

Summer Internships:2024-25(6th Sem)

Aditya Yadav	Slab Construction of G+1 Building, Bilaspur
Robin Kumar	Building construction, CPWD, Bilaspur
Samyak Tamgadge	Oil & Natural Gas Corporation Ltd Ahmedabad
Sourav singh	Bridging the Gap Between Thoery and Practice in construction, Kumar shanu singh and Company, Bilaspur
Churamani sahu	Water Resources and Hydraulic Structures, Kharung water resources , Bilaspur
Katarapu Vinay Kumar	Building construction, CPWD, Bilaspur
Agidi Koushik	Building Construction, CPWD, Bilaspur
Annu Kumari	Industrial Greywater Treatment using Electrochemical Advanced Oxidation Process, IICST, Shibpur, WB
Anshuman	Predicting Pier Scour using Explainable Machine Learning Models, NIT Patna
Antara Deb	Land Preparation for a Residential Colony construction, Yuvraj Buildcon,Bilaspur
Anukriti Bala	Land Preparation for a Residential Colony construction, Yuvraj Buildcon,Bilaspur
Arkeet Roy	Design and Analysis of a RCC Overhead Water, Reservoir using STAAD Pro, S & P Enterprises, Sodebpur , WB
Ayushi Sharaff	Water Resources and Hydraulic Structures, Kharung water resources, Bilaspur
Dasari Himabindhu	Construction and Maintence of Roads, Vishakhapatnam Steel Plant
Gudesh kumar	Upgradation of Bilaspur- Thkahtpur- Mugeli- Pandariya -Pondi Road NH130A, PWD Bilaspur
Himanshu Mishra	Water Resources and Hydraulic Structures , Kharung water resources , Bilaspur
Karan Gangwani	Building Construction, CPWD, Bilaspur
Anitha Kongalla	Architectural AutoCaD, Bhavanams
Manish Kumar	Building Construction, Shri Balaji Constructions, Bilaspur
Manish kumar ratre	Upgradation of Bilaspur- Thkahtpur- Mugeli- Pandariya -Pondi Road NH130A, PWD Bilaspur
MD SAHIL HAQUE	Slab Construction of G+1 Building, Bilaspur
Md Sohail Akram	Road Construction and Maintenance at NH-130, UNO Robotics Bilaspur
Neetika Singh	Varanasi – Gorakhpur 4 Lane Construction (NH-29), Jaiprakash Associates Ltd, Mau
NIKHIL PANDEY	Upgradation of Bilaspur- Thkahtpur- Mugeli- Pandariya -Pondi Road NH130A, PWD Bilaspur
PINKI KUMARI	Optimization of Design Parameters for Electro- Coagulation Unit,IEST, Shib[ur, WB
Piyush Keshri	HGBR, ETR for Modeling shaer Stress distribution in compound channels, Nit Patna

Prakash tiwari	Industrial Greywater Treatment using Electrochemical Advanced Oxidation Process, IICST, Shibpur, WB
PURUSHOTTAM DAS MAHANT	Building construction, CPWD, Bilaspur
Rahul Kumar Singh	Upgradation of Bilaspur- Thakhtpur- Mugeli- Pandariya -Pondi Road NH130A, PWD Bilaspur
Rajesh Kumar	Road Construction and Maintenance at NH-130, UNO Robotics Bilaspur
Rintu Kumar	Discharge Prediction in Rectangular Open Channel Flow using PINN Model, NIT Patna
Rishabh Kumar	Applying theoretical Concepts to Practical construction, Ms Kuar Shanu & company
Rishi Kesh Harsh	Upgradation of Bilaspur- Thakhtpur- Mugeli- Pandariya -Pondi Road NH130A, PWD Bilaspur
Riya Dewangan	An Insight into Field work in road construction, PWD, Rajnandgaon
Samir Kumar	Personal Protective Equipment Detection Model, Uno robotic Bilaspur
SATYAJEET AADIL	construction of Educational and Public Utility Building,PWD, Baloda Bazar
Shinde Chirag Krishana	Study the behaviour of Surface Runoff and Soil Erosion under Controlled Rainfall Events in Rainfall Stimulator, VNIT, Nagpur
Shivam Kumar	Construction of a Guest House, Kumar shanu singh and Company, Bilaspur
Shivam Kumar Singh	Construction of a Guest House, Kumar shanu singh and Company, Bilaspur
Shubham Kumar	Prediction of Scour Depth around Bridge Piers using Machine Learning Models , Nit Patna
Sidharth Kumar	On site Learning and Practices in Infrastructures construction, VVS Real Infra Private Ltd
Sumit Kumar	Optimization of Design Parameters for Electro- Coagulation Unit,IEST, Shibpur, WB
Sumit Ratre	Upgradation of Bilaspur- Thakhtpur- Mugeli- Pandariya -Pondi Road NH130A, PWD Bilaspur
Supriya kumari	Mini Secretariate Commercial Building , PWD
TARUN KUMAR	NH-32 Project, Purliya , DRA infracon Pvt. Ltd
Udit kumar nishad	Road Construction and Maintenance at NH-130, UNO Robotics Bilaspur
Vishal Kumar	Predicting Water Surface Evaluation Compound Channels, NIT , Patna
Vivek Kumar Meena	Upgradation of Rajasthan PWD Mandawar, Rajasthan
Harsh Vardhan Banjare	Civil Construction : Building and Roads, PWD, Dhamtari
Bandaru Saravanthi	REVIT Architecture, Skill Dezire
Sundram	Building Construction, Shri Blaji Constructions, Bilaspur



गुरु घासीदास विश्वविद्यालय, बिलासपुर
केंद्रीय विश्वविद्यालय अधिनियम 2009 संख्या 25, 2009 द्वारा केंद्रीय विश्वविद्यालय
Guru Ghasidas Vishwavidyalaya, Bilaspur
A Central University established by the Central Universities Act 2009 No. 25 of 2009

A COMPREHENSIVE TRAINING REPORT

SLAB CONSTRUCTION OF A G+1 BUILDING AT KUDUDAND, BILASPUR

KANAK CREATION

15TH MAY – 16TH JUNE 2025 (4 WEEKS)

ADITYA YADAV

GGV/21/01001

BATCH : 2022-2026 | SEMESTER - VII

Session 2025-26

Submitted to:

DEPARTMENT OF CIVIL ENGINEERING

School of Studies, Engineering & Technology

GURU GHASIDAS VISHWAVIDYALAYA

Bilaspur (C.G.) 495009

A CENTRAL UNIVERSITY

(Established under the Central Universities Act, 2009 No.25 of 2009).

Accredited with NAAC A⁺⁺

Handwritten notes:
D
Like Submission
[Signature]

CERTIFICATE OF INTERNSHIP

This is to certify that

ADITYA YADAV

Has completed an Internship course in Kanak Creation

Building Work Construction kududand bilaspur

From 15.05.2025 to 16.06.2025

As a civil engineer intern .

We wish him all the best for future.

KANAK CREATION

Proprietary

Company seal

GSTIN: 22EVZPR3692K1Z1

Date : 20.06.2025

Place : Bilaspur CG

ABSTRACT

This internship report presents the experiences and technical knowledge gained during a one-month vocational training program at a construction site managed by Kanak Creation, Bilaspur. The primary focus of the internship was on slab design and execution work for an institutional building. Throughout the training, I was exposed to both theoretical and practical aspects of civil engineering, with specific emphasis on the structural design and construction methodology of reinforced concrete slabs.

Under the supervision of site engineers and structural consultants, I learned about different types of slabs (one-way, two-way, and cantilever), load considerations, detailing of reinforcement as per IS 456:2000, and the application of IS 875 for load combinations. Key activities included reviewing structural drawings, checking formwork, observing bar bending schedules, and witnessing slab casting procedures. Software tools like AutoCAD and STAAD.Pro were also introduced for design visualization and analysis.

This hands-on training not only improved my understanding of slab behavior and structural safety but also gave me valuable insight into site coordination, quality control, and adherence to IS codes. The internship significantly enhanced my practical knowledge, bridging the gap between classroom learning and field application.



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Guru Ghasidas Vishwavidyalaya, Bilaspur
A Central University established by the Central Universities Act 2009 No. 25 of 2009

A COMPREHENSIVE TRAINING REPORT
BUILDING CONSTRUCTION
CENTRAL PUBLIC WORKS DEPARTMENT
Bilaspur (C.G.)
4 Weeks Vocational Training

Robin Kumar
GGV/21/01028
2022-26 & 7th semester
Session 2025-26

DEPARTMENT OF CIVIL ENGINEERING
School of Studies, Engineering & Technology
GURU GHASIDAS VISHWAVIDYALAYA

Bilaspur (C.G.) 495009

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May



भारत सरकार / GOVERNMENT OF INDIA
केंद्रीय लोक निर्माण विभाग / CENTRAL PUBLIC WORKS DEPARTMENT
कार्यालय कार्यपालक अभियंता बिलासपुर
OFFICE OF THE EXECUTIVE ENGINEER, BILASPUK
T-19, RAMA LIFE CITY, BILASPUK(C.G.) PIN - 495003
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टेलिफोन/Tel: 07752299628

बिलासपुर दिनांक 18.07.2025

पत्र क्रमांक 12(04)/दि.ग./2025/1213

कार्यालय आदेश

प्रमाणित किया जाता है कि पत्र क्र. सिविल इंजीनियरिंग विभाग अभियांत्रिकी एवम् प्रौद्योगिकी, अध्ययनशाला गुरु घासीदास विश्वविद्यालय, कोनी, बिलासपुर (छ.ग.) का Reference No. 158/CE/SoS, E&T/GGV/BSP/2025 dated 13.05.2025 व Reference No. 157/CE/SoS, E&T/GGV/BSP/2025 dated 13.05.2025 में वर्णित निम्न छात्रों ने इस कार्यालय के अधीन सम्पादित किये जा रहे निर्माणधीन कार्यों के अन्तर्गत श्री प्रकाश चन्द जैन, सहायक अभियंता (सिविल) के मार्गदर्शन में दिनांक 16.05.2025 से 16.06.2025 तक सफलतापूर्वक प्रशिक्षण प्राप्त किया है। यह कार्यालय इनके उज्जवल भविष्य की कामना करता है।

क्र. सं.	छात्र/छात्रा का नाम	पता	आधार सं.
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2.	श्री करन गंगवानी	परीजात कॉलोनी, नेहरू नगर, बिलासपुर (छ.ग.)	427609441824
3.	श्री एगीडी कौशिक	पुराना बस स्टैंड, उटनुर, अदिलाबाद, राज्य तेलंगाना	508426746147
4.	श्री पुरुषोत्तम	ग्राम कुंजेदावरी, बेलपाली, कोण्डातराई, रायगढ़ (छ.ग.)	346328973112
5.	श्री रोबिन कुमार	ग्राम मंगरार, जिला जमुई, राज्य बिहार	326621063268
6.	श्री विनय	3-90, नन्दीगामा, मंदालाम, गोल्लामुडी, कृष्णा, राज्य आन्ध्रप्रदेश	688547176715

(मनोज रस्तोगी)

कार्यपालक अभियंता-बिलासपुर
के.लो.नि.वि. बिलासपुर (छ.ग.)

प्रतिलिपि:-

- विभागाध्यक्ष, सिविल इंजीनियरिंग विभाग अभियांत्रिकी एवम् प्रौद्योगिकी, अध्ययनशाला गुरु घासीदास विश्वविद्यालय, कोनी, बिलासपुर (छ.ग.)
- सभी संबंधित प्रशिक्षणार्थी।

ABSTRACT

During my internship with the Central Public Works Department (CPWD) at Guru Ghasidas Vishwavidyalaya (GGU), Koni, Bilaspur (C.G.), I was involved in the construction project titled "Construction of Lecture Hall Complex (G+4), Boys Hostel (G+3) 250 seats, Girls Hostel (G+3) 250 seats and site development including all civil and E&M works and horticulture services etc." The work was executed on an Engineering, Procurement, and Construction (EPC) basis by Asian Construction Company, 716-A, Ajmer, Rajasthan. The estimated cost of the project was ₹55.21 crore, which included ₹43.81 crore for civil works, ₹10.99 crore for electrical works, and ₹0.40 crore for horticulture. The project was planned for completion in 21 months with an earnest money deposit of ₹65.21 lakh, a performance guarantee of 3%, and a security deposit of 2.5% of the tendered value. This internship helped me understand the various planning and execution stages in a large-scale public infrastructure project. During the planning phase, the project manager created several key documents to guide the execution. These included a Scope Statement that defined the project's objectives, deliverables, and milestones; a Work Breakdown Schedule (WBS) to divide the project into manageable parts; and a Gantt Chart that visually tracked project timelines. Milestones were identified to ensure smooth progress, and a Communication Plan was established for internal coordination and stakeholder updates. A Risk Management Plan was also in place to identify and prepare for possible risks such as budget constraints or schedule delays.

On site, I witnessed the implementation of several important features aligned with CPWD and National Building Code (NBC) guidelines. These included tactile tiles for accessibility in key locations such as entrances, corridors, and lift lobbies, along with ramps to support inclusive infrastructure. Rainwater harvesting systems with filtration units and recharge pits were installed in all buildings to promote sustainable water use. The lecture halls were designed with acoustic treatments using materials like mineral wool panels and double-glazed windows to improve sound quality. Water treatment units were installed for a safe water supply, adhering to IS 10500 standards. All buildings were equipped with fire safety measures including alarms, extinguishers, emergency exits, and signage. The inclusion of horticulture work also added greenery to the campus, improving the overall environment. This internship gave me practical exposure to technical, safety, and service systems used in public infrastructure and taught me how proper planning ensures successful project execution.



गुरु घासीदास विश्वविद्यालय, बिलासपुर
केंद्रीय विश्वविद्यालय अधिनियम 2009 संख्या 25, 2009 द्वारा केंद्रीय विश्वविद्यालय
Guru Ghasidas Vishwavidyalaya, Bilaspur
A Central University established by the Central Universities Act 2009 No. 25 of 2009

REPORT ON INDUSTRIAL INTERNSHIP AT
OIL & NATURAL GAS CORPORATION LIMITED
AVANI BHAVAN CHANDKHEDA,
AHMEDABAD ASSET



DURATION: 16th May, 2025 to 30th June, 2025.

SUBMITTED BY:
Samyak Tamgadge
GGV/21/01030
7th semester
Batch: 2022-26

SUBMITTED TO:

DEPARTMENT OF CIVIL ENGINEERING
School of Studies, Engineering & Technology
GURU GHASIDAS VISHWAVIDYALAYA
Bilaspur (C.G.) 495009
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DECLARATION

I, **Samyak Tamgadge**, a student of **B.Tech, Civil Engineering Dept., Guru Ghasidas Vishwavidyalaya**, hereby solemnly declare that the report entitled “**Report on Industrial Internship at OIL & NATURAL GAS CORPORATION LIMITED**” is a genuine and original record of the industrial training/internship undertaken at “**OIL & NATURAL GAS CORPORATION LIMITED**” during the period from **16th May, 2025 to 30th June, 2025**.

The work presented in this report is entirely my own and has not been copied, reproduced, or submitted elsewhere for any academic or professional purpose. I affirm that:

- All information and observations recorded were made during my tenure at the above-mentioned organization.
- No part of the report has been plagiarized or duplicated from any other source.
- Proper references and acknowledgments have been made wherever external information has been consulted.

I understand that any violation of this declaration may result in academic or disciplinary action as per the rules and regulations of the institution.

Place: Bilaspur.

Date:

Signature of the Student

Name: Samyak Tamgadge

Enrollment No.: GGV/21/01030.

ACKNOWLEDGEMENT

I sincerely thank my faculty mentor, **Mr. Roshan Singh (DGM Civil)**, for his invaluable guidance and support throughout the course of this industrial training. I am grateful to the entire team at “**OIL & NATURAL GAS CORPORATION**” for their mentorship, cooperation, and the opportunity to gain hands-on experience in the field.

I extend my heartfelt appreciation to our **Hon’ble Dean, Prof. Sharad Chandra Srivastava** the **Head of the Department Prof. M. Chakradhara Rao**, and all concerned faculty members of the Department of Civil Engineering, Guru Ghasidas Vishwavidyalaya, for their continuous encouragement.

Lastly, I am thankful to the **Central Training & Placement Cell** for facilitating and coordinating this training initiative, which has greatly contributed to my professional development.

Place: Bilaspur

Date:

Signature of the Student

Name: Samyak Tamgadge

Enrollment No.: GGV/21/01030.



ONGC Ltd.

Ahmedabad Asset, Navni Bhavan, Chaudheda, Ahmedabad-380 005, Gujarat
LOANS & ADVANCES ESTABLISHMENT-IPAR/TRANING
Phone : 079-2326 6406

No. AMD/HRD/TRG/Cert/2025

Dated: June 30, 2025

Certificate

This is to certify that **Mr. Samyak Pawan Tamgadge** pursuing **B.Tech, Civil Engineering** from **Guru Ghasidas Vishwavidyalaya, Bilaspur**. He has undergone Summer Internship at Oil and Natural Gas Corporation Limited, Ahmedabad Asset, from **May 16, 2025. To June 30, 2025.**

He has successfully completed his training at **Ahmedabad Civil Section, ONGC Ahmedabad Asset.**

During the training he took keen interest in the assigned work. We wish him all success in his academic endeavours and life.

(Suresh N Rathod)
HR Executive
ONGC, AHMEDABAD ASSET

SURESH N RATHOD
HR Executive
ONGC, Ahmedabad

ABSTRACT

The knowledge of any subject is incomplete until it is done practically. Civil Engineering particularly requires a thorough knowledge of practical training for a comprehensive understanding. The progress is certainly based on the discovery of new facts.

The discipline of civil engineering is the oldest and one of the most important areas under investigation. Hence utmost care and importance is given in the training of future engineers in this discipline. The young scientists and field scholars must be appreciated for their training and fieldwork.

This report describes the work carried out by me during 30 days of internship at Avani Bhavan ONGC Chandkheda, Ahmedabad Asset. During this period, I have understood a lot of things related to the building construction and road construction under the department of Civil. This has developed a sense of confidence in me. I perceive this opportunity as a big milestone in my career development. This internship is proved to be a good practical experience and has also enhanced my technical knowledge. A lot of credit goes to my instructors who helped me from the very beginning.

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ONGC at a Glance

ONGC Represents India's Energy Security Through its Pioneering Efforts.

Maharatna ONGC is the largest crude oil and natural gas Company in India, contributing around 71 per cent to Indian domestic production. Crude oil is the raw material used by downstream companies like IOC, BPCL, HPCL and MRPL (The last two are subsidiaries of ONGC) to produce petroleum products like Petrol, Diesel, Kerosene, Naphtha, and Cooking Gas LPG. ONGC has the unique distinction of being a company with in-house service capabilities in all areas of Exploration and Production of oil & gas and related oil-field services. Winner of the Best Employer award, this public sector enterprise has a dedicated team of around 26,000 professionals who toil round the clock in challenging locations.

ONGC Videsh Limited, a Miniratna Schedule “A” Central Public Sector Enterprise (CPSE) of the Government of India under the administrative control of the Ministry of Petroleum & Natural Gas, is the wholly owned subsidiary and overseas arm of Oil and Natural Gas Corporation Limited (ONGC), the flagship national oil company (NOC) of India. The primary business of ONGC Videsh is to prospect for oil and gas acreages outside India, including exploration, development and production of oil and gas. ONGC Videsh owns Participating Interests in 35 oil and gas assets in 15 countries and produced about 30.3% of oil and 23.7% of oil and natural gas in India’s domestic production. In terms of reserves and production, ONGC Videsh is the second-largest petroleum company of India, next only to its parent ONGC.



ONGC subsidiary Mangalore Refinery and Petrochemicals Limited (MRPL) is a schedule 'A' Miniratna, Central Public Sector Enterprise (CPSE) under the Ministry of Petroleum & Natural Gas. The 15.0 MMTPA (Million Metric Ton per annum) Refinery has got a versatile design with complex secondary processing units and a high flexibility to process Crudes of various API, delivering a variety of quality products. MRPL, with its parent company Oil and Natural Gas Corporation Limited (ONGC), owns and operates ONGC Mangalore Petrochemicals Limited (OMPL), a petrochemical unit capable of producing 0.905 MMTPA of Para Xylene and 0.273 MMTPA of Benzene.

ONGC subsidiary HPCL is a Maharatna CPSE. HPCL has the second largest share of product pipelines in India with a pipeline network of more than 3370 km for transportation of petroleum products and a vast marketing network consisting of 14 Zonal offices in major cities and 133 Regional Offices facilitated by a Supply & Distribution infrastructure comprising Terminals, Pipeline networks, Aviation Service Stations, LPG Bottling Plants, Inland Relay Depots & Retail Outlets, Lube and LPG Distributorships. Consistent excellent performance has been made possible by a highly motivated workforce of over 9,500 employees working all over India at its various refining and marketing locations.

The ONGC has been instrumental in transforming the country's limited upstream sector into a large viable playing field, with its activities spread throughout India and significantly in overseas territories. ONGC went offshore in the early 70's and discovered a giant oil field in the form of Bombay High, now known as Mumbai High. This discovery, along with subsequent discoveries of huge oil and gas fields in Western offshore changed the oil scenario of the country. Subsequently, over 5 billion tonnes of hydrocarbons, which were present in the country, were discovered. The most important contribution of ONGC, however, is its self-reliance and development of core competence in E&P activities at a globally competitive level.

Core Activities of ONGC:

1. Exploration and Production (E&P):

Onshore and Offshore Exploration: ONGC is involved in the exploration of hydrocarbon resources both onshore and offshore. This includes geological surveys, seismic studies, and drilling activities to discover new oil and gas reserves.

Production: Once reserves are discovered, ONGC develops these fields to produce crude oil and natural gas. It operates numerous oil and gas fields across India and in international locations.

Onshore Exploration (Key Onshore Fields)

- **Assam:** Major fields include Geleki, Lakwa, and Rudrasagar, known for their rich reserves.
- **Gujarat:** Ankleshwar, Mehsana, and Ahmedabad are prominent onshore fields.
- **Rajasthan:** Focused on the Barmer basin, known for its heavy crude oil.

Technologies Used

- **Horizontal Drilling:** Used to increase contact with the reservoir.
- **Hydraulic Fracturing:** Enhances oil and gas recovery from tight formations.
- **Enhanced Oil Recovery (EOR):** Techniques like polymer flooding and surfactant flooding are employed to maximize extraction.

❖ Offshore Major Exploration

Offshore Fields

- **Mumbai High:** One of the largest offshore oil fields in India.
- **Krishna-Godavari Basin:** Known for its significant gas reserves.

Technologies and Techniques

- **Offshore Drilling Rigs:** Jack-up rigs, semi-submersibles, and drillships for various depths.
- **Subsea Production Systems:** Utilized for deepwater exploration, including subsea manifolds and Christmas trees.
- **Advanced Seismic Imaging:** 3D and 4D seismic surveys for accurate reservoir Mapping.



Fig. 1: ONGC offshore field, Mumbai High.

2. Refining and Processing:

Crude Oil Refining: Although primarily an exploration and production company, ONGC also has stakes in refining operations through its subsidiaries and joint ventures. These refineries process crude oil into various petroleum products like gasoline, diesel, kerosene, and jet fuel.

Natural Gas Processing: ONGC processes natural gas to remove impurities and separate it into components such as methane, ethane, propane, and butane.

3. Distribution and Marketing:

Supply Chain Management: ONGC ensures the transportation of crude oil and natural gas from production sites to refineries and processing plants. This is done via pipelines, tankers, and other logistics solutions.

Marketing: The company markets petroleum products, including natural gas and LPG (Liquefied Petroleum Gas), to domestic and international customers.

4. Research and Development:

Innovation: ONGC invests in research and development to enhance exploration techniques, improve production efficiencies, and develop new technologies. This includes advancements in drilling technologies, seismic imaging, and enhanced oil recovery methods.

Sustainability: R&D efforts also focus on environmental protection, energy efficiency, and sustainable development practices.

5. International Ventures:

Global Presence: ONGC, through its subsidiary ONGC Videsh Limited (OVL), has a significant presence in the international oil and gas sector. OVL operates in multiple countries, acquiring and developing oil and gas assets worldwide.

6. Subsidiaries and Joint Ventures:

Diversified Operations: ONGC operates through several subsidiaries and joint ventures. Notable subsidiaries include Mangalore Refinery and Petrochemicals Limited (MRPL), Hindustan Petroleum Corporation Limited (HPCL), and ONGC Petro Additions Limited (OPaL).

Importance of ONGC:

- **Energy Security:** ONGC plays a critical role in ensuring India's energy security by exploring and developing domestic oil and gas resources, reducing reliance on imports.
- **Economic Contribution:** The company contributes significantly to the Indian economy through revenue generation, job creation, and industrial growth.
- **Technological Leadership:** ONGC is at the forefront of adopting and developing advanced technologies in the oil and gas sector, enhancing operational efficiency and environmental sustainability.

Vision and Mission

Vision

To be a global leader in integrated energy business through sustainable growth, knowledge excellence and exemplary governance practices.

Mission

1. World Class

- Dedicated to excellence by leveraging competitive advantages in R&D and technology with involved people.
- Imbibe high standards of business ethics and organizational values.
- Abiding commitment to safety, health and environment to enrich the quality of community life.
- Foster a culture of trust, openness and mutual concern to make working a stimulating and challenging experience for our people.
- Strive for customer delight through quality products and services.

2. Integrated In Energy Business

- Focus on domestic and international oil and gas exploration and production business opportunities.
- Provide value linkages in other sectors of the energy business.
- Create growth opportunities and maximize shareholder value.

3. Dominant Indian Leadership

- Retain a dominant position in the Indian Petroleum sector and enhance India's energy availability.

4. Carbon Neutrality

- Strive to reduce CO₂ emissions across the activity chain to achieve carbon neutrality

ONGC Ahmedabad Asset

The **ONGC Ahmedabad Asset** is a significant operational area for the Oil and Natural Gas Corporation (ONGC) in India. It spans approximately **6200 square kilometres** and includes over **1200 operational producing wells**. These wells are distributed across 28 Group Gathering Stations (GGS) and various Gas Collection Points (GCPs), Effluent Treatment Plants (ETPs), and Central Tank Farms (CTFs) within a 60 km radius of Ahmedabad city.

The Ahmedabad Asset is crucial for ONGC's onshore operations, contributing significantly to the company's oil production. It also features an extensive pipeline network of nearly **6250 km** for transporting oil. Additionally, ONGC plans to invest over **₹17,000 crore** in its onshore operations in Gujarat over the next five years, including setting up a **10-MW solar power project**.



Fig. 2: ONGC Ahmedabad Asset.

Role of Civil Engineer at ONGC

Civil engineers play a crucial role in various aspects of ONGC's operations. Here are some key areas where their expertise is utilized:

1. Infrastructure Development and Maintenance:

- **Refineries and Depots:** Designing, constructing, and maintaining various structures within refineries and depots, including:
 - o Storage tanks
 - o Process units
 - o Pipelines
 - o Buildings
 - o Roads and drainage systems
 - o Jetties and marine facilities
- **Main objective:** The main objective of an ONGC drill site is to explore and extract oil and natural gas reserves underground.
- **Location:** Drill sites can be located onshore (land) or offshore (ocean).
- **Components:** A typical onshore drill site will consist of the following main components:
 - o **Drilling rig:** This is the tall structure that houses the machinery and equipment used to drill the well.
 - o **Mud pit:** This is a large pit where drilling mud is stored. Drilling mud is a mixture of water, clay, and other additives that is circulated through the drill pipe to cool and lubricate the drill bit, remove cuttings, and maintain pressure in the wellbore.
 - o **Blower and shaker system:** This system removes cuttings (rock fragments) from the drilling mud.
 - o **Storage tanks:** These tanks store various fluids and materials used in the drilling process, such as water, oil, and cement.
 - o **Living quarters:** These provide temporary housing for the crew working at the drill site.

2. Project Management:

- Civil engineers are involved in the entire project lifecycle, from feasibility studies and detailed engineering to construction supervision and commissioning.
- They manage budgets, and timelines, and ensure adherence to safety and quality standards.

3. Geotechnical Engineering:

- Conducting soil investigations and foundation analysis for safe and stable construction of various structures.
- Designing foundations for tanks, buildings, and other critical infrastructure.
- Mitigating potential geotechnical risks like soil erosion and seismic activity.

4. Environmental Management:

- Designing and implementing measures to minimize the environmental impact of ONGC's operations.
- This includes wastewater treatment plants, solid waste management facilities, and air pollution control systems.
- Civil engineers also contribute to environmental compliance and sustainability initiatives.

5. Research and Development:

- Civil engineers may be involved in research and development projects related to:
 - New construction materials and technologies
 - Innovative infrastructure design
 - Sustainable and environmentally friendly solutions

Overall, civil engineers play a vital role in ensuring the safe, efficient, and sustainable operation of ONGC's vast infrastructure network.

The Core departments of Civil Engineering are:

1. Civil Maintenance
2. Projects
3. Engineering Services

The major types of Civil works include the following:

1. Doing maintenance work for existing buildings and structures.
2. Steel structure maintenance (Majorly painting).
3. Building and foundation maintenance.
4. Major maintenance works inside the refinery are Grass cutting and painting.
5. Insulation work done on pipelines to prevent heat loss.

Role of Civil Maintenance Department in ONGC

As the Oil and Gas Industry especially refineries have a large area say 800 to 1000 acres or even more depending upon their Refining capacity...The oil and gas industry requires the Civil Maintenance Department for the upkeep of the plant. The Civil Maintenance Department looks after the maintenance and development works of all the buildings, steel structures, and infrastructure like roads, drains, grassy land, etc. through their contractors as per the pre-approved schedule. The main jobs that can be listed are:

- Preparing estimates for lining up agencies for the execution of day-to-day routine maintenance and one-time development/ construction jobs.
- Tendering for awarding works to Techno-Commercially acceptable bidders.
- Supervise and assure the quality of maintenance and construction jobs executed by contractors.
- Taking measurements and processing periodic Bills for payment.
- Planning and keeping records of Budget requirements and expenditures.
- Following jobs like Painting Buildings and steel structures within the plant, re-carpeting roads, removing wild vegetation from unpaved areas, doing hard surfacing, construction of shutdown sheds, and office buildings, renovating of old buildings, etc.
- Shutdown activities like Insulation/ refractory/ Painting, etc.
- Follow the work permit system and Imparting Toolbox talk/ Training for the vocational trainees and contract labourers to ensure safety at the workplace.

License with Production, finance, HR, design, and other departments for smooth execution of operation and maintenance activities.

General Works Observed at Fields of ONGC

1. Celler Pits in ONGC Drilling Operations:

A Celler pit is a shallow, box-type excavation made at the drilling site of an oil or gas well. It serves as a foundation for the wellhead and facilitates safe and effective drilling operations.

Purpose of Celler Pit:

- **Supports Wellhead Installation:** Acts as a base for wellhead equipment like the casing head, blowout preventers (BOP), etc.
- **Provides Working Space:** Offers a secure space for rig crew to work under the drilling floor.
- **Protects Surface Equipment:** Shields crucial components from weather, external forces, and rig vibrations.
- **Prevents Surface Spills:** Helps contain and drain small quantities of drilling fluids or leaked hydrocarbons.
- **Ensures Safety:** Essential during well control operations like blowout prevention.

Construction Details (ONGC Standards):

- **Size & Shape:** Typically square or rectangular, 2–3 meters deep.
- **Reinforcement:** Sides may be lined with concrete, HDPE sheets, or brickwork to prevent soil erosion and fluid seepage.
- **Waterproofing:** HDPE lining is often used to prevent groundwater contamination.
- **Access:** Steps or ladders are provided for safe entry.
- **Drainage System:** A small sump or pump is sometimes installed to remove collected fluids.

Environmental Practices (ONGC):

ONGC follows MoEFCC (Ministry of Environment, Forest and Climate Change) and CPCB (Central Pollution Control Board) guidelines. Key practices include:

- **HDPE lining of pits** to avoid seepage.
- **Proper disposal** of pit contents post-drilling (dewatering and bioremediation).
- **Monitoring groundwater** near drilling sites.
- **Fencing** around the celler pit for safety.

If Celler Pit is Not Properly Managed:

- **Soil Contamination:** Leakage of oil-based mud or chemicals.
- **Groundwater Pollution:** Seepage into aquifers.
- **Occupational Hazards:** Slips, falls, or gas exposure.
- **Regulatory Violations:** Non-compliance with environmental norms can lead to legal actions and shutdowns.

CELLER PIT



Fig. 3: Celler Pit.

2. Drilling Rigs Used by ONGC

Overview

ONGC (Oil and Natural Gas Corporation) operates one of the largest fleets of drilling rigs in India to explore and produce oil and gas from onshore and offshore fields. These rigs are crucial in drilling exploratory, development, and workover wells.

Types of Drilling Rigs Used by ONGC

1. Land Rigs (Onshore)

- **Purpose:** Used for drilling in onshore locations like Gujarat, Assam, Andhra Pradesh, Rajasthan, etc.
- **Features:**
 - Mounted on trailers or skids for mobility.
 - Vary in horsepower (HP) from **350 HP to 2000+ HP**.
 - Equipped with **top drives or rotary tables**, **mud circulation systems**, and **BOP stacks**.
- **Automation:** Some modern rigs include **cyber control cabins** and **pipe-handling systems**.

2. Offshore Rigs

These are divided into two main types:

a. Jack-Up Rigs

- Used in shallow waters (up to ~120 meters depth).
- Self-elevating platforms with legs that rest on the seabed.
- Examples: ONGC has operated rigs like Sagar Vijay, Sagar Bhushan.

b. Semi-Submersible Rigs

- Float on water, partially submerged for stability.
- Used in deep water drilling (up to 1500 meters or more).
- More stable in rough seas than jack-up rigs.

c. Drillships (Used via partners)

- Advanced floating rigs used in ultra-deep water drilling (up to 3000 meters).
- ONGC charts such rigs from international service providers for operations in the Krishna-Godavari Basin and Arabian Sea.

Rig Specifications (Typical Examples)

Type	Depth Capability	Horsepower	Application Area
Onshore Land Rig	Up to 6000 meters	1000–2000 HP	Rajasthan, Assam, etc.
Jack-Up Rig	Up to 9000 meters (TD)	-	Western Offshore Basin
Semi-Submersible	Up to 7500 meters (TD)	-	Eastern Offshore, KG

(TD = Total Depth)

Technologies in ONGC Rigs

- Directional & Horizontal Drilling
- Measurement While Drilling (MWD)
- Managed Pressure Drilling (MPD)
- Real-Time Data Monitoring
- Blowout Preventer (BOP) Systems for well control
- Rig Automation & Safety Systems in new-generation rigs

Maintenance and Operations

- ONGC has Rig Maintenance Bases (RMBs) across India for servicing rigs.
- Follow strict HSE (Health, Safety, Environment) protocols.
- Rigs are often supported by mud plants, cementing units, logistics bases, and crew camps.

Strategic Partnerships

- For deepwater and ultra-deepwater projects, ONGC collaborates with international drilling contractors like Transocean, Seadrill, etc.
- Uses leased rigs for flexibility and advanced capabilities.

DRILLING RIG



Fig. 4: Drilling Rig.

3. Water Tanks Constructed by ONGC

Purpose of Water Tanks in Drilling Operations

In ONGC's oil and gas drilling projects, **water tanks** are essential infrastructure components used for:

- Storing water required during drilling (e.g. for mud preparation, cementing).
- Supporting firefighting systems and other utilities.
- Managing water for well flushing, cooling equipment, and sanitation at site.

Types of Water Tanks Used

1. Raw Water Storage Tanks

- Stores fresh or treated water brought to site.
- Used for mud preparation, rig washing, and cooling systems.

2. Mud Mixing Tanks

- Used to mix water with bentonite/barite and other chemicals to form drilling mud.
- Typically made of steel or RCC with agitators and baffles.

3. Fire Water Tanks

- Dedicated tanks constructed to supply water to fire suppression systems.
- Built as overhead or underground RCC tanks as per OISD (Oil Industry Safety Directorate) norms.

4. Effluent/Drain Water Collection Tanks

- Collects wastewater, rig wash, and stormwater runoff from the site.
- Must be lined (HDPE/concrete) to avoid soil or groundwater contamination.

Civil Engineering Design Parameters

Feature	Specification
Material	RCC, steel, or HDPE-lined earthen tanks
Capacity	Ranges from 50 m ³ to 500 m ³ , depending on rig water needs
Shape	Rectangular or cylindrical
Foundation	Reinforced concrete pad with anti-settlement provision
Waterproofing	HDPE lining or cementitious waterproofing
Drainage	Sloped base with sump and outlet pipe
Access	Manholes, steel ladders, level indicators
Safety	Proper fencing, warning signs, overflow pipes

Location and Layout Considerations

- Tanks are built near the rig site but outside the blast zone.
- Must be located at a higher elevation than the mud pump suction line for gravity flow if

applicable.

- Civil engineers must account for soil bearing capacity, wind load, and seismic zone classification.

Environmental Compliance

ONGC ensures that water tanks comply with:

- CPCB (Central Pollution Control Board) norms.
- OISD standards for oil industry safety.
- Zero Discharge practices in sensitive areas (e.g. KG basin, offshore setups).
- Lined embankments for earthen tanks to prevent seepage.

Maintenance Aspects

- Periodic desilting, inspection of lining, and leak checks.
- Chlorination or chemical dosing if water is stored for long periods.
- Painting and coating (for steel tanks) to prevent corrosion.

WATER TANK



Fig. 5: Water Tank.

4. Cutting Pits Constructed by ONGC

A **cutting pit** is an engineered earthen or lined excavation constructed at a drilling site to **collect and store drill cuttings** and **residual mud** generated during the drilling of oil and gas wells. These cuttings are rock fragments and mud residues returned to the surface along with drilling fluid.

Purpose of Cutting Pits in Drilling

- **Collection of Drill Cuttings:** Acts as a containment area for the solids separated from the drilling fluid.
- **Waste Management:** Temporary storage before safe disposal, solidification, or bioremediation.
- **Environmental Control:** Prevents spillage and seepage of oily waste into soil and water bodies.
- **Facilitates Dewatering:** Allows water to separate from solids for reuse or treatment.

Civil Engineering Design Features

Design Parameter	Specification
Material	HDPE-lined or RCC-lined earthen excavation
Typical Size	Varies by site, usually 10 m × 5 m × 2–3 m deep
Capacity	~75–150 m ³ depending on the well depth and drilling program
Base Preparation	Compacted soil with a graded slope for dewatering
Lining	1.5 mm thick HDPE geomembrane with proper anchoring
Drainage	Sloped bottom with sump pits and dewatering pump systems
Bunds	Raised embankments (~1 m) to prevent overflow
Access & Safety	Guardrails, warning signage, and access ladders or ramps

Construction Process (Step-by-Step)

Site Selection:

- Chosen near the shale shaker or solids control unit.
- At least 15–20 m away from the well center and outside the rig's danger zone.

Excavation:

- Performed using JCBs or backhoe loaders.
- Base is leveled and compacted.

Lining:

- HDPE liners are welded on-site and tested for leaks.
- RCC-lined pits are plastered and water-tested.

Bund Construction:

- Soil from excavation is used to form bunds on all sides.
- Bunds are compacted and sometimes stone-pitched or turf-lined for stability.

Water Separation Area:

- One end may be sectioned with a perforated partition for settling solids.

Environmental and Safety Measures

- HDPE lining is essential to prevent leaching of contaminants into the soil or groundwater.
- Regular monitoring of liner integrity and leak detection systems is implemented.
- Effluent Treatment or Bioremediation is done post drilling before pit closure.
- Compliance with:
 - o CPCB Guidelines
 - o EIA norms
 - o OISD (Oil Industry Safety Directorate) standards

Disposal and Post-Use Management

After well completion:

- Solids are either solidified and buried, transported to TSDF (Treatment, Storage, and Disposal Facility), or bioremediated on-site.
- Pits are cleaned, backfilled with soil, compacted, and vegetated to restore land.

Engineering Challenges

- Liner damage from heavy equipment.
- Ensuring bund stability in monsoon-prone areas.
- Managing high volumes of cuttings in deep wells or when using OBM (Oil-Based Mud).

CUTTING PIT UNDER CONSTRUCTION



Fig. 6: Cutting Pit Under Construction.

5. Beam Pump Unit (Pumpjack) by ONGC

A Beam Pump Unit is a surface mechanical device used to lift crude oil from wells where the reservoir pressure is insufficient to push oil to the surface naturally. It is commonly used in mature onshore oil fields operated by ONGC, such as in Gujarat, Assam, and Andhra Pradesh.

Also known as:

- **Pumpjack**
- **Horsehead Pump**
- **Nodding Donkey**

Purpose in Drilling & Production

- Artificial lift system to extract oil from low-pressure reservoirs.
- Operates via reciprocating motion that drives a downhole pump through a sucker rod.
- Typically installed after drilling and completion of the well.

Components of a Beam Pump Unit (Surface)

Component	Description
Walking Beam	Oscillates up and down, transferring motion to the sucker rod.
Samson Post & Saddle Bearing	Vertical support for the walking beam.
Crank & Counterweights	Attached to a rotating shaft to balance load and reduce motor effort.
Pitman Arm	Connects crank to walking beam.
Prime Mover (Motor)	Electric or gas engine that powers the crank.
Gearbox	Converts rotary motion into reciprocating motion.

Civil Engineering Considerations for Beam Pump Installation

Foundation Design

- Reinforced Cement Concrete (RCC) foundation is essential due to dynamic loading.
- Dimensions depend on the pump size (typically 4×4 m to 6×6 m).
- Includes:
 - Base slab (150–300 mm thick).
 - Anchor bolts embedded to secure the unit.
 - Designed for vibration damping and load transfer.

Site Preparation

- Site must be leveled, compacted, and graded to avoid water logging.
- Access roads, drainage ditches, and equipment clearances must be provided.
- Fencing and lighting for security and safety.

Drainage and Spill Control

- Oil spillage containment is critical.
- Often surrounded by an impervious bund wall with HDPE lining.

- Oil collection sump or interceptor pit is constructed nearby.

Environmental Protection

- Located away from water bodies and residential zones.
- Noise-reduction panels or fencing in sensitive areas.
- Must meet CPCB & MoEFCC norms for pollution and land restoration.

Load & Vibration Analysis

Civil engineers assess:

- Dynamic vertical and lateral forces from the beam motion.
- Long-term settlement of soil under cyclic loading.
- Need for soil improvement if bearing capacity is low.

Utilities and Supporting Infrastructure

- Electrical cabling trenches or generator sheds.
- Control room platform or PLC enclosure if automation is used.
- Access platform or ladder for maintenance crews.

Post-Installation Maintenance

- Foundation cracks are monitored over time.
- Corrosion protection via painting and cathodic protection if in coastal/saline zones.
- Periodic re-tightening of anchor bolts due to machine vibration.

BEAM PUMP UNIT (PUMPJACK)



Fig. 7: Beam Pump Unit (Pumpjack)

Conclusion

During my training period, I focused on understanding the practical application of various methodologies and learned how to effectively solve on-site problems. Through this experience, I reached several important conclusions.

There are significant differences between theoretical knowledge and practical execution in construction processes. Theoretical knowledge alone is not enough to start tasks on-site. Ensuring high-quality construction work was a top priority, alongside timely completion. To maintain quality, various checks were implemented at each step of the construction process. Factors such as climatic conditions, manpower, resource availability, and construction methods played a crucial role in optimizing project completion. Safety measures were always taken to prevent injuries and accidents on site.

During my 40-day training period, the mentors and site staff were incredibly supportive. They provided me with all the information I needed and answered any questions I had. Their guidance was invaluable, and I am deeply grateful to the ONGC Ahmedabad Asset for giving me this opportunity to learn and grow.

Overall, the internship program has laid a solid foundation for my professional journey. The skills and knowledge I gained during this internship will undoubtedly serve me well in the future. It is evident that scaling up this practice and replicating it in other disciplines would be highly beneficial, providing similar opportunities for growth and development across various fields.

My training period has been an enriching and transformative experience. The practical knowledge I acquired, combined with the theoretical foundation I already possessed, has prepared me well for the challenges ahead. I look forward to applying these lessons in my future career and continuing to contribute positively to the industry and society as a whole.

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गुरु घासीदास विश्वविद्यालय, बिलासपुर
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Guru Ghasidas Vishwavidyalaya, Bilaspur
A Central University established by the Central Universities Act 2009 No. 25 of 2009

A COMPREHENSIVE TRAINING REPORT

On

"Bridging The Gap Between Theory And Practice In Construction"

M/s. Kumar Shanu Singh & Company
(1st June 2025 – 30th June 2025)

Sourav Singh

GGV/21/01038

Of

VIIth Semester, Civil Engineering

Session 2025-26

Submitted to:

DEPARTMENT OF CIVIL ENGINEERING

School of Studies, Engineering & Technology

GURU GHASIDAS VISHWAVIDYALAYA

Bilaspur (C.G.) 495009

A CENTRAL UNIVERSITY

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A Complete Solution of Mining Development & Civil Engineering works

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KSS/BUH/CERTIFICATE/2025/36

Date. 30/06/2025

CERTIFICATE

This is to certify that Sourav Singh (B.Tech Civil), studying in VI semester in Branch Civil Engineering of Institute - Guru Ghasidas Vishwavidyalaya, Bilaspur has successfully and satisfactorily completed training in JMS MINING PVT. LTD Guest House Gohandra, VILLAGE BHASKHALA, KOTMA, DIST. ANUPPUR (M.P.) from 01.06.2025 to 30.06.2025. (30 Days)

Kumar Shanu Singh And Company

M/s Kumar Shanu Singh & Co.

Director

Partner

ABSTRACT

As a part of the Bachelor of Technology (B.Tech) curriculum in Civil Engineering, I completed a one-month internship at *M/s. Kumar Shanu Singh & Company*, under the supervision of *JMS Mining Pvt. Ltd.* at Bhaskhala, Kotma, District Anuppur (M.P.). The internship provided valuable hands-on exposure to civil construction activities, particularly focusing on the early-stage development of a G+2 residential structure with a floor area of 17,000 sq. ft. per level. Major activities observed included excavation up to a depth of 1.8 meters, shuttering setup, and reinforcement detailing for footings and columns. The experience allowed me to apply theoretical concepts in a practical setting, understand real-world challenges in fieldwork, and observe how technical tasks are executed with precision and safety. I also gained exposure to construction equipment, material management, and site supervision practices. This internship enhanced my technical competence and professional confidence, preparing me for a future career in construction and site engineering.

Keywords: Civil Engineering, Internship, Excavation, Shuttering, Reinforcement, Construction Site, G+2 Building, Foundation, Field Training, Practical Experience



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A COMPREHENSIVE TRAINING REPORT

WATER RESOURCES AND HYDRAULIC STRUCTURES

KHARUNG WATER RESOURCES DIVISION, BILASPUR

4 weeks vocational training

Churamani Sahu

(GGV/21/01044)

2022-26 & 7th semester

Session 2025-26

Submitted to:

Department of Civil Engineering

DEPARTMENT OF CIVIL ENGINEERING

School of Studies, Engineering & Technology

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DECLARATION

I, Churamani Sahu, a student of **B. Tech, Department of Civil Engineering, School of Studies in Engineering and Technology, Guru Ghasidas Vishwavidyalaya, Bilaspur**, hereby solemnly declare that the report entitled “**WATER RESOURCES AND HYDRAULIC STRUCTURES**” is a genuine and original record of the industrial training/internship undertaken at **Kharung Water Resources Division, Bilaspur** during the period from **2 June 2025 to 30 June 2025**.

