Tiruppur Location : Vanur Village, Tindivanam. Taluk, South Arcot District.	Inv. Power. Empt.	200 KW 330 Persons.
2)	Suraj Granite Industries (P) Ltd., 612, Raheja Chambers, Nariman Point, Bombay, Location : Kalpakkam, Chingleput District.	Inv. Power Empt.	325.95 lakhs 400 KW 120 Persons.
3)	The Coromandel Engineering Co., Ltd., Tiam House Annexe, Madras-1. Location : Ponneri Taluk, Chingleput Dist	Inv. Power Empt.	285.70 lakhs 400 KW 140 persons.
4)	Gem Granites, 58, Cathedral Road, Madras- 86. Location : Injambakkam, Saidapet Taluk.	Inv. Power Addl Empt.	300 lakhs 2000 KW 16 persons.
5)	Shanmugha Industries, Nilankarai Village, Nallavanpalayam Post., Tiruvannamalai. Location : Tiruvannamalai.	Inv. Empt.	1,38,48,000 275 persons.
6)	Aro Granite Industries (P) Ltd., M.66- Gratekkarkash. Part II, M.Block Market, New Delhi. Location : Hosur. Dharmapuri Dist.	Inv. Power Empt.	290 lakhs 650 KW 75 persons.
7)	Jayjee Exporters (P) Ltd. Location :	Empt.	35 persons.
8)	East India Granite Industries 63, Arunachala Asari Street, Salem -1. Location : Soorapalli Village, Jalakandapur, Mattur Taluk.		

(1)	(2)		(3)
9)	Emmersen Exports (P) Ltd., 83, Sir C. P. Ramasamy Iyer Road, Alwarpet, Madras 18. Location : Ekattur. Saidapet.	Inv. Power Empt.	119.50 lakhs 250 KW 60 persons.
10)	Thiru Y. Ravikumar, 1-10, 123/1 Ashok Nagar, Hyderabad -20.	Inv. Power Empt.	540.50 lakhs 1044 KW 131 persons.
11)	Wonder Technoart Centre (P) Ltd., 48. 12th avenue, Ashok Nagar, Madras-83. Location : Thirukazukundram Taluk Chingleput Dist.	Inv. Power Empt.	67.50 lakhs 100 KW 85 persons.
12)	Aarvee Granite Industries (P) Ltd., 10, South Avenue, Srinagar Colony, Madras-15. Location : Madurantagam Taluk.	Inv. Power. Empt.	202.38 lakhs 225 Kw 330 persons.
13)	Jay Granites, 12, VI Main road, Kasthuribai Nagar, Adyar, Madras-20.	Inv. Power Empt.	143.96 lakhs 140 Kw 330 persons
14)	K. V. Thangabalu, Prop. Karthic Granites, Ashok Nagar, Madras-18. Location : Hosur Taluk, Dharmapuri Dist.	Inv. Power Empt.	143.96 lakhs 140 KW 330 persons.
15)	Mylam Granites, 3, T.T.P. Staff Quarters, Anupparpalayam, Tirupur Location : Kolambakkam Village, Madurantagam Taluk, Chingleput Dist.	Inv. Power Empt.	142.25 lakhs 200 KW 330 persons
16)	King Granites (P) Ltd., D. 7, Parson Flats, 204, Mowbrays Road, Madras-18. Location : Madurantagam Taluk.	Inv. Power Empt.	143.96 lakhs 140 KW 330 persons.
17)	Galaxy Enterprises, 59, Cathedral Road, Madras- 86. Location :	Inv. Power Empt.	290 lakhs 1500 KW 48 persons.
18)	Mrs. Vidya Reddy, 1-68/1 Anna Nagar. Location : Gummidipoondi.	Inv. Power Empt.	330 lakhs 250 KW 150 persons.
19.	M/s Brite Granitise (P) Ltd., D.5, Second Floor, TRB Complex 22, First Avenue, Ashok Nagar, Madras-83. Location: Tindivanam Taluk.	Inv. Power Empt.	324 lakhs 550KW 236 persons.

