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STUDY ON EFFECTS OF COARSE AGGREGATE SIZES ON CONCRETE WITH QUARTZ POWDER

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ABSTRACT

Concrete has under gone many developments based on the studies of influence of both type and composition of cement ,aggregates and admixtures.This paper examines the influence of different proportions of coarse aggregate size on the mechanical properties of concrete,along with an intention of finding a suitable substitute material for the binder.For a concrete of M30 grade two types of aggregate proportion is chosen-Type I constitutes of 33.33% of 20mm,12mm and 10mm each.Type II constitutes of 50% of 20mm,25% of 12mm and 12.5% of 10mm and 6mm each.From both the cases of concrete mix, cement will be partially replaced by Quartz powder by 5%,10%,and15% by percentage weight of cement.The results obtained proved that the mechanical strength of concrete was more in Type II than in Type I and the nominal concrete mixes,also the results indicated that the characteristic strengths of concrete shows a linear variartion with increase in quantity of quartz powder.

KEYWORDS:Mechanical properties,Characterestic strength,Aggregate size,Quartz powder.

INTRODUCTION

In the past few decades building around the world have become heigher and so the demand for the structural strength is increased.This heigher demand also pulls for a substitute material for the cement ,which is at par with the strength properties .

The two main factors on which mechanical or macroscopic properties of concrete depends on the water-cement ratio and size of aggregate.It is well recognized that Coarse aggregate plays an important role in concrete.It occupies generally one-third of volume of concrete and researches indicates that change in coarse aggregate size can change the mechanical properties of concrete.To predict the behaviour of concrete under general loading requires an proper understanding of aggregates type,size and content.

Various researches are constantly undergone to find various proportions of both coarse aggregates size and percentage by weight of mineral and chemical admixtures,that can be optimized to find a suitable proportion of above ,which is eco-friendly and economic and also a one which acquires the desired characteristic properties.

QUARTZ POWDER

Quartz is the second most common material in Earths crust. It is made up of Silica(sio_2)tetrahedral, with a hardness of 7 on Mohs scale. It is an essential component of igneous and metamorphic rocks. The lustre in some specimen is Vitrious, in others it is Greasy or Glossy. In pure form quartz is colourless, but oftenly coloured by impurities.

EXPERIMENTAL INVESTIGATION

The experimental investigation is conducted as detailed below. All the materials tests were conducted in the laboratory as per relevant Indian Standard codes. Basic tests were conducted on fine aggregate, coarse aggregate and cement to check their suitability for concrete making. The study aims to investigate the strength related properties of concrete of M30 grade.The proportions of ingredients of the control concrete of grade M30 had to be determined by

mix design as per IS code. Workability of fresh concrete was determined by the slump test according to Indian standards. The typical size of cube 150mm×150mm×150mm was used to determine the Compressive strength. Split tensile strength was carried out on the cylinder with 150mm diameter and 300mm height.

MATERIALS

Cement

The cement used in this experimental investigation was 53 grade OPC manufactured by Chettinad cements.

Fine aggregate

The sand used for experimental program was locally produced and conforming to zone II. The sand was primarily sieved over 4.75 mm size sieve to take out any units bigger than 4.75 mm. The fine aggregates were tested as per Indian Standard Specification IS: 383-1970

Coarse aggregate

Locally available coarse aggregates were used in this work. Aggregates of size 20mm,12mm,10mm and 6mm were sieved and tested as per Indian Standard Specifications IS: 383-1970.

Water

The tap water available in the campus was tested for its suitability. Necessary properties such as pH value, chloride content, total hardness and total dissolved solids were evaluated.

Mix design

The mix design for M30 grade concrete is done according to the IS design method to obtain the optimum mix. Once the optimum mix is determined, it is used to produce concrete with two types of corse aggregate proportion along with 0%, 5%, 10%, 15%, replacement of Quartz powder.

