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CONSTRUCTION SAND, QUALITY AND SUPPLY MANAGEMENT IN INFRASTRUCTURE PROJECT

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Abstract:

Sand quality and cost-effective leads infrastructure in rural villages, a fundamental questions are identification of sources of construction sand mines, available quality and supply management how to maintain it is big challenges? Should the license holder suppliers or a government agency above them manage the construction of the infrastructure project? To answer this question, we surveyed all Society of Consulting Architectural and Engineering Firms, Nepal (SCAFE) members involved in infrastructure projects, As per Federation Contractors' Association of Nepal (FCAN), Sand quarry operator, Sand suppliers and sand washing plant operators in Kathmandu valley of Nepal. Findings clearly indicate that the most important causes were lack of proper management, awareness and understanding, quality, test skill and knowledge with contractor, consult and other stake holders. Also government and authority have not taken action to support legal aspects and control illegal operation as well as maintain supply management of construction sand for infrastructure projects.

Keywords: Construction Sand, Importance, Tests, Quality and Supply Management

I. INTRODUCTION

It is believed that after thousands of years, rocky materials finally turn into sand or clay. The sand that eroded from sandstone rocks, deposited as a beach, dune or desert. After millions of years, sandstone rocks turned into sandstone cliffs and eventually eroded for the second time. We can find the differences in the various kinds of sand, e.g. from beaches, rivers, dunes, mountains, deserts and also from sandpits or quarries. We are using these natural mineral as construction material in construction.

The construction sand and gravel industry continued to be concerned with safety and health regulations and environmental restrictions. Shortages in urban and industrialized areas were expected to continue, because of local zoning regulations and land development. For these reasons, movement of sand and gravel operations away from highly populated centers is expected to continue.

Construction sand is used for mortar and masonry work. Construction sand is using in various works, these materials are used for the construction of infrastructures like housing, road works, railway works, irrigation works, dam works, bridgeworks and other construction works.

As mentioned above, the train of urbanization is rapidly growing day by day in Kathmandu valley and the demand of sand as construction material is also increasing for building materials like concrete, mortar, soling, and asphalt work and so on. Demand of construction sand is being supplied from river terrace, pit and river bed mining in northern region of Kathmandu valley and west of Kathmandu like Belkhu in Dhading district. Extraction of construction sand from foundation of different bridges in Kathmandu valley has been banned by government but it hasn't been stopped completely, as still people are extracting sand illegally. But this is less compared to demand and river sand is expensive due to absence of impurities compared to pit sand.

The top most mantle of earth, which was once rock, has been transformed to soil by natural forces of weather. Texturally soil is not one material but a compound of three ingredients, derived from the same parental rock. They are sand, silt and clay. Though mostly soil occurs as a combination of the three materials, there are places where stretches of sand do occur alone where building activity has to be carried out. Besides occurrence of sand in a soil (its percentage) influences its strength characteristics to a great extent. For example, while constructing piers and abutments (of a bridge) which mostly stand on a sandy base, the bearing capacity of sand becomes the most important criterion in deciding the size and depth of the construction. Besides strength of silt and clay get drastically affected when it comes in contact with water. But sand except very fine sand, is least affected with water. It is therefore very important to study the extent to which the strength of sand is affected with water.

2. Objectives

The objective of the research is to study and analyze the quality of sand as construction materials and its supply management in the construction works, which can affect the cost, quality and time by means of construction industry.

3. Literature Review

3.1 Definition of sand or fine aggregate

“Fine aggregate: The material below 4.75mm. Size is termed as fine aggregate. The sum of all types of deleterious material in fine aggregate should not exceed 5%. Natural sand or crushed stone dust is the fine aggregate chiefly used in concrete mix. Sand may be obtained from sea, river, lake or pit, but when used in a concrete mix, it should be properly washed and tested to ascertain total percentage of clay, silt, salt and other such organic matter does not exceed of specified limit” (Kumar, 1992).

“Sand- A fine aggregate which is either natural sand crushed stone sand or crushed gravel sand.

Natural Sand-A fine aggregate produced by the natural of rock.

