

“Study on Consequence of Artificial Sand and Aggregate on Compressive Strength and Workability of Concrete”

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ABSTRACT

Structures are founded with concrete and steel materials mainly. Concrete is a main constituent of the Civil Engineering structures. Traditionally, concrete is mixture of cement, sand and aggregate. Properties of the sand and aggregate affect the durability and performance of concrete, so aggregate is an essential component of concrete. The most commonly used fine aggregate is natural river sand and coarse aggregate is stone quarry. Scarcity of good quality Natural River sand due to depletion of resources and restriction due to environmental consideration has made concrete manufactures to look for suitable alternative fine aggregate.

One such alternative is “Artificial sand” namely if graded by means may also be called as manufactured sand. In many parts of India, good natural river sand is not available and this makes manufacturing of good quality of concrete very difficult.

In this dissertation work an attempt has been made to determine and verify experimentally the effect of artificially graded sand and demolished concrete structural aggregates on compressive strength and workability of concrete. Artificial sand is manufactured from crushing of local chury, stone chips and demolished concrete fines while the artificial aggregates are prepared from demolished structures.

In the first phase of the study, the specimen of standard cube of (150 mm x 150 mm x 150 mm) was used to determine the compressive strength of concrete with natural sand and stone aggregates. The specimens were tested for each nominal mix and definite water cement ratio. Three cubes were prepared for obtaining average of 7, 14 and 28 days strength of concrete.

In the second phase of the study, another specimen of standard cube of (150 mm x 150 mm

x 150 mm) was used to determine the compressive strength of concrete with artificial sand with full replacement and demolished concrete structure aggregates. The specimens were tested for each nominal mix and definite water cement ratio. Three cubes were prepared for obtaining average of 7, 14 and 28 days strength of concrete.

Results were obtained and summarized to compare the nominal mix strength of traditional concrete with artificial concrete analytically as well as are compared graphically. The conclusions were made for the understanding the effect of artificial concrete in terms of strength and workability over traditional concrete.

INTRODUCTION

Structures are founded with concrete and steel materials mainly. Concrete is a main constituent of the Civil Engineering structures. It is becoming the backbone of infrastructural development of whole world. Concrete has capacity to enhance its properties with the help of other suitable constituents. The concrete is the most important construction material, which is manufactured at site. It has the advantage of being formed into any desired shape most conveniently. As an importance of the use of waste materials, number of research is currently being conducted concerning the use of artificial sand in increasing the workability and strengthening of reinforced cement concrete and plain cement concrete members.

In the first set, natural sand and stone aggregates from quarry sites is used to manufacture concrete for M15, M20 and M25 grade of concrete. For the determination of mix design various properties of concrete ingredients is conducted in the laboratory and results are recorded. For obtaining far more accurate results at least three samples are made for each grade of mix and then average value is taken for comparative study. In the second set, artificial sand and demolished aggregate is used to manufacture concrete for M15, M20 and M25 grade of concrete. For the determination of mix design various properties of concrete ingredients is conducted in the laboratory and results are recorded. For obtaining far more accurate results at least three samples are made for each grade of mix and then average value is taken for comparative study. In all sets of reading an attempt is made for keeping water cement ratio as 0.5. Lastly the cubes are tested for Workability and Compressive

strength using slump cone test apparatus and compression testing machine. Effect on workability and strength with variation in the quantity of artificial sand are studied from experimental data obtained for 7 days, 14 days and 28 days.

OBJECTIVES OF STUDY

On the basis of the recent trends in development in manufacturing of concrete and its ingredients the following becomes the part of study in the dissertation:

- To provide alternative to natural sand by replacing it with 100% artificial sand and aggregate for different concrete mix.
- To determine the effect of workability on compressive strength of concrete.
- To determine the compressive strength of concrete of different mixes once for natural sand and thereby replacing natural sand 100%.
- To determine the compressive strength of concrete of different mixes by grading of artificial coarse aggregate.
- To obtain graphically comparison of concrete for different mix.
- To draw graphical comparisons between different grades of concrete for improvement in workability and compressive strength of concrete.
- To draw conclusions about improvement in the workability and strength of concrete.
- To draw inferences for further scope in this direction.

