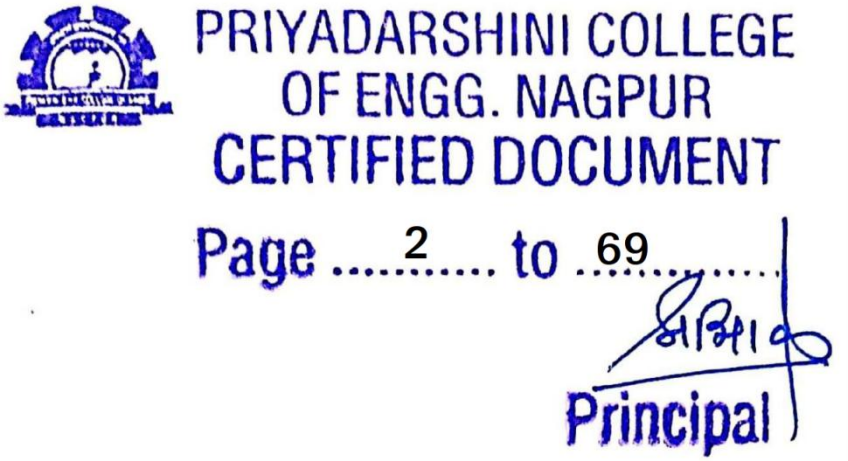
Lokmanya Tilak Jankalyan Shikshan Sanstha's
PRIYADARSHINI COLLEGE OF ENGINEERING
(Recognised by A.I.C.T.E., New Delhi & Govt. of Maharashtra, Affiliated to R.T.M.Nagpur University)
Near CRPF Campus, Hingna Road, Nagpur-440 019, Maharashtra (India)
Phone : 07104 – 236381, 237307, Fax : 07104 – 237681,
email : principal.pce.ngp@gmail.com, www.pcenagpur.edu.in

1.3.2 Average percentage of courses that include experiential learning through project work/field work/internship during last five years



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B. E –CIVIL ENGINEERING SESSION 2020-2021

Sr. No	Name of the course that include experiential learning through Project work/ Internship	Subject Code	Domain	Page No
1	Concrete Technology	BECVE305T/P	Construction Technology, and Management	3-14
2	Surveying – I	BECVE 404T/P		
3	Building Construction & Material	BECVE 405T/P		
4	Surveying-II	BECVE602T/P		
5	Building Design and Drawing	BECVE604P		
6	Estimating and Costing	BECVE702T/P		
7	Construction Management and Law	BECVE704T		
8	Engineering Geology	BECVE304T/P	Geotechnical Engineering and Geology	15-25
9	Geotechnical Engineering-I	BECVE 402T/P		
10	Geotechnical Engineering -II	BECVE504T		
11	Environmental Engineering – I	BECVE303T/P	Environmental Engineering, Hydraulics and Water Resources Engineering	26-38
12	Fluid Mechanics -I	BECVE503T/P		
13	Hydrology & Water Resources (HWR)	BECVE505T		
14	Fluid Mechanics -II	BECVE603T/P		
15	Environmental Engineering-II	BECVE605T		
16	Elective -I : Air Pollution And Solid Waste Management	BECVE703T		
17	Irrigation Engineering	BECVE801T		
18	Elective - III : Water and Waste Water Treatment	BECVE803T		
19	Strength of Materials	BECVE302T/P	Structural Engineering	39-52
20	Structural Analysis – I	BECVE 401T/P		
21	Structural Analysis -II	BECVE501T/P		
22	Reinforced Cement Concrete (RCC) Structures	BECVE502T/P		
23	Steel Structures	BECVE601T/P		
24	Advanced Concrete Structures	BECVE701T/P		
25	Elective -I : Earthquake Resistant Design of Structure	BECVE703T		
26	Elective - III : Advanced Reinforced Cement Concrete	BECVE803T/P		

	Design			
27	Transportation Engineering – I	BECVE 403T/P	Transportation Engineering	**53-61**
28	Transportation Engineering - II	BECVE705T		
29	Elective - II : Pavement Analysis And Design	BECVE802T		
30	Applied Mathematics-III	BECVE301	Other	**62-68**
31	Communicative English & Technical Writing	BECVE506P		
32	Site Visit & Mini Project	BECVE606P		
33	Industrial Case Study and Project Seminar	BECVE706P		
34	Construction Economics and Finance	BECVE804T		
35	Project	BECVE805P		

Domain 1: Construction Technology and Management

Sr. No	Name of the course that include experiential learning through Project work/ Internship	Subject Code	Domain
1	Concrete Technology	BECVE305T/P	Construction Technology and Management
2	Surveying – I	BECVE 404T/P	
3	Building Construction & Material	BECVE 405T/P	
4	Surveying-II	BECVE602T/P	
5	Building Design and Drawing	BECVE604P	
6	Estimating and Costing	BECVE702T/P	
7	Construction Management and Law	BECVE704T	

BECVE 305T **CONCRETE TECHNOLOGY**

Objectives:

1. To prepare the students to understand constituents of concrete and their effect on quality of concrete.
2. The course will prepare students to apply basic rules for manufacture of plastic concrete and its mechanization.
3. To prepare students to apply various methods for testing of plastic and hard concrete.
4. To prepare students to analyse behavior of concrete structure under different environmental conditions.
5. The course will prepare students to analyse and design various basic concrete building components.

Outcomes:

a. The students would be able to check and recommend different constituent of concrete.
b. The students would be able to control method of manufacture of concrete.
c. The students would be able to test strength and quality of plastic and set concrete.
d. The students would have the understanding of application admixture and its effect on properties of concrete.
e. The students would be able to understand the effect of process of manufacturing on different properties of concrete.
f. The students would be able to understand various environmental factors which affect durability of concrete, analyse cause of deterioration of concrete components and to suggest various preventive measures to it.
g. The students would be able to test various strength of concrete by destructive and nondestructive testing methods.

Syllabus:

Unit – I Cement

Chemistry of Cement, Main constituents of cement Hydration of cement, Water required, Physical properties and testing of cement, Soundness test. Hardening and compressive strength Grades and different types of cements. Ordinary Portland cement, Rapid Hardening Cement, B.B. Blast furnace slag cement, Low heat Portland cement, Portland pozzolones cement, Portland flyash cement, Sulphate resisting cement. Field test,

Aggregates : Sources of aggregates, classification and nomenclature. Coarse and fine aggregate, normal weight (light and heavy weight aggregates). Aggregate characteristics and their significance in strength, workability, placement and compartion of concrete.Sampling. Particle shape and texture, Bond of aggregate, size & grading of aggregate strength of aggregates Mechanical properties and test-Specific gravity, Bulk density, porosity absorption of aggregates, moisture content of aggregate, bulking of sand abrasion test, impact value. Sieve analysisDeleterious substances in aggregates, organic impurities class and other fine material etc.

Water : Quality of water for concrete mixing, suitability.

Unit – II

Fresh concrete : Batching, Mechanical mixers, automatic batching and mixing plants. Efficiency of mixing. Workability Measurement – Slump cont test, compacting factor test, flow table, Vee-Bee consistometer, Factor affecting workability, setting time. W/C Law Significance of w/c ratio cohesiveness.Segregation, bleeding,

voids, permeability.Hot weather concreting.Underwater concreting, Conveyance of concrete, Placing of concrete.Compaction-vibrators. Curing of concrete Significance, methods of curing, Temperature effect on

during& strength gain. IS code on curing.Maturity of concrete.

Unit - III

Strength of concrete-

Gain of strength, Wet ratio, Factor affecting compressive strength w/c ratio. Type of cement, air entrainment, aggregates, mixing water, Admixtures, curing conditions. Tensile and flexural strength.Relation between cracking in compression.Impact strength fatigue strength. Shear strength, Bond between concrete & reinforcement. Modulus of elasticity, Poison's ratio.

Testing of Hardnessof Concrete: Compression test-cube strength & cylinder strength their relation, effect of aspect ratio on strength. Flexural strength of concrete, Determination of tensile strength.Indirect tension test.Splitting test.Abrasion resistance.Accelerated curing test.

Unit – IV

Mix Design – Process, Statistical relation between mean & characteristic strength, Variance, Standard deviation. Factor affection mix properties. Grading of aggregate, aggregate/ cement ration etc. Degree of quality control. Design mix by Road note no. 4 (BS). IS:10262:2009.

Additives and Admixtures: Types of admixtures, Natural products-Dietomaceousearth By products-Pozzolones. Fly ash, silica fume, rice husk ash, , G.G. blast furnace slag. Admixturers-air encraining, water reducing, acceletors, retarders, plasticizers & Super plasticizers, permeability reducing,surface harderners.Corrosion inhibitors & water proofing agents.

Unit – V

Special concrete : Self compacting concrete, High performance concrete, fiber reinforced & polymer concrete, Ferro cement, Shortcrete pumped concrete, Free flow concrete.

Shrinkage-Early volume changes, drying shrinkage, mechanism of shrinkage.Factor affecting shrinkage. Influence of curing & storage conditions. Differential shrinkage.Carbonation shrinkage.Creep-Factors influencing.Relation between creep & time, nature of creep, effect of creep.

Unit – VI

Durability of concrete-significance water as an agent of deterioration. Permeability of concrete, Efflorescence.
Distress in concrete structures and its causes, causes of deterioration of concrete.
Cracks in concrete: Causes, types, prevention, repairs of cracks – materials and methods
Non Destructive tests.

BECVE 305 P LIST OF EXPERIMENTS

1. To determine the Normal consistency of cement .
2. To determine initial and final setting times of cement.
3. To determine soundness of cement.
4. To determine compressive strength and tensile strength of cement.
5. To determine particle shape , texture and elongation/ flakiness index of aggregate .
6. Sieve analysis and particle size distribution of aggregate.
7. To determine crushing value test, Impact value and Abrasion value of given aggregate.
8. To determine Bulk Density, Specific Gravity, Absorption & Moisture Content of Aggregate.
9. To determine Bulking and Percentage silt in sand.
10. To determine Workability - Slump test, Compaction factor of concrete.
11. Concrete mix design Road note 4 method, I.S. Method and ACI Method.
12. To determine Compressive strength of concrete cube.
13 To determine the quality of concrete by using Rebound hammer/ Ultrasonic Pulse Velocity Instrument.

Text Book

Sr.No	Title	Publication
1	Concrete Technology by GambhirMc. Graw Hill	
2	Concrete Technology by A.M. Neville	Pearson Education

RefrenceSr.NoTitle **Publication**

1 Properties of Concrete by A.M. Neville

BECVE 405 T BUILDING CONSTRUCTION & MATERIAL

Objectives:

1. To prepare the students to understand components of buildings and their functions.
2. To prepare students to understand execution of various constructions activities and material.
3. To prepare students to analyse behaviour of structure under different environmental conditions.
4. To prepare students to identify & suggest rectification the various defects in civil engineering works.

Outcomes:

a. The students are able to identify components of a building.
b. The students are able to differentiate and identify types of building materials.
c. The students are able to select appropriate material for building construction.
d. The students are able to plan various construction related activities and their quality control.

Syllabus :

Unit-I :

Foundations: Necessity and types of R.C.C. foundations, Detail of Deep foundation and precast foundation in general, Details shallow foundations. Bearing capacity of soils and its assessment. Preumptive bearing capacity values from codes. Loads on foundations. Causes of failures of foundations and remedial measures, Foundation on black cotton soils Setting out foundation trenches, excavation timbering of foundation trenches. Load bearing and framed structures.