Crushed stone sand and crushed gravel sand-Fine aggregates produced by the artificially crushing a hard stone or rock after quarrying, and a natural gravel respectively.” (IS Code 2116-1965)

3.2 Sand is a important construction material and its uses

Sand is really one of the most important construction materials. If we consider (1:2:4) proportion cement concrete work by its volume, the percentage of sand in totality is $2 / (1+2+4) \times 100 = 28.57$. Thus, the role of construction sand would be more than 28 %. Similarly, if we consider cost basis in Kathmandu valley the role of sand would be more than 21 %. So, sand is an important construction material.

“Sand is an important construction material of natural origin. Mixed with cement and lime, millions of tons of sand are used every month for construction as mortar, plasters and concrete. The term sand is used for rock particles that range in grain size between 2mm and 1/16mm. In composition, they are predominantly an oxide of silica (SiO_2). Mineralogical, they consist mostly broken grains of mineral Quartz (SiO_2) produced as a result of breakdown of granites, sandstone and similar rocks by natural processes of weathering and erosion” (Sing, 2004-2005).

3.3 Uses of Sand

Sand is massively used for concreting, Sand is used for preparation of mortar to bind with brick or stone or other materials, Sand is used for preparation of mortar to plaster and pointing on the wall and surfaces., Sand is massively used for concreting.,

Hydropower Work

- a. Catchment
- b. Dam construction
- c. Power house and much more

Road works, Side drain work, Seal coat work, Pre-mix asphalt concrete work, Soling work, Pavement work, RCC pipe joining work

Canal work, Damp proof work, Tar felt work, Bitumen paint DPC

Special work of sand: Sand is used for glass production., Sand is used for abrasive in sand blasting, Filtering water, Brick manufacture plant, Sand bags are used for protection against the flood, Sand castle building is popular activity for competition, Sand animation is a type of performance art., Aquaria are lined by sand, instead of gravel since it will be low cost., Rail road's use sand to improve the traction of wheels on the rails, Sandy soil will be ideal soil for some crops like watermelon, peaches and peanuts.

“Sand for construction works

Different construction works require different standards of sand for construction.

Brick Works: Finest modulus of fine sand should be 1.2 to 1.5 and silt contents should not be more than 4%.

Plastering Works, Finest modulus of fine sand should not be more than 1.5 and silt contents should not be more than 4%.

Concreting Works: Coarse and should be used with finest modulus 2.5 to 3.5 and silt contents should not be more than 4%” (Praveen, et al 2015-2016).

“Object of mixing sand

It prevents excessive shrinkage. Fat lime shrinks very much. Hydraulic lime and cement also do so to a lesser extent. Sand corrects this tendency. To improve the strength of mortar, the crystals formed have a tendency to adhere to a rough nucleus. They adhere better to particles of sand than to each other. To improve the setting power, if the binding material be fat lime. Sand makes the mortar porous, which absorbs CO_2 from air and becomes hard. To improve the setting power, if the binding material be fat lime, Sand makes the mortar porous, which absorbs CO_2 from air and becomes hard. To increase the bulk and thus reduce the cost” (Deshpande, 1965).

3.4 Classification of Sand:

It is true people do not wonder about the origin of sand. Thousands of years need to pass for rocky material to finally turn into sand or clay. The sand that eroded from sandstone rocks, deposited as a beach, dune or desert. After millions of years, sandstone rocks turned into sandstone cliffs and eventually eroded for the second time. I noticed the differences in the various kinds of sand, e.g. from beaches, rivers, dunes, mountains, deserts and also from sandpits or quarries.

Generally sand can be classified into three categories from different prospect:

Sand's origin point of view, Composition Point of view and Grain size point of view

Under origin point of view we can divided into 4 sub categories i.e.

- i) river sand ii) Pit sand and iii) Marine sand and iv) Sand dune

Under composition point of view, we can divide into 3 sub categories i.e.

i) Clean sand ii) Silt sand and iii) Clayey sand.

