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High Strength Concrete Using "MUTONS" (Metal Aggregates) The Gateway to New Concrete Technology for Mega Structures

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Abstract. Concrete technology has been changing rapidly and constantly since its discovery. Concrete is the most widely used man-made construction material, versatility of making concrete is the 2nd largest consumed material on earth. In this paper an effort has been made to use metal aggregates in concrete has been discussed, the metal aggregates has been named as "MUTONS" which had outstandingly qualities to resist shear, tension and compression forces. In this paper COARSE MUTONS AGGREGATES (C.M.A.) 10mm and 20mm and FINE MUTONS AGGREGATES (F.M.A.)3mm were divided and used for making high performance concrete (H.P.C). This "MUTONS" had cutting edge technology through draft and design by the use of Auto CAD, ANSYS software can be used effectively, high performance concrete (H.P.C) with "MUTONS" which is M60 grade for mega structures and irregular structures where center of gravity (CG) is not balanced. High Performance MUTONS Concrete is the extraordinary qualities like long-term performance, no sorptivity by MUTONS AGGREGATES, better rheological, mechanical and durability proportion that conventional concrete. This high strength MUTONS concrete using "MUTONS" is applied in the construction of mega structure like skyscrapers, dam, marine/offshore structures, nuclear power plants and bridges. High Performance MUTONS Concrete which is a controlled concrete possesses invariable high strength, reasonable workability and negligibly permeability as compare to conventional concrete.

Keywords: "MUTONS" High Strength Concrete, High Performance Concrete (H.P.C), FINE MUTONS AGGREGATE (F.M.A.), COARSE MUTONS AGGREGATE (C.M.A.), Metal Aggregates, Cutting Edge Technology, Controlled Concrete, High Performance MUTONS Concrete.

1. Introduction

Concrete has been used extensively across the global these days for the construction purpose of high performance concrete in a concrete, with more durability and life. In the present scenario H.P.C. is emerging as a construction material which will serve the basic dual purpose of strength and durability In this paper an effort has been made to use metal aggregates in concrete has been discussed, the metal aggregates has been named as "MUTONS" which had outstandingly qualities to resist shear, tension and compression forces. In this paper COARSE MUTONS AGGREGATES (C.M.A.) 10mm and 20mm FINE MUTONS AGGREGATES (F.M.A.) 3mm were divided and used for making high performance concrete (H.P.C). This "MUTONS" had cutting edge technology through draft and design by the use of Auto CAD, ANSYS software can be used effectively. It is very light in weight (Magnesium alloy aggregates) with ultimate high strength and high impact value. "MUTONS" AGGREGATES possess well defined edges formed at intersection of rough planer face. Conventional angular aggregates have 38 to 40% voids but here "MUTONS" AGGREGATES reduce the percentage up to 35% reason by its sphere shape had 6 cones around it .Interlocking between "MUTONS" AGGREGATES is better than conventional angular aggregates. "MUTONS" had no sorptivity (water absorption), no surface moisture and zero porosity because of metal properties. This "MUTONS" had rougher texture which considered better as it provides a better bond with

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cement paste and aggregate rougher texture is beneficial for obtaining high strength concrete, High performance concrete (H.P.C) with "MUTONS" which is M65 grade for mega structures and irregular structures where center of gravity (CG) is not balanced. "MUTONS" AGGREGATES also had the properties of High Density Concrete for the reason that it is prepared from high density COARSE MUTONS AGGREGATES (C.M.A.) and FINE MUTONS AGGREGATES (F.M.A.) of specific gravity of 1.74.This high strength concrete using "MUTONS" is applied in the construction of mega structure like skyscrapers, dam and bridges. Our High Strength Concrete is in the form of high performance concrete (H.P.C) by the mix of Super Plasticizers, silica fume, fly ash.

1.1. Characteristics of High Performance Concrete

High- performance concrete characteristics are developed for particular applications and environment: some of the properties that may be required include: High durability. High early strength. High modulus of elasticity. High abrasion resistance. High resistance to frost and deicer scaling damage. Toughness and impact resistance. Volume stability.