Unit-II

Brickwork :Qualities of good bricks, classification of bricks tests on bricks as per as codes.
Terms used in brickwork, commonly used types of bonds in brickwork such as header, stretcher, English andFlemish bonds, principles of construction. Reinforced brickwork, brick knogging.
Parapets, copings, sills and corbels, brief introduction to cavity walls, load bearing and partition walls.
Masonry construction using cement concrete blocks and clay walls, load bearing and partition walls.
Masonry construction using cement concrete blocks and clay blocks.
Precest construction : Introduction to method and materials. Precast elements likes poles, cover, jallies, steps corbets, truss element etc.

Unit-III:

Stone Work : Stones, cutting and dressing, selection of stones types of stone masonary, principles of construction joints in masonary. Lifting heavy stones, common building stones in India.
Arches and Lintels : Terminology in contraction, types chajjas and canopies, pre cast Lintels & Arches.
Damp Proofing : Causes and effect of dampness. Various methods of damp proofing
Damp proofing in plinth protection, New Techniques of Damp Proofing Damp Proofing in Plinth Protection,New Techniques of Damp proofing. Epoxy etc.

Unit-IV

Floors and Roofs : Floors : General principals, types and method of construction, floors finished quality, ~~testing floor tiles,~~ synthetic & Ceramic Tiles.
Roofs : Flat and pitches roofs, roof coverings, types AND their constructional features. Thermal Insulation

Unit-V :

Stairs : Types of stairs, functional design of stairs.
Doors and Windows : Purpose materials of construction and types.

Unit-VI :

Plastering and Pointing : Necessity, types and methods
Temporary Timbering : Centering and formwork shoring, underpining and scaffolding.
Painting : White washing, colour washing and distempering new materials & Techniques.

Text book

Sr. No.	Title	Publication
1	Building Construction by Rangwala	Charotar Pub. Hous

CONSTRUCTION MANAGEMENT & LAW

BECVE704T **Evaluation Scheme: (80/20)**
(L-4, T-0, P-0) Total Credits-4 **Exam Duration: 3 hrs**

OUTCOMES :
On completion of this syllabus, the students should be able to:

1. *Demonstrate the understanding of various types of projects, modern construction techniques and will exhibit the mastery in construction planning, scheduling and various controls.*
2. *Achieve the knowledge of various types' of equipments to be used in the construction and its operational cost estimates, understand manpower requirement, planning, resources utilization and management.*
3. *To know the quality control aspects in planning & management, modern trends project management, application of information system in management of construction projects, safety provisions and equipments.*
4. *Analyze the legal aspects in construction projects through the understanding of various laws pertaining to civil engineering and architectural planning & sanctioning, labor & organizational welfare measure, provisions of arbitration and litigations.*

UNIT - I :
BASIC STUDIES IN CONSTRUCTION PROJECT
Type of Project & its Financing, Detailed Project Report Analysis and Feasibility, Time of Completion, Provisions of Escalation in Time and Cost, Choice of Technology and Construction Tecniques, Site Planning.

UNIT- II :
CONSTRUCTION SCHEDULING
Network Analysis : The Critical Path Method (CPM) and Project Evaluation and Review Technique (PERT), Bar Chart, Resource Oriented Scheduling, Allocation, Leveling, Crashing and Time/Cost Tradeoffs, Line of Balance.

UNIT III - :
MANPOWER, MATERIAL AND MACHINERY (3M) MANAGEMENT
Manpower – Requirement and methods of calculating Productivity, Staffing, planning, directing & controlling. Organisational Charts, Duties and Responsibility of Personal Manager

Material – Requirement, Procuring, Storing & Delivery. Quality Checks, Inventory Control techniques, construction Waste generation and Management .

Machinery – different type of construction equipments and their applications- Excavators, Dozer,Rollers, Hoisting and Hauling equipments, Cost & Working Hour analysis, Depreciation analysis,

UNIT- IV:
QUALITY AND SAFETY MANAGEMENT
Concept of Total Quality Management, Safety Provisions as per National Building Code of India, Safety Equipments, MIS in Construction Project, Project Management System-MS Project.

UNIT –V :

LEGAL ASPECTS IN CONSTRUCTION PROJECTS

Town Planning Requirements, Acts and codes related to planning, Regional Town Planning, Housing Development act, Highway Act, Irrigation act, Local Rules (Gunthewari),

UNIT –VI :

INTRODUCTION TO DIFFERENT LAWS

Environmental (Protection) act, Forest Conservation - Water Pollution and air pollution, Transfer of property act – sale, purchase, lease. Land Acquisition and Rehabilitation act, Indian Contract act.

Reference Books :

1. Construction Planning and Management – Purifoy
2. Construction Planning and Management – Dr U K Shrivastava, Galgotia Publ.
3. Project Planning & Management – B C Punmia
4. Laws related to buildings and engineering contracts in India- Gajaria G T, LexisNexis Butterworths India Publisher, 2000
5. Construction Contracts- Jimmie Hinze McGraw Hill,
6. Contracts and the legal Environment for Engineers and Architects- Joseph T Bockrath, McGraw Hill,

A BRIEF STUDY ON CAUSES OF CRACKS, PREVENTION AND PATTERN OF CRACKS ON CONCRETE.

A Project Work Submitted In partial fulfillment of the requirement for the award of the Degree

Of

BACHELOR OF ENGINEERING

IN

CIVIL ENGINERRING

RASHTRASANT TUKDOJI MAHARAJ NAGPUR UNIVERSITY

NAGPUR

Submitted by: -

ANIKET MATE

JOGINDER KUSHWAH

RAJU KAMBLE

SAMIDHA THAMKE

SHUBHAM BOREKAR

Under the guidance of

Mrs. PRANITA S. BHANDARI

Asst. Professor

(Dept. of Civil Engineering)

DEPARTMENT OF CIVIL ENGINEERING

PRIYADARSHINI COLLEGE OF ENGINEERING,

SESSION 2020 – 2021

PRIYADARSHINI COLLEGE OF ENGINEERING,

NAGPUR

CERTIFICATE

This is certified that the work presented in that this project entitled "**A BRIEF STUDY ON CAUSES OF CRACKS, PREVENTION AND PATTERN OF CRACKS ON CONCRETE**" has been completed by **Shubham Borekar, Aniket Mate, Samidha Thamke, Raju Kamble, Joginder Khushwah,** students of B.E. (Civil Engineering) of this institution in satisfactory manner and in partial fulfillment of the requirements for the award of the degree of bachelor of engineering in civil engineering of the Rashtrasant Tukdoji Maharaj Nagpur University, Nagpur during year 2020-2021.

Mrs. Pranita S. Bhandari.
Guide
Asst. Professor, Civil Dept.,
PCE, Nagpur.

Dr. S. A. Dhale
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H.O.D. Civil Dept.,
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PCE, Nagpur.

ABSTRACT

Cracking is a common problem in concrete structures in real-life service conditions. In fact, crack-free concrete structures are very rare to find in real world. Cracks in plain and reinforced concrete possess a challenging to civil engineers from the six decades. Concrete can undergo cracking depending on the mix composition, exposure environment, hydration rate, and curing conditions. Understanding the causes and consequences of cracking thoroughly is essential for selecting proper measures to resolve the cracking problem in concrete. This thesis helps to identify the types of cracks and their patterns if that cracks are hazardous for structure such as slab, beam, column or retaining wall etc. and how we can identify the crack. Why cracks are form what are their causes. Also, this thesis is useful to adopt effective preventive measures for reducing or eliminating the cracking problem in concrete. What precautionary major to we take while before placing, during placing and after placing of concrete. If the cracks observed in structure how to repair, there techniques and procedure to repair cracks. Which material to use while repairing cracks? Among which method is suitable for the repair of cracks. A number of examples for various cracking problems of concrete found in different structural elements are also shown. Some recommendations are given for minimizing the cracking in concrete is given. With the help of 456:2000 "Indian standard of plain and reinforced concrete code of practice" Code of IS: 3414 – 1968 Indian standard practice for design and installation of joints in buildings and IS code SP25 which helped us to know lot about prevention and causes of cracks. It is hoped that the information conveyed in this thesis will be beneficial to improve the service life of concrete structures. In this thesis, causes and effects of concrete crack which are caused by different factors has been discussed. Not all type of cracks requires the same attention; some cracks have a great effect on the safety of structures and some hasn't a significant effect with the exception of reducing the aesthetic values. Identifying what type of crack, it is, and how it occurred, will help determine what repairs are required.

Keywords: Concrete, cracking mechanism, prevention, technique to repair cracks.

INTRODUCTION

Concrete plays a critical role in the design and construction of the nation's infrastructures. Concrete is the most widely used construction material today. The main constituents of concrete are coarse aggregate, fine aggregate, cement and water. Fine aggregate is a most important constituent of concrete. Generally, river sand or pit sand is used as fine aggregate in concrete. Together fine and coarse aggregate make about 75- 80 % of total volume of concrete and hence it is very important to find suitable type and good quality aggregate. In general, consumption of natural sand is high due to the large use of concrete.

Hence the demand of natural sand is very high in developing countries to satisfy the rapid infrastructure growth. For the past some years the escalation in cost of sand due to administrative restrictions in India, demands comparatively greater cost at around two to three times the cost of quarry dust even in places where river sand is available nearby

In recent years, the state of degradation of concrete infrastructure has become a critical issue in North America. A yearly cost of $18 billion has been estimated for concrete repair, protection and strengthening in the United States alone (Emmons & Sordidly, 2006). Concrete durability problems have left buildings and infrastructure in deteriorating conditions. Rehabilitation techniques and materials are becoming increasingly important in the construction industry. Cracking in particular poses a threat both to the structural integrity as well as the durability of concrete. The ingress of water and harmful agents lead to damaging mechanisms, such as the corrosion of steel reinforcement. Accordingly, cracks are repaired as a preventative maintenance measure to prolong the service life of the structure.

Cracking is a common occurrence in concrete bridge decks and barrier or parapet walls. In certain regions of North America where harsh winters are experienced, it is common practice to use de-icing chemicals. The effects of freeze-thaw alongside chloride ingress in the presence of cracks present ideal circumstances to promote the premature deterioration of the concrete material. The presence of cracks leads to poor durability and a shorter service life of the structure. The successful repair of cracks would reduce the deterioration effects resulting in a longer service life. Prolonging the service life defers the rehabilitation or replacement of the bridge and the government sectors responsible for the management of multiple bridges would experience economic benefits. The result of a longer service life is also indicative of a sustainable practice.