Under Grain size point of view, we can divide into 3 sub categories i.e.

i) Course sand ii) Medium sand and iii) Fine sand

“Sand found in land deposits is known as “pit sand” such grains are generally irregular, shape and angular. Sand carried by water, such as found along banks of rivers or lakes is known as “river sand” such grains are generally rounded and smooth, due to the action of water. Both types of sand are suitable for cement work, so long as they are well-graded and clean” (Thomas & Jordan, 1987).

“Texture: Sandstones are composed almost entirely of well-sorted, sub-angular to rounded sand grains. The texture of sand stone is: (i) “course grained” when the size of grains is 2 to 0.5mm, (ii) “medium grained” when the size of grains is 0.5 to 0.25mm, and (iii) “fine grained” when the size of grains is 0.25 to 0.1mm. Structure: The common structures seen in the sand stones are stratification, current bedding, ripple marks and rain prints” (Bangar, 1995)

“(8) Sand fraction: The fraction of soil composed of particles between the sizes 2.0 mm and 0.06mm. The sand fraction may be sub divided as follows.

		BS test sieve sizes to be Used for separation
Course sand	2.0mm to 0.6mm	2mm to 600 μ m
Medium sand	0.6mm to 0.2mm	600 μ m to 212 μ m
Fine sand	0.2mm to 0.06mm	212 μ m to 63 μ m” (BS 1377:1975).

“(a) According to mode of origin, sands are of three types, namely, pit sands, stream sands, and marine sands.

(b) According to composition. Following three categories of sand are recognized in engineering fields:

Clean sands. These are well-graded containing entirely or mostly quartz (SiO₂) particles in wide range of grain size.

Silty sands: These are poorly graded sands, which have considerable proportion of silt (particle size between (1/16 – 1/256mm) and other non plastic-fines.

Clayey Sands: These are poorly graded sands having a prominent clay fraction (particle size below 1/256 mm) and also plastic fines.

Obviously, for the use of making mortars, plasters and concrete, sand of category clean sands must only be used. Sand is also obtained by crushing natural quartzite rock to the required grain size.

(c) According to the grain size, sand is classified as coarse, medium and fine sand: 2-1mm, 1-0.25mm, and 0.25mm-0.15mm, respectively” (Sing, 2004-2005)

“Sand is generally considered to have a lower size limit of about 0.07 mm (0.003 in.) or a little less. Material between 0.06mm (0.002 in) and 0.02 mm (0.0008 in.) is classified as silt, and smaller particles are termed clay. Loam is a soft deposit consisting of sand, silt and clay in about equal proportions”(Neville & Brooks, 1997).

3.5 What is quality?

There are lot of definitions that have given by different academician and professionals.

As per Joseph Juran “fitness for purpose” is quality. As Per Philip Crosby “Do it right first time” and “Zero defect” is quality. As per Disney “we are in the business of making people happy” is quality. As per my point as a student of

construction management, “manage every activities perfect that makes happy to all stakeholder within the organization’s territory is quality.

“Quality of sand

The sand shall consist of natural sand; crushed stone sand or crushed gravel sand, or a combination of any of these.

The sand shall be hard, durable, clean and free from adherent coatings and organic matter and shall not contain any appreciable amount of clay balls or pallets.

The sand shall not contain any harmful impurities, such as iron pyrites, alkalis, salts, coal, mica, shale or similar laminated or other materials in such form or in such quantities as to affect adversely the hardening, the strength, the durability or the appearance of the mortar or applied or to attack any reinforcement used in the masonry work.

Unless found satisfactory, as a result of further tests as may be specified by the engineer architect in charge of the work, or unless evidence of such performance is offered which is satisfactory to him, the maximum quantities of clay, fine silt fine dust and organic impurities in the sand shall not exceed the following limit:

Clay, fine silt and fine dust: Not more than 5 percent by weight [determined in accordance with appendix C of IS: 383-1963* and also IS: 2386 (Part II)-1963†]

Organic impurities (determined in accordance with IS: 2386(Part II)-1963*-below

Note-In particular cases crushed stone sand with even higher proportions of fine aggregate than specified above may be satisfactory and the limit so permitted may be subject to the agreement between the supplier and purchaser”(IS2116-1965,).

