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A Study on the Strength of Concrete using Fine Aggregates Available in the Greater Jorhat Region of Assam

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ABSTRACT:. *Concrete these days, is the most widely used construction material. Surprisingly the ingredients of good concrete and bad concrete are the same i.e. cement, aggregates and water. It is only the know- how of making a desirable mix, backed by understanding of the mechanism that goes into making durable concrete of required strength that makes the difference. Good concrete has to fulfill the following two criteria; first in its fresh state it must be plastic enough or cohesive enough to be transported from the mixer and placed in the formwork and it must be consistent enough to be compacted by the means desired without excessive effort and secondly in its hardened state, it must have sufficient compressive strength and adequate durability. [4]*

In any concrete we make, our aim is always to make it a workable one. The strict definition of workability is the amount of useful internal work necessary to produce full compaction. If the concrete is not fully compacted, it will leave voids in the hardened state. As the strength of concrete is adversely and drastically affected by the presence of voids in the compacted mass, so it is vital to achieve a maximum possible density. This requires a sufficient workability or virtually full compaction. Gradation of aggregates is of immense importance in producing workable concrete.Good grading implies that a sample of aggregates contains all standard fractions of aggregate in required proportion such that the sample contains minimum voids. A sample of the well graded aggregate containing minimum voids will require minimum paste to fill up the voids in the aggregates. Minimum paste will mean less quantity of cement and less quantity of water, which will further mean increased economy, higher strength, lower-shrinkage and greater durability. Concrete strength increases when using dense gradation and increasing fineness modulus of aggregates. [4]

In our present technical report, we have investigated the gradation and fineness modulus of the fine aggregates available in three different sources in the greater Jorhat region of Assam; namely, Kanaighat, Bhogdai (Jorhat site) and Mariani. We have also found out the compressive strength of M-25 grade concrete cubes at the end of 3, 14 ,28 and 60 days made using the same cement (OPC 43) and the same content of it, same coarse aggregates of size 12.5mm (obtained from Bihubor quarry) and the same water-cement ratio (0.4) but using those three different fine aggregates in an attempt to study the influence of the gradation of fine aggregates on concrete strength and draw comparisons among their respective strength values and find out which of the three fine aggregate give the highest strength.

The fine aggregates from Kanaighat are well graded and the actual compressive strength of the concrete cubes made with it after 28 days of curing was found to be 2.10% more than the calculated target strength. While the fine aggregates obtained from Mariani and Bhogdai are gap graded and the actual compressive strengths of the concrete cubes were found to be respectively 3.4% and 7.15 % less than their calculated target strength.

KEYWORDS: Fine aggregates, Gradation, Fineness Modulus, Workability, Compressive strength.

INTRODUCTION

Jorhat is a major city and one of the fastest growing urban centers of the state of Assam in India. Deemed as the "**Cultural Capital** of Assam", Jorhat is one of the cities (the other being Guwahati) which is under way to be developed as a sunshine city of Assam as declared by the central government of India. Jorhat City is located at 26.75° N and 94.22°E and it has an average elevation of 116 metres. The total geographical area of the district is 2859.35 sq. km which happens to be about 3.63% of the state. To the east of Jorhat lies the

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district of Sibsagar, to the west lies the district of Golaghat, to the north lies the Brahmaputra river and the district of Lakhimpur and to the south lies the state of Nagaland.

Image1: Map of Assam

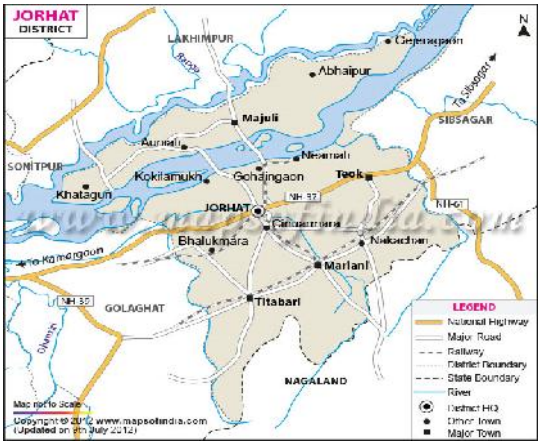

Image2: Map Of Jorhat

Jorhat is located to the southern bank of Brahmaputra. Bhogdai, Kakodonga, Jhanji, Teok are some of the tributaries that flow through the district.

