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Study of various Grades of Concrete with and without Admixture

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Abstract: The ingredient of concrete are mixed in different proportions, either by volume or by weight, the latter being more precise and scientific. Volume batching of concrete is not allowed by revised IS 456-2000 today and the common method of expressing the proportions of ingredients in concrete mix is in the form of parts or ratio of cement. The fine aggregate and coarse aggregate cement being taken as unity. Cubes are cured alternate wetting and drying condition (partially curing) average compressive strength of concrete cube 30.60 N/mm2. Which is approximately 60 % of target compressive strength. When cube are cost with no curing is carried out, the cube are cured in room, the average compressive strength of the cube at 28 days = 22.5 N/mm2 . which approximately 58% of target which do not satisfied the requirement of target of M30 grade concrete , but it will satisfy the requirement of strength for M15 grade concrete. Therefore if the curing is not carried out site , grade of concrete used is M30 then the actual strength obtained at site. Sever cracks in concrete which affect scope serviceability, stability and safety. Which affect stability stiffness strength and seafty of the structure. Therefore curing is essential to gain the strength of concrete, for all structural element such as slab, beam. column and footing curing is to be carried out for 21 days IS code of PPC.
Keywords: Concrete, Mix design, compressive strength and workability

I. INTRODUCTION

There are two aspects which require consideration. One, the cost of concreting. This is made up of the costs of material, equipment and labour. Since cement is several times more costly than aggregates, it is natural to aim at a mix which utilızes the least cement possible. The other is that the cement concrete has to satisfy certain minimum properties in its hardened state such as strengthened adequate durability. Since placing and compacting are necessary in order to achieve the desired objectives, a concrete mix has to have adequate workability to carry out efficiently these.

The principal objectives of a concrete mix design are,

Therefore,

A. To achieve the desired compressive strength.
B. To use the leanest mix possible, subject to minimum requirement for durability.
C. To use locally available aggregates subject to their satisfying minimum requirements.

Concrete is essentially a mixture of Portland cement, water, coarse aggregates and admixtures (if needed) that consolidates into hard mass due to the reaction between the cement and water. Each of the four constituents has a specific function the coarse aggregates act as filler. The fine aggregates fills the voids between the paste and the coarse aggregate while is cement into conjunction with water acts as a binder. In recent years, chemical admixtures are increasingly used in concrete to modify one or more properties of concrete, either in fresh, hardening or hardened states.
The ingredient of concrete are mixed in different proportions, either by volume or by weight, the latter being more precise and scientific. Volume batching of concrete is not allowed by revised IS 456-2000 today and the common method of expressing the proportions of ingredients in concrete mix is in the form of parts or ratio of cement. The fine aggregate and coarse aggregate cement being taken as unity.
The mix design can be defined as the process of selecting suitable ingredients of concrete and determining their relative proportions with the object of producing concrete of certain minimum strength and durability as economically as possible.

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II. LITERATURE REVIEW

Hunchate ET Al introduced a paper on design to Mix high performance concrete using silica smoke as a impurity. It was used in concrete for different proportions and found that the compressive strength was maximum at 15% of the replacement of cement from silica.

Alves et al presented a paper on comparing methods to Mix dosage for high concrete strength. The obtained results suggest the advantages of using specific dosage of methods for PAC, as well as compressive strength for 28 days and saving up to 50% for consumption cement. Singh et al made a comparative study between there is a method and a method of absolute volume of concrete mixture. It has been reported that CII techniques are well executed for low strength than higher strength and design strengths 30 MPA and 40 Mpa were obtained by the method of ACHIS.

Or El-Enien, et al presented a paper on the physico-mechanical properties of high-performance concretes using different units in the presence of silica. It was concluded that the addition of 10% of the smoke silica to cement content developed stronger and denser interfacial transition zone between concrete rough particles and cement matrix.

Amudhavalli et al studied the effect of silicon smoke on the strength and durability of concrete parameters. It has been reported that optimal compressive strength and strength strength were obtained in the range of 10-15% silicon smoke level replacement.

Duval ET Al studied the effect of silica smoke on performance and compressive strength of high performance concretes. Cement replacement 10% of silica Dyme reported, without affecting the performance and compressive strength of concrete. It achieved maximum compressive strength at 10% to 15% of cement substitution with smoke silica.