METHODOLOGY

Methodology is the process of performing any work in proper manner i.e. step by step procedure of work.

This procedure of methodology is shown in following steps;

- a) Procurement of material
- b) Material testing
- c) For specific gravity and Fineness
- d) Arriving mix proportion
- e) Cube Casting
- f) Curing of specimens

- g) Strength test 7 days
- h) Result and Discussion

The specimen of standard cube of (150 mm x 150 mm x 150 mm) was used to determine the compressive strength of concrete. Three specimens were tested for 7, 14 and 21 days with varying proportion of manufactured sand replacement. The constituents were weighed and the materials were mixed in a mixer. The mixes were compacted with the help of tamping rod. The specimens were de molded after 24 h, cured in water for 7, 14 and 28 days, and then tested for its compressive strength as per Indian Standards.

RESULT AND DISCUSSION

After the example of standard 3D square of (150 mm x 150 mm x 150 mm) was utilized to decide the compressive quality of cement. Three examples were tried for 7, 14 and 28 days with differing extent of fabricated sand substitution. The constituents were weighed and the materials were blended in a blender. The blends were compacted with the assistance of taping bar. The examples were de formed after 24 h, cured in water for 7, 14 and 28 days, and after that tried for its compressive quality according to Indian Standards. Taking after results were gotten and:

Abridged beneath

S No	Mix	W/C Ratio	Slump (mm)	For Natural Sand: Average Compressive Strength in N/mm ²					
				7 Days	Avg.	14 Days	Avg.	28 Days	Avg.
1	M15	0.5	110	15.28	15.44	20.15	20.25	24.00	24.02
				15.64		20.45		23.90	
				15.78		20.30		24.40	
				12.00		18.16		22.2	

2	M20	0.5	140	13.00	13.00	18.24	18.26	22.5	22.31
				13.98		18.37		22.2	
3	M25	0.5	130	12.12	12.32	28.3	28.45	33.45	33.61
				12.26		28.6		33.56	
				12.26		28.4		33.78	

Table 1: Compressive Strength of Concrete with Natural Sand.

MIX	7 days N/mm ²	14 days N/mm ²	28 days N/mm ²
M15	15.44	20.25	24.02
M20	13.00	18.26	22.31
M25	12.32	28.45	33.61

S No	Mix	W/C Ratio	Slump (mm)	For Artificial Sand: Average Compressive Strength in N/mm ²					
				7 Days	Avg.	14 Days	Avg.	28 Days	Avg.
1	M15	0.5	110	15.78	15.82	20.25	20.64	24.00	24.60
				16.14		20.85		24.00	
				15.88		20.70		25.80	
2	M20	0.5	140	14.00	14.10	19.16	19.78	23.2	23.08
				13.90		19.84		22.8	

				14.18		19.52		23.28	
3	M25	0.5	130	14.12	14.07	29.38	29.66	34.45	34.88
				14.26		29.96		35.56	
				13.26		30.4		34.78	

Table 2: Compressive Strength of Concrete with Artificial Sand.

MIX	7 days N/mm ²	14 days N/mm ²	28 days N/mm ²
M15	15.82	20.64	24.60
M20	14.10	19.78	23.08
M25	14.07	29.66	34.88

