STRUCTURAL RETROFITTING OF CORRODED REINFORCED CONCRETE BEAMS USING BAMBOO FIBER LAMINATE

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AUGUST, 2021

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A DISSERTATION SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES IN PARTIAL FUFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF ENGINEERING (M.Eng.) IN CIVIL ENGINEERING IN THE DEPARTMENT OF CIVIL ENGINEERING, COLLEGE OF ENGINEERING, COVENANT UNIVERSITY

AUGUST, 2021

ACCEPTANCE

This is to attest that this dissertation was accepted in partial fulfilment of the requirement for the award of Master of Engineering (M.Eng.) degree in Civil Engineering, Department of Civil Engineering, college of Engineering, Covenant Univesity, Ota

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(Secretary, School of Postgraduate Studies) **Signature and Date**

Prof. Akan B. Williams
(Dean, School of Postgraduate Studies) **Signature and Date**

DECLARATION

I, **NWORGU, TOBECHUKWU AUSTIN (18PCI01974)** declare that this research work was carried out by me under the supervision of Dr. Paul O. Awoyera of the Department of Civil Engineering, Covenant University. I also solemnly declare that to the best of my Knowledge, no part of this report either wholly or Partially has been submitted here in Covenant University or elsewhere in a previous application for theaward of a degree. All sources of Data and schorlarly publications have been duly acknowledged.

NWORGU, TOBECHUKWU AUSTIN

Signature and Date

CERTIFICATION

We certify that this dissertation titled "**STRUCTURAL RETROFITTING OF CORRODED REINFORCED CONCRETE BEAMS USING BAMBOO FIBER LAMINATE**" is an original research work carried out by **NWORGU, TOBECHUKWU AUSTIN ((18PCI01974)** in the Department of Civil Engineering, College of Engineering, Covenant University, Ota, Ogun State, Nigeria under the supervision of Dr.Paul O. Awoyera. We have examined and found this work acceptable as part of the requirements for the award of Master of Engineering in Civil Engineering.

Dr. Paul O. Awoyera
(Supervisor) **Signature and Date**

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(Head of Department) **Signature and Date**

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(External Examiner) **Signature and Date**

Prof. Akan B. Williams
(Dean, School of Postgraduate Studies) **Signature and Date**

DEDICATION

I dedicate theis research work to my strength, God Almighty, for his loving mercies and provisions given to me to carry out this research. I also want to dedicate this research to my parents, for their love and support towars fulfilling my ambitions and goals.

ACKNOWLEDGEMENT

Firstly, I want to thank the Almighty God for his gracious love, wisdom and mercy in the life of me and my family

I also want to appreciate the management of covenant university under the leadership of the chancellor, Dr. David Oyedepo, and the vice chancellor, Professor Abiodun H. Adebayo. whose vision and standards have provided an astounding platform for me to obtain this degree.

My sincerest appreciation goes to my supervisor, Dr. Paul O. Awoyera. He has been extremely supporting with his words and guidance. Which to this, I will eternally remain grateful, Sir.

Furthermore, I would love to appreciate the entire management of Civil Engineering under the leadership and guidance of Professor Anthony N. Ede and also past and present postgraduate Coordinators, Dr Isaac I. Akinwumi and Dr Gideon O.Bamigboye for creating a conducive environment for studies and research within the department and even for their encouraging words to the completion of the master's program. Again, special thanks to Dr Bamigboye for pushing me to write published papers.

I also want to thank the structure's staff for their advice and input in the research work. Special thanks to Engr. Jolayemi Joshua for his hands on support and advice, it is deeply appreciated. Mr Idowu and Mr David for their support also.

My sincerest regards to my friends and colleagues: Chinyere Nwafor, David enabulele, Daniel Bassey, Etim-Mmemek Paul and Academe Sunday, to name a few for their ideas and support. And lastly, I would love to appreciate my Parents, my siblings and cousins for their guidance and astounding support.

TABLE OF CONTENTS

.

LIST OF FIGURES

LIST OF TABLES

LIST OF PLATES

.

LIST OF ABBREVIATIONS

ASTM	American Society for Testing and Materials
AFRP	Aramid Fiber Reinforced Polymer
BFRPC	Bamboo fiber Reinforced polymer composites
CFRP	Carbon fibre reinforced polymer
CR	Corrosion Rate
DC	Direct Current
EB	External Bond
FRP	Fiber reinforced polymer
GFRP	Glass fiber reinforced polymer
GHG	Green house gas
HDPE	High Density Polyethylene
INBAR	International network for bamboo and rattan
LDPE	Low Density Polyethylene
MJ	Mega Joules
MP_a	Mega Pascal
NFRP	Natural Fiber reinforced Polymer
NSM	Near Surface Mount
RC	Reinforced concrete
UTM	Universal Testing Machine
UV	Ultra Violet
W/C	Water Cement Ratio

ABSTRACT

Corrosion is a major degradation mechanism in reinforced concrete (RC) structures that contributes to the high cost of maintenance and repair of affected buildings. However, as the cost of repairing corrosion damaged structures is high, alternative cheap, eco-friendly and sustainable methods are being proposed. In this study, the structural retrofitting of corroded reinforced concrete beam was carried out using bamboo fibre laminate. . The structural capacity of the beams, in flexure, was evaluated following the loading process of 1 ton increments. This was an experimental study that was carried out in two laboratories namely: the structural laboratory of civil engineering department, covenant university and university of lagos. during the time of performing the experiments, this aspects were assessed and recorded : load-displacements analysis, displacement characteristics, crack patterns and failure modes. The process of arriving at these results invoved three Reinforced Concrete beams, differently assembled for the tests (one control beam, one corroded beam un-strenghtned with bamboo laminate and a corroded beam strenghtened with bamboo laminate. The experiment ended with results showing that corroded beams strengthened with bamboo laminates increase the bearing capacity supporting other studies using natural fiber composites The use of a single Bamboo laminate in the tensile region increased the ultimate load capacity up to 21.1% greater than the corroded beam though 20% lesser than the control beam which can be attributed to corrosion of the steel reinforcemets. Hence, it can be recommended that bamboo fibers be used as a retrofitting material.

Keywords : Strengthening; fiber composites ; Bamboo laminate; Corrosion, flexural behavior; reinforced concrete beams