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Combined Grade Concrete Mix Design

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Abstract: ***The process of selecting suitable ingredients of concrete and determining their relative amounts with an objective of producing a concrete of required strength, durability, and workability as economically as possible is termed as concrete mix design. Here we are doing concrete mix design of M240, M40PT, M50 grade by adding various types of admixtures and get more strength as well as it's become less time consuming mix design as far as time is concern. Concrete mix design is a well-established practice around the world. All developed countries, as well as many developing countries, have standardized their concrete mix design methods. These methods are mostly based on empirical relations, charts, graphs, and tables developed as outcomes of extensive experiments and investigations of locally available materials. All of those standards and methods follow the same basic trial and error principles. The process of selecting suitable ingredients of concrete and determining their relative amount with the objective of producing a concrete of required strength durability and workability as economically as possible is termed the mix design. Some of the prevalent concrete mix design methods are: a) IS method b) ACI Mix Design Method, c) British Mix Design Method The concrete mix produced under quality control keeping in view the strength, durability, and workability is called the design Mix. Others factors like compaction equipment's available, curing method adopted, type of cement, quality of fine and coarse aggregate etc. have to be kept in mind before arriving at the mix proportion. The design mix or controlled mix is being used more and more in variety of important structures, because of better strength, reduced variability, leaner mixed with consequent economy, as well as greater assurance of the resultant quality.***
Keywords: Strength, durability, workability

I. INTRODUCTION

Concrete mix design may be defined as the art of selecting suitable ingredients of concrete and determining their relative proportions with the object of producing concrete of certain minimum strength & durability as economically as possible Mix design is a process of specifying the mixture of ingredients required to meet anticipated properties of fresh and hardened concrete. Concrete mix design is a well-established practice around the world. All developed countries, as well as many developing countries, have standardized their concrete mix design methods. These methods are mostly based on empirical relations, charts, graphs, and tables developed as outcomes of extensive experiments and investigations of locally available materials. All of those standards and methods follow the same basic trial and error principles. The process of selecting suitable ingredients of concrete and determining their relative amount with the objective of producing a concrete of required strength durability and workability as economically as possible is termed the mix design. Some of the prevalent concrete mix design methods are: a) IS method b) ACI Mix Design Method, c) British Mix Design Method The concrete mix produced under quality control keeping in view the strength, durability, and workability is called the design Mix.Others factors like compaction equipment's available, curing method adopted, type of cement, quality of fine and coarse aggregate etc. have to be kept in mind before arriving at the mix proportion.The design mix or controlled mix is being used more and more in variety of important structures, because of better strength, reduced variability, leaner mixed with consequent economy, as well as greater assurance of the resultant quality.

A. Problem Statement

1) It take more time to do the different grade concrete in slab & column at the same time.
2) It take time to cast the column & slab individually at the same time.
3) Use of two different grade concrete for slab & column costly as compared to make combined concrete of two different grade of same property

B. Scope Of Work

Scope of this work is to reduce the time of casting the structure consist different grade of concrete at the same time.

C. Objectives

1) To study the successful & ongoing application of combined grade concrete mix design.
2) To evaluate the potential use of combined grade concrete mix design in both column & slab by characterizing durability & strength based material behaviour.
3) To economise the concrete cost
4) To minimize the time for casting, supervision, quality control.

II. LITERATURE REVIEW

1) *A review of Concrete Mix Designs Santhosh R1 , Dr.P.Shivananda2 1,2VTU Research scholar, 2Proffesor Department of Civil Engineering, Reva University Bengaluru*

In this paper a study on mix designs of Indian standard method IS 10262: 2009, American concrete institute ACI 211.1-1991 and British standards BS 8500-1:2006 has been made for M15, M30 and M45 grades and comparison of water cement ratio, water content, cement content, fine aggregate and coarse aggregate content has been done and the observations have been presented. It was observed that water-cement ratio for all the said grade of concrete is more in BS method and less in IS method. And the variation of other parameter has been compared and concluded.