TABLES

Table 1. Physical properties of cement

PROPERTY	VALUE
Specific Gravity	3.05
Standard consistency	32%
Setting time	
(i) Initial setting time	50 minutes
(ii) Final setting time	217 minutes
Fineness	2.5%

Tables 2. Chemical composition of cement

COMPONENT	%
Sio2	21.8
Al2O3	4.8
Fe2O3	3.8
CaO	63.3
SO3	2.2
MgO3	0.9
P2O5	<0.04
Loss of ignition	2
Insoluble residue	0.4

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Table 3. Physical properties of Fine Aggregate

PROPERTY	VALUE
Specific gravity	2.45
Fineness modulus	2.515
Bulk density	1.65 kg/m^3
Type of sand	Medium sand (zone 2)
Total water absorption	1.0%

Table 4. Physical properties of Coarse Aggregate

PROPERTY	VALUE
Specific gravity	2.62
Density	1567 kg/m^3
Fineness modulus	7.42
Impact value	22.12% < 45%
Crushing value	24.44% < 45%
Total water absorption	0.6%

Table 5. Concrete mix design proportion (M30 grade)

UNIT	WATER	CEMENT	FA	CA
Kg/m^3	160	380	711	1283
Ratio	0.42	1	1.87	3.337

Table 6. Aggregate mix proportion (M30 grade)

Type of Coarse aggregate mix proportion By % weight of total Coarse aggregate	Size of Coarse aggregate used			
	20mm	12mm	10mm	6mm
Type-I	33.33%	33.33%	33.33%	NIL
Type-II	50%	25%	12.5%	12.5%

RESULTS AND DISCUSSION

Compressive strength

Compression test has been carried out on concrete cubes with standards confirming to IS 516-1999. All the samples were tested in a 1000KN capacity universal testing machine. After 28 days of curing, the cubes were permitted to turn into dry condition before testing. Plane surfaces of the specimen were between platens of compression testing machine and subjective to loading. The compressive strength of the concrete cubes are given in Table

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Curing time	Type of Coarse aggregate proportion	% By weight replacement of Cement by Quartz powder			
		0%	5%	10%	15%
7 Days	Type-I	18.89	21.77	24.22	26.22
	Type-II	19.33	22.66	27.11	28.88
28 Days	Type-I	33.11	35.566	37.11	40.44
	Type-II	34.22	36.66	38.66	41.33

Table 7.Characterestic compressive strength of cubes in MPa (M30 grade)

Tensile Splitting Test

The split tensile strength of a concrete is carried on cylindrical specimen of diameter 150mm and length 300mm.Two wooden-bearing strips are placed. The specimen was loaded until it fails. The test is done at the age of 7, and 28 days. The machine used was the same UTM that used for compression test.

Table 8.Split Tensile strength in MPa (M30 grade)

Curing time	Type of Coarse aggregate proportion	% By weight of replacement of Cement by Quartz powder			
		0%	5%	10%	15%
7 Days	Type-I	2.19	2.33	2.68	2.9
	Type-II	2.26	2.40	2.75	3.04
28 Days	Type-I	3.6	3.81	4.38	4.81
	Type-II	3.74	3.96	4.52	5.02

Flexural strength test

We observed that the flexural strength of beam increases as the partial replacement of quartz powder increases. But Flexural strength of the beam containing Type-II was heighr than that of which contain Type-I coarse aggregate proportion.

Table 9.Flexural strength in MPa (M30 grade)

Curing Time	Type of Coarse aggregate proportion	% By weight replacement of Cement by Quartz powder			
		0%	5%	10%	15%
28 Days	Type-I	11.4	13.21	14.62	15.8
	Type-II	12.9	14.9	16.2	16.9

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Figure:

Fig.1 Comparison of compressive strength of concrete-M0 grade

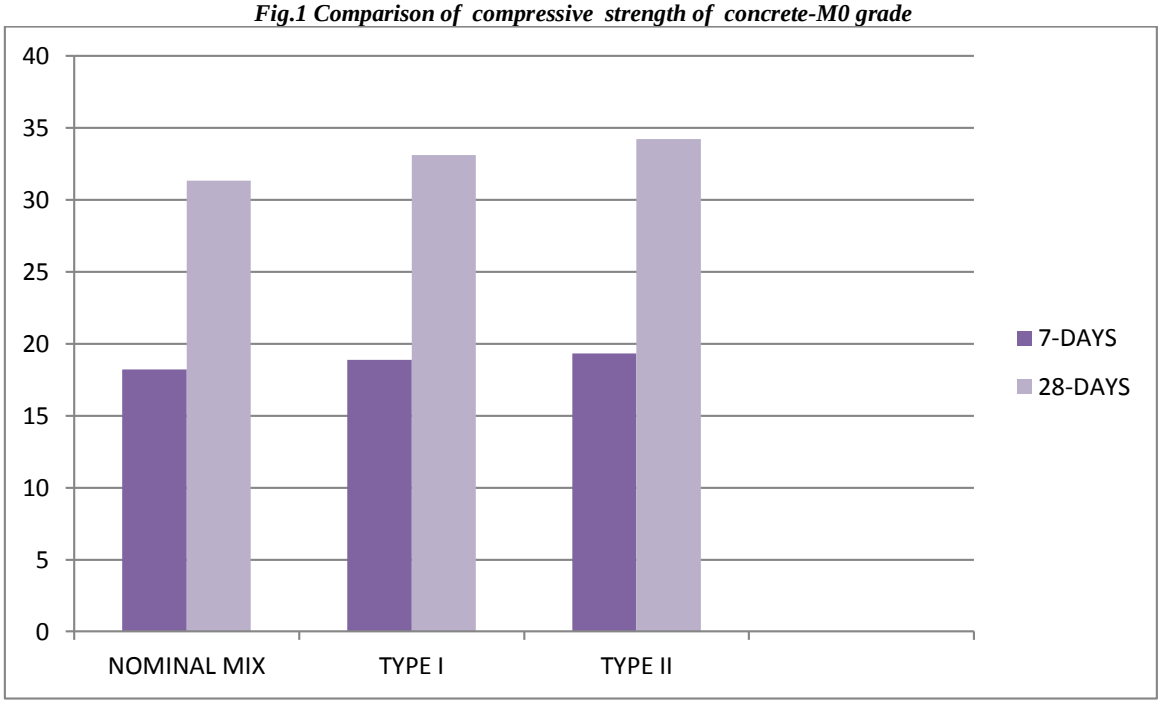

Fig.2 Comparison of split tensile strength of concrete-M30 grade

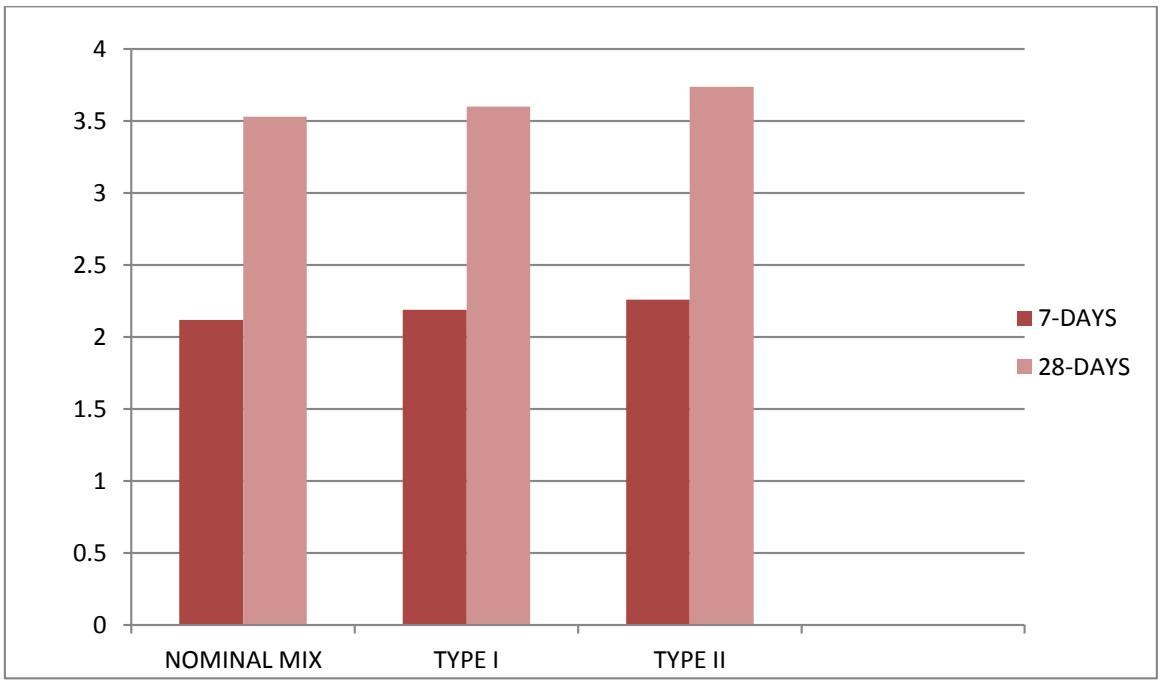

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Fig.3 Comparison of Compressive strength of Type-I Aggregate mix with Quartz powder replacement