“The specification controlling the sand qualities is highly variable. These depend upon the specifying agency, the availability of sand and the purpose for which the sand is to be used. However, there is no-such standards specified for sand used in the country. For present purpose, Indian standard Code (IS 1498-970) is taken”(Mannndhar , 2004).

“Quality of Aggregate

Natural aggregate used for concrete construction is required to comply with the norms laid down in IS: 383-1970 ‘Specification for coarse and fine aggregates from natural sources for concrete’ Some of the important characteristics of aggregates are: (1) strength (2) size (3) Particle shape (4) Surface texture (5) Grading (6) Impermeability (7) cleanliness (8) chemical inertness (9) Physical and chemical stability at high temperatures (10) coefficient of thermal expansion. And (11) cost” (Punimia & Jain , 1992).

“Example of good quality sand: This sand is all of about the same coarse texture and does not have stones in it or a lot of dust. Sand can be tested by lifting up a handful and letting it fall back to the ground. If a significant portion of it blows away instead of falling straight down, it has too much dust and needs to be sieved” (UNDP, 2007).

“Quality

A moist handful of the sample sand is rubbed between the palms of the hands. Suitable sand will leave the hands only slightly dirty.

Decantation Test: a drinking glass (or other clean glass container) is half-filled with the sample sand, and then filled $\frac{3}{4}$ -full with water. The glass is then shaken vigorously, and allowed to sit undisturbed for an hour or so. The clean sand will settle immediately, and clay and silt will settle as a dark layer on top of the sand. The thickness of the clay/silt layer should not be more than seventeenth (6%) of the thickness of the sand. Dirty sand can be washed by rinsing respectively with water” (Thomas & Jordan, 1987)

Grading:

The particle size grading of sand for use in mortars for unreinforced masonry work shall be within the limits specified in Table

Table 3.1.1 Requirements of Grading for Sands for Unreinforced masonry work

IS SIEVE DESIGNATION (see IS:460-1962*)	Percentage by weight passing IS Sieve
4.75mm	100
2.36mm	90-100
1.18mm	70-100
600micron	40-100
300micron	5-70
150micron	0-15

The particle size grading of sand for use in mortars for reinforced masonry work shall be within the limits specified in Table

Table 3.1.2 Requirements of Grading for Sands For reinforced masonry work

IS SIEVE DESIGNATION (see IS:460-1962*)	Percentage passing by weight
4.75mm	100
2.36mm	90-100
1.18mm	70-100
600micron	40-80
300micron	5-40
150micron	0-10

A sand whose grading falls outside the specified limits due to excess or deficiency of coarse or fine particles may be processed to comply with the standard by screening through a suitably sized sieve and/or blending with required quantities of suitable size of sand particles. Any deviation may be left to the discretion of the engineer or architect in charge of the work in the light of practical experience with the use of local material

The various sizes of particles of which the sand is composed shall be uniformly distributed through the mass.

The required grading may often be obtained by screening and/or by blending together either natural sands or crushed stone screenings, which are by themselves, unsuitable.”[Indian standards Specification for sand with masonry mortars :]”(IS2116-1965).

“Sieve analysis and Fineness Modulus. The object of this test is to study the grading of sand. The sample taken should be not less than 1.5 kg. Find the actual weight of the sample. The sample is separated into different sizes by sieving i.e. passing it through standard sieve. The percentage by weight of the residue on each sieve is noted. The standard sieve is noted. The standard sieves used are, 80mm, 63mm, 40mm, 20mm, 10mm, No. 480 (480 micron), No. 240 (240 micron), No. 120 (120 micron), No. 60 (60 micron), No. 30 (30 micron), No. 15 (15 micron).