Domain 2: Geotechnical Engineering and Geology

Sr. No	Name of the course that include experiential learning through Project work/ Internship	Subject Code	Domain
1	Engineering Geology	BECVE304T/P	Geotechnical Engineering and Geology
2	Geotechnical Engineering-I	BECVE 402T/P	
3	Geotechnical Engineering -II	BECVE504T	

B.E. III SEM (CIVIL ENGINEERING)
SUBJECT: ENGINEERING GEOLOGY

UNIT-I: General Geology

Definition and scope of Geology, Internal structure of the earth.Introduction to continental drift and plate tectonics.Volcanoes type and their products.Principles of stratigraphy, Geological Time Scale, Physiographic and tectonic divisions of India.Introduction to Indian stratigraphy. (4)

Geomorphology: Weathering and erosion, Geological action of Wind, River and Ground water and resulting land forms. Geomorphic forms and their consideration in civil engineering works. (3)

UNIT-II:Mineralogy:

Definition and classification of minerals, Physical properties of Minerals, introduction to common rock-forming minerals (3)

Petrology: Rock cycle, **Igneous rocks:** Formation of Igneous rocks, textures and structures, forms and tabular classification of Igneous rocks. Common Igneous rocks and their uses. **Sedimentary rocks:** formation of sedimentary rocks, classification of sedimentary rocks. Common Sedimentary rocks and their uses.**Metamorphic rocks:**Definitions, agents of metamorphism, types of metamorphism, zones of metamorphism, Common Metamorphic rocks and their uses. (6)

UNIT-III: Structural Geology:

Introduction, outcrops, dip and strike of beds. Problems on dip, strike, thickness and three bore hole problems. **Folds**: parts of fold, classification, effects on outcrops, their identification in field, Importance of folds in civil engineering projects .**Joints**: definition, nomenclature and classification, Importance of joints in civil engineering projects. **Faults**: terminology, classification, mechanics of faulting, recognition of faults in the field, Importance of faults in civil engineering projects. **Unconformity**: Formation of unconformity, Types of unconformity. (10)

UNIT-VI: Earthquake Engineering:

Introduction, Terminology, Earthquake waves, Causes and effects, Intensity, MMI and MSK intensity scale and magnitude, magnitude scales, Liquefaction, location of epicenter, Tsunami, Seismograph and seismogram, Classification of earthquake, Earthquake zones of India, Aseismic structures.(3)

Landslides and Subsidence: Introduction, Terminology, Causes of landslides, classification of landslides, stable and unstable slopes, Control of landslides, causes of land subsidence, subsidence hazard mitigation.(3)

UNIT-V: Geohydrology:

Introduction, Hydrologic cycle, Origin of groundwater, Occurrence and distribution of ground water, water table and water table contour maps, Aquifer, Aquitard, Aquiclud and aquifuges, confined and unconfined aquifers, perched aquifer, Artesian and flowing wells, Importance of groundwater studies in Civil Engineering works. (3)

Site Investigations: Surface and sub-surface investigation: Geological mapping, Drilling, Bore hole logs, geophysical methods: Electrical Resistivity and Seismic methods. (3)

UNIT-VI: Application of geology to civil engineering works:

Engineering properties of rocks. Engineering classification of rocks based on compressive strength. RQD, Rocks as a construction material: Building stone, Road metal, Railway ballast. (3)

Dams: Parts and terminology, Classification of dams, geological problems at dam site, dam location on different rocks and their stability, Reservoirs study,(2)

Tunnels: Terminology, soft ground tunneling, rock tunneling and their stability. (2)

Text Books

1. Geology for Engineers: FGH Blyth
2. Engineering and General Geology: Parbin Singh
3. Engineering Geology: B.S. SathyaNarayanswami
4. Principles of Engineering Geology: K.M. Bangar
5. Basic Geotechnical Earthquake Engineering: Kamalesh Kumar
6. Rock Mechanics for Engineers: B.P. Verma

Laboratory Work

1. Megascopic study of common rock-forming Minerals.
2. Megascopic study of common Rocks.
   a) Igneous Rocks
   b) Sedimentary Rocks
   c) Metamorphic Rocks
3. Geological Maps: Drawing of geological cross sections with civil engineering projects.
4. Field visit to civil engineering construction sites with reference to geological studies.

BECVE 402 T GEOTECHNICAL ENGINEERING-I

Objectives:

1. To impart knowledge about origin and classification of soils.
2. To impart knowledge about index properties and their determination.
3. To impart knowledge about engineering properties and their determination.
4. To impart knowledge about stress distribution in soil mass.

Outcomes:

a. Students would be able to determine the index and engineering properties of the soil.
b. Students would be able to determine the suitability of foundation for a particular type of soil.
c. Students will be able to classify the soils.
d. Students would be able to evaluate the stresses in the soil mass.

Syllabus :

Unit I

1. Introduction : Formation of soil, residual & transported soil, major deposits found in India, soils generally used in practice such as sand, gravel, organic soil, clay, Betonies, , black cotton soil etc. Introduction to clay mineralogy.
2. Phases of soil: Various soil weight & volume inter-relationship. Density index, methods of determining in situ density.

Unit II

Index Properties & Their Determination, Water content, specific gravity, sieve analysis, particle size distribution curve, sedimentation analysis, Differential and free swell value, Consistency of soil, Atterberge's limits . Classification of Soil : Particle size classification, Textual classification, Unified & I.S. classification system, field identification of Expansive soil, Swelling pressure.

Unit III

3. Permeability: Darcy's law & its validity, Discharge & seepage velocity, factors affecting permeability, Determination of coefficients of permeability by Laboratory and field methods, permeability of stratified soil.
4. Seepage : Seepage pressure, quick sand condition, characteristics & uses of flownets, Preliminary problems of discharge estimation in homogeneous soils, Effective, Neutral and total stresses in soil mass.

Unit IV

5. Stress Distribution : Stress distribution in soil Mass, Boussinesque equation, point load and uniformly distributed load over rectangular & circular areas, Use of Newmarks charts.

Unit V

6. Consolidation : Compression of laterally confined soil, Terzaghis 1-D consolidation theory (formation of Differential equation), Determination of coefficient of consolidation, Degree of consolidation. Determination of preconsolidation pressure, Settlement, Rate of settlement.
7. Compaction : Mechanism of compaction, factors affecting compaction, standard & modified proctor Tests, field compaction equipments, quality control, Advance compaction Techniques, Nuclear density meter.

Unit VI

8. Shear Strength : Introduction, Mohr Coulombs theory, Drainage condition, Measurement of shear strength by direct shear test, triaxial test, unconfined compression test, vane shear test, sensitivity.

BECVE 402 P PRACTICAL: GEOTECHNICAL ENGINEERING - I

These shall comprise ~~of~~ ten experiments and terms work to be presented in the form of journal for assessment of sessional and practical examination.

A. List of Experiments : Any 10

1. Moisture content and Specific gravity of soil.
2. Grain size Analysis – (Sieve Analysis).
3. Consistency limit, plastic limit and liquid limit of soil.
4. Hydrometer Analysis.
5. Constant Head Permeability test ~~of~~ or Falling Head Permeability test.
6. Consistency limit of soil (shrinkage limit).
7. Field Density by sand replacement method.
8. Field Density by core cutter method.
9. Unconfined compression test.
10. Direct shear Test.
11. Triaxial shear test (Demonstration).
12. Proctors compaction Test and Proctor needle test.

B. One field visit or one case study included in journal.

C. Use of plasticity Chart or Newmarks Chart.

Text book

Sr. No.	Title	Publication
1	Soil Mechanics & Foundation Engg. by K.R. Arora	Std. Publisher
2	Soil Mechanics & Foundation Engg.by B.C.Punmia	Laxmi Publication
3	Basic & Applied Soil Mechanics by Gopal Rajan & Rao	Newage international Pub.
4	Geotechnical Engg.by P. Raj	Dorling Kindersley Pvt. Ltd
5	Geotechnical Earthquake Engg. by Steven L. Kramer	Prentice Hall

Refrence book

Sr. No.	Title	Publication
1	Soil Mechanics & Foundation Engg by Modi	Std. Publisher
2	Soil Mechanics & Foundation Engg by V.N.S.Murthy	CBS Publisher

GEOTECHNICAL ENGINEERING-II

BECVE504T Evaluation Scheme: (80/20)
(L-3 Hrs/Week, T-1 Hr/Week); Total Credits- 4 Exam Duration: 3hrs

COURSE OUTCOMES: The students shall be able to

1. Use the knowledge of different soil exploration techniques to ascertain the properties of soil
2. To analyze the stability of natural slopes, safety & sustainability of the slopes, design of retaining structures, reinforced earth walls, etc.
3. Practice Ground Improvement Techniques.
4. Design the shallow & deep foundation.

Unit- I: GEOTECHNICAL EXPLORATION

Importance and objective of field exploration , geophysical methods and its limitations, methods of subsurface exploration, methods of boring, number, location and depth of boring, types of soil samples and samplers, principles of design of samplers, collection & shipments of samples, boring and sampling record.

Unit- II: STABILITY OF SLOPES

Causes and types of slope failure, stability analysis of infinite slopes, Taylor's stability numbers & stability charts, stability analysis of finite slope for purely C- soils and C - ϕ soils, center of

critical slip circle, (Swedish circle method), slices method for homogeneous C - ϕ soil slopes with pore pressure consideration, Friction circle method, method of improving stability of slopes; types, selection and design of graded filters.

Unit- III: LATERAL EARTH PRESSURE

Earth pressure at rest, active and passive pressure; general & local states of plastic equilibrium in soil. Rankine's and Coulomb's theories of earth pressure. Effects of surcharge & submergence. Determination of Active earth pressure through graphical construction; Rebhann's and Culman's method

Unit- IV: GROUND IMPROVEMENT

Need of ground improvement, ground improvement techniques, stabilization using lime, cement & flyash; prealoading concept, vibrocompaction/flotation, concept of sand drains, stone columns, encased stone column, concept of NPVD (natural prefabricated vertical drain) and PPVD (polymer prefabricated vertical drain). Basic concept of reinforced soil, different types of Geo- synthetics, Geo-synthetic application and functions in civil engineering

Unit- V: SHALLOW FOUNDATION

Bearing capacity of soil: Factor affecting bearing capacity, Terzaghis theory, its validity and limitation, types of shear failure in foundation soil, effect of water table on bearing capacity, (introduction to IS method, factor affecting bearing capacity, field determination of bearing capacity through plate load test and standard penetration test,) Settlement of shallow foundation: Causes of settlement, elastic and consolidation settlement, differential settlement, control of excessive settlement. (Standard penetration test, corrections for N - values to obtain design soil parameters**.)**

Unit- VI: PILE FOUNDATION

Classification of piles, constructional features of cast- in – situ & pre cast concrete piles. Pile driving methods, effect of pile driving on ground. Pile capacity by static formula & dynamic formulae, pile load test, group action of piles, spacing of piles in group, settlement of group of pile (pile group,) negative skin friction and its effect on pile capacity, general features of under reamed piles.

Slope Stability Analysis with Different Slope angle by Using Plaxis 2-D

A Project Work Submitted In partial fulfillment of the requirement for the award of the Degree of

BACHELOR OF ENGINEERING

IN

CIVIL ENGINEERING

RASHTRASANT TUKDOJI MAHARAJ,

NAGPUR UNIVERSITY

Submitted by:

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Pooja P. Sawang

Anuj A. Varhokar

Akash J. Makeshwar

Atul R. Singh

Sahil W. Borkar

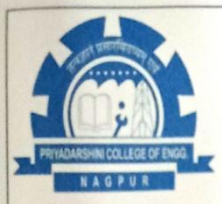
UNDER THE GUIDANCE OF

MR.V.S.GHUTKE

(Asst. Professor, Civil Department)

PRIYADARSHINI COLLEGE OF ENGG.
NAGPUR

SESSION 2020 – 2021



Lokmanya Tilak Jankalyan Shikshan Sanstha's

Priyadarshini College of Engineering, Nagpur

CERTIFICATE

This is certified that the work presented in this project entitled "**Slope Stability Analysis with different Slope angle by Using Plaxis 2-D**" has been completed by **Vaibhav Chavhan, Pooja Sawang, Anuj Varhokar, Akash Makeshwar, Atul Singh, Sahil Borkar** students of B.E. Civil Engineering of our institution in satisfactory manner and in partial fulfilment of the requirements for the award of the Degree of Bachelor of Engieering in Civil Engieering of Rashtrasant Tukdoji Maharaj Nagpur University, Nagpur during session 2020-2021.

