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**International Journal of Research Publication and Reviews**

Journal homepage: www.ijrpr.com ISSN 2582-7421

# Effect of Geological Characteristics of Coarse Aggregate on Properties of Concrete

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**ABSTRACT-**

Aggregate is one of the important constituents in concrete and it occupies 60 to 80% of the volume. They provide body to concrete, reduce shrinkage and also affect economy. Further, it is relatively inexpensive than other constituents and usually it has been considered all along as inert filler material. Hence, an attempt has been made in the present work to study effect of geological characteristics of aggregates on properties of concrete. Five types of coarse aggregates such as Grey Granite (GG), Anorthosite (AS), Charnockite (CK), Limestone (LS) and Gneiss (GS) were used in this work to study their geological characteristics and their effect on performance of concrete. The geological characteristics of aggregates such as mineralogical composition, proportion of minerals, texture, structural features etc were studied. Subsequently, concrete mixes were made with various types of aggregates to produce M30 grade of concrete. The concrete specimens were cast and cured over a period of 28 days. The cured specimens were tested for compressive strength, split tensile strength, flexural strength, rupture probability of coarse aggregate RPCA and also structural behavior of concrete. However, concrete mixes of same grade made of different aggregates demonstrated significant variations in compressive strength, indicating that geological characteristics of aggregates played a dominant role in influencing compressive strength. Also, similar trend was noticed in the case of tensile strength, flexural strength, modulus of elasticity, impact energy and fracture energy, RPCA and structural performance of concrete.

***Keyword: Coarse Aggregate, Durability, Compressive Strength, Flexural, Split Tensile, RPCA.***

## I. Introduction

Aggregate is one of the important constituents in concrete and it occupies 60 to 80% of the volume. They provide body to concrete, reduce shrinkage and also affect economy. Further, it is relatively in expensive than other constituents and usually it has been considered all along as inert filler material. Therefore, required attention was not focused to realize the possible influence of aggregates on strength, dimensional stability and durability of concrete. Hence, it is very much necessary to understand more about aggregate to produce the concrete with required characteristics. Further, geometrical characteristics of aggregates and their effect on characteristics of concrete were well established. Furthermore, effect of type of aggregate on abrasion resistance, fracture energy and RPCA was investigated by few researchers. However, almost entire research work was focused only type of aggregates without taking geological characteristics such as mineralogical composition, proportion of minerals, texture, structure, alteration of minerals in aggregates in to consideration. Further, geological characteristics of aggregates are site specific and cannot be generalized and attributed to similar aggregates available elsewhere. Hence, an attempt has been made in the present work to study geological characteristics of aggregates available around Malwa Region, Madhya Pradesh and their effect on properties of concrete.

## II. Objective

The present work entitled “Effect of geological characteristics of coarse aggregate on properties of concrete” has taken up with the objectives listed below.

• To evaluate geological characteristics, physical and mechanical properties of aggregates such as Grey Granite (GG), Anorthosite (AS), Charnockite (CK), Limestone (LS) and Gneiss (GS) and to find out relationship between geological characteristics of aggregates and physical as well as mechanical properties of aggregates.

• To assess role of geological characteristics of aggregates on strength characteristics of concrete such as compressive, tensile, flexural and durability.

## III. Experimental work

**Materials:**

**Cement**: Ordinary Portland cement of 53 Grade was used for making concrete.

**Silica Fumes**: Silica fume is a by-product of silicon and ferrosilicon metal. Its particles are spherical in shape with an average diameter of 0.1 micron.

**Fine Aggregate**: In the present work, locally available river sand was used as fine aggregate. It was tested for its physical characteristics as per procedure prescribed by BIS 2386-1963 (Reaffirmed 2011)

**Coarse Aggregate**: Five types of aggregate such as Grey Granite (GG), Anorthosite (AS), Charnockite (CK), Limestone, (LS) and Gneiss (GS) are used as coarse aggregate in the present work.