The work presented in this report is entirely my own and has not been copied, reproduced, or submitted elsewhere for any academic or professional purpose. I affirm that:

- All information and observations recorded were made during my tenure at the above-mentioned organization.
- No part of the report has been plagiarized or duplicated from any other source.
- Proper references and acknowledgments have been made wherever external information has been consulted.

I understand that any violation of this declaration may result in academic or disciplinary action as per the rules and regulations of the institution.

Place: Bilaspur

Date: 31/07/2025

Signature of the Student

Name: Churamani Sahu

Enrollment No.: GGV/21/01044

ACKNOWLEDGEMENT

I sincerely thank my faculty mentor, **Er. U. Ganguly**, for her invaluable guidance and support throughout the course of this industrial training. I am grateful to the entire team at **Kharung Water Resources Division** for their mentorship, cooperation, and the opportunity to gain hands-on experience in the field.

I extend my heartfelt appreciation to our **Hon'ble Dean, Prof. Sharad Chandra Srivastava** the **Head of the Department Prof. M. Chakradhara Rao**, and all concerned faculty members of the Department of Civil Engineering, Guru Ghasidas Vishwavidyalaya, for their continuous encouragement.

Lastly, I am thankful to the **Central Training & Placement Cell** for facilitating and coordinating this training initiative, which has greatly contributed to my professional development.

Place: Bilaspur

Date: 31/07/2025

Signature of the Student

Name: Churamani Sahu

Enrollment No.: GGV/21/01044

CERTIFICATE



ABSTRACT

The four week internship at water resources department (WRD) Bilaspur, as a part of Academic work was a good experience. The water resources department (WRD) is the government agency responsible for managing and developing water resources in a region or state. It oversees the planning, development and management of water resources, including irrigation, drinking water supply and flood control.

WRD promotes water conservation and efficient use of water resources through various initiative and programs.

During the internship at WRD, there was classroom learning as well as site visits as part of internship. In classroom learning, there were knowledge about different kinds of schemes in water resources department like minor irrigation scheme medium irrigation scheme and major irrigation scheme, types of schemes under water resources department of Chhattisgarh, Norms for topographical surveys, knowing about small dams and their structure, learning about the canal systems, different types of cross drainage works, level crossings etc.

Sites like Shivghat Barrage and Lagra Anicut were visited as a part of training. There were different field knowledge related to civil engineering and whatever studied in classroom were explained.

Major learning outcomes during site visits are teamwork, cooperation, field knowledge, practical knowledge of knowing the building of canal, etc.

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CHAPTER 1

INTRODUCTION

1.1. Purpose of training

The purpose of training in the Water Resources Department is multifaceted, means having many different aspects or features. Essentially, it's aimed at boosting capacity and performance of water professionals, ensuring they have the necessary skills and knowledge to tackle water-related challenges. This includes:

- Water management techniques, like participatory watershed management and sustainable water use practices.
- Knowledge about small dams and their structure.
- Theoretical knowledge on norms for topographical surveys.
- Types of Scheme under Chhattisgarh Water Resources Department.

The ultimate goal is to enhance water governance and improve water resource management, which is critical for economic development, social welfare, and environmental sustainability.

1.2. Company overview

The Water Resources Department (WRD) of Chhattisgarh, including the Bilaspur division, focuses on the integrated and optimal development of surface and groundwater resources within the state. Its responsibilities encompass assessment of water resources, policy formulation, and the construction and maintenance of irrigation projects. The department also works on flood control, quality control of construction materials, and maintaining irrigation system functionality.

Key Functions and Responsibilities:

1. **Project Development and Management:** This includes the construction, operation, and maintenance of major, medium, and minor irrigation projects, as well as lift and tube-well schemes.
2. **Flood Control:** The department is involved in designing and constructing flood control projects to mitigate flood damage.
3. **Quality Control:** They ensure the quality of construction materials used in water resource projects through quality control and testing.

4. Hydrological Data Management: The WRD collects and updates hydrological data, which is crucial for planning and managing water resources effectively.
5. Irrigation System Functionality: They maintain and review the performance of irrigation systems to improve their efficiency and effectiveness.
6. Interstate River Water Sharing: The department also protects the state's rights in sharing water from inter-state rivers.

Bilaspur Division Specifics:

1. Irrigation Potential: The WRD in Bilaspur works to enhance the irrigation potential of the region.
2. Geomorphology and Drainage: The Bilaspur district has various geomorphological features, including structural plains, pediment/Pedi plain, and floodplains, with the Arpa River and Mahanadi River and its tributaries playing a significant role in the drainage pattern, according to the Central Ground Water Board.
3. Aquifers: The area has various aquifer systems, including phreatic and fractured aquifers, with varying yields from different rock formations like shale, limestone, and granite.
4. Groundwater Use: A significant portion of the cultivated area in Bilaspur is irrigated through groundwater, highlighting the importance of groundwater management in the region.

1.3. Organizational structure

The Water Resources Department in Bilaspur, Chhattisgarh, is part of the larger Chhattisgarh Water Resources Department (CGWRD), which has a hierarchical structure. At the top is the Engineer-in-Chief, followed by Chief Engineers overseeing different basins (like the Hasdeo Basin), then Superintending Engineers of Circles, and finally Executive Engineers of Divisions. The department is responsible for the integrated and optimum development of both surface and groundwater resources in the state.

1.4. Training objectives

1. To Understand the practical applications of water resource management and the department's role in the region.
2. Knowledge of water resource management, project execution, and the department's operational procedures.

3. Developing Professional Skills like technical skills, teamwork, cooperation and developing the ability to identify and solve problems related to water resource management.

1.5. Duration and Location

1. Classroom lectures at Kharung Water Resource Department, Bilaspur.
2. Site-1, Shivghat Barrage on Arpa river, Bilaspur, Near Seepath Chauk.
3. Site-2, Langra Anicut, The Kharung River, a tributary to Shivrath River, is in the western part of Bilaspur district.

CHAPTER 2

WATER REQUIREMENT OF CROPS

2.1. General

WEIR: A weir is basically an obstruction in the flow path of an open channel. The weir will cause an increase in water depth as the water flows over the weir. In general the flow rate, the greater will be the increase in depth of flow. The height of water above the top of the weir is the measurement usually used to correlate with flow rate.

DAM: Dams are massive barriers hydraulic structures built across river and streams to confine and store water on upstream side reservoir and utilize the flow of water for multipurpose.

CHECK DAMS: They are small structure designed to control erosion, improve groundwater recharge and reduce water velocity.

STOP DAMS: these are small masonry structure used for water harvesting and irrigation particularly in areas with limited water resources.

ANICUT: A type of masonry check dam constructed across a stream in India, primarily for irrigation purpose. It is used to control the flow of water allowing it to divert or stored for irrigation, drinking water or even to recharge groundwater.

The **Kalani Dam** (Grand Anicut) on the Kaveri River is a famous example of an ancient and still functioning anicut.

- Minor Irrigation Schemes – Area < 2000 hectares.
- Medium Irrigation Schemes – Area 2000 hectares to 10000 hectares.
- Major Irrigation Schemes – Area > 10000 hectares.

2.2. Crop Period and Base Period

1. **CROP PERIOD:** The time period from the instant of crops sowing to the instant of its harvesting is called crop period.
2. **BASE PERIOD:** The time between first watering of the crop at the time of sowing to the instant of last watering before harvesting.

- Crop period is slightly more than the base period but for all practical purpose they are taken as same and generally expressed in days.

2.3. Relation Between Delta (Δ) Duty (D) and Base Period (B)

DELTA (Δ): Each crop requires a certain amount of water after a certain fixed interval of time through its period of growth. The depth of water required every time depends upon the type of crop. If these depths of water are required five times during the Base period. Then the total water required by the crop for its full growth will be $5 \times$ each time depth. The final figure will be representing the total quantity of water required by the crop for its full growth. These may be expressed in hectares meter Or in million cubic meter or simply as depth to which water would stand on the irrigated area to stand above the surface without percolating or evaporation. This depth of water (in cms) Required by a crop to come to maturity each coldest delta (Δ).

Problem: The rice requires about 10cm depth of water at an average interval of 10 days and crop period for rice is 120 days. Find out delta (Δ) for rice.

Ans: Given, Crop period = 120 days

Watering interval = 10 days

Depth of Water = 10 cm

Number of watering = $\frac{120}{10} = 12 \text{ days}$

Total depth of water required = Number of watering $\times$ depth of water
 $= 12 \times 10 = 120 \text{ cms}$

DUTY (D): The duty of water in the relationship between the Volume of water and the area of crop it matures. This volume of water is generally expressed in the Yoni discharge flowing from a time equal to the base period of the crop is called as Base of Duty.

If water flowing at a rate of 1 cubic meter per second runs continuously for B days and matures, say for example 200 hectares then the duty of water for the particular crop will be defined as 200 hectares per cumec to the base period of B days.

Hence, duty is defined as the area irrigated per cumec of discharge running for base period, the duty is generally represented by the letter D.

Let there be a crop of base period B days, Now let 1 cumec of water be applied to this crop in the field for B days now the volume of water applied to the crop during B days.

$$\text{Volume} = 1 \times B \times 24 \times 60 \times 60 = 86400B \text{ m}^3$$

By definition of Duty (D), 1 m³ Supplied for B days matures D hectares of land or 10⁴ m² of land.

$$\text{The depth of water supplied to this land} = \frac{\text{Volume}}{\text{Area}} = \frac{86400 B}{10000 D} \text{ m}$$

$$\Delta = \frac{8.64 B}{D} \text{ m}$$

By definition, Total depth of water is called delta (Δ)

$$\Delta = \frac{8.64 B}{D} \text{ m} = \frac{864 B}{D} \text{ cm}$$

Here, Δ in cms, B in days, and D in hectares/cumec.

2.3. Command Areas

1. **CATCHMENT AREA:** A catchment area also referred to as a watershed. It is an area that is topographically bounded, where all the precipitation collects it and drains off through a common outlet which could be a river, bay or other body of water.
2. **COMMAND AREA:** The area over which canal irrigated water flows by gravity is known as command area.
3. **GROSS COMMAND AREA (GCA):** It is the total area which can be physically irrigated from a scheme without considering the limitations of the quantity of water available.
4. **CULTURABLE COMMAND AREA (CCA):** It is the gross area minus the area of uncultivated land (including habitation area, pond, lakes) which is unfit for cultivation, Pastures and fallow lands. Which can be made cultivate world all included in this area but uncultivable populated areas including ponds reserved forests used lakes roads etc are excluded.

2.4. Irrigation Intensity

1. **INTENSITY OF IRRIGATION:** The sum of total of area irrigated under different crops in a year expressed in percentage of the CCA is called intensity of irrigation.

The intensity of irrigation of a particular land can be defined based on a particular season or annually.

The percentage of CCA which may be irrigated annually is called annual intensity of irrigation. This may include the irrigation of two or more crops during one year.

$$\text{Annual Intensity of Irrigation} = \frac{\text{Gross Irrigated Area}}{\text{CCA}}$$

$GIA = (\text{Total area irrigated once in a year}) + (\text{Area irrigated more than once in a year})$

2. **NET IRRIGATED AREA:** This is the area irrigated during a year counting the area only once even if two or more crops are irrigated on the same land.
3. **GROSS IRRIGATED AREA:** This is the total area irrigated under various crop during a year counting the area irrigated under more than one crop during the same year of many times as the number of crops grown.
4. **INTENSITY OF IRRIGATED CROPPING:** The ratio of difference of gross irrigation and net irrigated area to the gross irrigated area expressed as a percentage of is cold intensity of irrigated cropping.

CHAPTER 3

SHIVGHAT BARRAGE

3.1. General

In diversion schemes, water is directly drawn from the river or stream flow. This type of work is feasible when the normal flow of the river throughout the period of the growth of the crop proposed to be irrigated is never less than the requirements of irrigating the crop during the period of its growth. These consist of a weir or a barrage across the river stream with canal either on both sides or on any one side.

3.2. Components of Barrage

1. Weir or Barrage (gated or ungated)
2. Divide wall
3. Abutment wall
4. Wing walls
5. Returns
6. Scouring sluices
7. Friction Blocks
8. Stilling Basin
9. End Sill
10. Afflux Bund
11. CC Blocks
12. Toe Wall
13. Canal lining
14. Shalting Plate
15. Diaphragm Wall
16. Weep Holes

WEIR: A weir is a raised concrete (or masonry) crest wall constructed across the river width. It may be provided with a small shutter on its top. Most of the raising water (ponding) is done by solid wall and very little by shutters.

BARRAGE: If ponding of water is achieved by shutters or gates then it is called barrage. It has low crest wall with high gate.

DIVIDE WALL: The divide wall is masonry or a concrete wall constructed at right angle to the axis of the weir and separates the weir proper from the under sluices. It extends from beyond the end of the head regulator on u/s side to loose protection of the under sluice on d/s side.

ABUTMENT WALL: An abutment is the substructure at the ends of a bridge span or dam supporting its superstructure.

WING WALL: A wing wall is a smaller wall attached or next to a larger wall or structure. In a bridge, the wing walls are adjacent to the abutments and act as retaining walls. They are generally constructed of the same material as those of abutments. The wing walls can either be attached to the abutment or be independent of it. Wing walls are provided at both ends of the abutments to retain the earth filling of the approaches.

RETURN WALL: A return wall is provided at the endpoint of a culvert perpendicular to the culvert direction. This wall was built parallel to the centre line of a road and in continuation of an abutment or wing, to retain the embankment.

SCOURING SLUICES: The Under-Sluices are the openings which are fully controlled by gates, provided in weir wall with their crest at a low level. They are located on the same side as the off-taking canal. Under sluices are also called scouring sluices because they help in removing the silt near the head regulators.

FRICTION BLOCKS: These blocks are arranged in staggered position. Due to staggering the high velocity flow is diverted laterally. Thus, the water which flows in lateral direction obstructs the high velocity flow in the forward direction. As a result, energy of flow is dissipated.

STILLING BASIN: A stilling basins are transition structures constructed to dissipate excess energy confined by high velocity flow at the outlet of conduit or tunnel so that the flow beyond the basin does not endanger the stability of bed and banks of downstream channel.

ENDSILL: A vertical stepped, sloped or dentated wall, constructed at the downstream end of a stilling basin to help in dissipating residual energy and to reduce the length of the stilling basin.

AFFLUX BUND: An embankment or dyke designed to ensure that the structure is not outflanked during flood flows. In some cases, it also acts as an embankment to prevent flooding to the country side due to an afflux.

CC BLOCKS: These are of size 1.5 m×1.5 m×0.3 m. The CC blocks are concrete cement blocks they are performing functions like load bearing, partitioning, enclosure helps to regulate building temperature, help to reduce noise transmissions.

TOE WALL: It is the type of retaining wall in constructed at the base of slope its depth is 2.6 M it is used for erosion control and soil stability prevented landslide.

CANAL LINING: They are made in block to reduce seepage pressure.

SHALTERING PLATE: These are there to distribute impact forces and absorb it. It is used for casting various structures such as beam column wall etc. It is used to reduce honeycomb restructure we should use vibrator to distribute or settle concrete properly.

DIAPRAGAM WALL: It is the type of retaining wall under the foundation constructed using trench excavation method. It transfers load to deeper, more stable soil.

WEEP HOLE: We Falls are small opening on construction elements like walls and foundation designed to allow water to drain away preventing damage and moisture buildup they are used for pressure reduction and ventilation.

3.3. Project Details

Arpa River is the lifeline of Bilaspur City and district in Chhattisgarh. It is a major tributary of the river Shivnath that meets with Mahanadi. Arpa River originates from Khodri village of Pendraroad Gaurella block District GPM, (so many believe that, River Arpa originates from Village Amarapur near PENDRA) and flows to meet with Shivnath River at Matiyari village of Bilha block of Bilaspur district.

LOCATION: Shivghat is situated on the banks of the Arpa River, a tributary of the Mahanadi River. It is besides the Mahamaya chowk of Bilaspur district.

HYDROLOGY: The catchment area of the barrage is 1998 sqkm. The maximum flood level of river observed is 262.5 m.

TOPOGRAPHICAL FEATURES: The river is straight at the proposed site having a river bed level of 257.80 m, pond level of 261.30 m with a water depth of 3.50 m.

THE PROPOSAL: It is proposed to construct a barrage of length 334 m with a weir height of 0.6 m with an estimated cost of 50 Cr. The barrage has 20 barrage gates of 12x2.90 m and 4 under sluice gates of 12m×3.50 m.

MAIN BODY: This 334 m long barrage has 23 piers including 2 divide walls, and abutment on both ends. The piers and abutments are constructed with M20 Grade of concrete. The abutment walls have Weep holes so as to pass the excess pore water from the soil filling around abutment walls. The slab is casted out of M25 Grade of concrete with the dimensions of 14×7.5×.93 m.

DOWNSTREAM PROTECTION: As the stored water, when released, carry huge amount of energy which can scour the downstream bed of the river, hence protection is given in form of the energy dissipators such as Friction blocks, Stilling basin and End sill.

The downstream side has two layers of friction blocks laid in alternate manner, 10 m wide stilling basin which acts as cushion for the falling water and beyond the basin there is end sill for further protection.

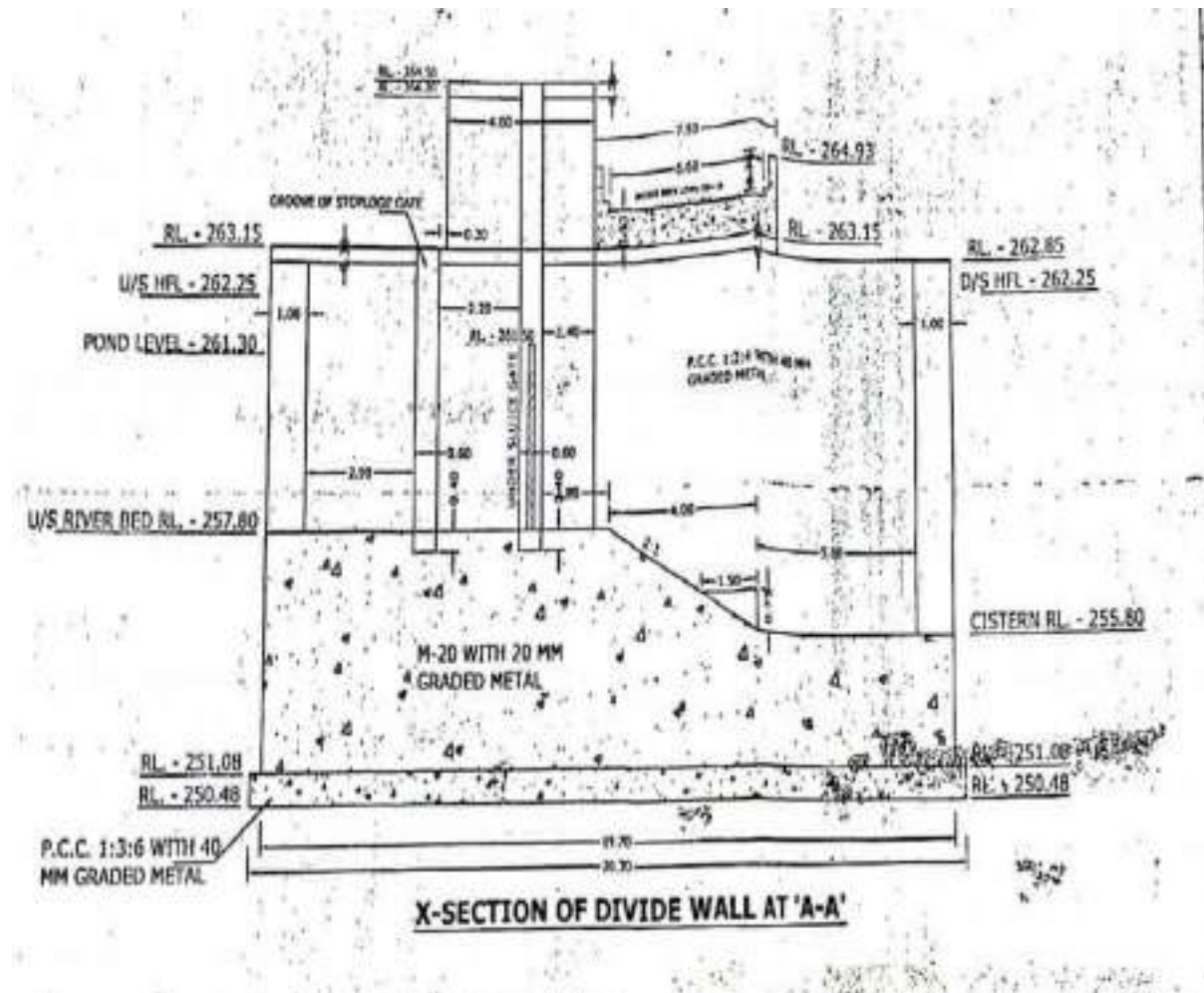
BANK PROTECTION: As the barrier cause the river level to rise, the water can flow out through the banks of the river hence Afflux bunds are provided along the stream at both the banks.

Table: Data of Shivghat Barrage

S. NO.	PARTICULARS	DATA
1	Catchment area	1998.00 sqkm
2	Bad level of river average NBL	257.8 m
3	HFL of river (before construction)	262.25 m
4	Permissible afflux	0.60 m
5	Pond level	261.30 m
6	Water depth	3.50 m
7	Safe exit gradient	1:6
8	Retrogression	0.5
9	Discharge concentration	20%
10	Length of barrage (overall) L	334.0 m

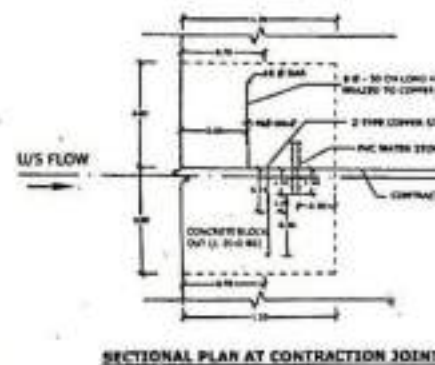
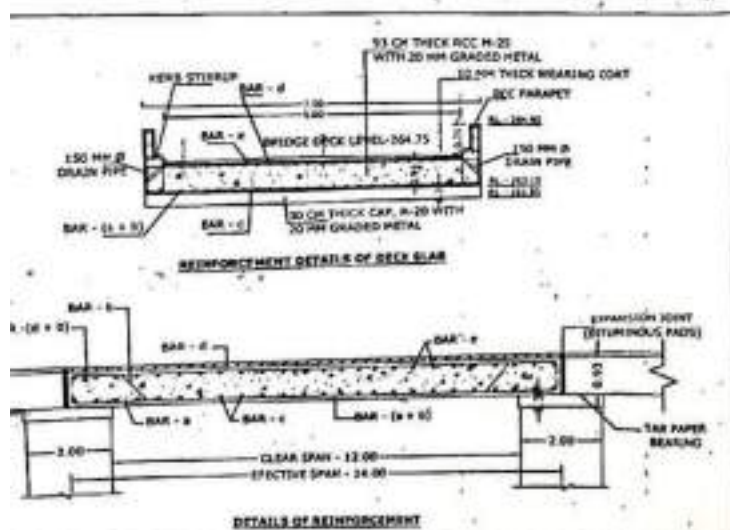
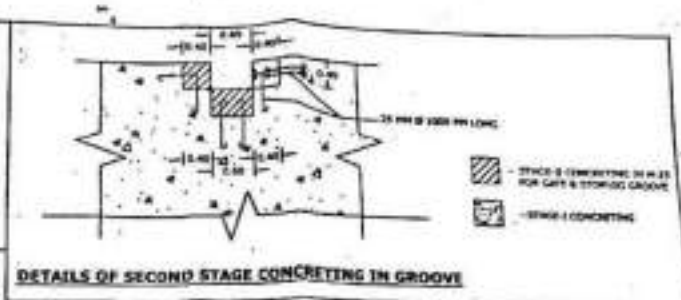
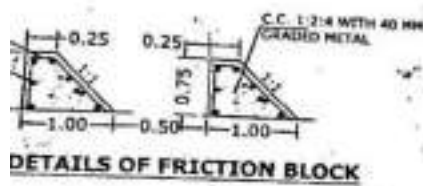
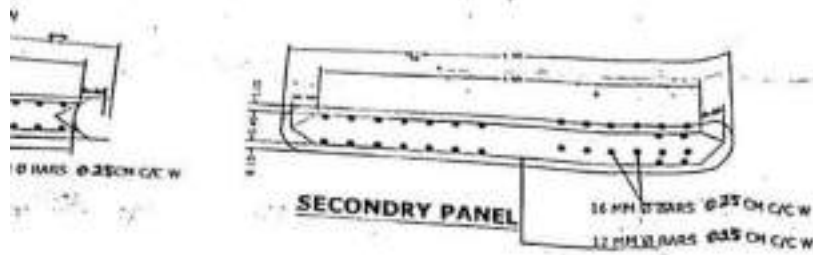
11	Crest level of wear	258.40 m
12	Height of Weir H	0.60 m
13	D/S HFL of river	262.25 m
14	Value of “n”	0.0225
15	U/S Floor level	257.80 m
16	U/S Floor level Of sluice	257.80 m
17	Horizontal floor length	47.90 m
18	Bed grade of river	1 in 670
19	Number of Barrage gate	20 Nos.
20	Size of Barrage Gate	12.00×2.90 m
21	Number of scouring gate	4 Nos.
22	Size of scouring gate	12.00×3.50 m

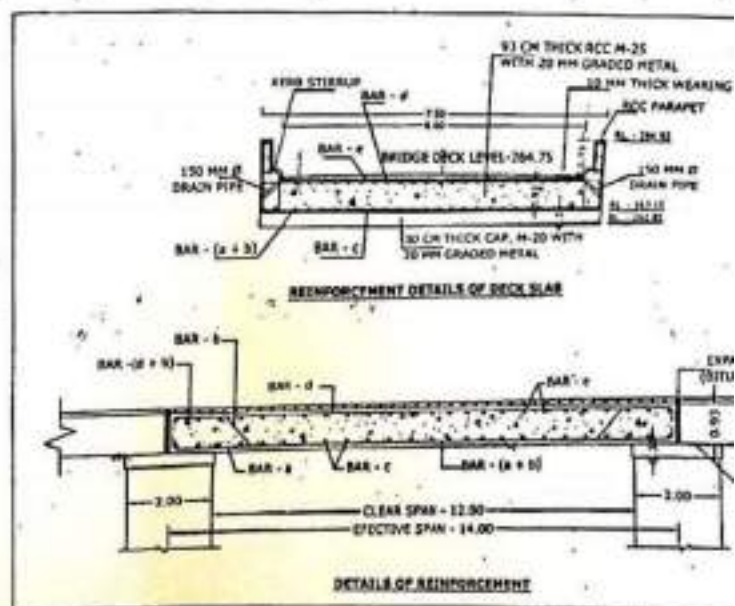
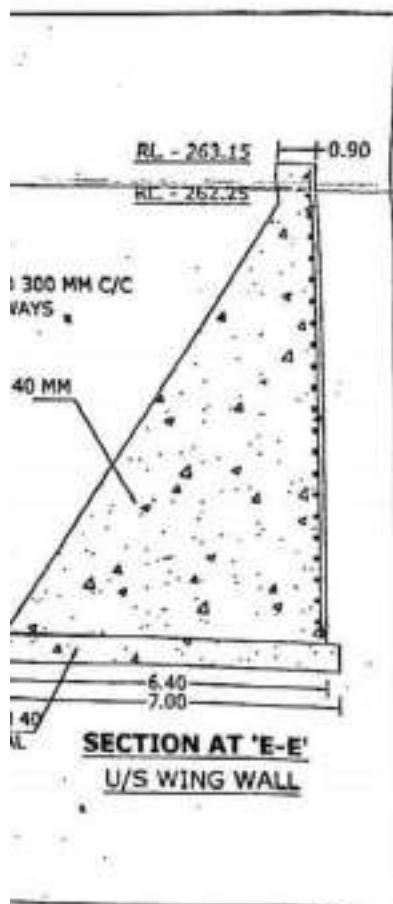
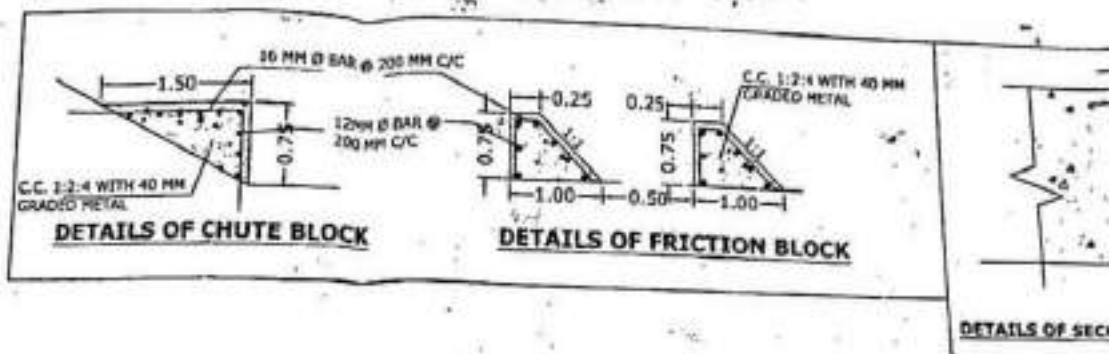
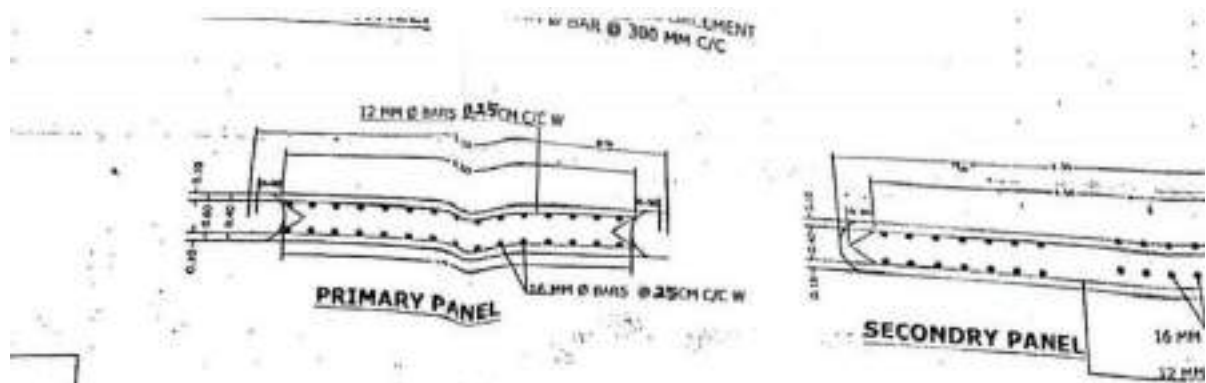
3.4. Pan/Layout of the Project





REINFORCEMENT
BAR @ 300 MM C/C





3.4. Some Glimpses of Site





Fig. Shivghat Barrage, Arpa river, Bilaspur

CHAPTER 4

IRRIGATION SCHEMES IN CHHATISGARH

4.1. Types of schemes

Irrigation schemes be constructed in this state are chiefly of the following six types:

1. Diversion Schemes
2. Storage Schemes
3. Diversion-cum-storage Scheme
4. Stopdams / anicut / percolation tanks
5. Lift Irrigation Scheme
6. Tubewells

DIVERSION SCHEMES: In diversion schemes water is directly drawn from the river or stream this type of work is feasible when the normal flow of the water or stream throughout the period of the growth of the crop proposed to be irrigated is never less than the requirement of irrigating the crop during the period of its growth these consist of wear or barrages across the river with canal either on both sides or on any one side.

STORAGE SCHEMES: When inflow of a river or stream is not uniform even during monsoon or in excess of dam and during one season and deficient during another storage is required for uniform supply of water to the crops and that's why storage scheme is adopted.

DIVERSION-CUM-STORAGE SCHEME: When the divergent scheme after a period of operation experience shortage of what are either due to insufficient flow or increase of area in the command Supplementary storage is constructed either on the same river or its tributaries and stored water is let into the river when there is demand to the peaked up at the diversion sites such schemes are called diversion-cum-storage scheme.

STOPDAMS / ANICUT / PERCOLATION TANKS: Any cuts and stop dams are barriers constructed across streams and river Let's store water to a certain depth confined within the top bank level water thus collected is generally used for

domestic purposes and drinking water for cattle just like a local pond. Thus can also be used for irrigation purpose with or without lifting of water according to individual site condition anicuts and stopdams significantly contribute to recharging of groundwater. Many time course we are constructed on the scheme facilitating means of transport for the villagers during dry period. Sometimes anicuts are constructed for supplying water to industries and also some anicuts are used for drinking supply.

Percolation Tanks are primarily meant to recharge groundwater in the locality.

LIFT IRRIGATION SCHEME: When the water available for irrigation is at a lower level than the land to be irrigated then it has to be lifted by pumps or another water lifting devices this water is sometimes also stored in storage tank and then distributed to the lands by gravity through pipes or open canals.

TUBE WELLS: Groundwater when extracted from pumped wells for irrigating water supply or drainage purpose it is turned as tubewell irrigation. Tube well can be used only in areas which are suitable for groundwater exploration.

CHAPTER 5

CANAL SYSTEM

5.1. Canal System

CANAL: A canal is an artificial channel constructed to convey water from rivers, reservoirs, etc. for several purposes like power generation, navigation, irrigation, etc.

The canal system consists of:

MAIN CANAL: It is the principal channel of a canal system taking off from a river or a reservoir.

BRANCH CANAL: A channel receiving its supply from the main canal and acting as a feeder for the distributaries.

DISTRIBUTRIES: The channel taking off from the main canal or branch canal with head discharge more than $1\text{m}^3/\text{s}$.

MINOR CANAL: A channel taking off from a main canal, branch canal or distributary with head discharge less than $1\text{m}^3/\text{s}$. A minor taking off from a main or branch canal is described as a "direct minor".

SUB-MINOR CANAL: It is a channel taking off from a minor which delivers water to more than one water coarse.

WATER COARSE: It is a channel taking off from a branch canal, distributary, minor, sub-minor which conveys water to the outlet serving 5 to 8 hectares.

FIELD CHANNEL: A channel taking off from the government outlet and leading to the farm.

FARM CHANNEL: It is a channel to carry water from the farm gate to the field.

5.2. Structures in The Canal System

Structures normally necessary in canals are:

- Cross drainage works
- Regulating structures
- Bridges

5.2.1. Cross Drainage Works

A cross drainage work is a structure carrying the discharge from a natural stream across a canal intercepting the stream. Canal comes across obstructions like rivers, natural drains, and other canals. The various types of structures that are built to carry the canal water across the above mentioned obstructions or vice versa are called cross drainage works.

It is structure constructed when there is a crossing of canal from mixing into canal water cross draining works included.

1. Super passage
2. Aqueduct
3. Syphon aqueduct
4. Canal Syphon
5. Level crossing

SUPER PASSAGE: Super passage structure carries drainage above the canal as the canal bed level is below the drainage bed level. The drainage trough is to be constructed at road level and drainage water flows through this from upstream to downstream and the canal water flows through the piers which are constructed below this drainage trough as supports. The FSL of canal is below the drainage trough in a super passage.

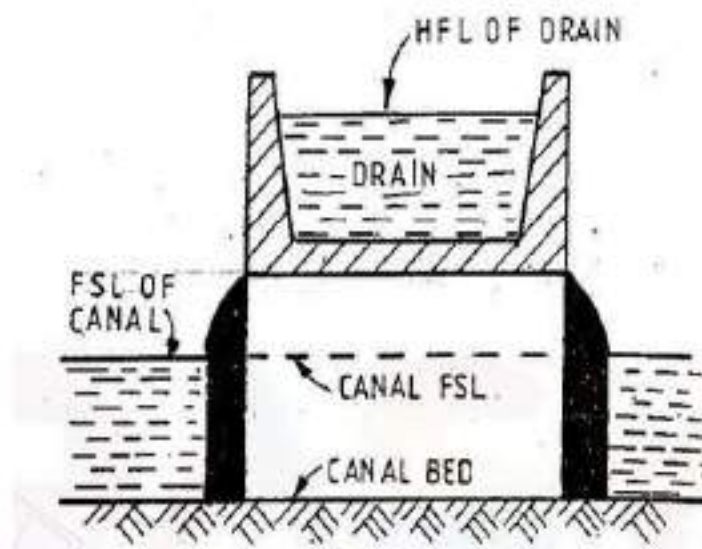


Fig. Super passage

AQUEDUCTS: In an aqueduct, the CBL is above the drainage bed level, so canal is to be constructed above drainage. A canal trough is constructed in which water flows from upstream to downstream. This canal trough is to be rested on a number of piers. The drainage flows through these piers. In an aqueduct, the HFL of the drainage is below the CBL. Aqueduct is similar to a bridge, instead of roadway or railway, canal water is carried in the trough and below that the drainage water flows under gravity.

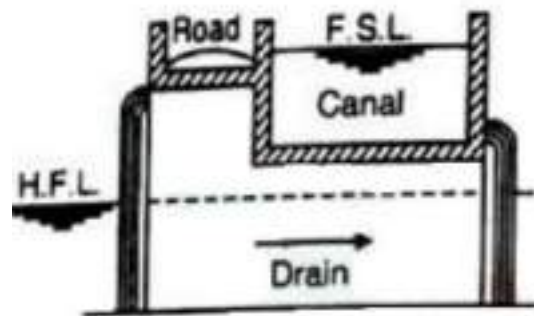


Fig. Aqueducts

SYPHON AQUEDUCTS: In a syphon aqueduct, canal water is carried above the drainage but the HFL of drainage is above the canal trough. The drainage water flows under syphonic action and there is no presence of atmospheric pressure in the natural. The construction of the syphon aqueduct structure is such that the flooring of drain is depressed downwards by constructing a vertical drop weir to discharge high flow water through the depressed concrete floor.

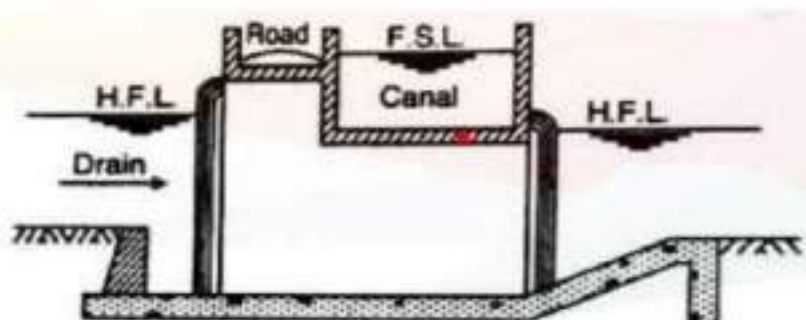


Fig. Syphon Aqueducts

CANAL SYPHON: In a canal syphon, drainage is carried over canal similar to a super passage but the FSL of canal is above the drainage trough, so the canal water flows under syphonic action. Flooring of canal is depressed and ramp like structure is provided at upstream and downstream to form syphonic action.

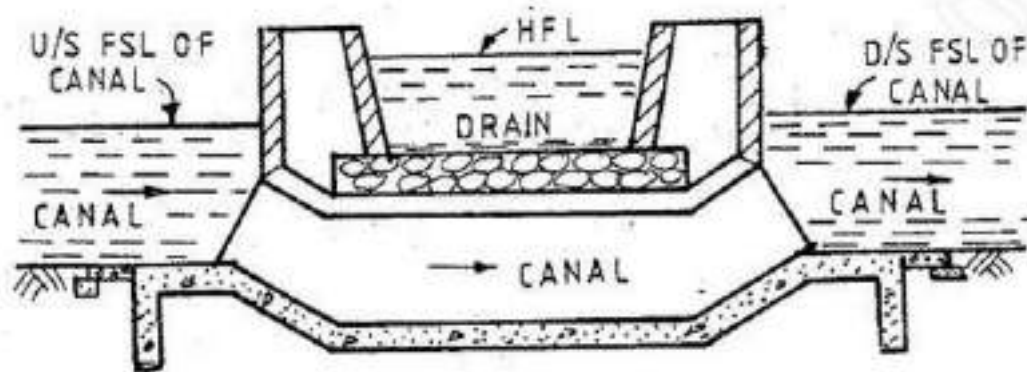


Fig. Canal Syphon

LEVEL CROSSING: When the bed level of canal is equal to the drainage bed level, then level-crossing is to be constructed.

This consists of following steps:

- Construction of weir to stop drainage water behind it.
- Construction of canal regulators across a canal.
- Construction of head regulators across a drainage.

In peak supply time of canal, water parallel to drainage, both the regulators are opened to clear the drainage water from that of canal for certain time interval. Once the drainage is cleared, the canal head regulators is closed. The cross regulator is always in open condition to supply canal water continuously.

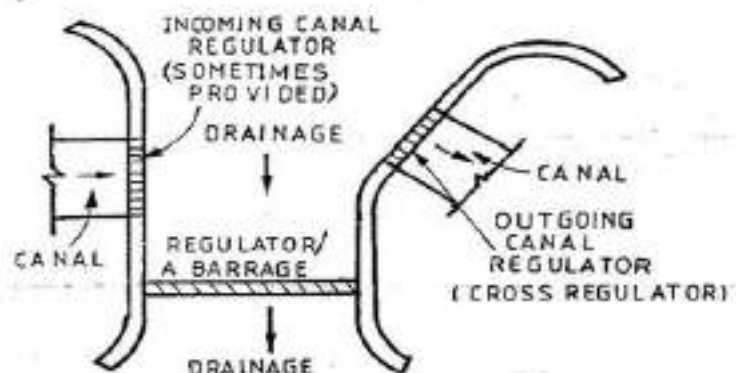


Fig. Level Crossing

5.2.2. Regulating Structures

The structures are required to maintain the level and the discharge of the designed valves.

They includes:

1. Falls
2. Cross Regulators
3. Head Regulator
4. Escapes
5. Outlets
6. Silt Ejectors

FALLS: Falls are provided in a canal when the fall of terrain is more than that of canal water level becomes more than the level required in the canal this structure dissipates excess energy and the need for filling is minimized.

CROSS REGULATOR: Cross regulator are required to maintain the FSL of canal. These are provided at intervals across the canal and below mean of take points so that when the canal is running at level lesser than supply discharge. Water can be raised to feed the off take canal.

HEAD REGULATOR: Head regulators are provided for regulating the discharge to feed the regulator's cruise regulators are required to maintain the FSL of canal These are provided at intervals across the canal and below major takeoff point so that when the canal is running at less than full supply discharge water can be raised to feed the off-take canal regulator are provided four regulating the discharge of feed and regulatoryies.

ESCAPES: Escapes are required for discharging the excess water out of the canal during periods of low demand in the command area. They are generally provided at upstream of cross regulator near a natural wall in order to release the water from the canal and avoid flooding in the command area during flood or rainy season.

OUTLETS: Outlets are waterproofs provided from minor and distributors according to demand in command area.

SILT EJECTORS: A silt ejector also known as a silt extractor is a structure built in a canal to remove silt from the water after it has already entered the canal.

5.2.3. Bridges

Bridges are provided for all existing and future anticipated roads to provide transportation facility in the command area. This is generally provided at intervals of 6 km but in case of distributors these are provided at two or three KM depending on local condition.

CHAPTER 6

EARTH DAMS

6.1. General

An earth dam may be termed as small earth and dam as it fulfil all the following criteria:

1. Its height is less than 15m above the deepest river bed level.
2. The volume of earth work involved in dam construction is less than 0.75 million m³.
3. Storage created by the embankment is less than 1 million m³.
4. The maximum flood discharge from the Intersected catchment area is less than 2000 m³/s

6.2. Components of Dams

1. Core or hearting
2. Casing or Shell
3. Internal Drainage Arrangement
4. Slope Protections
5. Impervious or Clay Blanket
6. Cut-off (puddle trench)
7. Relief Wells
8. Downstream Drainage Arrangements

CORE or HEARTING: Core is a zone of impervious earth and provides an impermeable barrier within the body of the dam.

CASING or SHELL: On outer side of core, a cover of relatively pervious soil is provided. This protects the core from external damages such as erosion from the rainwater, weathering and under conditions of sudden draw down and steady seepage. Shell helps core to retain its moisture content and thus prevents cracks in it.

INTERNAL DRAINAGE ARRANGEMENT: An internal drainage arrangement helps in safe passage of seeping water. This arrangement as far as, possible shall be provided with locally available sand and gravel.

SLOPE PROTECTION: For small dams, upstream slope shall be protected by providing 22 cm dry stone hand placed rip rap (pitching) using picked up boulders, over 15 cm picked up spalls. In case picked up boulders and/or spalls are not available at or near dam site, quarried stones and/or spalls be used for hand placed rip-rap. To protect downstream slope, turf shall be provided on its entire length. The slope shall also be properly drained.

IMPERVIOUS or CLAY BLANKET: It is a layer of impervious material laid on the upstream side of an earthen dam where the substratum is pervious, to reduce seepage and increase the path of flow. The blanket decreases both the seepage flow and excess pressure on the downstream side of the dam. A natural blanket is a cover of naturally occurring soil material of low permeability.

CUTT-OFF (PUDDLE TRENCH): An impervious construction by means of which seepage is reduced or prevented from passing through foundation material.

RELIEF WELL: Vertical wells or boreholes downstream of or in the downstream shoulder of an earth dam to collect and control seepage through or under the dam to reduce water pressure.

DOWNSTREAM DRAINAGE ARRANGEMENT:

- **TOE DRAIN:** A trench filled with filter material or without it along the downstream toe of an earth dam to collect seepage from horizontal filter and lead it to the natural drain. •
- **TURFING:** It is a cover of grass grown over downstream slope of an embankment to prevent erosion of soil particles by rain-wash and wind action.

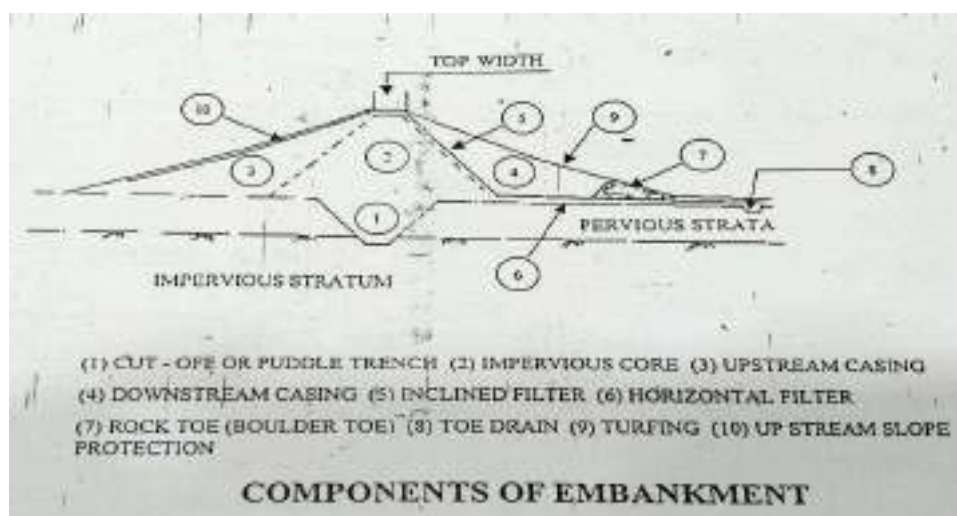


Fig. Components of Embankment

CHAPTER 7

TOPOGRAPHIC SURVEYING

7.1. Norms of Topographic Surveys

Topographical survey is an important activity of the field staff, engaged both on (a) S & I of new scheme and (b) schemes approved for construction. Likewise, the success of an irrigation scheme depends largely as to how accurately that topographical surveys (including levelling) has been carried out and plotted.