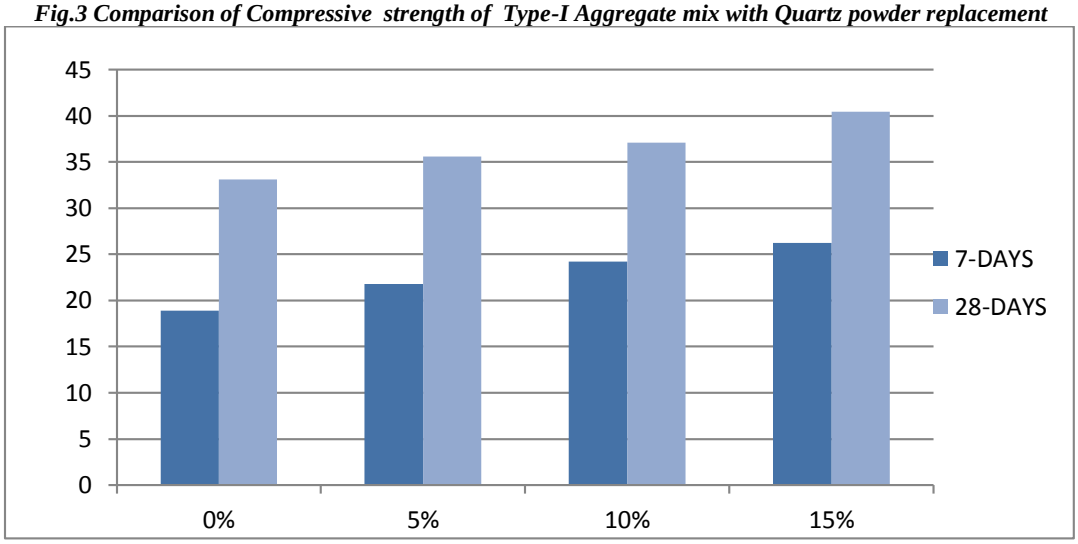

Fig.4 Comparison of Compressive strength of Type-II Aggregate mix with Quartz powder replacement