Mr.V.S.Ghutke
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ABSTARCT

In the present study, silty soil is used to construct soil slopes with different slope angles of 25°, 30°, 38°and 42° respectively. The failure surface pattern and the FOS studies are carried out for these slopes . The soil slopes of 45° and 60° are reinforced with the nails at three different nail inclinations of 0°, 15° and 30°. The behavior of reinforced soil slopes are also studied. The failure slip surface and the load carrying capacity of the nailed slopes are observed during the program. The unreinforced and reinforced slopes analyzed by using a Finite Element package PLAXIS 2-D. The reinforced soil slope give more stability as compare to unreinforced soil slope. Aslo found that for less soil slope angle the stability becomes more and vise versa.

1.1 General:

A landslide is a geological phenomenon that comprised a wide range of ground movements, such as rock fall, deep failure of slope etc. landslide can occur in offshore, coastal and onshore environment, It can be controlled by the use of proper slope stabilization technique. Soil Stabilization is a term in which the natural soil properties changes in order to coincide the engineering purpose by means of physical, chemical, method. Bearing capacity and the performance of the in-situ soil and sand can be increased by soil stabilisation.

Owing to rapid urbanization and the dearth of land, structures such as foundations for bridge abutment, electrical transmission tower, building, railways, and highways on hills are being built on slope, often close to its edge. In contrast to plane ground, foundations on the slope exhibit less bearing capacity and stability of the slope is also vulnerable. For that reason, stability of such slopes needs to be improved significantly. Over the years, several slope stabilization methods such as modification of slope geometry, grouting of soil mass with cement, lime etc., installation of retaining walls, piles, and reinforcing the soil through polymeric geo-synthetics such as geotextiles, geogrids, geocells, geofabrics, geomembranes, etc.are being used by several researchers.

Various types of geo-synthetics are used for slope stability such as geo-nets, geo-foam, geomembranes, geocells. Geo-synthetic aresynthetic products used to stabilize the soil. Nonwoven synthetic fibers like polyester, polyamide, polyethylene, polypropylene, fibers etc. can be used to reinforce the soil. Strength of soil can be enhanced using geotextiles, genets, geogrids which improves the bearing capacity, shear strength, stiffness and permeability characteristics, reduce the differential settlement etc. of soil through friction interaction between soil and geosynthetic material.

Reinforced earth structures are utilized to design earth retaining buildings and foundation. Reinforced earth is created by combining soil with geosynthetics such as geogrid, geonet and geotextile type of materials. Reinforced earth structures are preferred because of the high tensile strength, fast construction, high resistance to earthquake, economic feasibility and aesthetic appearance also.

Domain 3: Environmental Engineering, Hydraulics and Water Resources Engineering

Sr. No	Name of the course that include experiential learning through Project work/ Internship	Subject Code	Domain
1	Environmental Engineering – I	BECVE303T/P	Environmental Engineering, Hydraulics and Water Resources Engineering
2	Fluid Mechanics -I	BECVE503T/P	
3	Hydrology & Water Resources (HWR)	BECVE505T	
4	Fluid Mechanics -II	BECVE603T/P	
5	Environmental Engineering-II	BECVE605T	
6	Elective -I : Air Pollution And Solid Waste Management	BECVE703T	
7	Irrigation Engineering	BECVE801T	
8	Elective - III : Water and Waste Water Treatment	BECVE803T	

BECVE 303 TENVIRONMENTAL ENGINEERING – I

Objectives:

1. To prepare students to apply basic knowledge of environmental engineering in conventional civil engineering practice involving water supply engineering in particular.
2. The course will provide students knowledge regarding the sources, of water demands, population forecasting, and conveyance of water.
3. To prepare students to analyze, plan, and design of various phases of water supply systems.
4. To provide the students the knowledge regarding the various characteristics of water, estimation of the quantity of water.
5. The course will provide students with fundamentals of solid waste management

Outcomes:

a. The students would be able to understand the importance and necessity of water supply.
b. The students would be able to determine the capacity of water supply scheme.
c. The students would have the basic knowledge related to the conveyance systems and the appurtenances used.
d. The students would have knowledge of characteristics of water, drinking water standards and necessity of treatment.
e. The students would be able to design various units of conventional water treatment plant.
f. The students would be equipped with the basic knowledge related to design of water supply system.
g. The students should be able to understand of necessity of treatment, types of treatment processes and disposal methods for solid waste.

Syllabus :

Unit – I

Introduction: Importance and necessity of water supply scheme.

Water Demand: All types of water demand, empirical formulae, factors affecting per capita demand, variation in demand, design period, population forecasting methods and examples.

Sources of water: Rain water, Ground water-springs, infiltration galleries, Dug wells, tube wells, Surface water-stream, lake, river, impounding reservoirs, ponds & sea.

Intake structures: Location, types river, lake, canal, reservoir etc.

Unit – II

Conveyance of water: Types of pipes, joints, fittings, valves & appurtenances.

Hydraulic design aspects: Friction, Manning's, DarcyWeishbach& Hazen Williams equationand problem.

Rising main and pumps: Concept of rising main, Classification, working, merits and demerits, selection of pumps.

Unit – III

Water quality: Physical, Chemical and bacteriological characteristics of water, Health effects of various water characteristics, Standards of drinking water. (WHO 2011, CPHEOO, IS 10500). Water born diseases

Water treatment: Objective of treatment, unit operations and processes, house hold & community based rural water treatment, decentralized water treatment, flow sheet of conventional water treatment plant.

Aeration: Purpose, types of aerators, design of cascade aerator.

Coagulation and Flocculation: Definition, Principles, types of coagulants and reactions, coagulant doses, types of mixing and flocculation devices.

Unit – IV

Sedimentation: Principles, types of setting basins, inlet and outlet arrangements, simple design of sedimentation tank.

Clariflocculators: Principles and operation.

Filtration: Mechanism of filtration, types of filters-RSF, SSF, Pressure filters, elements of filters sand specification, operational problems in filtration, Design of SSF and RSF, Membrane filtration technique of water treatment.

Unit – V

Disinfection: Purpose, Mechanism, criteria for good disinfectant, various disinfectants, their characteristics, disinfection by chlorination using different forms of chlorine. Types of chlorination.

Distribution systems: Requirements of a good distribution system, methods of distribution systems and layouts, Leakage and leak detector, Study of fire hydrants.

Storage reservoirs for treated water: Types, capacity of reservoir, mass curve.

Unit – VI

Municipal solid waste management : Generation sources, composition, Methods of Collection, transportation, disposal, Recycle, Reuse.

Examples on simple hydraulic design of pipes, estimation of population and water quality, plain sedimentation tanks, cascade aerators, filters, pumps, dose of chlorine). Visit to Water treatment plant (compulsory).

FLUID MECHANICS-I

BECVE503T **Evaluation Scheme: (80/20)**
(L-3 Hrs/Week, T-1 Hr/Week); Total Credits- 4 **Exam Duration: 3 hrs**

COURSE OUTCOMES: The students shall be able to

1. Measure and determine fluid pressures and forces on plates/surfaces, pipe bends, etc.
2. Apply the Bernoulli's equation to solve the problems in fluid.
3. Understand the concepts of dimensional analysis use the dimensionless number suitably.
4. Understand the basic concepts related to laminar and turbulent flow.
5. Apply the principles of hydrostatics and determine the forces.

Unit-I :

Fluids and their Properties: Definition of fluid, fluid properties, mass density, specific weight and specific gravity, viscosity; Newton's equation, coefficients of dynamic and kinematic viscosity. Rheological Diagram. Ideal and real fluids. Compressibility and bulk modulus, Surface tension capillarity, pressure inside a bulb and cylindrical jet, vapor pressure and cavitations. Effects of pressure and temperature on fluid properties.

Fluids Pressure and its Measurement: Fluid pressure, law of fluid pressure, variation of fluid pressure with depth, pressure and head, Atmospheric pressure, Gauge pressures. Pressure measurements using manometer, differential manometer and gauges

Unit-II

Hydrostatics: Hydrostatic pressure on plane and curved surface. Centre of pressure, fluids in relative equilibrium; fluid masses subjected to horizontal, vertical and inclined acceleration.
Buoyancy and Floatation: Buoyant force and centre of buoyancy, Archimedes principle, Metacenter and Metacentric height - its determination by analytical and experimental methods. Stability of floating bodies and three states of equilibrium

Unit-III

Fundamentals of Fluid Flow-I: Kinematics of Flow: Velocity, its variation with space and time; Steady, unsteady, uniform & non-uniform; One, two and three dimensional; rotational, irrotational flow. Acceleration of fluid particles, Normal and Tangential acceleration. Stream line, path line & streak line; Lagrangian and Eularian approaches in fluid flow description. Equation of continuity in Cartesian co-ordinates, stream functions, velocity potential and potential flow. Relationship between stream function and velocity potential, flow nets, circulation, vortices, source and sink. Free and forced vortices.

Unit-IV

Fundamentals of Fluid Flow-II: Kinetics of Flow: Factors influencing motion, Euler's equations of motion. Bernoulli's equation, Assumptions, derivation, limitations and application, Kinetic energy correction factor. Momentum equation, Impact of Jets, forces on plates, pipe bends and closed conduits.

Fluid Measurement-I: Velocity measurement; pitot tube, pitot-static tube and Prandit tube. Discharge measurement: Venturimeter, Orificemeter and flow nozzles.

Unit-V

Fluid Measurement-II: Orifices and Mouth pieces- Orifice: definition, types, Hydraulic coefficients, factors affecting them and their experiments. Large/small orifices and submerged orifices. Time for emptying tanks by orifices Mouthpieces: Definition, types and utility, pressure at Vena contracta, Coefficients of discharge.

Flow Measurement and Control: Notches & Weirs – Definitions, Types; Rectangular, triangular and trapezoidal, End contraction. Co-efficient of discharge and its determination; Error in measurement of head. Velocity of approach and its effects Cipolletti, broad-crested and submerged weirs

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Unit-VI

Dimensional Analysis And Theory of Models: Dimensional Analysis: Fundamentals, methods, (Raleigh's and Buckingham); Similitude, Geometric, Kinematic and Dynamic similarities. Predominant forces, Dimension-less numbers and their significances.

Behavior of Real Fluids: Viscous flow - Laminar and Turbulent flows, Reynolds apparatus critical velocity. Reynolds Number, simple problems on determination of Laminar and Turbulent flows in pipes.

ENVIRONMENTAL ENGINEERING-II

BECVE605T **Evaluation Scheme: (80/20)**
(L-3 Hrs/Week, T-1 Hrs/Week); Total Credits-4 **Exam Duration: 3 hrs.**

COURSE OUTCOMES: The students shall be able to

1. Use the concept related to water & its quality, sewage, sewer, storm water, etc in its hydraulic design
2. Apply the knowledge of different components of sewer in construction, testing & maintenance of sewers,
3. To test the sample of waste water in the laboratory for physical & chemical characteristics.
4. Take-up functional planning, layout and design of water treatment plant components.
5. Take-up functional planning, layout and design of sewage treatment plant components.
6. Plan for rural sanitation provisions, perform functional design of septic tank,
7. Analyze the industrial waste water for its treatment units.
8. Make use of knowledge & effect of air pollution, solid waste in planning for its prevention and control.

