Availability of Construction Material Resources and Their Quality Assessment with Special Reference to Kolhapur Region

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Abstract*: Quality assurance of building materials is very essential in order to build strong durable and cost effective structures. When construction is planned building materials should be selected to fulfill the functions expected from them. The objective of this project is to discuss the importance of quality assurance of most common building materials such as cement, aggregates, steel and bricks in accordance with relevant standards. Material testing is a must in all industries, particularly the building sectors. This is because an incorrect assessment of a material would ultimately be harmful to people and the environment. The infrastructural development of a nation, eventually leads to the prosperity and growth of that country. Utilization of high quality construction materials leads to high quality infrastructures. The quality of such materials should be assessed properly in an accepted laboratory, using standard test methods. Construction includes the materials used in buildings, highways, bridges, railway and metro projects. The key to reliable construction and infrastructure development is the civil engineering techniques, technologies and most importantly the building/construction materials used. Construction materials include cement, aggregate, reinforced steel, bricks, various types of composites etc. Proper assessment of the properties of these materials is vital to ensure the quality and durability of the final structure that is made with them. The quality of building material used to construct any kind of structure plays a determining role in maintaining its durability. High quality building material ensures safety of the building and enhances its resistance against adverse climatic changes. Therefore, testing of building material, prior to its usage in construction, becomes of grave importance for construction material manufacturers. Testing for quality of construction materials is very important. Objective of testing construction materials is to provide an assurance to the user on the reliability of the materials. Thus, construction materials testing laboratories make a useful contribution to national development through the estimation of the quality of construction materials.

Keywords: Quality, materials, effective, structures. Construction, objective, cement, aggregates, cement, aggregate, reinforced steel, bricks, various types of composites etc.

I. INTRODUCTION

Construction investment accounts for nearly 52.4% of the Gross Fixed Capital Formation. Investments in construction have a positive domino effect on supplier industries, there by contributing immensely to economic development.

Construction materials and equipment sector accounts for approximately 8.6% of India's GDP1 and accounts for nearly two-third of the total construction costs on an average. The share of construction materials in project costs ranges from 40-60% .Construction component comprises nearly 60-80% of project cost of infrastructure projects like roads, housing etc. In projects like power plants, industrial plants, etc. the share, though lower, is critical. Construction materials sector comprises of various sub-industries such as: Cement, Steel, Aggregates, Sand, Bricks etc.

Cement: In the most general sense of the word, a cement is a binder, a substance that sets and hardens independently, and can bind other materials together. The word "cement" traces to the Romans, who used the term opus caementicium to describe masonry resembling modern concrete that was made from crushed rock with burnt lime as binder.

Aggregate: It is a broad category of coarse particulate material used in construction, including sand, gravel, crushed, slag, recycled concrete and geosynthetic aggregates. Aggregates are the most mined material in the world. Aggregates are a component of composite materials such as concrete and asphalt concrete; the aggregate serves as reinforcement to add strength to the overall composite material. Due to the relatively high hydraulic conductivity value as compared to most soils, aggregates are widely used in drainage applications such as foundation and French drains, septic drain fields, retaining wall drains, and road side edge drains. Aggregates are also used as base material under foundations, roads, and railroads. In other words, aggregates are used as a stable foundation or road/rail base with predictable, uniform properties.

Sand: It has become a very important mineral for the expansion of society. Sand is a naturally occurring granular material composed of finely divided rock and mineral particles. River sand is one of the world's most plentiful resources (perhaps as much as 20% of the Earth's crust is sand) and has the ability to replenish itself. River sand is vital for human well being & for sustenance of rivers.

As a resource, sand by definition is a loose incoherent mass of mineral materials and is a product of natural processes. These processes are the disintegration of rocks and corals under the influence of weathering and abrasion. When sand is freshly formed the particles are usually angular and sharply pointed but they grow gradually smaller and more rounded as they become constantly worn down by the wind or water.

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Bricks: A brick is a block, or a single unit of a ceramic material used in masonry construction. Typically bricks are stacked together, or laid as brickwork using various kinds of mortar to hold the bricks together and make a permanent structure. Bricks are typically produced in common or standard sizes in bulk quantities. They have been regarded as one of the longest lasting and strongest building materials used throughout history.

Materials management is the system for planning and controlling all of the efforts necessary to ensure that the correct quality and quantity of materials are properly specified in a timely manner, are obtained at a reasonable cost and most importantly are available at the point of use when required. Thus Materials management is an important element in project management. Materials represent a major expense in construction, so minimizing procurement costs improves opportunities for reducing the overall project costs. Hence it is essential to investigate the quality, quantity of materials and availability of various construction material recourses.

