شبكة المعلومات الجامعية

التوثيق الإلكتروني والميكروفيلم

بسم الله الرحمن الرحيم

HANAA ALY

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HANAA ALY

AIN SHAMS UNIVERSITY

FACULTY OF ENGINEERING

Structural Engineering

Study of the Structural Behavior of Jointed Precast Concrete Elements Reinforced with GFRP Bars

A Thesis submitted in partial fulfilment of the requirements of the degree of

Master of Science in Civil Engineering

(Structural Engineering)

by

Taha Hassan Mokhtar Ahmed El-Daleel

Bachelor of Science in Civil Engineering

(Structural Engineering)

Faculty of Engineering, Ain shams, 2014

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Cairo - (2021)

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STATEMENT

This thesis is submitted as partial fulfillment of Master of Science in Civil Engineering (Structural Engineering), Faculty of Engineering, Ain shams University.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

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ACKNOWLEDGEMENTS

First and foremost, I thank Allah through whom all things are possible.

I would like to express my deepest gratitude to my supervisor, Dr. Ahmad Fathy Abd El Aziz, for his support throughout this research project. I am grateful to him all for having the opportunity to work under his supervision.

I would like to express my deepest thanks and appreciation to my supervisor, Dr. Khalid Mohamed Morsy for his invaluable assistance, advice, and endless support throughout this research.

I would like to express my deepest gratitude and appreciation to my supervisor, Dr. Fareed Mahmoud Elgabbas, for his invaluable help, guidance, technical and moral support, and encouragement throughout all the phases of this research project.

I think this research would have not been completed without the continuous support from my family. I would like to thank my mother, for the ongoing love and sacrifice to make me in a good state of mind, which I really needed a lot. I would like to thank my father, for his continuous encouragement, consideration, and support. I would like to thank my brother and sister, for their support and encouragement in all the stages of this research. Thank you for believing in me and standing by my side for every step of the way.

I would like to express my gratitude for my friends. Thanks to every one of them, who gave me moral support during my downtimes and for their continuous support along different parts of the project.

ABSTRACT

In recent times, precast concrete technology has found its way in a lot of commercial and residential construction projects. This is because its many significant advantages such as less in-site labor and workforce, less waste material, less use of formwork in the site, faster and easier erection of the structures, reducing overall construction cost, high-quality control, providing better architectural appearance, improving durability, and less impact on the environment. Meanwhile, to avoid corrosion problems, precast elements were reinforced with FRP bars due to higher corrosion resistance than reinforced steel bars.

However, sometimes using precast concrete elements reinforced with GFRP bars is restrained by how to connect precast elements. So, one of the main challenges of precast concrete structures is proposing different methods to connect the precast members in a safe and efficient manner taking into consideration making the joint length small enough for easier and faster construction.

Accordingly, the main objective of this study is to propose two different methods to connect precast elements with smaller and more durable connections, using lap-splice or GFRP/steel sleeve filled with epoxy resin. That is achieved by investigating the structural behavior of jointed precast concrete elements reinforced with GFRP bars by both two methods and compare between them. Besides, investigating the tensile capacity of GFRP/steel spliced sleeve bars, affected by radial sleeve stiffness, as well as the bar embedment length.

This study consists of two main stages. The first stage investigates the tensile capacity of the GFRP/steel sleeve filled with epoxy resin by testing twelve specimens under tension up to failure in terms of failure load and mode of failure. While the second stage investigates the structural behavior of jointed precast

concrete elements reinforced with GFRP bars by testing ten beams under a four-point loading bending test up to failure in terms of flexural capacity, load-deflection response, crack pattern, and failure mode.

The experimental test results of the first stage showed that the tensile capacity increased by increasing bar embedment length for both GFRP and steel sleeves, as well as increasing the radial stiffness of the GFRP sleeve. Thus, an adequate radial stiffness and bar embedment length are required to produce a sleeve connector that achieves bar tensile strength. Furthermore, the optimum bar embedment length in a steel sleeve connector was found to be 15 times bar diameter. Also, the test results of the second stage showed that beam flexural capacity increased by increasing lap splice length, as well as increasing confinement lap splice region by GFRP sheets. Meanwhile, using normal strength concrete with different compressive strengths has a negligible effect on the beam behavior. Finally, the joint length between precast elements can be minimized by using a sleeve connector with an adequate radial stiffness or by confining the lap splice region to minimize lap splice length.

Keywords: GFRP Bars; Precast concrete joints; GFRP bars lap-splice; Sleeve connector; GFRP sleeve

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