CHAPTER VII

QUARTZITE AS DIMENSION STONE

Quartzite is a metamorphic equivalent of sandstone indurated through cementation by secondary silica or by recrystallization.

Quartzite which has been used for the first time as rubble in Kadana Reservoir Project, District Panchmahals has helped in saving valuable foreign exchange (Plate 7.1). In Gujarat quartzite occurs in districts of Panchmahals, Vadodara, Sabarkantha and Banaskantha (Fig. 7.1).

GEOLOGY

Geological setting of quartzite in Gujarat is as follows:

Erinpura Granite	Post-Delhi Intrusive
Ajabgarh series Alwar series (Quartzite)	Delhi system
- - - - - - - - - - - - - Unconformity - - - - - - - - - -	
Aravalli (including Champaner) Quartzite	Aravalli system
- - - - - - - - - - - - - Unconformity - - - - - - - - - -	
Banded Gneissic Complex	Archean

In Gujarat quartzites are of two geological ages occur viz. Aravalli (including Champaner) and Delhi. Quartzites of Aravalli system occur extensively in Panchmahals and Vadodara districts, while those of Delhi system occur extensively in Sabarkantha and Banaskantha districts.

DISTRIBUTION

In Panchmahals district the bands of the quartzite formation vary widely in size and extent from small

intercalatory ribbons measuring not more than few cms in thickness to massive belts measuring more than 600 mts across.

Joint planes in quartzites are often marked by veins of white quartz, occasionally containing irregular sheaves and booklets of white mica. Most of the hill ranges of Panchmahals district except in some parts of Godhra, Dohad and Devgadhbaria talukas, are of quartzite. The quartzites associated with the phyllites and schists, from their superior hardness, withstand weathering to a greater extent and thus at places form steep narrow ridges. Attitude of formation is NNE-SSW with vertical or steep dip towards WSW. Such ridges are seen in Devgadh Baria, Lunawada, Kadana and Santrampur areas. The quartzites are generally grey and light pink in colour and fine grained. At present quartzite is being quarried at Kadana, Shehra, Kothamba and Delwada. Flaggy quartzite occurs at Veganagar near Jambughoda. In Vadodara district the long narrow ridges of quartzite from Panchmahals occur near Kadwal and Rustampura. These quartzites occur in same way as those in Panchmahals district.

There are two formation of quartzites in Sabarkantha district. Quartzites occurring upto river Hatmati belong to

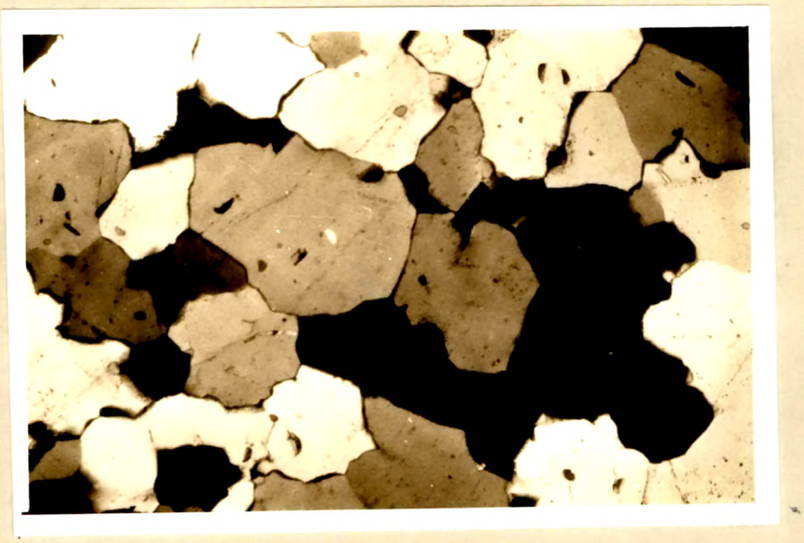

Plate 7.2: Photomicrograph showing compact and equigranular texture in Quartzite. (Crossed Nicols, X50)

Plate 7.3: Flaggy quartzite quarry, Veganagar, Panchmahals district.

