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FRACTURE BHEVIOUR OF AMORPHOUS MICROSTRUCTURE CONCRETE

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ABSTRACT: *Safety is an essential concept of engineering design, and it tends to receive greater attention when the consequences of failure are severe. Every industry has its own safety requirement and guidelines to meet its own safety requirements, which includes protection of life and environment against possible hazards due to failures. The safety requirements for different industries vary from one another depending upon their functionality. Mechanical safety is one of the most important of all. Thus considerable steps have been taken in ensuring mechanical safety of the structural components. Usually, for mechanical safety, the design guidelines are based on stress computations and give importance to strength alone. However, concept of designing solely for strength, and using highest strength material without regard to fracture toughness is unreliable. These flaws are neglected by the conventional design approach hence they cannot be relied on all occasions. Hence the structure has to be designed considering the defects or flaws in structural components. Due to these flaws the component's actual strength cannot be taken and new strength has to be found out for designing.*

keywords: Stress computation, Solely for Strength, Toughness, Flaws.

1 .**INTRODUCTION:** As demand for concrete as a construction material increases the production of Portland cement also increases which in pollutes the environment there by causing global warming which is an alarming problem all over the world. This has raised the world to go for alternates for conventional concrete which would have the same properties of conventional concrete but on the other hand it should have less impact on the environment.

2. OBJECTIVE OF THE STUDY:

- Study the fracture properties of geo-polymer concrete using FEM software.
- Develop beam model for geo-polymer concrete and conventional concrete
- Implement the various crack pattern in a beam model
- Compare conventional concrete beam and geo-polymer concrete beam

3. SCOPE OF THE STUDY:

- To design the concrete structure to withstand the failure due to fracture
- To perform trial and error manufacturing technique in short period of time
- To perform the general forming analysis, material comparison and process optimization.

4. FRACTURE PROCESS ZONE: It is defined as the softening zone where the crack is going to propagate when the stress is being applied. In brittle materials, elastic energies are consumed in the form of surface energy with no fracture process zone. In the ductile materials the FPZ is known as the plastic zone which can consume a considerable amount of energy, much more than the surface energy. For quasi-brittle material, a large FPZ which consumes a large amount of energy prior to failure is usually formed ahead of the crack tip.

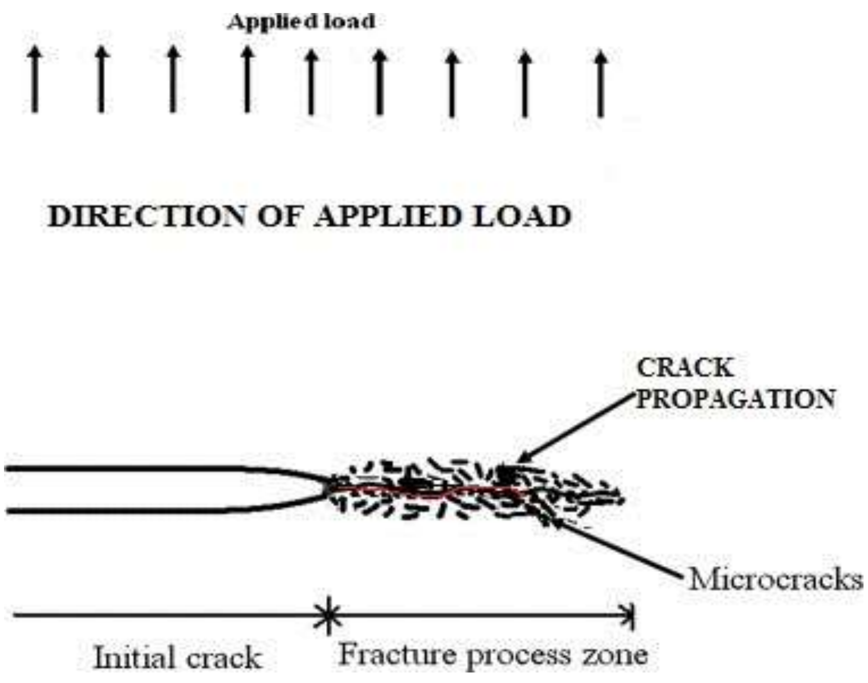

Figure 1.1 Fracture Process Zone

5. MATERIALS AND METHODOLGY: Fracture mechanics is the branch of mechanics which deals with the propagation of cracks in structures subjected to loading. It provides a methodology of evaluating the structural integrity of components containing defects. The basic criterion in any fracture mechanics analysis is to prevent failure. The importance of this topic are the initiation of crack like defects during service life needs to be understood and quantified, the influence of pre-existing cracks on the strength of materials needs to be understood and quantified, a defect tolerant design and maintenance philosophy needs to be developed.

6. Geo-polymer Concrete: Geo-polymers are members of family of inorganic polymers. The chemical composition of Geo-polymer materials is similar to zeolitic, but they reveal an amorphous microstructure. During the synthesized process, silicon and aluminium atoms are combined to form the building blocks that are chemically and structurally comparable to those binding the natural blocks.

7. Properties of Geo-polymer Concrete: Based on available experimental evidence, the Geo-polymer concrete has good compressive strength, Tensile strength, flexural strength, fracture toughness. Geo-polymer concrete when compared to normal concrete has following properties:

- Increased early strength
- Low shrinkage
- Increased freeze-thaw resistance
- Increased sulphate resistance
- Increased corrosion resistance
- Increased acid resistance
- Increased fire resistance
- Low curing time

8. RESULT: Conventional and geo-polymer concrete beam model is developed using abaqus software. Finite element method forms a basic of abaqus. The material properties assigned to model based on the literature review. The load was applied incrementally to the beam model and deflection behaviour of three types of beam model was obtained. From the deflection value various fracture parameters was calculated using the formula discussed in chapter three.

9. CONCLUSION: Different fracture parameters were studied for normal concrete and geopolymer concrete. The fracture parameters of Geopolymer concrete have been compared with conventional concrete.

The fracture parameters studied were stress intensity factor k, critical J-integral, fracture energy and fracture process zone. The fracture parameters have been studied by the molarity of Geopolymer concrete and also varying the notch to depth ratio from 0.05 to 0.2d

The stress intensity factor for Geopolymer concrete was higher when compared to that of normal conventional concrete with 12 molar Geopolymer concrete having the highest value.

The K value of Geopolymer concrete was 20% more when compared to that of normal conventional concrete. The value of K decreases as the notch to depth ratio increases. Since more stress intensity is required for the crack to propagate when there is less flaw in the structure

The values of J-integral for conventional were near to that Geopolymer concrete with Geopolymer concrete of 12 molarity having a little higher value

Fracture energy showed the same trend but the value of fracture energy for Geopolymer concrete was much higher than that of conventional concrete.

The fracture energy of 8 molar Geopolymer concrete was 80 % more than that of the normal concrete and 12 molar Geopolymer concrete showed nearly 90% increase in fracture energy value when compared to that of normal concrete.

The value of fracture energy decreased as the notch to depth ratio was increased since more energy is required for the crack to propagate when there is less flaws in the structure.

The fracture process value of normal concrete was nearly 30% more than 8 molar Geopolymer concrete and 25 % more than 12 molar Geopolymer concrete.

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