2) *Concrete Mix Design as Per IS Method of Mix Design Purvansh B. Shah International Journal of Science and Research (IJSR) ISSN (Online): 2319-7064 Index Copernicus Value (2016): 79.57 | Impact Factor (2015): 6.391*

Concrete mix design may be defines as the art of selecting suitable ingredients of concrete and determining their relative proportions with the object of producing concrete of certain minimum strength & durability as economically as possible. Considering objectives of mix design desired workability in the plastic stage, desired minimum strength in the hardened stage, desired durability in the given environment conditions & basic considerations like cost, specification, workability is to be studied while designing mix design. Grade of concrete & its Characteristics compressive strength of 150 mm cube at 28 days, N/mm2 is very important criteria to be considered. Factors affecting choice of mix design is being studied for better mix design.

3) *Comparative Study Of Concrete Mix Design By Adding Various Types Of Admixtures Jay H Shah1 *, Sachin B Shah2 National Conference on Recent Advances in Civil and Structural Engineering (RACSE-'14)*

Concrete occupies unique position among the modern construction materials, Concrete is a material used in building construction, consisting of a hard, chemically inert particulate substance, known as an aggregate (usually made of different types of sand and gravel), that is bonded by cement and water

III. METHODOLOGY

In order to make proper combined grade concrete mix design following materials are to be used: -

1) *N. Sand:* N.sand means natural sand. Natural sand impacts the fresh concrete properties of a maixture such as it gives workable concrete which gives good finishing to the structure. Natural sand has an ideal shape for use as fine aggregate in concrete which is provide workability also natural sand is well rounded & usually spherical in shape so it reduces the percentage of the voids within the concrete mixture so no extra work has to be done to fill the voids.
2) *C. Sand:* C.sand means crushed sand. Crushed sand is manufactured by crushing the quarried stone to a size that will completely pass through 4.75mm sieve. Crush sand gives higher durability & strength to concrete by overcoming problems like segregation, honeycombing, capillary, bleeding, voids. Crush sand consist of uniformly graded aggregates. It has higher compressive strength & It gives better quality of concrete or mortar.
3) *CA-10mm:* CA-10mm Means Coarse aggregate of 10mm. During the sieve analysis of CA-10mm, 70% of the aggregate passes through 10mm sieve & while 95% of the particles lie in between the range of 10mm & 4.75mm size used in RCC structure like the construction of buildings & flyovers etc.
4) *CA-20mm:* CA-20mm means Coarse aggregate of 20mm . These are obtained by ceushing of rocks having angular shape & are retained on 20mm sieve while 60-70% of the aggregates pass through the 20mm sieve used in RCC structure like the construction of buildings& flyovers etc.
5) *Cement:* Cement is used as a binder which bind the material used in production of concrete together. It is a chemical substance used for construction that hardens, sets, adheres to other materials to bind them together. Cement is mixed with sand to produce mortar. Concrete is used largely in construction industry for which manufacture of cement is extremely widespread.

6) *GGBS:* GGBS means Ground Granulated Blast Furnace Slag. It is a cementitious material whose main use is in concrete & is a by product from the blast furnaces used to make iron. GGBS reduce the likelihood of concrete thermal cracking, it offers great durability & GGBS improves concrete's resistance to damage from alkali-silica reaction, sulphates & chloride.
7) *Water:* Potable tap water used for mixture of concrete. Potable water is satisfactory for mixing & curing.
8) *Admixture:* We used FOSROC admixture for concrete mix design which is help in achieving the desired durability in concrete structure. FOSROC admixture enhance the properties & quality of concrete in both the hardened & plastic stages.
9) *Trial & Error Method:* To find out the proper proportion to get the concrete mix design for combined grade concrete mix design we used trial & error method. From trial & error method we found perfect mix which gives us required strength, workability, density & other properties of concrete.
10) *Flow Table Test:* We find out the flowability of concrete by flow table test. In which cone is place in the center of the flow table & filled with fresh concrete in equal two layers. Each layer is tamped for 10 times with a tamping rod. Wait for 30 sec before lifting the cone. The cone is lifted, allowing the concrete to flow. The flow table is then lifted upto 40mm & then dropped for 15 times causing the concrete to flow. After this the diameter of flow of the concrete is measured.