Image3: River Map of Jorhat

River Bhogdoi and the river Kaliyani are the sources of sand for construction purpose in the district. The river Bhogdoi is a small but perennial river coming down from the foothills of Assam-Nagaland border into the plains of Assam and finally pours into the Brahmaputra, while the river Kaliyani originates from the foothills of Karbi Anglong, and flowing pass the Numaligarh Refinery, it finally pours into the river Dhansiri which flows through the district of Golaghat and happens to be a major tributary of the river Brahmaputra. Sand is collected from Bhogdoi bed at various places in the upstream portion of the gauge sight. The state Forest Department has 6 sand mahals (quarries) from Mariani to Jorhat city. These 6 sand mahals have 8 sand collection sites namely Mariani-I, Mariani-II, Kathonibari, Pukhuria, MES Gate, Jorhat, Malow Ali and Salmora.[5] These 8 sites are located at the various lengths of the river Bhogdoi. Sand is also quarried from Kanaighat located at the banks of the river Kaliyani.

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SCOPE OF RESEARCH

With Jorhat developing as one of the major urban centers of Assam, various construction activities are being carried out in full swing. Various commercial complexes, apartment buildings, educational institutions have come up and many more are proposed to be constructed down the line. In Jorhat concrete is the most important material used for constructions and steel is used as reinforcements and so greater emphasis has to be laid in making quality concrete. Good grading in making quality concrete in consistent with economy is very important and this can have a direct consequence on its strength and the durability in its hardened state. This technical report tries to provide an opportunity to the engineer/contractor/builder/ clients to learn about the quality of fine aggregates found in the greater Jorhat region that are used for making concrete here and which one is best suited to produce the most workable concrete for structures and that can endure the maximum compressive stress in its hardened state.

EXPERIMENTAL PROGRAMMING

Sieve analysis is done on the fine aggregates collected from the three different sources as per IS: 2386 (Part 1)-1963 and their gradation and fineness modulus found and compared and their gradation curves are drawn.

Mix design of M-25 grade of concrete is performed as per IS: 10262-2009. 12 concrete cubes of M-25 grade of size 150mm x150mm x150mm are made with the same cement, same water cement ratio and the same coarse aggregates, 4 each with the three different fine aggregates from different sources. After curing for 3, 14, 28 and 60 days, they are tested for their compressive strengths and their strengths are compared.

A. MATERIALS USED

Cement: - Ordinary Portland cement of 43 grade conforming to Indian standard code IS 8112:1989 is used. Specific Gravity of cement is 3.15.

Coarse aggregate: - crushed stone aggregate from Bihubor quarry of size 12.5mm-10mm is adopted for mix. Specific Gravity of concrete is 2.63

Fine aggregates: - fine aggregates are collected from three different sources available in the greater Jorhat region of Assam; namely, Kanaighat, Mariani and Bhogdai (Jorhat site). Specific gravity is 2.60.