(1)	(2)	(3)	
20.	Thiru Vijaya D. Paul, 771, 9th Street, Syndicate Bank Colony, Anna Nagar (West), Madras-10. Location: Ponneri, Chingleput Dist.	Inv.	25.38 lakhs
		Power	130 KW
		Empt.	41 persons
21.	Monumarx Granites (P) Ltd., 771-9th Street, Syndicate Bank Colony, Anna Nagar (West), Madras-10. Location: Ponneri Taluk, Chingleput Dist.	Inv.	79.59 lakhs
		Power	220 KW
		Empt.	60 persons
22.	Darg Instone Indl. Co. Ltd., 37, First Floor, Jayalakshmpuram Nungambakkam, Madras-34. Location: Sriperumbudur Taluk, Chingleput Dist.		
23.	Thiru Adishesan. Sri Vidya Granites Tile Exports (P) Ltd. B. 8, Grasmene Apartment, 51-58. V. Stone road, Bangalore. Location: Sulagare, Hosur Taluk.	Inv.	330 lakhs
		Power	475 KW
		Empt.	80 persons
24.	Amarjothi Granites (India) (P) Ltd., 157, Kumaran Road, Tiruppur.	Inv.	218 lakhs
		Power	276 KW
		Empt.	78 persons
25.	Eastern King Granites (P) Ltd. 1289-32-8 Cross 4th Block, JayaNagar, Bangalore. Location: Krishnagiri Taluk.	Inv.	180 lakhs
		Power	230 KW
		Empt.	82 persons
26.	Royal Rocks (P) Ltd., 176, Bhavani Main Road, Erode. Location: Madurantagam Taluk, Chingleput Dist.	Inv.	217.20 lakhs
		Power	400 KVA
		Empt.	72 persons
27.	Pallava Minerals Ltd., 12, Basker Ahmed Road, Alwarpet, Madras-18. Location: South Arcot Dist. OR Chingleput Dist.	inv.	867.60 lakhs
		Power	1000 KW
		Empt.	351 person

(1)	(2)	(3)
28.	Thiru Durai Babu 67 a, Rue Candappa Mudali Street, Pondicherry-1. Location: Panaiyur Village, Madurantagam Taluk.	Inv. 181.37 lakhs Power 110 KW Empt. 40 persons
29.	Mukunda Shilashilpa (P) Ltd., 101, Hoyasala Apartments, 8, Cuningham Crescent, Bangalore. Location: Chengam Taluk.	Inv. 217.20 lakhs Power 400 KW Empt. 72 persons
30.	D.P. Rock Decar, 8/57, Mettupalayam Road, G.N. Mills Post, Coimbatore-9.	Inv. 31.25 lakhs Power 90KW Empt. 22 persons
31.	Sigma Granites Ltd., 61, Monteith Road, Madras -8 Location : Madurantagam Taluk Chingleput Dist.	Inv 289.85 lakhs Power 1200 KW Empt 40 persons.
32.	Southern Granites (P) Ltd., 2D, Kasturi Appartments, J. P. Avenue, Dr. Radhakrishna Road, Madras- 4 Location : Kurnam Village, Chingleput Dist.	Inv 16.6 lakhs Power 250 KW Empt. 198 persons
33.	Tokai Kanco Export Co. Ltd., 187, Reyapettah High Road, Madras-4. Location: Oggium Thuraipakkam Chingle put Dist.	Inv. 21.5 lakhs power 85 Kw Empt. 16 persons
34.	Emerald Granites Exporters (P) Ltd., 128, Bhavani Road, Erode-4. Location : Urachik kottai Village Periyar Dist.	Inv. 312.53 lakhs Power 400 Kw Empt. 146 persons
35.	Thiru V. Srinivasan, 13, Thiruchendur Flats, 1A, Babu Rajendra Prasad Road, West Mambalam, Madras - 33 Location : Maraimalai Nagar	Inv. 70 lakhs Power 210 KW Empt. 65 persons

ANNEXURE - IX

Some Foreign Manufacturers of Granite Processing Machinery

1. F. Lli Mordenti
P. O. Box 292-19100 La Spezia-Italy.
Telex 281041 Modem

*Represented In India by
Somani International Corpn..
1510 Maker Chambers, Nariman Point
Bombay - 400021.
Phone: 223543
2. Carl Meyer Gmbh & Co-kg
Postfach 380,
D-8590 Marktredwitz,
West Germany.

