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Experimental Study on Flexural Strength of Beam Using Acrylic Fibre and GGBS with Partial Replacement of Cement

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Abstract – *Failure of concrete has become a challenge for confronting the civil engineers. Usage of fiber like polypropylene, steel fiber is more expensive. The method of stringing the beam by acrylic fiber sheet with partial replacement of GGBS (20%) in concrete is discussed in this project. The object of this project is to strengthen the beam element by the help of acrylic sheet. Acrylic fibre sheet increase flexural strength of beam and control cracking. It's used in various aspects such as road bridges and pavements. After some period deterioration of beam start to occur due to weather conditions and temperature stresses. Due to this beam require minor repairs using addition of acrylic fibre sheet in beam. Normally the beam is casted and at bottom layer of beam acrylic sheet is pasted with the help of epoxy resin the strength of the beam is tested with GGBS which is partially replaced of 20% instead of cement in the concrete.*

Key Words: **Flexural strength.Deflection,Acrylic Fibre sheet**.

1. INTRODUCTION

The aim of the project is to increase the flexural strength in the beam. Concrete is widely used material worldwide. Normally it contains cement or lime, aggregate, water admixture. During hardening of concrete large amount of heat is released is called as heat of hydration. Here another two material is added GGBS & acrylic sheet. GGBS enhance lower heat of hydration, higher durability and higher resistant to sulphate and chloride attack when compared with normal ordinary concrete .Dupont created the first acrylic fibre sheet in 1941. Acrylic fibers sheet contain least 85% acrylonitrile monomer. This is used for lining of boots & gloves, furnishing fabrics & carpets. The modulus of elasticity of acrylic is more when compared to normal concrete. Usage of acrylic prevents from cracking, increase in flexural strength and acrylic fibres are environmental friendly & non-hazardous.

1.1 General

Ground-granulated blast-furnace slag (GGBS or GGBFS) is obtained by quenching molten iron slag (a by-product of iron and steel-making) from a blast furnace in water or steam, to produce a glassy, granular product that is then dried and ground into a fine powderComposition, properties and behaviour. Acrylic fibres sheet are synthetic fibers made from a polymer (polyacrylonitrile) with an average molecular weight of 1900 monomer units. For a fiber to be called "acrylic" in the United State, the polymer must contain at least 85% acrylonitrile monomer.

2. MATERIALS USED AND PRELIMINARY TEST

2.1 Sand

Red soil is a type of soil that develops in a warm temperature, moist climate under deciduous or mixed forest, having thin organic mineral layers overlying a yellowish brown leached layer resting on an alluvium red layer. Red soils are generally derived from crystalline rock. They are usually poor growing soils, low in nutrients and humus and difficult to cultivate because of its low water holding capacity.

2.2 Crushed stone

Crushed stone or angular rock is a form of construction aggregate, typically produced by mining a suitable rock deposit and breaking the removed rock down to the desired size using crushers. It is distinct from gravel which is produced by natural processes of weathering and erosion, and has a more rounded shape.

2.3 Cement

A cement is a binder, a substance used for construction that sets, hardens, and adheres to other materials to bind them together. Cement is seldom used on its own, but rather to blind sand and gravel together. Cement mixed with fine aggregate produces mortar for masonry, or with sand and gravel, produces concrete. Cement is the most widely used material in existence and is only blend with water as the planet's most consumed resource. Cement used in construction are usually inorganic, often lime or calcium silicate based, and can be characterized as either hydraulic or non hydraulic, depending on the ability of the cement to set in the presence of water.

2.4 GGBS

Ground-granulated blast-furnace slag (GGBS or GGBFS) is obtained by quenching molten iron slag (a by-product of iron and steel-making) from a blast furnace in water or steam, to produce a glassy, granular product that is then dried and ground into a fine powder.

2.5 Acrylic Fibre sheet

Acrylic is a transparent plastic material with outstanding strength, stiffness, and optical clarity. Acrylic sheet is easy to

fabricate, bonds well with adhesives and solvents, and is easy to thermoform. It has superior weathering properties compared to many other transparent plastics.The acrylic fiber help increase flexural strength. Acrylic fiber sheet are environmental friendly and non-hazardous.

2.6 Preliminary test

a) The specific gravity of cement is determined in this test. The test is said to be carried out in a lab. The specific gravity of cement, G = 3.10.
b) The specific gravity of coarse aggregate is determined in this test. The test is said to be carried out in a lab. The specific gravity of coarse aggregate, G = 2.67
c) The Fineness modulus of fine aggregate = 2.86g.
d) The fine aggregate belongs to grading zone II.
e) The Fineness modulus of coarse aggregate = 6.68g
f) The Fineness modulus of cement = 7.81g.
g) The normal consistency of cement = 27%.
h) Initial setting time of cement = 30 minutes
i) Final setting time of cement = 610 minutes
j) Water absorption of aggregate = 0.2 %.

3. TEST ON HARDENED CONCRETE, BEAM AND RESULTS

The tests are done on the specimens using various types of test methods and the results are said to be provided individually each below.

3.1 Compressive strength test

The Average compressive strength for 7 days is said to be 10.76 N/mm^2.

The Average compressive strength for 14 days is said to be 20.26 N/mm^2.

The Average compressive strength for 28 days is said to be 30.31 N/mm^2.

Fig-1: Compressive strength test

3.2 Split Tensile Strength

The Average Split Tensile strength for 7 days is said to be 1.06 N/mm^2.

The Average Split Tensile strength for 14 days is said to be 1.27 N/mm^2.