7.2. Instructions for Symmetric Surveying

In General

1. The same importance as prescribed for measurement books is to be given to field or level book.
2. The date of first entry in the book is to be intimated to the SDO /EE by the actual user.
3. The reducing of levels is to be done in the field immediately after levelling and the arithmetic check for each page conducted separately.
4. The levels taken on the day are to be plotted the same day as far as possible, or at least by the next day by the same person who conducted surveying or levelling and the remark given in red ink in column 8.
5. Before shifting of the survey camp or certificates should be sent to the SDO that are plotting work has been completed.
6. Every plotted sheet shall contain certificate as follows: “Certificates that survey was conducted me/us using field book and level books wearing number and issued by sub division (name of subdivision).”
6. “The BMS are shown plotted in red ink and identifiable with the description shown. The levels are related to the nearest GTS benchmark whose description is (give particulars)”.
7. The level of field book shall be return to the subdivision office after plotting is done and index completed unless of course required for another work

7.3. Sample Computations in a Levelling Field Book

Left Hand Page

Right Hand Page

- | | |
|-------------------------------------|-------------------|
| 1. Name of person conducting survey | 4. Instrument No. |
| 2. Name of Work | 5. Make..... |
| 3. Date and Weather | |

7.4. Methods

There are two methods:

1. Rise & Fall Method

R.D	B.S	I.S	F.S	Rise	Fall	R.L.	Distance	Remarks
-----	-----	-----	-----	------	------	------	----------	---------

Arithmetic check:

$$\sum B.S. - \sum F.S. = \sum RISE - \sum FALL = \text{LAST R.L.} - \text{FIRST R.L.}$$

2. Height of Instrument Method

R.D	B.S	I.S	F.S	H.I	R.L.	Distance	Remarks
-----	-----	-----	-----	-----	------	----------	---------

Arithmetic check:

$$\sum B.S. - \sum F.S. = \text{LAST R.L.} - \text{FIRST R.L.}$$

CHAPTER 8

LAGRA ANICUT

8.1. General

The **Kharung River**, a tributary to **Shivnath River**, is in the western part of Bilaspur district. It is the source of water of several villages of Bilaspur district.

The region nearby to the Kharung river is scarcity prone area and almost every alternate year, the crop is affected by scarcity. To provide the drinking water facilities to people and animals and water for Nistari purpose from river, it has been decided by government of Chhattisgarh to construct series of Anicuts/Stopdams in the rivers of Chhattisgarh state.

8.2. Salient Features

Table: Data of Langra Anicut

S. NO.	PARTICULAR'S	DATA
1	Catchment area	697.89 sqkm
2	Deepest bed level of river NBL	100.00 m
3	Top bank level of river TBL	105.570 m
4	Length of anicut cum Rapta – L	95.000 m
5	Crest level of weir	103.000 m
6	Height of Weir H	3.0 m
7	U/S HFL of river	103.940 m
8	D/S HFL of river	103.940 m
9	Value OF “n”	0.0250
10	Numbers and size of Open duct	5 Nos. 2.00×0.60 m
11	Numbers and size of Sluice Gate	5 Nos. 2.00×1.30 m

8.3. Project Details

LOCATION: The proposed side is located near village Lagara in block Bilha District Bilaspur and is about 15 km away from Bilaspur. The site is approachable by all-weather village road. The site can be located at Latitude 22-07'-40" Longitude 82 14'-30".

HYDROLOGY: The catchment area upto the anicut site is 697.89 sqkm. The maximum flood discharge is 2661.32 cumecs. The maximum flood level observed is 103.94 m.

TOPOGRAPHICAL FEATURES: The river is straight at the proposed site having high banks and narrow river width, the upstream side of proposed site is wide and is good for water storage. The average river bed level is 100 m with bank RL is 105.57 m. The width of river at proposed is 95 m. The natural bed grade of river is 1 in 654.

GEOLOGICAL FEATURES: The geological investigation is to be made by diamond core drilling in river bed at different point at proposed site. The average rock level of the site is 98 m.

THE PROPOSAL: It is proposed to construct anicut of 95 m length and 3 m height on average bed level of River 100 m with 5 gates of 2x1.3 m. The structural details of the proposed anicut are as follows:

- **MAIN BODY OF ANICUT:** The main body wall consists of solid weir with 5 gates of 2x1.3 m. The top width of solid weir has been kept as 3 m with straight face at upstream side and 1:1 slope at downstream side. Foundation level is kept below 0.6 m hard rock level & from the hard rock level both the faces kept straight.
- **WEIR:** There is 95 m long solid weir will be constructed along with provisions. 5 Nos. of openings of size 2x1.3 m above the sill level (River bed level). The height of weir is 3 m. The foundation for weir is kept at 0.6 m below rock level. The entire weir is encased by 30 cm thick layer of M-15 RCC with a minimum reinforcement of 0.15% of cross-section area of encasing in each direction. The portion of pier is filled up with M-10 PCC.
- **ABUTMENT/ END BLOCKS:** The Left and Right Banks are protected by CC abutment construction in M-15 concrete. The length of each abutment is 30 m. The foundation of abutment is kept at 0.60 m below hard rock. The top level of abutment is kept at HFL. The abutment shall be constructed monolithic with main body of anicut. The weep holes in the abutment have been provided above weir top. The earth face of abutment will be properly filled with dressed & compacted earth.
- **BANK PROTECTION WORK:** Each bank of river will be protected as follows.
 - a) **CC Flank Wall and Returns:** The right & left bank of river adjacent to abutment is to be protected by CC abutments and return walls on upstream and downstream side. The length of upstream flank wall will be 10 m and length of downstream flank wall is 15 m. The foundation of these flank walls is kept at the same level as the foundation RL of the

abutment i.e, 0.6 m below the hard rock level. The height of the flank wall is provided upto 106.10 m. The walls are constructed with CC M-15.

b) CC Return walls: The CC return walls are provided at each end of the river banks at both upstream and downstream side. The length of return wall will be 15 m. The height of the return wall is provided upto RL 106.10 m and the foundation is kept 0.6 m below the hard rock level.

- **ESTIMATED COST:** The estimated cost of the anicut is Rs 4.96 Cr.

8.4. Some Glimpses of Site







Fig. Langra Anicut, Bilha

CONCLUSION

- This internship was a great experience for me. I have gained new knowledge, skills and met many people. I achieved several of my goals. Books that I have referred, videos and presentations that I have watched, research papers I have gone through etc. helped me a lot.
- The main benefit of the internship was that I have gained an extensive amount of knowledge on water Resources and department it works with. The internship also provided me a chance to visit project sites like Shivghat Barrage and Lagra Anicut. It was a very wonderful experience.
- Classroom learning provides a structured, theoretical foundation, while fieldwork allows for practical application and real-world experience.



गुरु घासीदास विश्वविद्यालय, बिलासपुर

केंद्रीय विश्वविद्यालय अधिनियम 2009 संख्या 25, 2009 द्वारा केंद्रीय विश्वविद्यालय

Guru Ghasidas Vishwavidyalaya, Bilaspur

A Central University established by the Central Universities Act 2009 No. 25 of 2009

A COMPREHENSIVE TRAINING REPORT
BUILDING CONSTRUCTION
CENTRAL PUBLIC WORKS DEPARTMENT
BILASPUR (C.G.)

4 Weeks Vocational Training

Katarapu Vinay Kumar

GGV/21/01048

2021-26 & 7th semester

Session 2025-26

DEPARTMENT OF CIVIL ENGINEERING

School of Studies, Engineering & Technology

GURU GHASIDAS VISHWAVIDYALAYA

Bilaspur (C.G.) 495009

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(Established under the Central Universities Act, 2009 No. 25 of 2009)

Accredited with NAAC A



ABSTRACT

During my internship with the Central Public Works Department (CPWD) at Guru Ghasidas Vishwavidyalaya (GGU), Koni, Bilaspur (C.G.), I was involved in the construction project titled "Construction of Lecture Hall Complex (G+4), Boys Hostel (G+3) 250 seats, Girls Hostel (G+3) 250 seats and site development including all civil and E&M works and horticulture services etc." The work was executed on an Engineering, Procurement, and Construction (EPC) basis by Asian Construction Company, 716-A, Ajmer, Rajasthan. The estimated cost of the project was ₹55.21 crore, which included ₹43.81 crore for civil works, ₹10.99 crore for electrical works, and ₹0.40 crore for horticulture. The project was planned for completion in 21 months with an earnest money deposit of ₹65.21 lakh, a performance guarantee of 3%, and a security deposit of 2.5% of the tendered value. This internship helped me understand the various planning and execution stages in a large-scale public infrastructure project. During the planning phase, the project manager created several key documents to guide the execution. These included a Scope Statement that defined the project's objectives, deliverables, and milestones; a Work Breakdown Schedule (WBS) to divide the project into manageable parts; and a Gantt Chart that visually tracked project timelines. Milestones were identified to ensure smooth progress, and a Communication Plan was established for internal coordination and stakeholder updates. A Risk Management Plan was also in place to identify and prepare for possible risks such as budget constraints or schedule delays.

On site, I witnessed the implementation of several important features aligned with CPWD and National Building Code (NBC) guidelines. These included tactile tiles for accessibility in key locations such as entrances, corridors, and lift lobbies, along with ramps to support inclusive infrastructure. Rainwater harvesting systems with filtration units and recharge pits were installed in all buildings to promote sustainable water use. The lecture halls were designed with acoustic treatments using materials like mineral wool panels and double-glazed windows to improve sound quality. Water treatment units were installed for a safe water supply, adhering to IS 10500 standards. All buildings were equipped with fire safety measures including alarms, extinguishers, emergency exits, and signage. The inclusion of

horticulture work also added greenery to the campus, improving the overall environment. This internship gave me practical exposure to technical, safety, and service systems used in public infrastructure and taught me how proper planning ensures successful project execution.



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DECLARATION BY THE STUDENT

I, Agidi Koushik , a student of B.Tech, department of Civil Engineering, GURU GHASIDAS VISWAVIDYALAYA, hereby solemnly declare that the report entitled “**Internship**” is a genuine and original record of the industrial training/internship undertaken at **Central Public Works Department** during the period from 16/05/2025 to 16/06/2025.

The work presented in this report is entirely my own and has not been copied, reproduced, or submitted elsewhere for any academic or professional purpose. I affirm that:

- All information and observations recorded were made during my tenure at the above-mentioned organization.
- No part of the report has been plagiarized or duplicated from any other source.
- Proper references and acknowledgments have been made wherever external information has been consulted.

I understand that any violation of this declaration may result in academic or disciplinary action as per the rules and regulations of the institution.

Place: Bilaspur

Date: 4/08/2025

Signature of the Student

Name: Agidi Koushik

Enrollment No.: GGV/22/01001

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Lastly, I am thankful to the **Central Training & Placement Cell** for facilitating and coordinating this training initiative, which has greatly contributed to my professional development.

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During my internship with the Central Public Works Department (CPWD) at Guru Ghasidas Vishwavidyalaya (GGU), Koni, Bilaspur (C.G.), I was involved in the construction project titled “Construction of Lecture Hall Complex (G+4), Boys Hostel (G+3) 250 seats, Girls Hostel (G+3) 250 seats and site development including all civil and E&M works and horticulture services etc.” The work was executed on an Engineering, Procurement, and Construction (EPC) basis by Asian Construction Company, 716-A, Ajmer, Rajasthan. The estimated cost of the project was ₹55.21 crore, which included ₹43.81 crore for civil works, ₹10.99 crore for electrical works, and ₹0.40 crore for horticulture. The project was planned for completion in 21 months with an earnest money deposit of ₹65.21 lakh, a performance guarantee of 3%, and a security deposit of 2.5% of the tendered value. This internship helped me understand the various planning and execution stages in a large-scale public infrastructure project. During the planning phase, the project manager created several key documents to guide the execution. These included a Scope Statement that defined the project's objectives, deliverables, and milestones; a Work Breakdown Schedule (WBS) to divide the project into manageable parts; and a Gantt Chart that visually tracked project timelines. Milestones were identified to ensure smooth progress, and a Communication Plan was established for internal coordination and stakeholder updates. A Risk Management Plan was also in place to identify and prepare for possible risks such as budget constraints or schedule delays.

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INTRODUCTION

Infrastructure development plays a vital role in supporting education, sustainability, and social progress. As part of my academic training in civil engineering, I had the opportunity to undertake a practical internship with the Central Public Works Department (CPWD), which gave me valuable exposure to real-world construction practices. My internship was based at Guru Ghasidas Vishwavidyalaya (GGU), Koni, Bilaspur, Chhattisgarh, where I observed and participated in the construction of a major infrastructure project. The project included the development of a Lecture Hall Complex (G+4), a Boys' Hostel (G+3) with 250 seats, a Girls' Hostel (G+3) with 250 seats, and complete site development. The scope also covered all civil, electrical and mechanical (E&M) works, along with horticulture services. The project was executed under the Engineering, Procurement, and Construction (EPC) model by Asian Construction Company, Ajmer, Rajasthan.

The estimated cost of the entire project was ₹55.20 crore, divided into ₹43.81 crore for civil works, ₹10.99 crore for electrical works, and ₹0.40 crore for horticulture. The tender required an earnest money deposit of ₹65.20 lakh, a performance guarantee of 3% of the tendered value, and a security deposit of 2.5%. The target duration for completion was set at 21 months. Throughout my internship, I gained insights into how projects are executed in line with CPWD specifications, the National Building Code (NBC), and relevant IS codes, ensuring high-quality and safe construction. I also learned about the importance of the planning phase in project success. Documents such as the Scope Statement defined the goals and deliverables, while a Work Breakdown Structure (WBS) broke the work into manageable components. A Gantt Chart was used to schedule tasks, and milestones were set to track progress. A Communication Plan ensured coordination among teams and stakeholders, while a Risk Management Plan helped identify and prepare for potential issues like time delays or cost changes. On-site, I observed the implementation of inclusive and sustainable features like tactile tiles, accessible ramps, rainwater harvesting systems, fire safety equipment, water treatment units, and acoustic designs in the lecture halls. The incorporation of horticulture also contributed to a greener environment. This internship was a key learning experience that enhanced my technical knowledge, planning skills, and understanding of large-scale public infrastructure development.

PROJECT OVERVIEW

The construction project undertaken at Guru Ghasidas Vishwavidyalaya (GGU), Koni, Bilaspur (Chhattisgarh), was a significant infrastructure development initiative aimed at enhancing educational and residential facilities within the university campus. Executed on an Engineering, Procurement, and Construction (EPC) basis, the project comprised the construction of a Lecture Hall Complex (G+4), a Boys' Hostel (G+3) with a capacity of 250 students, and a Girls' Hostel (G+3) also designed for 250 students. Additionally, the scope of the work extended to comprehensive site development, including all civil and electrical & mechanical (E&M) works, along with horticulture and landscaping services to create an environmentally friendly campus atmosphere. The project was awarded to Asian Construction Company, located at 716-A, Ajmer, Rajasthan – 305001. The total estimated cost of the project stood at ₹55,20,90,727, which included ₹43,81,81,111 for civil works, ₹10,99,05,616 for electrical and mechanical components, and ₹40,04,000 allocated for horticulture services. The financial structure of the project also included an Earnest Money Deposit (EMD) of ₹65,20,927, ensuring the contractor's commitment to project execution. Furthermore, the contractor was required to furnish a Performance Guarantee amounting to 3% of the tendered value, and a Security Deposit equal to 2.5% of the tendered value, in accordance with CPWD norms.

The entire project was scheduled to be completed within a period of 21 months from the date of commencement. Under the EPC model, the contractor was responsible for the design, procurement of materials, construction, and overall project delivery, ensuring accountability for both quality and timelines. The EPC framework promoted an integrated approach, allowing for better coordination among design, engineering, and construction teams. The Lecture Hall Complex was planned with modern academic needs in mind, incorporating features like acoustic treatment, fire safety systems, and accessible infrastructure. The hostels were designed to provide comfortable and secure accommodation, adhering to safety standards and sustainability practices, including the installation of water treatment units, rainwater harvesting systems, and energy-efficient lighting. Overall, this project aimed to deliver a state-of-the-art academic and residential environment, supporting the university's mission of providing quality higher education while also promoting eco-friendly development and inclusive design.

SITE LOCATION



Figure 1: Front View of Lecture Hall Complex (G+4) Under Construction



Figure 2: Left Front View of Boys Hostel (250 seats) Under Finishing



Figure 3: Side View of Girls Hostel (250 seats) Under Finishing

PLANNING

The planning phase is one of the most crucial stages in project management, laying the groundwork for the successful execution and completion of the project. It involves establishing a well-defined roadmap that guides the team throughout the project lifecycle and ensures that all stakeholders remain aligned with the objectives. The process typically begins with setting clear and measurable goals that reflect the client's needs and the project's broader purpose. In this phase, the project manager plays a central role in preparing key documents that help maintain structure, transparency, and accountability.

One of the foundational documents prepared during this stage is the Scope Statement, which outlines the project's business justification, intended benefits, main objectives, key deliverables, and significant milestones. While the scope statement may be revised during the project, any changes must be formally approved by both the project manager and the project sponsor to maintain integrity and direction. Another essential tool is the Work Breakdown Structure (WBS), a visual breakdown of the overall scope into smaller, manageable tasks that can be assigned to individual team members. This helps improve task delegation, estimation, and tracking. To monitor progress effectively, the project team identifies important Milestones, which represent major achievements or phases within the project. These are integrated into a Gantt Chart, a visual timeline that maps tasks, dependencies, durations, and deadlines, offering a clear overview of the project schedule. A Communication Plan is also formulated to ensure smooth and timely information exchange, especially when multiple teams or external stakeholders are involved. This plan includes details about communication channels, frequency, formats, and responsible persons for each task update or report. Furthermore, a well-prepared Risk Management Plan is essential to anticipate and mitigate potential problems before they affect the timeline or budget. Common risks considered during planning include unrealistic deadlines, underestimated costs, unclear client feedback cycles, frequent scope changes, funding issues, and unavailability of resources. By identifying these risks early, the project manager can propose contingency strategies and assign risk owners for proactive handling. Overall, the planning phase is vital in creating a solid foundation that aligns team efforts, manages expectations, and prepares the project for successful execution within the given timeframe and resources.



Figure 4: Boys Hostel (250 seats) Plan

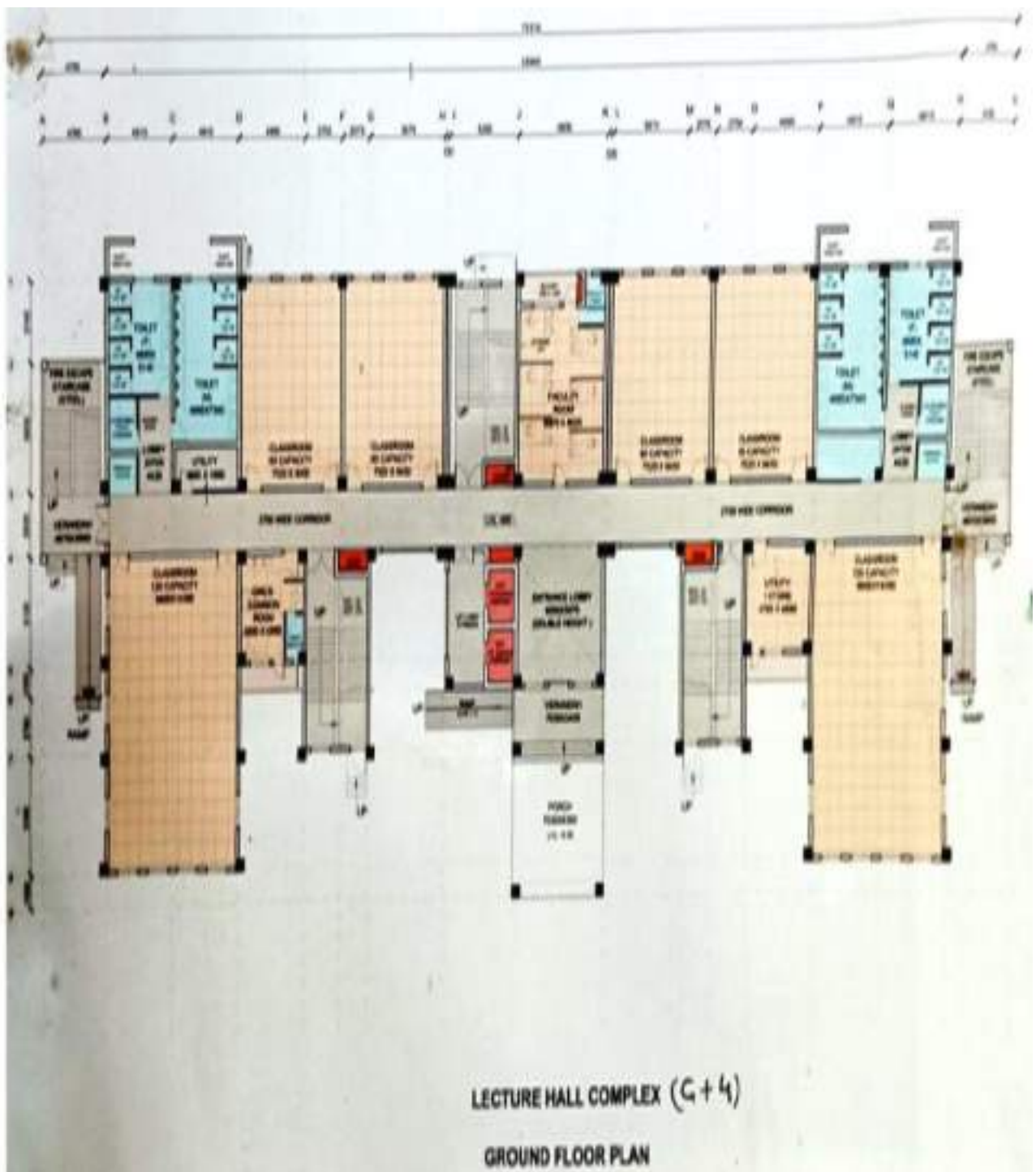


Figure 5: Lecture Hall Complex (G+4) Plan

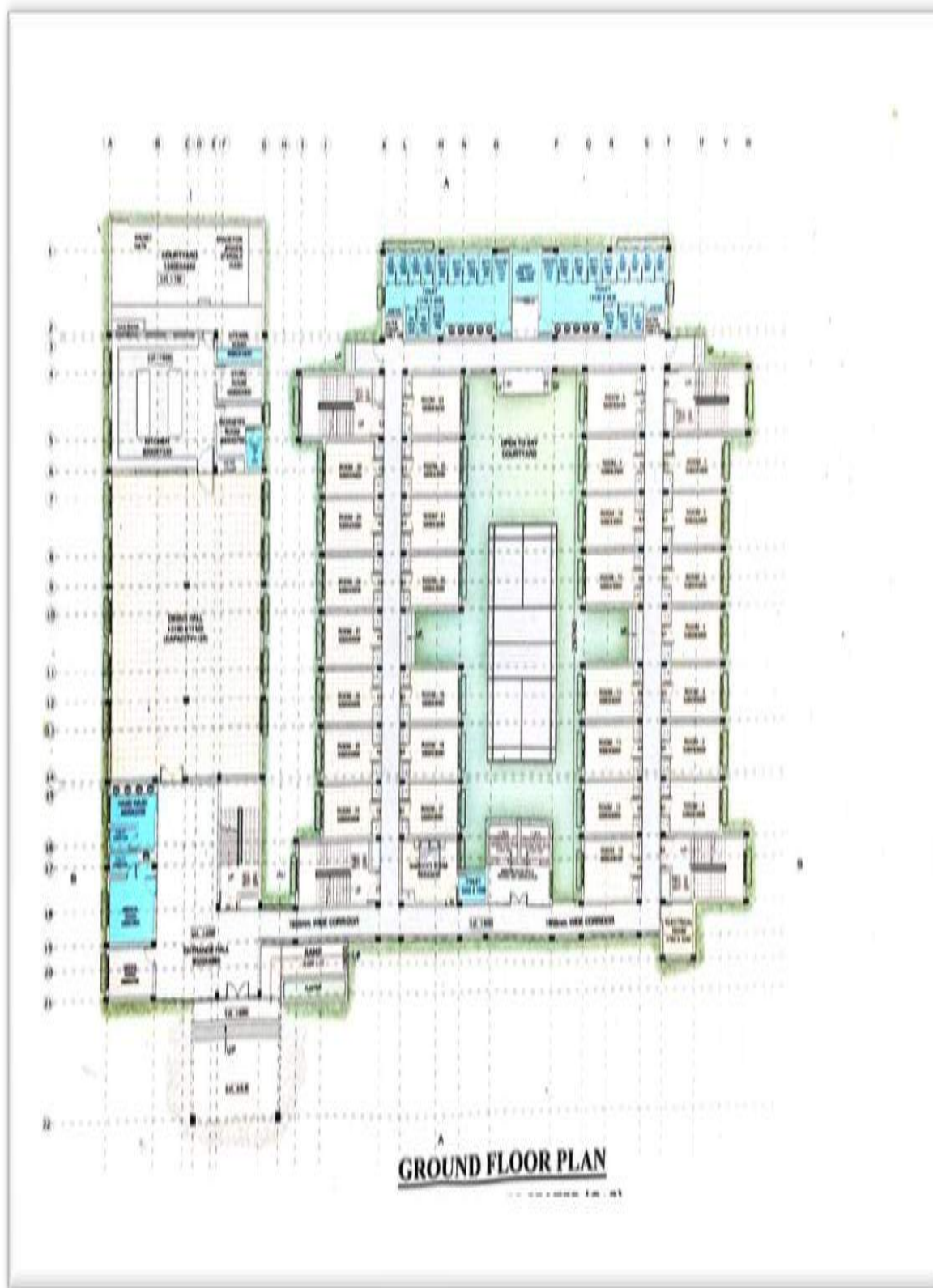


Figure 6: Girls Hostel (250 seats) Plan

PROJECT MONITORING

Project monitoring is a continuous and essential phase of project management that involves systematically tracking the progress and performance of the project to ensure it stays aligned with the original project management plan. This stage begins at the project's initiation and continues through its execution until completion. The main objective is to measure actual performance against planned performance and take corrective actions whenever deviations occur. Monitoring serves as the backbone of control, enabling the project manager to maintain oversight of schedules, costs, quality, and resource usage.

Regular communication with all stakeholders, particularly team leaders and supervisors, is vital during this phase. These interactions often take place during predetermined meetings or status updates and help ensure that activities are progressing smoothly. Key Performance Indicators (KPIs) are typically used as quantifiable metrics to measure different aspects of project success. These include schedule adherence, budget compliance, task completion, and overall project health.

Monitoring focuses on several critical areas. First is Project Objectives, where the project's alignment with schedule and budget is continuously assessed. Staying on track with these indicators signals that stakeholder expectations are likely to be met. Next is Quality Deliverables, which ensures that outputs from each team or task meet the desired standards and are delivered within the expected timeframe. This is crucial for maintaining quality across all project components. Another vital component is Effort and Cost Tracking, which allows project managers to monitor how much effort and expenditure are going into each activity. It provides insight into whether the allocated resources are being used efficiently and helps predict whether the project can be completed within the allocated budget and timeline. Deviations from expected values often prompt adjustments in planning and execution strategies. Project Performance monitoring also includes tracking unforeseen changes, such as unexpected issues, delays, or scope modifications. The project manager evaluates the type and frequency of these changes and how swiftly and effectively they are resolved. The ability to respond to issues and reassign resources as needed is critical in maintaining momentum and ensuring successful delivery.

QUALITY CONTROL

The technical audit of works done by CPWD used to be done in-house right from its inception. The functions of Quality Assurance and Technical Audit of works were shifted to CVC in the year 1964. On the recommendation of Ranganathan Committee, the Quality Assurance functions were again shifted to CPWD in the year 1979.

The implementation of Quality Assurance in the field will require close co- operation among the three agencies, namely (a) field engineers (b) the construction agency, and (c) the Quality Assurance team at Circle level for strict compliance of Quality Assurance Procedure forming part of agreement.

Quality Control System Of The Department

Multi level Quality checks have been created in CPWD as detailed below:

Field level

The direct responsibility for ensuring proper quality of work as per approved specifications for achieving the intended performance and structural, functional and aesthetical parameters, and the desired life of the building/installation/structure rests with the construction team of Executive Engineer, Assistant Engineer and Junior Engineer.

Quality Control team at Circle Level

To keep a watch on the effectiveness/adequacy of Quality Assurance measures at site, a Quality Assurance team with SE of the circle as its head and comprising of one AE.

The functions of the Quality Assurance team at Circle level are to check the compliance of Quality Assurance system by the field units, to locate the lapse/deficiency in the Implementation of the Quality Assurance Plan, and to guide the field engineers in quality related aspects of the work.

Core Wing at Directorate Level

This Core Wing carries out the following main functions to ensure systematic and comprehensive Assurance of quality in the works. Quality Assurance of works under the Special DG[S&P), (TD), ADG (Border) and Engineer-in-Chief (CPWD), Raipur.

Carry out comprehensive examination & technical audit of works.

To carry out investigations and enquiries with regard to quality related aspects. Quality Assurance works in various Regions are being looked after by the Regional QA units headed by the Superintending Engineer (TLQA) or Director Works of the Region

SEQUENCE OF WORK

Following are the sequence in which work is taking place in any site. This sequence must be followed for proper coordination of project before its deadline with full quality

1. ☐ Site clearance
2. ☐ Demarcation of site
3. ☐ Positioning of central coordinate i.e. (0,0,0) as per grid plan
4. ☐ Surveying and layout
5. ☐ Excavation
6. ☐ Laying of PCC
7. ☐ Bar binding and placement of foundation steel
8. ☐ Shuttering and scaffolding
9. ☐ Concreting
10. ☐ Electrical and plumbing
11. ☐ Deshuttering
12. ☐ Brickwork
13. ☐ Doors and Windows frames along with Lintel
14. ☐ Wiring for Electrical purposes
15. ☐ Plastering
16. ☐ Flooring and tiling work
17. ☐ Painting
18. ☐ Final Completion and handling of project

CPWD SPECIFICATIONS

CPWD has formed its own specifications according to various codal provisions which is to be followed in every site. Out of which most important are:

Site Clearance

Before the earth work is started, the area coming under cutting and filling shall be cleared of shrubs, rank vegetation, grass, brushwood, trees and saplings of girth up to 30cm measured at a height of one metre above ground level and rubbish removed up to a distance of 50 metres outside the periphery of the area under clearance. The roots of trees and saplings shall be removed to a depth of 60cm below ground level or 30 cm below formation level or 15 cm below sub grade level, whichever is lower, and the holes or hollows filled up with the earth, rammed and leveled.

Setting Out and Making Profiles

A masonry pillar to serve as a bench mark will be erected at a suitable point in the area, which is visible from the largest area. This bench mark shall be constructed as per Fig. 2.1 and connected with the standard bench mark as approved by the Engineer-in-Charge. Necessary profiles with strings stretched on pegs, bamboos or 'Burjis' shall be made to indicate the correct formation levels before the work is started. The contractor shall supply labour and material for constructing bench mark, setting out and making profiles and connecting bench mark with the standard bench mark at his own cost. The pegs, bamboos or 'Burjis' and the bench mark shall be maintained by the contractor at his own cost during the excavation to check the profiles.

Blasting

Where hard rock is met with and blasting operations are considered necessary, the contractor shall obtain the approval of the Engineer-in-Charge in writing for resorting to blasting operation.

Note: In ordinary rock blasting operations shall not be generally adopted. However, the contractor may resort to blasting with the permission of the Engineer-In-charge, but nothing extra shall be paid for such blasting operations.

General Precautions

For the safety of persons red flags shall be prominently displayed around the area where blasting operations are to be carried out. All the workers at site, except those who actually ignite the fuse, shall withdraw to a safe distance of at least 200 metres from the blasting site. Audio warning by blowing whistle shall be given before igniting the fuse. Blasting work shall be done under careful supervision and trained personnel shall be employed. Blasting shall not be done within 200 metres of an existing structure, unless specifically permitted by the Engineer-in-Charge in writing. All procedures and safety precautions for the use of explosives drilling and loading of explosives before and after shot firing and disposal of explosives shall be taken by the contractor as detailed in IS 4081, safety code for blasting and related drilling operation.

Excavation In All Kinds of Soils

All excavation activities, whether performed manually or using mechanical equipment, shall include both the excavation itself and the process of "getting out" or removing the excavated earth or materials from the excavation site. This includes clearing and throwing the excavated material to a suitable distance to prevent obstruction at the edge of the excavation area. Specifically, in the case of excavation for trenches, basements, pipelines, or water lines, the excavated material must be placed at a distance of at least one metre or half the depth of the excavation—whichever is greater—from the edge of the pit or trench. This is essential for maintaining site safety and facilitating further work. For other types of excavation works, the excavated material shall be deposited or stacked as per the direction given in the project specifications or drawings. The "getting out" of the material is considered an essential part of the excavation operation. If the excavated material is to be disposed of beyond the initial dumping area, the additional transport or lead shall be clearly specified. Such disposal, if not part of the excavation item, must be stated separately, including the lead distance, to ensure accurate scope definition and cost estimation.

Measurements

The length and breadth of excavation or filling shall be measured with a steel tape correct to the nearest cm. The depth of cutting or height of filling shall be measured, correct to 5 mm, by recording levels before the start of the work and after the completion of the work. The cubical contents shall be worked out to the nearest two places of decimal in cubic metres. In case of open footings up to the depth of 1.5 metres, around excavation of 30 cm. beyond the outer dimension of footing shall be measured for payment to make allowances for centering and shuttering. Any additional excavation beyond this limit shall be at the risk and cost of the contractor and shall not be measured for payment.

In case of open footings/Rafts at a depth of more than 1.5 metre, around excavation of 75 cm

shall be measured for payment to make allowance for centering and shuttering. Additional excavation beyond this limit shall be at the risk and cost of the contractor and shall not be measured for payment. In case the ground is fairly uniform and where the site is not required to be levelled, the Engineer-in-Charge may permit the measurements of depth of cutting or height of filling with steel tape, correct to the nearest cm. In case of borrow pits, diagonal ridges, cross ridges or dead-men, the position of which shall be fixed by the Engineer-in-Charge, shall be left by the contractor to permit accurate measurements being taken with steel tape on the completion of the work Deduction of such ridges and dead men shall be made from the measurements unless the same are required to be removed later on and the earth so removed is utilized in the work. In the latter case nothing extra will be paid for their removal as subsequent operation.

Rates:

The rates for the project are determined based on the Delhi Schedule of Rates (DSR), which provides standardized unit costs for various construction activities and materials. Each component of the work, as defined in the project scope, is measured in its appropriate unit—whether area, volume, length, or number—depending on the nature of the item. Once the quantities are calculated accurately through detailed measurements, they are multiplied by the corresponding unit rates provided in the DSR to estimate the cost of each item. This standardized approach ensures consistency and transparency in cost estimation. The DSR tables serve as a reliable reference for determining the financial requirements of materials and labor for different tasks. After individual costs of all items are computed, they are collectively summed to obtain the total estimated cost of the project. This method of estimation not only streamlines the budgeting process but also helps in ensuring compliance with government norms and maintaining cost efficiency throughout the project execution.

OTHER FIXTURES/ AMENITIES

1.Tactile tiles provision:

Tactile tiles, also known as tactile paving or detectable warning surfaces, are specially designed tiles with textured surfaces that provide guidance and alerts to visually impaired individuals. They are installed on walking surfaces to communicate changes in the environment using the sense of touch.

These are provided on:

- ☐ At staircases, ramps, and entrances of the lecture hall building
- ☐ Along corridors and pathways to assist mobility-impaired users
- ☐ Near lift lobbies and exits

Benefits:

- ☐ Promotes universal accessibility
- ☐ Helps meet statutory accessibility and safety standards
- ☐ Enhances inclusive infrastructure for all users



Fig 7. Tactile tiles

2.Rain-Water Harvesting:

As per CPWD guidelines, rainwater harvesting (RWH) is mandatory for all new buildings with plot areas above 1000 sq.m. The system involves collecting rainwater from rooftops and paved areas through a network of down pipes, which is then directed to a filtration chamber and either stored for non-potable use or used to recharge groundwater through recharge pits or wells.

The typical CPWD-compliant RWH system includes first flush arrangements, silt traps, a 3-layer filter chamber (sand, gravel, charcoal), and recharge pits filled with aggregates. It helps reduce reliance on external water sources, supports groundwater recharge, and ensures compliance with sustainability and statutory norms under CPWD and NBC guidelines.

3.Acoustics and Sound proofing:

Good acoustics in lecture halls are essential to ensure clear audibility for all students, especially in large 120-seater and 60-seater halls. Acoustic treatment includes installing sound-absorbing materials like mineral wool panels, acoustic ceiling tiles, and wall panels to reduce echo and reverberation. The false ceiling system in each hall typically integrates these materials to enhance speech clarity. Soundproofing is achieved through double-glazed windows, solid-core doors with seals, and acoustically insulated partitions to prevent sound leakage between adjacent halls. These measures comply with NBC Part 8 – Building Services and aim to maintain an ambient reverberation time (RT) of around 0.6 to 0.8 seconds, ideal for lecture spaces.

4. Water treatment unit:

A Water Treatment Unit is a critical component in modern institutional infrastructure, ensuring the continuous supply of clean and safe water for various applications such as drinking, sanitation, and laboratory use. In the construction of the Lecture Hall Complex under CPWD, Bilaspur Division, a dedicated water treatment system was installed to meet the water quality standards required for non-potable and potable usage.

The system installed comprises dual pressure filters—a sand filter and an activated carbon filter—each encased in robust blue cylindrical vessels, as shown in Figure 8. The sand filter is responsible for removing suspended particles and turbidity, while the carbon filter eliminates chlorine, organic compounds, and odors from the water. The transparent piping system and valves seen in the figure enable flow control, backwashing, and flushing operations necessary for regular maintenance. As depicted in Figure 8, the system includes a support structure and a base concrete slab for stable installation. During the installation, gravel (as seen in the technician's hand) was added as the filter media base, over which sand and carbon layers are filled. This setup ensures high filtration efficiency and longer filter life.

Depending on the raw water characteristics, additional treatment stages such as micron filtration, UV disinfection, or Reverse Osmosis (RO) can be integrated. In this particular case, the filtration unit is suitable for general usage such as drinking water stations, wash basins, and toilet flushing, especially important in institutional buildings where consistent water quality is essential. The system aligns with CPWD norms and follows Bureau of Indian Standards (BIS) guidelines, particularly IS 10500 for drinking water quality. Maintenance procedures such as periodic backwashing, media replacement, and routine water quality testing are planned to ensure operational efficiency and hygiene.



---knygnclusion of such a treatment unit not only reflects an emphasis on occupant health and hygiene but also aligns with sustainable building practices by enhancing water reuse and

minimizing dependence on external sources. Through this installation, the CPWD has demonstrated a commitment to implementing modern utility systems that support the long-term functionality and environmental responsibility of public infrastructure.

A Water Treatment Unit ensures the supply of clean, safe water for non- potable and potable use within the building. It typically includes filtration, disinfection, and softening systems to remove suspended solids, chlorine, iron, hardness, and microbial contaminants. The unit consists of sand and carbon filters, micron filters, UV or ozone disinfection systems, and sometimes reverse osmosis (RO) systems, depending on water quality requirements. In institutional buildings like a lecture hall complex, the treated water is used for drinking water stations, hand wash areas, and laboratories, if any. The system complies with CPWD and BIS standards (e.g., IS 10500 for drinking water) and is maintained through regular backwashing, filter replacement, and quality checks to ensure continuous, safe water supply.

5.Fire safety provision:

Fire safety in the lecture hall complex is ensured through a combination of active and passive fire protection measures as per NBC Part 4, CPWD Fire Safety Manual, and local fire authority guidelines. Key provisions include fire extinguishers, smoke detectors, manual call points, and fire alarm panels installed on each floor. Fire exit signage, emergency lighting, and fire-rated doors are provided to guide safe evacuation during emergencies.

Additionally, the building includes external emergency staircases, dedicated fire escape routes, and provisions for fire hose reels and water hydrants connected to a central firefighting water tank and pump system. Lift shafts and electrical panels are equipped with fire-rated materials, and regular fire drills and inspections are mandated to ensure compliance and preparedness.

As seen in the image below fig. 9, a dedicated steel staircase structure has been installed on the exterior of the building as a crucial fire safety provision. This staircase serves as an emergency exit to ensure safe and efficient evacuation during fire incidents or other emergencies. The structure is composed of steel channels and I-sections, providing a robust yet lightweight framework suitable for quick assembly. Each landing is aligned with floor levels and securely anchored to the RCC building frame, ensuring stability under both regular and emergency loads.

Fig 9: Fire safety provision



The staircase extends from the ground to the terrace level, covering all floors of the G+4 building. Temporary bracing supports are visible at the base, indicating the installation is still in progress. The fire escape staircase reflects compliance with safety codes and enhances the building's overall emergency response system. Its provision is mandatory for all public and institutional buildings of this height, contributing significantly to occupant safety.

CONCLUSION

The internship at the Central Public Works Department (CPWD), Bilaspur Division, provided me with valuable exposure to real-time construction practices and project management in the execution of major infrastructure works. Being part of the construction of the Guru Ghasidas Vishwavidyalaya Girls Hostel, Boys Hostel, and Lecture Complex was an enriching experience that bridged the gap between academic learning and field application.

During the internship, I gained practical knowledge in areas such as site layout, planning, foundation work, RCC structures, quality control measures, estimation, billing, safety protocols, and coordination among various stakeholders. I observed how CPWD ensures strict adherence to design specifications, government norms, and construction standards while maintaining project timelines and cost-efficiency. A key technical learning involved understanding how rates are derived using the Delhi Schedule of Rates (DSR), which standardizes costing for various works. Each work component—excavation, RCC, brickwork, plastering, etc.—was measured in its respective unit and multiplied by DSR unit rates to determine overall costs. This systematic estimation was vital in budgeting and tendering.

Excavation work, both manual and mechanical, was carried out efficiently, following safety protocols. ‘Getting out’ of excavated material and its subsequent disposal were done in accordance with prescribed lead and lift conditions, minimizing environmental impact and maintaining site cleanliness. Another crucial observation was the inclusion of fire safety provisions, particularly the external steel staircase installed at the rear of the hostel buildings. This structure ensures emergency egress and reflects CPWD’s commitment to safety and compliance with fire regulations. The staircase, supported by robust steel members and securely anchored to the building façade, was constructed with attention to accessibility, durability, and code compliance.

This hands-on learning opportunity enhanced my technical understanding, improved my problem-solving ability, and provided me with insights into professional communication and teamwork in large-scale public sector projects. Witnessing each stage of construction and its alignment with engineering principles and government norms was invaluable. Overall, the internship strengthened my foundation for a career in civil engineering and inspired me to continue learning and contributing meaningfully to the construction industry.

REFERENCE

- **Central Public Works Department (CPWD)** – *Standard Schedule of Rates (DSR), Specifications and Manuals*. Government of India.
- **IS 456:2000** – *Code of Practice for Plain and Reinforced Concrete*, Bureau of Indian Standards (BIS), New Delhi.
- **IS 875 (Part 1 to 5)** – *Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures*, BIS, New Delhi.
- **CPWD Works Manual 2023** – *Guidelines and procedures followed by CPWD in construction works and project execution*.
- On-site learning and observations under: **CPWD, Bilaspur Division**,
Rama Life City, Block 14, Bilaspur, Chhattisgarh - 495001



गुरु घासीदास विश्वविद्यालय, बिलासपुर
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Guru Ghasidas Vishwavidyalaya, Bilaspur
A Central University established by the Central Universities Act 2009 No. 25 of 2009

A COMPREHENSIVE TRAINING REPORT

“Industrial Greywater Treatment using Electrochemical Advanced Oxidation Process”

Indian Institute of Engineering Science and Technology, Shibpur,

West Bengal

(6 WEEKS)

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CIVIL ENGINEERING & VIIth Semester

Session 2025-26 Submitted to:

DEPARTMENT OF CIVIL ENGINEERING

School of Studies, Engineering & Technology

GURU GHASIDAS VISHWAVIDYALAYA

Bilaspur (C.G.) 495009

A CENTRAL UNIVERSITY

(Established under the Central Universities Act, 2009 No. 25 of 2009)

Accredited with NAAC A⁺⁺

DECLARATION

I, Annu Kumari hereby declare that the work presented in this report entitled “Industrial Greywater Treatment using Electrochemical Advanced Oxidation Process” submitted to Indian Institute of Engineering Science and Technology (IEST), Shibpur, West Bengal for fulfilment of Research Internship in the Environmental Engineering Laboratory, Civil Engineering Department, IEST Shibpur is an authentic record of our work carried out under the guidance of Dr Asok Adak.

Annu Kumari
Prakash Tiwari

Undergraduate Research Intern at IEST
(May-June 2025)

Final Year Undergraduate
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CERTIFICATE

Certified that the Summer Internship Program report entitled “Industrial Greywater Treatment using Electrochemical Advanced Oxidation Process” submitted by Annu kumari, Prakash Tiwari of B. Tech 7th Semester in Civil Engineering, School of Studies in Engineering and Technology, Guru Ghasidas Vishwavidyalaya, Bilaspur, is a record of bonafide work carried out by them during the academic session 2024–25 at the Indian Institute of Engineering Science and Technology (IEST), Shibpur.

The internship was undertaken under the guidance and supervision of Dr. Asok Adak, Professor, Department of Civil Engineering, IEST Shibpur.

This report is submitted in partial fulfillment of the requirements for the award of the degree of Bachelor of Technology in Civil Engineering. The work embodied in this report is the original contribution of the students and has not been submitted to any other institution for the award of any other degree or diploma.

Date:

Place:

Signature

Name – Dr. Asok Adak
Associate Professor
IEST Shibpur

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GROUP MEMBERS:

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Abstract

Dye-bearing wastewater poses a major threat to aquatic ecosystems due to its high color intensity and resistance to biodegradation. When discharged untreated into natural water bodies, it significantly reduces light penetration, disrupting the photosynthesis process and lowering the dissolved oxygen content, thereby harming aquatic life. In this study, Electrochemical Advanced Oxidation Process (EAOP) was employed to remove Reactive Orange 84 dye from synthetic dye-bearing wastewater. The effect of key operational parameters such as electrolyte concentration (NaCl), current density, pH, and initial dye concentration was studied to evaluate their impact on the degradation efficiency.