2. Material Detail: a. Magnesium alloy; b. Mild Steel; c. Structural Steel.

2.1. Magnesium Alloy

Magnesium or its alloys are available in almost all the common forms in which metals are commercially used. Practically pure magnesium, 99.8 percent, Magnesium alloy is lightest in weights (Half of steel). [1] We also use magnesium alloy AZ91[2] having the proof stress of 160-240 , Yield Strength of +600 MPa, Tensile Strength is +285 MPa with the Elongation of 2-10%. Cost around 170 Rs/kg . AZ91 had the Composition of Mg=90.8%, Al=8.25%, 2n=0.63%, Si=.035%, Mn=.22% and Other metals= Cu-0.00 ;fe-0.014 ;Be–0.002.(Notes= Used for die castings)

2.2. Mild Steel

Mild Steel is the most common form of steel and not brittle. It is cheap and often used when large amounts of steel are needed. Mild steel is a carbon steel typically with a ma a maximum of 0.25% Carbon and 0.4%-0.7% manganese, 0.1%-0.5% Silicon and some + traces of other elements such as phosphorous, it may also contain lead (free cutting mild steel) or sulphur (again free cutting steel called re-sulphureted mid steel). Many everyday objects are made of mild steel,. Mild steel so-called carbon steel) is a general term for a range of low carbon (a maximum of about 0.3%)

2.3. Structural Steel

In the field of steel civil engineering steel structure material is use for high strength material which we also use as a metal for MUTONS.

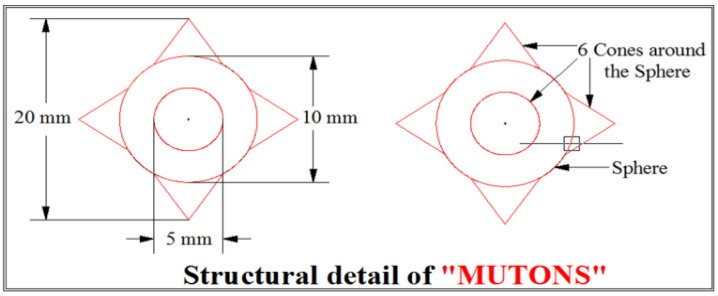

Fig. 1. Structural details of MUTONS

3. Drafting

"MUTONS" was draft in Auto CAD in millimeters, The basic shape is sphere had the diameter of 10mm and around its whole body cone is fixed with the height of 5 mm each, the whole body is in union as show in Fig. 1 and Fig. 2 FINE MUTONS AGGREGATES (F.M.A.) size is in the shape of sphere had the dimension of 1 mm, we face the problem of die work so that we decided it 1 mm in dimension. COARSE MUTONS AGGREGATES (C.M.A) dimensions are according to different size i.e. 20 mm and 10mm [3]. 20 mm COARSE MUTONS AGGREGATES (C.M.A) as show in Fig. 1 and Fig. 2.

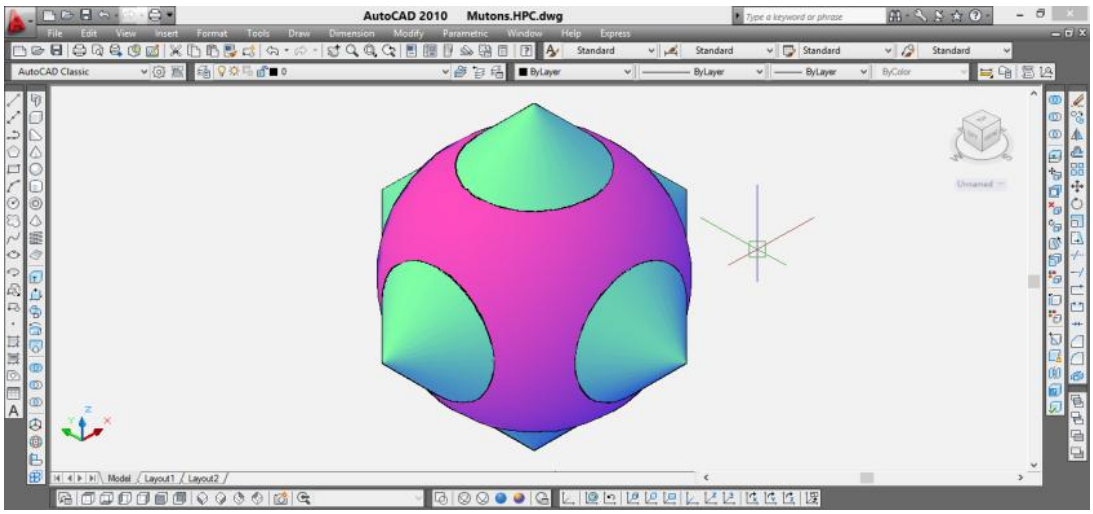

Fig. 2. 3D view of MUTONS.

4. Analysis and its Results

Selecting as a Mild Steel material and analysis the COARSE MUTONS AGGREGATES (C.M.A) with the dimension of 20mm. The 3D model is import into ANSYS 14. for analysis results. The results are worthy as show in Fig. 3. The whole software experiments are done in CADD Centre's study labs. Finally the analysis result shows that **"MUTONS"** is a Static Structural as shown by Fig. 3. It bears great load. It acts as a compression as well as tension member. It plays a great role between the bonding of concrete [4] and steel in the rough condition of seismic shakes [5], [6]. It resists the developing of cracks.