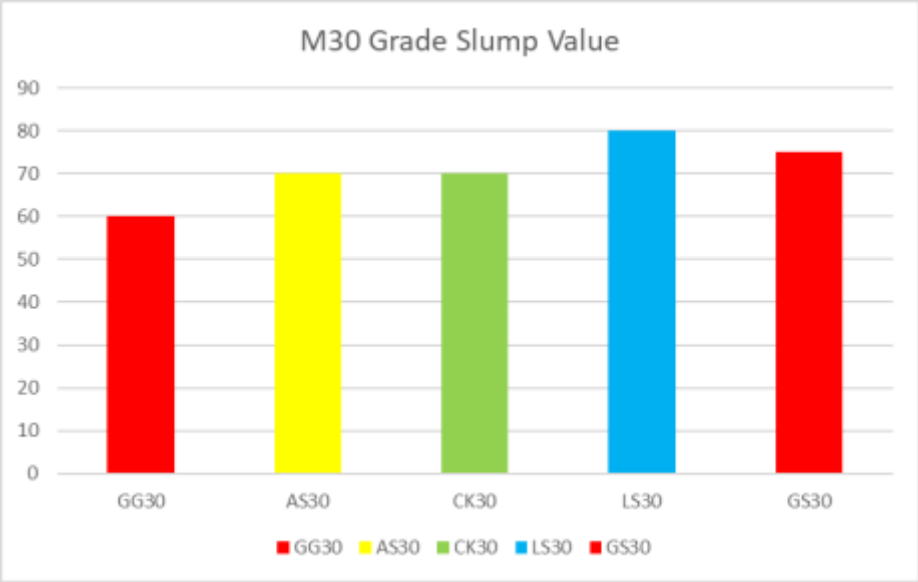
**Water**: The water available in the premises of SAIT, Madhya Pradesh, India, conforming to requirements specified by IS: 456-2000 was used as mixing water as well as for curing of concrete specimens.BIS:456-2000 (Reaffirmed 2011)

**Super Plasticizer**: Super-plasticizer is a chemical admixture used to enhance workability of concrete mixes made with low w/b ratio. Melamine based super plasticizer having specific gravity of 1.22 was utilized in this work

## IV. Results & Discussion

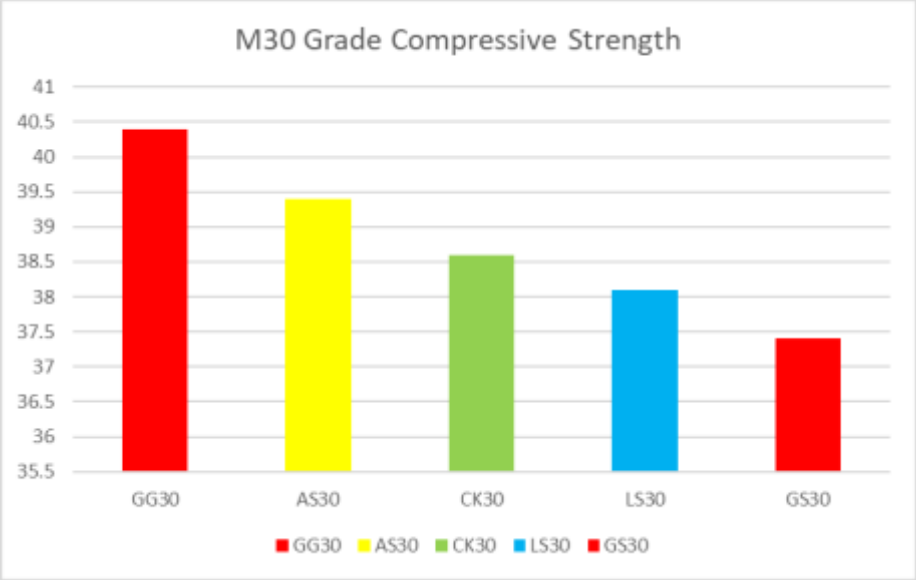
**Workability:**

| Mix Code | Type of Coarse Aggregate | Density ($kg/m^3$) | Slump(mm) |
|---|---|---|---|
| GG30 | Grey Granite | 2400 | 60 |
| AS30 | Anorthosite | 2461 | 70 |
| CK30 | Charnockite | 2447 | 70 |
| LS30 | Limestone | 2410 | 80 |
| GS30 | Gneiss | 2436 | 75 |