Table 3.1.3 Requirements of Grading for Sands for reinforced masonry work

IS Sieve Number	Percentage amount of fine aggregate retained on each sieve	Percentage amount of coarse aggregate retained on each sieve
80mm	-	-
63mm	-	-
40mm	-	3.5
20mm	-	15.0
10mm	-	59.5
No.480	3.5	90.5
No.240	19.5	100
No.120	29.5	100
No.60	53.3	100
No.30	88.5	100
No.15	109	100
Total	249.5	668.5

The sum of percentage amount of fine aggregate retained on each sieve divided by 100 gives the fineness modulus of the aggregate.

Based on the fineness modulus sand can be classified into (i) fine sand (FM 2.2 to 2.60). (ii) Medium sand (FM 2.60 to 2.90), and (iii) Coarse sand (FM 2.90 to 3.20).

The following results relate to a test for fineness modulus of fine aggregates = $294.5/100 = 2.945$ (Ramamrutham & Narayan, 1990)

“Bulking of sands

As regards the rate of making of bulking, it has been observed that it is related to two factors:

Percentage of moisture content in the sand

Grain-size of the sand particles

Thus, bulking effect is at its maximum when moisture content in sand is between 4-6 per cent. As the water-content increases, this effect goes on decreasing, becoming negligible at 15-20 per cent moisture content. Similarly, other things being same, the fine sand (particles size 0.25 to 0.15 mm) show higher bulking rate compared to the coarse sands (particle size around 2mm). Bulking may be able to an extent of 30 per cent of original dry volume of sand in fine sands and 15 per cent in case of coarse sands. A quick method to determine bulking of sand containing some moisture is as follows:

Take a clean glass cylinder and fill it about $\frac{3}{4}$ with sand sample. Note down its volume. Say it is $V_1=30$ cm.

Now carefully take the sand out and place it on a glass plate. Fill the glass cylinder with water to $\frac{3}{4}$ of its volume.

Put the sand sample back into the glass cylinder very slowly, stirring the water while adding sand in it. This is essential to make all the sand grains settle fully in the cylinder.

Note down the new volume of the sand sample; let it be V_2 . If $V_2=V_1$, it will mean sand sample has retained its original volume, i.e. it has shown no bulking.

But let us say in the case $V_2=24$ cm. then bulking of sand sample is:

$$V_1-V_2/V_1*100 = 30-24/30*100 = 6/30*100 = 20\%$$
 (Sing , 2004-2005).

“Bulking Factor of sand

Take 6 liters of dry compacted sand, and weigh it and dump it into a mixing pan. Add a certain known percentage of water by weight of dry sand. Mix rapidly and thoroughly till uniform colour is obtained and fill the container with the wet sand without any tamping. Now strike off the top surface and weigh and thus find the weight of wet sand. Repeat the experiment a number of times increasing the percentage of water from 0 to 20%.

Let W_1 =weight of 1 cu.m. Of compacted dry sand, W_2 =weight of dry sand contained 1 cu.m. Of wet loose sand, W_3 =weight of 1 cu.m. Of loose wet sand, x =Percentage of water added,

W_3 =weight of dry sand + weight of water.

$$\therefore W_3 = W_2 + (x/100)W_2$$

$$\therefore W_3 = W_2 (1+x/100)$$

$$\therefore W_2 = W_3 / (1+x/100)$$

$$\% \text{ of bulking} = 100(W_1 - W_2) / W_2$$

Bulking Factor= W_1 / W_2 ” (Ramamrutham & Narayan, 1990).

“Bulking of Sand

Fine aggregate, when dry or saturated, has almost the same Volume but dampness causes increase in volume. (CPWD, 2009)

Table 3.1.4 Bulking of sand

Moisture Content % age	Bulking % age (by Volume)
2 %	15 %
3 %	20 %
4 %	25 %
5 %	30 %

Source: (CPWD, 2009)

When the moisture content of a fixed weight of construction sand increases, the volume also increases up to a point. This phenomenon is called “bulking”. As the moist or water added in the sand its volume increases compared to dry sand. This process is known bulking and investigated by Feret at French school of Bridges and Roads.