Aravalli system while those occurring above river Hatmati belong to Alwar series of Delhi system. Aravalli quartzite ridges extended beyond Panchmahals district. They occur around Shamlaji, Malpur, Meghraj, Modasa and Bhetali.

Alwar quartzites are generally monotonous in their uniformity and form chains of small hill ranges. They are mainly exposed near Harnav river, Vasai, Jamla, Chithoda, Bhiloda and Atarsumba. These quartzites are harsh and rough in texture and break up into smaller and more irregular fragments than the Aravallis.

There is only one hill range at Malana where Alwar quartzite occurs in Banaskantha district. The nature of occurrence is similar to that of Alwar quartzites of Sabarkantha district.

PROPERTIES

Aravalli quartzite is well crystallised, fine grained grey to pinkish in colour. It is compact and equigranular in texture (Plate 7.2). It is essentially composed of quartz. These rocks are hard but jointed and brittle. The joint planes are often coated with iron oxide generally known as staining.

Alwar quartzite is rough in texture though it is not coarse grained. These rocks are pinkish brown and greyish white in colour. These quartzites are also jointed and joints are coated with iron oxide. The Alwar quartzite breaks up into smaller and irregular fragments as compared to Aravallies quartzite which tend to form quadrangular block because of well developed joints. Alwar quartzites because of their fragmentary nature cannot be used as dimension stone.

Engineering properties of quartzite are given in Table 7.1. Aravalli quartzites are hard and show high compressive strength. According to Hawkes and Mellore (1970) this rock is classified as strong to very strong. Water absorption is very low (Table 7.1). These quartzites are brittle in nature and because of that large size rubble is not possible and quarry yield is very less. They are also not amenable to dressing hence they are useful only in uncoursed masonry work. Because of this it was not possible to use quartzite as Khandkies, in Kadana Irrigation Project.

The joint planes are stained with iron oxide due to percolation of water. During the construction of

Kadana dam doubt was expressed about the bonding of cement mortar with such stained smooth surface joint planes. The surface stained with iron oxide is reddish in colour. The stains were removed effectively by scrubbing the stained surface with iron brush and then washing it with water. Kulkarni and Shah (1975) proved that staining of iron oxide on joint planes of quartzite is not harmful to the bonding characteristics of mortar.

Flaggy quartzite available near Jambughoda, Panchmahals district in the form of slab is fine grained, well foliated and pinkish brown in colour (Plate 7.3). These slabs are used in the laboratories as tiles because there is no action of chemicals on this stone.

Micaceous quartzite available near Narukot is not useful as rubble because it contains flakes of mica which are deleterious in nature when reacts with water.

QUARRY METHOD

All the existing quarries of quartzite are shown in Fig. 7.1 and list of quarries is given in Table 7.2. All quarries of quartzite are approachable in all seasons

throughout the year by rough motorable road (Fig. 1.2).

There are two methods used for quarrying quartzite (1) Wedge method and (2) Drilling and blasting method.

Wedge Method: In this method of quarrying quartzite advantage of joint planes has been taken. This method is useful when only small quantity of rubble or block has to be quarried. In case of quartzite overburden is almost absent or if present it is only 10-15 cm. This overburden is removed with the help of shovels. Wedges are driven by hammer along joint planes and rock is separated from parent mass. In case of rubble, dressing is not much required. Dressing of blocks is done at quarry site with chisel and hammer. Blocks of only 30 cm$ cube are prepared for bridge piers. Rubble is normally weighing 25 to 80 kg in weight. Any face is not less than 25 cm. Quarry waste is normally used as road metal and crushed aggregates. Blocks and rubble are generally produced only on consumers demand. At some places joints are not open, in such cases quartzite is heated by burning fire wood, grass and then it is allowed to cool for several hours during which the joints become wide open.