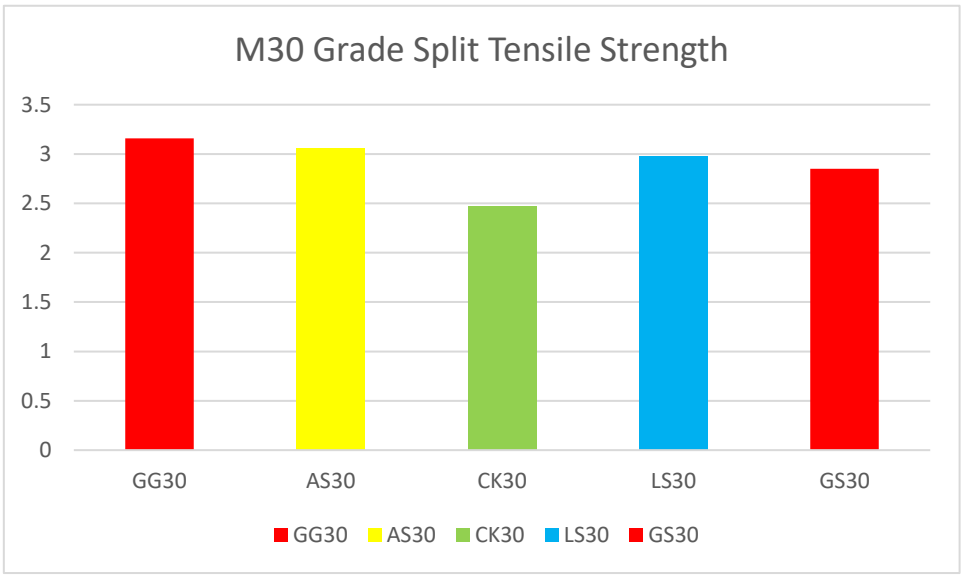
**Compressive Strength:**

| Mix Code | Compressive Strength (MPa) fc | | |
|---|---|---|---|
| | Mean | SD | COV |
| GG30 | 40.4 | 1.14 | 2.82 |
| AS30 | 39.4 | 0.95 | 2.42 |
| CK30 | 38.6 | 1.67 | 0.95 |
| LS30 | 38.1 | 0.65 | 1.71 |
| GS30 | 37.4 | 0.86 | 2.30 |



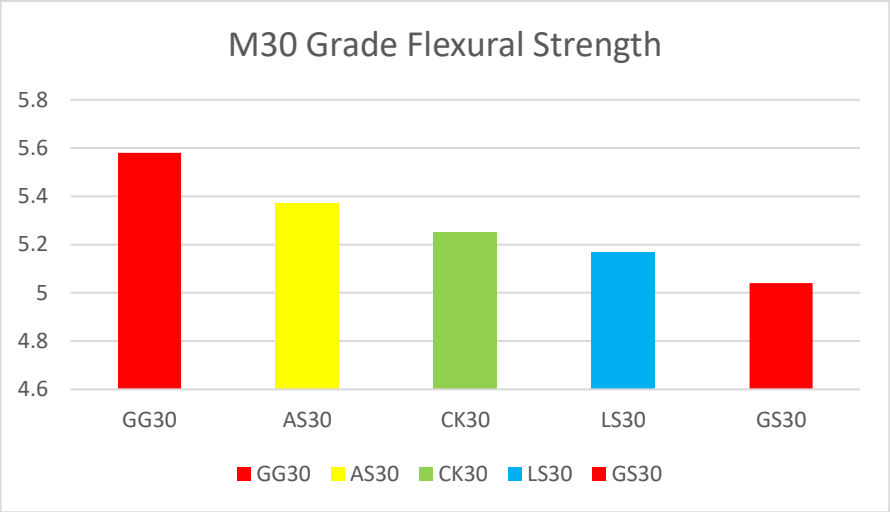

**Split Tensile Strength:**

| Mix Code | Split Tensile Strength (MPa) fst | | |
|---|---|---|---|
| | Mean | SD | COV |
| GG30 | 3.16 | 0.01 | 0.32 |
| AS30 | 3.06 | 0.02 | 0.5 |
| CK30 | 2.47 | 0.04 | 1.76 |
| LS30 | 2.98 | 0.02 | 0.51 |
| GS30 | 2.85 | 0.03 | 0.88 |



**Flexural Strength:**

| Mix Code | Flexural Strength (MPa), $f_t$ | | |
|---|---|---|---|
| | **Mean** | **SD** | **COV** |
| GG30 | 5.58 | 0.09 | 1.56 |
| AS30 | 5.37 | 0.10 | 1.80 |
| CK30 | 5.25 | 0.07 | 1.33 |
| LS30 | 5.17 | 0.12 | 2.24 |
| GS30 | 5.04 | 0.02 | 0.30 |




