

# “Jodhpur Sand Stone” – A Splendid Architectural Building Material

<sup>1</sup>Dr. Pulkit Gupta, <sup>2</sup>Ankit Laddha

<sup>1</sup>Assistant Professor, Department of Architecture and Town Planning, M.B.M. Engineering College, J.N.V. University, Jodhpur, Rajasthan, India

<sup>2</sup>Assistant Professor, Civil Engineering Department, Jodhpur Institute of Engineering & Technology, Jodhpur, Rajasthan, India

**Abstract—** Although the unsustainability of the human civilization has been recognized long ago, little has ever been done to change it. During the last century, materials use increased 8-fold and as a result Humanity currently uses almost 60 billion tons (Gt) of materials per year. The construction industry alone consumes more raw materials than any other economic activity. However, research on construction materials still is excessively focused on their mechanical properties with minor concerns regarding environmental considerations. In this paper we discuss about a major construction material that is stone, for this we choose one of most attractive and famous sand stone in Western Rajasthan “Jodhpur Sand Stone”. Sandstone is an extremely hard and tough material and consists of consolidated masses of sand deposited by moving water or by wind. Some of the sandstone is so homogeneous and soft that they are capable of receiving most elaborate carving and filigree work. The colour of the rock is largely determined by the cementing material - iron oxides produces red or reddish-brown sandstone, and the other materials produce sandstone in white, greyish or yellowish sandstone. Jodhpur sandstone is mostly used in monuments, important buildings and residential buildings. Jodhpur sand stone is also termed as "chittar patthar".

**Index Terms—** Sand Stone, Jodhpur Sand Stone.

## I. INTRODUCTION

Sandstone may be defined as a sedimentary stone made up of tiny grains of quartz and other minerals of fairly uniform size and often smooth and rounded. These grains are held together by a cementing material which may be siliceous or ferruginous. The toughness of sandstone depends mostly on the nature of this cementing material. Mostly sandstone is formed in oceans, lakes and rivers where tiny bits of rock and dirt settle to the bottom. Year after year, these layers of sand get buried under tons of more sand and dirt until it is turned into solid rock. Characteristics of sandstone is an extremely hard and tough material and consists of consolidated masses of sand deposited by moving water or wind. Some of the sandstones are so homogeneous and soft that they are capable of receiving most elaborate carving and filigree work. Color of sandstone can be found in many colors across different places. The color of the rock is largely determined by the cementing material: Iron oxides produces red or reddish-brown sandstone and the other materials produce sandstone in white, grayish or yellowish sandstone.

Rajasthan being the largest producer is an important sandstone producing state of India. It is an excellent building stone. This can be chiseled and dressed to a smooth surface in various attractive shapes. The sandstone has a verity of uses such as roofing, flooring, paving, paneling, beams, pillars, arches, doors and window sills, wall facing, fence posts, mile stones etc. It is especially useful for exterior cladding in sea shore buildings due to acid & thermal resistant properties. As such the effect of saline winds is negligible on sandstone. It is also suitable for use in chemical industries as flooring, wall fixing & lining due to its acid and alkali resistant properties. It is also suitable for carving and making windows and jallis. The sandstone is being quarried and used from centuries and a number of historical buildings and monuments such as Budhist Stupas of Sarnath, Red Fort, Sansad Bhawan, Rashtrapati Bhawan, and National Museum, Delhi; Chhitar Palace, Jodhpur etc. are made of sandstone.

## II. ABOUT JODHPUR SAND STONE

Rajasthan sandstone is mainly found in the main Vindhyan and Trans-Aravalli- Vidhyan sequence exposed in an area of about 34,000 sq. km. covering parts of Dholpur, Bharatpur, Karauli, Sawai Madhopur, Bundi, Jhalawar, Kota, Bhilwara, Chittaurgarh Jaisalmer and Baran districts in eastern Rajasthan and in scattered form in Jodhpur, Nagaur and Bikaner districts of western desert plain.

Jodhpur sand stone is also termed as “chittar patthar”. It is mostly used in monuments, beautiful buildings and houses. Natural Jodhpur Sandstone is believed to be the youngest of the quartz-based stones as each stone has a different level of porosity, hardness and compressive strength. Its texture is noteworthy and the medium sized grains are all of the same size. The color of sandstone is variable and depends upon the composition of the binding material and therefore it varies from Red, Brown, Pink, Greenish, Yellow, Gray and White. It is superior to other sandstones from other parts of India as well as globe in many ways.