Unit-I

General Aspects of Environmental Engineering – Study of waste water, black water & grey water. System of collection and conveyance of sewage- separate and combined systems, patterns of sewage collection systems. Quantity of storm water and sanitary waste water, Sewer: Types, Shapes, Hydraulic Design (Capacity, Size, Grade, etc.)

Unit - II

Construction of sewer - Shoring, Trenching and laying to grade. Sewer materials, Sewer Appurtenances - manhole street inlets, storm water overflows, inverted syphons, flushing and ventilation: House plumbing systems, sanitary fitting and appliances, traps, anti-syphonage, inspection chambers and intercepting traps. Sewage pumping - location of pumping station and types of pumps. Sewer testing and maintenance.

Unit - III

Physical and chemical characteristics of wastewater, significance of BOD, COD, BOD rate constant, Sewage treatment flow sheet, site selection for sewage treatment plant. Preliminary and primary treatment - Screens, Grit chambers, oil & grease removal. Primary settling tank (including simple design)

Unit- IV

Secondary treatment - Principle of Biological Treatment Activated sludge process, trickling filter, (Indian Standard for disposal), Methods of disposal, Sewage farming, self purification of stream (Streeter

Phelp's equation, Oxygen sag curve). Recycle & reuse of sewage (Zero discharge concept). Sludge digestion, sludge drying beds.

Unit - V

Rural sanitation; Pit privy, aqua privy, bio-gas recovery Septic tank including soak pit, including design problem (as per relevant I.S. Code) Sullage collection and disposal

Industrial Waste Water Treatment - Significance of Industrial Waste Water Treatment, important physical and chemical parameters, unit operations and processes (flow equalization, neutralization, adsorption, chemical and biological treatment (in brief)

Unit VI

Air pollution and solid waste: Sources, classification, Effects, prevention and control. Introduction to carbon credit system and climate change

REFERENCE BOOKS

1. B.C.Punmia," Waste Water Engineering" - Laxmi Publication
2. S.K.Garg, "Environmental Engineering" -Vol II Standard Publication
3. G.S.Birdie, "Water Supply & Sanitary Engineering"
4. M.J.Macghee, "Water Supply & Sewage" – McGraw Hill Publication
5. M.N.Rao & HV.N.Rao, "Air 'Pollution" McGraw Hill Publication
6. C.S.Rao,"Enviromental Pollution Control Engineering".

AIR POLLUTION AND SOLID WASTE MANAGEMENT (ELECTIVE-I)

BECVE703T **Evaluation Scheme: (80/20)**
(L-3 Hrs/Week, T-1 Hrs/Week); Total Credits-4 **Exam Duration: 3 hrs**

COURSE OUTCOMES:-The students will be able to

1 Understand different aspects of air pollutants, its sources and effects on man and material etc.
2 Design controls methods and equipments for air pollution to reduce its impact on environment.
3 Understand problems arriving in handling large amount of solid waste generated ,its collection and transportation, processing and will bw able to design safe collection and disposal methods.

Unit - I

Introduction to air pollution : Definition, air pollution episodes, atmosphere & its zones.

Classification and sources of air pollutants, Standards for air pollution (as per Indian Standards and CPHEEO). Effects of air pollutants on man, and materials.

Unit - II

Meteorological parameters and Air sampling: Primary and secondary parameters, atmospheric stability, plume behavior. Wind rose diagram, wind data analysis & wind impact area diagram, Stack height determination.

Air sampling and measurement : ambient air sampling and stack sampling, collection of particulate and gaseous pollutants, site selection criteria methods of estimation.

Unit – III pollution control

Air pollution controls methods and equipments ; Principles of control methods for particulates and gaseous pollutants, gravity settlers, electrostatic precipitators, bag filters, cyclones and wet scrubbers, (adsorption, absorption, incineration, condensation)

Automobile exhaust :Introduction to Pollution due to diesel & petrol engines,

Noise Pollution : Sources, ill effects, control measures.

Unit - IV

Introduction to solid waste management.(SWM) : Structure , necessity and responsibility,

Sources, Quantity and quality, Sources of solid waste, classification and components, physical and chemical characteristics, per capita contribution, sampling and analysis.

Unit – V : Collection and Transportation methods:

Collection and transportation of solid waste: Method of collection, equipment used for collection and transportation, transfer stations, optimization of transport route.

Solid waste processing : Methods of processing, choice of methods, merits and demerits of various methods, gas control measures.3R concept

Unit – VI : Disposal methods:

Composting of waste, methods of composting, factors affecting composting

Sanitary land filling : Site requirements, methods, leachate management., control of gases.

Incineration: Principles of incineration, types of incinerators, advantages and disadvantages.,3T Diagrams

REFERENCE BOOKS

1. M.N. Rao & H.V.N.Rao, " Air Pollution", Tata McGraw Hill Publishing Co. Ltd.
2. C.S.Rao, "Environmental Pollution Control Engineering", Wiley Estern Ltd. New Delhi.
3. Stern A.C., "Air Pollution" Vol I to X.
4. A. D. Bhide, & Sunderesan B.B., "Solid Waste Management in developing countries, INSDOC, N. Delhi.
5. Tchobanoglous, "Integrated Solid Waste Management in Engineering principles and management isssues,
6. K.V.S.G. Murlikrishna" Air Pollution" JTNU, Kakinada.

POWER GENERATION FROM BIODEGRADABLE WASTE BY USING DUAL CHAMBER MICROBIAL FUEL CELL.

A thesis submitted in partial fulfilment of the requirement for the award of the degree of

BACHELOR OF ENGINEERING

IN

CIVIL ENGINERRING

OF THE RTM NAGPUR UNIVERSITY, NAGPUR.

Submitted by: -

Radha Nasare

Sakshi Gajbhiye

Shruti Brahmankar

Yash Raut

Rahul Vyas

Sarang Mahajan

Under the guidance of

Dr. Prashant T. Dhorabe
(Assistant Professor, Dept. of Civil Engineering)

Mr. Hemant B. Bherwani
(Scientist, CSIR-NEERI)

DEPARTMENT OF CIVIL ENGINEERING

PRIYADARSHINI COLLEGE OF ENGINEERING

NAGPUR

SESSION 2020-2021

PRIYADARSHINI COLLEGE OF ENGINEERING

NAGPUR

CERTIFICATE

This is to certify that the work presented in this project entitled "**POWER GENERATION FROM BIODEGRADABLE WASTE BY USING DUAL CHAMBER MICROBIAL FUEL CELL**" has been completed by Radha Nasare, Shruti Brahmankar, Sakshi Gajbhiye, Sarang Mahajan, Rahul Vyas and Yash Raut, students of B.E (Civil Engineering) of Priyadarshini College of Engineering, Nagpur has successfully completed the work and submitted the report in a satisfactory manner and in partial fulfilment of the requirement for the degree of Bachelor of Engineering in Civil Engineering of the Rashtrasant Tukdoji Maharaj Nagpur University during the session 2020 - 2021.

Dr. Prashant T. Dhorabe
(Guide)
Asst. Professor, Civil Dept.
PCE, Nagpur.

Mr. Hemant B. Bherwani
(Co-guide)
Scientist,
CSIR-NEERI, Nagpur.

Dr. S. A. Dhale
(Vice Principal)
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Principal
Priyadarshini College of Engg.
Nagpur

Dr. M.P. Singh
(Principal)
PCE, Nagpur.

ABSTRACT

Nowadays, electricity crisis and exponential growth of food waste has become a major problem in the world. Food wastes constitutes to a major part in Municipal Solid Waste (MSW) and accumulation of this waste leads to serious threat to our society like environmental pollution, land pollution, health risks and scarcity of dumping area with increase in global population. Microbial Fuel Cell (MFC) has the potential of producing electricity by using food waste as substrate and can reduce the waste generation. Microbial fuel cell is a device that converts organic matter to electricity using microbes as biocatalyst. MFC offer effective waste treatment along with the production of clean energy so it can be adopted as a sustainable technique for treatment of food waste. There are various designs of microbial fuel cell among them is dual chamber microbial fuel cell which had been used in this review. The readings of current and voltage were noted with 6% and 8% salt concentrations in salt bridge with anaerobic conditions. It is observed that MFC with 8% salt concentration in salt bridge gives more amount of current and voltage than 6% salt concentration. There are also various parameters by which efficiency of MFC could be increased. There are several microorganisms available in food waste most of them belong to Geobacter species which are efficient in microbial fuel cells to generate clean, cheap electricity. It is noted that the effect of pH, mediators, substrates and variation of NaCl concentration in salt bridge also greatly affects the performance of microbial fuel cell. Also, the variation in temperature and moisture condition has a great impact on the current and voltage readings. Thus, this project proves that microbial fuel cell can be efficiently used as a green technology with various application that can tackle the environment crisis all over the world.

Keywords: Anaerobic, Current, Microbial fuel cell, Salt concentrations, Voltage, Waste food.

Chapter 1:
Introduction

1.1. Introduction

According to the Food and Agriculture Organization (FAO) of the United Nations an estimated 1.3 billion tonnes of food are wasted globally each year, one third of all food produced for human consumption. Food wastes constitutes to a major part in Municipal Solid Waste (MSW) and accumulation of this waste leads to serious threat to our society like environmental pollution, land pollution, health risks and scarcity of dumping area due to increase in global population. Microbial fuel cell has the potential of producing electricity by using food waste as substrate and can reduce the waste generation. MFC offer effective waste treatment along with the production of clean energy so it can be adopted as a sustainable technique for treatment of food waste.

Microbial fuel cell (MFC) is a device which converts the chemical energy released by the oxidation of complex organic carbon sources that are utilized as a substrate by microorganisms to produce electrical energy. It is simply a sustainable device that converts organic matter to electricity using microbes as biocatalyst. MFC effectively uses the self-replicating ability of bacteria to produce energy and thus the catalyst for the organic matter oxidation also exhibits self-sustaining ability therefore representing it as an effective method for bioenergy production.

In this research the construction and working of a dual chamber microbial fuel cell is observed. Generally, biodegradable waste includes any organic matter in waste which can be broken down into carbon dioxide, water, methane or simple organic molecules by micro-organisms and other living things by composting, aerobic digestion, or anaerobic digestion. It will be noticed how under anaerobic condition the decayed food waste will produce methane gas which can be further utilized as a fuel gas. This review article will also examine the microbial fuel cell currently in use and its potential future scope. Also, in this research it is examined how various parameters affects the overall performance of the MFC and how to increase the generation of electricity produced. We hope that this research will highlight the potential use of microbial fuel cell and its advancement in novel green technology.

Domain 4: Structural Engineering

Sr. No	Name of the course that include experiential learning through Project work/ Internship	Subject Code	Domain
1	Strength of Materials	BECVE302T/P	Structural Engineering
2	Structural Analysis – I	BECVE 401T/P	
3	Structural Analysis -II	BECVE501T/P	
4	Reinforced Cement Concrete (RCC) Structures	BECVE502T/P	
5	Steel Structures	BECVE601T/P	
6	Advanced Concrete Structures	BECVE701T/P	
7	Elective -I : Earthquake Resistant Design of Structure	BECVE703T	
8	Elective - III : Advanced Reinforced Cement Concrete Design	BECVE803T/P	

BECVE 302 T STRENGTH OF MATERIALS

Objectives:

1. To make students learn and apply basic theories and concepts of equilibrium, shear force, bending moment in beams and frames, bending stress, shear stress, torsional stress and stress-strain laws to different materials for different conditions of loading.
2. To make students learn and understand the concept and theory of deflection of beams, frames, trusses.