Drilling and Blasting Method: This method is useful when large quantity of material is required. At Kadana

Plate 7.4: Quartzite quarry, Kadana Dam, Panchmahals district.

Plate 7.5: Quartzite Rubble carried by labourers from storage yard, Kadana Dam, Panchmahals district.

large quantity of rubble was required for construction of masonry dam. Quarry was opened in hill ridges near dam site. The quarry was opened from the top and on the eastern face of the hill i.e. against the dip direction to avoid overhangs, sliding etc. (Plate 7.4). Overburden in this case is about 1.5 to 6 m which was removed with the help of shovels or primary blasting. For quarrying of quartzite, the holes were drilled with air driven jack hammer. Gelatin 80% cartridge capped by detonators were used extensively for blasting. Sand or local soil was used as stemming. Firing was done by electric exploder or by ordinary method. The drilling in quartzite is very expensive because of greater hardness and resistance to abrasion of quartzite. The 31 to 34 mm size holes spaced at 1.2 to 1.8 m apart and 1.5 to 2.5 m deep were drilled by air driven jack hammer and filled with 0.3 to 0.4 kg of explosive. The advantage of joints are being taken while drilling holes. Once the rock mass was loosened by blasting blocks of rock were detached by wedging along joint planes. These were further broken with the help of big hammers to make the required size of rubble which can also be handled manually. Sometime secondary blasting was resorted to break large chunks of rocks thrown out during blasting. The rubble useful for masonry was loaded in trucks to carry from quarry site to

storage yard at dam site. Manual labour carry this stone from storage yard to site of construction with the help of sling of chain (Plate 7.5). On account of joints and brittle nature, the quartzite produces large quantity of smaller pieces in blasting. Quarry yield is about 50 to 60 per cent.

USES

Quartzite is mainly used as rubble in Kadana dam and Watrak dam. Quartzite blocks are used in bridge piers at some places.

Quartzite is brittle in nature hence many small size pieces are available after blasting. The rubble below 25 kg in weight is not useful for masonry and is to be used for pitching or in rock toe in earthen dam. The large size chunks of rock when blasted or broken to extract rubble, leave large quantity of rock spauls. These spauls are used to fill in the voids between large size rubble stones so as to attain dense masonry.

Quarry waste when used as road metal, good blindage or asphalt surface is necessary because quartzite breaks with sharp edges and do not get blunt. It can also be used as crushed aggregate for construction.

Table 7.1 : Engineering Properties of Quartzite

Sr. No.	Name of Quarry	Compressive strength kg/cm^2	Water Absorption %	Specific Gravity	Durability
		IS 1121: Part I - 1974	IS 1124-1974	IS 1124-1974	IS 1126-1974
1.	Malana (216)	907	0.29	2.73	-
2.	Dalwada (218)	1000	0.84	2.66	-
3.	Kadana (219)	1400-1760	0.2-0.36	2.55-2.65	0.16/30 cycle
4.	Narukot (221)	820-880	0.52	2.61	-
5.	Shehra (223)	1826-2020	0.14-0.32	2.60-2.64	0.15/30 cycle
6.	Vaghodia (227)	950	0.22	2.55	-

Table 7.2 : List of Quartzite Quarries (Fig. 1.2 and 7.1).

District		Location
Banaskantha	(216)	Malana
Panchmahals	(217)	Baria
	(218)	Dalwada
	(219)	Kadana
	(220)	Kotha
	(221)	Narukot
	(222)	Panchwada
	(223)	Shehra
	(224)	Veganagar
Sabarkantha	(225)	Vavdi
	(226)	Watrak
Vadodara	(227)	Vaghodia

Plate 8.1 : Jain Temple of Dilwara (Mt. Abu) constructed with the help of Ambaji Marble.