ADAPTATION OF CORRUGATION WEB IN CELLULAR BEAMS WITH HOLLOW FLANGE

A PROJECT REPORT

Submitted by

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To

APJ Abdul Kalam technological university

In partial fulfillment of the requirement for the award of the

Degree of

Master of technology

In

Computer Aided Structural Engineering

Department of Civil Engineering

SREE NARAYANA GURU COLLEGE OF ENGINEERING &

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I undersigned hereby declare that the project report "adaptation of corrugation web in cellular beams with hollow flange", submitted for partial fulfillment of the requirements for the award of the degree of Master of Technology of the APJ Abdul Kalam Technological University, Kerala is a bonafide work done by me under supervision of Mr. Shibin B. This submission represents my ideas in my own words and where of others have been included; I have adequately and accurately cited and referenced the original sources. I also declare that I have adhered to ethics of academic honesty and integrity and have not misrepresented or fabricated any data or idea or fact or source in my submission. I understand that any violation of the above will be a cause for disciplinary action by the institute and/ or the University and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been obtained. This report has not been previously formed the basis for the award of any degree, diploma or similar title of any other University.

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ACKNWOLEDGEMENT

First and foremost, I concede the surviving presence and the flourishing refinement of the Al mighty God for his concealed hand yet substantial super vision all through the project.

I extend my sincere gratitude to **Dr. Leena A V, The Principal, Sree Narayana Guru College of Engineering and Technology, Payyannur,** for her countenance towards the successful accomplishment of our course.

I express my deep fence of gratitude to **Mrs. B Mary Sonia George, Head of the Department of Civil Engineering**, for her kind co-operation and technical support rendered by her in making my project successful.

I express my heartfelt gratitude to my project coordinator **Mrs. Saritha Sasindran, Department of Civil Engineering** for her valuable guidance throughout my project.

I express my heartfelt gratitude to my project guide **Mr. Shibin B, Assistant Professor, Department of Civil Engineering** whose efficient guidance and direction encouraged me to make this effort successful.

Last but not least I express my gratitude to my parents, my friends, all staffs of the Civil Engineering Department who gifted me the necessary driving force and boost to remain positive always with high spirits.

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ABSTRACT

Nowadays Cold Formed Steel (CFS) sections are extensively used in structural engineering works replacing the conventional hot-rolled sections. It is due to the inherent advantages of the CFS. In industrial buildings and also in multi-storey buildings it is mandatory to provide web openings and they are generally provided in CFS roof and flooring systems to accommodate the pipelines and the building services, which leads to the reduction of floor heights. The disadvantage of placing web openings are, it will influence the shear behaviour reduce the strength and shear capacity significantly. The beam stiffness will decrease when web openings are placed, so it will buckle the beam easily when high seismic force or working loads are acted. Also shear failure will takes place. To prevent these hollow flanges are provided with straight beams. So very limited research studies have been conducted on hollow flange CFS beam with web openings. In this study to avoid shear buckling, use the method of implementation of corrugated webs. This study is about how strength and the shear capacity are improvising by implementing corrugated design in cellular beams. Two methods are used for improvising. First is with different type of corrugated shapes. They are dovetail type corrugation, rectangular type corrugation and trapezium type corrugation. Second is with varying the thickness of the web. In this method instead of stiffening the web externally, they are in-building it by these corrugation design. The test conducting are shear and flexural test. By this it is expected that the moment of inertia of web and strength will increase, also the possibility of shear buckling decreases. The complete study is carried out using a finite element method in ANSYs software. The results details that the corrugated web hollow flange cellular beams has less weight and more strength than the flat web hollow flange. So the corrugated web cellular hollow flange beams have better performance than the flat web cellular hollow flange beams.

***Keywords**: Hollow Flange Beam, Web Openings, Corrugated Web, Cellular Beam*

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ABBREVATIONS

CFS	Cold Formed Steel
OATM	One Steel Australian Tube Mills
HFC	Hollow Flange Channel
LSB	Lite Steel Beam
RHFB	Rectangular Hollow Flange Beams
CFST	Concrete-filled steel tubes
CSW	Corrugated steel web
WSP	Web Side Plates
CHFCB	Corrugation web hollow flange cellular beam

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STRUCTURAL PERFORMANCE OF GROOVED GUSSET PLATE DAMPER IN EBF AND CBF