Outcomes:

a. The students would be able to understand the behavior of materials under different stress and strain conditions.
b. The students would be able to draw bending moment, shear force diagram, bending stress and shear stress distribution for beams under the different conditions of loading and calculate the deflection.

Syllabus :

Unit – I

Mechanical properties and uniaxial problems.

Types of force distribution, concept of stress and strain, Stress strain behavior of ductile and brittle material in uniaxial state of stress, elastic, plastic and strain hardened zones stress-strain relations, Elastic constants, relation between elastic constant, Uniaxial loading and deformation of simple cases of statically indeterminate problems under axial loading, temperature change etc., Thin wall pressure vessels cylindrical and spherical subjected to internal pressure.

Unit – II

Axial force, shear force and bending moment diagram

Concepts of free body diagrams, types of loads, Determination of axial forces, shear forces and bending moment at a section, axial force, shear force and bending moment in beams and simple frames, Differential relations between shear force and bending moment, Relation between load and shear force.

Unit – III : Stress in beams

Bending stresses in simple beams, Assumptions and derivation of simple bending theory relation between bending moment, bending stress and curvature of homogeneous and composite beams, Shear stresses in simple beams, Shear flow and shear stress distribution, shear stress in composite beams, combined effect of bending moment and axial force.

Unit – IV : Torsion

Torsion of circular section, assumptions and derivation of relations between torsional moment, shear stress and angle of twist, Torsional stress in solid and circular sections, Introduction to Torsion in rectangular section, Torsion in thin walled hollow section

Unit – V : Deflection of beams

Derivation of differential equation of moment curvature relation, Differential equation relating deflection and moment, shear and load, Deflection of simple beams by integration, Introduction to Deflection of linearly varying beams by integration.

Unit –VI : State of stress in two dimensions

State of stress in two dimensions, differential equation of equilibrium, Transformation of stresses, principal stresses, maximum shear stresses, Mohr's circle, Combined bending and torsion, Combined effect of torsion and shear, Shear flow in thin walled section, Concept of shear centre of thin wall sections, unsymmetrical bending.

BECVE 302 P : STRENGTH OF MATERIALS
(Any Eight practicals)

1. To study various types of Strain Gauge apparatus.
2. To determine the Tensile Strength of Steel specimen.
3. To perform Hardness test on various metals. (Brinell's hardness test & Dynamic hardness test)
4. To perform standard Torsion test on metals.
5. To perform the Impact test on metal (Izod/ Charpy).
6. Compression test on Bricks and Stones.
7. To determine the spring constant of Closely Coiled Spring.
8. To perform shear test on different metals.
9. To perform fatigue test on mild steel bar.
10. To perform the bending test on wooden beam and find its Flexural Rigidity.

Text Book:

Sr.No	Title	Publication
1.	Strenght of Materials by S.P. TimoShenko	Mc. Graw Hill
2	Mechanics of Materials by Ferdinand P. Beer, E. Russell John StonJr	Mc. Graw Hill

Refrence :

Sr.No	Title	Publication
1	**Strength of materials by Singer**	**Haper and Row**

BECVE 401 T STRUCTURAL ANALYSIS – I

Objectives:

1 To make students understand the determinate and indeterminate structures, their method of analysis And construction of influence lines.

2 To make students understand the behavior of beams and frame using, Column Analogy Method, strain energy method, slope deflection method etc.

Outcomes:

a. The student would be able to apply knowledge to analyse concept of deflection, bending moment and shear force diagram in beams, frames, trusses and columns under various loading conditions using different analysis methods.
b. The student would be able to apply knowledge to determine forces in determinate and indeterminate structures by the force and matrix method.
c. The students would be able to perform ILD analysis of determinate beams and trusses.

Syllabus:

Unit – I

Introduction of Statically indeterminate Structures : Concept of Static indeterminacy,
Analysis of fixed and continues beams by theorem of three moments, effects of sinking of support.

Unit – II

Rolling loads on simply supports beams with concentrated and uniformly distributed loads, maximum B.M. and S.F. Influence lines for reactions, bending moments and shear forces in simply supported beam, cantilevers and beams with overhangs. Influence lines for forces in members of simple trusses and for BM and SF in panels of simple trusses.

Unit – III

Strain energy method as applied to the analysis of redundant frames and redundant truss up to two Degrees, Determination of deflection of trusses. Castiglinos theorems. Maxwells reciprocal theorem. Bettis theorem.

Unit – IV

Bucking of columns and beams. Eulers and Rankines formula.
Analysis of Two-Hinged arches. Three Hinged Arch, S.F. and normal thrust, parabolic arches.

Unit – V

Slope defection method as applied to indeterminate beams & continues beams portal frames. Frame with inclined legs upto 3 degree of freedom.
Approximate method: Analysis of multi-stored frame, portal,cantilever and substitude frame methods.(max. three bay three storey).

Unit – VI

Introduction to flexibility method upto two DOF, Column Anology Method.

STRUCTURAL ANALYSIS –II

BECVE501T **Evaluation Scheme: (80/20)**
(L-3 Hrs/Week, T-1 Hr/Week); Total Credits- 4 **Exam Duration: 3 hrs**

COURSE OUTCOMES: The students shall be able to

1. Apply the different methods of analysis of frames in practical problems
2. Formulation of stiffness matrix, transformation matrix, load matrix for various structural components for analysis purposes.
3. Understand the basics of finite element method in the analysis of structural components.
4. Understand the concepts related to structural dynamics.

Unit – I

Kani's Method applied to symmetrical and unsymmetrical frames with sway (Up to single bay Two storey)

Unit - II

Analysis of Continuous Beams & Simple Portal frames (sway and Non Sway) Using Moment Distribution.

Unit - III

Basic concept, Degree of Freedom, Basic concept of Direct Stiffness Method. Formulation of elemental/local stiffness matrix and global stiffness matrix for plane truss. Transformation Matrix, Assembly of Global/ Structural stiffness matrix up to (8x8). Member load matrix including lack of fit, temperature, Assembly of Global/ Structure load matrix, Solution to problems with maximum degree of freedom three.

Unit - IV

Formulation of element/local stiffness matrix and global stiffness matrix for beam members (without axial deformations) for continuous beams, Transformation matrix Assembly of global/ structural stiffness matrix, Member load matrix due to concentrated loads, uniformly distributed Loads, Assembly of global/ structure load matrix up to Three Elements. Solution to problems with maximum degree of freedom Three.

Unit – V

Formulation of element/ local stiffness matrix and global stiffness matrix for Plane frame members (without axial deformations), Transformation matrix Assembly of global/ structural stiffness matrix, Member load matrix due to concentrated loads, uniformly distributed Loads, temperature Moments Assembly of global/ structural load matrix.

Solution to Plane frame problems with maximum degree of freedom six inclined member problems.

Unit - VI

Introduction to structural dynamics, D'Alembert principle, inertia force, equation of motion (free vibration), SDOF system, Damping, natural frequency, (MDOF (up to 3 DOF), mode shape and nodal frequency).

Introduction to finite Element method, basic concepts, discretization of structures, Rayleigh Ritz method for bar elements (prismatic/Non-prismatic) Displacement based bar elements (Prismatic/Non-prismatic)

REFERENCE BOOKS:

1. C K Wang, 'Intermediate Structural Analysis"
2. S P Timoshenko, 'Theory of Structure'
3. Jain, Jain Krishna, 'Plain & Reinforced Concrete Structures', Vol-II
4. Rally and Dally, 'Experimental Stress Analysis'

STRUCTURAL ANALYSIS –II

BECVE501P **Evaluation Scheme: (25-Internal/25-External)**
(P – 2 Hrs/Week); Total Credit - 1

Student shall undertake Practicals on:

Minimum Eight Problems, on complete syllabus with hand calculations using scientific calculators and also solution to same problems by using available application software.
(Solution is restricted to four degree of freedom problems and assembly restricted to eight degree of freedom problems)

REINFORCED CEMENT CONCRETE (RCC) STRUCTURES

BECVE502T **Evaluation Scheme: (80/20)**
(L-3 Hrs/Week, T-1 Hr/Week); Total Credits- 4 **Exam Duration: 4 hrs**

COURSE OUTCOMES: The students shall be able to

1. Understand the basic concepts of structural design Methods of RCC to the practical problem
2. Understand the composite action of reinforced steel and concrete in reinforced concrete structural members
3. Use the knowledge of the structural properties of materials i.e. steel and concrete in assessing the strength.
4. Use the knowledge in structural planning and design of various components of buildings.
5. Apply the concepts and applications of prestressed concrete in real problems

Unit – I

Introduction to the Working Stress Method of RCC design. Basic concepts in design for flexure, assumptions, design constants. Analysis of the rectangular section, Balanced, under-reinforced and over-reinforced sections; Drawbacks and limitations of Working stress methods.

Unit – II

Prestressed Concrete: Properties of high grade/strength materials, concepts of prestressed concrete, methods of prestressing, losses in prestressing. Various systems of prestressing with particular reference to Freyssinet, Magnel Blatton and Gifford Udall systems Analysis of rectangular, T and I section. Design of prestressed slab/ rectangular beam

Unit - III

Introduction to Limit State Design: Concept of probabilistic design and limit state design. Characteristic values, partial safety factors, stress strain relationship stress block parameters, failure criteria, types and properties of reinforcement, limit state of Serviceability and limit state of collapse, other limit states. Review of IS – 456-2000.

Limit state of collapse in flexure: Analysis and design of singly reinforced rectangular section. Balanced failure mode, primary tension failure mode and primary compression failure mode

Analysis & Design of Doubly reinforced sections

Unit - IV

Limit state of collapse in flexure: Analysis and design of Tee and L-beam section.
Limit state of collapse in compression: Analysis & design of short axially loaded column. Columns subjected to uniaxial bending, use of interaction curves.

Design of rectangular pad/ slopped footing for axial load

Unit - V

Limit state of Collapse in Shear & Bond: Design of beam for shear, shear span, post cracking resistance, shear mechanism approach, shear failure modes and collapse loads, interaction of shear, flexure and force. Check for bond.

Limit state of Serviceability:

Causes and control cracking: Crack in plastic concrete at early age, Cracks due to temperature and shrinkage, restrain induced cracks, Cracks due to loading. Needs for crack width control

Moment- curvature relationship, deflection control of beams; Deflection calculation for beam.

Limit state of collapse in torsion: Concepts of interaction to torsion, shear and flexure Analysis & design of rectangular section for torsion, shear and flexure

Unit – VI (with LSM)

Design of one-way, simply supported, single span and cantilever slabs, and continuous slab/ beam with IS coefficients.