Figure 1: Sand Stone

Some of its superior qualities are:

- Inherent aesthetic appeal
- Attractive appearance
- Least affected by air, sunshine, rain and extreme weather conditions.
- Do not require surface treatment due to high silica content
- Works almost like granite when used in cladding.
- Resistant to acid, alkali, salinity and thermal variance

For thousands of years Sandstone has been quarried from Jodhpur and used in construction. It can be seen in form of the archeological monuments and the cenotaphs built all around Jodhpur. Large scale quarrying was done in 14 century to build the most magnificent fort of India, the Mehrangarh Fort and the Grand Ummed Bhawan Place in Jodhpur. Due to its superior qualities it is exported to Canada, Japan and Middle East countries also. With the availability of new machines recently some entrepreneurs have tried for cutting and polishing of sandstone with less thickness. Due to the straight/curved lines of bedding/current bedding & attractive figures developed due to iron solutions, the cut sandstone after polishing looks very attractive. It has resulted in its use in place of granite/marble.

#### Physical Properties of Sandstone:

**Color:** The color varies from red, pink, brown and white. The variation is result of the binding material and its percentage constituent.

**Water Absorption:** The capacity of water absorption is 1.25%.

**Density:** It is 2.42 Kg/m<sup>3</sup>.

**Compressive Strength:** It is 390 Kg/cm<sup>3</sup>.

**Modulus of Rupture:** It is 220 Kg/cm<sup>3</sup>.

#### Chemical Properties:

Material	Composition
SiO <sub>2</sub>	96.60
Fe <sub>2</sub> O	1.20
Al <sub>2</sub> O <sub>3</sub>	1.00
CaO	0.28
MgO	0.20
L.O.I.	0.50

#### Sandstone Textures:

Sandstones have different surface textures, which varies according to their formation. However nowadays the stones are fabricated as the desired texture and the usage. There are six main types of surfaces that are in use.

**Natural:** The natural surface texture is achieved by ripping along its line of cleavage to reveal the natural grain & texture. This texture gives an undulating surface with great character. The surface comes with natural clefts giving a very natural look.

**Flamed:** Texture provides a rough surface. The roughness in the surface is a result of bursting of crystals when the stone is heated. Such a surface gives an irregular textured finish.

**Polished:** Polished surface texture is a reflection of polished crystals. Such texture brings out the brilliant colours and grains of natural stones. The shine on stone surface comes from polishing bricks and powders used during fabrication and not from any coating.

**Honed:** The honed texture is produced by grinding a surface with high grit material to a uniform specification, such that it does not produce a reflective surface. Thus honed stone colours are not as vibrant as polished stones. A smooth finish with a slight sheen is produced by using a polishing head. This surface is very smooth, but often very porous.

**Bush Hammered:** A pounding action that develops a textured surface. The top surface is pneumatically tooled to produce a pitted or grooved surface finish.

**Sawn:** Sawn surface is coarsely polished leaving a semi-smooth, regular finish. It is done by using a gang saw.

**Sand Blasted:** Producing a finish similar to cleft, sand blasting involves projecting a high-pressure airline coarse-grained grit, onto the top surface of the stone. It is characterized by a textured surface with a matte gloss.

**Sandstone Edges:** The finish and the smoothness of the tiles and the slabs made of sandstone depends on the edges, which is further dependent on the way they are cut. The edges play a major role in the overall appearance of the architecture they are used in. The fine edges of a stone can enhance the overall look of ceiling, flooring or any other exterior or interior looks. The edges are available in three different finishes. These are - Machine cut/sawn, Hand chiselled/hand dressed or Chamfered/beveled

**Machine cut/Sawn Edges:** Such tiles or slabs are the commonly used types of edges. Using machine lends the fine edges which simplifies the work of the fitter as these slabs or tiles fit perfectly. The machine cut/ sawn edges slabs are subjected to a high-speed rolling cutter blade to get a very smooth edge surface with a complementary (90°) angle at the vertices of the tiles/slabs.

**Hand chiselled Edges:** Hand chiselled edges, as the name suggests are smoothed by the professional workers. Hand chiselled or hand dressed edges are best suited for exterior walls and pavements. This type of tiles is first cut into different sizes and then, they are worked upon to achieve the smoothness. This edge finish is very much similar to natural surface finish and hand dressed edges are a good combination with natural surface finish.

**Chamfered Edges:** The chamfered edge slabs looks classic on exterior walls or any part of the interior. These slabs most commonly find a place in kitchen tops or on table tops. Chamfering the edges is achieved by following the two processes of first sawing and then polishing. Chamfering removes the shine and whiteness of sawn edges.