*Represented in India by
Greaves Cotton & Co. Ltd.,
1 Dr. V. B. Gandhi Marg,
P. B. No : 91,
Bombay - 400023.
Phone: 271524.
3. Eisenwerk Hensel Bayreuth
P. O. Box 5020, Rathenaustrasse 47,
D-8580 Bayreuth 13,
Federal Republic of Germany.
Telex 642823 ebutd

*Represented in India By
Bangalore Commercial Corporation,
6th Floor, Devatha Plaza,
131, Residency Road,
Bangalore - 560025.
Phone: 212143
4. Pellegrini Meccanica S. P. A.
Viabe delle Nazioni 8-37135
Verona/Italy.
Telex 480379 Pelmec I
5. Fickert Winterling Wolsaver Strasse 20
Postfach 166,
D-8590 Marktredwitz,
West Germany.

*Represented in India by
Mr. N. Ashokan,
4E Prof. Subramanian St. Kilpark,
Madras - 10.
Phone 661908 / 616335
6. Pedrini S. P. A. Via Fusine 1-24060
Carobb 10 Angeli Bergamo, Italy.
Telex 302182 Pedrini I.

*Represented in India by
Stono Machines & Castings Pvt. Ltd.,
13, Heavy Industrial Area,
Jodhpur - 342003.
7. Eisenwerk Eberstadt Adolf Riesterer
Postafach - 1
61, Darmstadt - Eberstadt,
West Germany.
8. Giorgini Maggi S. R. L.
55047, Seravezza,
Italy.
9. Tema S. P. A.
Casella Postale 239
54033, Carrara,
Italy.

10. 37034 Quinto Valpentena Verona,
Telex 480527 Brai
Italy.
11. Ditta Moria Bernucci
1-54033. Carrara,
Post Box 117,
Italy.
12. Anderson Grace Co. Ltd.,
Thomas Engineering Works Ltd.,
Carnostie (Scotland).
13. Alexander Wilson (Aberdeen) Ltd.,
Asgron Road,
Aberdeen (Scotland).
14. George Cassie and Sons Ltd.,
Mechanical & Electrical Engineers,
600 King Street,
Aberdeen (Scotland).
15. Flextol Engineering Co. Ltd.,
The Green Ending
London SW-5.
16. Jordan Shaoji Co. Ltd.,
Tokyo (Japan).
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Durability

Service life expectancy of stone.

Efflorescence

Surface encrustation, commonly powdery, sometimes found on the surface stone masonry, deposited by soluble salts carried through or on to the surface by moisture.

Expansion/Contraction joint

A joint between stone units designed to expand or contract with temperature change.

Fabric

Pattern of internal arrangement of the mineral components of a rock indicating its mode of formation.

Face

The exposed surface of stone on a building or structure, quarry face.

Fines

Powder, dust, and sand size material resulting from the processing of crushed stone.

Finish

Final surface applied to the face of stone during fabrication.

Flashing

Flexible impervious material, usually metallic, dressed over the intersection of two surfaces to make the junction watertight.

Float

Boulders or rocks which have become detached from their outcrops.

Gabbro

A plutonic rock mainly composed of plagioclase and pyroxene.

Gang Saw

A mechanical device for reducing stone block to slabs of pre-determined thickness. Also known as "frame saw".

Gloss

A shiny, lusturous finish.

Gneiss

A coarse-grained rock in which bands rich in granular minerals alternate with bands in which schistose minerals predominate.

Grain

- 1) The particles or crystals which comprise a rock or sediment.
- 2) A direction of splitting in rock.

Granite

A plutonic rock mainly comprising alkali feldspar and quartz, sodic plagioclase, usually oligoclase, is commonly present in small amounts and muscovite, biotite hornblende, or rarely, pyroxene, may be dark constituents. Sometimes applied commercially to all crystalline rocks of igneous origin such as true granite, diabase, dolerite, gabbro, gneiss, granodiorite, norite and syenite.

Granodiorite

A plutonic rock comprising quartz, calcic oligoclase or andesine and orthoclase. Biotite, hornblende, or rarely, pyroxene may be dark constituents.

Gritting

Smoothing by abrasion.

Grout

Mortar of pouring or pumping consistency.

Hardness

Resistance of substance to abrasion. Hardness in stone depends on degree of cohesion of grains and not only on hardness of mineral constituents.

