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EXTENDED ABSTRACT

Investigating the Effect of Increasing Temperature on the Spalling Phenomenon in High Strength Concrete Parts

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1. Introduction

In this research, by introducing an analytical model, the behavioral investigation of various types of concrete parts made of high-resistance concrete against the increase in temperature has been investigated, and at the same time, the phenomenon of flaking of concrete under heat has been investigated. In the upcoming research, the relationship between the heating rate and the initial spalling time has been determined by introducing a relationship.

2. Methodology

2.1. FE modeling

Abaqus software is known as one of the famous mechanical engineering analysis software. In this research, the analytical results of this software have been used to evaluate the issue of applying heat to high strength concrete parts. The modeling process in Abaqus software has been done in two separate parts:

1) Heat transfer model of high strength concrete parts
2) Fluid transfer model (water or steam) in the holes of high strength concrete parts

3. Results and discussion

3.1. Spalling

The purpose of this research is analytical modeling of high-strength concrete parts (non-reinforced slab) and investigating the effect of temperature increase on its behavior, considering the compressive strength of concrete between 60 and 100MPa (limit of high-strength concrete). The reason for examining the behavior of non-reinforced concrete parts in this research is that the increase in temperature applied to reinforced concrete parts, due to the concrete coating on the steel parts, affects the concrete part more and the steel parts are less affected by heat in the initial state and the reduction of the strength of these components is initially due to the reduction of the strength of the concrete part. Fig. 1 and 2 show, respectively, the initial spalling depth and initial spalling time in the base concrete part, under various heating mechanisms considered in the research.

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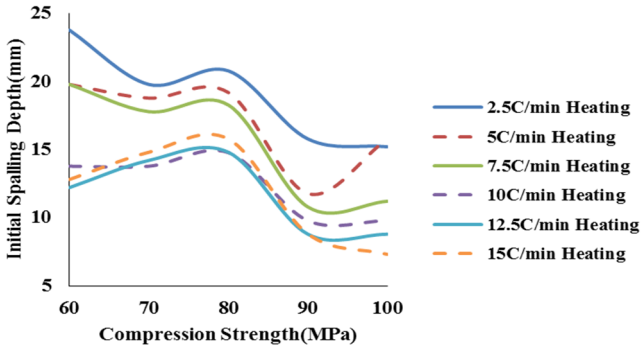

Fig. 1. The depth of initial spalling of concrete types with different heat patterns

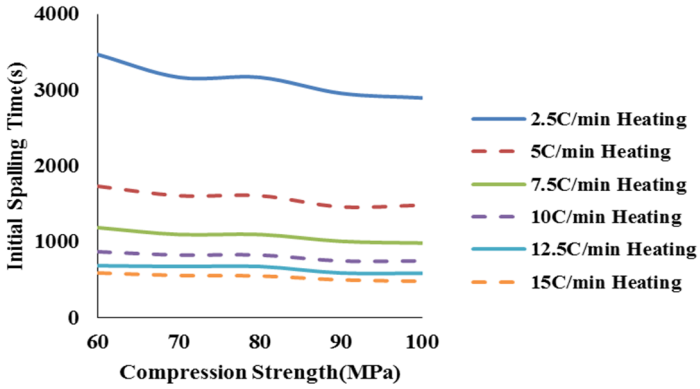

Fig. 2. Initial spalling time of concrete types with different heat patterns

Fig. 1 and 2 show that the heating pattern of this research can cause initial spalling of more than 2cm in the high-strength concrete part, and the maximum amount of initial spalling can be seen in the heating pattern of 2.5°C/min.

4. Conclusions

In this research, an analytical modeling method was presented which is able to predict the general behavior of high resistance concrete parts against temperature increase. In this model, which has been in Abaqus comprehensive software environment, the effect of temperature increases according to a special mechanism of applying heat to high strength concrete piece has been investigated. The results show that:

1) With the increase of the resistance class of concrete, under the increase of temperature, the pore pressure in the concrete piece will increase significantly, so that there is an expectation of spalling of more than 2cm in the studied concrete classes.

2) The speed of reaching the initial spalling increases with the increase of the slope of the permeability drop, so that for this reason, the 80MPa strength class concrete has twice the speed of reaching the initial spalling compared to other types of high-strength concrete.

5. References

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