A. Profile of city

Kolhapur city is known as Karveer Nagari. Kolhapur is located on the Sahayadri mountain range and south western part of the Maharashtra state. The city is close to the Konkan coast which is connected by 12 Ghats going through Western Ghats like Anuskura, Amba, Phonda, Amboli, Bawada, Shivgarh, etc. Kolhapur city is situated on the bank of Perennial River Panchaganga on the adjoining hill named as Bramhapuri. During the historic period from first century B.C to ninth century AD, Kolhapur was situated on the Brahmpuri hills. Adjacent to this high hill the settlements like Kesapur, Kholkhandoba, Rankala, and Padmala which are as old as Bramhapuri were located. Kolhapur is abode of Goddess Mahalaxmi and is one of the Shaktipeeths mentioned in Indian mythology. In 634 AD, King Kamadeo initiated construction of Mahalaxmi temple which was completed in 1210 AD during the period of Gandaradivya King and city is called as 'Dakshin Kashi'. The city is renowned for its ancient heritage. Kolhapur was ruled by Silaharas, Yadavas, Rashtrakutas and Chalukyas in the medieval times. Maharani Tararani established her kingdom in Kolhapur. Since then Kolhapur has been the centre of the great Maratha kingdom ruled by Chhatrapati Shahu Maharaj, Chhatrapati Rajaram Maharaj who were an architect and founder of modern Kolhapur.

Location of the City: The main system of the hills is the Sahayadri, which run North South in the western portion of the Kolhapur. There is a gradual change in land forms from hilly west to the bare open east, and Kolhapur is located in this area. It is located in Panchganga river basin which is formed by the tributaries namely Kasari, Kumbi, Tulsi, Dhamani and Bhogavati. This city has spread in between area of about 6682 hectors in the Southern part of Maharashtra in the Western Ghats 550 m above mean sea level and between 16^{o} 42” N Latitude to 74^{o} 14” E Longitude.

Geology: - The geology of Kolhapur consists of Deccan traps with inter-trapped beds. These volcanic lava flows are spread out in the form of horizontal sheets and beds. The rock is mainly of igneous basalt types. The soil type of Kolhapur consists of black soil and red soil. The city has ample supply of water, good quality of soil, plentiful green areas, etc. which are responsible for overall growth and development of the city.

Economy:- Kolhapur was a rich city at the time of Satwahan dynasty. It got destroyed in the earthquake during 8th to 10th century. Then Rashtrakoot Kings re-established it in 12th century. King Shilahar made it capital of his kingdom. The history of Kolhapur has 3 main periods, up to 1347 Danduri era , from 1347 to 1700 Mohamedan era and after 1700 Maratha kingdom. During British period Shahu Maharaj developed the city in a true sense and established a fully developed city. He promoted people in all fields like arts, sports, industries, wrestling, education, cinema, cultural programmes etc. Naturally people progressed in these fields and achieved reputation. Chhatrapati Shahu Maharaj and Chhatrapati Rajaram Maharaj laid the foundation of industrial growth in Kolhapur.

B. Kolhapur City in Civil Engineering Point of View

Kolhapur is historical place. In Kolhapur lot of historical buildings are present. e.g Shalini Palace, New palace, Bhavani-mandap, Mahalaxmi temple. Also the KT weir like Rajarambandhara on the PanchagangaRiver. The big civil engineering structure like Radhanagari Dam. From these examples we can understand that there is scope of civil engineering work since ago. Presently there is tremendous scope of civil engineering work in Kolhapur city. Government has also given the permission to construct eleven story building in the year 2010-11 as well as there is five star hotel by D. Y. Patil group which is under construction. Also there is scope of infrastructure project like roads, sewage treatment plant. For this civil engineering construction works huge amount of construction material is required.

The major construction material is concrete. Concrete is a mixture of cement, fine aggregate, course aggregate and water in definite proportion for desired grade.

For long life, safe structure it is necessary to give a good quality sources. For good quality sources we are going to studying different sources of these materials in Kolhapur and will suggest for best sources to the builders.

The sands are available in Warana, Krishna, Bhima River bank. Aggregates are available in Shiye, Sangavade etc. These concrete ingredients have various physical, mechanical and chemical characteristics so we are study of concrete ingredients in Kolhapur region.

Cement mortar and concrete are the most widely used construction materials. It is difficult to point out another material of construction which is as versatile as concrete, it is material of choice where strength, permanence, durability, impermeability, fire resistance and obtaining resistance are required it is closely associated now with every human activity that it touches every human being in his day to day living.

Cement concrete is one of the seemingly simple hot actually complete materials, many of its complete behaviours are yet to be identified to employ their material advantageously and economically the behaviour of concrete with respect to long term drying shrinkage, creep, fatigue, morphology of gel structure bond, fracture mechanism and polymer modified concrete.

In any country, construction accounts for about 60 percent of the plan outlay, out of this cement and cement product would account for more than 50 percent. Today in India, the annual consumption of cement is in the order of 22 million tons.