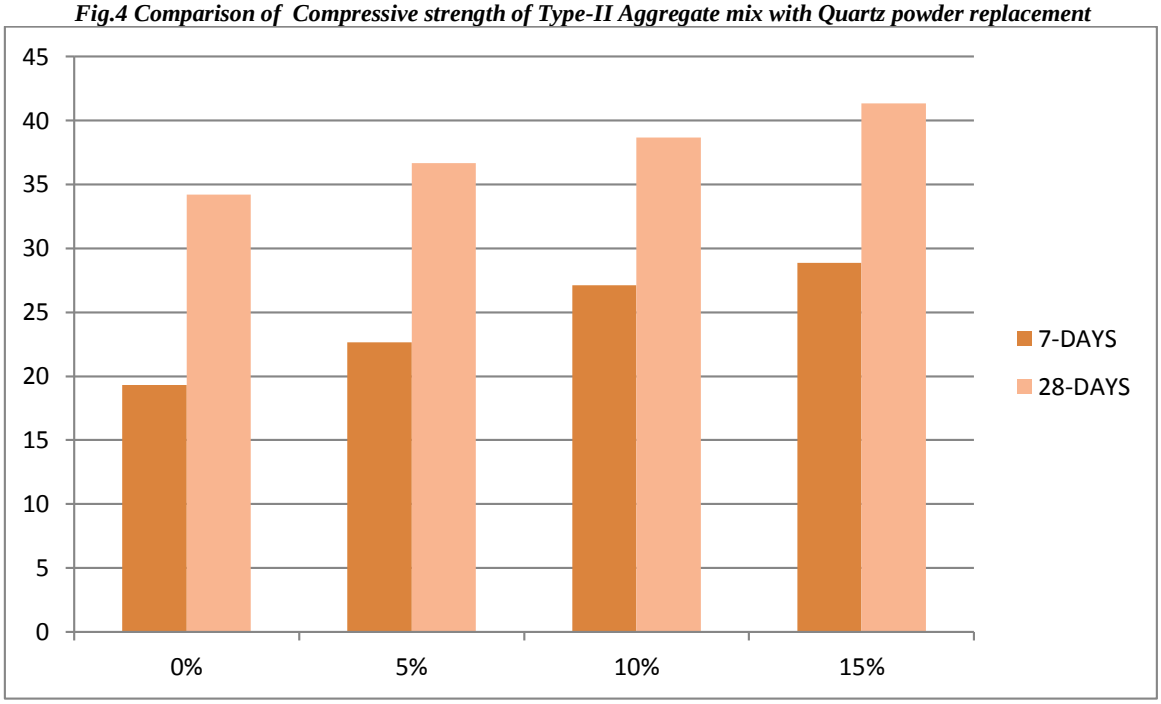

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Fig.5 Comparison of split tensile strength of Type-I Aggregate mix with Quartz powder replacement

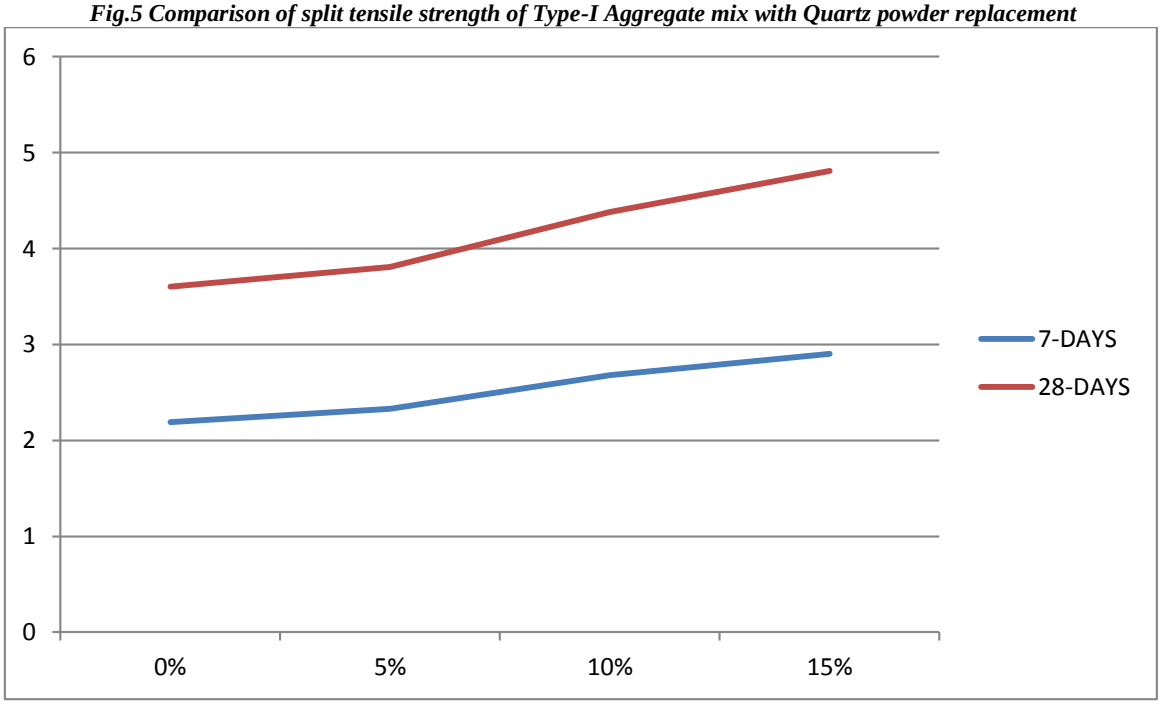

Fig.6 Comparison of split tensile strength of Type-I Aggregate mix with Quartz powder replacement