A PROJECT REPORT

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To

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In partial fulfilment of the requirement for the award of the
Degree of
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I undersigned hereby declare that the project report "Structural Performance of Grooved Gusset Pate Damper in EBF and CBF", submitted for partial fulfillment of the requirements for the award of degree of Maters of Technology of the APJ Abdul Kalam Technological University, Kerala is a bonafide work done by me under supervision of Mrs. B. Mary Sonia George. This submission represents my ideas in my own words and where ideas or words of others have been included; I have adequately and accurately cited and referenced the original sources. I also declare that I have adhered to ethics of academic honesty and integrity and have not misrepresented or fabricated any data or idea or fact or source in my submission. I understand that any violation of the above will be a cause of disciplinary action by the institute and/or the University and can also evoke penal action from the source which has thus not been properly cited or from whom proper permission has not been obtained. This report has not been previously formed the basis for the award of any degree, diploma or similar title of any University.

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ACKNOWLEDGEMENT

"First and foremost I thank almighty God for his blessings showered upon me to complete my project.

I extend my sincere gratitude to **Dr. Leena A V, The Principal, Sree Narayana Guru College of Engineering and Technology, Payyanur,** for her countenance towards the successful accomplishment of our course. I express my deep fence of gratitude to my project guide **Mrs. B Mary Sonia George, Head of the Department of Civil Engineering,** for her kind cooperation and technical support rendered by her in making my project successful. I express my heartfelt gratitude to my project coordinator **Mrs. Saritha Sasidran, Department of Civil Engineering** for her valuable guidance throughout my project.

Last but not the least I express my gratitude to my parents, my friends, all staffs of the Civil Engineering Department who gifted me the necessary driving force and boost to remain positive always with high spirits".

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ABSTRACT

The purpose of this study is to modify the braces by installing some energy dissipation device that is added to braces, to absorb the energy and protect the structures from severe earth quakes. Here we use Eccentrically Braced Frame (EBF) and Concentrically Braced Frame (CBF). It prevents all other member including beam, column, connection and also braces from seismic damages. Therefore it improves seismic performance of EBF and CBF. The proposed device includes a gusset plate which is grooved so that it yields in several places and also prevents the plastic action or buckling in the braces. This type of device is known as Grooved Gusset Plate Damper (GGPD). The damper is a small plated metallic element. It can be installed in a braced frame then it act as an energy dissipater. It dissipates the seismic energy through inelastic deformation at its steel strips and absorbs the complete shear. After that, the failure of the damper plate takes place rather than the bracings. In this study, an easily replaceable cost effective damper plate can be utilized on the EBF and CBF. It is expected that improve the performances of EBF and CBF when GGPD is installed. The complete studies have been carried out using a nonlinear finite element method in ANSYs software.

Keywords: Grooved Gusset Plate Damper, Eccentric Braced Frame, Concentric Braced Frame, Seismic performance.

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ABBREVATION

GGPD	Grooved Gusset Plate Damper
CBF	Concentrically Braced Frame
EBF	Eccentrically Braced Frame

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Project Report on

PERFORMANCE OF 3D PRINTED AESTHETIC STRUCTURAL DUPLET COLUMN

Submitted in partial fulfillment for the award of the degree of the

Degree of Master of Technology In

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Of

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I extend my sincere gratitude to **Dr.Leena AV, The Principal, Sree Narayana Guru College of Engineering and Technology, Payyanur,** for her countenance towards the successful accomplishment of our course. I express my deep sense of gratitude to **Dr. Susan Abraham, Dean of Sree Narayana Guru College of Engineering and Technology,** for her kind cooperation and technical support rendered by her in making my project successful.

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ABSTRACT

The commercial finite element programme ANSYS is used to create a numerical model in order to examine the structural performance of 3D printing on attractive structural duplet columns. To create three-dimensional shapes, material is consecutively stacked while being controlled by a computer during 3D printing. It is highly useful for creating prototypes and geometrically challenging components. In this study, two I-shaped columns that are set up in series and parallel are taken into consideration. Let's examine the behaviour of the column at various rotational degrees in both series and parallel arrangements. The ANSYS software was used to create 18 models (nine parallel and nine perpendicular). After the performance study is completed, strengthen the chosen model to determine which of these models has the best structural performance. Both inside and externally, steel plates and engineered cement concrete can be used to strengthen structures.

Keywords- ANSYS software

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STRUCTURAL PERFORMANCE OF STEEL ENCASED COMPOSITE MULTILAYER CONCRETE BEAM

A PROJECT REPORT

Submitted by

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To

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In partial fulfilment of the requirement for the award of the
Degree of
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In
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I am extremely grateful to our respected Principal **Dr. Leena A V**, for all the help and guidance given.