Some Pictures of Jodhpur Sand Stone varieties





**Figure 2: Jodhpur Sand Stone Tiles and Slabs**

### III. USES OF JODHPUR SAND STONE

Jodhpur Sandstone is suitable for both domestic and commercial use. Due to the ease of workability Jodhpur sand stone can be chiseled and dressed to a smooth surface in various attractive shapes. It is highly admired for its natural beauty and architectural properties, which makes it useful for interior as well as exterior decoration.

#### **Jodhpur Sandstone is used:**

- In load bearing Masonry.
- In cladding as Sandstone Slabs and Tiles.
- In Roofing, Flooring, Paving, Paneling, Beams, Arches, Doors and Window Sills, Wall Facing, Fence Posts, Mile Stones etc.
- As Pillars, Arches, Garden Furniture, Fountains, Landscaping Products, Stone Arts & Crafts due to its ideal carving and architectural properties.
- For carving Windows and Jallis.

- In chemical industries as Flooring, Wall Fixing and Lining due to its acid and alkali resistant properties.
- As Decorative Stones In Fireplaces, Walls, and Walkways, Paperweights, Coaster, etc.
- For exterior Cladding in Seashore Buildings due to acid & thermal resistant properties.

#### IV. JODHPUR SAND STONE IN CONSTRUCTION

Sandstone is a natural Rock abundantly available in Rajasthan. This state has the largest deposits of the material. Extensive Sedimentary Formation are exposed the state and large deposits of available in north- eastern part of the state. There are scattered sediments in Western Rajasthan around Jodhpur and Nagaur district. Rajasthan possess geological reserves of 900 million tones contributing about 90 percent of country's sandstone production. There are about 16,000 quarries under quarry licenses and mining leases.

Mining of Sandstone around Jodhpur is going on prior to its rehabilitation in the year 1459 as indicated by the historical old fort and building of Mandore garden. With the increase in population more and more sandstone quarried for the purpose of construction forts, Palaces, Castles and other historical monuments. Sandstone usage is associated with ancient landmark construction in Rajasthan.

In this experimental study we use local stone of Jodhpur city that is sandstone also known as "Chittar Stone". Sandstone is basically a sedimentary rock. Sandstone is termed as future stone by western architectures. If we consider building exterior, since time immemorial, sandstone is being fascinated by kingdoms and civilization for its grand look in the form of forts, palace and castles. It is commonly used as roofing material, for making pillars, arches, wall facings and other exterior works. Its masonry use in the form of natural stone bricks is quite popular. It can be easily dressed, chiseled and polished. Its use in producing fine art work can be seen in building of different types.

Texture and Shades of Jodhpur sandstone varies from fine to medium coarse grained, hard and compact. It is available in different shades. Its Pink, Multicolor Brown and Red are exquisite and attractive looking shades most commonly available.

Jodhpur sandstone because of its strength, resistance to abrasion and aesthetic looks is one of the best sandstones of the world. Though sandstones of other regions are of the best quality Jodhpur sandstone stands almost at par as far as its chemical and physical properties are concerned. Some examples of buildings constructed by Jodhpur sand stone is given below.





Figure 3: Building construction and other variety with Jodhpur Sandstone

## V. CONCLUSION

In this article, we have studied about the Jodhpur sand stone as good and satisfactory building stone for construction. Jodhpur sandstone is one of the important sandstones of India. It is an excellent building stone. This can be chiselled and dressed to a smooth surface in various attractive shapes. The sandstone has a verity of uses such as roofing, flooring, paving, panelling, beams, pillars, arches, doors and window sills, wall facing, fence posts, mile stones etc. It is especially useful for exterior cladding in sea shore buildings due to acid & thermal resistant properties. As such the effect of saline winds is negligible on sandstone. It is also suitable for use in chemical industries as flooring, wall fixing & lining due to its acid and alkali resistant properties. It is also suitable for carving and making windows and jallis. The sandstone is being quarried and used from centuries and a number of historical buildings and monuments such as Buddhist Stupas of Sarnath, Red Fort, Sansad Bhawan, Rashtrapati Bhawan, and National museum, Delhi; Chhitar Palace, Jodhpur etc. are made of sandstone. Rajasthan Sandstone because of its regular bedding, uniform grain size, suitable nature and durability, has been used extensively not only in Rajasthan but also in Northern India and even exported to Canada, Japan, and Middle East countries. In this paper we also conduct various tests on Jodhpur sandstone and the resultant strength was very excellent.

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