This bulking process of sand is explained by moisture hulls or films which surround the sand particles. The contact moisture films, absorbed to the sand particles by moisture surface tension forces tend to cause the sand particles to occupy a large volume as compared to their dry state. When bulking of sand occurs, increases volume as the particle size of sand decreases. If further added moisture or water to the sand, reaches maximum increases its volume in a point in which inundation takes place because surface tension forces are neutralized and most of bulking vanishes. As a consequence the sand particles are rearranged into denser firm.

“Global Issue the Environment Protection.....The infrastructure, housing, and real estate projects degrade the environment if it is allowed run without planning. In order to implement even a one project, it is essential to import the construction materials, construction equipment, human resources and new technology from inside and outside the country. During construction period, lots of chemicals are used. By-product generated from the projects affects the environment. The byproduct and chemicals need to be disposed properly in the appropriate places”(Koirala, ,2017).

3.6 Supply management

Supply management plays a key role in the construction industry. Supply must be operating at right time and right place. Supply of sand lately, implies the loss of productivity due to delay of project and supply operated very early becomes wasted due to storing problem further leading to inefficiency. Supply must be operated from qualitative sources and try to operate from short route as much as possible.

So what is supply management?

Supply management is creative art formulated by skilled experienced supply manager in the organization. It does not have to be practiced in managerial aspects like the speech of political leader, which they teach discipline, ethics, morale but they, themselves are not implementing it within their party. So supply management should be a discipline of creative art where clear direction are followed from which objectives are fulfilled by utilizing optimum resources to enhance the productivity of the organization.

“Construction material producer are vital industries from where supplying the demand of emerging construction materials to infrastructure and habitat projects as per projects' need. These industries employing lot of workers but they are not being worry about health and safety” (Koirala, 2016).

“Management is largely concerned with making decisions and any action originating from such decisions, however according to one of many definitions, management also has come to imply a disciplined approach to the use of available resources” (Sharma, 1995-96).

“General practiced management

Customer or client can save remarkable cost of sand as construction material, which can affects project profitability, affects timely completion, unused /salvaged sand needs care, wastage control is important and improve current asset holding.

“Components of material management are:

Material estimation, budgeting, planning and programming, Scheduling, purchasing and procurement, Receiving and inspection, Inventory control, storage and warehousing, Material handling and transport, Waste management”(Vyas, & Patel, 2011)

4. Methodology

Table-4.1.1 Population and sample

Items	(1) Consultants listed with (SCAF)	(2) A-class Contractors register with (FCAN)	(3) Sand quarry operator listed in Kathmandu Valley's DDC	(4) Sand supplier's companies about	(5) Sand washing Plant Operator
Available data	147	19	20	103	2
Respondents	Involved in Building in Kathmandu (SCAF)	Involved in Building in Kathmandu valley (FCAN)	Sand quarry operator in Valley (DDC) listed	Major Sand suppliers (Major depots)	Sand washing Plant operator in Kathmandu Valley
Population data	15	19	20	19	2
Sample data	8	10	11	10	2
Percentage taken	53%	52%	55%	52%	100%

Source: Survey research,2017

It adopts purposive method for sampling. It has 33 respondents, the main person of different institution as mentioned in table above. Surveyor will reach the site and asks the questions in the spot. It is targeted to make inquiry from proprietor, secondly staff or the worker of respective firm. Between proprietor, staff and workers who handle the more responsibility of quality and supply management within their territory, i.e. construction site or quarry or depot or spot, that has to be identified. The person who takes care of the quality and supply management will be made target from this research, I choose the same person for respondents. Observation will be carried out in the respective industry's areas where workers will be found first and secondly, literatures will be reviewed to identify place to carry out the survey of sand as construction material, quality and supply management in Kathmandu valley.

The methodology of the study is described below:

1. A thorough literature review was done.
2. A questionnaire was developed with the help of information extracted from literature review.
3. Distribution and collection of questionnaire.
4. Analyze the collected data.
5. Relevant conclusions and recommendations were drawn.

The methodology is explained as follows.

In the first step, a thorough literature review was performed to identify the key elements that can cause the alteration in the cost of the project. Using those factors then a questionnaire was developed. In this step a structured questionnaire consisting of two parts was designed. Part A and B.