III. METHODOLOGY

For proportioning in connection with a concrete mix, four factors are important, namely (a) Water Cement ratio, (b) Cement Content, (c)Gradation of aggregates, and (d) Consistency. Our effort in proportion in should be to use a minimum amount of paste that will lubricate the concrete mass, while fresh and after hardening will bind the aggregate particles to get hired fill the space between them. Any excess of paste involves greater cost, greater drying shrinkage, greater susceptibility to percolation of water, and therefore, attacked by aggressive water and weathering action. This can be achieved by minimizing the voids by proper gradation.

IV. RESULTS

From the above methodology the results are obtained as follows.

A. Design of M30 grade concrete

1) Design Parameters

a) F_{CK}= 30 Mpa

b) MSA = 10 mm, 20 mm aggregates

c) Degree of workability = Medium for R.C.C. work

Slump = 50 mm to 100 mm

Compacting factor = 0.85 to 0.92

d) Degree of quality control = Good

Tolerance factor - (t) = 1.65

e) Type of exposure = Sever

f) Natural sand (River sand) =100 %

g) Max. Water cement ratio = 0.45

h) Standard deviation = 5

i) OPC 53 grade cement = Birla gold OPC 53 grade

2) Mix Design Steps

a) Target Strength Of Concrete

$$F_t = F_{CK} + (t \times s)$$
$$= 30 + (1.65 \times 5)$$
$$= 38.25 \text{ Mpa}$$

b) Section of water cement ratio for OPC 53 Grade

(As per IS 10262 – 1982)

Water cement ratio = 0. 44 ……. (From E- curve) *c) Selection Of Water Content*

Max^{m} Water content as per IS 10262 - 2009 = 1861 free for 25 to 50 mm
for 20 mm coarse aggregate slump

Estimated water content for 100 mm slump
= 186 + (6 x 186) /100
= 197 liters

d) Calculation Of Cement Content

Water – cement ratio = 0.44
OPC 53 Cement content = 197/0.44
= 447.73
= 448 kg/m^3< 450 kg/m^3
= 448 kg/m^3>320kg/m^3
OK

OPC 53 cement bag consumption (Each bag = 50 kg)
= 448/50
= 8.96 kg/m^3

e) Proportion of volume of coarse aggregate and fine aggregate content.

From table 3,
Volume of coarse aggregate corresponding to 20 mm M.S.A. & F.A. (zone - I) for w/c = 0.5
Volume of C.A. = 0.60
For w/c = -0.05 (Decrease in w/c)
Increase in C.A. by 0.01
Actual decrease in w/c = (0.5 – 0.44)
= 0.06
Increase in C.A. = (0.01 X 0.06)/0.05
= 0.012
Actual volume of C.A. = 0.6 + 0.012
=0.612
Volume of F.A =1 – 0.612
=0.338

f) Mix Calculations

Mix calculations per unit volume of concrete

- Volume of concrete = 1m3
- Volume of OPC 53 grade cement
= (Mass of cement)/ (Sp. Gr. of cement) X (1/1000)
= (448/3.15) X (1/1000)
= 0.1422
- Volume of water
= (Mass of water)/ (Sp. Gr. of water) X (1/1000)
= (197/ 1) X (1/1000)
= 0.1970
- Volume of chemical admixture
(Super plasticizer @ 2% by mass of concrete)
= N.A. (Not used)
= 0

e) Volume of all in aggregate
= a – b – c – d
= 1 – 0.1422 – 0.1970 – 0

= 0.6608

- Mass of coarse aggregate

  = e X volume of C.A. X Sp. Gr. of C.A. X 1000
  = 0.6608 X 0.612 X 2.93 X 1000
  = 1184.92
  = 1185 kg
- Mass of fine aggregate

  = e X volume of F.A. X Sp. Gr. of F.A. X 1000
  = 0.6608 X 0.388 X 2.78 X 1000
  = 712.76 kg
  = 713 kg
- Concrete mix Proportion for 1m^3 of Concrete of M30 Grade

Water		Cement		F.A.		C.A.		W/c
197	:	448	:	713	:	1185	:	0.440

Mix proportion for dry

W/c		C		F.A.		C.A.
0.44	:	1	:	1.592	:	2.645

Quantity of dry C.A., F.A. per bag of cement

W/c F.A. C.A. Water 0.44 :
50 : 132.25: 22kg
(60%) 20mm 10mm (40%)
79.35kg + 52.90kg

