MOHAMED SATHAK A J COLLEGE OF ENGINEERING

Sponsored by Mohamed Sathak Trust

(Approved by AICTE, New Delhi and Affiliated to Anna University, Chennai)

Siruseri IT Park, Egattur, Chennai 603 103

M.E. - STRUCTURAL ENGINEERING

S.No	Name of the course that include experiential learning through Project work/ Internship (2018 - 2019)
1	ST5101 - Advanced Concrete Structures
2	ST5201 - Advanced Steel Structures
3	ST5014 - Design of Steel Concrete Composite Structures

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ST5101 **ADVANCED CONCRETE STRUCTURES** **L T P C**
3 0 0 3

OBJECTIVE:

- To make the students be familiar with the limit state design of RCC beams and columns
- To design special structures such as Deep beams, Corbels, Deep beams, and Grid floors
- To make the students confident to design the flat slab as per Indian standard, yield line theory and strip method.
- To design the beams based on limit analysis and detail the beams, columns and joints for ductility.

UNIT I DESIGN PHILOSOPHY **9**

Limit state design - beams, slabs and columns according to IS Codes. Calculation of deflectionand crack width according to IS Code. interaction curve generation for axial force and bending

UNIT II DESIGN OF SPECIAL RC ELEMENTS **9**

Design of slender columns - Design of RC walls. Strut and tie method of analysis for corbels anddeep beams , Design of corbels, Deep-beams and grid floors.

UNIT III FLAT SLABS AND YIELD LINE BASED DESIGN **9**

Design of flat slabs and flat plates according to IS method – Check for shear - Design of spandrelbeams - Yield line theory and Hillerborg's strip method of design of slabs.

UNIT IV INELASTIC BEHAVIOUR OF CONCRETE BEAMS AND COLUMNS **9**

Inelastic behaviour of concrete beams and Baker's method, moment - rotation curves,ductilitydefinitions, evaluation

UNIT V DUCTILE DETAILING **9**

Concept of Ductility – Detailing for ductility – Design of beams, columns for ductility - Design ofcast-in-situ joints in frames.

TOTAL: 45 PERIODS

OUTCOME:

- On completion of this course the students will have the confidence to design various concrete structures and structural elements by limit state design and detail the same for ductility as per codal requirements.

REFERENCES:

1. Gambhir.M. L., "Design of Reinforced Concrete Structures", Prentice Hall of India, 2012.
2. Purushothaman, P, "Reinforced Concrete Structural Elements: Behaviour Analysis and Design", Tata McGraw Hill, 1986
3. Unnikrishna Pillai and Devdas Menon "Reinforced Concrete Design', Third Edition, Tata McGraw Hill Publishers Company Ltd., New Delhi, 2007.
4. Varghese, P.C, "Advanced Reinforced Concrete Design", Prentice Hall of India, 2005.
5. Varghese, P.C., "Limit State Design of Reinforced Concrete", Prentice Hall of India, 2007.

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ST5201 **ADVANCED STEEL STRUCTURES** **L T P C**
3 0 0 3

OBJECTIVE:

 To study the behaviour of members and connections, analysis and design of Industrial buildings and roofs, chimneys. Study the design of with cold formed steel and plastic analysis of structures.

UNIT I

GENERAL **9**

Design of members subjected to combined forces – Design of Purlins, Louver rails, Gable columnand Gable wind girder – Design of simple bases, Gusseted bases and Moment Resisting BasePlates

UNIT II DESIGN OF CONNECTIONS **9**

Types of connections – Welded and Bolted – Throat and Root Stresses in Fillet Welds – SeatedConnections – Unstiffened and Stiffened seated Connections – Moment Resistant Connections –Clip angle Connections – Split beam Connections – Framed Connections HSFG boltedconnections.

UNIT III ANALYSIS AND DESIGN OF INDUSTRIAL BUILDINGS **9**

Analysis and design of different types of trusses – Analysis and design of industrial buildings –Sway and non sway frames – Aseismic design of steel buildings.

UNIT IV PLASTIC ANALYSIS OF STRUCTURES **9**

Introduction, Shape factor, Moment redistribution, Combined mechanisms, Analysis of portal frames, Effect of axial force - Effect of shear force on plastic moment, Connections - Requirement– Moment resisting connections. Design of Straight Corner Connections – Haunched Connections– Design of continuous beams.

UNIT V DESIGN OF LIGHT GAUGE STEEL STRUCTURES **9**

Introduction to Direct Strength Method - Behaviour of Compression Elements - Effective width forload and deflection determination – Behaviour of Unstiffened and Stiffened Elements – Design ofwebs of beams – Flexural members – Lateral buckling of beams – Shear Lag – Flange Curling –Design of Compression Members – Wall Studs.