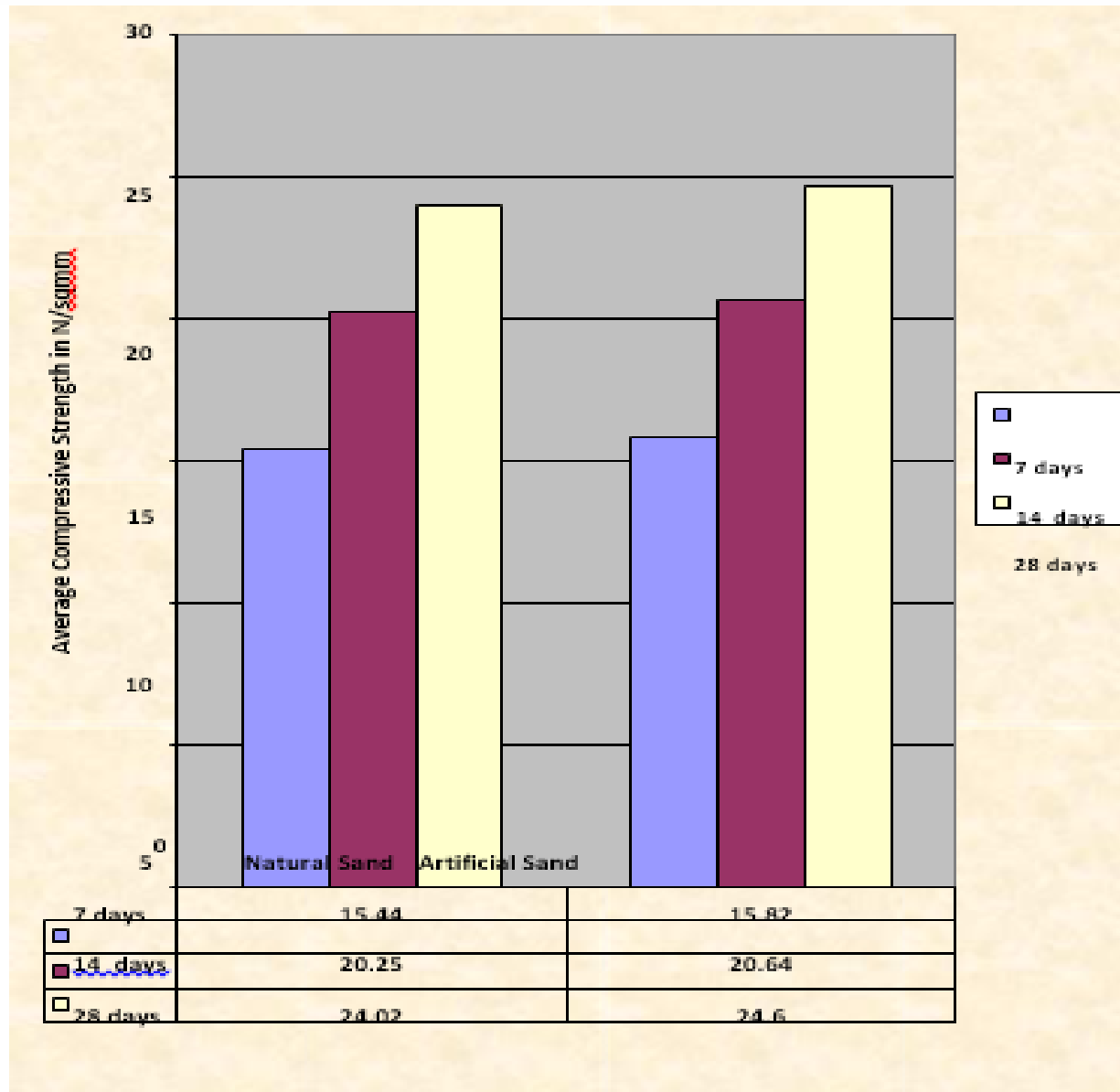


Fig 1: Graphical Comparison for M15 Grade of Concrete

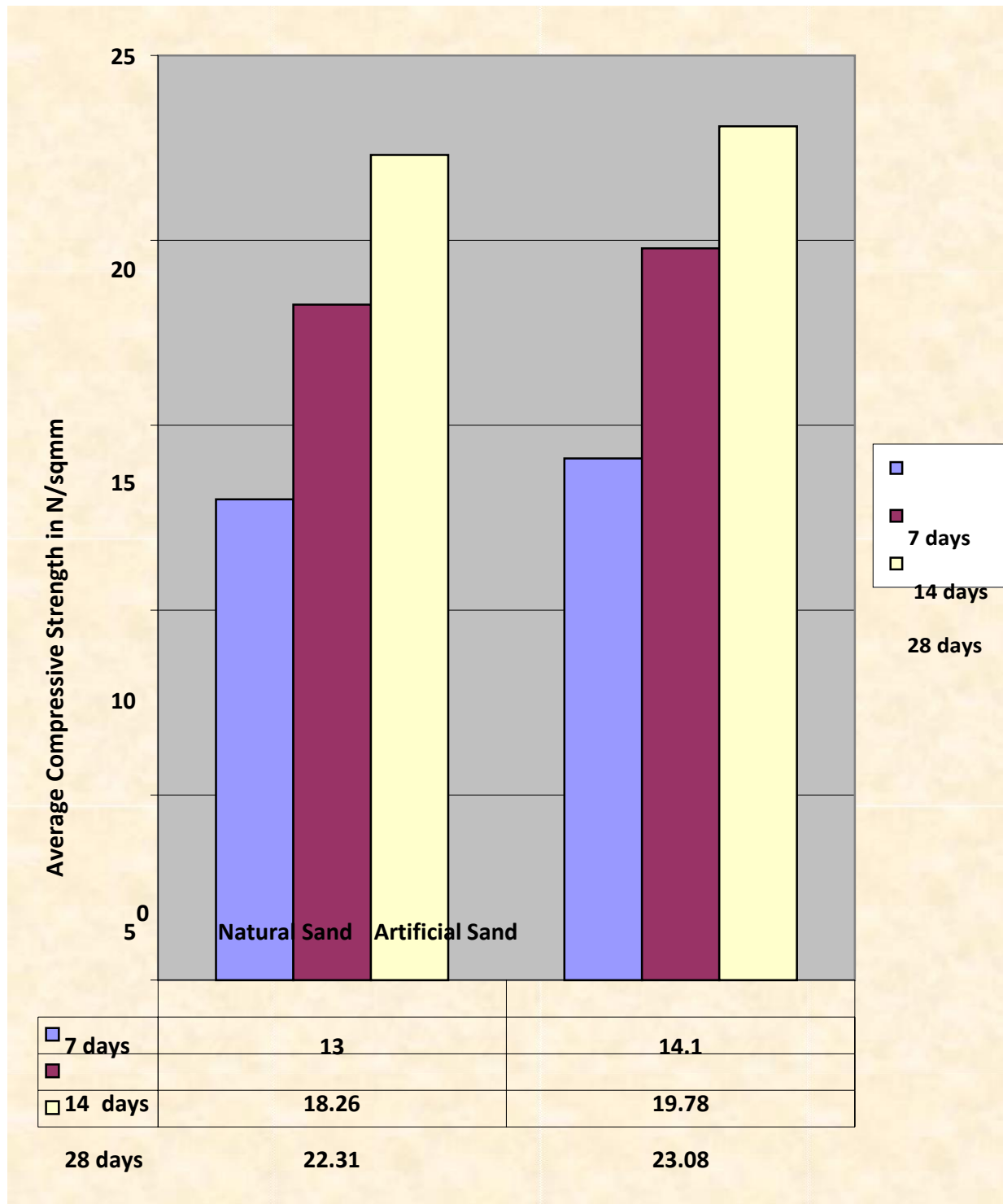


Fig2: Graphical Comparison for M20 Grade of Concrete