Results indicated that an increase in NaCl concentration, acting as a supporting electrolyte, enhanced the generation of reactive species, thereby improving dye degradation. Similarly, higher current densities contributed to greater oxidant production, increasing the rate of dye removal. However, an increase in pH and initial dye concentration was found to negatively affect the degradation efficiency due to reduced availability of hydroxyl radicals and increased dye loading, respectively.

Optimization of these parameters was carried out using a statistical design approach, and the optimum conditions for maximum dye removal were determined as: current density of 1.77685 mA/cm², NaCl concentration of 1 mM, pH of 3, and initial dye concentration of 500 mg/L. Under these conditions, a maximum removal efficiency of 67.4641% was achieved with a desirability value of 0.814, making this solution the most optimal among 47 experimental runs. The study demonstrates the effectiveness of EAOP in degrading synthetic dye under controlled parameters and contributes to the development of sustainable dye wastewater treatment technologies.

1: Introduction

The use of synthetic dyes in industries such as textiles, paper, cosmetics, and leather is rising rapidly due to their vivid colors and ease of application. However, this widespread usage results in the generation of significant volumes of dye-bearing wastewater, which poses severe environmental challenges. During industrial dyeing processes, approximately 10–15% of the total dye used is lost to wastewater, leading to the discharge of over 0.8 million tons of dye into water bodies annually [1]. These effluents hinder sunlight penetration and reduce photosynthetic activity in aquatic ecosystems, resulting in lower dissolved oxygen levels and adverse effects on aquatic flora and fauna [2]. Additionally, dye-laden wastewater often contains high Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD) values, ranging between 150–30,000 mg/L and 80–6,000 mg/L respectively [3], making it highly resistant to conventional biological treatment methods.

To address these issues, advanced oxidation processes (AOPs), particularly Electrochemical Advanced Oxidation Processes (EAOPs), have gained attention due to their ability to generate reactive oxygen species (ROS) such as hydroxyl radicals ($\bullet\text{OH}$), which are capable of non-selectively oxidizing and mineralizing a wide range of organic pollutants [4,5]. The performance of EAOP largely depends on parameters like the applied current, pH, initial pollutant concentration, and nature and concentration of the supporting electrolyte [6,7].

In the present study, Reactive Orange 84 (RO84) dye was selected as the model pollutant for treatment via EAOP. A Graphite Substrate Lead Dioxide (GSLD) anode was employed along with a stainless-steel cathode to form the electrochemical cell. The GSLD electrode is known for its excellent electrocatalytic activity, chemical stability, and mechanical strength. Although various studies have previously explored the use of GSLD anodes for pollutant degradation [8–10], this work focused solely on analyzing the degradation efficiency without comparing different anode or cathode materials.

Electrolyte selection plays a vital role in EAOP efficiency. Sodium chloride (NaCl) was used as the supporting electrolyte in this study due to its ability to generate active chlorine species under anodic conditions, which further enhance oxidation. The generation of these secondary oxidants contributes significantly to the overall dye degradation mechanism. Additionally, NaCl is cost-effective and commonly available, making it a practical choice for large-scale applications.

Parameter optimization is crucial in maximizing the degradation efficiency of the EAOP system. The effectiveness of the process was studied with variations in current density, NaCl concentration, pH, and dye concentration. Increasing current density and NaCl concentration was found to improve dye degradation due to enhanced ROS formation, while higher pH and dye concentrations led to reduced performance. The optimum removal efficiency of 67.4641% was achieved under conditions of 1.77685 mA/cm² current density, 1 mM NaCl, pH 3, and 500 mg/L initial dye concentration, with a desirability of 0.814, indicating statistically optimal performance. This study provides insight into the efficient design of electrochemical treatment systems and offers a potential route for scaling up dye removal technologies in industrial applications.

2: Literature Review

2.1. Wastewater Characterization based on quality parameters

Wastewater is a by-product of human activities, ranging from domestic chores to large-scale industrial operations. As societies develop and industrialize, the volume and complexity of wastewater increase significantly, making its management a critical environmental concern. A fundamental step in wastewater management is its characterization, which involves the detailed analysis of its physical, chemical, and biological qualities. Wastewater is broadly classified into municipal and industrial types, each with unique features influenced by their respective sources. Understanding these characteristics is essential for designing effective treatment systems and ensuring that discharged effluents meet environmental and regulatory standards.

Municipal wastewater, often referred to as domestic sewage, originates from households, institutions, and small-scale commercial activities. It comprises wastewater from kitchens, bathrooms, toilets, and laundry, mixed with minor contributions from commercial establishments and public facilities. This type of wastewater is primarily composed of organic matter such as carbohydrates, proteins, and fats, as well as inorganic substances like salts and trace metals. Suspended solids, nutrients like nitrogen and phosphorus, and microbial pathogens are also commonly present. The characteristics of municipal wastewater are relatively uniform compared to industrial effluents, although they can vary with population density, water usage patterns, and socio-economic status.

The quality parameters used to assess municipal wastewater include a range of physical, chemical, and biological indicators. Physically, municipal sewage is typically greyish when fresh, turning darker and more odorous as it becomes stale due to anaerobic decomposition. Turbidity, which refers to the cloudiness caused by suspended particles, is also a key indicator. Temperature, while usually near ambient, can influence biological treatment processes if significantly elevated. Chemically, the pH of municipal wastewater usually remains between 6.5 and 8.5, indicating a neutral to slightly alkaline nature. Biochemical oxygen demand (BOD), which measures the amount of oxygen microorganisms need to decompose organic matter, typically ranges from 150 to 300 mg/L. Chemical oxygen demand (COD), indicating both biodegradable and non-biodegradable organic load, is generally higher than BOD, often lying between 250 and 500 mg/L. Total suspended solids (TSS) and total dissolved solids (TDS) commonly range between 150–350 mg/L and 200–500 mg/L respectively. Nutrient concentrations, particularly nitrogen in the form of ammonia and nitrate, and phosphorus as phosphates, are significant due to their potential to cause eutrophication in receiving waters. Biologically, municipal wastewater

harbors numerous microorganisms, including pathogenic bacteria such as *Escherichia coli*, viruses, and protozoa, posing serious public health risks if not properly treated.

In contrast, industrial wastewater arises from a wide variety of manufacturing and processing activities. It is far more heterogeneous in nature, and its composition depends heavily on the type of industry, raw materials used, production processes, and cleaning operations. Unlike municipal wastewater, which is relatively predictable, industrial effluents can contain a diverse array of pollutants, including toxic chemicals, heavy metals, synthetic compounds, high-strength organics, and substances that are resistant to biodegradation. As such, industrial wastewater often demands specialized treatment approaches and stringent regulatory monitoring.

Industrial effluents can exhibit extreme values for various quality parameters. Physically, they may possess a wide range of colors depending on dyes, pigments, or chemical residues used in production. Odors can range from mildly unpleasant to overwhelmingly pungent due to volatile organic compounds or sulfur-based compounds. Temperature levels can be considerably higher, especially in cases where heat is a by-product of the manufacturing process. Chemically, the pH of industrial wastewater can vary from highly acidic to highly alkaline, with values as low as 3 or as high as 11 or more, depending on the specific processes involved. BOD values may range from several hundred to several thousand milligrams per liter, particularly in food processing, paper, or textile industries. COD levels can be extraordinarily high, often reaching or exceeding 10,000 mg/L, indicating the presence of a large load of chemically oxidizable substances. The BOD/COD ratio in industrial effluents is a critical indicator of biodegradability. A low ratio (less than 0.3) often suggests the dominance of non-biodegradable components, necessitating advanced or chemical treatment methods.

Suspended and dissolved solids in industrial wastewater can be excessive. Total suspended solids might exceed 5,000 mg/L in cases involving raw material handling or surface washing, while TDS levels can surpass 10,000 mg/L in effluents from tanneries, textile dyeing, or chemical manufacturing plants. Toxic pollutants such as heavy metals—lead, chromium, mercury, cadmium, and arsenic—are common in many industrial discharges and pose significant threats to aquatic life and human health. Phenolic compounds, cyanides, pesticides, and persistent organic pollutants may also be present, depending on the industry. Biological characteristics of industrial wastewater vary widely. While some effluents may be rich in biodegradable organic matter and microorganisms, others may be virtually sterile or even contain bactericidal substances that inhibit microbial activity, complicating biological treatment processes.

2.2. Dye removal from wastewater

There are two ways by which dye-bearing wastewater can be treated. The treatment techniques can either separate the dye from wastewater (passive treatment) or degrade it into end products (active treatment). Different physiochemical method such are coagulation, sorption, and membrane-based filtration are the examples of passive treatment studied by different researchers for treatment of dye-bearing wastewater. At the same time, in techniques like AOP and biological treatment, dyes are degraded into their end products. Figure 1 shows the flow diagram of different treatment methods reviewed in this paper.

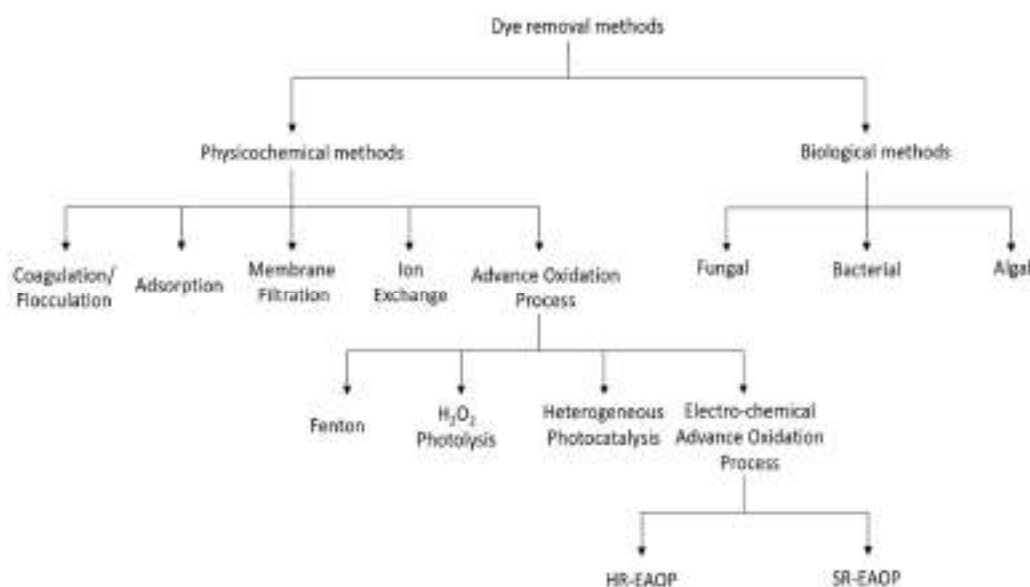


Figure 1: Classification of different physicochemical and biological methods for the treatment of dye-bearing wastewater

2.2.1. Electrochemical Advanced Oxidation Process

Electrochemical Advanced oxidation processes (EAOPs) are water treatment processes that generate a powerful oxidizing agent, such as ($\text{OH}^\bullet$) and ($\text{SO}_4^{\bullet-}$), to decontaminate wastewater effectively. These radicals are powerful oxidants that can non-selectively destroy most organic and organometallic contaminants until their complete mineralization into CO_2 , water and inorganic ions.

2.2.1.1. Dye removal by EAOP-based on hydroxyl radicals

Hydroxyl radicals are electrochemically generated in an electrochemical reactor (Figure 2). The reactor consists of a direct current power supply, a cathode, an anode and electrolyte (a medium that provides the ion transport mechanism between anode and cathode necessary to maintain the electrochemical process).

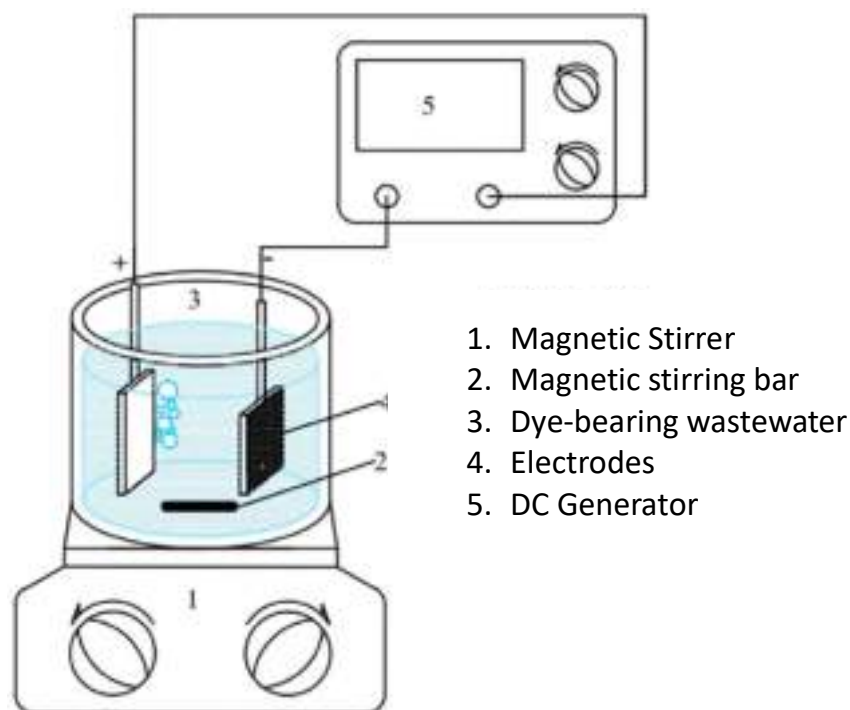


Figure 2: Conceptual diagram of an electrochemical reactor

The anodic oxidation (AO) is a direct way to electrochemically generate $\text{OH}^\bullet$ radicals without using any extra chemicals. AO has two steps: (i) dye diffuses to the anode surface from the aqueous solution, and (ii) dye is then oxidized at the anode surface. Thus, substrate mass transfer and electron transfer at the electrode surface (S) will determine the degradation efficiency. The $\text{OH}^\bullet$ is electrocatalytically generated by the following reaction (Eq. 01). Figure 3 demonstrates the mechanisms of electrochemical degradation for organic contaminants in wastewater. There are three main degradation mechanisms – direct electrolysis of pollutants, anodic oxidation and mediated or indirect oxidation.



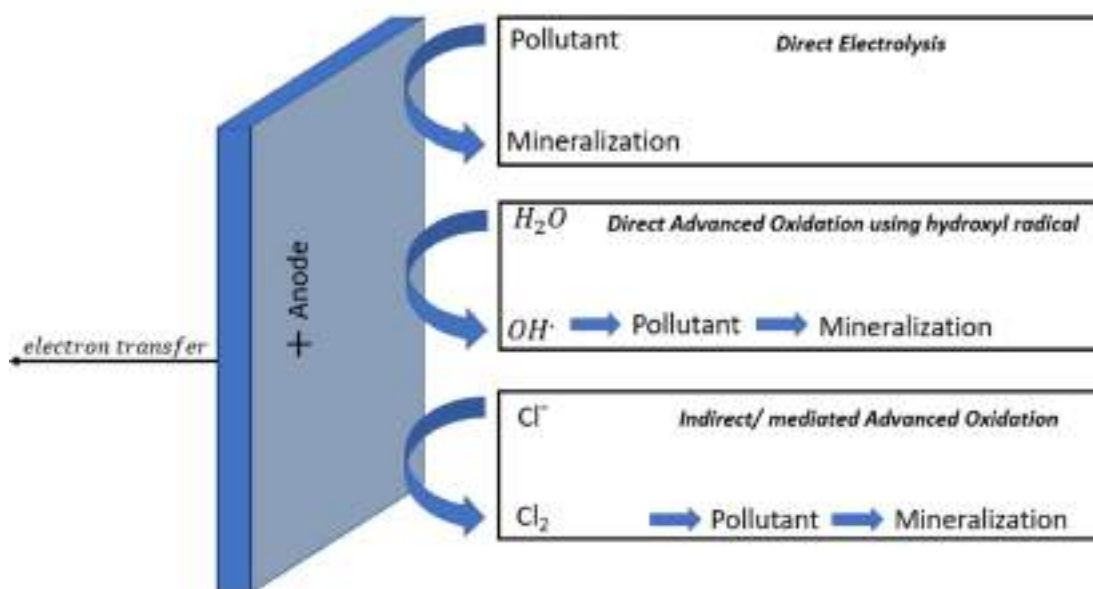


Figure 3: The mechanisms of dye removal by Electro-chemical advanced oxidation process

2.3. CPCB Guidelines

The Central Pollution Control Board (CPCB) under the Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India, issues guidelines and standards for wastewater treatment from municipal and industrial sources. These guidelines are crucial for maintaining environmental and public health standards.

Municipal Wastewater Treatment Guidelines (Sewage)

Discharge Standards (CPCB General Standards for STPs):

Table 1a: Municipal Wastewater Treatment Guidelines

Parameter	Limit (mg/L)
BOD (5 days, 20°C)	≤ 10
COD	≤ 50
TSS (Total Suspended Solids)	≤ 20
pH	6.5–9.0
Total Nitrogen	≤ 10
Faecal Coliform	<1000 MPN/100 mL

Industrial Wastewater Treatment Guidelines:

CPCB mandates that every industry must treat its effluent to meet specific Effluent Discharge Standards, which vary by sector (e.g., textile, chemical, food processing, etc.).

Common CPCB Industrial Discharge Standards:

Industries discharging directly into surface water or marine systems must meet stricter standards than those discharging to CETPs (Common Effluent Treatment Plants).

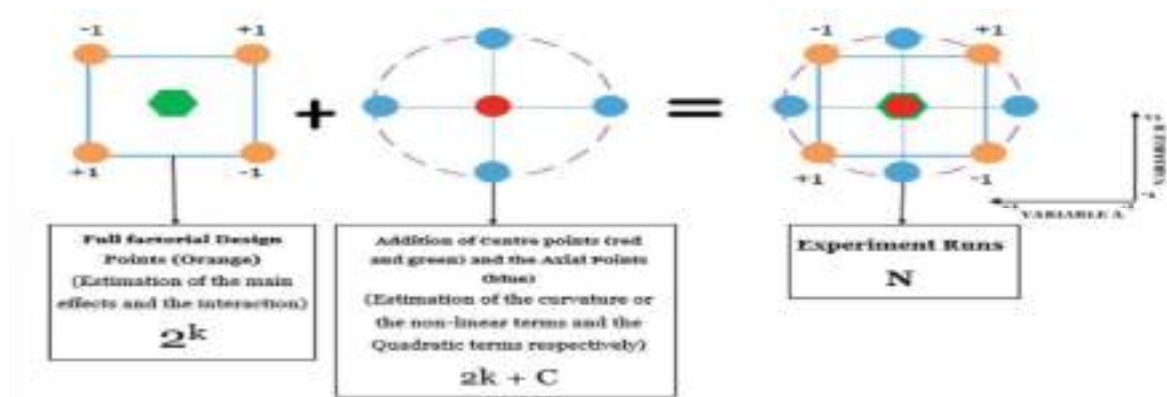
Table 1b: Industrial Wastewater Treatment Guidelines

Parameter	Inland Surface Water	Public Sewers
pH	5.5–9.0	5.5–9.0
BOD (mg/L)	≤ 30	≤ 350
COD (mg/L)	≤ 250	≤ 500
TSS (mg/L)	≤ 100	≤ 600
Oil & Grease (mg/L)	≤ 10	≤ 20
Heavy metals (Zn, Pb, Cr, etc.)	Sector-specific	Sector-specific

2.4. Central composite design

Central composite design (CCD): This is a unique kind of response surface design that can fit a full quadratic model. It is comprised of factorial also known as fractional factorial design with a center point attached to a group of stars or axial points. Using the included axial points is an effective method for calculating the coefficients of a second-degree polynomial for the factors. A CCD can be denoted as a square (for two factors design) or a cube (for a three factors design) having corners, which represent the levels (high and low represented as +1, -1 respectively), a star or axial points along the axes at or outside the square helps to account for the curvature and a center point at the origin. The general model for a two-factor full factorial CCD is represented graphically in Figure 4 below.

Figure 4: The general model for a two-factor full factorial CCD is represented graphically



A visual depiction of the CCD model for determination of total runs for all experiments for two factors full factorial design. K in the model is the number of factors; C is the replicated central points that help to eliminate pure error and N is the experiment runs required for the design.

Figure 5 displays a three-factor lay out for a CCD made up of a full factors factorial that forms the cube where each side is coded -1 and $+1$ just like in Figure 4 above. The Stars stand for axial points and alpha is the distance from the edge of the cube to the stars.



Figure 5: A graphical representation of three factors in a full factorial design.

2.5. Spectrophotometer

A spectrophotometer is a scientific instrument used to measure the amount of light absorbed by a sample. It plays a vital role in analytical chemistry, especially for determining the concentration of solutes in a solution based on how much light is absorbed when the solution is placed in a cuvette. The method relies on the principle that substances absorb specific wavelengths of light, and the amount of absorbed light is proportional to the concentration of the absorbing substance.

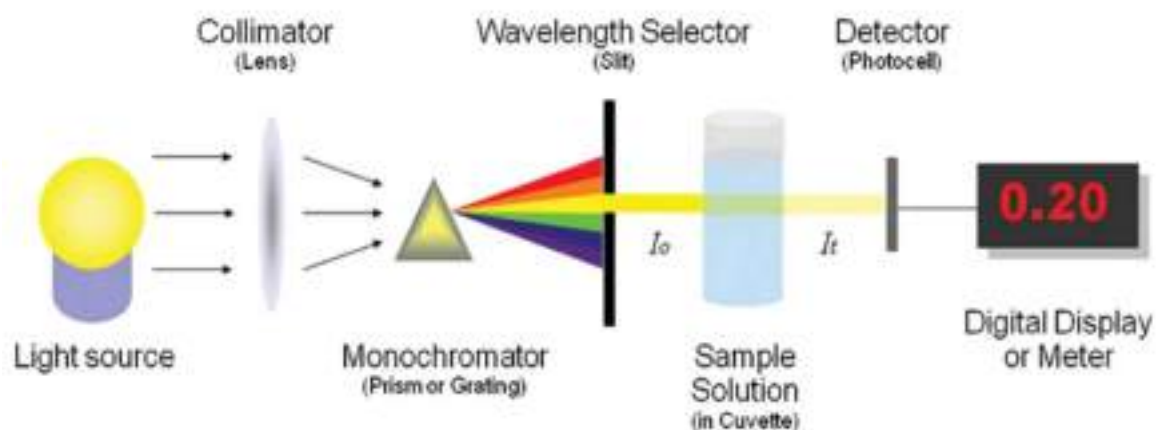


Figure 6: Spectrophotometer

The invention of the spectrophotometer dates back to 1940, when Arnold J. Beckman and his team at the National Technologies Laboratory developed the Beckman DU spectrophotometer. The working principle involves measuring light intensity across a range of wavelengths. This is achieved by splitting a light beam into its constituent wavelengths using either a prism or a diffraction grating. The desired wavelength is then directed toward the sample, and the transmitted light is detected and analyzed.

The basic instrumentation includes a radiant energy source (like electrically heated materials), a monochromator (using prisms or gratings to isolate specific wavelengths), a sample holder (cuvette), and a photosensitive detector. Prisms such as cornu quartz or Littrow prism and diffraction gratings are used for light dispersion. Cuvettes are generally made of glass or quartz, depending on the wavelength region. The detector system relies on the photoelectric effect to convert light into electrical signals, which are then amplified and displayed in readable formats.

Spectrophotometers have broad applications across scientific and industrial domains. They are used to detect concentrations of chemicals, identify impurities, characterize proteins, analyze respiratory gases, and study the molecular structure of compounds. Additionally, they help in determining molecular weights and monitoring dissolved oxygen in environmental studies. Spectrophotometry, especially in UV and visible regions, is also useful in both pure and biological sample analysis.

3: Scope and Objective

3.1. Objective

The objective of this study is to investigate and optimize the degradation of a synthetic dye in aqueous solution through a sequential Electrochemical Advanced Oxidation Process (EAOP), using statistical optimization techniques to enhance process efficiency and evaluate the degradation mechanism.

3.2. Scope

- i. Selection of a model dye.
- ii. Optimization of the electrode.
- iii. Variation of different parameters.
- iv. Optimisation of the process

4.1. Chemicals and reagents

Reagent grade lead (II) nitrate ($\text{Pb}(\text{NO}_3)_2$) and Copper (II) nitrate ($\text{Cu}(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$) were obtained from Qualigens. NaOH (0.1N) and HCl were used for pH adjustments. Sodium chloride (NaCl) as an electrolyte were brought from Fischer scientific. For the preparation of samples and dilution, deionized water was used. GSLD electrode (6*5*1 cm) prepared at optimized condition and stainless-steel plate of same size of GSLD were used as anode and cathode in the anodic oxidation.

4.1.1. Electrochemical degradation and analytical methods

The anodic oxidation of RO 84 took place in an 800 ml batch reactor. Anode and cathode materials comprised GSLD and stainless steel, respectively, with a fixed spacing of 2 cm between them. To ensure uniform mixing, a magnetic stirrer operated was employed. As an electrolyte, sodium chloride was used as an electrolyte. The samples were taken from the reactor at an interval of 0, 5, 10, 15, 20, 30, 45 and 60 min.

Dye removals were measured using UV-Vis. spectrophotometer at the maximum absorption wavelength of 490 nm. Colour removal efficiency can be measured using the (Eq. 18) and rate constant (K) of the dye removal can be measured using (Eq. 19).

$$\text{Colour removal efficiency} = C_0 - C_t / C_0 * 100 \quad (2)$$

$$\ln(C_t / C_0) = -K * t \quad (3)$$

Where, C_0 is the initial dye concentration, C_t is the dye concentration at time t and K is the rate constant.

4.1.2. Experimental design and process optimization

Central Composite Design is a type of experimental design used in statistical modeling, especially in the field of RSM. CCD is particularly useful for studying the relationship between multiple independent variables and a response variable. For the optimization purpose, a four- factorial five levels CCD was performed consisting of 30 trials. All the four operation parameters that are current, NaCl concentration, pH and initial concentration of RO 84, with their respective levels have been

shown in (Table 2). All the 30 trials with their respective responses colour removal efficiency (R1) have been shown in (Table 3).

Table 2: Experimental range and levels of operational parameters

Varying Parameters	Code	Coded Levels					Unit
		-2	-1	0	+1	+2	
Current	X_1	1	2	3	4	5	mA/cm ²
NaCl	X_2	1	2	3	4	5	mM
pH	X_3	3	5	7	9	11	
IC	X_4	100	200	300	400	500	mg L ⁻¹

4.1.3. Result and discussions

4.1.3.1. Analysis of Central Composite Design

A total of 30 experimental trials were performed varying all the four operational parameters that are current (X_1), NaCl concentration (X_2), pH (X_3) and initial concentration of RO 84 dye (X_4). Colour removal efficiency was the single response (R_1) that was determined after a period of 60 min. for each trial.

Upon scrutinizing the experimental data (Table 3), it is unequivocally established that an increase in the 1st two parameters lead to increase in the colour removal efficiency, while, it got decreased due to increase in the last two parameters. Consequently, the improvement in colour removal efficiencies can be attributed to this escalation in hydroxyl radical formation for colour removal efficiencies using the sequential model sum of squares, a quadratic model as a best suitable fit was proposed, yielding an R^2 value of 0.998. The quadratic equation that best captures the relationship, expressed in terms of coded values, is provided in (Eq. 4). Utilizing this coded equation allows for predicting the influence of different parameters on the colour removal efficiencies of RO 84.

$$R = 58.23 + 13.84*A - 0.20*B - 1.57*C - 11.43*D - 1.49*AB - 0.455*AC + 2.5*AD - 2.56*BC - 4.27*BD - 0.4525*CD - 3.9*A^2 + 4.34*B^2 + 3.5*C^2 + 11.74*D^2 \quad (4)$$

Table 3: Experimental design matrix and obtained responses for RO 84 using CCD

Trials	Varying Parameters				Response
	Current (X_1) (mA/cm ²)	NaCl (X_2) (mM)	pH (X_3)	IC (X_4) (mg L ⁻¹)	Current (R) (Amp)
1	1	3	3	300	60.68

2	5	3	3	300	96.38
3	1	3	11	300	28.62
4	5	3	11	300	58.35
5	3	1	7	100	88.46
6	3	5	7	100	90.52
7	3	1	7	500	62
8	3	5	7	500	62.25
9	1	3	7	100	72.25
10	5	3	7	100	91.08
11	1	3	7	500	41.9
12	5	3	7	500	70.72
13	3	1	3	300	80.64
14	3	1	11	300	45.52
15	3	5	3	300	92.58
16	3	5	11	300	50.22
17	1	1	7	300	37.15
18	5	1	7	300	64.56
19	1	5	7	300	43.53
20	5	5	7	300	67.12
21	3	3	3	100	96.6
22	3	3	11	100	57.42
23	3	3	3	500	89.25
24	3	3	11	500	33
25	3	3	7	300	60.49
26	3	3	7	300	58.14
27	3	3	7	300	57.6
28	3	3	7	300	51.77
29	3	3	7	300	62.15
30	3	3	7	300	59.24

Analysis of Variance (ANOVA) was conducted to assess both the significance and adequacy of the model. (Table 4) reveals a substantial model F value of 255.28 for the proposed quadratic model, signifying its significance. The probability of obtaining such a large F value purely by chance is a mere 0.01%. Additionally, the p-value is less than 0.05, indicating the significance of the model terms. The Lack of Fit F-value of 3.2 implies the Lack of Fit is not significant relative to the pure error. There is a 10.56 % chance that a Lack of Fit F-value this large could occur due to noise. Non-significant lack of fit is good. The model's fitness was evaluated through determination coefficients, including R^2 , adjusted R^2 , predicted R^2 , and adequate precision. From (Table 4), it is quite evident that the discrepancy between adjusted and predicted R^2 is below 0.2, suggesting the fitness of the model.

Table 4: ANOVA results of the quadratic model for the response in terms of decolorization efficiencies of RO 84 using CCD

Source	Sum of squares	Degree of freedom	Mean square	F-value	Prob<F	Remarks
Model	10108.12	14	722.01	17.74	<0.0001	Significant
Residual	610.6	15	40.71			
Lack of Fit	546.97	10	54.7	4.3	0.0606	Not significant
Pure error	63.63	5	12.73			
R^2	0.9430					
Adjusted R^2	0.8899					
Predicted R^2	0.6975					

To further assess the model's adequacy, an actual vs predicted color removal efficiency plot was generated (Figure 7) from (Table 5) which illustrates a strong

correlation, with variations staying below 5%. The (Eq. 5) in terms of actual factors can be used to make predictions about the response for given levels of each factor. In summary, the ANOVA results and model evaluation metrics collectively affirm the significance and adequacy of the suggested quadratic model for color removal efficiency.

$$\begin{aligned}
 R = & 107.82177 + 12.54156*A - 5.67896*B - 1.54667*C - 0.211274*D - 0.186562*AB - \\
 & 0.11375*AC + 0.006244*AD - 0.32*BC - 0.005334*BD - 0.001131*CD - 0.974583*A^2 \\
 & + 0.271354*B^2 + 0.875729*C^2 + 0.000294*D^2
 \end{aligned}
 \tag{5}$$

Table 5: Actual Vs predicted color removal efficiencies for all the 30 trials

Trials	Varying Parameters				Color removal efficiency	
	Current	NaCl	pH	IC	Experimental	Predicted
	(X ₁)	(X ₂)	(X ₃)	(X ₄)	(%)	(%)
	(mA/cm ²)	(mM)		(Mg/L)		
1	1	3	3	300	60.68	63.39
2	5	3	3	300	96.38	94.06
3	1	11	3	300	32.62	26.39
4	5	11	3	300	58.35	51.08
5	3	7	1	100	70.46	82.89
6	3	7	5	100	90.52	86.94
7	3	7	1	500	47	61.06
8	3	7	5	500	62.25	63.31
9	1	7	3	100	72.25	66.17
10	5	7	3	100	91.08	88.86
11	1	7	3	500	41.9	38.44
12	5	7	3	500	70.72	71.12
13	3	3	1	300	80.64	81.99
14	3	11	1	300	45.52	47.12
15	3	3	5	300	92.58	90.26
16	3	11	5	300	50.22	45.15
17	1	7	1	300	37.15	42.02
18	5	7	1	300	64.56	70.61

19	1	7	5	300	43.53	46.08
20	5	7	5	300	67.12	72.85
21	3	3	3	100	96.6	101.49
22	3	11	3	100	57.42	70.03
23	3	3	3	500	89.25	87.28
24	3	11	3	500	33	38.76
25	3	7	3	300	60.49	58.29
26	3	7	3	300	58.14	58.29
27	3	7	3	300	57.6	58.29
28	3	7	3	300	51.77	58.29
29	3	7	3	300	62.15	58.29
30	3	7	3	300	59.24	58.29

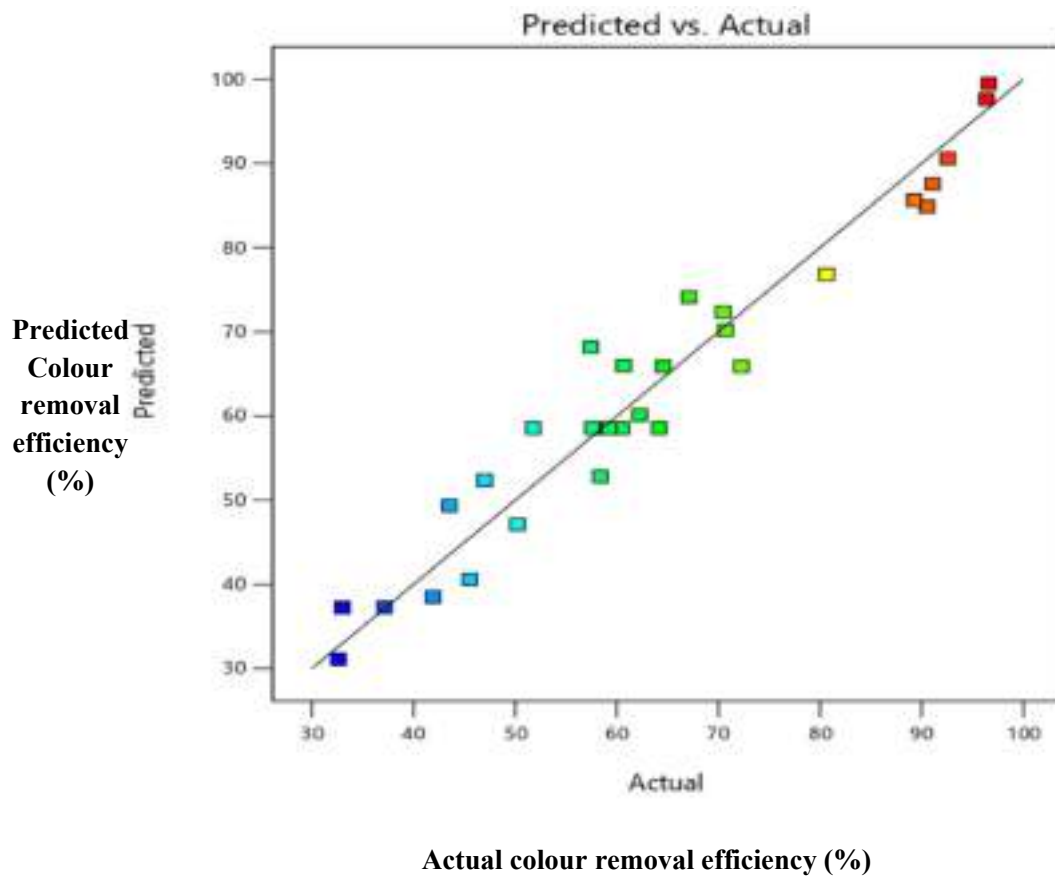


Figure 10: Diagnostic plot of actual vs predicted values for response R1

The coefficients of all the model terms in the mathematical expression (Eq. 4) illustrate the influence of each process variable on color removal efficiency which can also be identified by Pareto chart showing percentage effect of individual model term on color removal efficiency. The coefficient estimate represents the expected change in response per unit change in factor value when all remaining factors are held constant. From (Table 06), it can be seen that factors BD and B² have p-values more than 0.05. So, after removing these factors, the (Eq. 4) can be modified into (Eq. 6). All these factors will affect the response R₁. Both the sign and magnitude of coefficients of model terms in the mathematical expression are important for understanding the individual as well as synergistic effects of variables as positive sign indicates that there will be an increment in efficiency with increase of those factors whereas negative terms affect the system in reverse way.

$$R = 58.23 + 13.84*A - 0.20*B - 1.57*C - 11.43*D - 1.49*AB - 0.455*AC + 2.5*AD - 2.56*BC - 4.27*BD - 0.4525*CD - 3.9*A^2 + 4.34*B^2 + 3.5*C^2 + 11.74*D^2 \quad (6)$$

Table 6: Factors and their corresponding coefficient estimate and P values

Factor	Coefficient Estimate	P-value
Intercept	2298.55	<0.0001
A-Current	4800	<0.0001
B-pH	29.74	0.0012
C-NaCl	1568.88	<0.0001
D-IC	8.91	0.6466
AB	0.8281	0.8885
AC	24.95	0.4459
AD	26.21	0.4348
BC	72.85	0.2009
BD	0.819	0.8891
CD	104.21	0.1304
A ²	129.26	0.095
B ²	84.14	0.1711
C ²	945.17	0.0002
D ²	2298.55	<0.0001

Pareto analysis can be used to facilitate interpretation of the results and can be applied based on the following (Eq. 7).

$$P_i = 100 * b^2 / \sum b^2 \quad (7)$$

From (Figure 11), it can be confirmed that current has the highest effect on the colour removal efficiency of RO 84, while initial concentration of dye has the least effect. NaCl concentration and pH have the similar kind of effects. The effects of model terms on color removal efficiency of RO 84 can be represented in descending order as $A > B > C > D$.

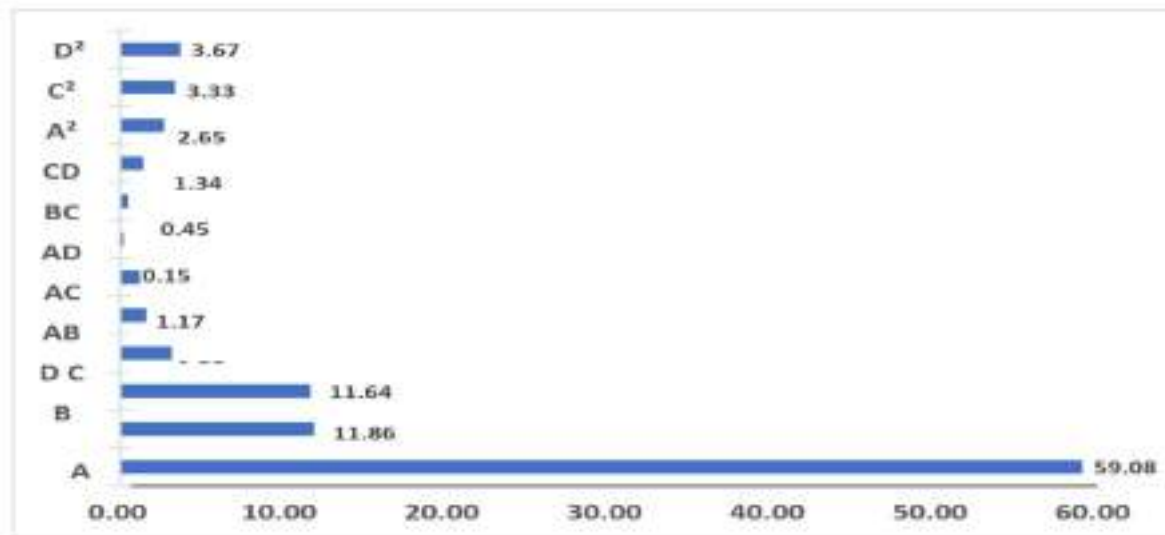


Figure 11: Percentage effect of each factor

4.1.3.2. Optimization of the varying parameters

Color removal efficiency of RO 84 (R1) was optimized using Design Expert 13, which was dependent on the four varying parameters that are current (X_1), NaCl (X_2), pH (X_3) and IC (X_4). The conditions that were imposed to optimize the color removal efficiency were to keep X_1 , X_2 , and X_3 at minimum and X_4 at maximum while response to maximum. The optimum conditions were obtained as current (X_1) = 1.77685 mAmp/cm², NaCl (X_2) = 1 mM, pH (X_3) = 3 and IC (X_4) = 500 mg/l. The optimum value of R under optimized conditions was obtained as 67.4641%.

5: Conclusion

The study successfully employed Central Composite Design (CCD) to optimize the electrochemical advanced oxidation process for RO 84 dye removal. A total of 30 experimental trials varying current, NaCl concentration, pH, and initial dye concentration were conducted, with color removal efficiency as the response variable. Results indicated that increasing current and NaCl enhanced efficiency, while higher pH and initial dye concentration reduced it. A quadratic model with high statistical significance ($R^2 = 0.998$) was developed to represent the system, and ANOVA confirmed the model's adequacy with a significant F-value and non-significant lack of fit. The actual vs predicted plot showed strong correlation, and Pareto analysis identified current as the most influential factor. Optimization using Design Expert 13 yielded the ideal conditions: current = 1.77685 mA/cm², NaCl = 1 mM, pH = 3, and IC = 500 mg/L, achieving a maximum predicted color removal efficiency of 67.46%. This model provides a reliable predictive and optimization tool for dye removal processes in industrial wastewater treatment.

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गुरु घासीदास विश्वविद्यालय, बिलासपुर
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Guru Ghasidas Vishwavidyalaya, Bilaspur
A Central University established by the Central Universities Act 2009 No. 25 of 2009

A CONPREHENSIVE TRAINING REPORT

“PREDICTING BRIDGE PIER SCOUR USING EXPLAINABLE MACHINE
LEARNING MODELS”

NATIONAL INSTITUTE OF TECHNOLOGY, PATNA, BIHAR
(6 WEEKS)

Submitted by

Anshuman

Enrolment No.: GGV/22/01003

4th Year, 7th Semester

Session: 2025-26

Submitted to:

DEPARTMENT OF CIVIL ENGINEERING

School of Studies, Engineering & Technology
GURU GHASIDAS VISHWAVIDYALAYA
Bilaspur (C.G.) 495009
A CENTRAL UNIVERSITY

(Established under the Central Universities Act 2009 No.25 of 2009)

Accredited with NAAC A⁺⁺

DECLARATION BY THE STUDENT

I, **Anshuman**, a student of **B.tech, Department of Civil Engineering, Guru Ghasidas Vishwavidyalaya**, hereby solemnly declare that the report entitled “ **Prediction Bridge Piers Scour Using Explainable Machine Learning Model**” is a genuine and original record of the industrial training/internship undertaken at **National Institute of Technology, Patna** during the period from **19/05/2025 to 30/06/2025**.

The work presented in this report is entirely my own and has not been copied, reproduced, or submitted elsewhere for any academic or professional purpose. I affirm that:

- All information and observations recorded were made during my tenure at the above-mentioned organization.
- No part of the report has been plagiarized or duplicated from any other source.
- Proper references and acknowledgments have been made wherever external information has been consulted.

I understand that any violation of this declaration may result in academic or disciplinary action as per the rules and regulations of the institution.

Place: Bilaspur, Chhattisgarh

Date: 04/08/2025

Signature of the Student

Name: Anshuman

Enrollment No.: GGV/22/01003

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I extend my heartfelt appreciation to our **Hon'ble Dean, Prof. Sharad Chandra Srivastava** the **Head of the Department Prof. M. Chakradhara Rao**, and all concerned faculty members of the Department of Civil Engineering, Guru Ghasidas Vishwavidyalaya, for their continuous encouragement.

Lastly, I am thankful to the **Central Training & Placement Cell** for facilitating and coordinating this training initiative, which has greatly contributed to my professional development.

Place: Bilaspur, Chhattisgarh

Date: 04/08/2025

Signature of the Student

Name: Anshuman

Enrollment No.: GGV/22/01003

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Abstract

Scour around bridge piers is one of the main reasons for damage to hydraulic structures and can threaten the safety and stability of bridges. Predicting the depth of scour accurately is important for designing safe and long-lasting bridges. Traditional methods like the Classical Water Scour (CWS) formula are simple but often not accurate enough because they do not fully capture the complex relationships between flow, sediment, and pier characteristics. To improve prediction accuracy, this study uses the Explainable Boosting Machine (EBM), a modern machine learning model. The model was trained using both experimental and field data, with key inputs including pier width, sediment size, flow velocity, Froude number (Fr), and bed material gradation (σ). Both the EBM and CWS models were tested on the same data for a fair comparison.

Results show that EBM performed much better, achieving an R^2 score of 0.9663 and RMSE of 0.0793, compared to the CWS model's R^2 of 0.5591 and RMSE of 0.2870. EBM also provided useful explanations using SHAP analysis, showing which features influenced the results most. Overall, the EBM model offers better accuracy and understanding, making it a strong tool for predicting scour depth and improving bridge safety.

Keywords: (Hydraulic Structure, Classical Water Scour(CWS), Explainable Boosting Machine (EBM), Shap Analysis, Flow Velocity, Pier width, Froude Number(Fr), Bed Material Gradation(σ))



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A COMPREHENSIVE TRAINING REPORT

PRE LAND PREPARATION FOR A RESIDENTIAL COLONY CONSTRUCTION

YUVRAJ BUILDCON

10TH MAY – 10TH JUNE 2025 (4 WEEKS)

Antara Deb

GGV/22/01004

BATCH : 2022-2026 | SEMESTER - 7

Submitted to:

DEPARTMENT OF CIVIL ENGINEERING

School of Studies, Engineering & Technology

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Certificate

Certificate of Internship

This is to certify that

Antara Deb

Has Completed an internship course in Yuvraj Buildcon Pvt. Ltd.
from May 10, 2025 to June 10, 2025
as a Civil Engineering intern.

We wish ___(him/her) all the best for future endeavours.

YUVRAJ BUILDCON PVT. LTD.


Director

Company seal

Director

Jitendra Sahu

Yuvraj Buildcon Pvt. Ltd.

Reg. No. 22AABCW1906F1ZU

Date: June 15, 2025

Place: Bilaspur, Chhattisgarh

ABSTRACT

This summer internship provided hands-on experience in land surveying, plotting, diversion, and boundary construction for residential colony development. Focuses on land surveying, plotting, diversion, and boundary construction for residential colony development. Through hands-on experience, I gained practical skills in conducting land surveys, designing land layouts, creating detailed plots, and managing boundary construction. I worked closely with professionals in the field, developing technical, analytical, and problem-solving abilities. This internship provided valuable insights into land development processes, preparing me for a career in surveying, construction management, or urban planning. Key areas of focus included:

1. Conducting land surveys and creating detailed maps
2. Designing and developing land layouts and plots
3. Managing boundary construction and diversion projects
4. Collaborating with professionals in the field

Through this internship, I gained practical skills and knowledge in land development, surveying techniques, and construction management. This experience has prepared me for a career in land surveying, urban planning, or construction management, with a strong foundation in technical, analytical, and problem-solving skills.