Design of RCC Two way slab with various end conditions using IS code coefficient.
Deflection calculation for one-way slabs

REINFORCED CEMENT CONCRETE (RCC) STRUCTURES

BECVE502P **Evaluation Scheme: (25-Internal/25-External)**
(P – 2 Hrs/Week); Total Credit - 1

Student shall undertake Practicals on:

1. Design of beams, columns, slab and foundation as per relevant IS Code
2. Understanding the professional RCC drawing.
3. Minimum One Site visit pertaining to above design

DESIGN AND ANALYSIS OF RCC T-BEAM SUPERSTRUCTURE FOR DIFFERENT LOAD COMBINATION

A Project work Submitted in partial fulfillment of

The requirements for the degree of

BACHELOR OF ENGINEERINGINCIVIL ENGINEERING

OF

RASHTRASANT TUKDOJI MAHARAJ NAGPUR UNIVERSITY

NAGPUR

Submitted by

Shubham Raghorte

Akshay kale

Aamir Jabar

Akshara Chapke

Shushwet Parbat

Under the Guidance of

Prof V.S.Vairagade

Asst. Prof, Civil Engineering

DEPARTMENT OF CIVIL ENGINEERING

PRIYADARSHINI COLLEGE OF ENGINEERING NAGPUR-440019

SESSION 2020-2021

PRIYADARSHINI COLLEGE OF ENGINEERING

NAGPUR

CERTIFICATE

This is certified that the work presented in this project entitled " **Design and analysis of Rcc T-beam superstructure for different load combination** " has been completed by Shubham Raghorte, Akshara Chapke, Akshay Kale , Shushwet Parbat and Aamir Jabar students of BE Civil Engineering of this institution in satisfactory manner and in partial fulfillment of the requirements for the award of the degree of bachelor of engineering in civil engineering of Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur during session 2020-2021

Prof. V. S. Vairagade
Guide
Asst. Professor, Civil Dept.
PCE, Nagpur.

Prof. V. Ghutke
H.O.D
Civil Dept.
PCE, Nagpur.

ABSTRACT

Bridges are the structures which are constructed to connect the way separated by river or valley. In India, there are different codes which are used to design bridges. Each code have different design provisions and methods. This study includes two IRC codes which are used to design bridges those are IRC: 21-2000 which is based on working stress method and IRC: 112-2011 based on limit state method. In this study, three single span of T-beam bridge of 15m, 20m and 25m length are designed as per both IRC codes and AASHTO code and analyzed with the help of STAAD pro software. Two comparisons are made. The first comparison is in between design and analysis results by IRC: 21- 2000 working stress method with the results of AASHTO and another comparison is between IRC 112-2011 limit state method with the results of AASHTO and it will be concluded that which comparison have more or less similarities and also the most preferable design method or code for RCC T-beam bridge.

Chapter 1

Introduction

INTRODUCTION

1.1 OVERVIEW:

Engineers in India have been using IRC 21-2000 for designing bridges which is based on working stress method, also IRC:112-2011 for RCC and pre-stressed bridges has been introduced by Indian road congress which is based on limit state method. Both the codes have different guidelines for design of bridges. In working stress method, it has been observed that 13 is the allowable length and depth ratio while 20 is the most preferable length and depth ratio in limit state method. 30 to 35% reduction in cost of concrete is possible using limit state method as compared with working stress method. This study is performed on RCC T-beam bridge. The bridge span is designed by using both IRC:21-2000 and IRC:112-2011 codes and analyzed by using STAAD Pro. The results by both the codes are compared with the results of design and analysis of same span of RCC-T Beam Bridge by AASHTO. IRC6:2017 is used for load and load combination.

1.2 BRIDGE HISTORY AND DEVELOPMENT:

T- beam bridge are cast in situ, fortified solid bars with essential deck areas to either side of the highest points of the pillars. In cross segment the shafts are more profound than their deck segments, which delivers the T-shape that gives them their names. The essential fortifying steel is put longitudinally in the base of the bar to oppose the pressure on (the powers that would pull separated) the pillar. The deck that frames the top piece of the T-formed bars is dependent upon pressure (powers that crush or push it together). As solid opposes pressure, it is moved in the deck alongside less considerable fortifying steel laid over the width of the scaffold. The improvement of the tee bar connect in the mid twentieth century mirrored a superior comprehension by specialists of the powers of pressure and strain inside fortified solid scaffolds. This comprehension permitted them to create solid and efficient tee beam bridge. The scaffolds were solid in light of the fact that the fortifying steel and cement were put where they were generally required, and prudent in light of the fact that material was not squandered.

Domain 5: Transportation Engineering

Sr. No	Name of the course that include experiential learning through Project work/ Internship	Subject Code	Domain
1	Transportation Engineering – I	BECVE 403T/P	Transportation Engineering
2	Transportation Engineering - II	BECVE705T	
3	Elective - II : Pavement Analysis And Design	BECVE802T	

BECVE 403 T TRANSPORTATION ENGINEERING – I

Objectives:

1. To educate the students on the various components of Highway Engineering and Bridge engineering.
2. To expose the students to highway planning, engineering surveys for highway alignment, Design of Geometric Elements of Highways and Urban roads, Flexible and Rigid pavements design, Traffic Engineering, traffic safety analysis, transportation planning and Highway material testing.
3. To make them understand desirable properties and testing procedures of highway materials as per BIS standard and Indian Roads Construction (IRC) for various practices adopted for construction.
6. To educate students on the various components of Pavements.
7. It exposes the student to learn types of pavements, components and functions of pavements, types of highway vehicles and aircrafts, IRC loadings, equivalent axle loading and load factors, Flexible and Rigid design methods, etc.

Outcomes:

a. A person with broad vision and complete knowledge of design and construction practices in highway engineering and pavement.
b. The student will be able to test highway materials and draw appropriate conclusion.
c The student will be able to maintain and propose measurement.
d. The student will be able to undertake Traffic studies.

Syllabus:

Unit -I

Highway Development & Planning: Principles of Highway planning, Road development in India Classification of roads, network patterns, Planning, Surveys.
Highway Alignment: Requiremnts, Engineering Surveys.
Highway Materials: Properties of sub grade and pavement component materials, Tests on subgrade soils, aggregates and bituminous materials. Application of Geosynthetics.

Unit - II:

Highway Geometric Design: Cross Section elements, carriageways, camber, stopping & overtaking sight distances Horizontal alignment- Curves, design of super elevation, widening, transition curves, vertical curves.

Unit- III

Pavement Design: Types of pavements & characteristic, Design parameters, Axle & Wheel load, tyre pressure, ESWL for dual Wheels, repetitions, Group Index & IRC method of flexible pavement design. Analysis of load & temperature stresses of rigid pavement, joints

Highway Construction & Maintenance: Earthen/Gravel road, Water Bound Macadam, Wet Mix macadam, Bituminous pavement, Cement Concrete pavement. Pavement failures, Pavement evaluation, Maintenance and strengthening measures.

Unit-IV

Traffic Engineering: Traffic characteristics (Road User, Driver and Vehicular characteristics)
Traffic Studies (Volume studies, speed studies, parking studies and accident studies.)
Traffic Safety (Causes and types of accidents, Use of intelligent transportation system)

Unit- V

Bridge Engineering: Classification, identification and site selection.
Flood discharge, waterways, scour depth, economic span.
IRC classification of Loads, Forces, Stresses: IRC Specification & code of practices,Critical combinations.

Unit-VI

Sub-Structure: Types of foundations & their choice, Open, Pile and well foundation, pneumatic Caissons, cofferdams. Abutment, Piers & Wing walls, Their types general design principles (empirical.)

Super Structure: Different structural forms
Rating and Maintenance: Methods & Techniques of rating of existing bridges Inspection, Repairs, maintenance, corrosion-causes and prevention, Aesthetics.

PRACTICAL : BECVE 403 P TRANSPORTATION ENGINEERING - I

Every student must carry minimum of 10 (Ten) experiments from the following:

1. Sub grade Soil: CBR test
2. Sub grade Soil: AASHO Classification
3. Aggregates: crushing value test.
4. Aggregates: Los Angeles abrasion value test.
5. Aggregates: impact test.
6. Aggregates: shape test.(Elongation Index, Flakiness index and Soundness test)
7. Aggregates: Specific Gravity and Water absorption test.
8. Bitumen: Penetration Value.
9. Bitumen: Ductility Test.
10. Bitumen: Softening point test.
11. Bitumen: Flash and Fire point test.
12. Bitumen: Specific gravity.
13. Bitumen: Adhesion Test.
14. Short Field Visit

Text book

Sr. No.	Title	Publication
1.	Highway Engineering: Khanna and Justo.	Nem Chand
2.	Bridge Engineering by S. P. Bindra.	**Dhanpat Rai Publication**
3.	Bridge Engineering by S. C. Rangwala.	Charotar Publishing House Pvt. Limited
4.	Principles and practices of Highway Engineering by S. K. Sharma	Khanna Publication

Refrence book

Sr. No.	Title	Publication
1	. Pavement Design: Yoder and Witzak	Wiley
2	Traffic Engineering: L.R.Kadiyali	Khanna Publisher

TRANSPORTATION ENGINEERING-II

BECVE705T **Evaluation Scheme: (80/20)**

(L-3 Hrs/Week, T-1 Hrs/Week); Total Credits-4 **Exam Duration: 3 hrs**

COURSE OUTCOMES:-The students are able to

1. Understand the functions of various elements of railways, airports, tunnels and docks and harbor.
2. Plan and design various elements of railways, airports, tunnels and docks and harbor.
3. Understand the various principles traffic control in railways, airports, tunnels and docks and harbor.
4. Understand layout, design and construction permanent way, runway, taxiways, tunnels, births and jetty.
5. Understand the maintenance of various elements of railways, airports, tunnels and docks and harbor.

Unit – I : RAILWAYS

Classification of Rail way: lines and their track standards.

Traction and Tractive Resistance, Hauling capacity and Tractive effort of locomotives, Different Typesof tractions

Permanent Way: (Ideal permanent way), gauges, track section. Coning of wheels, Stresses in railwaytrack, High speed track.

Unit – II

Rail types and functions, selection for rails, wear & defects, creeps of rails, long welded rails., sleepers -function, types, merits and demerits, sleeper density. Ballast cushion. Ballast section, Spikes,fishplates, hook bolts, Dog bolt, pondrot clip .

Geometric design of railway track, Gauge, Gradients speed, super elevation, cant deficiency, Negativesuper elevation, objectives of transition curves, grade compensations.

Unit - III

Points & crossings: Left and right hand turnouts, design calculations for turnouts ,-Station and Yards: Types, functions, Railway signaling and interlocking: Objects of signaling, principles of signaling. Classification and types of signals. Necessity of interlocking methods and mechanical devices Railway track construction, inspection & modern techniques of maintenance. Modern technology related to track, signaling & controlling.

Unit – IV : AIRPORTS

Aircraft components and characteristics, Airport site election. modern aircrafts.

Airport obstructions: Zoning Laws, Approach and turning Zone, clear zone, . (vertical) Clearance for Highway & Railway.

Runway and taxiway design: Wind rose, cross wind component, Runway Orientation and configuration. Basic runway length and correction, runway geometric design standards. Taxiway Layout and geometric design standards, Exit Taxiway.

Unit – V

Airport layout and classification: Terminal Area, Aircraft parking, configuration and system. Aprons,Hangers, Helipads and Heliports,

Visual Aids: AirPort marking and Lighting for runway, Taxiway and other areas.

Air traffic control: Need, network, control aids, instrumental landing systems, Microwave loadingsystem

Unit – VI (Tunnel Engineering and Docks and Harbors)

16. Tunnel (Engineering) – surveys, Drainage, Ventilation, Lighting ~~(~~and Lining~~)~~

Text Books and Reference Book:

1 A text book of Railway Engineering *by*S.C.Saxena and S.P.Arora, Dhanpat Rai Publicatios, N.Delhi.
2 Railway Track Engg. *by* J.S.Mundray, Tata McGraw-Hill Publishing Co. Ltd. N.Delhi.
3 Airport Planning and Design *by*S.K. Khanna, M.G.Arora, Nem Chand Bros., Roorkee.
4 Planning and Design of Airports *by*RobortHornjeff, McGraw Hill Book Co.
5 Air Transportation Planning and Design *by* Virender Kumar &Satish Chandra, Galgotia Publications, N.Delhi.
6 Mundary, J.S. Railway Track Engineering, Tat McGraw Hill, New Delhi.
OZA, Docks and Harbours, Charotar Publisher)
7 Air Planning and Design by G.V. Rao

PRIYADARSHINI COLLEGE OF ENGINEERING

NAGPUR

CERTIFICATE

This is certified that the work presented in this project entitled "**THE COMPARATIVE STUDY OF RAILWAY BOX BRIDGE USING STAAD PRO AND MDM**" has been completed by Virendra Talmale, Viabhav Chikte, Dhruvesh Paunikar, Vishal Bomprey, Sumedh Kamble, Palash Gondane students of BE Civil Engineering of this institution in satisfactory manner and in partial fulfillment of the requirements for the award of the degree of bachelor of engineering in civil engineering of Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur during session 2019-2020

Dr. (Mrs.). Sarika Modak

Guide

Asst. Professor, Civil Dept.