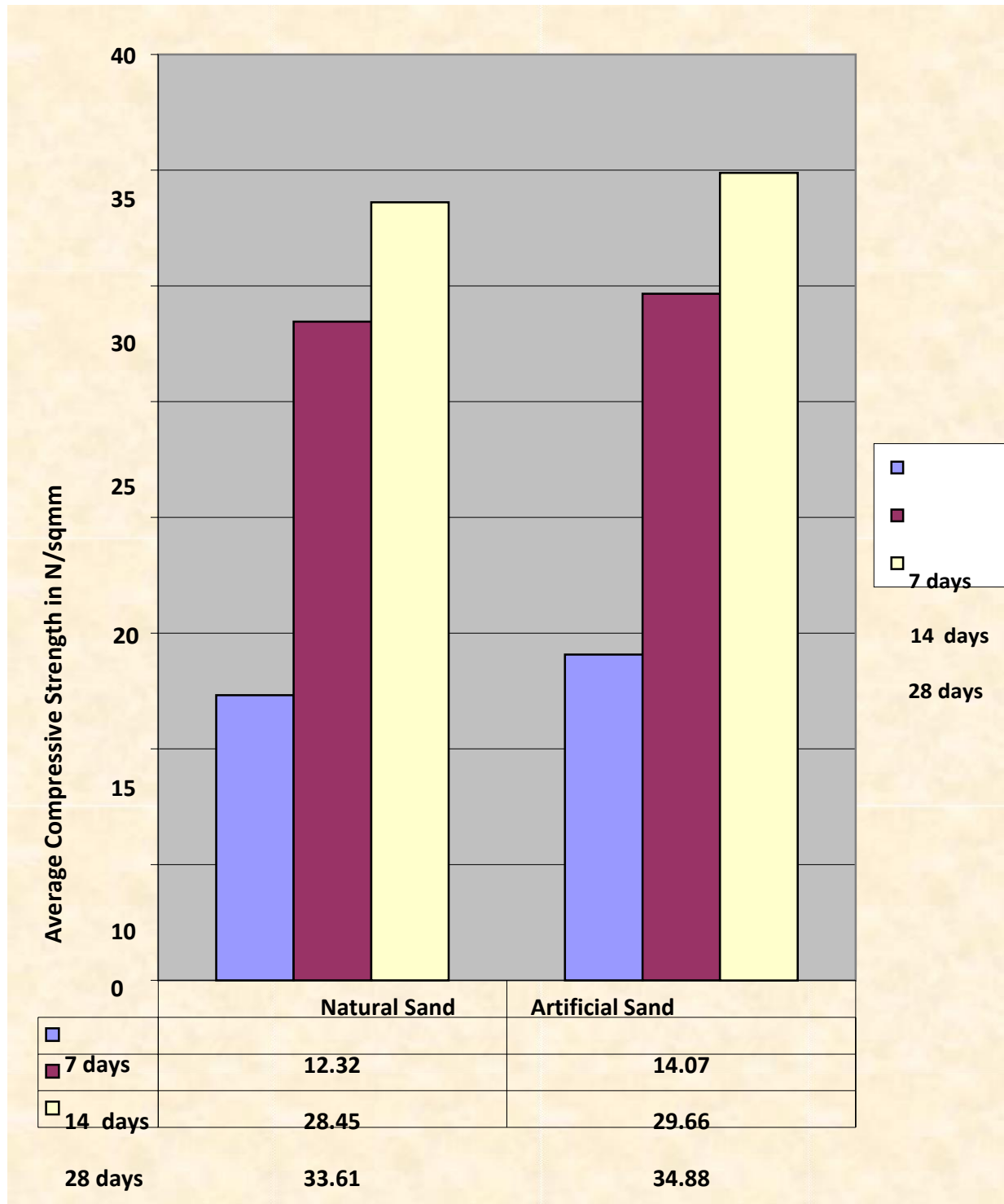


Fig 3: Graphical Comparison for M25 Grade of Concrete

WORKABILITY

The workability of the mixes was determined using a slump cone test having same water cement ratio for all the three mix design (M15, M20, and M25).

Workability by

Slump Cone Test

Table 5: Cube

with slump

heights.

