Composite Rebar for Concrete Structures

CASE STUDY

LAURIER-TACHE PARKING GARAGE

PROJECT DATA :
Name of the project: Laurier-Tache Parking Garage
Client/Owner: Public Work and Government Service Canada
Engineer: Benmokrane and al.
Designing Engineer: Harmer Podolak Engineering Consultants
Contractor: Genivar Consultants
Installation Date: 2005

Project History:
Laurier-Tache Parking Garage consists of three wings, Maisonneuve Wing and Laurier-Tache East & West Wings. The two newest wings have three levels, while Maisonneuve Wing only has two levels, all constructed with reinforced concrete columns, beams and slabs. As a result of corrosion of the steel reinforcement, the structural concrete slabs suffered from the partial or total loss of steel reinforcement and spalling of concrete cover at several locations.

Objective:
- to build more durable, maintenance-free and long lasting concrete structures which will advance the commitment of the Canadian Federal Government to sustainability and reduction of greenhouse gas emission.
- to implement FRP reinforcing bar technology in parking garages
- to evaluate long-term performance of FRP under service and environmental conditions
- to compare the in-service behaviour of FRP with that of steel
- to validate and/or improve the design codes and guidelines
- to enhance the confidence of using FRP as concrete reinforcement based on real-life monitoring information

The design also took into account the concerns raised by the project design team regarding the fire rating of 2h as specified by CSA-S413.
Benefits:
FRP rods are used as reinforcement for concrete structures in which the corrosion of steel reinforcement has typically led to significant deterioration and rehabilitation needs. The non-corrosive nature of the FRP rods is beneficial for improved durability.

Conclusions:
Laboratory testing

1. The load carrying capacity of concrete slabs reinforced with composite FRP bars (carbon & glass) was higher than the control slab reinforced with steel (22%-65%) satisfying the same strength and serviceability requirements. In addition, the slabs reinforced with FRP bars failed by concrete crushing, while the control slab failed by steel yielding followed by concrete crushing.

2. At service load level, the calculated cracking control parameter based on actual measured strains and the maximum measured crack width were below the allowable limits of 38 000 N/mm and 0.5mm respectively.

3. At service load level, the maximum measured deflections for all tested slabs were below the allowable limits of span/360 (CSA 2002)

4. The values of the deformability factor for the five concrete slabs reinforced with FRP were in the range of 14 to 19, which are more than three times the minimum (4 for rectangular sections) required by the CSA-S6-02.

5. The ratios of measured deflections, number or cracks, crack penetration depth, and crack spacing at failure to those at service load level were in the range of 17 to 21, 2, 1.5 to 2, and 0.3 to 0.4 respectively. This, along with the values of the deformability factor, indicates the ample warning that the FRP-reinforced slabs would give before failure. Test results showed that all FRP reinforcement configurations satisfied both serviceability and strength requirements of the available codes and design guidelines mentioned earlier. The proposed design configurations for the reconstruction of the structural slabs of the Laurier-Tache parking garage can be considered adequate. Based on this work, PWGSC is planning to incorporate the use of FRP into sections of the structural slabs would give before failure.

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AT PULTRALL, WE BELIEVE IN CHALLENGING THE STATUS QUO.
We are convinced that safe and durable concrete structures are achieved by eliminating the corrosion problem at its roots. Our solution, a stronger, well tested, widely used and corrosion proof reinforcement that advantageously replaces the easily corroded steel rebar. Our solution, V-ROD!

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