I express my deep and sincere gratitude to **Mrs. B Mary Sonia George**, Head of the Department, Department of Civil Engineering for her support, valuable suggestions and guidance in completing this paper.

I am also grateful to **Ms Shamya Sukumaran M**, Assistant Professor, department of Civil Engineering and our project co-ordinator **Mrs. Saritha Sasindran** for providing me an opportunity to present this project.

I also extend my heartfelt thanks to the Department of Civil Engineering, SNGCET and all my friends and family for their support and co-operation.

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ABSTRACT

In this paper, a composite multilayered concrete beam is analyzed by using ANSYS workbench software. An I section which is partially encased with Ultra-High Performance Concrete [UHPC] and Ultra-Light weight Cement Concrete [ULCC]. These composite materials had been arranged horizontally and vertically along the I Section. Hot rolled wide flange beams [WB] was used as an I section. Multiple aspects were taken into consideration when conducting the investigation on the partially encased multi-layered concrete beam. Multiple specimens were cast based on the objective. Compressive strength of various multilayered composite beams has been compared. Instead of using conventional steel or reinforced concrete members, this form of beams offers greater strength and stiffness. To enhance the ductility of the beam shear connectors are provided. To enhance the strength of the beam stiffeners are provided. The compressive strength of partially encased steel multilayered composite beam with stiffeners is higher compared to other partially encased steel multilayered composite models.

Keywords:- *Ultra-High Performance Concrete [UHPC], Ultra-Light weight Cement Concrete[ULCC], ANSYS software, Hot rolled wide flange beams.*

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ABBREVIATIONS

UHPC	Ultra-High Performance Concrete
ULCC	Ultra-Light Weight Cement Concrete
	ULCC-ULCC-ULCC Layer
ECC	Engineered Cementitious Concrete
LWC	Light Weight Concrete

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PERFORMANCE OF INTEGRATED ORTHOGONAL COLUMNS WITH AND WITHOUT FRP WRAPPING SUBJECTED TO LOCALIZED CORROSION

A PROJECT REPORT

Submitted by

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To

APJ Abdul Kalam Technological University

In partial fulfilment of the requirement for the award of the

Degree of

Master of Technology

In

Computer Aided Structural Engineering

Department of Civil Engineering

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I undersigned hereby declare that the project report "Performance Of Integrated Orthogonal Columns With And Without FRP Wrapping Subjected To Localized Corrosion" submitted for partial fulfillment of the requirements for the award of degree of Master of Technology of the APJ Abdul Kalam Technological University, Kerala is a bonafide work done by me under supervision of Mrs. Shilpa Valsakumar. This submission represents my ideas in my own words and where ideas or words of others have been included; I have adequately and accurately cited and referenced the original sources. I also declare that I have adhered to ethics of academic honesty and integrity and have not misrepresented or fabricated any data or idea or fact or source in my submission. I understand that any violation of the above will be a cause for disciplinary action by the institute and/or the University and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been obtained. This report has not been previously formed the basis for the award of any degree, diploma or similar title of any other University.

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First and foremost, I think almighty God for his blessings showered upon me to complete my project.

I am extremely grateful to our respected Principal **Dr. Leena A V**, for all the help and guidance given.

I express my deep and sincere gratitude to **Mrs. B Mary Sonia George**, Head of the Department, Department of Civil Engineering for her support, valuable suggestions and guidance in completing this paper.

I am also grateful to **Mrs. Shilpa Valsakumar**, Assistant Professor, department of Civil Engineering and our project co-ordinator **Mrs. Saritha Sasindran** for providing me an opportunity to present this project.

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ABSTRACT

In reinforced concrete constructions, steel corrosion results in loss of reinforcing area and damage to the surrounding concrete. Increases in deflections, crack widths, and stresses may result as a result, and the structural design and redundancy may also cause a loss in the bearing capacity. The study aims to investigate the impact of local corrosion on the ability of orthogonal concrete filled steel tube (CFST) columns to support loads under axial and eccentric loads. Because of its many advantages, such as improved strength owing to confinement generation, superior ductility due to the high steel ratio, and reduced construction cost and time as compared to encased reinforced concrete, concrete filled steel tube (CFST) columns have been employed extensively in the engineering field. A T-shaped column is used to satisfy the structural design specifications. It is frequently used in bridge construction. In the corners of boundary walls, the L-shaped column, which resembles a square or rectangular column, is widely used. The L and T shaped columns are examples of non-symmetrical columns. If a column is damaged, corrosion is very likely to occur since they are not symmetrical. Corrosion impacts are checked on each column's face and corner. Similarly, figuring out where in the column damage appears when corrosion is near the middle. The same corrosion rate was used to show how an orthogonal CFST column's capacity to support weight decreased. Analyze how the CFST column will eventually respond to corrosion and a linked sustained load. In the event of the same corrosion rate, CFST columns with localized corrosion at the face had higher axial and eccentric load carrying capacities than those at the corner. A carbon fibre reinforced polymer (CFRP) system can be layered all around the structure to strengthen it. The test results show that utilizing CFRP improves a column's capacity to support loads.