**RPCA:**

| Mix Code | Compressive Strength (MPa) $f_c$ | Split Tensile Strength (MPa) $f_{st}$ | Flexural Strength (MPa), $f_t$ | RPCA (%) |
|---|---|---|---|---|
| GG30 | 40 | 3.16 | 5.58 | 58 |
| AS30 | 39 | 3.06 | 5.37 | 35 |
| CK30 | 39 | 2.47 | 5.25 | 37 |
| LS30 | 38 | 2.98 | 5.17 | 67 |
| GS30 | 37 | 2.85 | 5.04 | 69 |

## V. Conclusion

The conclusions with respect to the strength - related properties, microstructural properties and durability-related properties on fresh and hardened M30 Grade Concrete are as follows:

i. The aggregates selected for the present study are grey granite, anorthosite, charnockite, limestone and gneiss. Among these aggregates, grey granite has exhibited best performance in terms physical and mechanical properties and it is followed by anorthosite, charnockite, limestone and gneiss.

ii. The concrete mixes made of GG, AS, CK and GS aggregates demonstrated relatively low workability than concrete mix made of LS aggregate. The relatively smooth surface texture of limestone aggregate due to presence of extremely fine grain minerals, made it to impart higher workability to concrete than GG, AS, CK and GS aggregates having very high surface roughness.

iii. M30 grade of concrete made of different types aggregates exhibited compressive in the range of 37 to 40 MPa, indicating that type of aggregate has not shown considerable effect on compressive strength of normal strength concrete. It is due to the fact that aggregate is not strength limiting factor as it is stronger than cement matrix and transition zone.

iv. Further, compressive strength of different grades of concrete mixes made of same aggregates has improved with increase in compressive strength of concrete. However, concrete mixes of same grade made of different aggregates demonstrated significant variations in compressive strength, indicating that geological characteristics of aggregates played a dominant role in influencing compressive strength.

v. The variations in split tensile strength, flexural strength of concrete made with different aggregates are same as that of compressive strength.

Hence, it is very much essential to take into account geological characteristics of aggregates such as mineralogical composition, proportion of minerals, arrangement of minerals, degree of alteration, structural features while selecting aggregates to produce high strength concrete.

**References**

1. Abd Hamid, NA & Abas, NF 2015, „A study on effects of size coarse aggregate in concrete strength", JurnalTeknologi, Vol. 75, no. 5, pp. 51-55.

2. Abdullah, A, Almusallam, HamoudBeshr, Mohammed Maslehuddin, & Omar SB Al-Amoudi 2004, „Effect of silica fume on the mechanical properties of low quality coarse aggregate concrete", Cement and Concrete Composites, Vol. 26, no. 7, pp. 891-890.

3. Abdullahi, M 2012, „Effect of aggregate type on compressive strength of concrete", International Journal of Civil and Structural Engineering" Vol. 2, no. 3, pp. 791-800.

4. Abdulrahman & Alhozaimy, M 2009, „Effect of absorption of limestone aggregates on strength and slump loss of concrete", Cement & Concrete Composites, Vol. 31, no. 7, pp. 470-473.

5. ACI 544.2R-89 (Reapproved 2009): Measurement of properties of fiber reinforced Concrete (Reapproved 2009), American Concrete Institute, Detroit.

6. Aginam, CH, Chidolue, CA & Nwakire, C 2013, „Investigating the effects of coarse aggregate types on the compressive strength of concrete" International Journal Engineering Research and Application, Vol. 3, no. 04, pp. 1140-1144.

7. Ahmed Brara Janusz, R & Klepaczko 2007, „Fracture energy of concrete at high loading rates in tension", International Journal of Impact Engineering, Vol. 34, pp. 424-435.

8. Aitcin, PC & Mehta, PK 1990, „Effect of coarse aggregate characteristics on mechanical properties of high-strength concrete", ACI Materials Journal, Vol. 87, no. 2, pp. 103-107.

9. Ajamu, SO & Ige, JA 2015, „Effect of coarse aggregate size on the compressive strength and the flexural strength of concrete beam", International Journal of Engineering Research and Applications, Vol. 5, no. 1, pp. 67-75.