Actual Mix proportion for saturated surface dry condition of C.A. and F.A. per
Bag of OPC 53 grade
Water per bag of OPC cement

a) For w/c = 0.44 water = 22kg
b) Extra quantity of water to be added foe water observation in case coarse aggregate @ 0.5 % by mass of coarse aggregate.
   = (0.5/100) X 132.25
   = 0.66 =0.7
c) Quantity of water to be deducted for free moisture present in sand = 0.77

d) Extra quantity of water to be added for water absorption in case of fine aggregate @ 1% by mass of fine aggregate .
   = (1/100) X 79.6
   = 0.796 = 0.8

   Actual quantity of water to be added per bag of OPC 53
   = 22 + 0.7 + 0 + 0.8
   = 23.5 liters or kg

   Actual quantity of water to be added per bag of OPC 53
   = 132.25 – 0.7
   = 131.55 kg

   Actual quantity of fine aggregate per bag of OPC 53
   = 79.6 – 0.8
   = 78.8 kg

   Actual mix proportion per bag of OPC53

Water		OPC53		Sand		C.A.
23.5	:	50	:	78.8	:	131.55

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W/c
0.47 : 1 : 1.576 : 2.631

Quantity of ingredients of M30 required for casting cubes in the laboratory.

OPC53 = 14
Sand = 22.12kg
C.A. 20mm (60%) = 22.1 kg
C.A. 10mm (40%) = 14.4 kg
C.A. (Total) = 36.82kg
Water = 14 X 0.47
= 6.58 liters

For casting 6 cubes in laboratory
M30 – (0.47 : 1 : 1.58 : 2.63)

OPC 53 = 12 kg
Sand = 19 kg
C.A. 20 mm (60%) = 19kg
C.A. 10mm (40%) = 12.6 kg
C.A. (Total) = 31.6kg
Water = 12 X 0.47
= 5.64 liter

Table No.1: Compressive strength of M30 grade of concrete without superplasticizers

Grade of size of concrete cube	Cross section Area (A) mm^2	Workability Slump	Period of curing	Compressive strength in (N/mm^2)
M30 (0.47:1:1.58:2.63) 150 X 150 X 150 mm (Without plasticizers)	150 X 150 = 22500 mm^2	50 mm	7 days	1) 23.1 2) 25.7 3) 28.4
		50 mm	28	1) 37.6 2) 38.4 3) 38.9
		50 mm	Partial curing by wet gunny bag – 28 days	1) 30.60
		50 mm	No curing Testing after 28 days	1) 22.5

Table No.2: Compressive strength of M30 grade of concrete With super plasticizers 20 % Reduction

Grade of size of concrete cube	Cross section Area (A) mm^2	Workability Slump	Period of curing	Compressive strength in (N/mm^2)
M30 (0.48:1:2.138:3.57:2%) 150 X 150 X 150 mm (With super plasticizers) 20% Reduction	150 X 150 = 22500 mm^2	55 mm	7 days	1)20.067 2) 20.40 3) 20.53
		55 mm	28 days	1) 26.00 2) 28.27 3) 30.40
		55 mm	Partial curing by wet gunny bag – 28 days	1) 21.30
		55 mm	No curing Testing after 28 days	1) 13.10

Table No.3: Compressive strength of M30 grade of concrete With super plasticizers 15 % Reduction

Grade of size of concrete cube	Cross section Area (A) mm^2	Workability Slump	Period of curing	Compressive strength in (N/mm^2)
M30 (0.477:1:1.98:3.30:2%) 150 X 150 X 150 mm (With super plasticizers) 15 % Reduction	150 X 150 = 22500 mm^2	70 mm	14 days	1) 30.71 2) 32.22 3) 33.73
		70 mm	7 days	1) 16.88 2)17.67 3)18.46
		70 mm	28 days	1) 25.2 2) 26.40 3) 27.56
		70 mm	Partial curing by wet gunny bag – 28 days	1) 26.22
		70 mm	No curing Testing after 28 days	1) 26.36

Table No.4: Compressive strength of M30 grade of concrete With super plasticizers 10 % Reduction