Keywords: CFST L- shaped column, T- shaped column, Localized corrosion, ANSYS software, BFRP, CFRP.

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ABBREVIATIONS

CFSTs	Concrete Filled Steel Tubular structures
CFRP	Carbon Fibre Reinforced Polymer
FRP	Fibre Reinforced Polymer
FEA	Finite Element Analysis
DCM	Displacement Control Method

PROGRESSIVE COLLAPSE MITIGATION STUDY ON BOX COLUMN AND STEEL BEAM WITH CORRUGATED WEB RBS

A PROJECT REPORT

Submitted by

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To

APJ Abdul Kalam Technological University

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DECLARATION

I undersigned hereby declare that the project report "Progressive Collapse Mitigation Study on Box Column and Steel Beam with Corrugated Web RBS", submitted for partial fulfillment of the requirements for the award of degree of Master of Technology of the APJ Abdul Kalam Technological University, Kerala is a bonafide work done by me under supervision of Mrs.Saritha Sasindran. This submission represents my ideas in my own words and where ideas or words of others have been included, I have adequately and accurately cited and referenced the original sources. I also declare that I have adhered to ethics of academic honesty and integrity and have not misrepresented or fabricated any data or idea or fact or source in my submission. I understand that any violation of the above will be a cause for disciplinary action by the institute and/or the University and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been obtained. This report has not been previously formed the basis for the award of any degree, diploma or similar title of any other University.

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CERTIFICATE

This is to certify that the project report entitled "**PROGRESSIVE COLLAPSE MITIGATION STUDY ON BOX COLUMN AND STEEL BEAM WITH CORRUGATED WEB RBS**" submitted by '**NANMA JAYARAJ E**' to the A.P.J Abdul Kalam Technological University in partial fulfillment of the requirements for the award of the Degree of Master of Technology in Computer Aided Structural Engineering, Civil Engineering is a bonafide record of the project work carried out by him/her under my/our guidance supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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ABSTRACT

Steel frame constructions using traditional weld connections frequently experience brittle breakdowns. To mitigate this issue,steps were taken to incorporate plastic hinges and improve the ductility of the steel connections.The beam-to-column connection has been identified as a key element for steel frame structures to maintain the structural integrity during progressive collapse phenomenon.In this study box column and steel beams subjected to progressive loading are considered with two types of corrugated web RBS connection, called the curved cell web RBS (CW-RBS) and hexagonal cell web RBS(HW-RBS).In the case of conventional RBS a portion of beam is being cut from the web and flanges so that plastic hinge gets relocated to the portion which is weak and this prevents welding failure at the end of beam and failure in column but this reduces the stiffness of beam. In the proposed connection CW-RBS and HW-RBS are implemented on the beam that is web of the beam is cut in an area near the column and the cut-out section is replaced by a cell made with two corrugated plates,this increases the stiffness which inturn increases the moment capacity and time of progressive collapse. Thus failures on box column completely gets relocated to CW-RBS ad HW-RBS and makes the box column and joint safe thereby preventing welding failures at the joint.Through this progressive capacity of column can be increased. These are done according to FEMA 350. Modelling and analysis is carried out using ANSYS software . In this study we obtain ultimate load capacity, moment capacity, drift angle, ultimate deflection.

Keywords: Progressive Collapse Mitigation, RBS, CW-RBS, HW-RBS, Corrugated Web RBS

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ABBREVIATIONS

RBS	-	Reduced Beam Section
CWRBS	-	Curved Cell Web RBS
HWRBS	-	Hexagonal Cell Web RBS
FEMA	-	Federal Emergency Management Agency
wmax	-	Max vertical displacement
Pmax	-	Ultimate load carrying capacity
Mmax	-	Ultimate moment capacity
θ_{max}	-	Rotational capacity

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