B. SIEVE ANALYSES

Table 1. Sieve analysis for Kanaighat fine aggregates [2]

Sieve	Weight Retained (Gm)	Weight Retained (%)	Cumulative Retained (%)	Weight Passing (%)
4.75 mm	38	7.6	7.6	92.4
2.36 mm	17	3.4	11	89
1.18 mm	110	22	33	67
600 µm	103	20.6	53.6	46.4
300 µm	153	30.6	84.2	15.8
150 µm	69	13	97.2	2.8
PAN	10			

Fineness modulus: 2.86 [2]

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Table 2. Sieve analysis for Mariani fine aggregates [2]

SIEVE	WEIGHT RETAINED (gm)	WEIGHT RETAINED (%)	CUMULATIVE RETAINED (%)	WEIGHT PASSING (%)
4.75 mm	10	2	2	98
2.36 mm	2	0.4	2.4	97.6
1.18 mm	23	4.6	7	93
600 µm	25	5	12	88
300 µm	268	53.6	65.6	34.4
150 µm	155	31	96.6	3.4
PAN	15			

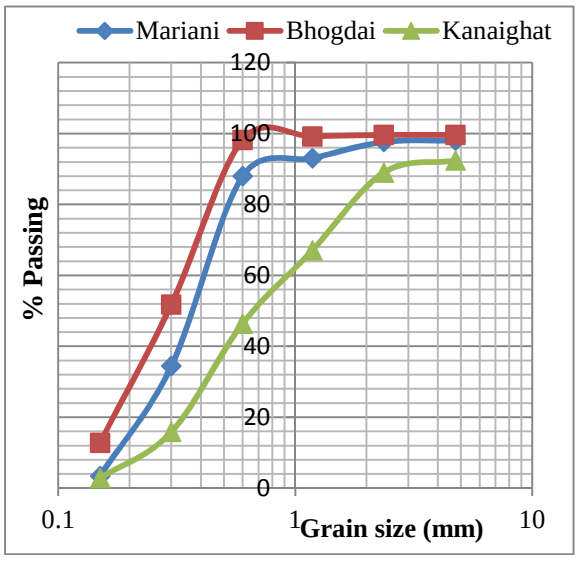
Fineness modulus: 1.856 [2]

Table 3. Sieve analysis for Bhogdai fine aggregates [2]

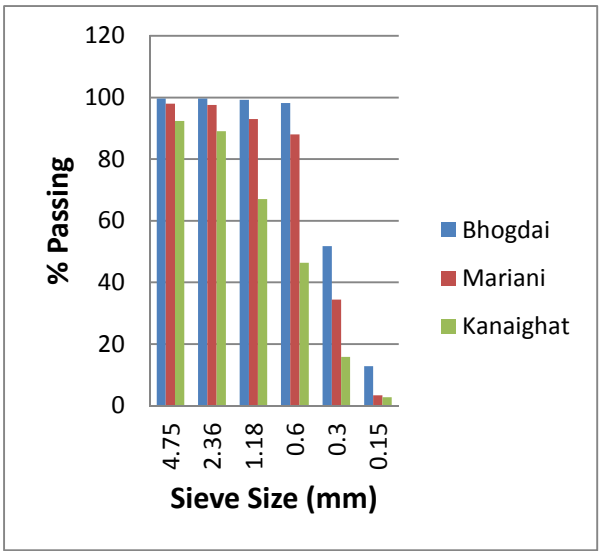
SIEVE	WEIGHT RETAINED (gm)	WEIGHT RETAINED (%)	CUMULATIVE RETAINED (%)	WEIGHT PASSING (%)
4.75 mm	2	.4	.4	99.6
2.36 mm	0	0	.4	99.6
1.18 mm	2	.4	.8	99.2
600 µm	5	1	1.8	98.2
300 µm	232	46.4	48.2	51.8
150 µm	195	39	87.2	12.8
PAN	60			

Fineness modulus: 1.38 [2]

Graph1. Particle size distribution graph aggregates



Graph 2. Comparison of the sieve analysis of the 3 fine



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C. MIX DESIGN

Mix design is performed for M-25 grade of concrete in accordance to Indian Standard Code, IS: 10262-2009.