TOTAL: 45 PERIODS

OUTCOME:

 At the end of this course students will be in a position to design bolted and welded connections in industrial structures.

 They also know the plastic analysis and design of light gauge steel structures.

REFERENCES:

1. Lynn S. Beedle, Plastic Design of Steel Frames, John Wiley and Sons, 1990.
2. Narayanan.R.et.al., Teaching Resource on Structural steel Design, INSDAG, Ministry of Steel Publishing, 2000.
3. Subramanian.N, Design of Steel Structures, Oxford University Press, 2014.
4. Wie Wen Yu, Design of Cold Formed Steel Structures, McGraw Hill Book Company, 1996

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ST5014 DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURES L T P C
3 0 0 3

OBJECTIVE:

 To develop an understanding of the behaviour and design concrete composite elements and structures.

UNIT I INTRODUCTION **9**

Introduction to steel - concrete composite construction – Codes – Composite action – Serviceability and Construction issues in design

UNIT II DESIGN OF COMPOSITE MEMBERS **9**

Design of composite beams, slabs, columns, beam – columns - Design of composite trusses.

UNIT III DESIGN OF CONNECTIONS **9**

Shear connectors – Types – Design of connections in composite structures – Design of shear connectors – Partial shear interaction.

UNIT IV COMPOSITE BOX GIRDER BRIDGES **9**

Introduction - behaviour of box girder bridges - design concepts.

UNIT V CASE STUDIES **9**

Case studies on steel - concrete composite construction in buildings - seismic behaviour of composite structures.

TOTAL: 45 PERIODS

OUTCOME:

 At the end of this course students will be in a position to design composite beams, columns, trusses and box-girder bridges including the related connections.

 They will get exposure on case studies related to steel-concrete constructions of buildings.

REFERENCES:

1. Johnson R.P., "Composite Structures of Steel and Concrete Beams, Slabs, Columns and Frames for Buildings", Vol.I, Blackwell Scientific Publications, 2004.
2. Oehlers D.J. and Bradford M.A., "Composite Steel and Concrete Structural Members, Fundamental behaviour", Pergamon press, Oxford, 1995.
3. Owens.G.W and Knowles.P, "Steel Designers Manual", Steel Concrete Institute(UK), Oxford Blackwell Scientific Publications, 1992.

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COMPARATIVE SEISMIC ANALYSIS OF RCC AND STEEL-CONCRETE COMPOSITE STRUCTURE

A THESIS - PHASE-II

Submitted by

S.CHANDRA SEKAR

(311817413002)

in partial fulfillment for the award of the degree of

MASTER OF ENGINEERING
IN
STRUCTURAL ENGINEERING

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MAY- 2019

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INTERNAL EXAMINER

21/05/19

EXTERNAL EXAMINE

ABSTRACT

Steel-Concrete composite constructions are nowadays very popular owing to their advantages over conventional Concrete and Steel constructions. Concrete structures are bulky and impart more seismic weight and less deflection whereas Steel structures instruct more deflections and ductility to the structure, which is beneficial in resisting earthquake forces. Composite Construction combines the better properties of both steel and concrete along with lesser cost, speedy construction, fire protection etc. Hence the aim of the present study is to compare seismic performance of a 3D (G+7) storey RCC, Steel and Composite building frame situated in earthquake zone V. All frames are designed for same gravity loadings. The RCC slab is used in all three cases. Beam and column sections are made of either RCC, Steel or Steel-concrete composite sections. Equivalent static method and Response Spectrum method are used for seismic analysis. ETABS 2015 software is used and results are compared. Cost effectiveness based on material cost for all types of building frames is determined.

Comparative study concludes that the composite frames are best suited among all the three types of constructions in terms of material cost benefit added with better seismic

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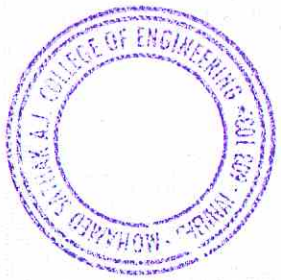
CHAPTER-4
CONCLUSION

Conclusion:

- ✓ Storey drift in Equivalent Static Analysis in X-direction is more for Steel frame as compared to Composite and RCC frames.
- ✓ RCC frame has the lowest values of storey drift because of its high stiffness.
- ✓ The differences in storey drift for different stories along X and Y direction are owing to orientation of column sections. Moment of inertia of column sections are different in both directions.
- ✓ Same storey drift patterns are obtained by using Response Spectrum method validating the results obtained by the Equivalent Static method.
- ✓ Base Shear for RCC frame is maximum because the weight of the RCC frame is more than the steel and the composite frame. Base shear gets reduced by 40% for Composite frame and 45% for Steel frame in comparison to the RCC frame.
- ✓ Reduction in cost of Composite frame is 33% and Steel frame is 27% compared with cost of RCC frame. This involves material cost only and doesn't include fabrication cost, transportation cost, labour cost etc.



