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Evolution of mechanical properties of concrete with temperature and humidity at high temperatures

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Abstract.

The mechanical behavior of concrete in tension is studied at different values of water saturation for temperatures ranging from 110 C to 160 C. In order to prevent the concrete from drying, the experiments are performed at the vapor saturation pressure in a specific vessel. Inverse analysis based on numerical simulation is used to compute the values of fracture energy, tension strength and elasticity modulus. The experimental results show that the fracture energy is increasing with saturation and temperature, while the tension strength and the modulus of elasticity are decreasing for a saturation ranging from 35% to 65% and then increasing for higher values of saturation, while they decrease slightly with temperature.

Introduction

In France, every ten years, the containment buildings of power plants are tested under an air pressure level similar to that can occur in containment buildings in the event of a severe accident. This test aims to check containment tightness so as to ensure safety. These tests are performed at low relative humidity, at ambient temperature and under a pressure of $5 \cdot 10^5$ Pa [1].

However, in an accident, these are not the conditions that a containment building has to withstand. For example, during the Fukushima disaster, the temperature reached 180 C, while the pressure reached $5 \cdot 10^5$ Pa at 100% relative humidity.

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