Target Strength (f_{ck}') = f_{ck} + 1.65s
=25 + 1.65x4
=31.6 N/mm^2
Where s is the standard deviation from Table 1 of IS: 10262-2009
Water-cement ratio is taken as 0.4 [1]

Table 4: Mix Design [1], [3]

Type of fine aggregates	Mass per unit volume or volume				Ratio (Cement: fine aggregate: coarse aggregate: water)
	CEMENT (kg/m^3)	COARSE AGGREGATES (kg/m^3)	FINE AGGREGATES (kg/m^3)	WATER (Litres)	
Kanaighat	492.5	1054.998	639.240	197	1:1.298:2.142:0.4
Mariani	492.5	1123.062	571.948	197	1:1.16:2.28:0.4
Bhogdai	492.5	1123.062	571.948	197	1:1.16:2.28:0.4

RESULTS AND DISCUSSIONS

Table 5. Compressive strengths of the cubes

Type of fine aggregates	Compressive Strength(N/mm^2)			
	3 days	7 days	28 days	60 days
Kanaighat	12.28	20.92	32.264	36.624
Mariani	13.08	22.67	30.52	35.316
Bhogdai	11.28	19.53	29.34	30.28

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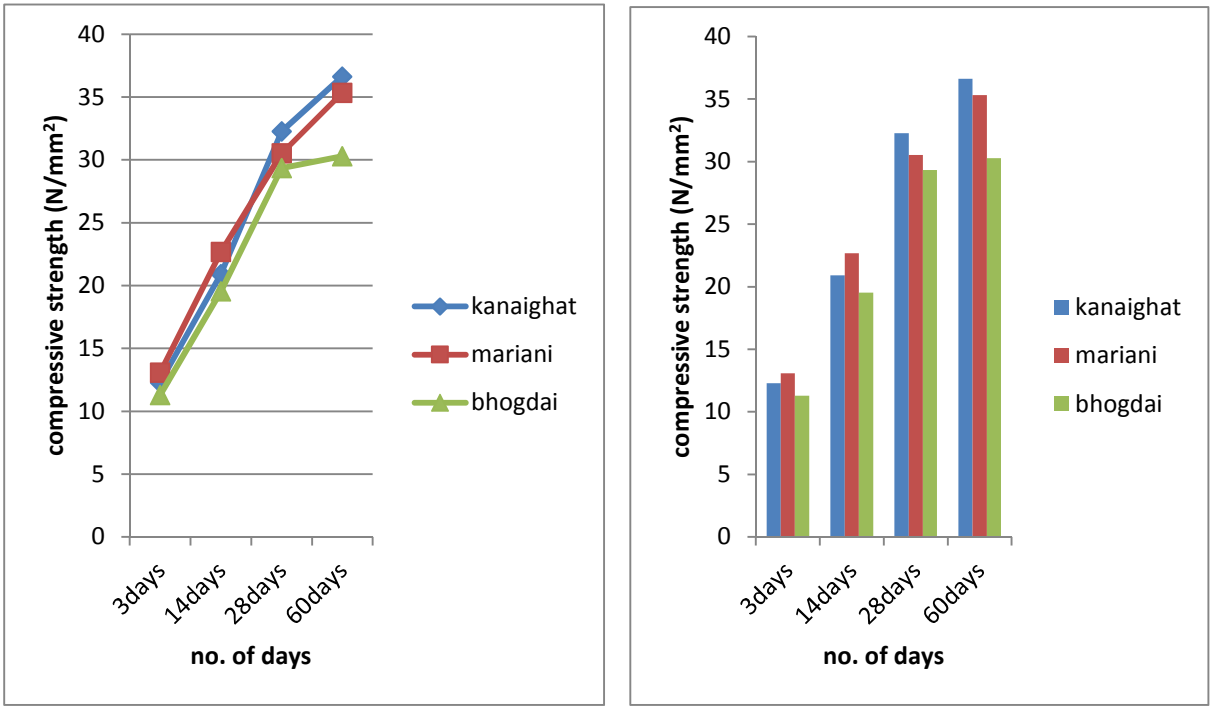
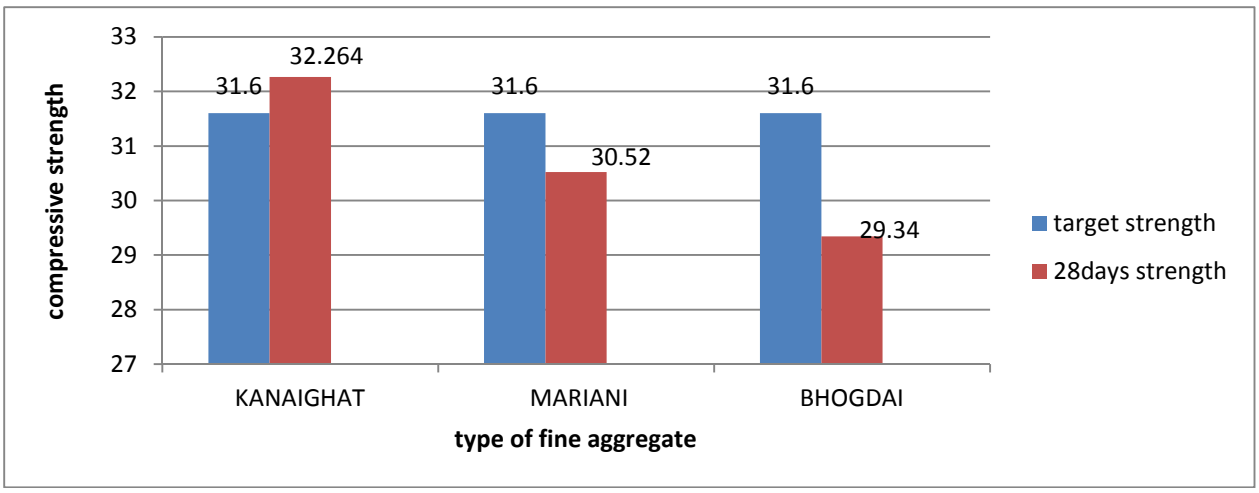
Graph 3. Comparison of the compressive strengths of the cubes made with the three different fine aggregates