Grade of size of concrete cube	Cross section Area (A) mm^2	Workability Slump	Period of curing	Compressive strength in (N/mm^2)
M30 (0.47:1:1.312:3.29) 150 X 150 X 150 mm (Withsuper plasticizers) 10% Reducing	150 X 150 = 22500 mm^2	80 mm	7 days	1) 28.36 2) 27.09 3) 25.82
		80 mm	28 days	1) 42.321 2)40.430 3) 38.540
		80 mm	Partial curing by wet gunny bag – 28 days	1) 23.51
		80 mm	No curing Testing after 28 days	1) 14.80

B. Design of M25 grade concrete

1) Design Parameters

a) F_{CK}= 25 Mpa

b) MSA = 10 mm, 20 mm aggregates

c) Degree of workability = Medium for R.C.C. work

Slump = 50 mm to 100 mm

Compacting factor = 0.85 to 0.92

d) Degree of quality control = Good

Tolerance factor - (t) = 1.65

e) Type of exposure = Sever

f) Natural sand (River sand) =100 %

g) Max. Water cement ratio = 0.44

h) Standard deviation = 5

i) OPC 53 grade cement = OPC 53 grade

2) M25 Mix Design Steps

a) Target strength of Concrete

$F_t = F_{CK} + (t \times s)$
$= 25 + (1.65 \times 5)$
$= 33.25$ Mpa

b) Section of Water Cement ratio for OPC 53 Grade

(As per IS 10262 – 1982)
Water cement ratio = 0.44 ……. (From E- curve)

c) Selection of Water Content

Max^{m} Water content as per IS 10262 - 2009 = 1861 free for 25 to 50 mm
for 20 mm coarse aggregate slump

Estimated water content for 100 mm slump
= 186 + (5 x 186) /100
= 195.3 liters

d) Calculation of Cement Content

Water – cement ratio = 0.44
OPC 53 Cement content = 195.3/0.44
= 443.86
= 443.86 kg/m^3< 450 kg/m^3
= 443.86 kg/m^3>320 kg/m^3
OK

OPC 53 cement bag consumption (Each bag = 50 kg)
= 443.86/50
= 8.87kg/m^3

e) Proportion of Volume of Coarse Aggregate And Fine Aggregate Content

From table 3,
Volume of coarse aggregate corresponding to 20 mm M.S.A. & F.A. (zone - I) for w/c = 0.44
Volume of C.A. = 0.60
For w/c = -0.05 (Decrease in w/c)
Increase in C.A. by 0.01
Actual decrease in w/c = (0.5 – 0.44)
= 0.06
Increase in C.A. = (0.01 X 0.06)/0.05
= 0.012
Actual volume of C.A. = 0.6 + 0.012
=0.612
Volume of F.A =1 – 0.612
=0.338

f) Mix Calculations

Mix calculations per unit volume of concrete
a) Volume of concrete = 1m3
b) Volume of OPC 53 grade cement
= (Mass of cement)/ (Sp. Gr. of cement) X (1/1000)
= (443.86/3.15) X (1/1000)
= 0.140
c) Volume of water
= (Mass of water)/ (Sp. Gr. of water) X (1/1000)
= (195.3/ 1) X (1/1000)

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= 0.1953

d) Volume of admixture
(Fly Ash @ 20% by Volume of Cement)
Fly Ash = 443.86 x 20/100 = 88.77
Cement = 355.088
Volume of all in aggregate
= a – b – c – d
= 1 – 0.1389 – 0.1970 – 0
= 0.6641

f) Mass of coarse aggregate
= e X volume of C.A. X Sp. Gr. of C.A. X 1000
= 0.6641 X 0.612 X 2.884 X 1000
= 1172.14
= 1172 kg

g) Mass of fine aggregate
= e X volume of F.A. X Sp. Gr. of F.A. X 1000
= 0.6641 X 0.388 X 2.605 X 1000
= 671.23 kg
= 671 kg

Concrete mix proportion for 1m^3 of concrete of M30 grade

Water	:	Cement	:	F.A.	:	C.A.	:	W/c
195.3	:	437.77	:	671	:	1172	:	0.440

Concrete Mix Design - M25
(With Chemical Admixture Fly Ash)

A) Design Specifications:

1) Characteristic Compressive Strength Required @ 28 Days	25
2) Maximum Size Of Aggregate	20
3) Degree Of Workability - Compaction Factor	1
Minimum Cement Content	320
Max W/C Ratio	0.45
Method Of Conc. Placing	Pumping
4) Degree Of Quality Control	Good
5) Type Of Exposure	Severe
6) Type Of Agg.	Crushed Angular Agg.
7)Max Cement Content	450
8)Chemical Admixture Type	Fly Ash

B) Technical Data Of Material:

1) Cement Used	Ultratech Opc 53 Grade
2) Specific Gravity Of Cement	2.75
Admixture Used	Fly Ash
Specific Gravity Of Water	1
3) Specific Gravity Of Flash	2.2

4) Specific Gravity Of Aggregate		
I) Coarse Aggregate - 20mm / 10mm	2.74	2.74
Ii) Fine Aggregate - Natural Sand		2.65
5) Water Absorption		
I) Coarse Aggregate - 20mm / 10mm	0.5	0.5
Ii) Fine Aggregate - Natural Sand		1
6) Surface Moisture		
I) Coarse Aggregate - 20mm / 10mm	0	0
Ii) Fine Aggregate - Natural Sand		0
7) Sieve Analysis		
I) Fine Aggregate - Natural Sand :		

Table No.5: Sieve Analysis Fine aggregate

IS Sieve	Wt. Ret.	% Wt. Ret.	Cum % Wt. Ret.	% Passing
10	0	0	0	100
4.75	430	8.6	8.6	91.4
2.36	960	19.2	27.8	72.2
1.18	1550	31	58.8	41.2
600 mic	795	15.9	74.7	25.3
300 mic	655	13.1	87.8	12.2
150 mic	500	10	97.8	2.2
pan	110	2.2	100	0
		Total	355.5	
Sample wt.	5000	F.M.	3.555	

Table No.6: Sieve Analysis Fine aggregate for different zones

Fine Aggregate						
IS Sieve	N. Sand					
	100	100				
	% Passing	% Passing combined	Zone I	Zone II	Zone III	Zone IV
10	100	100	100	100	100	100
4.75	91.4	91.4	90 to 100	90 to 100	99 to 100	95 to 100
2.36	72.2	72.2	60 to 95	75 to 100	85 to 100	95 to 100
1.18	41.2	41.2	30 to 70	55 to 90	75 to 100	90 to 100
600 mic	25.3	25.3	15 to 34	35 to 59	60 to 79	80 to 100
300 mic	12.2	12.2	5 to 20	8 to 30	12 to 40	15 to 50
150 mic	2.2	2.2	0 to 10	0 to 10	0 to 10	0 to 15
F.M.	3.555					

Table No.6: Sieve Analysis Fine aggregate for different zones Coarse Aggregate - 10mm / 20mm : (10mm Aggregate)

IS Sieve	Wt. Ret.	% Wt. Ret.	Cum % Wt. Ret.	% Passing	
40	0	0	0	100	0
25	0	0	0	100	0
22.4	0	0	0	100	0
20	0	0	0	100	0
12.5	100	1	1	99	100
10	1240	12.4	13.4	86.6	85-100
4.75	7670	76.7	90.1	9.9	0-20
2.36	580	5.8	95.9	4.1	0-5
pan	410	4.1	100	0	
	Total		200.4		
Sample wt.	10000	gm F.M.=	2.004		

Table No.7: IS code provisions for fine aggregate sieve analysis

IS Sieve	Limits As Per IS	Values obtained
	20 MSA	10 MSA
40	--	--
25	100	--
22.4	--	--
20	85-100	--
12.5	--	100
10	0-5	85-100
4.75	--	0-20
2.36	--	0-5
Pan	--	--

Table No.8: Blending of coarse aggregate

Blending of coarse aggregate				
IS Sieve	10mm	20mm		
	50	50	100	
	% Passing	% Passing	Total	IS Limits
40	100	100	100	100
20	100	90.5	95.25	95 to 100
12.5	99	90.5	94.75	
10	86.6	4.8	45.7	25 to 55
4.75	9.9	0.6	5.25	0 to 10
2.36	4.1	0	2.05	
pan	0	0	0	

Table No.8: IS Limits for all aggregates

	% Passing	% Passing	Total	IS Limits
	50	50	100	
40	100	100	100	100
20	100	95.25	97.625	95 to 100
10	100	45.7	72.85	
4.75	91.4	5.25	48.325	30 to 50
2.36	72.2	2.05	37.125	
1.18	41.2	0	20.6	
600 mic	25.3	0	12.65	10 to 35
300 mic	12.2	0	6.1	
150 mic	2.2	0	1.1	0 to 6