Part A consisted of requesting respondent's personal information & company information. Part B consisted of requesting ranking the different variables which take part in fluctuating cost.

To get data for this study the questionnaire was distributed among the contractors, and the collected back. In fourth step analysis was done on the data gathered. Based on the survey result and analysis, relevant conclusions and recommendations were drawn.

“Perhaps the best-known measure of central tendency is what layman calls an average. Statisticians call this the mean the word average or mean becomes so common and popular that is why it is used in everyday language. Besides that Arithmetic Mean (A.M.) is the most commonly used of all the average.....Standard deviation is often powerful and helpful measure of dispersion in order to measure the size of deviations from the average. Standard Deviation (S.D.) is the positive square root of the average of the square of the deviations of the measurements from their means. It is denoted by” (Sthapit, Yadhav & Khanal , 2010).

$$\text{Mean (X)} = \frac{n_1x_1 + n_2x_2 + n_3x_3 + n_nx_n}{n_1 + n_2 + n_3 + n_n} \dots\dots\dots (A)$$

$$\text{Standard deviation (D)} = \sqrt{1/n * \sum x^2} \dots\dots\dots (B)$$

Where $x_1, x_2, \dots, x_n$ be the values of n observation and n is number of observation

5. Analysis:

Construction Sand is a fundamental raw material used primarily by the construction and paving industries. Combined, with gravel they take the form of "aggregate" in concrete, portland cement, asphalt, mortar, and plaster. Sand is a loose, fragmented, naturally-occurring material consisting of very small particles of decomposed rocks, corals, or shells. Sand is used to provide bulk, strength, and other properties to construction materials like asphalt and concrete. It is also used as a decorative material in landscaping. Specific types of sand are used in

the manufacture of glass and as a molding material for metal casting.

Regarding the same, open ended question is asked to well define sample population and same is described below.

It was asked to check their prospect about how seriously customers' take sand, why it is an important part to be careful during choosing construction sand. Every construction owner has to think twice whether particular sand fulfill the quality or for his purpose.

Responses were received that 37% viewed, that sand fulfills the compressive strength, 36% was sand should be normally mixed with cement for construction materials and 27% viewed sand used to maintain good quality. After looking analyzed data is reflected as per aspect result. Because function of sand is to fulfill compressive strength and mix with cement so that quality is maintained.

5.1 Sources Preferred for Supply Construction Sand

This question was asked to know which sources of sand they preferred to use in construction field, this question was allowed to choose more than one source if applicable more sources of sand.

Precisely, responded, 42% voters prefer pit sand because their commitment are for pit sand, 34% viewed river sand is best and they prefer it and 24% preferred terrace sand. After looking the data observed in site, river sand is considered best, but river sand cannot take permit due to prohibition by government so only the option is pit sand.

5.2 Bulking of Sand

Let it be precisely, the views of respondents were 78% respondents told bulking of sand affects the quality of construction sand, 11% respondents told they do not know whether bulking of sand affect its quality or not, and 11% respondents viewed bulking of sand does not affect its quality.

5.3 Priority of sand buying

To know perfectly, let the views received from respondents' were 37% respondents viewed priority for good quality, 27% respondents told priority for price, 25% respondents said priority for enough quantity for one source and 11% respondents viewed priority for availability in time.

5.4 Test of Sand Impurities

The views received from respondents were mentioned, 36% reported they preferred dust contain test, 35% respondents told decantation test and 29% preferred silt/clay test in the construction side.

5.5 Factors to be considered before choosing sand

The views received from respondents were 34% participants reported us they perform test often, 24% participants performed never test, 23% participants performed regular test and 19% participants performed rare test.