The Average Split Tensile strength for 28 days is said to be 1.47 N/mm^2.

Fig -2: Split Tensile Strength Test.

3.3 Flexural strength Test

The Average Flexural Strength Test for 7 days is said to be 1.5 N/mm^2.

The Average Flexural Strength Test for 7 days is said to be 3.3 N/mm^2.

The Average Flexural Strength Test for 28 days is said to be 4.5 N/mm^2.

Fig -3: Average Flexural Strength Test.

3.4 RESULT

The Flexural strength of conventional Beam 2.83N/mm^2

Fig- 4: Flexural strength of beam with acrylic sheet

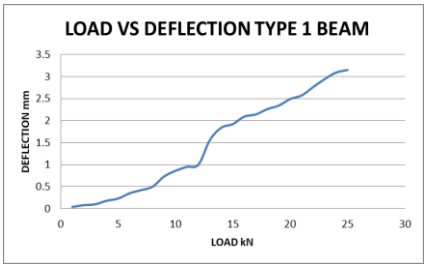

Chart -1: Load vs deflection Type 1

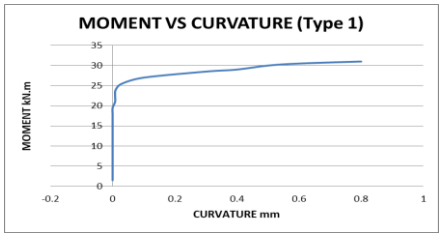

Chart -2: Moment vs curvature Type 1

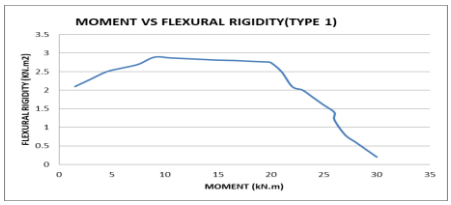

Chart -3: Moment vs Flexural rigidity Type 1

Deflection Details of Beam with GGBS, the flexural strength of beam with GGBS is 2.94N/mm^2

Fig- 5: Flexural strength of beam with GGBS

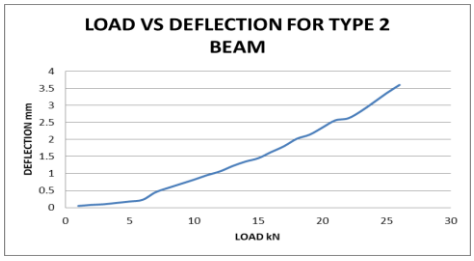

Chart -4: Load vs deflection Type 2

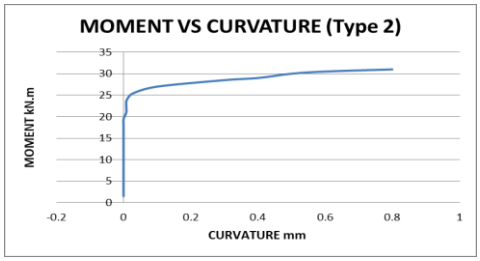

Chart -5: Moment vs curvature Type 2

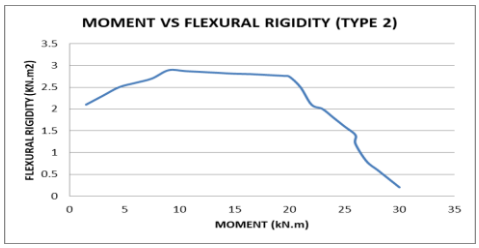

Chart -6: Moment vs Flexural rigidity Type 2

Deflection Details of Beam with Acrylic fibre sheet

The Flexural strength of beam with acrylic sheet is 3.17N/mm^2

Fig- 6: Flexural strength of beam with acrylic fibre sheet

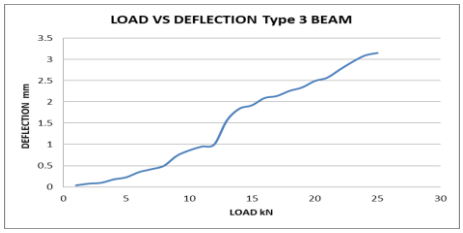

Chart -7: Load vs deflection Type 3

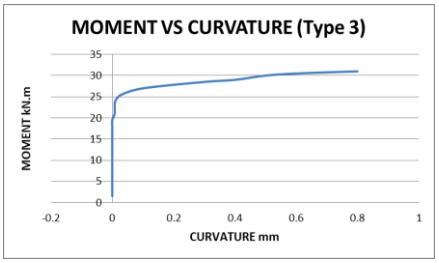

Chart -8: Moment vs curvature Type 3

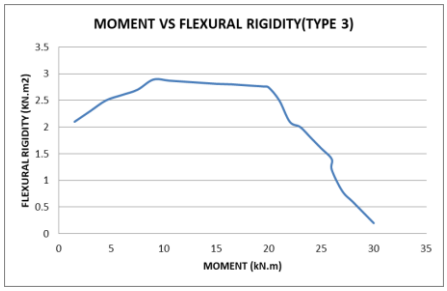

Chart -9: Moment vs Flexural rigidity Type 3

4. CONCLUSION

In a comparison of study the load carrying capacity of beam is varied, the acrylic sheet is added with beam and higher point of ultimate load is said to be achieved higher than that of the other two beams when compared. Experimental result shows that addition of acrylic sheet and GGBS decreases the deflection of beam when compared to the conventional beam. Flexural Strength and rigidity is gradually increased when compared with other beams. The number of crack is said to be high in conventional beam, while addition of acrylic sheet the number of cracks are said to be reduced.

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