Hone finish

A satin smooth surface finish with little or no gloss.

Igneous

Formed by solidification from a molten or partially molten state magma.

Joint

The space between installed stone units or between stone and adjoining material.

Jointing scheme

Architect's drawings detailing dimensions, locations and configuration of stone units and joints as related to the structure.

Liners

Structurally sound section of stone cemented and dowelled to the back of thin stone units to give greater strength, additional bearing surface, or to increase joint depth.

Masonry

An assembly of building units usually laid in mortar and so arranged as to be bonded together.

Mullion

A vertical masonry detail sub-dividing a window.

Norite

A variety of gabbro in which orthopyroxene is dominant over clinopyroxene.

Outcrop

Part of exposed bedrock or stratum.

Overburden

Material overlying useful rock.

Panel

Single unit of fabricated stone veneer.

Parging

Damp-proofing by applying a coat of mortar to the back of a stone.

Power

A single unit of fabricated stone for use as an exterior paving material.

Phenocryst

One of the relatively large and ordinarily conspicuous crystals of the earliest generation in porphyritic igneous rocks.

Plinth

The projecting base of a wall or column.

Plutonic

Igneous rocks which have crystallised at depth and thereby, as a rule, assumed coarse and holocrystalline textures of granitoid-type.

Polished Finish

A glossy surface which brings out the full colour and texture of the stone.

Porosity

The ratio of the total volume of interstices in a rock to its overall volume. It is usually expressed as a percentage.

Porphyry

Igneous rock containing phenocrysts in a fine-grained ground mass.

Quarry

A working where stone is extracted from the earth, generally from an open pit or hill side opening. But in the stone industry it may also include an underground extraction operation.

Quarry block

Generally, a rectangular piece of rough stone as it comes from the quarry, frequently scabbled (dressed) or sawed by wire for shipment.

Quarry sap

The moisture contained in newly quarried stone.

Rift

Direction of easiest splitting.

Rough sawn

A stone surface finish achieved by sawing.

Rubbles

Accumulation of loose angular stone fragments which may be used in the walls and foundations of buildings.

Sample

A piece of stone, usually of specified size, showing general range of marking and colour of a given variety of stone.

Sandblasted

A matt textured stone surface finish without gloss.

Scabbing

Removal of surface irregularities from stone blocks to provide the required size and shape for storage and shipment.

Schist

A foliated metamorphic rock with sub-parallel orientation of the micaceous minerals which dominate its composition and cause it to split readily

Sculpture

The work of sculpter in a three dimensional form, by cutting from a block of stone.

Sealant

An elastic adhesive compound used to seal stone veneer joints.

Sealing

Making a stone veneer joint watertight or leakproof with an elastic adhesive compound.

Seam

A plane of a stratum or bed at which the different layers are easily separated.

Sedimentary rocks

Rocks formed by the accumulation of sediments in water or from the air.

Shop drawing

A detailed fabrication and installation drawing showing dimension and methods of anchoring, usually prepared by stone manufacturer.

Sill

A horizontal unit of stone used at the base of an exterior opening in a structure.

Slab

A piece of stone cut from the quarry block.

- labbing**
Cutting or sawing into slabs.
- Smoothing**
Fine grind prior to polishing.
- Soffit**
The finished underside of a lintel beam vault, arch or overhead member.
- Soundness**
Describes relative freedom from cracks, faults and similar imperfections in an untreated stone.
- Spalling**
The breaking away of the surface of a building stone.
- Statuary**
Monumental, adaptable for carving and sculpting.
- Structure**
One of the large features of a rock, like bedding, flow-banding, jointing, cleavage, also the sum total of such features.
- Tectonics**
Pertaining to rock structure and external forms resulting from deformation of the earth's crust.
- Texture**
As applied to a stone surface means size, degree of uniformity and arrangement of constituent minerals.
- Vein**
A seam or thin, irregular body or mineral material different from the surrounding formation.
- Veneer**
A relatively thin facing of stone for buildings.
- Waxing**
The process of filling natural void in stone with cement, shellar or other materials.
- Weep holes**
An opening for drainage in veneer joints or in the structural components supporting the veneer.
- Wire saw**
A sawing device with one or more wire cables under tension, running over pulleys. Cut stone in blocks and slabs by abrasion using slurry of an abrasive and water.