गुरु घासीदास विश्वविद्यालय, बिलासपुर

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A COMPREHENSIVE TRAINING REPORT

Land survey, plotting, diversion and boundary constructions for a residential colony construction

YUVRAJ BUILDCON

10TH MAY – 10TH JUNE 2025 (4 WEEKS)

Anukriti Bala

GGV/22/01005

BATCH : 2022-2026 | SEMESTER - 7

Submitted to:

DEPARTMENT OF CIVIL ENGINEERING

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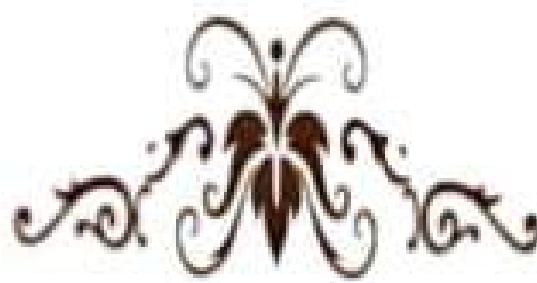
Abstract

This report presents a comprehensive analysis of my internship experience at Yuvraj buildcon Pvt. Ltd a construction firm involved in building residential colonies and flats.

The primary focus of internship was to understand and analyze actual construction process done in field for residential infrastructure construction. I was involved in planning, survey, plotting and evaluation of land area meant for construction.

The internship provided us an invaluable opportunity to apply theoretical knowledge acquired in academic studies to real world scenarios. The project involved the basic land survey, ground water table, creating flat land for construction purpose where after preparing the land layout, land plotting and diversification was done to convert the agriculture land into commercial land

This project involves conducting land surveys, plotting, and diversification for a residential colony development. The objective is to create a comprehensive plan for optimal land use, ensuring efficient boundary construction and infrastructure development. Using advanced surveying techniques, GIS, and CAD tools, this project aims to deliver a precise and sustainable design for the residential colony. The outcome will provide a valuable framework for future development, balancing residential needs with environmental considerations.



Certificate of Internship

This is to certify that

Anukriti Bala

Has Completed an internship course in Yuvraj Buildcon Pvt. Ltd.
from May 10, 2025 to June 10, 2025
as a Civil Engineering intern.

We wish ___(him/her) all the best for future endeavours.

Director

Jitendra Sahu

Yuvraj Buildcon Pvt. Ltd.

Reg. No. 22AABCW1906F1ZU

YUVRAJ BUILDCON PVT. LTD.

Director

* Company seal

Date : June 15, 2025

Place : Bilaspur, Chhattisgarh



गुरु घासीदास विश्वविद्यालय, बिलासपुर
केंद्रीय विश्वविद्यालय अधिनियम 2009 संख्या 25, 2009 द्वारा केंद्रीय विश्वविद्यालय
Guru Ghasidas Vishwavidyalaya, Bilaspur
A Central University established by the Central Universities Act 2009 No. 25 of 2009

A COMPREHENSIVE TRAINING REPORT

**DESIGN AND ANALYSIS OF A R.C.C. OVERHEAD WATER
RESERVOIR USING STAAD.Pro**

S & P ENTERPRISE, SODEPUR, WEST BENGAL

6 WEEKS VOCATIONAL TRAINING

ARKEET ROY

(GGV/22/01006)

2022-26 & 7th semester

Session: 2025-26

Submitted to:

DEPARTMENT OF CIVIL ENGINEERING

School of Studies, Engineering & Technology

GURU GHASIDAS VISHWAVIDYALAYA

Bilaspur (C.G.) 495009

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8/8/22



S. & P. ENTERPRISE

M. : 9836586783
Phone : 2565-3452

*Construction & General Order Suppliers
Specialist in : All kinds of Pipe Line job etc.*

S. N. Banerjee Road 'C'-Block P.O. Sodepur Kolkata - 700 110
Email ID : samaddersankar@rediffmail.com

Memo No. : S&P/EC/01/2025-26.

Date : 10/07/2025.

TO WHOM IT MAY CONCERN

This is to certify that, Sri **ARKEET ROY**, S/o Sri Sandip Roy, resident of 30, Serpentine Lane, Entally, Kolkata - 700 014, was entrusted with the Post of "DESIGNER (TRAINEE)" in our Concern on and from 16/05/2025 till 30/06/2025. He was engaged with the above post in the field of "DESIGN OF R.C.C. ELEVATED SERVICE WATER RESERVOIR".

He completed his design work successfully under the guidance of our senior Engineers.

His simplicity, responsibility and accuracy to the work was observed carefully by us and shown remarkable.

So far we know he bears a good and moral character and we wish him every success in his future life.

S&P ENTERPRISE

Sankar
Proprietor



ABSTRACT

The training was a vocational internship with **S&P Enterprise**, where the focus was on the structural design and analysis of an Overhead Water Reservoir. I gained hands-on experience by applying theoretical knowledge to a real-world project, using a combination of manual calculations and a professional software suite. Key activities included performing calculations for wind and seismic loads, analysing various components of the tank such as the domes and ring beams, and assisting in the ductile design of the columns and bracing. A crucial part of the training was the cross-verification of manual analysis results against the output from **STAAD.Pro**. This approach provided a solid understanding of Indian Standard codes and the practical importance of meticulously checking software-generated data, reinforcing a foundational knowledge of structural engineering principles without overstating the intern's role in the final design.



गुरु घासीदास विश्वविद्यालय, बिलासपुर

केंद्रीय विश्वविद्यालय अधिनियम 2009 संख्या 25, 2009 द्वारा केंद्रीय विश्वविद्यालय

Guru Ghasidas Vishwavidyalaya, Bilaspur

A Central University established by the Central Universities Act 2009 No. 25 of 2009

A COMPREHENSIVE TRAINING REPORT

WATER RESOURCES AND HYDRAULIC STRUCTURES

KHARUNG WATER RESOURCES DIVISION, BILASPUR

4 weeks vocational training

Ayushi Sharaff

(GGV/22/01008)

2022-26 & 7th semester

Session 2025-26

Submitted to:

Department of Civil Engineering

DEPARTMENT OF CIVIL ENGINEERING

School of Studies, Engineering & Technology

GURU GHASIDAS VISHWAVIDYALAYA

Bilaspur (C.G.) 495009

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DECLARATION

I, **Ayushi Sharaff**, a student of **B. Tech, Department of Civil Engineering, School of Studies in Engineering and Technology, Guru Ghasidas Vishwavidyalaya, Bilaspur**, hereby solemnly declare that the report entitled **“WATER RESOURCES AND HYDRAULIC STRUCTURES”** is a genuine and original record of the industrial training/internship undertaken at **Kharung Water Resources Division, Bilaspur** during the period from **2 June 2025 to 30 June 2025**.

The work presented in this report is entirely my own and has not been copied, reproduced, or submitted elsewhere for any academic or professional purpose. I affirm that:

- All information and observations recorded were made during my tenure at the above-mentioned organization.
- No part of the report has been plagiarized or duplicated from any other source.
- Proper references and acknowledgments have been made wherever external information has been consulted.

I understand that any violation of this declaration may result in academic or disciplinary action as per the rules and regulations of the institution.

Place: Bilaspur

Date: 31/07/2025

Signature of the Student

Name: Ayushi Sharaff

Enrollment No.: GGV/22/01008

ACKNOWLEDGEMENT

I sincerely thank my faculty mentor, **Er. U. Ganguly**, for her invaluable guidance and support throughout the course of this industrial training. I am grateful to the entire team at **Kharung Water Resources Division** for their mentorship, cooperation, and the opportunity to gain hands-on experience in the field.

I extend my heartfelt appreciation to our **Hon'ble Dean, Prof. Sharad Chandra Srivastava** the **Head of the Department Prof. M. Chakradhara Rao**, and all concerned faculty members of the Department of Civil Engineering, Guru Ghasidas Vishwavidyalaya, for their continuous encouragement.

Lastly, I am thankful to the **Central Training & Placement Cell** for facilitating and coordinating this training initiative, which has greatly contributed to my professional development.

Place: Bilaspur

Date: 31/07/2025

Signature of the Student

Name: Ayushi Sharaff

Enrollment No.: GGV/22/01008

CERTIFICATE

OFFICE OF THE EXECUTIVE ENGINEER
KHARUNG WATER RESOURCES DIVISION, BILASPUR, DISTT. BILASPUR (C.G.)



CERTIFICATE

This is to certify that Ayushi Sharaff, student of 6th Semester of Civil Engineering, School of Studies in Engineering and Technology, Guru Ghasida Vishwavidyalaya, Bilaspur (C.G.) has successfully completed her vocational training of 4 weeks conducted from May-June, 2025.

In this training she has acquired knowledge of Construction of Earthen Dams, Diversion/Barrages, Afcuts, Canals and Survey Work etc.

I wish her all success and a bright future.

Bilaspur

Date : 30.06.2025


(M.K. Chandra)
Executive Engineer
Kharung W.R. Division
Bilaspur (C.G.)

ABSTRACT

The four week internship at water resources department (WRD) Bilaspur, as a part of Academic work was a good experience. The water resources department (WRD) is the government agency responsible for managing and developing water resources in a region or state. It oversees the planning, development and management of water resources, including irrigation, drinking water supply and flood control.

WRD promotes water conservation and efficient use of water resources through various initiative and programs.

During the internship at WRD, there was classroom learning as well as site visits as part of internship. In classroom learning, there were knowledge about different kinds of schemes in water resources department like minor irrigation scheme medium irrigation scheme and major irrigation scheme, types of schemes under water resources department of Chhattisgarh, Norms for topographical surveys, knowing about small dams and their structure, learning about the canal systems, different types of cross drainage works, level crossings etc.

Sites like Shivghat Barrage and Lagra Anicut were visited as a part of training. There were different field knowledge related to civil engineering and whatever studied in classroom were explained.

Major learning outcomes during site visits are teamwork, cooperation, field knowledge, practical knowledge of knowing the building of canal, etc.

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केंद्रीय विश्वविद्यालय अधिनियम 2009 संख्या 25, 2009 द्वारा केंद्रीय विश्वविद्यालय
Guru Ghasidas Vishwavidyalaya, Bilaspur
A Central University established by the Central Universities Act 2009 No. 25 of 2009

A COMPREHENSIVE TRAINING REPORT

Construction and Maintenance of Roads

Vishakhapatnam Steel Plant

19/05/25 – 14/06/25

Himabindhu

GGV/22/01010

7th Semester 2025 - 2026

Session 2025 -26

Submitted to :

DEPARTMENT OF CIVIL ENGINEERING

School of Studies, Engineering & Technology

GURU GHASIDAS VISHWAVIDYALAYA

Bilaspur (C.G.) 495009

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DECLARATION BY THE STUDENT

I, **Dasari Himabindhu**, a student of **B. Tech, Civil Engineering, Guru Ghasidas Vishwavidyalaya**, hereby solemnly declare that the report entitled **Construction and maintenance of roads** is a genuine and original record of the industrial training/internship undertaken at **Vishakhapatnam Steel Plant** during the period from **19/05/2025 to 14/06/25**.

The work presented in this report is entirely my own and has not been copied, reproduced, or submitted elsewhere for any academic or professional purpose. I affirm that:

- All information and observations recorded were made during my tenure at the above-mentioned organization.
- No part of the report has been plagiarized or duplicated from any other source.
- Proper references and acknowledgments have been made wherever external information has been consulted.

I understand that any violation of this declaration may result in academic or disciplinary action as per the rules and regulations of the institution.

Place: Bilaspur

Date: 01/08/25

Signature of the Student

Name: Himabindhu

Enrollment No.: GGV/22/01010

ACKNOWLEDGEMENT

I sincerely thank my faculty mentor, **Sri. V.R.R Siva prasad. T, Sr. Manager (C&STED)** for his invaluable guidance and support throughout the course of this industrial training. I am grateful to the entire team at **(C&STED)** for their mentorship, cooperation, and the opportunity to gain hands-on experience in the field.

I extend my heartfelt appreciation to our **Hon'ble Dean, Prof. Sharad Chandra Srivastava** the **Head of the Department Prof. M. Chakradhar Rao**, and all concerned faculty members of the Department of Civil Engineering, Guru Ghasidas Vishwavidyalaya, for their continuous encouragement.

Lastly, I am thankful to the **Central Training & Placement Cell** for facilitating and coordinating this training initiative, which has greatly contributed to my professional development.

Place: Bilaspur

Date: 01/08/25

Signature of the Student

Name: Himabindhu

Enrollment No.: GGV/22/01010

अधिगम व विकास केंद्र
Learning & Development Centre
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यह प्रमाणित किया जाता है कि निम्नलिखित छात्र ने नीचे दिए गए विवरण के अनुसार राष्ट्रीय इस्पात निगम लिमिटेड-विशाखपट्टणम इस्पात संयंत्र में इंटरनशिप/परियोजना कार्य पूरा किया है।
This is to certify that the following student has undergone Internship /Project Work in Rashtriya Ispat Nigam Limited-Visakhapatnam Steel Plant as detailed below:

छात्र का नाम Name of the Student	: HIMABINDHU DASARI
कोर्स Course	: BE/B TECH
शाखा Branch	: CIVIL
विश्वविद्यालय/कॉलेज का नाम Name of the University / College	: GURU GHASIDAS VISWA VIDYALAYA,BILASPUR
परियोजना का शीर्षक Project Title	: CONSTRUCTION AND MAINTENANCE OF ROADS
विभाग Department	: CIVIL ENGINEERING DEPT.
इंटरनशिप /परियोजना की अवधि Period of Internship/Project work	: 4 Weeks (from 19-05-2023 to 14-06-2023)

उपरोक्त कथित अवधि के दौरान उनका आचरण संतोषजनक पाया गया। During the aforestated period his / her conduct was found to be SATISFACTORY.

 100048950
पंजीकरण नं.
Registration No.



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❖ ABOUT VISAKHAPATNAM STEEL PLANT

LOCATION: This plant is located on the coast of Bay of Bengal, 16 km to the south – west of Visakhapatnam.



BACKGROUND: The decision of the Government of India to set up an integrated Steel Plant at Visakhapatnam was announced by the Prime Minister Smt , Indira Gandhi in Parliament on 17th April 1970. The formal inauguration was done on 20th January 1971 by the then Prime Minister. A detailed project report of the plant with an annual capacity of about 3 million tones of liquid steel was submitted in October 1977. The Government of India and USSR signed an agreement in 1979 in setting up the 3.4 million tones

integrated Steel plant at Vizag. The project was estimated to cost Rs.3897.28 crores based on 1981 prices but the cost has

increased substantially over the sanctioned cost and finally the project is estimated to cost Rs.5822.17 crores as per 1987.

PRODUCT MI: VSP produces angles, channels, bars, wire rods and billets for rerolling. The Plant produces Pig Iron, 1.44 million tones per annum of granulated slag and there are also normal by-products from coke-oven and coal chemical plant.

PLANT FACILITIES: VSP has these major production facilities.

- Three coke-ovens Batteries.
- Two Sinter machines of 312 m square area
- Two Blast Furnace of 3200 m cube use full volume
- Steel Melt shop with three L D converters of 150 tones
- Light & Medium Merchant mill of 710000 tons per year capacity.
- Wire Rod Mill of 850000 tons per year.
- Medium Merchant & Structural Mill of 850000 tones.



-

MODERN TECHNOLOGY:

VSP is the most sophisticated and modern integrated steel plant it contains selective crushing of coal.

- o 7M tall coke- ovens

- o Dry quenching of coke

- o On ground blending of sinter base mix

- o 100% continuous casting of liquid steel
- o Hot metal de-sulphuration
- o Computerization for process control

- o And many more integrated systems are being used in this plant

POWER SUPPLY: The plant has in plant power generation from a power plant having three turbo generators of 60 MW and one 67.5 MW generators totally supplying 247.5 MW power supply.

PLANT COST: The plant is estimated to cost about Rs. 8755 crores based on prices as on 1994.

EMPLOYMENT: VSP has employed about 17450 persons. The indirect employment due to various ancillary units development is much more so these are the several parts of VSP and this gives an brief description about the technical aspects and the capacity of VSP which is most sophisticated steel plant in India.



1.0 Introduction

With the present expansion of VSP from 3.0mtpa to 6.3mtpa, the existing roads are to be upgraded to cater to the needs of the plant. The TPP at VSP generates by product fly ash which is mixed with water and the slurry is sent to the ash pond. So with increasing amount wet ash day by day it is difficult to maintain the ash pond. Also the fly ash which is mixed with water cannot be further used by cement industry or in the manufacture of fly ash bricks. Keeping the above points in view the VSP management has thought of moving the ash through dumpers outside the plant. In order to transfer the ash through Appikonda gate all along the boundary wall to the BCSY gate, the present road width available is 4m approx and is also not structurally strong enough to bear the load. Further a new road 7m wide has to be laid from watch tower 8 to watch tower 14 along Pedakonda measuring about 2.5 Kms approx which is considered to be Part 'A' of the proposal. Since the road from Gangavaram gate to BCSY gate all along the boundary wall in the salt pan area also comes under the proposed route for moving out the ash, the existing road of 4m wide has to be upgraded to 7m wide. It is considered as Part 'B' of the proposal. This up gradation will be also useful for the dumpers moving along that road for the earth disposal of

6.3 mtpa expansion works and beyond in the salt pan area. In these roads design the BF slag a granular material can be used along with gravel in suitable proportions as sub base.

2.0 Design Approach and criteria for flexible pavements:

The flexible pavements have been modelled as a three-layer structure and stresses and strains at critical locations have been computed using linear elastic model FPAVE developed under the MORT&H research scheme 56 “Analytical Design of Flexible pavements”.

To give proper consideration to the aspect of performance, the following three types of pavement distress resulting from repeated application of traffic loads are considered:

1. Vertical compressive strain at the top of the sub grade. If the strain is excessive, the sub grade will deform resulting in permanent deformation at the pavement surface during the design life.
2. Horizontal tensile strain at the bottom of the bituminous layer. Larger tensile strains cause fracture of the bituminous layer during the design life.
3. Pavement deformation within the bituminous layer.

While the permanent deformation within the bituminous layer can be controlled by meeting the mix design requirements, thicknesses of granular and bituminous layers are selected using the analytical design approach so that the strains at critical points are within the allowable limits. For calculation of tensile strains at the bottom of the bituminous layer, the

elastic modulus of dense bituminous macadam (DBM) layer with 60/70 bitumen has been used in the analysis.

2.1 Rutting Criteria:

From large amount of data for rutting failure of pavements obtained from the research scheme of MORT&H, the allowable rut depth was fixed as 20 mm. The

The equation is

$$N_R = 4.1656 \times 10^{-8} [1/e_z]^{4.5337}$$

Where,

N_R = Number of cumulative standard axles to produce rutting of 20 mm e_z

= vertical sub grade strain (micro strain)

2.2 Fatigue Criteria:

Bituminous surfacings of pavements display flexural fatigue cracking if the tensile strain at the bottom of the bituminous layer is beyond certain limit. Based on the large amount of field performance data of pavements of south, north, east and west zones in India collected under the research schemes R- 6 and R-19 of Ministry of surface transport, Govt. of India, the relation between the fatigue life of pavement and tensile strain in the bottom of the bituminous layer was obtained as

$$N_f = 2.21 \times 10^{-4} [1/\epsilon_r]^{3.89} [1/E]^{.854}$$

N_f = Number of cumulative standard axles to produce 20 percent cracked surface area

e_r = Tensile strain at the bottom of BC layer (micro strain) E = Elastic modulus of bituminous surfacing (Mpa)

The above fatigue equation was calibrated at 35°C for bituminous concrete surfacing having 80/100 bitumen and the equation was generalised by introducing the term containing the elastic modulus (E) of bituminous layer so that the pavement can be designed for temperatures from 20°C to 40 °C using any grade of bitumen.

The values of the elastic moduli of bituminous concrete/ dense bituminous macadam and bituminous macadam meeting the specifications of the MOST are given in Table

2. 1.Table 2.1 Elastic

Modulus (Mpa) values of bituminous materials

Mix type	Temperature °C				
	20	25	30	35	40
BC and DBM 80/100 bitumen	2300	1966	1455	975	797
BC and DBM 60/70 bitumen	3600	3126	2579	1695	1270
BC and DBM 30/40 bitumen (75 blow compaction and 4 per cent air void)	6000	4928	3809	2944	2276
BM 80/100 bitumen	-	-	-	500	-
BM 60/70 bitumen	-	-	-	700	-

The poisons ratio of bituminous layer may be taken as 0.5 for pavement temperatures of 35 °C and 40 °C. For temperatures from 20 °C to 30 °C a value of 0.35 may be adopted. Fatigue equation at any pavement temperature from 20 °C to 40 °C can be evaluated by substituting the elastic modulus of the pavement temperature.

2.3 Modulus of elasticity of subgrade, sub-base and base layers

2.3.1 Sub grade

$$E(\text{MPa}) = 10 * \text{CBR} \quad \text{for } \text{CBR} \leq 5 \quad \text{and} \quad = 176 * (\text{CBR})^{0.64} \\ \text{for}$$

$$\text{CBR} > 5$$

2.3.2 Granular sub-base and base $E_2 =$

$$E_3 * 0.2 * h^{0.45}$$

E_2 = Composite elastic modulus of granular subbase and Base

(Mpa)

E_3 = elastic modulus of subgrade (Mpa)

h = thickness of granular layers (mm)

Poisson's ratio for both the granular layer as well as subgrade layer may be taken as 0.4

3.0 Pavement composition:

3.1 Granular lower sub-base (with granulated BF slag and gravel) The material recommended for lower sub base layers is gravel (60%) mixed with Granulated Blast Furnace slag (GBFS) (40%) by weight. The requisite quantities of materials shall be spread over the prepared sub- grade and thoroughly mixed preferably by using mechanical mixers like 'rotillor' and compacted in layers with compacted thickness of 150 mm each layer with optimum moisture content to 100 per cent of the maximum laboratory density as per IS:2720 (Part-VIII). The gravel from approved quarry is to be collected and the gravel-GBFS are to be mixed as per the Grading-1 as shown in the Table 3.1 and the materials will be used in the lower layers of roads. The mixed material shall be free from organic or other deleterious constituents.

Table 3.1 Grading for granular lower sub-base

IS sieve Designation	Percent by weight passing the sieve		
	Grading I	Grading II	Grading III
80 mm	100	100	100
63mm	90-100	90-100	90-100
4.75mm	35-70	40-90	50-100

75 micron	0-20	0-25	0-30
CBR value (min)	30%	25%	20%

Note: The material passing 425 micron sieve for all the three gradings when tested according to IS:2720 (Part V) shall have liquid limit and plasticity index not more than 25 and 6 per cent respectively.

3.1.1 Physical requirements

The fraction of material passing 22.4 mm sieve shall give a CBR value not less than 30%, when tested in accordance with IS:2720 (Part-XVI) after preparing the samples at maximum dry density and optimum moisture content corresponding to IS:2720 (Part VIII) and soaking the same in water for a period of 4 days prior of testing.

3.2 Granular upper sub-base (Gravel or Crushed Stone)

The material to be used for the work shall be gravel, crushed stone or combination there of depending upon the grading required. The material shall be free from organic or other deleterious constituents and conform to Grading- 1 as shown in Table-3.2/3.3. Grading-1 in Table-3.2 are in respect of close-graded granular sub-base materials, one each for maximum particle size of 75 mm, 53 mm and 26.5 mm, the corresponding Grading-1 for the coarse-graded materials for each of three maximum particle sizes are given in Table3.3.

Table 3.2 Grading for close graded granular sub-base material

IS sieve Designation	Percent by weight passing the sieve		
	Grading I	Grading II	Grading III
75.0 mm	100	-	-
53.0 mm	80-100	100	-
26.5 mm	55-90	70-100	100
9.50 mm	35-65	50-80	65-95
4.75 mm	25-55	40-65	50-80
2.36 mm	20-40	30-50	40-65
0.425 mm	10-25	15-25	20-35
.075 mm	3-10	3-10	3-10
CBR (min)	30%	25%	20%

Table 3.3 Grading for coarse graded granular sub-base materials

IS sieve Designation	Percent by weight passing the sieve		
	Grading I	Grading II	Grading III
75.0 mm	100	-	-
53.0 mm	-	100	-
26.5 mm	55-75	50-80	100
9.50 mm	-		
4.75 mm	10-30	15-35	25-45

2.36 mm			
0.425 mm			
.075 mm	<10	<10	<10
CBR (min)	30%	25%	20%

3.3 Wet mix Macadam base

This work shall consist of laying and compacting clean, crushed, graded aggregate and granular material, premixed with water, to a dense mass on a prepared granular sub-base. The material shall be laid in one or more layers as necessary to lines, grades and cross sections as directed by the Engineer/Consultant. The thickness of a single compacted Wet Mix Macadam layer shall not less than 75 mm. When vibrating or other approved types of compacting equipment are used, the compacted depth of a single layer of the wet mix macadam course may be increased to 200 mm upon a approval of the Engineer/Consultant. The tested CBR value of wet mix macadam shall be 60% (minimum).

3.3.1 Physical requirements for Aggregates

Coarse aggregates shall be crushed stone. If crushed gravel/shingle is used, not less than 90 per cent by weight of the gravel/shingle pieces retained on

4.75 mm sieve shall have at least two fractured faces. The aggregates shall conform to the physical requirements set forth in Table

3.4 below:

Table 3.4 Physical requirements of coarse aggregates for wet mix macadam for sub-base/base courses

	Test	Test method	Requirements
1.	Los Angeles abrasion value	IS:2386 (part-4)	40 percent (max)
2.	Aggregate impact value	IS:2386 (part-4) or IS 5640	30 percent (max)
3.	Combined flakiness and elongation indices	IS:2386 (Part-1)	30 percent (max)

Aggregate may satisfy requirements of either of the two tests. To determine this combined proportion, the flaky stone from a representative sample should first be separated out. Flakiness index is weight of flaky stone metal divided by weight of stone sample. Only the elongated particles be separated out from the remaining (non-flaky) stone metal.

Elongation index is weight of elongated particle divided by total non-flaky particles. The value of flakiness index and elongation index so found are added up. If the water absorption value of the course aggregates is greater than 2 per cent, the soundness test shall be carried out on the material delivered to site as per IS:2386 (Part-5).

3.3.2 Grading requirements:

The aggregates shall conform to the grading given in Table 3.5 below Table 3.5 Grading requirement of aggregates for wet mix macadam

Is sieve	Designation	Percent by weight passing the IS sieve
53.00	mm	100
45.00	mm	95-100
26.5	mm	-
22.4	mm	60-80
11.2	mm	40-60
4.75	mm	25-40
2.36	mm	15-30
600-0	micron	8-22
75.00	micron	0-8

Materials finer than 425 micron shall have Plasticity Index (PI) not exceeding 6. The final gradation approved within these limits shall be well graded from coarse to fine and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice-versa.

3.4 Open Graded Premix Carpet Using Bitumen

This work shall consist of laying and compacting an open graded carpet of 20 mm thickness in a single course composed of suitable small sized aggregates premixed with a bituminous binder on a previously prepared base, in accordance with the requirements of this specification, to serve as a wearing course.

Binder: The binder shall be bitumen of a suitable grade of 60/70 grade as per IS:73.

Aggregates: The coarse aggregates shall consist of crushed rock, crushed stone, crushed gravel or other hard material. The aggregates shall satisfy the quality requirement mentioned in the table 3.6.

Table 3.6 Physical requirements of aggregates for open graded pre-mix carpet

S No	Test	Test Method	Requirement
1	Los Angeles Abrasion Value (Max)	IS:2386(Part- 4)	40%
2	Aggregate Impact Value (Max)	IS:2386(Part- 4)	30%
3	Flakiness and Elongation (max)	IS:2386(Part- 1)	30%

4	Water absorption (max)	IS:2386(Part- 3)	1%
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Aggregates may satisfy requirements of either of the two tests as given in S No1 and 2.

To determine this combined proportion, flaky stone from a respective sample should first be separated out. Flakiness index is the weight of flaky stone metal divided by weight of stone sample. Only the elongated particles be separated out from the remaining (non flaky) stone metal. Elongation index is the weight of elongated particles divided by total nonflaky particles. The value of flakiness index and elongation index so found are added up.

4.0 Construction Operation

4.1 Preparation of Sub-grade

Bottom of excavation before laying of sub-base shall be prepared, watered and re-rolled for compaction with minimum six (6) passes of 80-100 kN power roller to the specified lines and cross fall (camber), to get the required CBR value of 4%/6% as per requirement.



Any ruts or soft yielding places shall be corrected in an approved manner and rolled with minimum two passes of 80 – 100 kN smoothed wheeled roller with sprinkling of water to achieve the required dry density. Haulage of materials over the formed surface shall not be permitted.



The sub-grade shall comply with the following requirements to receive the granular sub-base course:

- a) No soft spots shall be present.
- b) It shall be properly drained during construction.
- c) The minimum compaction shall not be less than 97 per cent of maximum laboratory dry density as per IS:2720 (Part VIII). This should be ensured by taking sample from finished top and tested in laboratory.
- d) CBR value at sub-grade level shall not be less than specified value as mentioned above. This should be ensured by taking undisturbed sample from finished top and tested in laboratory as per IS:2720 (Part XVI). Field CBR test shall also be done as per IS:2720 (Part XXXI) at a depth of about 500 mm to ascertain the CBR value.

4.2 Spreading and Compacting of sub-base:



The sub-base material of grading specified in Table-3.1 shall be mixed mechanically by mix in place method and spread on the prepared subgrade with the help of a motor grader of adequate capacity, its blade having hydraulic controls suitable for initial adjustment and maintain the required slope and grade during the operation or other means as approved by the Engineer/Consultant.

Manual mixing shall be permitted only where the width of laying is not adequate for mechanical operations, as in small sized jobs. The equipment used for mix-in-place construction shall be a rotavator or similar approved equipment capable of mixing the material to the desired degree. If so desired by the Engineer/Consultant, trial runs with the equipment shall be carried out to establish its suitability for the work.

Moisture content of the loose material shall be checked in accordance with IS:2720 (Part-II) and suitably adjusted by sprinkling additional water from a truck mounted or trailer mounted water tank and suitable for applying water uniformly and at controlled quantities to variable widths of surface or other means approved by the Engineer/Consultant so that at the time of compaction it is from 1 percent above to 2 per cent below the optimum moisture content corresponding to IS:2720 (Part VIII). While adding water, due allowance shall be made for evaporation losses. After water has been added, the material shall be processed by mechanical or other approved means if so directed by the Engineer/Consultant until the layer is uniformly wet.

Immediately thereafter, rolling shall start, if the thickness of the compacted layer does not exceed 100 mm, a smooth wheeled roller of 80 to 100 kN weight may be used. For a compacted single layer upto 225 mm the compaction shall be done with the help of a vibratory roller of minimum 80 to 100 kN static weight with plain drum or pad foot-drum or heavy pneumatic tyred roller of minimum 200 to 300 kN weight having a minimum tyre pressure of 0.7 kN/sq m or equivalent capacity roller capable of achieving the required compaction. Rolling shall commence at the lower edge and proceed towards the upper edge longitudinally for portions having unidirectional crossfall and super elevation and shall commence at the edges and progress towards the centre for portions having crossfall on both sides.

Each pass of the roller shall uniformly overlap not less than one-third of the track made in the preceding pass. During rolling, the grade and crossfall (camber) shall be checked and any high spots or depressions, which become apparent, corrected by removing or adding fresh material.

The speed of the roller shall not exceed 5 km per hour.

Rolling shall be continued till the density achieved is at least 97 per cent of the maximum dry density for the material determined as per IS:2720 (Part VIII). The surface of any layer of material on completion of compaction shall be well closed, free from movement under compaction equipment and from compaction planes, ridges, cracks or loose material. All loose, segregated or other defective areas shall be made good to the full thickness of layer and re-compacted.

4.3 Formation of shoulders:

While constructing Wet Mix Macadam (WMM) arrangement shall be made for lateral confinement of wet mix. This shall be done by laying materials in adjoining shoulders along with that of matching thickness of wet mix macadam layer. The pavement layer shall be compacted first. The corresponding layer in shoulder portion shall be compacted thereafter with watering and rolling using 80 kN vibratory roller. During all stages of shoulder construction, the required cross fall shall be maintained to drain off water.



4.4 Preparation of mix:

Wet Mix Macadam shall be prepared in an approved mixing plant of suitable capacity having provision for controlled addition of water and forced/positive mixing arrangement like pug mill or pan type mixer of concrete batching plant. Optimum moisture for mixing shall be determined in accordance with IS:2720 (Part-VIII) after replacing the aggregate fraction retained on 22.4 mm sieve with material of 4.75 mm to 22.4 mm size. While adding water, due allowance shall be made for evaporation losses.



However, at the time of compaction, water in the wet mix shall not vary from the optimum value by more than agreed limits.

The mixed material shall be uniformly wet and no segregation is permitted.



4.5 Spreading of mix:

Immediately after mixing, the aggregates shall be spread uniformly and evenly upon the prepared granular sub-base in required quantities. In no case should these be dumped in heaps directly on the area where these are to be laid nor shall their hauling over a partly completed stretch be permitted.



The mix may be spread either by a Paver finisher or motor grader. For portions where mechanical means cannot be used, manual means as approved by the Engineer/Consultant shall be used. The motor grader shall be capable of spreading the material uniformly all over the surface. Its blade shall have hydraulic control suitable for initial adjustments and maintaining the same so as to achieve the specific slope and grade.

The paver finisher shall be self-propelled, having the following features:

- i) Loading hoppers and suitable distribution mechanism.

- ii) The screed shall have tamping and vibrating arrangement for initial compaction to the layer as it is spread without rutting or otherwise marring the surface profile.
- iii) The Paver shall be equipped with necessary control mechanism so as to ensure that the finished surface is free from surface blemishes.

The surface of the aggregate shall be carefully checked with templates and all high or low spots remedied by removing or adding aggregate as may be required. The layer may be tested by depth blocks during construction. No segregation of larger and the fine particles shall be allowed. The aggregates as spread shall be of uniform gradation with no pockets of fine materials.



4.6 Compaction:

After the mix has been laid to the required thickness, grade and cross fall/camber the same shall be uniformly compacted to the full depth with suitable roller. If the thickness of single compacted layer does not exceed 100 mm, a smooth wheel roller of 80 to 100 kN weight may be used. For a compacted single layer upto 250 mm, the compaction shall be done with the help of vibratory roller of minimum static weight of 80 to 100 kN or equivalent capacity roller. The speed of the roller shall not exceed 5 km/hr.



In portions having unidirectional cross fall/super elevation, rolling shall commence from the lower edge and progress gradually towards the upper edge. Thereafter, roller should progress parallel to the center line of the road, uniformly overlapping each preceding track by at least one third width until the entire surface has been rolled. Alternate trips of the roller shall be terminated in stops at least 1 m away from any preceding stop.

In portions of camber, rolling shall begin at the edge with the roller running forward and backward until the edges have been firmly compacted. The roller shall then progress gradually towards the centre parallel to the centre line of the road uniformly overlapping each of the preceding track by at least one-third width until the entire surface has been rolled.

Any displacement occurring as a result of reversing of the direction of a roller or from any other cause shall be corrected at once as specified and/or removed and made good. Along forms, kerbs, walls or other places not accessible to the roller, the mixture shall be thoroughly compacted with mechanical tampers or a plate compactor. Skin patching of an area without scarifying the surface to permit proper bonding of the added material shall not be permitted. Rolling shall not be done when the sub grade is soft or yielding or when it causes a wave-like motion in the base course or sub grade. If irregularities develop during rolling which exceed 12 mm when tested with a 3 metre straight edge, the surface shall be loosened and premixed material added or removed as required before rolling again so as to achieve a uniform surface conforming to the desired grade and cross-fall. In no case the use of unmixed material be permitted to make up the depressions. Rolling shall be continued till the density achieved is at least 98 per cent of the maximum dry density for the material as determined by the method outlined in IS:2720 (Part-8).

The exact number of passes required for achieving the desired result should be established before hand by test rolling over a test bed over similar sub grade. After completion, the surface of the any finished layer shall be well- closed, free from movement under compaction equipment or any compaction planes, ridges, cracks and loose material. All loose, segregated, or otherwise defective areas shall be made good to the full thickness of the layer and recompacted.

4.7 Setting and drying



After final compaction of wet mix macadam course, the road shall be allowed to dry for 24 hours. No vehicular traffic of any kind shall be allowed on the finished wet mix macadam surface till it is dried and next course laid

Application of premix carpet with bitumen

Hot mix plant of appropriate capacity and type shall be used for the preparation of mix material. The hot mix plant shall have separate dryer arrangement for heating aggregates and pug mill for mixing aggregates and binder. The temperature of binder at the time of mixing shall be in the range of 150°C to 163°C and that of the aggregates in the range of 155°C to 163°C provided that the difference in temperature between the binder and aggregates at no time exceeds 14°C. Mixing shall be thorough to ensure that a homogeneous mixture is obtained in which all particles of the aggregates are coated uniformly and the discharge temperature of mix shall be between 130°C and 160°C. The mix shall be immediately transported from the mixer to the point of use in suitable



vehicles or wheel barrows. The vehicles employed for transport shall be clean and the mix being transported covered in transit if so directed by the Engineer/Consultant.

5.0 Conclusions:

The Bill of quantities for the road Part 'A' & Part 'B' comes out to 2.5 & 4.5 crores (approx) respectively. An approximate amount of 1800 tons/ day of fly ash generated by TPP totaling to 600,000 tons per annum can be moved out timely through the proposed road. In addition to it an approx quantity of 1,547,705 tons (present quantity) and 2,395,000 tons (after expansion) of Blast furnace granulated slag can be sold out at Rs 200 per ton. An approx quantity of 10,000 cu m of BF slag is utilized in the road construction. With all the above benefits it can be said that the road construction in Parts 'A' & 'B' is very much useful for the Plant.



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A COMPREHENSIVE TRAINING REPORT

Upgradation of Bilaspur -Takhatpur- Mungeli - Pandariya – Pondi Road On NH-130A

Public Works Department

BILASPUR (C.G.)

4 Weeks Vocational Training

GUDESH KUMAR

(GGV/22/01012)

2022-26 & 7th semester

Session: 2025-26

Submitted to:

DEPARTMENT OF CIVIL ENGINEERING

School of Studies, Engineering & Technology

GURU GHASIDAS VISHWAVIDYALAYA

Bilaspur (C.G.) 495009

A CENTRAL UNIVERSITY

(Established under the Central Universities Act, 2009 No. 25 of 2009)

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ABSTRACT

This report summarizes a one-month summer internship focused on the upgradation of National Highway 130A. Conducted under the supervision of the Public Works Department (PWD) Bilaspur division, the training provided an immersive experience into the practical application of civil engineering principles. The primary objective was to gain hands-on knowledge of road construction, quality control, and project management within a government infrastructure project. The report contains the development process of the highway project, up, Bilaspur - Takhatpur- Mungeli - Pandariya – Pondi Road, having total length of 25.695 km.

The internship involved observation and participation in construction stages. A significant portion of the training was dedicated to understanding and assisting in on-site quality control tests for materials such as soil, aggregates, and bitumen, ensuring adherence to Indian Standard codes like IS 456. Furthermore, the experience offered insight into the administrative aspects of the project, including project documentation, progress reporting, and team coordination.

In addition to technical skills, the internship fostered the development of essential soft skills, including effective communication, teamwork, and a heightened sense of professional punctuality and observation. This practical exposure has been invaluable, bridging the gap between theoretical knowledge and professional practice and has reinforced a strong understanding of highway engineering principles.

Key words: National highway, GSB, Culvert, Road construction, Tests.



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A COMPREHENSIVE TRAINING REPORT

WATER RESOURCES AND HYDRAULIC STRUCTURES

KHARUNG WATER RESOURCES DIVISION, BILASPUR

4 weeks vocational training

Himanshu Mishra

GGV/22/01013

2022-26 & 7th semester

Session 2025-26

Submitted to:

Prof. Nishant Yadav

DEPARTMENT OF CIVIL ENGINEERING

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DECLARATION BY THE STUDENT

I, **Himanshu Mishra**, a student of **B. Tech, Department of Civil Engineering, School of Studies in Engineering and Technology, Guru Ghasidas Vishwavidyalaya, Bilaspur**, hereby solemnly declare that the report entitled “**WATER RESOURCES AND HYDRAULIC STRUCTURES**” is a genuine and original record of the industrial training/internship undertaken at **Kharung Water Resources Division, Bilaspur** during the period from **2 June 2025 to 30 June 2025**.

The work presented in this report is entirely my own and has not been copied, reproduced, or submitted elsewhere for any academic or professional purpose. I affirm that:

- All information and observations recorded were made during my tenure at the above-mentioned organization.
- No part of the report has been plagiarized or duplicated from any other source.
- Proper references and acknowledgments have been made wherever external information has been consulted.

I understand that any violation of this declaration may result in academic or disciplinary action as per the rules and regulations of the institution.

Place: Bilaspur

Date: 31/07/2025

Signature of the Student

Name: Himanshu Mishra

Enrollment No.: GGV/22/01013

ACKNOWLEDGEMENT

I sincerely thank my faculty mentor, **Er. U. Ganguly**, for his invaluable guidance and support throughout the course of this industrial training. I am grateful to the entire team at **Kharung Water Resources Division** for their mentorship, cooperation, and the opportunity to gain hands-on experience in the field.

I extend my heartfelt appreciation to our **Hon'ble Dean, Prof. Sharad Chandra Srivastava** the **Head of the Department Prof. M. Chakradhara Rao**, and all concerned faculty members of the Department of Civil Engineering, Guru Ghasidas Vishwavidyalaya, for their continuous encouragement.

Lastly, I am thankful to the **Central Training & Placement Cell** for facilitating and coordinating this training initiative, which has greatly contributed to my professional development.

Place: Bilaspur

Date: 31/07/2025

Signature of the Student

Name: Himanshu Mishra

Enrollment No.: GGV/22/01013

CERTIFICATE



ABSTRACT

The four week internship at water resources department (WRD) Bilaspur, as a part of Academic work was a good experience. The water resources department (WRD) is the government agency responsible for managing and developing water resources in a region or state. It oversees the planning, development and management of water resources, including irrigation, drinking water supply and flood control.

WRD promotes water conservation and efficient use of water resources through various initiative and programs.

During the internship at WRD, there was classroom learning as well as site visits as part of internship. In classroom learning, there were knowledge about different kinds of schemes in water resources department like minor irrigation scheme medium irrigation scheme and major irrigation scheme, types of schemes under water resources department of Chhattisgarh, Norms for topographical surveys, knowing about small dams and their structure, learning about the canal systems, different types of cross drainage works, level crossings etc.

Sites like Shivghat Barrage and Lagra Anicut were visited as a part of training. There were different field knowledge related to civil engineering and whatever studied in classroom were explained.

Major learning outcomes during site visits are teamwork, cooperation, field knowledge, practical knowledge of knowing the building of canal, etc.

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CHAPTER 1

INTRODUCTION

1.1. Purpose of training

The purpose of training in the Water Resources Department is multifaceted, means having many different aspects or features. Essentially, it's aimed at boosting capacity and performance of water professionals, ensuring they have the necessary skills and knowledge to tackle water-related challenges. This includes:

- Water management techniques, like participatory watershed management and sustainable water use practices.
- Knowledge about small dams and their structure.
- Theoretical knowledge on norms for topographical surveys.
- Types of Scheme under Chhattisgarh Water Resources Department.

The ultimate goal is to enhance water governance and improve water resource management, which is critical for economic development, social welfare, and environmental sustainability.

1.2. Company overview

The Water Resources Department (WRD) of Chhattisgarh, including the Bilaspur division, focuses on the integrated and optimal development of surface and groundwater resources within the state. Its responsibilities encompass assessment of water resources, policy formulation, and the construction and maintenance of irrigation projects. The department also works on flood control, quality control of construction materials, and maintaining irrigation system functionality.

Key Functions and Responsibilities:

1. Project Development and Management: This includes the construction, operation, and maintenance of major, medium, and minor irrigation projects, as well as lift and tube-well schemes.
2. Flood Control: The department is involved in designing and constructing flood control projects to mitigate flood damage.
3. Quality Control: They ensure the quality of construction materials used in water resource projects through quality control and testing.

4. Hydrological Data Management: The WRD collects and updates hydrological data, which is crucial for planning and managing water resources effectively.
5. Irrigation System Functionality: They maintain and review the performance of irrigation systems to improve their efficiency and effectiveness.
6. Interstate River Water Sharing: The department also protects the state's rights in sharing water from inter-state rivers.

Bilaspur Division Specifics:

1. Irrigation Potential: The WRD in Bilaspur works to enhance the irrigation potential of the region.
2. Geomorphology and Drainage: The Bilaspur district has various geomorphological features, including structural plains, pediment/Pedi plain, and floodplains, with the Arpa River and Mahanadi River and its tributaries playing a significant role in the drainage pattern, according to the Central Ground Water Board.
3. Aquifers: The area has various aquifer systems, including phreatic and fractured aquifers, with varying yields from different rock formations like shale, limestone, and granite.
4. Groundwater Use: A significant portion of the cultivated area in Bilaspur is irrigated through groundwater, highlighting the importance of groundwater management in the region.

1.3. Organizational structure

The Water Resources Department in Bilaspur, Chhattisgarh, is part of the larger Chhattisgarh Water Resources Department (CGWRD), which has a hierarchical structure. At the top is the Engineer-in-Chief, followed by Chief Engineers overseeing different basins (like the Hasdeo Basin), then Superintending Engineers of Circles, and finally Executive Engineers of Divisions. The department is responsible for the integrated and optimum development of both surface and groundwater resources in the state.

1.4. Training objectives

1. To Understand the practical applications of water resource management and the department's role in the region.
2. Knowledge of water resource management, project execution, and the department's operational procedures.

3. Developing Professional Skills like technical skills, teamwork, cooperation and developing the ability to identify and solve problems related to water resource management.

1.5. Duration and Location

1. Classroom lectures at Kharung Water Resource Department, Bilaspur.
2. Site-1, Shivghat Barrage on Arpa river, Bilaspur, Near Seepath Chauk.
3. Site-2, Langra Anicut, The Kharung River, a tributary to Shivrath River, is in the western part of Bilaspur district.

CHAPTER 2

WATER REQUIREMENT OF CROPS

2.1. General

Weir: A weir is basically an obstruction in the flow path of an open channel. The weir will cause an increase in water depth as the water flows over the weir. In general the flow rate, the greater will be the increase in depth of flow. The height of water above the top of the weir is the measurement usually used to correlate with flow rate.

Dam: Dams are massive barriers hydraulic structures built across river and streams to confine and store water on upstream side reservoir and utilize the flow of water for multipurpose.

Check Dams: They are small structure designed to control erosion, improve groundwater recharge and reduce water velocity.

Stop Dams: these are small masonry structure used for water harvesting and irrigation particularly in areas with limited water resources.

Anicut: A type of masonry check dam constructed across a stream in India, primarily for irrigation purpose. It is used to control the flow of water allowing it to divert or stored for irrigation, drinking water or even to recharge groundwater.

The **Kalani Dam** (Grand Anicut) on the Kaveri River is a famous example of an ancient and still functioning anicut.

- Minor Irrigation Schemes – Area < 2000 hectares.
- Medium Irrigation Schemes – Area 2000 hectares to 10000 hectares.
- Major Irrigation Schemes – Area > 10000 hectares.