5.6 Priority during sand choosing

Perfectly, let the views received from respondents were, 39% respondents said that they gave the most important was for quality of sand and not important is for time of supply, 35% respondents said that they chosen for most important factor is quality of sand and not important factor is cost of sand, 12% respondents said that they viewed for most important factor is cost of sand and not important factor is time of supply and 7% respondents said that they chosen for most important factor is time of supply sand and not important factor is quality of sand

5.7 How to identify that Sand is as per Required Quantity and Quality?

37% respondents said that to maintained better supply management should be plan i) supplying procedure) Storing procedure iii) Loading and unloading procedure too, 30% respondents said that, to properly plan for strong procedure, 22% participants said that they have to plan for proper loading and unloading procedure, 9% participants said that they have to plan for other factors too along with these mentioned factors and 2% respondents said that they have to plan supply procedure.

5.8 Measurement of Supplying Sand before use in the Site

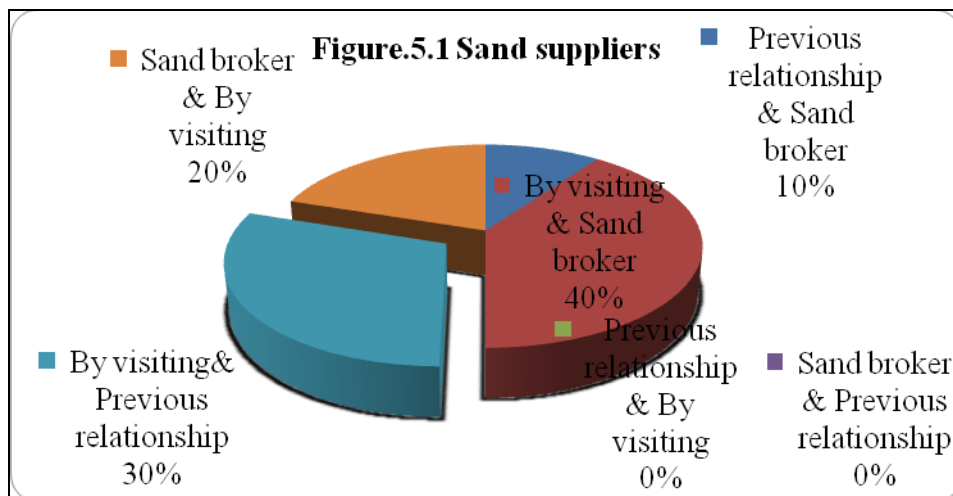
Respondents replied, 44% said that they take measurement of supplying sand regularly, 20% respondents said that they never take measurement of supplying sand at site, 19% respondents said that they take measurement of supplying sand rarely, and 17% respondents said that they take measurement of supplying sand often.

5.9 How often Supplied sand is as per requirement?

More precisely, 37% respondents said that the supplied sand is as per required quantity and quality is very rare, 23% respondents said that the supplied sand is as per required quantity and quality is very often, 20% respondents said that the supplied sand is as per required quantity and quality is always, and 20% respondents said that the supplied sand is never as per required quantity and quality.

5.10 Identification Sand Customers

Whatever response received from respondent are tabulated, in summery as given below in the Pie-chart. After looking the variable we can say how participants identify the sand costumer.



To know perfect result, let the views received from respondents be plotted on pie-chart. 40% respondents they identified sand customers by visiting to construction places with the help of broker, 30% respondents they identified sand customers by visiting to construction places and by the help of previous relationship, 20% respondents said by visiting with sand broker 10% respondents were sand customers from previous relation and by visiting to construction places, which given in the figure above.

6. Conclusion

In this research literatures have been reviewed and survey had been made with sample population, Based on the facts and literatures following conclusion have been made, as sources of construction sand is one of the most

important construction material, but availability is limited and there is a need for proper management, awareness and understanding of construction sand by suppliers, quarry operators, washing plant operators, builders and respective government is not enough. Test of sand must be needed before using in the infrastructure construction projects to maintain its quality which was not adopted as mandatory. Government and related authority need to support legal aspect and action for control the illegal operation and need to maintain the supply management based on demand and supply of the construction sand.

7. Limitation/ Scope of Future Works

Need to urgent and practicable measures to be taken which enhance the quality control in construction sand, available from supplier's company. Identification of other areas regarding the qualities of construction sand in infrastructures projects will be for further researches. The conclusions drawn by the study will be worthwhile to be considered in developing standards for construction sand its quality and supply management.

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