The College of Graduate Studies and the College of Engineering Cordially Invite You to a

Master Thesis Defense

Entitled

BEHAVIOR OF TWO-SPAN CONTINUOUS GFRP-REINFORCED CONCRETE DEEP BEAMS

By

Mohamed Shokry Abouelsaoud

Faculty Advisor

Dr. Bilal El-Ariss, Department of Civil and Environmental Engineering

College of Engineering

Date & Venue

9:30 AM

Friday, 10 November 2023

F1-1

Abstract

Steel-reinforced concrete deep beams are structural elements characterized by their large depth-to-span ratio. They play a crucial role in supporting heavy loads and transferring them to columns or walls in bridges, high-rise buildings, and marine structures. Corrosion is a major concern in steel-reinforced concrete structures, which can significantly reduce their lifespan and undermine their structural integrity. By replacing steel bars with fiber reinforced polymer (FRP) bars, the corrosion resistance of reinforced concrete (RC) structures can be improved and prolong their longevity. However, FRP bars behave elastically up to failure and have lower modulus of elasticity compared to steel, which affects the overall stiffness of the structure. While the effects of FRP bars on simply-supported FRP-RC beams have been studied extensively, the structural behavior of continuous FRP-RC deep beams is not well understood. Design codes and guidelines are also lacking in this area.

This research aimed to achieve an improved understanding of the structural behavior of continuous concrete deep beams reinforced internally with glass fiber-reinforced polymer (GFRP) bars. Eight large-scale two-span continuous GFRP-RC deep beam specimens were fabricated and tested for failure. The study investigated three main parameters: specimen concrete compressive strength, GFRP longitudinal reinforcement ratio, and GFRP vertical and horizontal web reinforcement ratio (same ratio for both). The test results confirmed the development of the tie-arch action as well as the impacts of the concrete compressive strength and GFRP longitudinal and web reinforcements on the structural behavior of the continuous deep beam specimens.

The experimental results were employed to evaluate the applicability of the Strut-and-Tie Model (STM) recommended by the American, Canadian, and European codes and by previous studies to predict the load carrying capacities of the tested GFRP-RC continuous deep beam specimens. It was found that, overall, the load capacities predicted by the STM recommended by different codes and by previous investigations exhibited varying degrees of discrepancy with the study test results. Therefore, a new empirical effectiveness factor was proposed to be used with the STM analysis to better predict the load capacity of two-span continuous GFRP-RC deep beams.

Keywords: Glass fiber reinforced polymer (GFRP) bars; Continuous concrete deep beams; Web reinforcement; Strut-and-tie model (STM); Effectiveness factor