2.2. Crop Period and Base Period

1. Crop period: The time period from the instant of crops sowing to the instant of its harvesting is called crop period.
2. Base Period: The time between first watering of the crop at the time of sowing to the instant of last watering before harvesting.

- Crop period is slightly more than the base period but for all practical purpose they are taken as same and generally expressed in days.

2.3. Relation Between Delta (Δ) Duty (D) and Base Period (B)

Delta (Δ): Each crop requires a certain amount of water after a certain fixed interval of time through its period of growth. The depth of water required every time depends upon the type of crop. If these depths of water are required five times during the Base period. Then the total water required by the crop for its full growth will be $5 \times$ each time depth. The final figure will be representing the total quantity of water required by the crop for its full growth. These may be expressed in hectares meter Or in million cubic meter or simply as depth to which water would stand on the irrigated area to stand above the surface without percolating or evaporation. This depth of water (in cms) Required by a crop to come to maturity each called delta (Δ).

Problem: The rice requires about 10cm depth of water at an average interval of 10 days and crop period for rice is 120 days. Find out delta (Δ) for rice.

Ans: Given, Crop period = 120 days

Watering interval = 10 days

Depth of Water = 10 cm

Number of watering = $\frac{120}{10} = 12 \text{ days}$

Total depth of water required = Number of watering $\times$ depth of water
 $= 12 \times 10 = 120 \text{ cms}$

Duty (D): The duty of water in the relationship between the Volume of water and the area of crop it matures. This volume of water is generally expressed in the Yoni discharge flowing from a time equal to the base period of the crop is called as Base of Duty.

If water flowing at a rate of 1 cubic meter per second runs continuously for B days and matures, say for example 200 hectares then the duty of water for the particular crop will be defined as 200 hectares per cumec to the base period of B days.

Hence, duty is defined as the area irrigated per cumec of discharge running for base period, the duty is generally represented by the letter D.

Let there be a crop of base period B days, Now let 1 cumec of water be applied to this crop in the field for B days now the volume of water applied to the crop during B days.

$$\text{Volume} = 1 \times B \times 24 \times 60 \times 60 = 86400B \text{ m}^3$$

By definition of Duty (D), 1 m³ Supplied for B days matures D hectares of land or 10⁴ m² of land.

$$\text{The depth of water supplied to this land} = \frac{\text{Volume}}{\text{Area}} = \frac{86400 B}{10000 D} \text{ m}$$

$$\Delta = \frac{8.64 B}{D} \text{ m}$$

By definition, Total depth of water is called delta (Δ)

$$\Delta = \frac{8.64 B}{D} \text{ m} = \frac{864 B}{D} \text{ cm}$$

Here, Δ in cms, B in days, and D in hectares/cumec.

2.3. Command Areas

1. **Catchment Area:** A catchment area also referred to as a watershed. It is an area that is topographically bounded, where all the precipitation collects it and drains off through a common outlet which could be a river, bay or other body of water.
2. **Command Area:** The area over which canal irrigated water flows by gravity is known as command area.
3. **Gross Command Area (GCA):** It is the total area which can be physically irrigated from a scheme without considering the limitations of the quantity of water available.
4. **Culturable Command Area (CCA):** It is the gross area minus the area of uncultivated land (including habitation area, pond, lakes) which is unfit for cultivation, Pastures and fallow lands. Which can be made cultivate world all included in this area but uncultivable populated areas including ponds reserved forests used lakes roads etc are excluded.

2.4. Irrigation Intensity

1. **Intensity of Irrigation:** The sum of total of area irrigated under different crops in a year expressed in percentage of the CCA is called intensity of irrigation.

The intensity of irrigation of a particular land can be defined based on a particular season or annually.

The percentage of CCA which may be irrigated annually is called annual intensity of irrigation. This may include the irrigation of two or more crops during one year.

$$\text{Annual Intensity of Irrigation} = \frac{\text{Gross Irrigated Area}}{\text{CCA}}$$

$$\text{GIA} = (\text{Total area irrigated once in a year}) + (\text{Area irrigated more than once in a year})$$

2. **Net Irrigated Area:** This is the area irrigated during a year counting the area only once even if two or more crops are irrigated on the same land.
3. **Gross Irrigated Area:** This is the total area irrigated under various crop during a year counting the area irrigated under more than one crop during the same year of many times as the number of crops grown.
4. **Intensity of Irrigated Cropping:** The ratio of difference of gross irrigation and net irrigated area to the gross irrigated area expressed as a percentage of is cold intensity of irrigated cropping.

CHAPTER 3

SHIVGHAT BARRAGE

3.1. General

In diversion schemes, water is directly drawn from the river or stream flow. This type of work is feasible when the normal flow of the river throughout the period of the growth of the crop proposed to be irrigated is never less than the requirements of irrigating the crop during the period of its growth. These consist of a weir or a barrage across the river stream with canal either on both sides or on any one side.

3.2. Components of Barrage

1. Weir or Barrage (gated or ungated)
2. Divide wall
3. Abutment wall
4. Wing walls
5. Returns
6. Scouring sluices
7. Friction Blocks
8. Stilling Basin
9. End Sill
10. Afflux Bund
11. CC Blocks
12. Toe Wall
13. Canal lining
14. Shalting Plate
15. Diaphragm Wall
16. Weep Holes

WEIR: A weir is a raised concrete (or masonry) crest wall constructed across the river width. It may be provided with a small shutter on its top. Most of the raising water (ponding) is done by solid wall and very little by shutters.

BARRAGE: If ponding of water is achieved by shutters or gates then it is called barrage. It has low crest wall with high gate.

DIVIDE WALL: The divide wall is masonry or a concrete wall constructed at right angle to the axis of the weir and separates the weir proper from the under sluices. It extends from beyond the end of the head regulator on u/s side to loose protection of the under sluice on d/s side.

ABUTMENT WALL: An abutment is the substructure at the ends of a bridge span or dam supporting its superstructure.

WING WALL: A wing wall is a smaller wall attached or next to a larger wall or structure. In a bridge, the wing walls are adjacent to the abutments and act as retaining walls. They are generally constructed of the same material as those of abutments. The wing walls can either be attached to the abutment or be independent of it. Wing walls are provided at both ends of the abutments to retain the earth filling of the approaches.

RETURN WALL: A return wall is provided at the endpoint of a culvert perpendicular to the culvert direction. This wall was built parallel to the centre line of a road and in continuation of an abutment or wing, to retain the embankment.

SCOURING SLUICES: The Under-Sluices are the openings which are fully controlled by gates, provided in weir wall with their crest at a low level. They are located on the same side as the off-taking canal. Under sluices are also called scouring sluices because they help in removing the silt near the head regulators.

FRICTION BLOCKS: These blocks are arranged in staggered position. Due to staggering the high velocity flow is diverted laterally. Thus, the water which flows in lateral direction obstructs the high velocity flow in the forward direction. As a result, energy of flow is dissipated.

STILLING BASIN: A stilling basins are transition structures constructed to dissipate excess energy confined by high velocity flow at the outlet of conduit or tunnel so that the flow beyond the basin does not endanger the stability of bed and banks of downstream channel.

ENDSILL: A vertical stepped, sloped or dentated wall, constructed at the downstream end of a stilling basin to help in dissipating residual energy and to reduce the length of the stilling basin.

AFFLUX BUND: An embankment or dyke designed to ensure that the structure is not outflanked during flood flows. In some cases, it also acts as an embankment to prevent flooding to the country side due to an afflux.

CC BLOCKS: These are of size 1.5 m×1.5 m×0.3 m. The CC blocks are concrete cement blocks they are performing functions like load bearing, partitioning, enclosure helps to regulate building temperature, help to reduce noise transmissions.

TOE WALL: It is the type of retaining wall in constructed at the base of slope its depth is 2.6 M it is used for erosion control and soil stability prevented landslide.

CANAL LINING: They are made in block to reduce seepage pressure.

SHALTERING PLATE: These are there to distribute impact forces and absorb it. It is used for casting various structures such as beam column wall etc. It is used to reduce honeycomb restructure we should use vibrator to distribute or settle concrete properly.

DIAPRAGAM WALL: It is the type of retaining wall under the foundation constructed using trench excavation method. It transfers load to deeper, more stable soil.

WEEP HOLE: We Falls are small opening on construction elements like walls and foundation designed to allow water to drain away preventing damage and moisture buildup they are used for pressure reduction and ventilation.

3.3. Project Details

Arpa River is the lifeline of Bilaspur City and district in Chhattisgarh. It is a major tributary of the river Shivnath that meets with Mahanadi. Arpa River originates from Khodri village of Pendraroad Gaurella block District GPM, (so many believe that, River Arpa originates from Village Amarpur near PENDRA) and flows to meet with Shivnath River at Matiyari village of Bilha block of Bilaspur district.

LOCATION: Shivghat is situated on the banks of the Arpa River, a tributary of the Mahanadi River. It is besides the Mahamaya chowk of Bilaspur district.

HYDROLOGY: The catchment area of the barrage is 1998 sqkm. The maximum flood level of river observed is 262.5 m.

TOPOGRAPHICAL FEATURES: The river is straight at the proposed site having a river bed level of 257.80 m, pond level of 261.30 m with a water depth of 3.50 m.

THE PROPOSAL: It is proposed to construct a barrage of length 334 m with a weir height of 0.6 m with an estimated cost of 50 Cr. The barrage has 20 barrage gates of 12x2.90 m and 4 under sluice gates of 12m×3.50 m.

MAIN BODY: This 334 m long barrage has 23 piers including 2 divide walls, and abutment on both ends. The piers and abutments are constructed with M20 Grade of concrete. The abutment walls have Weep holes so as to pass the excess pore water from the soil filling around abutment walls. The slab is casted out of M25 Grade of concrete with the dimensions of 14×7.5×.93 m.

DOWNSTREAM PROTECTION: As the stored water, when released, carry huge amount of energy which can scour the downstream bed of the river, hence protection is given in form of the energy dissipators such as Friction blocks, Stilling basin and End sill.

The downstream side has two layers of friction blocks laid in alternate manner, 10 m wide stilling basin which acts as cushion for the falling water and beyond the basin there is end sill for further protection.

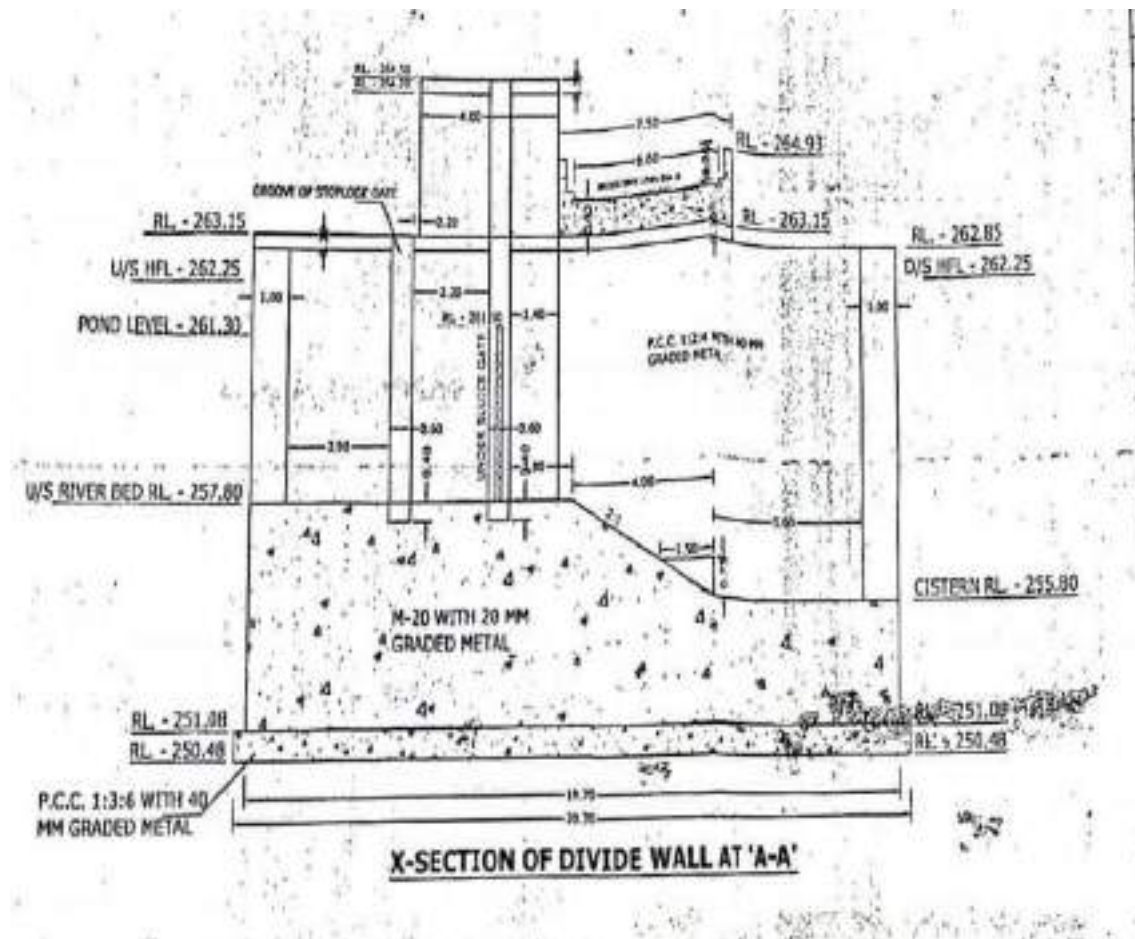
BANK PROTECTION: As the barrier cause the river level to rise, the water can flow out through the banks of the river hence Afflux bunds are provided along the stream at both the banks.

DESIGN DATA

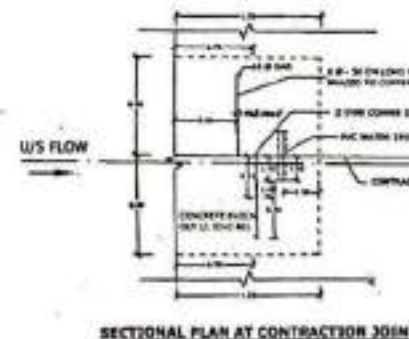
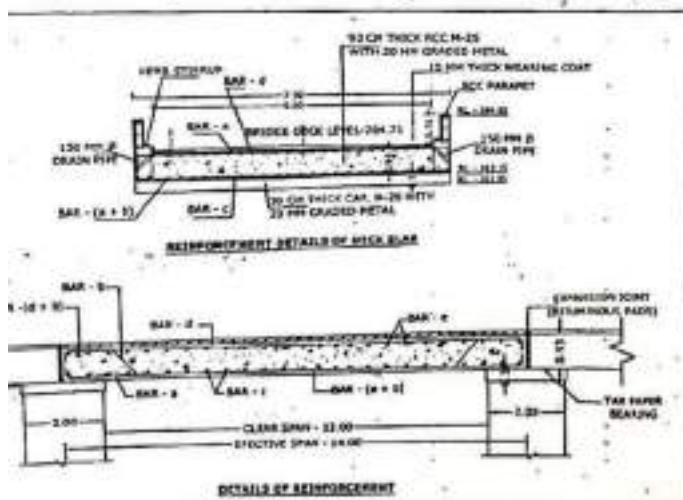
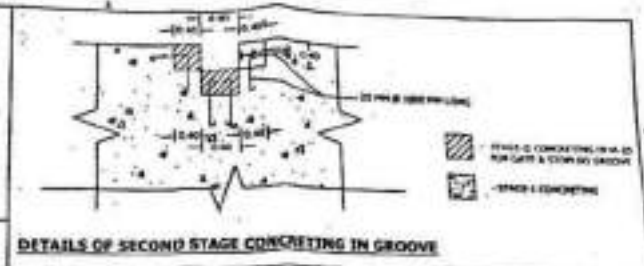
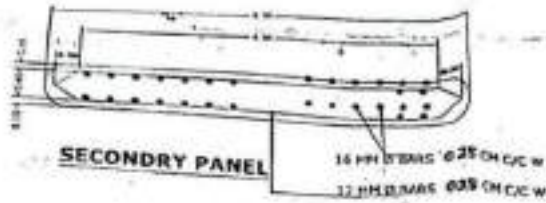
S. NO.	PARTICULARS	DATA
1	Catchment area	1998.00 sqkm
2	Bad level of river average NBL	257.8 m
3	HFL of river (before construction)	262.25 m
4	Permissible afflux	0.60 m
5	Pond level	261.30 m
6	Water depth	3.50 m
7	Safe exit gradient	1:6
8	Retrogression	0.5
9	Discharge concentration	20%
10	Length of barrage (overall) L	334.0 m

11	Crest level of wear	258.40 m
12	Height of Weir H	0.60 m
13	D/S HFL of river	262.25 m
14	Value of “n”	0.0225
15	U/S Floor level	257.80 m
16	U/S Floor level Of sluice	257.80 m
17	Horizontal floor length	47.90 m
18	Bed grade of river	1 in 670
19	Number of Barrage gate	20 Nos.
20	Size of Barrage Gate	12.00×2.90 m
21	Number of scouring gate	4 Nos.
22	Size of scouring gate	12.00×3.50 m

3.4. Pan/Layout of the Project



REINFORCEMENT
BAR @ 200 MM C/C



3.4. Some Glimpses of Site





CHAPTER 4

IRRIGATION SCHEMES IN CHHATISGARH

4.1. Types of schemes

Irrigation schemes be constructed in this state are chiefly of the following six types:

1. Diversion Schemes
2. Storage Schemes
3. Diversion-cum-storage Scheme
4. Stopdams / anicut / percolation tanks
5. Lift Irrigation Scheme
6. Tubewells

Diversion Schemes: In diversion schemes water is directly drawn from the river or stream this type of work is feasible when the normal flow of the water or stream throughout the period of the growth of the crop proposed to be irrigated is never less than the requirement of irrigating the crop during the period of its growth these consist of wear or barrages across the river with canal either on both sides or on one side.

Storage Schemes: When inflow of a river or stream is not uniform even during monsoon or in excess of dam and during one season and deficient during another storage is required for uniform supply of water to the crops and that's why storage scheme is adopted.

Diversion-cum-storage Scheme: When the divergent scheme after a period of operation experience shortage of water which is either due to insufficient flow or increase of area in the command Supplementary storage is constructed either on the same river or its tributaries and stored water is let into the river when there is demand to the peaked up at the diversion sites such schemes are called diversion-cum-storage scheme.

Stopdams / anicut / percolation tanks: Any cuts and stop dams are barriers constructed across streams and river Let's store water to a certain depth confined within the top bank level water thus collected is generally used for domestic

purposes and drinking water for cattle just like a local pond. Thus can also be used for irrigation purpose with or without lifting of water according to individual site condition anicuts and stopdams significantly contribute to recharging of groundwater. Many time course we are constructed on the scheme facilitating means of transport for the villagers during dry period. Sometimes anicuts are constructed for supplying water to industries and also some anicuts are used for drinking supply.

Percolation Tanks are primarily meant to recharge groundwater in the locality.

Lift Irrigation Scheme: When the water available for irrigation is at a lower level than the land to be irrigated then it has to be lifted by pumps or another water lifting devices this water is sometimes also stored in storage tank and then distributed to the lands by gravity through pipes or open canals.

Tube wells: Groundwater when extracted from pumped wells for irrigating water supply or drainage purpose it is turned as tubewell irrigation. Tube well can be used only in areas which are suitable for groundwater exploration.

CHAPTER 5

CANAL SYSTEM

5.1. Canal System

CANAL: A canal is an artificial channel constructed to convey water from rivers, reservoirs, etc. for several purposes like power generation, navigation, irrigation, etc.

The canal system consists of:

MAIN CANAL: It is the principal channel of a canal system taking off from a river or a reservoir.

BRANCH CANAL: A channel receiving its supply from the main canal and acting as a feeder for the distributaries.

DISTRIBUTRIES: The channel taking off from the main canal or branch canal with head discharge more than $1\text{m}^3/\text{s}$.

MINOR CANAL: A channel taking off from a main canal, branch canal or distributary with head discharge less than $1\text{m}^3/\text{s}$. A minor taking off from a main or branch canal is described as a "direct minor".

SUB-MINOR CANAL: It is a channel taking off from a minor which delivers water to more than one water coarse.

WATER COARSE: It is a channel taking off from a branch canal, distributary, minor, sub-minor which conveys water to the outlet serving 5 to 8 hectares.

FIELD CHANNEL: A channel taking off from the government outlet and leading to the farm.

FARM CHANNEL: It is a channel to carry water from the farm gate to the field.

5.2. Structures in The Canal System

Structures normally necessary in canals are:

- Cross drainage works
- Regulating structures
- Bridges

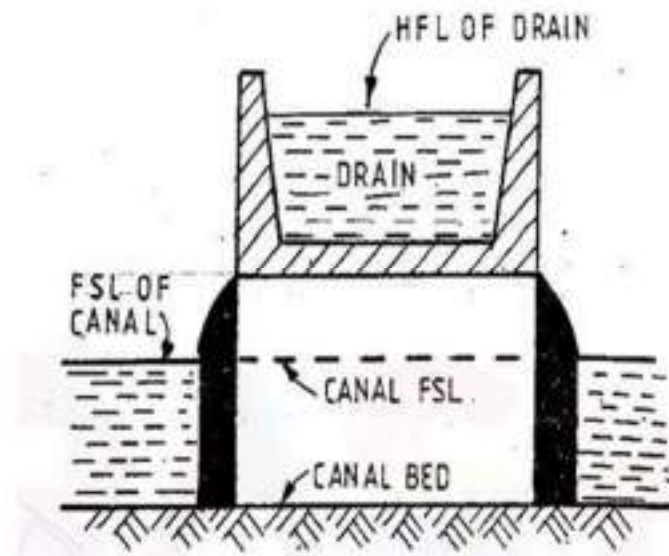
5.2.1. Cross Drainage Works

A cross drainage work is a structure carrying the discharge from a natural stream across a canal intercepting the stream. Canal comes across obstructions like rivers, natural drains, and other canals. The various types of structures that are built to carry the canal water across the above mentioned obstructions or vice versa are called cross drainage works.

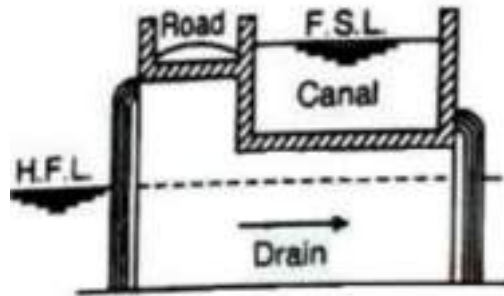
It is structure constructed when there is a crossing of canal from mixing into canal water cross draining works included.

1. Super passage
2. Aqueduct
3. Syphon aqueduct
4. Canal Syphon
5. Level crossing

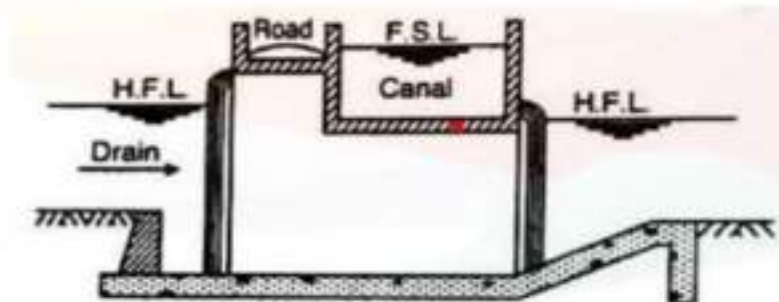
SUPER PASSAGE: Super passage structure carries drainage above the canal as the canal bed level is below the drainage bed level. The drainage trough is to be constructed at road level and drainage water flows through this from upstream to downstream and the canal water flows through the piers which are constructed below this drainage trough as supports. The FSL of canal is below the drainage trough in a super passage.



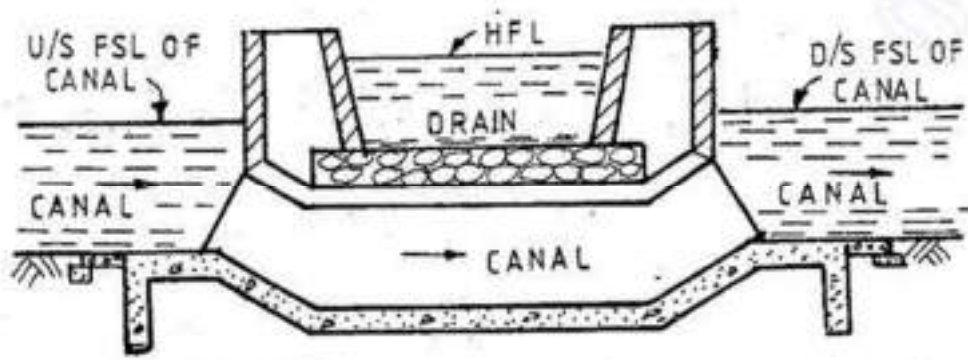
AQUEDUCTS: In an aqueduct, the CBL is above the drainage bed level, so canal is to be constructed above drainage. A canal trough is constructed in which water flows from upstream to downstream. This canal trough is to be rested on a number of piers. The drainage flows through these piers. In an aqueduct, the HFL of the drainage is below the CBL. Aqueduct is similar to a bridge, instead of roadway or railway, canal water is carried in the trough and below that the drainage water flows under gravity.



SYPHON AQUEDUCTS: In a syphon aqueduct, canal water is carried above the drainage but the HFL of drainage is above the canal trough. The drainage water flows under syphonic action and there is no presence of atmospheric pressure in the natural. The construction of the syphon aqueduct structure is such that the flooring of drain is depressed downwards by constructing a vertical drop weir to discharge high flow water through the depressed concrete floor.



CANAL SYPHON: In a canal syphon, drainage is carried over canal similar to a super passage but the FSL of canal is above the drainage trough, so the canal water flows under syphonic action. Flooring of canal is depressed and ramp like structure is provided at upstream and downstream to form syphonic action.

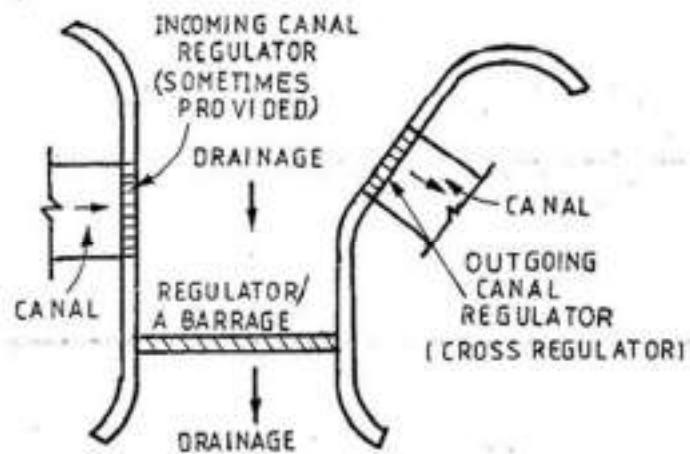


LEVEL CROSSING: When the bed level of canal is equal to the drainage bed level, then level-crossing is to be constructed.

This consists of following steps:

- Construction of weir to stop drainage water behind it.
- Construction of canal regulators across a canal.
- Construction of head regulators across a drainage.

In peak supply time of canal, water parallel to drainage, both the regulators are opened to clear the drainage water from that of canal for certain time interval. Once the drainage is cleared, the canal head regulators is closed. The cross regulator is always in open condition to supply canal water continuously.



5.2.2. Regulating Structures

The structures are required to maintain the level and the discharge of the designed valves.

They includes:

1. Falls
2. Cross Regulators
3. Head Regulator
4. Escapes
5. Outlets
6. Silt Ejectors

FALLS: Falls are provided in a canal when the fall of terrain is more than that of canal water level becomes more than the level required in the canal this structure dissipates excess energy and the need for filling is minimized.

CROSS REGULATOR: Cross regulator are required to maintain the FSL of canal. These are provided at intervals across the canal and below mean of take points so that when the canal is running at level lesser than supply discharge. Water can be raised to feed the off take canal.

HEAD REGULATOR: Head regulators are provided for regulating the discharge to feed the regulator's cruise regulators are required to maintain the FSL of canal These are provided at intervals across the canal and below major takeoff point so that when the canal is running at less than full supply discharge water can be raised to feed the off-take canal regulator are provided four regulating the discharge of feed and regulatories.

ESCAPES: Escapes are required for discharging the excess water out of the canal during periods of low demand in the command area. They are generally provided at upstream of cross regulator near a natural wall in order to release the water from the canal and avoid flooding in the command area during flood or rainy season.

OUTLETS: Outlets are waterproofs provided from minor and distributors according to demand in command area.

SILT EJECTORS: A silt ejector also known as a silt extractor is a structure built in a canal to remove silt from the water after it has already entered the canal.

5.2.3. Bridges

Bridges are provided for all existing and future anticipated roads to provide transportation facility in the command area. This is generally provided at intervals of 6 km but in case of distributors these are provided at two or three KM depending on local condition.

CHAPTER 6

EARTH DAMS

6.1. General

An earth dam may be termed as small earth and dam as it fulfil all the following criteria:

1. Its height is less than 15m above the deepest river bed level.
2. The volume of earth work involved in dam construction is less than 0.75 million m³.
3. Storage created by the embankment is less than 1 million m³.
4. The maximum flood discharge from the Intersected catchment area is less than 2000 m³/s

6.2. Components of Dams

1. Core or hearting
2. Casing or Shell
3. Internal Drainage Arrangement
4. Slope Protections
5. Impervious or Clay Blanket
6. Cut-off (puddle trench)
7. Relief Wells
8. Downstream Drainage Arrangements

CORE or HEARTING: Core is a zone of impervious earth and provides an impermeable barrier within the body of the dam.

CASING or SHELL: On outer side of core, a cover of relatively pervious soil is provided. This protects the core from external damages such as erosion from the rainwater, weathering and under conditions of sudden draw down and steady seepage. Shell helps core to retain its moisture content and thus prevents cracks in it.

INTERNAL DRAINAGE ARRANGEMENT: An internal drainage arrangement helps in safe passage of seeping water. This arrangement as far as, possible shall be provided with locally available sand and gravel.

SLOPE PROTECTION: For small dams, upstream slope shall be protected by providing 22 cm dry stone hand placed rip rap (pitching) using picked up boulders, over 15 cm picked up spalls. In case picked up boulders and/or spalls are not available at or near dam site, quarried stones and/or spalls be used for hand placed rip-rap. To protect downstream slope, turf shall be provided on its entire length. The slope shall also be properly drained.

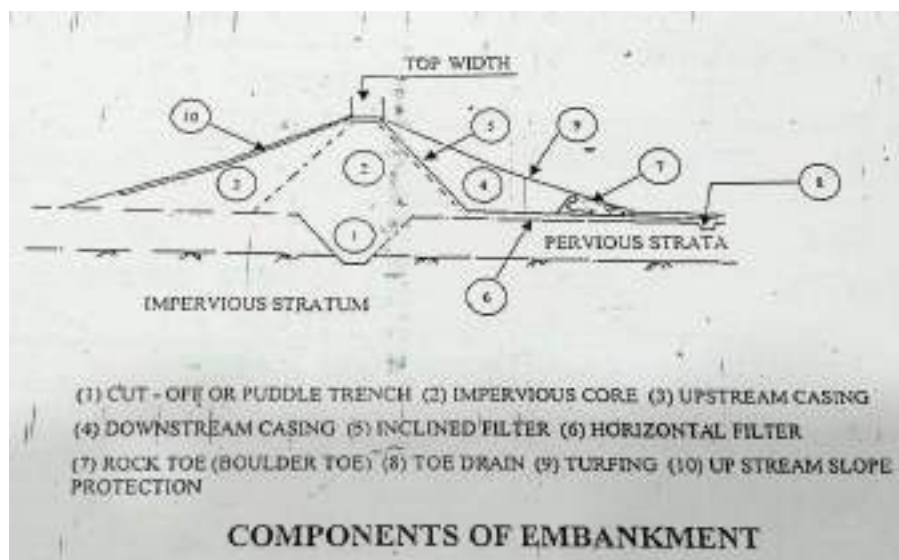
IMPERVIOUS or CLAY BLANKET: It is a layer of impervious material laid on the upstream side of an earthen dam where the substratum is pervious, to reduce seepage and increase the path of flow. The blanket decreases both the seepage flow and excess pressure on the downstream side of the dam. A natural blanket is a cover of naturally occurring soil material of low permeability.

CUTT-OFF (PUDDLE TRENCH): An impervious construction by means of which seepage is reduced or prevented from passing through foundation material.

RELIEF WELL: Vertical wells or boreholes downstream of or in the downstream shoulder of an earth dam to collect and control seepage through or under the dam to reduce water pressure.

DOWNSTREAM DRAINAGE ARRANGEMENT:

- **TOE DRAIN:** A trench filled with filter material or without it along the downstream toe of an earth dam to collect seepage from horizontal filter and lead it to the natural drain.
- **TURFING:** It is a cover of grass grown over downstream slope of an embankment to prevent erosion of soil particles by rain-wash and wind action.



CHAPTER 7

TOPOGRAPHIC SURVEYING

7.1. Norms of Topographic Surveys

Topographical survey is an important activity of the field staff, engaged both on (a) S & I of new scheme and (b) schemes approved for construction. Likewise, the success of an irrigation scheme depends largely as to how accurately that topographical surveys (including levelling) has been carried out and plotted.

7.2. Instructions for Symmetric Surveying

In General

1. The same importance as prescribed for measurement books is to be given to field or level book.
2. The date of first entry in the book is to be intimated to the SDO /EE by the actual user.
3. The reducing of levels is to be done in the field immediately after levelling and the arithmetic check for each page conducted separately.
4. The levels taken on the day are to be plotted the same day as far as possible, or at least by the next day by the same person who conducted surveying or levelling and the remark given in red ink in column 8.
5. Before shifting of the survey camp or certificates should be sent to the SDO that plotting work has been completed.
6. Every plotted sheet shall contain certificate as follows: "Certificates that survey was conducted by me/us using field book and level books bearing number and issued by sub division (name of subdivision)."
6. "The BMS are shown plotted in red ink and identifiable with the description shown. The levels are related to the nearest GTS benchmark whose description is (give particulars)".
7. The level of field book shall be returned to the subdivision office after plotting is done and index completed unless of course required for another work

7.3. Sample Computations in a Levelling Field Book

Left Hand Page

1. Name of person conducting survey
2. Name of Work
3. Date and Weather

Right Hand Page

4. Instrument No.
5. Make.....

7.4. Methods

There are two methods:

1. Rise & Fall Method

R.D	B.S	I.S	F.S	Rise	Fall	R.L.	Distance	Remarks
-----	-----	-----	-----	------	------	------	----------	---------

Arithmetic check:

$$\sum B.S. - \sum F.S. = \sum RISE - \sum FALL = \text{LAST R.L.} - \text{FIRST R.L.}$$

2. Height of Instrument Method

R.D	B.S	I.S	F.S	H.I	R.L.	Distance	Remarks
-----	-----	-----	-----	-----	------	----------	---------

Arithmetic check:

$$\sum B.S. - \sum F.S. = \text{LAST R.L.} - \text{FIRST R.L.}$$

CHAPTER 8

LAGRA ANICUT

8.1. General

The **Kharung River**, a tributary to **Shivnath River**, is in the western part of Bilaspur district. It is the source of water of several villages of Bilaspur district.

The region nearby to the Kharung river is scarcity prone area and almost every alternate year, the crop is affected by scarcity. To provide the drinking water facilities to people and animals and water for Nistari purpose from river, it has been decided by government of Chhattisgarh to construct series of Anicuts/Stopdams in the rivers of Chhattisgarh state.

8.2. Salient Features

S. NO.	PARTICULAR'S	DATA
1	Catchment area	697.89 sqkm
2	Deepest bed level of river NBL	100.00 m
3	Top bank level of river TBL	105.570 m
4	Length of anicut cum Rapta - L	95.000 m
5	Crest level of weir	103.000 m
6	Height of Weir H	3.0 m
7	U/S HFL of river	103.940 m
8	D/S HFL of river	103.940 m
9	Value OF “n”	0.0250
10	Numbers and size of Open duct	5 Nos. 2.00×0.60 m
11	Numbers and size of Sluice Gate	5 Nos. 2.00×1.30 m

8.3. Project Details

LOCATION: The proposed side is located near village Lagara in block Bilha District Bilaspur and is about 15 km away from Bilaspur. The site is approachable by all-weather village road. The site can be located at Latitude 22-07’-40” Longitude 82 14’-30”.

HYDROLOGY: The catchment area upto the anicut site is 697.89 sqkm. The maximum flood discharge is 2661.32 cumecs. The maximum flood level observed is 103.94 m.

TOPOGRAPHICAL FEATURES: The river is straight at the proposed site having high banks and narrow river width, the upstream side of proposed site is wide and is good for water storage. The average river bed level is 100 m with bank RL is 105.57 m. The width of river at proposed is 95 m. The natural bed grade of river is 1 in 654.

GEOLOGICAL FEATURES: The geological investigation is to be made by diamond core drilling in river bed at different point at proposed site. The average rock level of the site is 98 m.

THE PROPOSAL: It is proposed to construct anicut of 95 m length and 3 m height on average bed level of River 100 m with 5 gates of 2x1.3 m. The structural details of the proposed anicut are as follows:

- **MAIN BODY OF ANICUT:** The main body wall consists of solid weir with 5 gates of 2x1.3 m. The top width of solid weir has been kept as 3 m with straight face at upstream side and 1:1 slope at downstream side. Foundation level is kept below 0.6 m hard rock level & from the hard rock level both the faces kept straight.
- **WEIR:** There is 95 m long solid weir will be constructed along with provisions. 5 Nos. of openings of size 2x1.3 m above the sill level (River bed level). The height of weir is 3 m. The foundation for weir is kept at 0.6 m below rock level. The entire weir is encased by 30 cm thick layer of M-15 RCC with a minimum reinforcement of 0.15% of cross-section area of encasing in each direction. The portion of pier is filled up with M-10 PCC.
- **ABUTMENT/ END BLOCKS:** The Left and Right Banks are protected by CC abutment construction in M-15 concrete. The length of each abutment is 30 m. The foundation of abutment is kept at 0.60 m below hard rock. The top level of abutment is kept at HFL. The abutment shall be constructed monolithic with main body of anicut. The weep holes in the abutment have been provided above weir top. The earth face of abutment will be properly filled with dressed & compacted earth.
- **BANK PROTECTION WORK:** Each bank of river will be protected as follows.
 - a) **CC Flank Wall and Returns:** The right & left bank of river adjacent to abutment is to be protected by CC abutments and return walls on upstream and downstream side. The length of upstream flank wall will be 10 m and length of downstream flank wall is 15 m. The foundation of these flank walls is kept at the same level as the foundation RL of the

abutment i.e, 0.6 m below the hard rock level. The height of the flank wall is provided upto 106.10 m. The walls are constructed with CC M-15.

b) CC Return walls: The CC return walls are provided at each end of the river banks at both upstream and downstream side. The length of return wall will be 15 m. The height of the return wall is provided upto RL 106.10 m and the foundation is kept 0.6 m below the hard rock level.

- **ESTIMATED COST:** The estimated cost of the anicut is Rs 4.96 Cr.

8.4. Some Glimpses of Site







CONCLUTION

- This internship was a great experience for me. I have gained new knowledge, skills and met many people. I achieved several of my goals. Books that I have referred, videos and presentations that I have watched, research papers I have gone through etc. helped me a lot.
- The main benefit of the internship was that I have gained an extensive amount of knowledge on water Resources and department it works with. The internship also provided me a chance to visit project sites like Shivghat Barrage and Lagra Anicut. It was a very wonderful experience.
- Classroom learning provides a structured, theoretical foundation, while fieldwork allows for practical application and real-world experience.



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केन्द्रीय लोक निर्माण विभाग / CENTRAL PUBLIC WORKS DEPARTMENT
कार्यालय कार्यपालक अभियंता बिलासपुर
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पत्र क्रमांक 12(04)/बि.म./2025/1219(वि)

बिलासपुर, दिनांक 07.07.2025

कार्यालय आदेश

प्रमाणित किया जाता है कि पत्र क्र. सिविल इंजीनियरिंग विभाग अभियांत्रिकी एवम् प्रौद्योगिकी, अध्ययनशाला गुरु घासीदास विश्वविद्यालय, कोनी, बिलासपुर (छ.ग.) का Reference No. 158/CE/SoS, E&T/GGV/BSP/2025 dated 13.05.2025 व Reference No. 157/CE/SoS, E&T/GGV/BSP/2025 dated 13.05.2025 में वर्णित निम्न छात्रों ने इस कार्यालय के अधीन सम्पादित किये जा रहे निर्माणधीन कार्यों के अन्तर्गत श्री प्रकाश चन्द जैन, सहायक अभियंता (सिविल) के मार्गदर्शन में दिनांक 16.05.2025 से 16.06.2025 तक सफलतापूर्वक प्रशिक्षण प्राप्त किया है। यह कार्यालय इनके उज्ज्वल भविष्य की कामना करता है।

क्र. सं.	छात्र/छात्रा का नाम	पता	आधार सं.
1.	श्री आशीष नागेश	म.का. 165, बडेतुमनार, दत्तेवाड़ा (छ.ग.)	701088998715
2.	श्री करन गंगवानी	परीजात कॉलोनी, नेहरू नगर, बिलासपुर (छ.ग.)	427609441824
3.	श्री एमीडी कौशिक	पुराना बस स्टैण्ड, उटनुर, अदिलाबाद, राज्य तेलंगाना	508426746147
4.	श्री पुरुषोत्तम	ग्राम कुंजेदाबरी, बेलपाती, कोण्डातराई, रायगढ़ (छ.ग.)	346328973112
5.	श्री रोबिन कुमार	ग्राम मंगरार, जिला जमुई, राज्य बिहार	326621063268
6.	श्री विनय	3-90, नन्दीगामा, मंदालाम, गोल्लामुडी, कृष्णा, राज्य आन्ध्रप्रदेश	688547176715

(मनोज रस्तोगी)

(मनोज रस्तोगी)

कार्यपालक अभियंता-बिलासपुर
के.लो.नि.वि. बिलासपुर (छ.ग.)

प्रतिलिपि:-

- विभागाध्यक्ष, सिविल इंजीनियरिंग विभाग अभियांत्रिकी एवम् प्रौद्योगिकी, अध्ययनशाला गुरु घासीदास विश्वविद्यालय, कोनी, बिलासपुर (छ.ग.)
- सभी संबंधित प्रशिक्षणार्थी।

ABSTRACT

During my internship with the Central Public Works Department (CPWD) at Guru Ghusidas Vishwavidyalaya (GGU), Koni, Bilaspur (C.G.), I was involved in the construction project titled "Construction of Lecture Hall Complex (G+4), Boys Hostel (G+3) 250 seats, Girls Hostel (G+3) 250 seats and site development including all civil and E&M works and horticulture services etc." The work was executed on an Engineering, Procurement, and Construction (EPC) basis by Asian Construction Company, 716-A, Ajmer, Rajasthan. The estimated cost of the project was ₹55.21 crore, which included ₹43.81 crore for civil works, ₹10.99 crore for electrical works, and ₹0.40 crore for horticulture. The project was planned for completion in 21 months with an earnest money deposit of ₹65.21 lakh, a performance guarantee of 3%, and a security deposit of 2.5% of the tendered value. This internship helped me understand the various planning and execution stages in a large-scale public infrastructure project. During the planning phase, the project manager created several key documents to guide the execution. These included a Scope Statement that defined the project's objectives, deliverables, and milestones; a Work Breakdown Schedule (WBS) to divide the project into manageable parts; and a Gantt Chart that visually tracked project timelines. Milestones were identified to ensure smooth progress, and a Communication Plan was established for internal coordination and stakeholder updates. A Risk Management Plan was also in place to identify and prepare for possible risks such as budget constraints or schedule delays.

On site, I witnessed the implementation of several important features aligned with CPWD and National Building Code (NBC) guidelines. These included tactile tiles for accessibility in key locations such as entrances, corridors, and lift lobbies, along with ramps to support inclusive infrastructure. Rainwater harvesting systems with filtration units and recharge pits were installed in all buildings to promote sustainable water use. The lecture halls were designed with acoustic treatments using materials like mineral wool panels and double-glazed windows to improve sound quality. Water treatment units were installed for a safe water supply, adhering to IS 10500 standards. All buildings were equipped with fire safety measures including alarms, extinguishers, emergency exits, and signage. The inclusion of horticulture work also added greenery to the campus, improving the overall environment. This internship gave me practical exposure to technical, safety, and service systems used in public infrastructure and taught me how proper planning ensures successful project execution.



गुरु घासीदास विश्वविद्यालय, बिलासपुर
केंद्रीय विश्वविद्यालय अधिनियम 2009 संख्या 25, 2009 द्वारा केंद्रीय विश्वविद्यालय
Guru Ghasidas Vishwavidyalaya, Bilaspur
A Central University established by the Central Universities Act 2009 No. 25 of 2009

A COMPREHENSIVE TRAINING REPORT

ARCHITECTURAL AUTOCAD

BHAVANAMS

15/05/2025 – 1/07/2025

Anitha Kongalla

GGV/22/01017

7th semester

Session 2025-2026

DEPARTMENT OF CIVIL ENGINEERING

School of Studies, Engineering & Technology

GURU GHASIDAS VISHWAVIDYALAYA

Bilaspur (C.G.) 495009

A CENTRAL UNIVERSITY

(Established under the Central Universities Act, 2009 No. 25 of 2009)

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DECLARATION

I, **Anitha Kongalla**, a student of **B. Tech, Civil Engineering, Guru Ghasidhas Vishwavidyalaya**, hereby solemnly declare that the report entitled “**Internship on Architectural AutoCAD**” is a genuine and original record of the industrial training/internship undertaken at **Bhavanams** during the period from **15-05-2025 to 1-07-2025**.

The work presented in this report is entirely my own and has not been copied, reproduced, or submitted elsewhere for any academic or professional purpose. I affirm that:

- All information and observations recorded were made during my tenure at the above-mentioned organization.
- No part of the report has been plagiarized or duplicated from any other source.
- Proper references and acknowledgments have been made wherever external information has been consulted.

I understand that any violation of this declaration may result in academic or disciplinary action as per the rules and regulations of the institution.

Place: Bilaspur

Date: 1/08/2025

Signature of the Student

Name: Anitha Kongalla

Enrollment No.: GGV/22/01017

ACKNOWLEDGEMENT

I sincerely thank my faculty mentor, **Srinivas Reddy sir**, for his valuable guidance and support throughout the course of this industrial training. I am grateful to the entire team of Bhavanams for their mentorship, cooperation, and the opportunity to gain hands-on experience in the field.

I extend my heartfelt appreciation to our **Hon'ble Dean, Prof. Sharad Chandra Srivastava**, the **Head of the Department, Prof. M. Chakradhara Rao**, and all concerned faculty members of the Department of Civil Engineering, Guru Ghasidas Vishwavidyalaya, for their continuous encouragement.

Lastly, I am thankful to the **Central Training & Placement Cell** for facilitating and coordinating this training initiative, which has greatly contributed to my professional development.