MIX	Cube with Natural sand	Cube with Artificial Sand
M15	80 mm	76 mm
M20	70 mm	67 mm

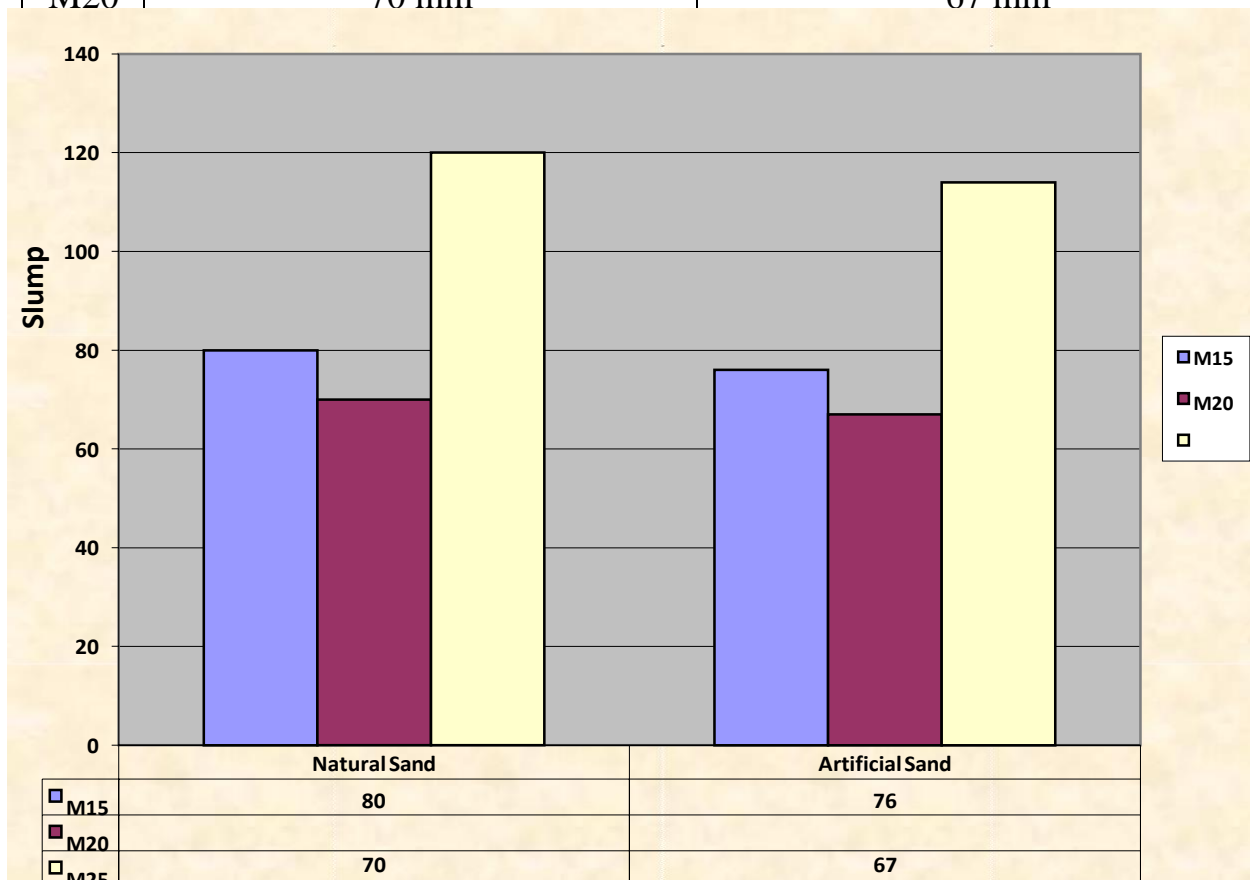


Fig 4: Graphical comparison of workability of concrete

CONCLUSION

- In Case of 100% replacement of natural sand by artificial sand, it is found that the compressive strength of the concrete for all grades increases.
 - Bonding strength increases due to fineness of artificial sand.
 - Increase in bonding strength results to increase in stiffness.
- Workability reduces slightly with the replacement of natural sand by artificial sand.
 - To increase the workability plasticizer can be used.
- Results show that the river sand can be fully replaced by artificial sand.
 - Proves to be economical in terms of availability.
- Concrete with artificial sand and aggregates design results are satisfactory.
- Cube strength of Narmada sand concrete is found to be less than artificial sand.
- Workability is more in case of natural sand made concrete as compared to artificial sand. ■ Results obtained after validation were satisfactory.

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