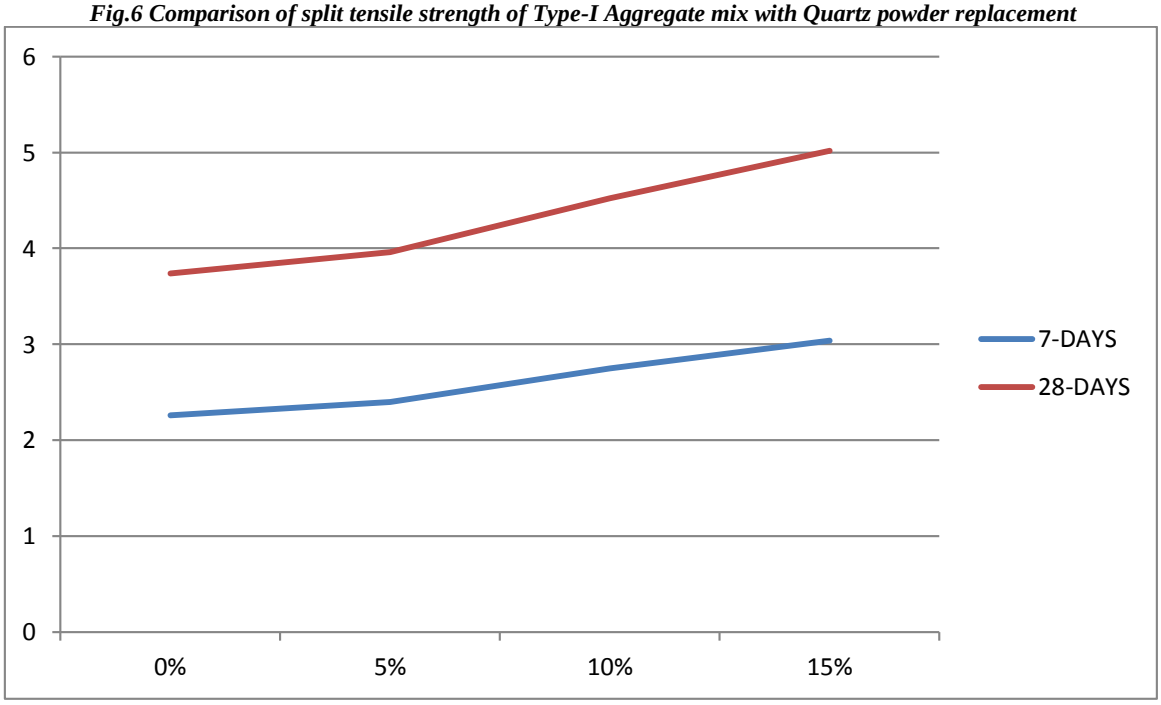

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Fig.7 Comparison of Flexural strength of cconcrete-M30 grade(28 days)