Graph 4. Comparison of compressive strength of the cubes at the end of 28 days of curing and the target strength



CONCLUSIONS

1) Of the three different types of fine aggregates, the one obtained from Kanaighat falls in zone II as per IS: 383-1970. It is well graded. The fine aggregates obtained from Mariani and Bhogdai fall in zone IV. Both of them are gap graded.

2) The actual compressive strength of the concrete cubes made with fine aggregates from Kanaighat after 28 days of curing is more than the target strength by 2.10%.

3) The actual compressive strengths of the concrete cubes made with fine aggregates from Mariani and Bhogdai after 28 days of curing are less than the target strength by 3.4 % and 7.15% respectively.

4) The actual compressive strength of the concrete cubes made with fine aggregates from Kanaighat after 28 days of curing is more than that made with Mariani and Bhogdai by 5.71% and 9.97%

5) The actual compressive strength of the concrete cubes made with fine aggregates from Kanaighat after 60 days of curing is more than that made with Mariani and Bhogdai by 3.57% and 17.32%

REFERENCES

[1] IS: 10262-2009 "Recommended Guidelines For Concrete Mix Design".
[2] IS: 2386(Part I)-1963 "Methods Of Test For Aggregates For Concrete (Part I Particle Size And Shape)
[3] IS: 383-1970 (Reaffirmed 1997) "Specification For Coarse And Fine Aggregates From Natural Source For Concrete" (2nd Division).
[4] "Concrete Technology" by M.S. Shetty.
[5] Chapter 8 "A Case Study Of The Bhogdai River Basin" of the thesis "Land Cover Dynamics In The Foothills Of Assam- Nagaland Border And Its Geo-Environmental Impact On The Plains Of Assam" written by Mrinal Nath under the guidance of A K Bora.