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REVIEW PAPER

The Effect of Polypropylene and Steel Fibers on the Properties of Concrete at Normal and Elevated Temperatures—A Review

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Abstract

Fibers are especially used to boost different characteristics of concrete and to make concrete efficient, wherever it lacks performance. This study was carried after addition of synthetic fibers namely Polypropylene fibers and Steel fibers and their respective effects on some important characteristics of concrete like mechanical properties, crack analysis, permeability, and spalling at ambient and raised temperatures. It was found that polypropylene enhances the mechanical properties and impact resistance of concrete. An optimum quantity of fiber enhances these properties, but if fiber dosage exceeds the optimum dosage, there is a certain decrement in properties. Although the optimum percentage obtained was different for different properties, but in general, all properties got enhanced if the addition of polypropylene was less than 2%. Polypropylene also increased the spalling resistance of concrete up to 600 °C, but beyond 600 °C, it reduces the effect of spalling and could not prevent it entirely. The inclusion of steel fibers to concrete showed a significant positive influence on the mechanical properties at high temperatures and increased the temperature at which spalling occurs up to a dosage of 1–1.5%, beyond 1.5%, compressive strength decreases. Between 20 and 700 °C, steel fiber reinforced concrete showed 40% more split tensile strength than normal concrete.

Keywords Polypropylene fibers · Steel fibers · Elevated temperature · Compressive strength · Permeability · Spalling · Split tensile Strength · Modulus of Elasticity

Abbreviations

Notations	Full Form
CS	Compressive strength
E/E'	Relative elastic modulus
FA	Fly ash
fc/f'c	Relative compressive strength
FRC	Fiber reinforced concrete
ft/f't	Relative tensile strength
f_u	Ultimate compressive stress
GGBS	Ground granulated blast furnace slag
H–C	Heating-cooling
HPC	High-performance concrete
HPP	High performance synthetic macro polypropylene
HPPF	High performance synthetic macro polypropylene fibers
HSC	High strength concrete
HyFRC	Hybrid fiber reinforced concrete
M1	Concrete mix with 0% fiber
M2	Concrete mix with 1% fiber
M3	Concrete mix with 1.5% fiber
M4	Concrete mix with 2% fiber
MK	Metakaolin
MOE	Modulus of elasticity
NC	Normal concrete
NSC	Normal strength concrete
PP12	Polypropylene fiber of 12 mm length
PPF	Polypropylene fibers
PPFRC	Polypropylene fiber reinforced concrete
PVA	Polyvinyl alcohol (fibers).
RC	Reinforced concrete
RC80/60 BN	Dramix® bright and low carbon steel fiber reinforced concrete of fiber length 60 mm and slenderness ratio of 80 [ø of fiber = 0.75 mm)
RCS	Residual compressive strength

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