Place: Biaspur

Date: 1/08/2025

Signature of the Student

Name: Anitha Kongalla

Enrollment No.: GGV/22/01017

CERTIFICATE



ISO CERTIFICATE NO: **TSNUK99454**

DATE: 02/07/2025

CERTIFICATE OF COMPLETION

This is to certify that

Kongalla Anitha

Has Successfully Completed Course on

“Short Term Internship course on AutoCAD Architectural”

As Prescribed and Designed by Bhavanam's C2C

During the Course she Exhibited Good Erudite Skills with a Self Motivated Attitude
To Learn New Things Her Performance Exceeded Expectations and was able to
Complete The Project Successfully On Time

**Her Association With us was Very Fruitful &
We Wish Her All The Best In Future Endeavours**

B. Srinivasa Reddy

CEO OF BHAVANAM'S

This is a system generated certificate and Requires No Signature

ABSTRACT

In this report, I have explained the step-by-step procedure I followed for 2D architectural modeling using AutoCAD. This work aimed to understand the complete process of planning and drafting a residential building—from initial concept to final presentation drawings. I started by learning the AutoCAD interface, various CAD commands, and important tools such as Draw, Modify, Layers, Annotations, and Blocks.

I also studied and applied Vastu principles, which play a major role in traditional Indian building design. Based on client requirements such as site dimensions, road access, number of floors, and parking space, I prepared a hand-drawn conceptual plan. Then, I drafted the floor plans digitally using AutoCAD, including external and internal walls, doors, windows, furniture blocks, hatching, annotations, and proper layer management.

Furthermore, I worked with different layout sizes and understood the plotting and printing process to create final output drawings suitable for client presentation. I also gained an overview of structural aspects like column positioning, slab types, load transfer methods, and basic RCC concepts as per IS codes.

This project helped me apply architectural planning principles using AutoCAD practically and provided me with hands-on experience in preparing professional 2D drawings for real-world building design.

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INTRODUCTION

1.1 General

As a final year B.Tech Civil Engineering student, I undertook architectural training to gain hands-on experience in the field of planning and drafting using AutoCAD. The primary purpose of this training was to bridge the gap between theoretical knowledge acquired in the classroom and practical application in the professional field. Through this training, I aimed to understand the actual workflow involved in architectural design, client interaction, and the use of software tools like AutoCAD for preparing accurate 2D building plans. The exposure also helped me to improve my technical drawing skills, planning strategies, and understanding of Vastu-based design principles.

The training was conducted at Bhavanams, a well-known architectural and construction firm based in Hyderabad, Telangana. Bhavanams is recognized for its innovative residential planning and client-focused design approach. The firm has successfully executed numerous residential buildings, duplex houses, villas, and small-scale commercial projects. The organization operates with a clear departmental structure consisting of architectural planning, structural design, interior design, site supervision, and client coordination teams. During my training, I got the opportunity to interact with professionals from different departments, which helped me understand how coordination among various teams leads to the successful completion of a project.

Bhavanams has undertaken many notable projects in and around Hyderabad, focusing primarily on residential developments that follow both modern aesthetics and traditional Vastu principles. Some of their ongoing projects include gated communities, independent villas, and apartment layouts designed to suit customer requirements and local building regulations. I was also introduced to the details of one of their project sites, where I learned about the proposed site dimensions, road access, building orientation, and basic site analysis. Understanding project site conditions helped me relate the importance of on-site data to the planning and drafting work done in the office.

The training lasted for six weeks and was conducted at the company's head office located in Hyderabad. During this period, I focused on learning architectural drafting using AutoCAD, understanding how to convert client requirements into 2D building plans, and preparing layouts

suitable for presentation and approval. The key objectives of the training included learning the step-by-step process of architectural planning, drafting according to Vastu guidelines, working with layers and annotations, and understanding the basics of layout management and plotting. This experience has been valuable in developing my confidence and preparing me for future roles in architectural design and planning.

TRAINING ACTIVITIES (WEEK-WISE LOG)

2.1 Week-wise log

Week	Key Activities	Description
Week 1	Introduction to AutoCAD, Interface & Commands	Software familiarity, command usage, workspace setup
Week 2	Vastu Concepts & Client Requirement Collection	Vastu planning, site analysis, room requirement sketching
Week 3	2D Floor Plan Drafting (Walls, Doors, Windows)	Drawing setup, wall creation, door/window placement, use of blocks
Week 4	Furniture Layout, Layers, Annotation	Layer management, furniture block insertion, text and dimensioning
Week 5	Layout Creation, Title Blocks, Plotting	Sheet setup, viewports, page scaling, plotting and printing
Week 6	Structural Basics & Final Report Preparation	Column layout, slab types, documentation, report writing

Week 1: Introduction to AutoCAD and Display Interface

In the first week, I was introduced to the basics of AutoCAD and its application in architectural planning. I explored the CAD display interface and familiarized myself with various command tools such as line, rectangle, circle, and trim. I also learned how to set up a new drawing file,

manage drawing units, and understand the workspace. This initial orientation helped me become comfortable with the software and understand its role in architectural design.

Week 2: Understanding Vastu and Planning Concepts

This week focused on the application of Vastu principles in architectural layout planning. I studied the importance of Vastu in room arrangement and orientation based on directions. I also learned how to collect and analyze client requirements, including site dimensions, building orientation, road width, and room specifications. With this knowledge, I started sketching rough layout plans on paper, integrating both Vastu principles and client needs.

Week 3: Drafting Floor Plans in AutoCAD

In the third week, I began drafting the floor plan in AutoCAD based on the approved sketch. I created the external and internal walls, positioned doors, windows, and ventilators using standard dimensions and blocks. I applied appropriate hatching patterns for walls and began using layers to organize various elements such as walls, furniture, and openings. I also practiced using annotations to label rooms, dimensions, and symbols accurately.

Week 4: Furniture Layout and Layer Management

This week, I focused on placing furniture and preparing detailed room layouts using AutoCAD blocks. I used standard furniture blocks to indicate beds, sofas, tables, and kitchen counters in the plan. I assigned different components (walls, furniture, doors, text) to different layers for better control and visibility. This helped me understand the importance of a well-structured drawing file for clarity and professional presentation.

Week 5: Working with Layouts and Plotting

In the fifth week, I worked on preparing the final output drawings for presentation. I learned how to set up layout sheets in different sizes such as A4, A3, and A1, and how to insert viewports for multiple drawings. I also created a standard company title block and arranged floor plans within the layout. Using the Plot Manager, I configured page setup, scales, and print styles to generate clean and properly dimensioned printed drawings.

Week 6: Structural Overview and Final Report Preparation

In the final week, I was introduced to the basic structural aspects that follow architectural planning. This included column placement as per floor plan, RCC slab types, and load transfer methodology

Minimum Size, Width and Height of different components of residential premises

S. No.	Components of Building	Minimum Requirement for a Dwelling Unit up to 50sq.m			Minimum Requirement for a Dwelling Unit above 50sq.m		
		Area (sq. m)	Width (m)	Height (m)	Area (sq. m)	Width (m)	Height (m)
(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)
1	Habitable Rooms	7.5	2.1	2.75	9.5	2.4	2.75
2	Kitchen	3.3	1.8	2.75	4.5	1.8	2.75
3	Pantry	-	-	-	3.0	1.4	2.75
4	Kitchen with Dining area	7.5	2.1	2.75	7.5	2.1	2.75
5	Bathroom	1.2	1.0	2.2	1.8	1.2	2.2
6	WC	1.0	0.9	2.2	1.2	0.9	2.2
7	Combined Bath & WC	1.8	1.0	2.2	2.8	1.2	2.2
8	Door ways (Habitable rooms)	-	0.9	2.1	-	0.9	2.1
	(Kitchen, Bath, WC)	-	0.75	2.0	-	0.75	2.0
9	Staircases	-	1.0	-	-	1.0	-
10	Garage	Two-wheeler garage: 1 x 2 m			18.0	3.0	2.4
11	Store room	Area and width of the store has no restriction, however Minimum Height has to be 2.20mt. If the area of the store is 9.5sqm and above, the light and ventilation clause shall also apply.					
12	Projections	Permitted within the plot boundary, up to 0.75 m width. No portions of any projection whatsoever shall project outside the plot boundary.					

Table(1): Decide Rooms Arrangement { As per Vastu}.

Minimum Setbacks and Height Permissible

Sl. No.	Plot Size (in Sq.m) Above – Up to	Parking provision	Height (in m) Permissible Up to	Building Line or Minimum Front Setback to be left (in m)					Minimum setbacks on remaining sides (in m)
				Abutting Road Width					
				Up to 12m	Above 12m & up to 18m	Above 18m & up to 24 m	Above 24m & up to 30m	Above 30m	
(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)
1	Less than 50		7	1.5	1.5	3	3	3	-
2	50-100	-	7	1.5	1.5	3	3	3	-
			10	1.5	1.5	3	3	3	0.5
3	100 - 200	Stilt floor	10	1.5	1.5	3	3	3	1.0
4	200 - 300	Stilt floor	7	2	3	3	4	5	1.0
			10	2	3	3	5	6	1.5
5	300 - 400	Stilt floor	7	3	4	5	6	7.5	1.5
			12	3	4	5	6	7.5	2.0
6	400 - 500	Stilt floor	7	3	4	5	6	7.5	2.0
			12	3	4	5	6	7.5	2.5
7	* 500 - 750	Stilt floor	7	3	4	5	6	7.5	2.5
			12	3	4	5	6	7.5	3.0
			15	3	4	5	6	7.5	3.5
8	750 - 1000	Stilt + One Cellar floor	7	3	4	5	6	7.5	3.0
			12	3	4	5	6	7.5	3.5
			15	3	4	5	6	7.5	4.0
9	1000 - 1500	Stilt + 2 Cellar floors	7	3	4	5	6	7.5	3.5
			12	3	4	5	6	7.5	4.0
			15	3	4	5	6	7.5	5.0
			18**	3	4	5	6	7.5	6.0

Table(2) : Decide Setbacks in Four Directions { As per GVMC Rules}

Room / Structure Placements								
Structure Placements	North East	East	South East	South	South West	West	North West	North
Pooja Mandir	✓✓	✓	✗	✓	✗	✓	✗	✓
Kitchen	☠	✗	✓✓	✓✗	✗	✓✗	✓✓	✗
Master Bedroom	☠	✗	✗	✓	✓✓	✓	✗	✗
Kids Bedroom	✓✗	✓	✗	✓	✗	✓	✓	✓
Living Room	✓	✓	✓✗	✓	✗	✓	✓✗	✓
Guest Room	✗	✓✗	✓	✗	☠	✗	✓✓	✓✗
Computer Table	✓	✓	✗	✓	✓✗	✓	✗	✓
StairCase	☠	✗	✓✓	✓	✗	✓	✓✓	✗
Dining Room	✓	✓	✓✗	✓	✗	✓	✓✗	✓
Water Sump/Bore	✓✓	✓	✗	☠	☠	☠	✗	✓
Cup Boards	☠	✗	✓✓	✓	✓✓	✓	✓✓	✗
Toilet	☠	✓	✓✓	✓	☠	✓	✓✓	✓
✓✓ = Excellent ✓✓ = Very Good ✓ = OK ✓✗ = Doubtful ✗ = Bad ☠ = Danger								

Table (3): Draw each Floor Plan like {Ground, First floor}

TECHNICAL CONCEPTS APPLIED

3.1 Technical concepts applied

During my training at Bhavanams, I was exposed to several technical concepts that are essential in both architectural and structural planning. One of the key aspects was the use of relevant Indian Standards (IS) codes to ensure the quality, safety, and stability of structures. Codes such as IS 456:2000 (for reinforced concrete design), IS 875 (for calculating dead, live, and wind loads), and IS 1893 (for earthquake-resistant design) were referred to for understanding structural detailing and load considerations. These standards helped me understand how building components must comply with national guidelines during design and execution.

Another major area of learning was engineering drawings and their interpretation. I learned how to read and draft floor plans, elevations, sections, and working drawings using AutoCAD. Emphasis was placed on understanding symbols, notations, dimensions, and layer management for clear communication of design intent. Interpreting drawings correctly is crucial for construction execution, and this training helped strengthen my skills in both manual sketching and digital drafting.

OBSERVATIONS & REFLECTIONS

4.1 Observations & reflections

Throughout my training at Bhavanams, I observed several differences between classroom learning and field practices. While academic learning focuses more on theoretical knowledge, design principles, and software operations, field training exposed me to the practical aspects of architectural drafting, client handling, and project management. For example, while I had previously learned how to use AutoCAD in a structured lab setting, applying those skills to real client-based projects required faster decision-making, attention to detail, and adherence to project standards. Understanding Vastu principles, interpreting site conditions, and considering client preferences added a whole new dimension to the design process that isn't always emphasized in textbooks.

During the training, I faced a few challenges, especially in the initial phase. Adapting to a professional work environment, learning to apply AutoCAD tools efficiently, and managing drawing standards under time constraints were some of the hurdles. Also, working with layered CAD files and understanding how structural and architectural components overlap was initially overwhelming. However, with consistent practice and guidance from experienced team members, I was able to overcome these difficulties and gradually gained confidence in my drafting abilities.

One of the noteworthy observations was the firm's adherence to client-centric planning and Vastu-based designs, which helped me understand how cultural and lifestyle considerations influence modern architectural practices. The systematic use of layers in AutoCAD, reusable block libraries, and efficient layout plotting methods were some of the good practices that significantly enhanced workflow. The team also demonstrated the use of structured templates and naming conventions, which helped maintain consistency and reduced errors.

In addition to technical knowledge, I also developed essential soft skills during the training. Regular interaction with team members helped improve my communication and teamwork abilities, especially while discussing design feedback or receiving corrections. I also learned the importance of professional ethics, punctuality, and respecting client requirements in a real project setting. These soft skills, along with the technical experience, have made this training a valuable and transformative part of my engineering education.

CONCLUSION

The training at **Bhavanams** gave me valuable practical exposure to architectural planning and 2D drafting using AutoCAD. I learned how to convert client requirements into clear floor plans by applying Vastu principles and using essential CAD tools like layers, blocks, and annotations. This hands-on experience helped me connect classroom concepts with real-world drafting practices.

For future batches, I suggest focusing on live projects, practicing more advanced AutoCAD features, and visiting construction sites to better understand how drawings are used in execution.

Overall, this training has enhanced my technical skills and design understanding, and I believe it will play a crucial role in my future career in civil and architectural engineering.

APPENDICES

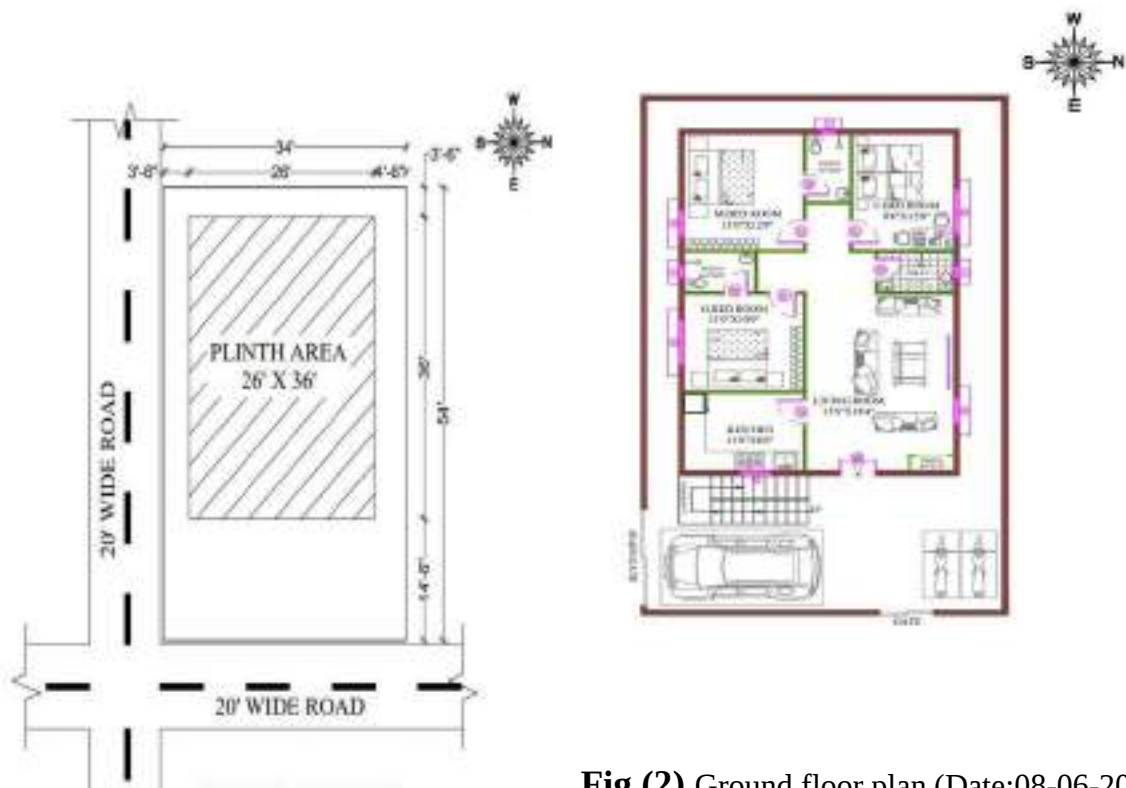


Fig (2) Ground floor plan (Date:08-06-2025)

Fig (1): Site Layout (Date:1-06-2025)



Fig:(3) First floor plan (Date:25-06-2025)

REFERENCES

1. www.bhavanams.com
2. www.bis.gov.in
3. https://drive.google.com/drive/folders/1f5l2aMtglwtXeuqPDq9jt56cyWemkA1E?usp=drive_link
4. https://drive.google.com/drive/folders/1f5l2aMtglwtXeuqPDq9jt56cyWemkA1E?usp=drive_link



गुरु घासीदास विश्वविद्यालय, बिलासपुर
केंद्रीय विश्वविद्यालय अधिनियम 2009 संख्या 25, 2009 द्वारा केंद्रीय विश्वविद्यालय
Guru Ghasidas Vishwavidyalaya, Bilaspur
A Central University established by the Central Universities Act 2009 No. 25 of 2009

A COMPREHENSIVE TRAINING REPORT

BUILDING CONSTRUCTION

SHRI BALAJI CONSTRUCTIONS

4 Weeks Vocational Training

Manish Kumar

(GGV/22/01019)

2022-26 & 7th Semester

Session: 2025-26

Submitted to:

DEPARTMENT OF CIVIL ENGINEERING

School of Studies, Engineering & Technology

GURU GHASIDAS VISHWAVIDYALAYA

Bilaspur (C.G.) 495009

A CENTRAL UNIVERSITY

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ABSTRACT

This report outlines the one-month industrial training undertaken in the field of Building Construction, organized by **Shri Balaji Constructions, Dharamjaigarh** a reputable firm known for its comprehensive approach to civil and structural engineering. The training was designed to bridge academic knowledge with practical field experience, exposing trainees to real-world construction processes and site management practices.

The nature of the training was hands-on and field-oriented, focusing on core aspects of building construction, including site preparation, foundation laying, formwork, reinforcement, concrete works, masonry, plastering, and finishing.

Key activities during the training included daily supervision of construction tasks, interpretation of architectural and structural drawings, participation in site meetings, and on-site problem-solving under the guidance of experienced engineers and site supervisors.

Major learning outcomes from the training include enhanced understanding of construction sequencing, improved skills in reading and interpreting building plans, practical knowledge of materials and construction techniques, and an appreciation for the importance of safety, quality, and time management in construction projects. The experience significantly contributed to the professional and technical development of the trainees, providing a solid foundation for future roles in the construction industry.



गुरु घासीदास विश्वविद्यालय, बिलासपुर
केंद्रीय विश्वविद्यालय अधिनियम 2009 संख्या 25, 2009 द्वारा केंद्रीय विश्वविद्यालय
Guru Ghasidas Vishwavidyalaya, Bilaspur
A Central University established by the Central Universities Act 2009 No. 25 of 2009

A COMPREHENSIVE TRAINING REPORT

**Upgradation of Bilaspur -Takhatpur- Mungeli - Pandariya –
Pondi Road On NH-130A**

Public Works Department

BILASPUR (C.G.)

4 Weeks Vocational Training

Manish Kumar Ratre

(GGV/22/01020)

2022-26 & 7th semester

Session: 2025-26

Submitted to:

DEPARTMENT OF CIVIL ENGINEERING

School of Studies, Engineering & Technology

GURU GHASIDAS VISHWAVIDYALAYA

Bilaspur (C.G.) 495009

A CENTRAL UNIVERSITY

(Established under the Central Universities Act, 2009 No. 25 of 2009)

Accredited with NAAC A++

*Take
Certificate*

*Very like Submission
21 AUG 2024*

OFFICE OF THE EXECUTIVE ENGINEER
P.W.D. N.H. DIVISION BILASPUR (C.G.)

Date 09/07/2025

CERTIFICATE

This is to certify that Mr. Manish Ratre, student of B.Tech. 6th semester (civil engineering) of Guru Ghasidas Vishwavidyalaya, bilaspur (C.G.) has successfully completed his vocational training under P.W.D. for duration of 30 days from 16.05.2025 to 15.06.2025.

During the above period, we found him to be sincere and hardworking.

We wish him every success in all future endeavours.



Highway Engineer

(Project Training Officer)

NH130A Package - 3

P.W.D.(N.H.) Division Bilaspur

fake
official

ABSTRACT

This report summarizes a one-month summer internship focused on the upgradation of National Highway 130A. Conducted under the supervision of the Public Works Department (PWD) Bilaspur division, the training provided an immersive experience into the practical application of civil engineering principles. The primary objective was to gain hands-on knowledge of road construction, quality control, and project management within a government infrastructure project. The report contains the development process of the highway project, up, Bilaspur -Takhatpur- Mungeli - Pandariya - Pondi Road, having total length of 25.695 km.

The internship involved observation and participation in construction stages. A significant portion of the training was dedicated to understanding and assisting in on-site quality control tests for materials such as soil, aggregates, and bitumen, ensuring adherence to Indian Standard codes like IS 456. Furthermore, the experience offered insight into the administrative aspects of the project, including project documentation, progress reporting, and team coordination.

In addition to technical skills, the internship fostered the development of essential soft skills, including effective communication, teamwork, and a heightened sense of professional punctuality and observation. This practical exposure has been invaluable, bridging the gap between theoretical knowledge and professional practice and has reinforced a strong understanding of highway engineering principles.

Key words: National highway, GSB, Culvert, Road construction, Tests.



गुरु घासीदास विश्वविद्यालय, बिलासपुर

केंद्रीय विश्वविद्यालय अधिनियम 2009 संख्या 25, 2009 द्वारा केंद्रीय विश्वविद्यालय

Guru Ghasidas Vishwavidyalaya, Bilaspur

A Central University established by the Central Universities Act 2009 No. 25 of 2009

A COMPREHENSIVE TRAINING REPORT

**SLAB CONSTRUCTION OF A G+3
INSTITUTIONAL BUILDING AT
HATIGAON, GUWAHATI**

SRINATH BUILDERS & HOUSING COMPANY, GS ROAD, GUWAHATI

16TH MAY – 15TH JUNE 2025 (4 WEEKS)

MD SAHIL HAQUE

GGV/22/01021

BATCH : 2022-2026 | SEMESTER - 7

Session 2025-26

Submitted to:

DEPARTMENT OF CIVIL ENGINEERING

School of Studies, Engineering & Technology

GURU GHASIDAS VISHWAVIDYALAYA

Bilaspur (C.G.) 495009

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DEPARTMENT OF CIVIL ENGINEERING
SoS, ENGINEERING & TECHNOLOGY
Guru Ghasidas Vishwavidyalaya
A Central University (Established under the Central
Universities Act, 2009 No.25 of 2009),
Accredited with NAAC A⁺⁺
Bilaspur (C.G.) 495009

DECLARATION

I, MD SAHIL HAQUE, a student of B.Tech in Civil Engineering, Department of Civil Engineering, Guru Ghasidas Vishwavidyalaya, hereby solemnly declare that the report entitled "**SLAB CONSTRUCTION OF A G+3 INSTITUTIONAL BUILDING AT HATIGAON, GUWAHATI**" is a genuine and original record of the industrial training undertaken at Srinath Builders and Housing Pvt. Ltd. during the period from 16th May 2025 to 15th June 2025.

The work presented in this report is entirely my own and has not been copied, reproduced, or submitted elsewhere for any academic or professional purpose. I affirm that:

- All information and observations recorded were made during my tenure at the above-mentioned organization.
- No part of the report has been plagiarized or duplicated from any other source.
- Proper references and acknowledgments have been made wherever external information has been consulted.

I understand that any violation of this declaration may result in academic or disciplinary action as per the rules and regulations of the institution.

Place: Srinath Builder Pvt Ltd, Hatigaon, Guwahati

Date: [15/06/2025]

Signature of the Student

Name: MD. SAHIL HAQUE

Enrollment No.: GGV/22/01021



DEPARTMENT OF CIVIL ENGINEERING
SoS, ENGINEERING & TECHNOLOGY
Guru Ghasidas Vishwavidyalaya
A Central University (Established under the Central
Universities Act, 2009 No.25 of 2009),
Accredited with **NAAC A⁺⁺**
Bilaspur (C.G.) 495009

ACKNOWLEDGEMENT

I sincerely thank my faculty mentor, Mr. Haragobind Rajkhowa, for his invaluable guidance and support throughout the course of this industrial training. I am grateful to the entire team at Srinath Builders and Housing Pvt. Ltd. for their mentorship, cooperation, and the opportunity to gain hands-on experience in the field.

I extend my heartfelt appreciation to our Hon'ble Dean, Prof. Sharad Chandra Srivastava, the Head of the Department, Prof. M. C. Rao, and all concerned faculty members of the Department of Civil Engineering, Guru Ghasidas Vishwavidyalaya, for their continuous encouragement.

Lastly, I am thankful to the Central Training & Placement Cell for facilitating and coordinating this training initiative, which has greatly contributed to my professional development.



Srinath Builders & Housing Co. (P) Ltd.

▲ CONTRACTORS ▲ BUILDERS ▲ ENGINEERS ▲

3rd FLOOR, ANIL PLAZA-1, ABC, G.S. ROAD, GUWAHATI-781005 (ASSAM)

Ph :- +91- 9401549370 ; email :- officesrinath@gmail.com

CIN : U45201AS1997PTC005230

VOCATIONAL TRAINING CERTIFICATE

This is to certify that Mr. MD SAHIL HAQUE (Roll No: 22024121), a student of 6th Semester, B.Tech in the Department of Civil Engineering, School of Studies of Engineering and Technology, Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.), has successfully completed his Vocational Training from 16th May 2025 to 15th June 2025.

During this period, he was found to be punctual, hardworking, and eager to learn. He has gained valuable practical knowledge and experience in the field related to his academic-curriculum.

We wish him all the best in his future endeavors.



Authorized Signatory

ABSTRACT

This internship report presents the experiences and technical knowledge gained during a one-month vocational training program at a construction site managed by Srinath Builders (P) Ltd, Guwahati. The primary focus of the internship was on slab design and execution work for an institutional building. Throughout the training, I was exposed to both theoretical and practical aspects of civil engineering, with specific emphasis on the structural design and construction methodology of reinforced concrete slabs.

Under the supervision of site engineers and structural consultants, I learned about different types of slabs (one-way, two-way, and cantilever), load considerations, detailing of reinforcement as per IS 456:2000, and the application of IS 875 for load combinations. Key activities included reviewing structural drawings, checking formwork, observing bar bending schedules, and witnessing slab casting procedures. Software tools like AutoCAD and STAAD.Pro were also introduced for design visualization and analysis.

This hands-on training not only improved my understanding of slab behavior and structural safety but also gave me valuable insight into site coordination, quality control, and adherence to IS codes. The internship significantly enhanced my practical knowledge, bridging the gap between classroom learning and field application.



UNO ROBOTICS
TECH & RESEARCH PVT. LTD.
KATYAKRANTHI, BHANUPUR

+91 9876543210, 91 78901234
www.unorobotics@gmail.com
New Sarhanda, Krishna Complex, Flat
No.-200, Bhanupur (C.G.) 495001

BATCH/LT/201808

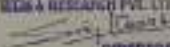
Date: 15/06/2019

TRAINING CERTIFICATE

This is to certify that Mr. **SHRI SUDAN AGRAWAL** (Roll No: 2204022), a student of 6th Semester, BTech in the Department of Civil Engineering, School of Studies of Engineering and Technology, GGS Chaudhary Vishwanandjiya, Bhanupur (C.G.), has successfully completed his Vocational Training from 10th May 2018 to 15th June 2019.

During this period, he was found to be practical, hardworking, and eager to learn. He has gained valuable practical knowledge and experience in the field related to his academic curriculum.

We wish him all the best in his future endeavors.

UNO ROBOTICS
TECH & RESEARCH PVT. LTD.

DIRECTOR

UNO ROBOTICS TECH
KATYAKRANTHI, BHANUPUR



गुरु घासीदास विश्वविद्यालय, बिलासपुर

गुरुदास विश्वविद्यालय अधिनियम २००९ संख्या २५, २००९ द्वारा गुरुदास विश्वविद्यालय

Guru Ghasidas Vishwavidyalaya, Bilaspur

A Central University established by the Central Universities Act 2009 No. 25 of 2009

A COMPREHENSIVE TRAINING REPORT

CONSTRUCTION SITE VISIT

[UNORBITICS TECH & RESEARCH PVT. LTD.]

[16TH MAY 2025 - 15TH JUNE 2025]

MD. SOHAIL AGRAM

22034122

[2022 -2026]

[7TH SEMESTER]

Session 2025-26

Scheduled to:

DEPARTMENT OF CIVIL ENGINEERING

School of Studies, Engineering & Technology

GURU GHASIDAS VISHWAVIDYALAYA

Bilaspur (C.G.) 495009

A CENTRAL UNIVERSITY

(Established under the Central Universities Act, 2009 No.25 of 2009)

ABSTRACT

During my civil engineering internship, I had the opportunity to visit a live construction site and observe various practical aspects of the field. This internship helped me understand how different civil works are carried out in real life, which I had only studied in theory before. I learned about site supervision, material handling, and the step-by-step process of construction. I observed how mix designing of concrete is done to achieve the required strength and quality for different structural elements. I also gained knowledge about pavement design and how roads and base layers are prepared before final surfacing.

Additionally, I learned about foundation works, reinforcement placement, curing of concrete, and the importance of safety measures on site. Seeing the use of construction machinery and tools in real-time gave me a better understanding of project execution. This internship improved my practical knowledge and made me more confident in understanding how civil engineering projects are planned and completed on-site.



गुरु घासीदास विश्वविद्यालय, बिलासपुर

केंद्रीय विश्वविद्यालय अधिनियम 2009 संख्या 25, 2009 द्वारा केंद्रीय विश्वविद्यालय

Guru Ghasidas Vishwavidyalaya, Bilaspur

A Central University established by the Central Universities Act 2009 No. 25 of 2009

A COMPREHENSIVE TRAINING REPORT

Varanasi – Gorakhpur Four Lane Construction (NH-29)

[16th May 2025 – 30TH JUNE 2025]

Neekita Singh

22024123

[2022 -2026]

[7TH SEMESTER]

Session 2025-26

Submitted to:

DEPARTMENT OF CIVIL ENGINEERING

School of Studies, Engineering & Technology

GURU GHASIDAS VISHWAVIDYALAYA

Bilaspur (C.G.) 495009

A CENTRAL UNIVERSITY

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JAL/VNS-GKP/2025-26/P&A/110

Date : 26.07.2025

TO WHOM SO EVER IT MAY CONCERN

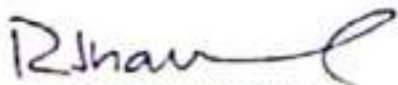
INTERNSHIP CERTIFICATE

This is to certify that **Miss Neetika Singh**, Roll No. 22024123 of 6th semester B.Tech Undergraduate in the department of Civil Engineering, Guru Ghasidas Vishwavidyalaya, completed Industrial Training in Civil w.e. from 16.05.2025 to 30.06.2025, in the Project " Four Laning of Varanasi-Gorakhpur Section of NH-29, Package- IV Design Chainage KM 149.540 to KM 215.160 in the State of U.P under NHDP Phase-IV on EPC Mode .

During the period we found her very sincere, punctual, technically sound and result oriented . She worked well as part of a team during the internship period .

We wish her all the best in his future endeavors .

For Jaiprakash Associates Limited



Authorized Signatory
VNS-GKP Highway Project, NH-29
Dohrighat, Mau, Uttar Pradesh

Abstract

Seeing the Current increase in the traffic conditions and water logging problems during the rainy seasons at Dohrighat MAU, JAIPRAKASH ASSOCIATES LIMITED has bagged the contract to PRL for bridge over Dohrighat MAU.

The bridge is constructed 950m over Dohrighat. The bridge which will connect the Varanasi, it is expected to reduce the pressure of high traffic coming straight to the city.

The type of bridge that is been constructed over Ghaghara river. A girder bridge in general is a bridge that uses girders as the mean of supporting the deck. A bridge consists of three parts: Foundation (Foundation and piers), the superstructure (girder, slab), and the deck.

Solid slab and deck slab with girders are used in bridge. The bridge is made of concrete and steel.

Girders are casting at site itself. Prestressed girders are used.

Due to high traffic it was decided that finish first one side with parallel work on the other side.



गुरु घासीदास विश्वविद्यालय, बिलासपुर
केंद्रीय विश्वविद्यालय अधिनियम 2009 संख्या 25, 2009 द्वारा केंद्रीय विश्वविद्यालय
Guru Ghasidas Vishwavidyalaya, Bilaspur
A Central University established by the Central Universities Act 2009 No. 25 of 2009

A COMPREHENSIVE TRAINING REPORT

Upgradation of Bilaspur -Takhatpur- Mungeli - Pandariya – Pondi Bypass On NH-130A

Public Works Department

BILASPUR (C.G.)

4 Weeks Vocational Training

Nikhil Pandey

(GGV/22/01025)

2022-26 & 7th semester

Session: 2025-26

Submitted to:

DEPARTMENT OF CIVIL ENGINEERING

School of Studies, Engineering & Technology

GURU GHASIDAS VISHWAVIDYALAYA

Bilaspur (C.G.) 495009

A CENTRAL UNIVERSITY

(Established under the Central Universities Act, 2009 No. 25 of 2009)

Accredited with NAAC A++

ABSTRACT

This report summarizes a one-month summer internship focused on the upgradation of National Highway 130A. Conducted under the supervision of the Public Works Department (PWD) Bilaspur division, the training provided an immersive experience into the practical application of civil engineering principles. The primary objective was to gain hands-on knowledge of road construction, quality control, and project management within a government infrastructure project. The report contains the development process of the highway project, up, Bilaspur - Takhatpur- Mungeli - Pandariya – Pondi Bypass , having total length of 25.695 km.

The internship involved observation and participation in construction stages. A significant portion of the training was dedicated to understanding and assisting in on-site quality control tests for materials such as soil, aggregates, and bitumen, ensuring adherence to Indian Standard codes like IS 456. Furthermore, the experience offered insight into the administrative aspects of the project, including project documentation, progress reporting, and team coordination.

In addition to technical skills, the internship fostered the development of essential soft skills, including effective communication, teamwork, and a heightened sense of professional punctuality and observation. This practical exposure has been invaluable, bridging the gap between theoretical knowledge and professional practice and has reinforced a strong understanding of highway engineering principles.

Key words: National highway, Culvert, Road construction, Tests.



PUBLIC WORKS DEPARTMENT

Date...25-07-25

CERTIFICATE

This is to certify that **Mr. Nikhil Pandey** student of B.Tech. 6th semester (civil engineering) of Guru Ghasidas Vishwavidyalaya, bilaspur (C.G.) has successfully completed his vocational training under P.W.D. N.H(130A Package-III Bypasses) for duration of 30 days from 16.05.2025 to 15.06.2025.

During the above period, we found him to be sincere and hardworking.

We wish him every success in all future endeavours.


Highway Engineer
(Project Training Officer)
NH130A Package - 3
P.W.D.(N.H.) Division Bilaspur


Sub Divisional Officer
P.W.D. N.H. Sub Division
Bilaspur (C.G.)



गुरु घासीदास विश्वविद्यालय, बिलासपुर
केंद्रीय विश्वविद्यालय अधिनियम 2009 संख्या 25, 2009 द्वारा केंद्रीय विश्वविद्यालय
Guru Ghasidas Vishwavidyalaya, Bilaspur
A Central University established by the Central Universities Act 2009 No. 25 of 2009

A COMPREHENSIVE TRAINING REPORT

“Optimization Of Design Parameters for Electro-Coagulation Unit”

Indian Institute of Engineering Science and Technology, Shibpur,
West Bengal
(6 WEEKS)

PINKI KUMARI (GGV/22/01026)

SUMIT KUMAR (GGV/22/010143)

CIVIL ENGINEERING & VIIth Semester

Session 2025-26

Submitted to:

DEPARTMENT OF CIVIL ENGINEERING

School of Studies, Engineering & Technology

GURU GHASIDAS VISHWAVIDYALAYA

Bilaspur (C.G.) 495009

A CENTRAL UNIVERSITY

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Accredited with NAAC A⁺⁺

CERTIFICATE

This is to certify that Mr. Pinki Kumari and Sumit Kumar, students of B.Tech in Civil Engineering, School of Studies in Engineering & Technology, Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.), have successfully completed their 45-day internship at the Indian Institute of Engineering Science and Technology (IEST), Shibpur, West Bengal, from 16th May 2025 to 30th June 2025.

During this internship, they jointly worked on the project titled:

“Optimization of design parameters for electro-coagulation unit”. Their work involved conducting laboratory experiments, analyzing the effects of key operational parameters (current, time, and electrode spacing), and applying statistical optimization techniques using Design Expert software. Both students displayed excellent teamwork, dedication, and an active interest in learning throughout the course of the internship.

This certificate is awarded in recognition of the successful completion of their internship and their valuable contributions to the project.

We wish them both continued success in their academic and professional pursuits.

Date: 04/08/2025

Place: Bilaspur

(Signature with Seal)

Name of Supervisor / Internship Guide

Designation

Department / Laboratory

IEST Shibpur, West Bengal

Abstract

Water quality management is a critical concern in today's world due to rapid industrialization, population growth, and increasing pressure on freshwater resources. During our 45-day research internship at the Indian Institute of Engineering Science and Technology (IIST), Shibpur. We undertook a project focused on the design, experimentation, and optimization of an electrocoagulation (EC) unit for the treatment of contaminated pond and river water.

The core objective was to explore how varying operational parameters such as electric current, electrolysis time, and electrode spacing influence water purification efficiency, particularly in terms of turbidity removal and pH regulation. A two-phase approach was followed: initial rough estimation experiments and then statistical optimization using Design Expert software.

The study revealed that current intensity and time significantly impact treatment effectiveness. A combination of 0.875 A, 10 minutes, and 2 cm spacing resulted in up to 95.8% turbidity removal, making the method promising for cost-effective, decentralized water treatment. The hands-on nature of the work provided valuable insight into the practical application of environmental engineering concepts. The experiments also evaluated the energy consumption under varying operating conditions, enabling a trade-off analysis between performance and efficiency.



गुरु घासीदास विश्वविद्यालय, बिलासपुर

केंद्रीय विश्वविद्यालय अधिनियम 2009 संख्या 25, 2009 द्वारा केंद्रीय विश्वविद्यालय

Guru Ghasidas Vishwavidyalaya, Bilaspur

A Central University established by the Central Universities Act 2009 No. 25 of 2009

A COMPREHENSIVE TRAINING REPORT

“ENSEMBLE LEARNING APPROACHES (HGBR, ETR) FOR MODELING SHEAR STRESS DISTRIBUTION IN COMPOUND OPEN CHANNELS”

NATIONAL INSTITUTE OF TECHNOLOGY, PATNA, BIHAR
(6 WEEKS)

Submitted by

Piyush Keshri

Enrolment No.: GGV/22/01027

4th Year, 7th Semester

Session: 2025-26

Submitted to:

DEPARTMENT OF CIVIL ENGINEERING

School of Studies, Engineering & Technology

GURU GHASIDAS VISHWAVIDYALAYA

Bilaspur (C.G.) 495009

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जनपदीय अभियांत्रिकी विभाग/ CIVIL ENGINEERING DEPARTMENT

राष्ट्रीय प्रौद्योगिकी संस्थान पटना/ NATIONAL INSTITUTE OF TECHNOLOGY PATNA

अशोक राजपथ, पटना - 800005, बिहार/ ASHOK RAJPATH, PATNA - 800005, BIHAR

विश्व मंचावर, भारत सरकार के अधीन एक राष्ट्रीय महत्व का संस्थान/ An Institute of National Importance under Ministry of Education, Govt. of India

Web site: www.nitp.ac.in

संदर्भ/Ref.:CED/005

दिनांक/ Date: 01/07/2025

CERTIFICATE

This is to certify that **Mr. Piyush Keshri** (Roll No. 22024127), a student of Civil Engineering Department, Guru Ghasidas Vishwavidyalaya, Bilaspur, Chhattisgarh, has successfully completed his internship work on the topic of "**Ensemble Learning Approaches (HGBR, ETR) for Modeling Shear Stress Distribution in Compound Open Channels**" dated from 19/05/2025 to 30/06/2025, in the Department of Civil Engineering, National Institute of Technology (NIT) Patna, under the supervision of Dr. Bhabani Shankar Das. During this internship work, the student has performed the machine modeling activity related to shear stress distribution in compound channel in which he learned about different ML models, statistical error analysis, and conference paper writing skill.

Dr. Bhabani Shankar Kumar

Assistant Professor

Dept. of Civil Engineering,

National Institute of Technology Patna

Patna- 800005, Bihar (India)

सहायक प्राध्यापक/Assistant Professor

जनपदीय अभियांत्रिकी विभाग

Civil Engineering Department

राष्ट्रीय प्रौद्योगिकी संस्थान पटना-5

National Institute of Technology Patna-5

Abstract

Accurate estimation of boundary shear stress in compound open channels remains a challenging task due to complex flow interactions between the main channel and floodplains. This study presents a comparative analysis of three approaches to predict the percentage of shear force acting on the floodplain ($Sf\%$): Histogram-Based Gradient Boosting Regressor (HGBR), Extra Trees Regressor (ETR), and an empirical model proposed by Khatua et al. (2012). A synthetic dataset was constructed using key geometric and hydraulic parameters such as aspect ratio (α), width ratio (β), relative depth (δ), and Reynolds and Froude numbers. Performance evaluation using R^2 , MAE, RMSE, and MAPE indicated that the ETR model outperformed others, achieving higher accuracy and generalization. SHAP analysis further validated feature influence, aligning with established hydraulic theories. This study highlights the applicability of ensemble learning models over empirical methods in modelling complex channel flow behaviours.



गुरु घासीदास विश्वविद्यालय, बिलासपुर
केंद्रीय विश्वविद्यालय अधिनियम 2009 संख्या 25, 2009 द्वारा केंद्रीय विश्वविद्यालय
Guru Ghasidas Vishwavidyalaya, Bilaspur
A Central University established by the Central Universities Act 2009 No. 25 of 2009

A COMPREHENSIVE TRAINING REPORT

“Industrial Greywater Treatment using Electrochemical Advanced Oxidation Process”

Indian Institute of Engineering Science and Technology, Shibpur,

West Bengal

(6 WEEKS)

ANNU KUMARI (GGV/22/01002)

PRAKASH TIWARI (GGV/22/01028)

CIVIL ENGINEERING & VIIth Semester

Session 2025-26 Submitted to:

DEPARTMENT OF CIVIL ENGINEERING

School of Studies, Engineering & Technology

GURU GHASIDAS VISHWAVIDYALAYA

Bilaspur (C.G.) 495009

A CENTRAL UNIVERSITY

(Established under the Central Universities Act, 2009 No. 25 of 2009)

Accredited with NAAC A⁺⁺

DECLARATION

I, Annu Kumari hereby declare that the work presented in this report entitled “Industrial Greywater Treatment using Electrochemical Advanced Oxidation Process” submitted to Indian Institute of Engineering Science and Technology (IEST), Shibpur, West Bengal for fulfilment of Research Internship in the Environmental Engineering Laboratory, Civil Engineering Department, IEST Shibpur is an authentic record of our work carried out under the guidance of Dr Asok Adak.

Annu Kumari
Prakash Tiwari

Undergraduate Research Intern at IEST
(May-June 2025)

Final Year Undergraduate
Department of Civil Engineering,
School of Studies of Engineering and Technology
Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G)

CERTIFICATE

Certified that the Summer Internship Program report entitled “Industrial Greywater Treatment using Electrochemical Advanced Oxidation Process” submitted by Annukumari, Prakash Tiwari of B. Tech 7th Semester in Civil Engineering, School of Studies in Engineering and Technology, Guru Ghasidas Vishwavidyalaya, Bilaspur, is a record of bonafide work carried out by them during the academic session 2024–25 at the Indian Institute of Engineering Science and Technology (IEST), Shibpur.

The internship was undertaken under the guidance and supervision of Dr. Asok Adak, Professor, Department of Civil Engineering, IEST Shibpur.

This report is submitted in partial fulfillment of the requirements for the award of the degree of Bachelor of Technology in Civil Engineering. The work embodied in this report is the original contribution of the students and has not been submitted to any other institution for the award of any other degree or diploma.

Date:

Place:

Signature

Name – Dr. Asok Adak

Associate Professor

IEST Shibpur

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Abstract

Dye-bearing wastewater poses a major threat to aquatic ecosystems due to its high color intensity and resistance to biodegradation. When discharged untreated into natural water bodies, it significantly reduces light penetration, disrupting the photosynthesis process and lowering the dissolved oxygen content, thereby harming aquatic life. In this study, Electrochemical Advanced Oxidation Process (EAOP) was employed to remove Reactive Orange 84 dye from synthetic dye-bearing wastewater. The effect of key operational parameters such as electrolyte concentration (NaCl), current density, pH, and initial dye concentration was studied to evaluate their impact on the degradation efficiency.

Results indicated that an increase in NaCl concentration, acting as a supporting electrolyte, enhanced the generation of reactive species, thereby improving dye degradation. Similarly, higher current densities contributed to greater oxidant production, increasing the rate of dye removal. However, an increase in pH and initial dye concentration was found to negatively affect the degradation efficiency due to reduced availability of hydroxyl radicals and increased dye loading, respectively.

Optimization of these parameters was carried out using a statistical design approach, and the optimum conditions for maximum dye removal were determined as: current density of 1.77685 mA/cm², NaCl concentration of 1 mM, pH of 3, and initial dye concentration of 500 mg/L. Under these conditions, a maximum removal efficiency of 67.4641% was achieved with a desirability value of 0.814, making this solution the most optimal among 47 experimental runs. The study demonstrates the effectiveness of EAOP in degrading synthetic dye under controlled parameters and contributes to the development of sustainable dye wastewater treatment technologies.

