Fire Impact on the Compressive Strength of Concrete Masonry Materials - A Review

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Abstract:

Concrete Masonry has been known to have excellent fire protection properties. Its large thermal mass helps keeping the fire contained and reduces the temperature at the core of the masonry assembly, which allows for a longer time for the loads to be carried. This is important because the mechanical properties of concrete blocks and mortar begin to deteriorate as the material heats up. The main properties that affect the stability and temperature profile of masonry exposed to fire are its thermal expansion, density, thermal conductivity, and specific heat capacity. There can be a large difference in the properties between two concrete mixes, based on factors such as aggregate type, mix design, moisture content, and the addition of supplementary cementitious materials. This paper aims to outline the (a) effects of temperature on the compressive strength of masonry materials and (b) effects of different concrete types on the performance of concrete masonry at fire temperatures. This is done by explaining the chemical and physical changes that concrete undergoes when it is heated, as well as outlining the results from various research work. In conclusion, thermal expansion is an important factor that needs to be taken into account when deciding which materials to use in concrete masonry to reduce negative effects at elevated temperatures and keep the residual compressive strength high. The residual compressive strength of concrete is usually unchanged below 400°C. Above 400°C the strength starts to decrease due to a combination of moisture loss, micro cracks, chemical decomposition, and thermal stresses. The strength loss can be mitigated by using thermal stable aggregate such as lightweight aggregates or certain recycled aggregates. Supplementary cementitious materials can also be used to reduce micro cracking and improve the mechanical properties of concrete at elevated temperatures.

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