IV. RESULT & DISCUSSION

A. *Mix Design Trial Sheet 1*

50FF (Combined Grade Concrete Mix Design)

	N. Sand		C. Sand		CA-10mm		CA-20mm		Cement	GGBS	Water	Admix.	
	%	kg	%	kg	%	kg	%	kg	%	kg	%	kg	
Mix on SSD	0		855		749		324		350	120	155	4.7	1% added
Water Absorption	0	0	3.63	31.04	1.04	7.79	0.84	2.72					
Moisture Content	0	0	0.81	6.93	0	0	0	0					
Corrected Mix	0		830.89		741.21		321.28		350	120	189.62	4.7	
	Qty of water/deducted=					34.62	W/C @ S.S.D.		0.33				

Mix Design				
C. sand	831	×	0.027	22.434
CA-10mm	741	×	0.027	20.013
CA-20mm	321	×	0.027	8.675
Cement	350	×	0.027	9.45
GGBS	120	×	0.027	3.24
Water	190	×	0.027	5.12

Initial Flow	650mm	11:18AM
1hr	630mm	12:18AM
2hr	630mm	1:18PM

36 Hrs Strength			
9200	467.3	20.77	21.1
9162	474.4	21.08	
9128	482.4	21.44	

4 Days Strength			
9140	729	32.4	32.19
9242	736.8	32.75	
9102	706.8	31.41	

B. Mix Design Trial Sheet

50FF (Combined Grade Concrete Mix Design)

	N. Sand		C. Sand		CA-10mm		CA-20mm		Cement	GGBS	Water	Admix.	
	%	kg	%	kg	%	kg	%	kg	%	kg	%	kg	
Mix on SSD	0		864		717		360		370	100	150	4.23	0.90% added
Water Absorption	0	0	3.41	29.46	1.19	8.53	0.99	3.56					
Moisture Content	0	0	1.08	9.33	0	0	0	0					
Corrected Mix	0		843.87		708.47		356.44		370	100	182.23	4.7	
	Qty of water/deducted=			32.23	W/C @ S.S.D.		0.32						

Mix Design				
C. sand	844	×	0.027	22.784
CA-10mm	708	×	0.027	19.129
CA-20mm	356	×	0.027	9.624
Cement	370	×	0.027	9.99
GGBS	100	×	0.027	2.7
Water	182	×	0.027	4.92
Admix.	4.23	×	0.027	0.127
	2566			69.274

Initial Flow		**03:40PM**
1hr	610mm	04:40PM
2hr	575mm	05:40PM

4 Days Strength			
9218	730	32.44	32.89
9100	710	31.56	
9082	780	34.67	

28 Days Strength			
9200	1320	58.66	61.32
9220	1450	64.44	
9130	1370	60.88	

C. Mix Design Trial Sheet 3

50FF (Combined Grade Concrete Mix Design)

	N. Sand		C. Sand		CA-10mm		CA-20mm		Cement	GGBS	Water	Admix.	
	%	kg	%	kg	%	kg	%	kg	%	kg	%	kg	
Mix on SSD	0		864		717		360		370	100	150	3.76	0.80% added
Water Absorption	0	0	3.41	29.46	1.19	8.53	0.99	3.56					
Moisture Content	0	0	0.94	8.12	0	0	0	0					
Corrected Mix	0		842.66		708.47		356.44		370	100	183.44	4.7	
	Qty of water/deducted=					33.44	W/C @ S.S.D.		0.32				

C. sand	843	×	0.027	22.752
CA-10mm	708	×	0.027	17.129
CA-20mm	356	×	0.027	9.624
Cement	370	×	0.027	9.99
GGBS	100	×	0.027	2.7
Water	183	×	0.027	4.953
Admix.	3.76	×	0.027	0.127
	2566			69.274

Initial Flow	630mm	11:26 PM
1hr	610mm	12:26 PM
2hr	570mm	01:26 PM

4 Days Strength			
9006	680	30.22	30.52
9142	660	29.33	
9136	720	32	

28 Days Strength			
9244	1390	61.77	62.96
9314	1420	63.11	
9076	1440	64	

V. CONCLUSION

After carried out multiple trials we found out following conclusion

1) It gives the strength of multiple grade in single grade (i.e. combined grade concrete design (50FF))

2) In multiple grade concrete we achieve the slab cycle in 18 to 20 days but in combined grade concrete we reduce upto 12 days slab cycle.

