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Flexural Behaviour of Geopolymer Concrete Beams Exposed to Elevated Temperatures

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Abstract

Flexural behaviour of fly ash based geopolymer concrete beams exposed to elevated temperatures (200 °C ,400 °C , 600 °C and 800 °C) has been discussed in this paper. Beams of size 150 mm (W) x 200 mm (D) x 1100 mm (L) were cast with 0.52% reinforcing steel. Cover to the reinforcement has been varied (20 mm, 30 mm and 40 mm) and the geopolymer concrete used had a cube compressive strength of 57 MPa. The deformation characteristics, moment–curvature relationship and cracking behaviour were observed. It could be concluded that, the deformation characteristics of reinforced geopolymer concrete beams at ambient temperature is similar to that of the reinforced cement concrete beams and could be predicted using strain compatibility approach. However, when they are exposed to elevated temperatures, the strain compatibility approach underestimates the deformation behaviour of reinforced geopolymer concrete beams. Further, ductility of the geopolymer concrete beams reduces rapidly with the increase in exposure temperature. Approximate equation has been proposed to predict the service load crack width of geopolymer concrete beams after exposure to elevated temperatures.

Key words: geopolymer; fly ash; concrete beam; high temperature; flexure; crack width.

1. Introduction

Consumption of concrete in the world is second to water (Plenge 2001). Production of cement, the binder material in concrete releases almost equal quantity of CO_2 to the atmosphere (Mehta 2002). As a result, different methods to minimize the use of cement in concrete, either partially or fully have been attempted by many researchers (Sumajouw *et al.* 2011). One of such methods is to use geopolymer (GP) concrete. Geopolymer completely replaces cement in concrete and can be considered as an environment friendly construction material than Ordinary Portland Cement (OPC) concrete. Geopolymer, the binding material in geopolymer concrete, is formed by alkali activation of amorphous alumino-silicate material under warm atmosphere. It has been reported that, the geopolymer concrete having compressive strength up to or even greater than 60 MPa could be easily produced (Hardjito *et al.* 2011and Bernal *et al.* 2011).

Fly ash is one of the alumino-silicate materials for making geopolymer (Sumajouw *et al.* 2011). Fly ash is generated as a waste product at thermal power stations and its effective disposal is a major concern