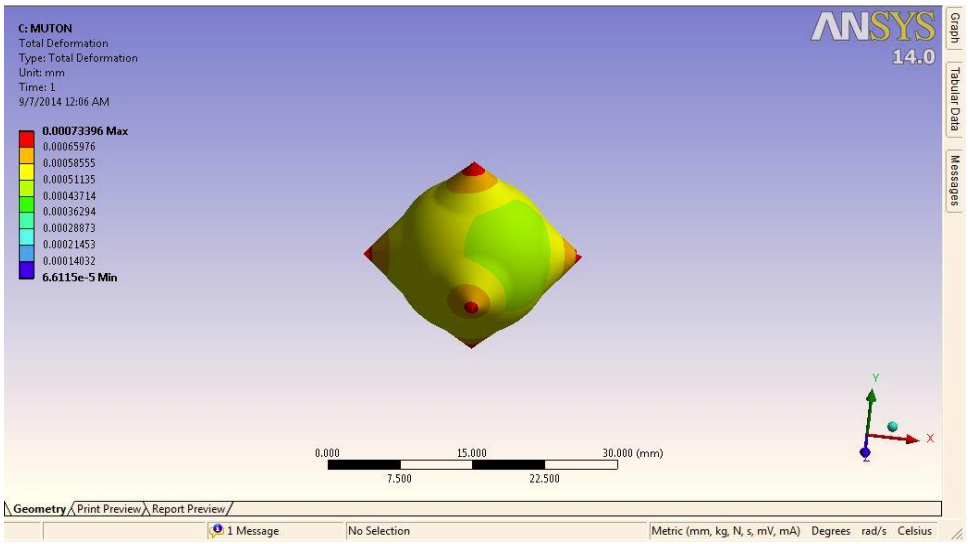

Fig. 3. Results show the STATIC STRUCTURAL of MUTONS

5. Die Work and Manufacturing of "MUTONS"

Die work is done by following the concept of "MUTONS", through die the pattern is made, then the process of manufacturing "MUTONS" is done by casting. Fig. 4 show the die for the production of "MUTONS" 20mm. In Fig. 5 fine mutons aggregates shown with the dimension of 3mm.

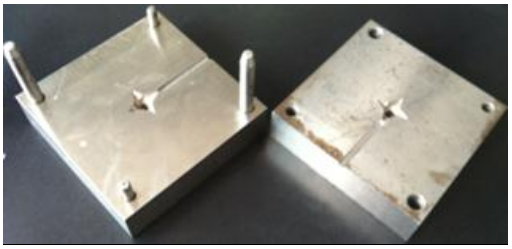

Fig. 4. show die of "MUTONS" 20mm C.M.A.

Fig. 5. Fine Mutons Aggregates 3mm.

6. Concrete Design Proportioning

Target M60= Fine Aggregates 1726 kg/m^3

Coarse Aggregates 1638 kg/m^3

Water 170 kg/m^3

Super plasticizer 3.26 kg/m^3

M60 Grade is of High strength Concrete As show in Fig. 6.

Group	Grade Designation	Specified characteristic Compressive strength of 150mm cube at 28 days N/mm²
Ordinary Concrete	M10	10
	M15	15
	M20	20
Standard Concrete	M25	25
	M30	30
	M35	35
	M40	40
	M45	45
	M50	50
	M55	55
High Strength Concrete	M60	60
	M65	65
	M70	70
	M75	75
	M80	80

Fig. 6. Grades of concrete As per IS: 456-200.

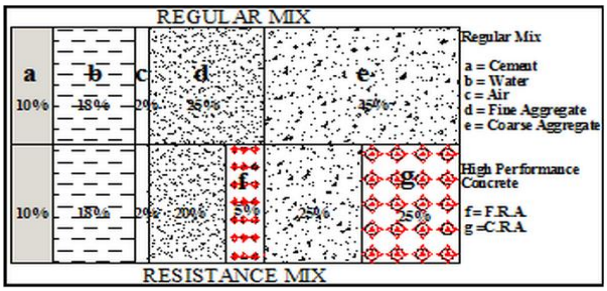

Fig. 7. Resistance mix design of 'MUTONS'.

