

**R.V. COLLEGE OF ENGINEERING, Bengaluru – 560059**  
**(Autonomous Institution Affiliated to VTU, Belgaum)**



**FATIGUE ANALYSIS OF FIBRE REINFORCED GEOPOLYMER  
CONCRETE**

**(Funded by KSCST)**

**PROJECT REPORT**

*Submitted by*

**NAME OF THE CANDIDATES**

**USN**

Anees A Naik

1RV09CV004

Anup Kanoj

1RV09CV008

Aviratna Kumar

1RV09CV012

Bharath A

1RV09CV015

Under the Guidance of  
Dr Radhakrishna,  
Associate Professor & Dean,  
Department of Civil Engineering, R.V. College of Engineering, Bengaluru.

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## SYNOPSIS

The cement industry is the major contributor to greenhouse gases mainly by carbon dioxide emissions. Also there is a large generation of fly ash from thermal power stations. Thus in the view of sustainable development the proposed research aims at developing alternate materials like fly ash thereby producing concrete with complete (100%) elimination of cement. Geopolymer concrete has excellent properties like low carbon dioxide emission, high early strength, durability, fast setting etc. One of the drawbacks of conventional concrete is low tensile strength. Tensile strength can be enhanced by the addition of fibres. Thus fibre reinforced geopolymer concrete (FRGC) is developed combining the two concepts of geopolymer and fibre reinforced concrete. The objective of the research is to compare the properties of geopolymer fibre reinforced concrete with the conventional cement concrete. Thus the properties of this new material would be helpful in various engineering applications. The reported literature is silent about the concept of cement less fibre reinforced concrete. The development of fibre reinforced geopolymer concrete combines the benefits of geopolymer and conventional fibre reinforced concrete. This new material would add the benefits of both. Hence there is a need to develop such material.

Various materials used for the research were Fly ash and Ground Granulated Blast Furnace Slag (GGBS), sodium hydroxide flakes and sodium silicate powder. Fibre reinforced geopolymer concrete was prepared using Fly ash and GGBS as binders and activator solution using conventional aggregates. Optimum dosages of fibres were determined and added to concrete to enhance the properties. Suitable mix proportion was arrived at, to get desired strength. The tests were carried out on conventional concrete, geopolymer concrete with and without fibres to assess mechanical properties. Various tests conducted include compressive, flexural, split tensile, flexural fatigue strength and ultrasonic pulse velocity test.

The minimum compressive strength required for FRGC to be designated as structural concrete is 20MPa which was successfully achieved. The flexural strength of FRGC showed a marginal (3.43%) increase when compared to conventional concrete whereas the split tensile strength increased by 15%. The fatigue life was also determined. The non-destructive test performed using ultrasonic pulse velocity indicated that the quality of FRGC was “good” as per Indian Standards IS 13311- Part 1. Since the fatigue life of the FRGC is relatively better compared to the conventional concrete, it finds the application in highway and airport pavements, bridge decks resulting in safe, effective and economical design.

**Key words:** Geopolymer, fibre, fly ash, slag, tensile strength, flexural strength, pavement.