# STUDY OF THERMAL CONDUCTIVITY IN MASS CONCRETE WITH POLYPROPYLENE AND STEEL FIBERS

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***Palabras Clave:*** *Thermal conductivity; polypropylene fiber; steel fiber, concrete.*

## 1. Introduction

Thermal conductivity is the physical property of materials that measures their capacity to transfer heat by conduction, increased with increasing saturation, temperature, volumetric fraction and thermal conductivity of the aggregate and decreasing with the increase of the relation w / C [1,2]. This property influences aspects as important as the fire behavior of reinforced concrete structures. On the other hand, the incorporation of polypropylene fibers, due to its physical, chemical and mechanical characteristics, improves its resistance and controls the cracking while the incorporation of steel fibers, modifies the nonlinear behavior of the structural concrete, especially in tensile, delaying the propagation of cracks and increasing their ductility [3,4]. Based on the above premises, the objective of the present study is to compare the thermal conductivity of different concretes, without addition and with additions of polypropylene fibers and steel fibers in different percentages by weight of cement.

## 2. Method

To perform this investigation, cubic specimens of 15x15x15cm$^3$ have been tested in accordance with ASTM D5334 [5]. HM-25 mass concrete has been manufactured and steel fibers have been added as percentages of 1% and 2% by weight of cement (FA 1% -FA 2%) and polypropylene fibers in amounts of 1% and 2% by weight of cement (PP 1% -PP 2%). Concrete without additions (SA) has also been manufactured as reference concrete, as can be observed in figure 1. Once the specimens have been cured, a week has been introduced in a climatic chamber at 20ºC and 50% relative humidity, conditions in which have been made the measurement of thermal conductivity. The equipment used for the measurements of the test specimens is the "Decagon Device" and each of the measurements has been repeated 3 times, according to the standard, and the average of the thermal conductivities measured in W/mK has been calculated.


***Fig. 1: Cubic specimens with additions of 1% and 2% by weight of FA and PP cement and without addition.***

## 3. Results and Discussion

Figure 2 shows the results of the thermal conductivity in specimens with 1% and 2% of polypropylene fibers, 1% and 2% of steel fibers and without addition. As can be seen, concrete with addition of steel fibers increases its coefficient of thermal conductivity with respect to traditional concrete, being higher when 1% addition is used. As for the results of thermal conductivity in specimens with 1% and 2% of polypropylene fibers, the elements incorporating PP fibers have a lower coefficient of thermal conductivity compared to traditional concrete, decreasing when increases the percentage of fiber in the matrix of the concrete, achieving an optimization of the material for the effects of fire.

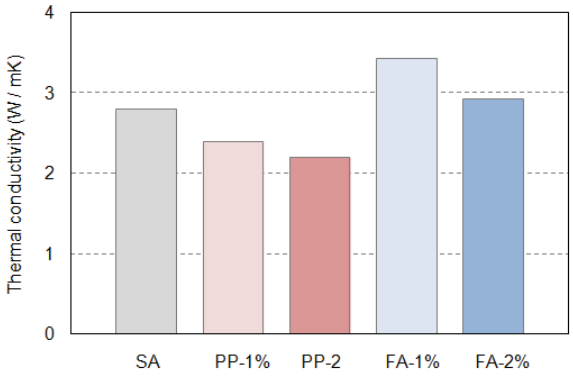


***Fig. 2: Thermal conductivity in concrete without additions and with 1% and 2% of polypropylene fibers and 1% and 2% of steel fibers.***

## 4. Conclusions

The analysis of the results allows us to conclude that the incorporation of polypropylene fibers contributes to an improvement in the heat transfer conditions inside the concrete in front of the fire. The fibers collaborate reducing the thermal conductivity of the material and therefore improving its behavior against the passage of heat by the material, which reverts in minimizing the dilatation-retraction effect of the concrete, thus avoiding the cracking of the concrete and delaying the propagation of the temperature inside the structural element.

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