3) It improves the quality of the structure because we can use monolithic concrete for beam, slab, column.

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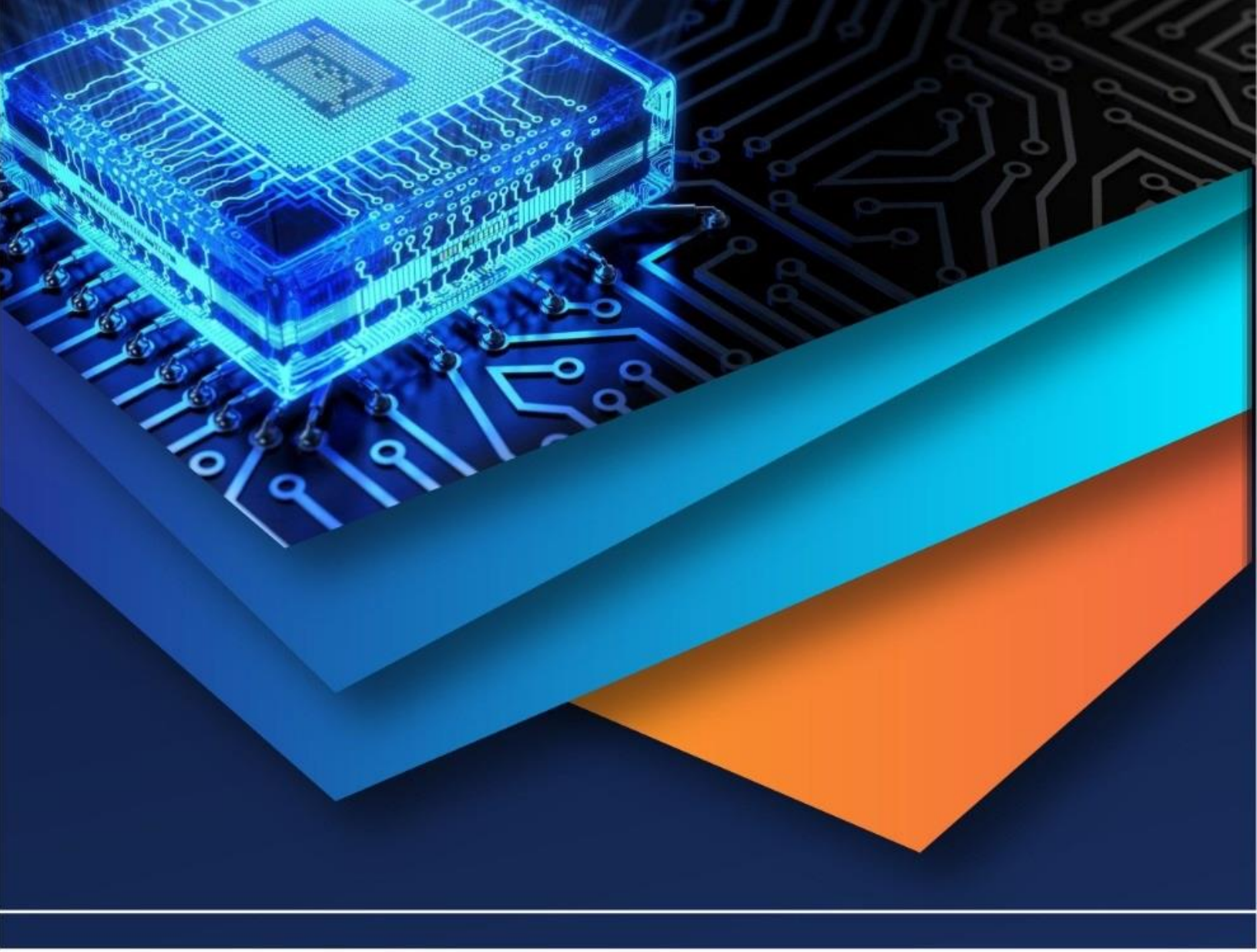

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