PCE, Nagpur

Dr. S. A. Dhale

Vice Principal & HOD Civil Dept.

PCE, Nagpur

PRIYADARSHINI COLLEGE OF ENGINEERING PCE Nagpur

Principal
Priyadarshini College of Engg.
Nagpur

Dr. M. P. Singh

Principal

PCE, Nagpur

ABSTRACT

This study demonstrates the structural analysis and design of RCC box type bridge using manual approach (i.e. MDM method) and by computational approach (Staad-pro) using IRS - CBC codes. The structural elements (top slab, bottom slab, side wall) were designed to withstand Ultimate Load criteria (maximum bending moment and shear force) due to various loads (Dead Load, Live Load, LL surcharge, DL surcharge) and serviceability criteria (Crack width) and a comparative study of the results obtained from the above two approach has been carried out to validate the correctness of the results. Further, it was also observed that the analysis using manual calculation becomes very tedious and cumbersome and for a complex type of structure, thus it is quite a complex task to perform the analysis manually, so the use of computational method (Staad Pro and excel sheet) becomes the obvious choice for design. The results obtained using MDM method shows a good agreement with the results obtained from computational methods. Bridges are the structural components that are required for the efficient movement of Trains and locomotives and under earth embankment for crossing of water course like streams across the embankment as road embankment cannot be allowed to obstruct the natural water way. Bridges can be of different shapes such as arch, slab and box. These can be constructed with different material such as masonry (brick, stone etc.) or reinforced cement concrete. Since bridge pass through the earthen embankment, these are subjected to same traffic loads as the road carries and therefore, required to be designed for such loads. The cushion depends on rail profile at the bridge location. The structural design involves consideration of load cases (box empty, full, surcharge loads etc.) and factors like live load, effective width, braking force, dispersal of load through fill, impact factor, co-efficient of earth pressure etc. Relevant IRCs are required to be referred. The structural elements are required to be designed to withstand maximum bending moment and shear force. This Project work provides discussions on the provisions in the Codes, considerations and justification of all the above aspects on design. The box bridge can be analysed either by Software or Computational methods.so it is necessary to study the effectiveness of results obtained from both the methods.

INTRODUCTION

1.1 INTRODUCTION

Bridge construction nowadays has achieved a worldwide level of importance. With rapid technology growth the conventional bridge has been replaced by innovative cost effective structural system. The efficient dispersal of congested traffic, economic considerations, and aesthetic desirability has increased the popularity of box type bridges these days in modern highway systems, including urban interchanges. They are prominently used in freeway and bridge systems due to its structural efficiency, serviceability, better stability, pleasing aesthetics and economy of construction. They are efficient form of construction for bridges because it minimizes weight, while maximizing flexural stiffness and capacity. It has high torsional stiffness and strength, compared with an equivalent member of open cross section. Although significant research has been underway on advanced analysis for many years to better understand the behavior of all types of box bridges, the results of these various research works are scattered and unevaluated. Hence, a transparent understanding of more recent work on straight and curved box bridges is highly desired which divulged the attention towards aiming a present study. The main objective is to provide a clear vision about the analysis and design of box type minor railway bridges. This study would enable bridge engineers to better understand the behavior of Box Bridge outlining a different approach towards analysis and design.

PRELIMINARY INFORMATION :-

This study was a part of contract package of Eastern Dedicated Freight Corridor – Design and Construction of Civil, Structures and Track works for double line Railway under which a box type bridge of 4.5 m span. Specific details for the design are discussed below:

- The box is having the clear height is 2.25m and top and bottom slab thickness of 0.25m.
- The carriage way of box bridge is of 2 lanes.
- The thickness of wearing coat is 0.065m.
- The minimum soil bearing capacity for RCC box Structures is assumed to be 20 kN/m2.
- The design life of a structure is that period for which it shall be designed to fulfil its intended function. The design life of all bridge structures is considered as 100 years.

A box structure with top slab, side wall and bottom slab is shown in Fig. 1 along with the loads and reactions. The top slab is subjected to uniformly distributed loads while the sidewalls are subjected to trapezoidal load varying along the height of the structure. The bottom slab is directly resting on soil and is taken as a spring support.

Domain 6: Other

Sr. No	Name of the course that include experiential learning through Project work/ Internship	Subject Code	Domain
1	Applied Mathematics-III	BECVE301	Other
2	Communicative English & Technical Writing	BECVE506P	
3	Site Visit & Mini Project	BECVE606P	
4	Industrial Case Study and Project Seminar	BECVE706P	
5	Construction Economics and Finance	BECVE804T	
6	Project	BECVE805P	

SITE VISITS & MINI PROJECT

BECVE606P **Evaluation Scheme: (25-Internal/25-External)**

(P-3 Hrs/Week); Total Credits-3

COURSE OUTCOMES: The students shall be able to

1. Get an idea of various project details such as contracts, layout, planning, drawing, estimates, Arbitration provision, licensee & licensor, architects, structural designer, etc
2. Get an idea of various construction equipment, manpower & techniques used at site, techniques of batching, mixing, transportation, and placement of different construction materials.
3. Get an overview on safety measures, basic amenities to provide, inventory control.
4. Write a legible, correct and technically sound report after the visit.
5. Ascertain the provisions and execution as per the working drawing.

Students should be taken for visit to various Civil Engineering construction sites such as R. C. C. Structures, Steel Structures, Bridges, culverts, Hydraulic Structures, water tanks, Roadwork, Railways, Water supply and Sanitary works, Geotechnical Exploration, Maintenance and Rehabilitation works, Irrigation systems, Formwork, Reconnaissance and Detailed Surveying & leveling etc.

- Minimum Five visits are expected.
- Students should submit a detailed report on the visit duly approved by the concerned teacher. **The Detailed Report should mainly consist of the following: -**
  - Name of Construction Site with address
  - Nature of construction work and various structural components

- Nature of ownership, executing and supervising authority
- Architect and Structural Engineer
- Architectural concept and Design features
- Commencement of the work and tentative completion
- Present Status of work
- Estimated cost of the work (Money spent till date)
- Mode of availability of finance
- Various types of manpower for the work
- Various safety measures and amenities provided to manpower
- Various construction equipments for the work
- Various materials used for the work
- CPM / PERT of the project
- Type of inventory control
- Resource planning implemented
- Social benefits and implication
- Safety measures during and posts construction
- Post Construction Maintenance provisions
- Effect on environmental aspect and sustainable development
- Various of scaffolding, Formwork, lifting devices
- Site of precast units for the work and its mode of transportation
- Use of local available material like fly-ash, slag, silica-fumes, etc.
- Causes for delay / faulty construction

MINI PROJECT REPORT

On

MODULAR BUILDING CONSTRUCTION

A Project report submitted in partial fulfilment of The requirements for the degree of

BACHELOR OF ENGINEERING IN CIVIL ENGINEERING OF

RASHTRASANT TUKDOJI MAHARAJ NAGPUR UNIVERSITY NAGPUR

Submitted by

1. PRITI RAHANGDALE
2. DNYANDIP DHORE
3. PRACHI TEMBHURNE
4. KAUSTAV DATTA
5. TEJAS KAMBLE

Under the guidance of

DR.SARIKA MODAK

DEPARTMENT OF CIVIL ENGINEERING

PRIYADARSHINICOLLEGE OFENGINEERING

NAGPUR-440019

2020 - 2021

PRIYADARSHINICOLLEGE OFENGINEERING

NAGPUR

CERTIFICATE

This is to certify that the mini project work entitled as a "MODULAR BUILDING CONSTRUCTION" Is bonafied work carried out by PRITI RAHANGDALE, DNYANDIP DHORE, PRACHI TEMBHURNE, KAUSTAV DUTTA AND TEJAS KAMBLE under my guidance in satisfactory manner and submitting to the Rashtrasant Tukdoji Maharaj Nagpur University. The project report submitted is the Impartial fulfilment of the requirement for the degree of Bachelor of engineering in Civil Engineering.

DR.SARIKA MODAK
Asst. Prof. & Guide
Departmentof CivilEngg.

Dr, S.A Dhale
Head of Dept &
Vice Principal

Dr. M.P Singh Principal,
PCE,Nagpur

PRIYADARSHINI COLLEGE OF ENGINEERING NAGPUR PCE

INTRODUCTION

An increasing number of building projects across several markets are using modular construction, the process by which components of a building are prefabricated off-site in a controlled setting and then shipped to the project site and assembled. This approach allows projects to capture the efficiencies gained by integrating the processes and technologies of design, manufacturing, and construction— without having to compromise on aesthetic intent. According to research conducted by McGraw-Hill Construction, when implemented effectively this approach has been shown to result in a higher-quality building, delivered in a shorter time frame, with more predictable costs, and fewer environmental impacts—for example, through reduced material use and waste. While a range of factors are driving increased use of modular construction, a number of barriers are preventing its wider adoption. And although the planning and design process involved in modular construction is in several ways similar to that of traditional on-site construction, there are some significant differences and a number of considerations that project teams unfamiliar with the modular approach must understand before committing toit. For example, with modular construction many decisions have to be made much earlier inthe process. And because a large amount of work is performed off-site, a much higher levelof coordination between the various parties involved—on such matters as construction tolerances and scheduling—becomes critical.

Modularity involves constructing sections away from the building site, then deliveringthem to the intended site. Installation of the prefabricated sections is completed on site. Prefabricated sections are sometimes placed using a crane. The modules can be placed side-by-side, end-to-end, or stacked, allowing for a variety of configurations and styles.
After placement, the modules are joined together using inter-module connections, also known as inter-connections. The inter-connections tie the individual modules together toform the overall building structure

AIMS TO MODULAR BUILDING CONSTRUCTION

1. The principle objectives of modular system is to provide practical and coherent solutionsfor coordination of the position and dimensions of elements, components and space in building design.
2. This process can contribute to increase design freedom and improved balance betweenquality and cost in manufacture and construction.

ABSTRACT

The article considers temporary methods of using modular units in construction. The advanced experience in the construction of modular buildings is analyzed. It is emphasized that modular construction has the potential to shorten project design and engineering time, reduce costs and improve construction productivity. The installation of modular buildings is cost-efficient, safe and eco-friendly. Modern modular systems arebased on using not only large elements such as «block rooms» but various small 3D building elements. The analysis result of Russian developments in the construction of modular buildings proves that Russia has great experience in the development of 3D reinforced concrete modules. As the research results the article shows promise for developing of modern modular construction systems in order to provide the population with affordable, comfortable and eco-friendly housing. The paper describes the prospects and relevance of introducing modular prefabricated units not only into low-rise into multi-storey and high-rise construction as well.