II. CONSTRUCTION MATERIALS AND THEIR RESOURCES

A. Cement

Cement is well known building material and has occupied an indispensable place in construction works. There are a variety of cements available in market and each type of cement is used under certain condition. The cement is commonly used as Portland cement and the fine and course aggregates used are those that are usually obtainable from nearby sand, gravel and rock deposit.

Types of Cement:

- Ordinary Portland cement
- Rapid hardening cement
- Sulphate resisting cement
- Portland slag cement
- Quick setting cement
- Low heat cement
- Portland pozzolana cement
- Masonry cement
- Expansive cement
- Oil well cement
- High alumina cement
- Coloured cement/ White cement

Physical Properties of Cement:-

The important physical properties of cement are given below:

a) *Fineness:* The degree of grinding of cement is called fineness, for a given weight of cement the surface area is more for a fines cement and less for courser cement. The rate of chemical reaction or rate of hydration is faster when the cement is faster and therefore setting and hardening of cement is shortened. This results in greater strength development. As per Indian standard, the residue should not exceed 10% by weight when the cement is sieved an IS sieve 300 u. fineness is also measured in surface area cm^2 per gram of cement.

b) *Setting Time:* The cement is mixed with water forms slurry which gradually loses its plasticity and finally a hard mass is obtained. The time to reach this stage is termed as setting time. The setting is further divided as initial and final setting time cement paste loses its plasticity after adding the water is known as initial setting time. The time when the paste become a hard mass is known as final setting time. initial setting time should not be less than 30 min. and final setting time should not be less than 600 min.

c) *Soundness:* Soundness of cement is generally expressed by the expansion of cement paste in mm. unsoundness is caused by under expansion of the some constituents in cement and expansion results in developing cracks and disintegration. After the setting of cement, there should not be any volumetric change. This under expansion is due to free lime (CaO) and MgO in the cement. This unsoundness is reduced by –

i. Through mixing by fine grinding

ii. Limiting the MgO cement up to 0.5 percent

Soundness of cement is generally expressed by the expansion of cement paste in mm. byte caterer method cement should not have an expansion of more than 10 mm.

d) Compressive Strength: It is one of the important properties. The quality of cement for its strength in compression is judged by finding comp. strength of cement, sand, mortar, cement mortar, cubes having an area of 50 cm^2 are prepared in cement block casting machine and tested in comp. testing machine

B. Aggregates

Aggregates are the important constituents in concrete. They give body to the concrete reduce shrinkage and effect economy. The more fact that the aggregates occupy 70-80 percent of the volume of concrete their impact on various characteristic and properties of concrete is undoubtedly considerable without the study of the aggregate in depth and range the study of concrete is incomplete cement is the only factory made standard component in concrete other ingredients namely water and aggregates are natural material and can vary to any extent in many of their properties.

Classification:

According to source of nature of formation.

1) Natural Aggregate:

These aggregates are obtained from natural deposits of sand and gravels from river bed sea store, from quarries by cutting rocks or crushed rock.

2) Artificial Aggregate:

The most commonly used artificial aggregates are broken bricks and air cooled blast furnace slag broken bricks are used only for mass concrete not used for reinforced concrete work.

According to Size :

1) Course Aggregate:

The aggregate which mostly passes through 75 mm. IS sieve and entirely retain on 4.75 mm. IS sieve is known as course aggregate. The more sizes of course aggregate is 75 mm. and minimum size of course aggregate is 4.75 mm

2) Fine Aggregates:

The aggregate which are passes through 4.75 mm. IS sieve, fine aggregates are raging between 4.75 mm to 150 µ. Depending upon cumulative percentage of aggregate retain over various size of sieves they are further graded to different zones.

According to Shape:

- Rounded Aggregates
- Irregular Aggregates
- Angular Aggregate
- Flaky and Elongated Aggregate

Characteristic of aggregate:

A) Surface Texture:-Surface texture of the aggregate influence, the workability of plastic concrete and comp. Strength, hard concrete.

B) Bulk Density:-Bulk Density of an aggregate is defined as the weight of material in given volume and is expressed in gm/cc. or Kg./litre.

C) Specific Gravity:-As aggregate contains permeable and impermeable pores there are two types of the specific gravity.

i) Apparent Specific Gravity

ii) Absolute Specific Gravity

D) Porosity:-All aggregate have some pores and they are vary in size, some pore are open to the surface and some are wholly within the solid. The porosity of aggregate is varies from 0 to 20 percent in concrete aggregate are 75 percent.

E) Water Absorption:-The percentage of water observed by an aggregate when immersed in water is termed as water absorption of aggregate.

F) Surface Moisture:-It is defined as the difference in weight of aggregate in saturated surface dry condition and moist condition.

H) Bulking of Sand:-The increase the volume of a given mass of fine aggregate due to presence of surface moisture up to certain extent is known as bulking of sand.