6.1. Grade Designation

Cement > Fine aggregates + 1/3 aggregate of FINE MUTONS (F.M.A.) > Course aggregates + 1/2 aggregate of COARSE MUTONS (C.M.A.).(by weight if the material is magnesium alloy). Note: The grade designation giving the characteristics strength requirement of concrete. GRADE Designation is not fixed.

a) TYPE OF CEMENT: 297 kg/m^3 - Note: Type of Cement influences the rate of development of compressive strength of concrete

b) TYPE OF AGGREGATES: Fine aggregate 20%+5% F.M.A.1mm (1726 kg/m3) &

Crushed Aggregates 50% **(1638 kg/m3)** 25%+25% C.M.A. 10 mm and 20 mm as total amount. Note: Aggregates maximum normal size of aggregate to be used in concrete is according to IS code.

c) WATER: 170 kg/m^3.

d) ADMIXTURE: Silica Fume and Fly Ash is added to gain good compressive strength.10% each as performing best results in concrete lab.

e) SUPER PLASTICIZERS: SMF to increase compressive strength and Concrete Super Plasticizers to Increase Flexure Strength 1.34 kg m3. Note: This SUPER PLASTICIZERS is only use for best results.

The objective of producing a concrete of the required ultimate compressive strength , durability as economically as possible is termed the concrete Resistance mix design which is determined according to the need of site work as show in Fig. 7.

7. Results: Design of INGENUITY: "MUTONS" with Cutting Edge Technology.

- High Strength:

A. Compressive Strength: High Performance Concrete (H.P.C) takes the result of HIGH STRENGTH MUTONS CONCRETE. Target +60 Mpa. Grade of concrete = M 60

B. Specified Characteristic Compressive Strength N/mm2 at 28 days = 60-65 MPa.

C. The compressive test results provide greater strength at latter stage and increasing trend of compressive strength up to great level.

D. Tensile Strength: Increase static and dynamic tensile strength reason of HIGH STRENGTH MUTONS CONCRETE.

E. Bond Strength: Increase due to interlocking of "MUTONS" AGGREGATES and ADMIXTURE.

F. Shear Strength :By Design of INGENUITY, "MUTONS" with cutting edge technology and SUPER PLASTICIZERS

- Minimum Dimensional Changes:(a) Shrinkage (b) Elasticity (c) Creep (d) Thermal Expansion.
- Reduce the size of structural member, rise impact strength and increase strain energy.
- WORKABILITY: The slump test is carried with a sample of concrete with the proportion of material and it is up to 115mm. To get the desirable slump value SLUMP RETENTION SUPERPLASTICIZER is added.
- Freedom from Bleeding , Segregation and Reduction in self-weight and Light Weight Structure.
- High Durability, low permeability, Increase Flexure Strength and fatigue strength of concrete.
- High Abrasion Resistance, long term performance and increase the building height.
- Volume Stability and good bond/griping in concrete.
- F.M.A. reduces the bulking of sand because it covers the 10% proportion of F.B.A.
- Effective modulus of elasticity +40 (5.8x106) GPa (Psi).
- The concrete absorb the maximum moments, share and axial forces.
- The structure had great resistance to the Seismic shocks and high Resistance to cracks propagation.
- Reduce maintenance/repair cost which saves money.
- Consequent reduction in construction time and construction cost e.g. foundation.
- Reduction in the area of the form work and early removal of form work.
- Elimination of a few footing because of adoption of large spans.
- Resist chemical attack and Control alkali-silica reaction.

Note: Reason of minimum pages (conference regulation) we write the results in short form.

8. Conclusion

The research paper covers three levels: Theoretical, Analytical and Practical. Magnesium Alloy or Mild Steel Aggregates in different sizes as FINE MUTONS AGGREGATES (F.M.A.) 3mm and COARSE MUTONS AGGREGATES (C.M.A.) 10mm and 20mm. "MUTONS" in concrete gives high strength concrete >High Durability Concrete and long life in severe environment.>Self-Consolidating Concrete, High strength and High early strength.>High modulus of elasticity. >High abrasion resistance.> High durability and long life in severe environments.> Low permeability and diffusion and Resistance to chemical attack.> High resistance to frost and deicer scaling damage. >Toughness and impact resistance. >Volume stability and Ease of placement. >Compaction without segregation.> Inhibition of bacterial and mold growth.

9. Further Enhancement

(1) High Strength MUTONS Concrete has compressive strength of up to +96 Mpa as compare to conversional concrete.

(2) Revolutionary ULTRA High Strength MUTONS Concrete Using "MUTONS" (Metal Aggregates) with FIBERS.

(3) "MUTONS" (Metal Aggregates) are also design as an Active Group.

(4) FINE MUTONS AGGREGATES (F.M.A.) may be in other dimensions and shapes i.e. Dodecahedron shape & Icosahedron shape.

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