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Numerical modeling to simulate the concrete spalling when it is exposed to fire

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Abstract

This paper presents a model that simulates heat and mass transport in concrete column when it is subjected to elevated temperatures. The process is a complicated process which is coupled of temperature, moisture and dry air. A mathematical model for simulating the multidimensional, thermo, moisture migration in concrete is inherited the model of Tenchev *et al.*(2001). Here presents the simulation results of one-dimension and two-dimension. Then it develops the relationship between the pore pressure and the concrete skeleton stress. The paper presents the stress coupled with temperature and pore pressure. It is assumed that the pores are spheres and they distribute in equal distance. Then the stress field model can be gained at the assumption that the state of concrete is elastic. After that this paper will give out the rule of the concrete column spalling when it subject to the fire. It is assumed that when the stress exceed the tension strength.

Key words: *Concrete spalling, High temperature, Coupled thermo-moisture-mechanical process*

1. Introduction

In modern society, most buildings are built by using concrete for its excellent performance. But it also has its shortcomings in real use especially when it faces high temperature. On November 3, 2003, the Hengzhou Building suddenly collapsed after it was in fire a long time. The reason is that one column was destroyed. So it is very important to investigate the reason from microstructure. According to the research, the probability of spalling deceases accompanied the small initial water ratio and big water cement ratio(Fu, 2006; Zheng, 2006) .Concrete is constituted of anhydrous concrete, bound water, liquid water, vapor and dry air. When it is subjected to fire, the temperature of it will elevate by both conduction and convection. Then free water begins to evaporate and later the bound water also begins to dehydrate and evaporate. Since the low permeability and the high initial mass of water, the pore pressure accelerates rapidly. When it exceeds the strength of concrete, crack will appear.

There are two main hypotheses to explain the thermal spalling. One is due to pressure and the other is due to

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