I) Soundness of aggregate:- The soundness means ability of aggregate to resist excessive change in volume due to change in physical condition.

J) Fineness modulus: It is the numerical index of aggregate which gives idea about the fineness or course of an aggregate, also it indicates the mean size of the particles present in the entire body of aggregate.

Location and names of sand stockers:

- ✓ Market yard: i) Prakash Chavan. ii) Salim Mujawar.
- ✓ Shiroli: i) Sanjay Jagtap. ii) S. Khan.
- ✓ Uchgaon: i) Anil Yaday. ii) Mahesh Jadhav.
- ✓ Neharu Nagar: i) Vasant Pawar. ii) Sambhaji Maradhe

The sources of aggregates

A) Sand (Fine Aggregate)

The sources of fine aggregate are as follows:

- Malkhed
- Begampur
- Kodoli

B) Course aggregate

The sources of aggregate are as follows:

- Shiye:
- sangawade/Tamgaon:

C. Steel

Properties of Reinforcement:

concrete is very good in compression but weak in tension. Various members in the structure are always subjected to tensile forces, bending forces etc. To take these forces and to transfer them safely to other members, the structural members are always reinforced with C.T.D. (Cold twisted deformed) bars.

There are two common types of reinforcement bars:

- Mild steel bars C.T.D. (Cold twisted deformed) bars
- High yield stress deformed bars (H.Y..D.)

I. Chemical Composition

Constituent	*Percent, Max*
Carbon (for thickness/diameter 20 mm and below)	0.23
Carbon (for thickness/diameter over 20 mm)	0.25
Sulphur	0.055
Phosphorus	0.055

D. Bricks

About conventional bricks:- Clay bricks are used in a wide range of buildings from housing to factories, and in the construction of tunnels, waterways, bridges etc. Their properties vary according to the purpose for which they are intended, but clays have provided the basic material of construction for centuries. Brick is the oldest manufactured building material, and much of its history is lost in antiquity. The oldest burnt or fired bricks have been found on the sites of the ancient cities of Babylonia, some of which are estimated to be about 6000 years old.

The industry developed on traditional lines, using hand-making processes for the most part. The first patent for a clay-working machine was granted in the year 1619. Mechanization however did not begin.

III. CONCLUSION

The quality of construction materials and their resources plays an vital role in construction industry. The various construction materials tested from Kolhapur region are suitable for construction works and are easily available.

Cement: Test results of cement fulfills all the requirement as specified in IS 1489 1991(part1)

Sand (Fine Aggregate):

The sand of Warana Contains more silt as compared to Bhima and Krishna River so the Strength of sand of Warana River is minimum among all the three rivers. The silt content in Krishna River sand is minimum so it gives maximum strength among all the three rivers and it is best sand for any type of construction work.

For Rainy Season

Sand of Krishna River and Bhima River is excellent and can be used for any type of construction work.

Sand of Warana River is unsuitable for construction work.

For Winter Season

Sand of Krishna River and Bhima River is excellent and can be used for any type of construction work.

Sand of Warana River is unsuitable for construction work.

For Summer Season

Sand of all the three Rivers is suitable for any type of construction work.

Course Aggregate

In all the three season, the course aggregate of Kolhapur region are suitable for any type of construction work.

Steel

- The sample tested Surpasses the IS – specifications. The bars attains the high yield strength with good ductility.
- High corrosion Resistance .
- Excellent workability and bendability.
- High earthquake resistance because of better ductility of the core.
- Better weldability because carbon content is limited to 0.25.

- Better bond strength because of better design in lugs.
- Because of perfect physical properties, Mahalaxmi TMT 500 grade will give 15 % saving in usage of steel. Thus economical.
- The Average per meter weight of the bar is always on negative tolerance by 2% or so, within ISI limits.
- Bars are available in the sizes 8, 10, 12, 16, 20, 25, 32 mm dia of standard length 11 or 12 meters or as per specific order for bulk quantities.

Bricks: Few samples tested are weak in compression as specified in IS Code. so it is necessary to improve the quality of bricks for few regions.

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5. IS: 1077-1992 Indian standard common burnt clay building bricks-specification, Scope: This standard lays down requirements for classification, general quality, dimensions and physical requirements of common burnt clay building bricks used in buildings.
6. IS: 383-1970 Coarse and fine aggregates from natural sources for concrete (second revision) Scope: This standard covers the requirements for aggregates, crushed or uncrushed, derived from natural sources, such as river terraces and riverbeds, glacial deposits, rocks, boulders and gravels, for use in the Production of concrete for normal structural purposes including mass concrete works.
7. IS: 226-1975 Structural steel (standard quality) (fifth revision), Scope: This standard (Part I) covers the requirements of mild steel and medium tensile steel plain bars in round and square sections for use as reinforcement in concrete.

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