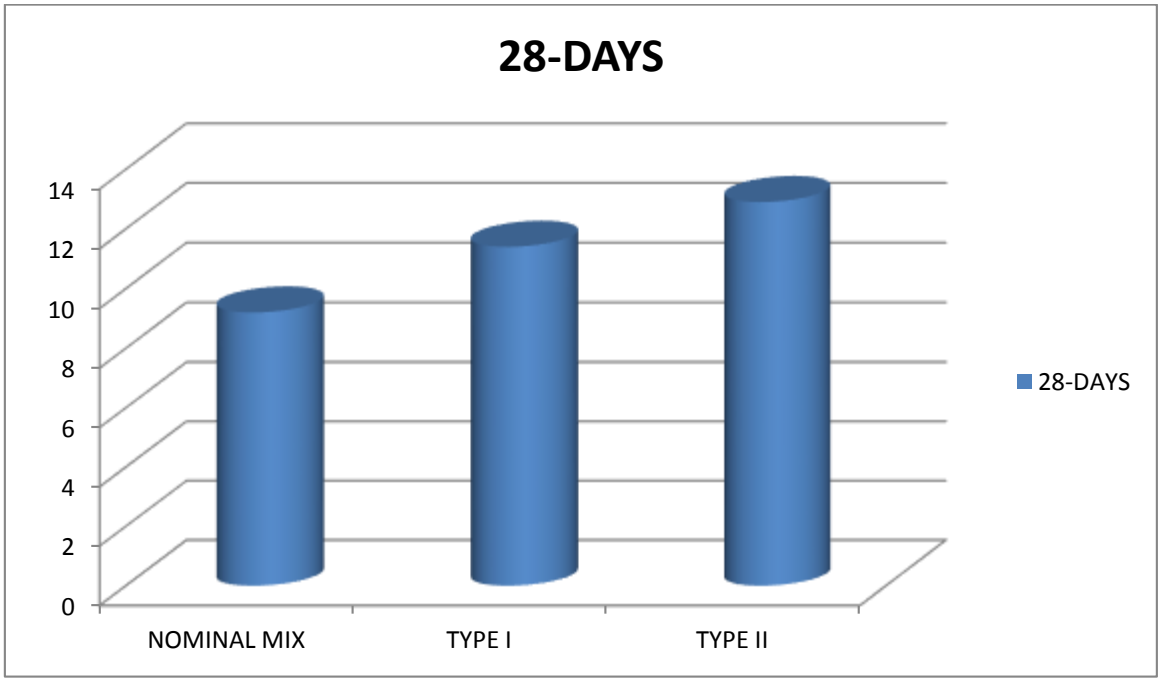
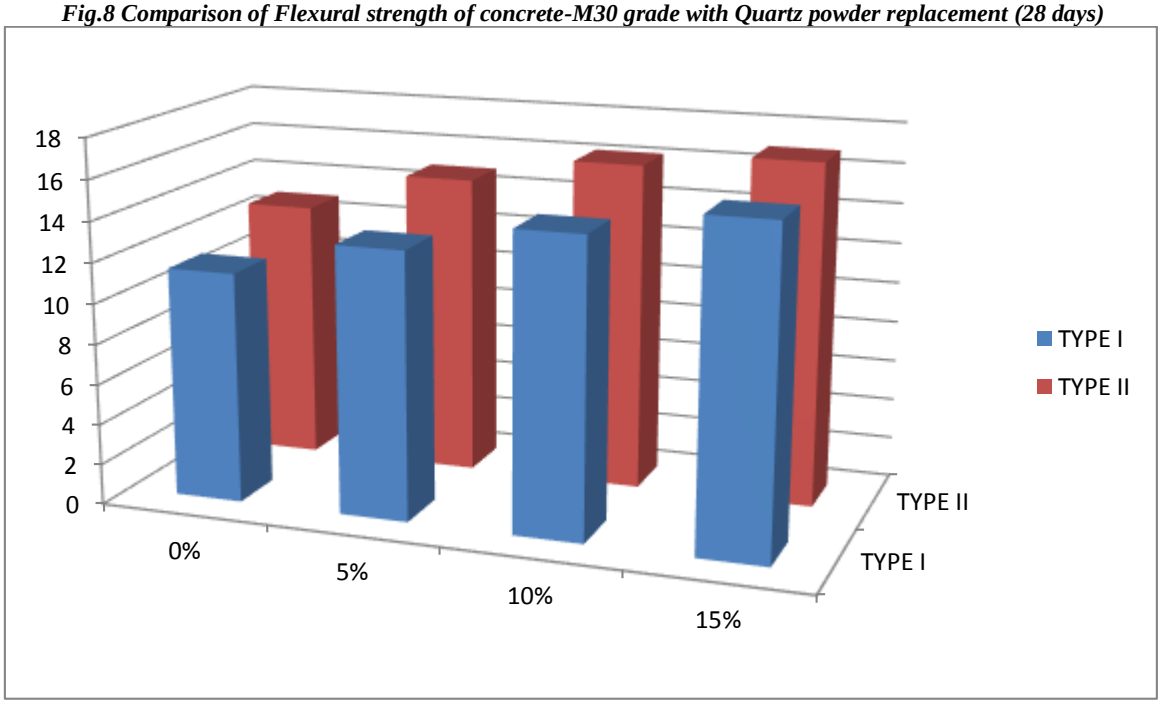


Fig.8 Comparison of Flexural strength of concrete-M30 grade with Quartz powder replacement (28 days)



CONCLUSION

- The influence of Coarse aggregate on the mechanical properties of concrete was depended mainly on the size of the aggregates used.

- The mix with Type-II Coarse aggregate mix showed heigher mechanical properties than Type-I and Nominal mix proportions.
- The smaller Coarse aggregates size used, occupied the voids created by the larger sized coarse aggregates.
- It was also observed that on replacing concrete with Quartz powder by 15% by weight of cement, the compressive strength was increased by 22.5% in Type-I and 24.1% in Type-II Coarse Aggregate mix.
- Split tensile strength showed an increase of 26.66% and 29.68% for Type-I and type-II respectively.
- Flexural strength showed an increase of 42.22% and 45.5% for Type-I and Type-II respectively.

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