Target Mean Strength Of Concrete (From IS 10262 Table No,1) 31.6
Selection Of Water-Cement Ratio: From Fig No. 1 IS 10262 0.442
W/C Ratio
30 0.45
31.6 0.442
40 0.4
Selection Of Water & Sand Content:
From Table No. 4 Water Content Per M3 Of Conc. IS 10262
Size 10mm 20mm
208 186
Water Content
Selection Of Cement Content (Kg): 331.391
Selection Of Water-Cement Ratio: 0.442
Fly Ash @20% 66.2783
Cement 265.113
For Pumpable Conc. Value Should Reduce By 10%
Vol.Of Coarse Agg. 55.80%
Vol.Of Fine Agg. 44.20%
Mix Propertion
Vol.Of Conc. 1
Vol.Of Cement 0.0964
Vol. Of Fly Ash 0.03013
Vol.Of Water 0.14648
0.72699
Mass Of Coarse Agg. 20mm 10MM
Mass Of Fine Agg. 555.758 555.758
851.528

	Trial No W/C Ratio						
1cum	0.44	Cement	Fly Ash	20mm	10mm	N. Sand	Water
0.035		265	66	556	556	852	146
		9.27896	2.31974	19.4515	19.4515	29.8035	5.12663

V. CONCLUSIONS

A. Concrete mix design using mix proportion 1:1.58:2.63when concrete used for desirable property this mix proportion achieve the desirable property this mix proportion achieve the target strength 38.25 N/mm2 .judicious selection and best combination of ingredients of concrete so as to achieve desirable properties of fresh and harden concrete as laid down in the specification (as per IS 10262-2009).
B. Fresh concrete we want medium workability slump and C.F observed.
C. Slump is found to be equal to 50 mm is lies between 50mm to 100 mm required for medium workability of concrete.
D. C.F is found to be equal to 0.89 lies between 0.89 to 0.92 required for medium workability f concrete.
E. M30 mix proportion of concrete OPC53 grade cement is used cement consumption per cum concrete found to be equal to 8.96 bags per cum equal to 450kg/m3 less than maximum cement consumption equal to 450kg/m3 cement consumption is adequate satisfy the requirement of IS 456-2000.
F. Super plasticizers is used as per IS 456-2000 code provision (2% by weight of cement).
G. Super plasticizer reduces the cement content.
H. 20% cement content reduces and concrete cubes are cost, compressive strength of cube at 28 days curing = 30.4 N/mm2. Less than target strength 38.25 N/mm2. Therefore 20% reduction in cement not satisfy the target strength of concrete.
I. 15% cement content reduces and concrete cube are cost compressive strength of cube at 28 days curing equal to 32.22 N/mm2. Less than target strength 38.25 N/mm2. Therefore 15% % reduction in cement not satisfy the target strength of concrete.
J. 10% cement content reduces and concrete cubes are cost. Using 2% super plasticizer by weight of cement.
K. the workability of fresh cement concrete is as slump= 80mm which lies between 50mm to 100mm required for medium workability.
L. C.F = 0, 90 which lies between 0.85 to 0.92 required for medium workability.
M. Average compressive strength of concrete cube at 28 days curing is equal to 40.43 N/mm2, therefore concrete mix for M30 grade concrete reduces.
N. Concrete cubes is used M30 concrete mix proportion as per conclusion number one. Cubes are cure in three different situation.
O. curing by water tank use as 100% compressive strength 38.40 N/mm2 greater than target strength 38.25 N/mm2.
P. Cubes are cured alternate wetting and drying condition (partially curing) average compressive strength of concrete cube 30.60 N/mm2. Which is approximately 60 % of target compressive strength.
Q. when cube are cost with no curing is carried out, the cube are cured in room, the average compressive strength of the cube at 28 days = 22.5 N/mm2 . which approximately 58% of target which do not satisfied the requirement of target of M30 grade concrete , but it will satisfy the requirement of strength for M15 grade concrete. Therefore if the curing is not carried out site , grade of concrete used is M30 then the actual strength obtained at site.
R. Sever cracks in concrete which affect scope serviceability, stability and safety. Which affect stability stiffness strength and seafty of the structure. Therefore curing is essential to gain the strength of concrete, for all structural element such as slab, beam. column and footing curing is to be carried out for 21 days (IS code of PPC.
S. This mix design is used for reinforced concrete work such as multistoried building, re-farm structure, earthquake resistance structure, retaining wall , water tank, CSR ,GISR, in savior explores condition such as in costal area.