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EXPERIMENTAL STUDY OF THINNER SLAB

PHASE II PROJECT

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INTERNAL EXAMINER

21/5/19

EXTERNAL EXAMINER

MOHAMED SATHAK A.J. COLLEGE OF ENGINEERING - CHENNAI - 603 103

ABSTRACT

The experimental and analytical study of flexural behaviour of thinner slab is given in this report. Slabs are the most widely used structural elements of modern structural complex . The cast in-situ reinforced concrete roof is the simplest form of slab construction, but it is rather wasteful in materials particularly cement. Substantial savings can be effectively done by modifying the composition of the slab so that its weight is reduced without imparting its strength or behaviour, for which ferrocement slab has been adopted , the effectiveness of ferrocement largely depends on its durability and corrosion property of thin reinforcing wire or welded mesh . As a laminated spacing composite , ferrocement often suffers from spalling of matrix cover and delamination of extreme layer . In order to overcome the above effects this work focuses on the various steps to be adopted to minimize the defects in ferrocement slabs. The experimental program consists of testing three ferrocement slab panels of size (1m X 0.3m X 0.025m , 1m X 0.4m X 0.025m, 1m X 0.5m X 0.025m). Testing of slabs were done by two point loads , test results of various parameters will give the flexural behaviour of slab

Keywords : square welded mesh , Ferrocement slabs, Flexural behaviour.

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CHAPTER 7

CONCLUSION

Table 7.1 - Comparative Results of Thinner Slab

Sl. No	DESCRIPTION	EXPERIMENTAL VALUES			THEORETICAL VALUES		
		S 1	S 2	S 3	S 1	S 2	S 3
1.	FIRST CRACK LOAD	6 KN	6 KN	6 KN	4.8KN	4.8 KN	4.8 KN
2.	SHEAR CRACK LOAD	14 KN	14 KN	20 KN	7.18KN	7.27KN	9.82KN

* S1 - SLAB SPECIMEN 1 (1m X 0.3 m X 0.025 m)

* S2 - SLAB SPECIMEN 2 (1m X 0.4 m X 0.025 m)

* S3 - SLAB SPECIMEN 3 (1m X 0.5 m X 0.025 m)

An experimental investigation carried out on complete thinner slab used as a component in building has been presented. The following conclusion results were arrived as follows:

1. Raw materials are available in abundant and it can be constructed in any shape.
2. Labour is not required to be very experienced, Construction work is easy, less weight and durable.

SELF SENSING CONCRETE BY USING FUNCTIONAL FILLERS FOR STRUCTURAL HEALTH MONITORING

PHASE II PROJECT

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INTERNAL EXAMINER

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SYNOPSIS

Structural Health Monitoring (SHM) aims to give, at every moment during the life of the structure, a diagnosis of the state of constituent materials of the different parts, and of the full assembly of these parts constituting the structure as a whole. Self sensing concrete refers to a structural material that can monitor itself without the need of embedded, attached or remote sensors. By measuring electrical resistance of the self sensing concrete, the stress, strain, crack and damage can be in situ monitored.

In the present investigation, concrete of M30 grade with 53 grade ordinary Portland cement were designed using IS 13920 code has arrived. For the study of electrical resistivity, with various percentage addition of CRIMPED steel fibres (0.5% and 2%), Graphite powder (0.5% and 2%), Super plasticizer (CONPLAST SP-430) has been used as a chemical admixture. Cubes and cylinders are casted without fillers and with fillers. Slump test were conducted to examine workability of fresh concrete.

In this investigation, the resistivity comparison (conventional with fillers and conventional without fillers) were carried out in order to declare the sensible concrete which would conduct itself based on its resistive property.

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CHAPTER – 7

CONCLUSION

This study enables monitoring damage of the concrete cubes and cylinders by correlating the durability parameter of corrosion with their electrical resistivity.

The resistivity tests were carried out for all the compositions with the curing time of 3 days and 7 days with two different Regulated power supplies of 4V and 6V. In that, combination of 2% of steel fiber along with 2% of possess high electrical resistivity and also high compressive strength but possess low resistivity in split tensile test. This results that the possibilities of corrosion but will never attain fairly like other mix composites.

