



NRC-CNRC

Institute for
Research in
Construction

Bringing quality
to the
built environment

Fire Resistance of FRP-Reinforced Concrete Members

Objective

To develop fire-resistance design guidelines for FRP-reinforced concrete structures.

Background

FRPs or fibre-reinforced polymers are high in strength, lightweight and non-corrosive, and their effectiveness as externally bonded repair materials is now widely recognized. However because they are relatively new, and only limited work has been done on their performance in fires, they have not been used in buildings where fire safety is a critical design consideration.

Statement of Work

- Conducted nine full-scale and four intermediate-scale fire-endurance experiments on columns, slabs, and beam-slab assemblies strengthened with carbon and/or glass FRP wraps and insulated with a specially designed fire-protection system.
- Developed numerical models to predict the fire resistance of the members, and validated them against experimental data.

Results

The study demonstrated that:

- FRP-strengthened systems that were adequately insulated achieved a minimum 4-hour fire resistance rating under service load
- The insulating fire-protection systems maintained low temperatures in the concrete and reinforcing steel, thus enabling the concrete and steel to retain most of their ambient strength during the fire tests
- Even though the glass transition temperature of the FRPs was exceeded, satisfactory fire resistance ratings were achieved because the insulation stayed in place. The insulation and its proper installation were key to protecting the structure.

Outcomes

- Numerical models capable of predicting with sufficient accuracy the thermal effects of fire on the assemblies tested
- Preliminary fire-resistance design guidelines for FRP-strengthened concrete structural members submitted to the American Concrete Institute (ACI) for inclusion in the ACI standards.

Partners

Members of the Intelligent Sensing for Innovative Structures Network (ISIS Canada) at Queen's University, Fyfe Co., and BASF Building Systems

Start/Expected Completion Dates

The project began in July 2002 and was completed in March 2007.

Project Manager

Dr. Nouredine Bénichou: 613-993-7229; Nouredine.Benichou @nrc-cnrc.gc.ca

For more information, see http://irc.nrc-cnrc.gc.ca/fr/frss/frc_hw_frp_e.html

Factsheet 47, July 2007



Beam slab assemblies before testing



Beam-slab assemblies after testing



National Research
Council Canada

Conseil national
de recherches Canada

Canada