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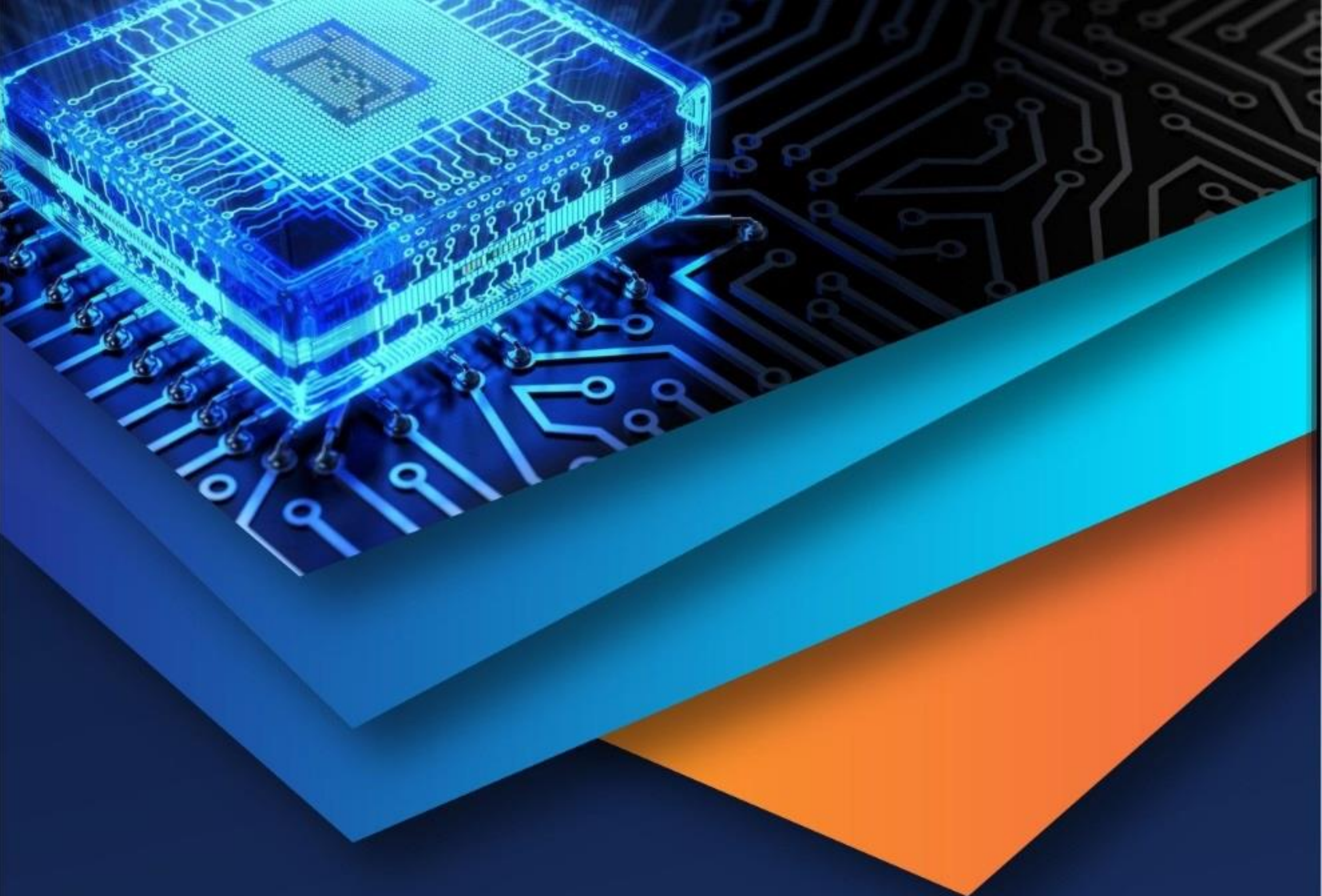

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