The resistivity has been compared with mechanical properties of concrete in order to assess its durability and also to determine the possibilities of corrosion in concrete.

EXPERIMENTAL STUDY ON STEEL COLUMN STRENGTHENED BY USING ARAMID FIBRE

PHASE II PROJECT

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INTERNAL EXAMINER

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EXTERNAL EXAMINER

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ABSTRACT

Excessive fatigue deterioration is usually experienced when Reinforced Concrete structural elements are subjected to loadings. This emphasizes the desire to strengthen as well as improve the fatigue performance and extend the fatigue life of RC structural components particularly beams. As the number of civil infrastructure systems increases worldwide, the number of deteriorated buildings and structures also increases. In the case of Steel Structure, the main cause of damage is corrosion and also the loading causes. But the complete replacement is likely to be an increasing financial burden and might certainly be a waste of natural resources if upgrading or strengthening is a viable alternative. During the last few decades, strengthening of concrete structural elements by fiber-reinforced polymer (FRP) has become a widely used technique where high strength is needed for carrying heavy loads or repairing is done due to fatigue cracking, failure modes and or corrosion. This paper reviews various aspects of steel column strengthened with FRP. This technique eliminates and reduces the crack growth rate, delay initial cracking and extend the fatigue life of RC beams.

CHAPTER 6

CONCLUSION

Retrofitting of Steel Tubular column for axial compression using external bonded FRP sheets have been studied by several investigators. However, study on the retrofitting of structural columns using Aramid FRP in horizontal wrapping and their comparison has received least attention.

In the investigation, the axial compression behavior with respect to the strength of short Circular Hollow Steel Tubular (CHST) columns retrofitted for compression by Aramid sheets has been studied. This study is carried out through a series of experiments. From the detailed study of the experimental results and the data obtained from that of the FRP retrofitted columns, the major conclusions drawn are summarized below.

1. The results of this study shows that the use of Aramid sheet is feasible and effective for retrofitting of steel structures without causing catastrophic brittle failure.
2. As can be seen, loads and deflections are increased almost proportionally up to the failure mode.
3. The stress-strain behavior is also gives a quite satisfaction with the increase of stress. Comparing all those results it is observed that the use of wrapping can able to withstand more stress.
4. In the controlled sample, the ultimate load carrying capacity was 319 KN. It has been observed that in the controlled sample the column failed by local buckling. The top and bottom undergoes uniform buckling through the cross-section and in the middle portion it buckles laterally in to some extent.
5. HW (50 @ 28.5)-1L:- The ultimate load was 325 kN. Here, it was observed that cracks formed in top and bottom of steel column and it has failed by buckling of the unwrapped portion. Due to the stiffness of the FRP, the portion wrapped by FRP doesn't buckled.

EXPERIMENTAL STUDY OF MECHANICAL AND AXIAL PROPERTIES OF POLYMER CONCRETE

PHASE II PROJECT

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INTERNAL EXAMINER

EXTERNAL EXAMINER

ABSTRACT

An experimental investigation will be carried out into the deformation behaviour of fibre-reinforced concrete in bond, flexure and tension. A study will be done regarding the compression and axial behaviour of polymer concrete. Tests that are going to be conducted in this paper are try and error method of mixing of concrete, cube compression test, split tensile test, and cylinder compression test for finding the axial stress strain behaviour.

Previously a few researches were conducted in our country regarding this topic as the initial cost of the implementation of such concrete is high. Few researchers do this research in our country to study the mechanical and durable properties of polymer concrete by referring the design procedure of foreign scholars as well as researchers.

This paper broaches with an effective mix ratio of polymer concrete and their fundamental physical properties.

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CONCLUSION

In this paper the increase of resin content in polymer is investigated. To increase the polymerisation promoter and catalyst has been added. The experimental investigation is based on the tests conducted for compressive (cube), split tensile (cylinder). The addition of calcium carbonate as filler material in polymer resin concrete results in an economical mixture and also the ductility can be improved with increasing resin content. With the combination of different mechanical properties, no water absorption, ability to withstand environmental condition, no chemical attack. In this study comparison between normal concrete and polymer concrete has been carried out, where polymer concrete gives more strength compared to normal concrete. Polymer concrete with a mix of M sand, calcium carbonate and resin provides an excellent material for many structural engineering applications.

The following consequences were drawn:

1. The strength of the polymer concrete is much more than compared to normal conventional concrete.
2. As compared to conventional concrete polymer concrete is much more durable and abrasion resistance.
3. This type of concretes can be used for special purpose such as acid storage tanks, underground pipe, etc.
4. By the use of carbon fibre in the concrete mix, the flexibility of the concrete increases.

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