10. Alexander, MG & Milne, TI 1995, „Influence of cement blend and aggregate type on stress-strain behavior and elastic modulus of concrete", ACI Materials Journal, Vol. 92, no. 3, pp. 227-235.

11. Alexander, MG 1996, „Aggregates and the deformation properties of concrete", ACI Materials Journal, vol. 93, no. 6, pp. 569-577.

12. Ali Ugur Ozturk, Tugrul Erdem, R & Celal Kozanoglu 2012, „Investigation of Crushing Type of concrete aggregates on mechanical properties of concrete", International Journal of Material Engineering, Vol. 2, no. 2, pp. 6-9.

13. Amir Elsharief, Menashi, D Cohen & Jan Olek 2003, „Influence of aggregate size, water cement ratio and age on the microstructure of the interfacial transition zone", Cement and Concrete Research, Vol. 33, no. 11, pp. 1837-1849.

14. An Yan, Ke-Ru Wu, Dong Zhang & Wu Yao 2001, „Effect of fracture path on the fracture energy of high-strength concrete", Journal of Cement and Concrete Research, Vol. 31, pp. 1601-1606.

15. Anthony Woode, David Kwame Amoah, Bright Aforla, Francis Avor & Frank KojoKissi 2015, „Engineering geological characteristics of quartzite types for concrete production in Ghana", Civil and Environmental Research, Vol. 7, no. 10, pp. 6-11.

16. Antonio Princigallo, Klaas Van Breugel & Giovanni Levita 2003, „Influence of the aggregate on the electrical conductivity of Portland cement concrete", Cement and Concrete Research, Vol. 33, no. 11, pp. 1755-1763.

17. Appa Rao, G & Raghu Prasad, BK 2002a, „Influence of the roughness of aggregate surface on the interfacial bond strength", Cement and concrete research, Vol. 32, pp. 253-257.

18. Appa Rao, G & Raghu Prasad, BK 2002b, „Fracture energy and softening behavior of high-strength concrete", Cement and Concrete Research, Vol. 32, pp. 247-252.

19. Asadulla Kazi & Zuhdi Raja Al Mansour 1980, „Influence of geological factors on abrasion and soundness characteristics of aggregates", Engineering Geology, Vol. 15, no. 3-4, pp. 195-203.

20. Ashraf Ragab Mohammed & Will Hansen 1999, „Micromechanical modeling of crack- aggregate interaction in concrete material", Journal of Cement and Concrete Composites, Vol. 21, no. 5-6, pp. 349-359. 21. Azimah Hussin & Colin Poole 2011, „Petrography evidence of the interfacial transition zone (ITZ) in the normal strength concrete containing granitic and limestone aggregates", Construction and Building Materials, Vol. 25, pp. 2298-2303.

22. Basheer, L, Basher, PAM & Long, AE 2005, „Influence of coarse aggregate on the permeation, durability and micro structure characteristics of ordinary Portland cement concrete", Construction and Building Materials, Vol. 19, no. 9, pp. 682-690.

23. Beshr, H, Almusallam, AA & Maslehuddin, M 2003, „Effect of coarse aggregate quality on the mechanical properties of high strength concrete", Construction and Building Materials, Vol. 17, no. 2, pp. 97-103.

24. Bhavya, K & Sanjeev, N 2017, „Effect of different types of coarse aggregates on physical properties of mostly used grades M20, M25, M30 of concrete", Journal of Mechanical and Civil Engineering, Vol. 14, no. 1 pp. 46-51.

25. Bing Chen, A & Juanyu Liu, B 2004 , „Effect of aggregate on the fracture behavior of high strength concrete" Construction and Building Materials, Vol. 18, no. 8, pp. 585-590.

26. Bing Chen, A & Juanyu Liu, B 2007, „Investigation of effects of aggregate size on the fracture behaviour of high performance concrete by acoustic emission", Construction and Building Materials, Vol. 21, no. 8, pp. 1696-1701.

27. BIS 10086-1982, (Reaffirmed 2008) „Specification for moulds for use in tests of cement and concrete", Bureau of Indian Standards, New Delhi.

28. BIS 1199-1959 (Reaffirmed 2004), „Method of sampling and analysis of concrete", Bureau of Indian Standards, New Delhi.