1: Introduction

The use of synthetic dyes in industries such as textiles, paper, cosmetics, and leather is rising rapidly due to their vivid colors and ease of application. However, this widespread usage results in the generation of significant volumes of dye-bearing wastewater, which poses severe environmental challenges. During industrial dyeing processes, approximately 10–15% of the total dye used is lost to wastewater, leading to the discharge of over 0.8 million tons of dye into water bodies annually [1]. These effluents hinder sunlight penetration and reduce photosynthetic activity in aquatic ecosystems, resulting in lower dissolved oxygen levels and adverse effects on aquatic flora and fauna [2]. Additionally, dye-laden wastewater often contains high Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD) values, ranging between 150–30,000 mg/L and 80–6,000 mg/L respectively [3], making it highly resistant to conventional biological treatment methods.

To address these issues, advanced oxidation processes (AOPs), particularly Electrochemical Advanced Oxidation Processes (EAOPs), have gained attention due to their ability to generate reactive oxygen species (ROS) such as hydroxyl radicals ($\bullet\text{OH}$), which are capable of non-selectively oxidizing and mineralizing a wide range of organic pollutants [4,5]. The performance of EAOP largely depends on parameters like the applied current, pH, initial pollutant concentration, and nature and concentration of the supporting electrolyte [6,7].

In the present study, Reactive Orange 84 (RO84) dye was selected as the model pollutant for treatment via EAOP. A Graphite Substrate Lead Dioxide (GSLD) anode was employed along with a stainless-steel cathode to form the electrochemical cell. The GSLD electrode is known for its excellent electrocatalytic activity, chemical stability, and mechanical strength. Although various studies have previously explored the use of GSLD anodes for pollutant degradation [8–10], this work focused solely on analyzing the degradation efficiency without comparing different anode or cathode materials.

Electrolyte selection plays a vital role in EAOP efficiency. Sodium chloride (NaCl) was used as the supporting electrolyte in this study due to its ability to generate active chlorine species under anodic conditions, which further enhance oxidation. The generation of these secondary oxidants contributes significantly to the overall dye degradation mechanism. Additionally, NaCl is cost-effective and commonly available, making it a practical choice for large-scale applications.

Parameter optimization is crucial in maximizing the degradation efficiency of the EAOP system. The effectiveness of the process was studied with variations in current density, NaCl concentration, pH, and dye concentration. Increasing current density and NaCl concentration was found to improve dye degradation due to enhanced ROS formation, while higher pH and dye concentrations led to reduced performance. The optimum removal efficiency of 67.4641% was achieved under conditions of 1.77685 mA/cm² current density, 1 mM NaCl, pH 3, and 500 mg/L initial dye concentration, with a desirability of 0.814, indicating statistically optimal performance. This study provides insight into the efficient design of electrochemical treatment systems and offers a potential route for scaling up dye removal technologies in industrial applications.

2: Literature Review

2.1. Wastewater Characterization based on quality parameters

Wastewater is a by-product of human activities, ranging from domestic chores to large-scale industrial operations. As societies develop and industrialize, the volume and complexity of wastewater increase significantly, making its management a critical environmental concern. A fundamental step in wastewater management is its characterization, which involves the detailed analysis of its physical, chemical, and biological qualities. Wastewater is broadly classified into municipal and industrial types, each with unique features influenced by their respective sources. Understanding these characteristics is essential for designing effective treatment systems and ensuring that discharged effluents meet environmental and regulatory standards.

Municipal wastewater, often referred to as domestic sewage, originates from households, institutions, and small-scale commercial activities. It comprises wastewater from kitchens, bathrooms, toilets, and laundry, mixed with minor contributions from commercial establishments and public facilities. This type of wastewater is primarily composed of organic matter such as carbohydrates, proteins, and fats, as well as inorganic substances like salts and trace metals. Suspended solids, nutrients like nitrogen and phosphorus, and microbial pathogens are also commonly present. The characteristics of municipal wastewater are relatively uniform compared to industrial effluents, although they can vary with population density, water usage patterns, and socio-economic status.

The quality parameters used to assess municipal wastewater include a range of physical, chemical, and biological indicators. Physically, municipal sewage is typically greyish when fresh, turning darker and more odorous as it becomes stale due to anaerobic decomposition. Turbidity, which refers to the cloudiness caused by suspended particles, is also a key indicator. Temperature, while usually near ambient, can influence biological treatment processes if significantly elevated. Chemically, the pH of municipal wastewater usually remains between 6.5 and 8.5, indicating a neutral to slightly alkaline nature. Biochemical oxygen demand (BOD), which measures the amount of oxygen microorganisms need to decompose organic matter, typically ranges from 150 to 300 mg/L. Chemical oxygen demand (COD), indicating both biodegradable and non-biodegradable organic load, is generally higher than BOD, often lying between 250 and 500 mg/L. Total suspended solids (TSS) and total dissolved solids (TDS) commonly range between 150–350 mg/L and 200–500 mg/L respectively. Nutrient concentrations, particularly nitrogen in the form of ammonia and nitrate, and phosphorus as phosphates, are significant due to their potential to cause eutrophication in receiving waters. Biologically, municipal wastewater

harbors numerous microorganisms, including pathogenic bacteria such as *Escherichia coli*, viruses, and protozoa, posing serious public health risks if not properly treated.

In contrast, industrial wastewater arises from a wide variety of manufacturing and processing activities. It is far more heterogeneous in nature, and its composition depends heavily on the type of industry, raw materials used, production processes, and cleaning operations. Unlike municipal wastewater, which is relatively predictable, industrial effluents can contain a diverse array of pollutants, including toxic chemicals, heavy metals, synthetic compounds, high-strength organics, and substances that are resistant to biodegradation. As such, industrial wastewater often demands specialized treatment approaches and stringent regulatory monitoring.

Industrial effluents can exhibit extreme values for various quality parameters. Physically, they may possess a wide range of colors depending on dyes, pigments, or chemical residues used in production. Odors can range from mildly unpleasant to overwhelmingly pungent due to volatile organic compounds or sulfur-based compounds. Temperature levels can be considerably higher, especially in cases where heat is a by-product of the manufacturing process. Chemically, the pH of industrial wastewater can vary from highly acidic to highly alkaline, with values as low as 3 or as high as 11 or more, depending on the specific processes involved. BOD values may range from several hundred to several thousand milligrams per liter, particularly in food processing, paper, or textile industries. COD levels can be extraordinarily high, often reaching or exceeding 10,000 mg/L, indicating the presence of a large load of chemically oxidizable substances. The BOD/COD ratio in industrial effluents is a critical indicator of biodegradability. A low ratio (less than 0.3) often suggests the dominance of non-biodegradable components, necessitating advanced or chemical treatment methods.

Suspended and dissolved solids in industrial wastewater can be excessive. Total suspended solids might exceed 5,000 mg/L in cases involving raw material handling or surface washing, while TDS levels can surpass 10,000 mg/L in effluents from tanneries, textile dyeing, or chemical manufacturing plants. Toxic pollutants such as heavy metals—lead, chromium, mercury, cadmium, and arsenic—are common in many industrial discharges and pose significant threats to aquatic life and human health. Phenolic compounds, cyanides, pesticides, and persistent organic pollutants may also be present, depending on the industry. Biological characteristics of industrial wastewater vary widely. While some effluents may be rich in biodegradable organic matter and microorganisms, others may be virtually sterile or even contain bactericidal substances that inhibit microbial activity, complicating biological treatment processes.

2.2. Dye removal from wastewater

There are two ways by which dye-bearing wastewater can be treated. The treatment techniques can either separate the dye from wastewater (passive treatment) or degrade it into end products (active treatment). Different physiochemical method such are coagulation, sorption, and membrane-based filtration are the examples of passive treatment studied by different researchers for treatment of dye-bearing wastewater. At the same time, in techniques like AOP and biological treatment, dyes are degraded into their end products. Figure 1 shows the flow diagram of different treatment methods reviewed in this paper.

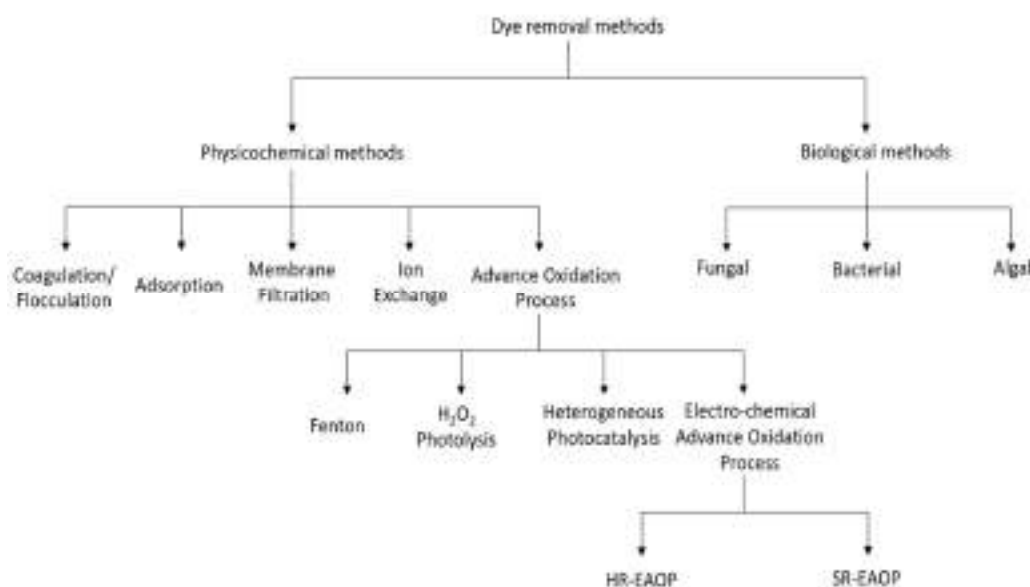


Figure 1: Classification of different physicochemical and biological methods for the treatment of dye-bearing wastewater

2.2.1. Electrochemical Advanced Oxidation Process

Electrochemical Advanced oxidation processes (EAOPs) are water treatment processes that generate a powerful oxidizing agent, such as ($\text{OH}^\bullet$) and ($\text{SO}_4^{\bullet-}$), to decontaminate wastewater effectively. These radicals are powerful oxidants that can non-selectively destroy most organic and organometallic contaminants until their complete mineralization into CO_2 , water and inorganic ions.

2.2.1.1. Dye removal by EAOP-based on hydroxyl radicals

Hydroxyl radicals are electrochemically generated in an electrochemical reactor (Figure 2). The reactor consists of a direct current power supply, a cathode, an anode and electrolyte (a medium that provides the ion transport mechanism between anode and cathode necessary to maintain the electrochemical process).

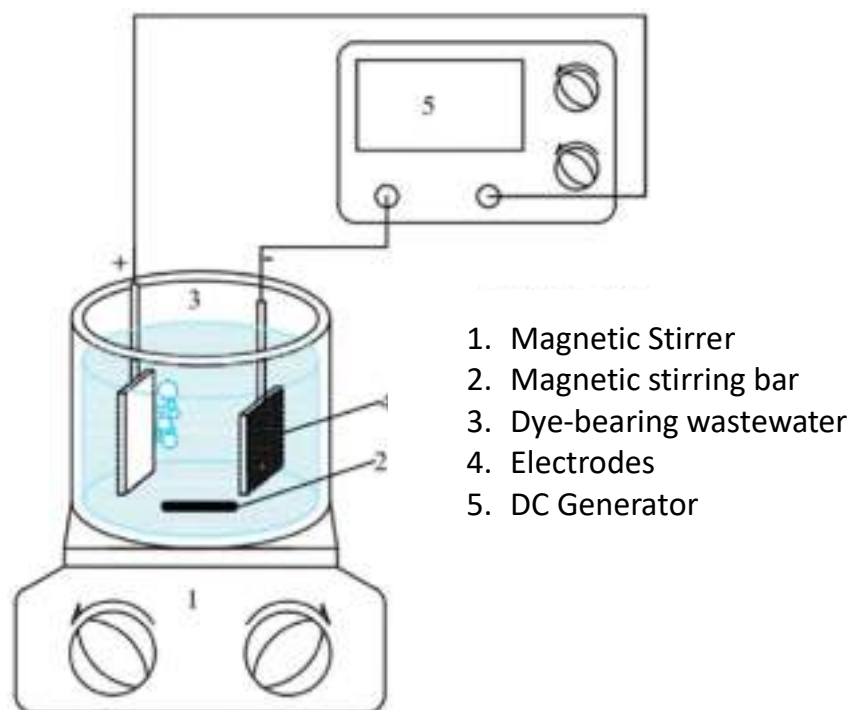


Figure 2: Conceptual diagram of an electrochemical reactor

The anodic oxidation (AO) is a direct way to electrochemically generate $\text{OH}^\bullet$ radicals without using any extra chemicals. AO has two steps: (i) dye diffuses to the anode surface from the aqueous solution, and (ii) dye is then oxidized at the anode surface. Thus, substrate mass transfer and electron transfer at the electrode surface (S) will determine the degradation efficiency. The $\text{OH}^\bullet$ is electrocatalytically generated by the following reaction (Eq. 01). Figure 3 demonstrates the mechanisms of electrochemical degradation for organic contaminants in wastewater. There are three main degradation mechanisms – direct electrolysis of pollutants, anodic oxidation and mediated or indirect oxidation.



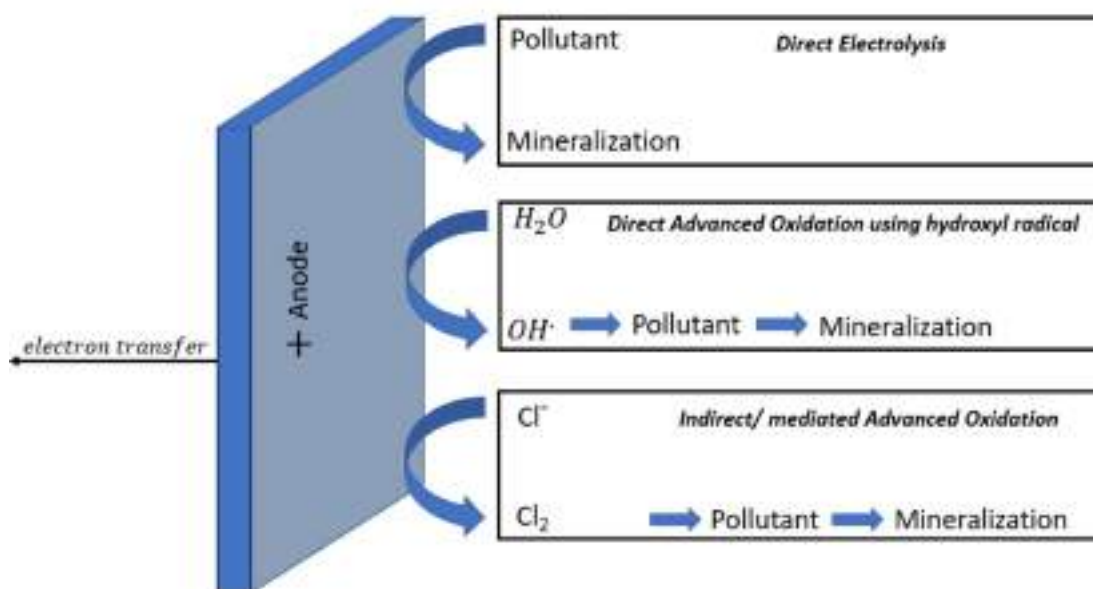


Figure 3: The mechanisms of dye removal by Electro-chemical advanced oxidation process

2.3. CPCB Guidelines

The Central Pollution Control Board (CPCB) under the Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India, issues guidelines and standards for wastewater treatment from municipal and industrial sources. These guidelines are crucial for maintaining environmental and public health standards.

Municipal Wastewater Treatment Guidelines (Sewage)

Discharge Standards (CPCB General Standards for STPs):

Table 1a: Municipal Wastewater Treatment Guidelines

Parameter	Limit (mg/L)
BOD (5 days, 20°C)	≤ 10
COD	≤ 50
TSS (Total Suspended Solids)	≤ 20
pH	6.5–9.0
Total Nitrogen	≤ 10
Faecal Coliform	<1000 MPN/100 mL

Industrial Wastewater Treatment Guidelines:

CPCB mandates that every industry must treat its effluent to meet specific Effluent Discharge Standards, which vary by sector (e.g., textile, chemical, food processing, etc.).

Common CPCB Industrial Discharge Standards:

Industries discharging directly into surface water or marine systems must meet stricter standards than those discharging to CETPs (Common Effluent Treatment Plants).

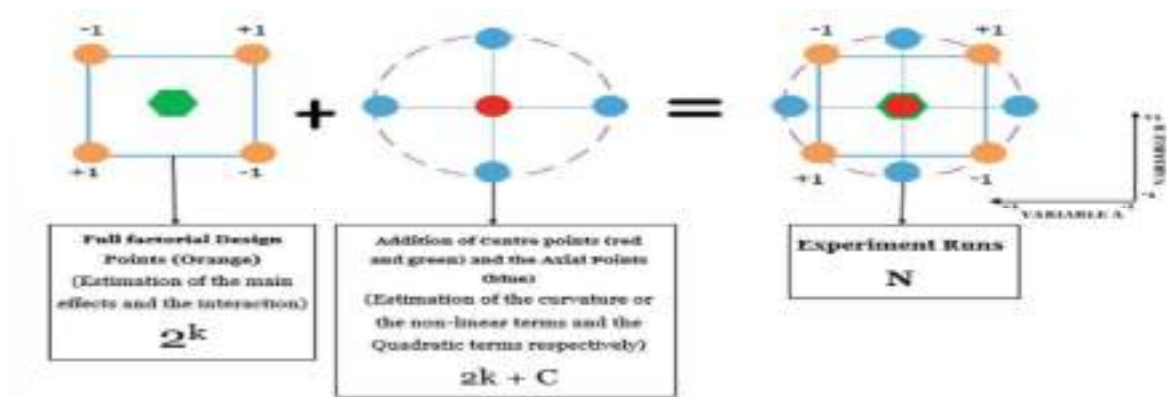
Table 1b: Industrial Wastewater Treatment Guidelines

Parameter	Inland Surface Water	Public Sewers
pH	5.5–9.0	5.5–9.0
BOD (mg/L)	≤ 30	≤ 350
COD (mg/L)	≤ 250	≤ 500
TSS (mg/L)	≤ 100	≤ 600
Oil & Grease (mg/L)	≤ 10	≤ 20
Heavy metals (Zn, Pb, Cr, etc.)	Sector-specific	Sector-specific

2.4. Central composite design

Central composite design (CCD): This is a unique kind of response surface design that can fit a full quadratic model. It is comprised of factorial also known as fractional factorial design with a center point attached to a group of stars or axial points. Using the included axial points is an effective method for calculating the coefficients of a second-degree polynomial for the factors. A CCD can be denoted as a square (for two factors design) or a cube (for a three factors design) having corners, which represent the levels (high and low represented as +1, -1 respectively), a star or axial points along the axes at or outside the square helps to account for the curvature and a center point at the origin. The general model for a two-factor full factorial CCD is represented graphically in Figure 4 below.

Figure 4: The general model for a two-factor full factorial CCD is represented graphically



A visual depiction of the CCD model for determination of total runs for all experiments for two factors full factorial design. K in the model is the number of factors; C is the replicated central points that help to eliminate pure error and N is the experiment runs required for the design.

Figure 5 displays a three-factor lay out for a CCD made up of a full factors factorial that forms the cube where each side is coded -1 and $+1$ just like in Figure 4 above. The Stars stand for axial points and alpha is the distance from the edge of the cube to the stars.



Figure 5: A graphical representation of three factors in a full factorial design.

2.5. Spectrophotometer

A spectrophotometer is a scientific instrument used to measure the amount of light absorbed by a sample. It plays a vital role in analytical chemistry, especially for determining the concentration of solutes in a solution based on how much light is absorbed when the solution is placed in a cuvette. The method relies on the principle that substances absorb specific wavelengths of light, and the amount of absorbed light is proportional to the concentration of the absorbing substance.

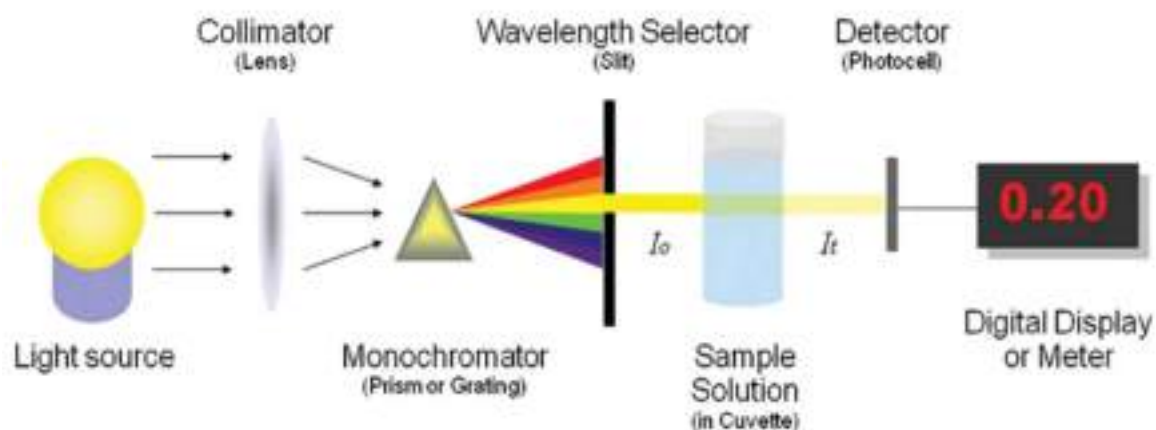


Figure 6: Spectrophotometer

The invention of the spectrophotometer dates back to 1940, when Arnold J. Beckman and his team at the National Technologies Laboratory developed the Beckman DU spectrophotometer. The working principle involves measuring light intensity across a range of wavelengths. This is achieved by splitting a light beam into its constituent wavelengths using either a prism or a diffraction grating. The desired wavelength is then directed toward the sample, and the transmitted light is detected and analyzed.

The basic instrumentation includes a radiant energy source (like electrically heated materials), a monochromator (using prisms or gratings to isolate specific wavelengths), a sample holder (cuvette), and a photosensitive detector. Prisms such as cornu quartz or Littrow prism and diffraction gratings are used for light dispersion. Cuvettes are generally made of glass or quartz, depending on the wavelength region. The detector system relies on the photoelectric effect to convert light into electrical signals, which are then amplified and displayed in readable formats.

Spectrophotometers have broad applications across scientific and industrial domains. They are used to detect concentrations of chemicals, identify impurities, characterize proteins, analyze respiratory gases, and study the molecular structure of compounds. Additionally, they help in determining molecular weights and monitoring dissolved oxygen in environmental studies. Spectrophotometry, especially in UV and visible regions, is also useful in both pure and biological sample analysis.

3: Scope and Objective

3.1. Objective

The objective of this study is to investigate and optimize the degradation of a synthetic dye in aqueous solution through a sequential Electrochemical Advanced Oxidation Process (EAOP), using statistical optimization techniques to enhance process efficiency and evaluate the degradation mechanism.

3.2. Scope

- i. Selection of a model dye.
- ii. Optimization of the electrode.
- iii. Variation of different parameters.
- iv. Optimisation of the process

4.1. Chemicals and reagents

Reagent grade lead (II) nitrate ($\text{Pb}(\text{NO}_3)_2$) and Copper (II) nitrate ($\text{Cu}(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$) were obtained from Qualigens. NaOH (0.1N) and HCl were used for pH adjustments. Sodium chloride (NaCl) as an electrolyte were brought from Fischer scientific. For the preparation of samples and dilution, deionized water was used. GSLD electrode (6*5*1 cm) prepared at optimized condition and stainless-steel plate of same size of GSLD were used as anode and cathode in the anodic oxidation.

4.1.1. Electrochemical degradation and analytical methods

The anodic oxidation of RO 84 took place in an 800 ml batch reactor. Anode and cathode materials comprised GSLD and stainless steel, respectively, with a fixed spacing of 2 cm between them. To ensure uniform mixing, a magnetic stirrer operated was employed. As an electrolyte, sodium chloride was used as an electrolyte. The samples were taken from the reactor at an interval of 0, 5, 10, 15, 20, 30, 45 and 60 min.

Dye removals were measured using UV-Vis. spectrophotometer at the maximum absorption wavelength of 490 nm. Colour removal efficiency can be measured using the (Eq. 18) and rate constant (K) of the dye removal can be measured using (Eq. 19).

$$\text{Colour removal efficiency} = C_0 - C_t / C_0 * 100 \quad (2)$$

$$\ln(C_t / C_0) = -K * t \quad (3)$$

Where, C_0 is the initial dye concentration, C_t is the dye concentration at time t and K is the rate constant.

4.1.2. Experimental design and process optimization

Central Composite Design is a type of experimental design used in statistical modeling, especially in the field of RSM. CCD is particularly useful for studying the relationship between multiple independent variables and a response variable. For the optimization purpose, a four- factorial five levels CCD was performed consisting of 30 trials. All the four operation parameters that are current, NaCl concentration, pH and initial concentration of RO 84, with their respective levels have been

shown in (Table 2). All the 30 trials with their respective responses colour removal efficiency (R1) have been shown in (Table 3).

Table 2: Experimental range and levels of operational parameters

Varying Parameters	Code	Coded Levels					Unit
		-2	-1	0	+1	+2	
Current	X_1	1	2	3	4	5	mA/cm ²
NaCl	X_2	1	2	3	4	5	mM
pH	X_3	3	5	7	9	11	
IC	X_4	100	200	300	400	500	mg L ⁻¹

4.1.3. Result and discussions

4.1.3.1. Analysis of Central Composite Design

A total of 30 experimental trials were performed varying all the four operational parameters that are current (X_1), NaCl concentration (X_2), pH (X_3) and initial concentration of RO 84 dye (X_4). Colour removal efficiency was the single response (R_1) that was determined after a period of 60 min. for each trial.

Upon scrutinizing the experimental data (Table 3), it is unequivocally established that an increase in the 1st two parameters lead to increase in the colour removal efficiency, while, it got decreased due to increase in the last two parameters. Consequently, the improvement in colour removal efficiencies can be attributed to this escalation in hydroxyl radical formation for colour removal efficiencies using the sequential model sum of squares, a quadratic model as a best suitable fit was proposed, yielding an R^2 value of 0.998. The quadratic equation that best captures the relationship, expressed in terms of coded values, is provided in (Eq. 4). Utilizing this coded equation allows for predicting the influence of different parameters on the colour removal efficiencies of RO 84.

$$R = 58.23 + 13.84*A - 0.20*B - 1.57*C - 11.43*D - 1.49*AB - 0.455*AC + 2.5*AD - 2.56*BC - 4.27*BD - 0.4525*CD - 3.9*A^2 + 4.34*B^2 + 3.5*C^2 + 11.74*D^2 \quad (4)$$

Table 3: Experimental design matrix and obtained responses for RO 84 using CCD

Trials	Varying Parameters				Response
	Current (X_1) (mA/cm ²)	NaCl (X_2) (mM)	pH (X_3)	IC (X_4) (mg L ⁻¹)	Current (R) (Amp)
1	1	3	3	300	60.68

2	5	3	3	300	96.38
3	1	3	11	300	28.62
4	5	3	11	300	58.35
5	3	1	7	100	88.46
6	3	5	7	100	90.52
7	3	1	7	500	62
8	3	5	7	500	62.25
9	1	3	7	100	72.25
10	5	3	7	100	91.08
11	1	3	7	500	41.9
12	5	3	7	500	70.72
13	3	1	3	300	80.64
14	3	1	11	300	45.52
15	3	5	3	300	92.58
16	3	5	11	300	50.22
17	1	1	7	300	37.15
18	5	1	7	300	64.56
19	1	5	7	300	43.53
20	5	5	7	300	67.12
21	3	3	3	100	96.6
22	3	3	11	100	57.42
23	3	3	3	500	89.25
24	3	3	11	500	33
25	3	3	7	300	60.49
26	3	3	7	300	58.14
27	3	3	7	300	57.6
28	3	3	7	300	51.77
29	3	3	7	300	62.15
30	3	3	7	300	59.24

Analysis of Variance (ANOVA) was conducted to assess both the significance and adequacy of the model. (Table 4) reveals a substantial model F value of 255.28 for the proposed quadratic model, signifying its significance. The probability of obtaining such a large F value purely by chance is a mere 0.01%. Additionally, the p-value is less than 0.05, indicating the significance of the model terms. The Lack of Fit F-value of 3.2 implies the Lack of Fit is not significant relative to the pure error. There is a 10.56 % chance that a Lack of Fit F-value this large could occur due to noise. Non-significant lack of fit is good. The model's fitness was evaluated through determination coefficients, including R^2 , adjusted R^2 , predicted R^2 , and adequate precision. From (Table 4), it is quite evident that the discrepancy between adjusted and predicted R^2 is below 0.2, suggesting the fitness of the model.

Table 4: ANOVA results of the quadratic model for the response in terms of decolorization efficiencies of RO 84 using CCD

Source	Sum of squares	Degree of freedom	Mean square	F-value	Prob<F	Remarks
Model	10108.12	14	722.01	17.74	<0.0001	Significant
Residual	610.6	15	40.71			
Lack of Fit	546.97	10	54.7	4.3	0.0606	Not significant
Pure error	63.63	5	12.73			
R^2	0.9430					
Adjusted R^2	0.8899					
Predicted R^2	0.6975					

To further assess the model's adequacy, an actual vs predicted color removal efficiency plot was generated (Figure 7) from (Table 5) which illustrates a strong

correlation, with variations staying below 5%. The (Eq. 5) in terms of actual factors can be used to make predictions about the response for given levels of each factor. In summary, the ANOVA results and model evaluation metrics collectively affirm the significance and adequacy of the suggested quadratic model for color removal efficiency.

$$\begin{aligned}
 R = & 107.82177 + 12.54156*A - 5.67896*B - 1.54667*C - 0.211274*D - 0.186562*AB - \\
 & 0.11375*AC + 0.006244*AD - 0.32*BC - 0.005334*BD - 0.001131*CD - 0.974583*A^2 \\
 & + 0.271354*B^2 + 0.875729*C^2 + 0.000294*D^2
 \end{aligned}
 \tag{5}$$

Table 5: Actual Vs predicted color removal efficiencies for all the 30 trials

Trials	Varying Parameters				Color removal efficiency	
	Current	NaCl	pH	IC	Experimental	Predicted
	(X ₁)	(X ₂)	(X ₃)	(X ₄)	(%)	(%)
	(mA/cm ²)	(mM)		(Mg/L)		
1	1	3	3	300	60.68	63.39
2	5	3	3	300	96.38	94.06
3	1	11	3	300	32.62	26.39
4	5	11	3	300	58.35	51.08
5	3	7	1	100	70.46	82.89
6	3	7	5	100	90.52	86.94
7	3	7	1	500	47	61.06
8	3	7	5	500	62.25	63.31
9	1	7	3	100	72.25	66.17
10	5	7	3	100	91.08	88.86
11	1	7	3	500	41.9	38.44
12	5	7	3	500	70.72	71.12
13	3	3	1	300	80.64	81.99
14	3	11	1	300	45.52	47.12
15	3	3	5	300	92.58	90.26
16	3	11	5	300	50.22	45.15
17	1	7	1	300	37.15	42.02
18	5	7	1	300	64.56	70.61

19	1	7	5	300	43.53	46.08
20	5	7	5	300	67.12	72.85
21	3	3	3	100	96.6	101.49
22	3	11	3	100	57.42	70.03
23	3	3	3	500	89.25	87.28
24	3	11	3	500	33	38.76
25	3	7	3	300	60.49	58.29
26	3	7	3	300	58.14	58.29
27	3	7	3	300	57.6	58.29
28	3	7	3	300	51.77	58.29
29	3	7	3	300	62.15	58.29
30	3	7	3	300	59.24	58.29

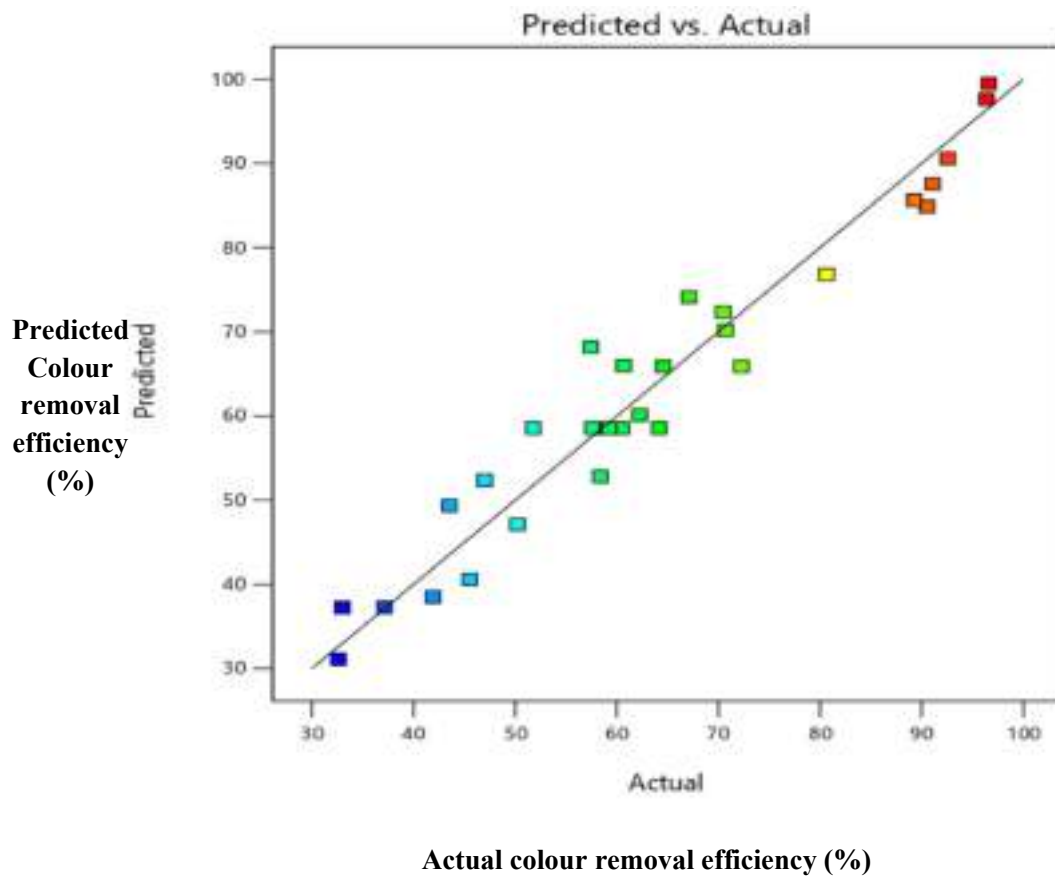


Figure 10: Diagnostic plot of actual vs predicted values for response R1

The coefficients of all the model terms in the mathematical expression (Eq. 4) illustrate the influence of each process variable on color removal efficiency which can also be identified by Pareto chart showing percentage effect of individual model term on color removal efficiency. The coefficient estimate represents the expected change in response per unit change in factor value when all remaining factors are held constant. From (Table 06), it can be seen that factors BD and B² have p-values more than 0.05. So, after removing these factors, the (Eq. 4) can be modified into (Eq. 6). All these factors will affect the response R₁. Both the sign and magnitude of coefficients of model terms in the mathematical expression are important for understanding the individual as well as synergistic effects of variables as positive sign indicates that there will be an increment in efficiency with increase of those factors whereas negative terms affect the system in reverse way.

$$R = 58.23 + 13.84*A - 0.20*B - 1.57*C - 11.43*D - 1.49*AB - 0.455*AC + 2.5*AD - 2.56*BC - 4.27*BD - 0.4525*CD - 3.9*A^2 + 4.34*B^2 + 3.5*C^2 + 11.74*D^2 \quad (6)$$

Table 6: Factors and their corresponding coefficient estimate and P values

Factor	Coefficient Estimate	P-value
Intercept	2298.55	<0.0001
A-Current	4800	<0.0001
B-pH	29.74	0.0012
C-NaCl	1568.88	<0.0001
D-IC	8.91	0.6466
AB	0.8281	0.8885
AC	24.95	0.4459
AD	26.21	0.4348
BC	72.85	0.2009
BD	0.819	0.8891
CD	104.21	0.1304
A ²	129.26	0.095
B ²	84.14	0.1711
C ²	945.17	0.0002
D ²	2298.55	<0.0001

Pareto analysis can be used to facilitate interpretation of the results and can be applied based on the following (Eq. 7).

$$P_i = 100 * b^2 / \sum b^2 \quad (7)$$

From (Figure 11), it can be confirmed that current has the highest effect on the colour removal efficiency of RO 84, while initial concentration of dye has the least effect. NaCl concentration and pH have the similar kind of effects. The effects of model terms on color removal efficiency of RO 84 can be represented in descending order as $A > B > C > D$.

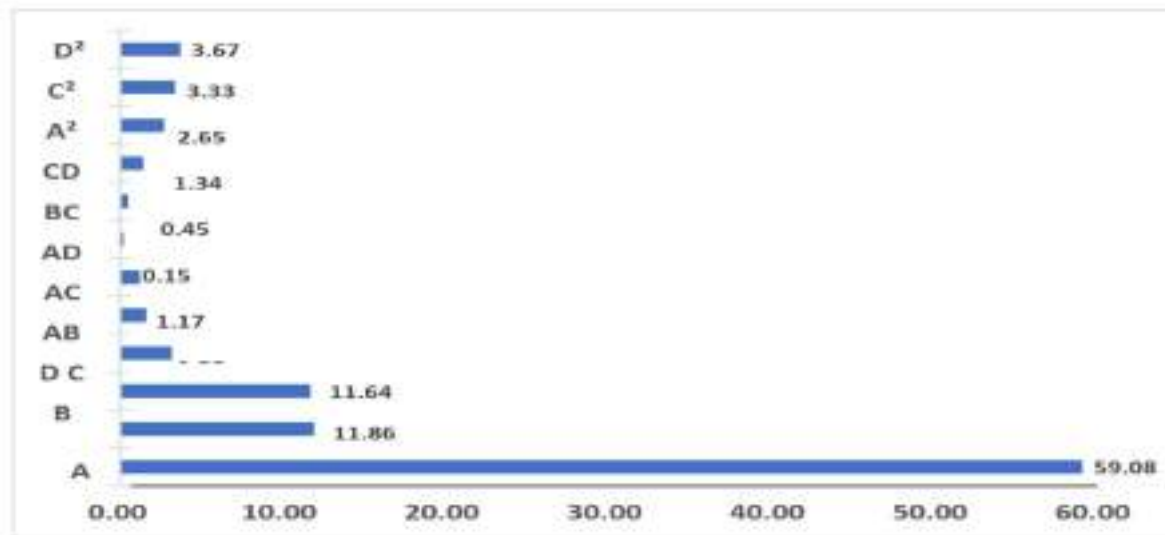


Figure 11: Percentage effect of each factor

4.1.3.2. Optimization of the varying parameters

Color removal efficiency of RO 84 (R1) was optimized using Design Expert 13, which was dependent on the four varying parameters that are current (X_1), NaCl (X_2), pH (X_3) and IC (X_4). The conditions that were imposed to optimize the color removal efficiency were to keep X_1 , X_2 , and X_3 at minimum and X_4 at maximum while response to maximum. The optimum conditions were obtained as current (X_1) = 1.77685 mAmp/cm², NaCl (X_2) = 1 mM, pH (X_3) = 3 and IC (X_4) = 500 mg/l. The optimum value of R under optimized conditions was obtained as 67.4641%.

5: Conclusion

The study successfully employed Central Composite Design (CCD) to optimize the electrochemical advanced oxidation process for RO 84 dye removal. A total of 30 experimental trials varying current, NaCl concentration, pH, and initial dye concentration were conducted, with color removal efficiency as the response variable. Results indicated that increasing current and NaCl enhanced efficiency, while higher pH and initial dye concentration reduced it. A quadratic model with high statistical significance ($R^2 = 0.998$) was developed to represent the system, and ANOVA confirmed the model's adequacy with a significant F-value and non-significant lack of fit. The actual vs predicted plot showed strong correlation, and Pareto analysis identified current as the most influential factor. Optimization using Design Expert 13 yielded the ideal conditions: current = 1.77685 mA/cm², NaCl = 1 mM, pH = 3, and IC = 500 mg/L, achieving a maximum predicted color removal efficiency of 67.46%. This model provides a reliable predictive and optimization tool for dye removal processes in industrial wastewater treatment.

6: References

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गुरु घासीदास विश्वविद्यालय, बिलासपुर
केंद्रीय विश्वविद्यालय अधिनियम 2009 संख्या 25, 2009 द्वारा केंद्रीय विश्वविद्यालय
Guru Ghasidas Vishwavidyalaya, Bilaspur
A Central University established by the Central Universities Act 2009 No. 25 of 2009

A Comprehensive Training Report
"Industrial Greywater Treatment using Electrochemical Advanced Oxidation Process"

INDIAN INSTITUTE OF ENGINEERING SCIENCE AND TECHNOLOGY,
SHIBPUR, WEST BENGAL

(6 WEEKS)

Submitted by

Annu Kumari

Prakash Tiwari ✓

Civil Engineering & VIIth Semester

Session 2024-25

Submitted to:

Department of Civil Engineering

School of Studies, Engineering & Technology

GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.) 495009

A Central University

(Established under the Central Universities Act 2009 No.25 of 2009)

T-shirt

CERTIFICATE

Certified that the Summer Internship Program report entitled "Industrial Greywater Treatment using Electrochemical Advanced Oxidation Process" submitted by Annu Kumari, Prakash Tiwari of B. Tech 7th Semester in Civil Engineering, School of Studies in Engineering and Technology, Guru Ghasidas Vishwavidyalaya, Bilaspur, is a record of bonafide work carried out by them during the academic session 2024-25 at the Indian Institute of Engineering Science and Technology (IIST), Shibpur.

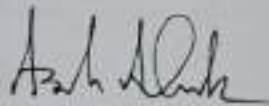
The internship was undertaken under the guidance and supervision of Dr. Asok Adak, Professor, Department of Civil Engineering, IIST Shibpur.

This report is submitted in partial fulfillment of the requirements for the award of the degree of Bachelor of Technology in Civil Engineering. The work embodied in this report is the original contribution of the students and has not been submitted to any other institution for the award of any other degree or diploma.

Date: 30/02/2025

Place: IIST, Shibpur

Signature



Name – Dr. Asok Adak

Associate Professor

IIST, Shibpur



Asok Adak, Ph.D.
Associate Professor
Civil Engineering Department
Indian Institute of Engineering Science and Technology
Shibpur, Howrah-711 103, INDIA

Abstract

Dye-bearing wastewater poses a major threat to aquatic ecosystems due to its high color intensity and resistance to biodegradation. When discharged untreated into natural water bodies, it significantly reduces light penetration, disrupting the photosynthesis process and lowering the dissolved oxygen content, thereby harming aquatic life. In this study, Electrochemical Advanced Oxidation Process (EAOP) was employed to remove Reactive Orange 84 dye from synthetic dye-bearing wastewater. The effect of key operational parameters such as electrolyte concentration (NaCl), current density, pH, and initial dye concentration was studied to evaluate their impact on the degradation efficiency.

Results indicated that an increase in NaCl concentration, acting as a supporting electrolyte, enhanced the generation of reactive species, thereby improving dye degradation. Similarly, higher current densities contributed to greater oxidant production, increasing the rate of dye removal. However, an increase in pH and initial dye concentration was found to negatively affect the degradation efficiency due to reduced availability of hydroxyl radicals and increased dye loading, respectively.

Optimization of these parameters was carried out using a statistical design approach, and the optimum conditions for maximum dye removal were determined as: current density of 1.77685 mA/cm^2 , NaCl concentration of 1 mM , pH of 3, and initial dye concentration of 500 mg/L . Under these conditions, a maximum removal efficiency of 67.4641% was achieved with a desirability value of 0.814 , making this solution the most optimal among 47 experimental runs. The study demonstrates the effectiveness of EAOP in degrading synthetic dye under controlled parameters and contributes to the development of sustainable dye wastewater treatment technologies.



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Guru Ghasidas Vishwavidyalaya, Bilaspur
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A COMPREHENSIVE TRAINING REPORT
BUILDING CONSTRUCTION
CENTRAL PUBLIC WORKS DEPARTMENT
BILASPUR (C.G.)

4 Weeks Vocational Training

Purushottam Das Mahant

GGV/22/01029

2022-26 & 7th semester

Session 2025-26

DEPARTMENT OF CIVIL ENGINEERING

School of Studies, Engineering & Technology

GURU GHASIDAS VISHWAVIDYALAYA

Bilaspur (C.G.) 495009

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ABSTRACT

During my internship with the Central Public Works Department (CPWD) at Guru Ghasidas Vishwavidyalaya (GGU), Koni, Bilaspur (C.G.), I was involved in the construction project titled “Construction of Lecture Hall Complex (G+4), Boys Hostel (G+3) 250 seats, Girls Hostel (G+3) 250 seats and site development including all civil and E&M works and horticulture services etc.” The work was executed on an Engineering, Procurement, and Construction (EPC) basis by Asian Construction Company, 716-A, Ajmer, Rajasthan. The estimated cost of the project was ₹55.21 crore, which included ₹43.81 crore for civil works, ₹10.99 crore for electrical works, and ₹0.40 crore for horticulture. The project was planned for completion in 21 months with an earnest money deposit of ₹65.21 lakh, a performance guarantee of 3%, and a security deposit of 2.5% of the tendered value. This internship helped me understand the various planning and execution stages in a large-scale public infrastructure project. During the planning phase, the project manager created several key documents to guide the execution. These included a Scope Statement that defined the project's objectives, deliverables, and milestones; a Work Breakdown Schedule (WBS) to divide the project into manageable parts; and a Gantt Chart that visually tracked project timelines. Milestones were identified to ensure smooth progress, and a Communication Plan was established for internal coordination and stakeholder updates. A Risk Management Plan was also in place to identify and prepare for possible risks such as budget constraints or schedule delays.

On site, I witnessed the implementation of several important features aligned with CPWD and National Building Code (NBC) guidelines. These included tactile tiles for accessibility in key locations such as entrances, corridors, and lift lobbies, along with ramps to support inclusive infrastructure. Rainwater harvesting systems with filtration units and recharge pits were installed in all buildings to promote sustainable water use. The lecture halls were designed with acoustic treatments using materials like mineral wool panels and double-glazed windows to improve sound quality. Water treatment units were installed for a safe water supply, adhering to IS 10500 standards. All buildings were equipped with fire safety measures including alarms, extinguishers, emergency exits, and signage. The inclusion of horticulture work also added greenery to the campus, improving the overall environment. This internship gave me practical exposure to technical, safety, and service systems used in public infrastructure and taught me how proper planning ensures successful project execution.



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Guru Ghasidas Vishwavidyalaya, Bilaspur
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A COMPREHENSIVE TRAINING REPORT

Upgradation of Bilaspur -Takhatpur- Mungeli - Pandariya -
Pondi Road On NH-130A

Public Works Department

BILASPUR (C.G.)

4 Weeks Vocational Training

Rahul Kumar Singh

(GGV/22/01030)

2022-26 & 7th semester

Session: 2025-26

Submitted to:

DEPARTMENT OF CIVIL ENGINEERING

School of Studies, Engineering & Technology

GURU GHASIDAS VISHWAVIDYALAYA

Bilaspur (C.G.) 495009

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11.08.25

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11 AUG 2025



PUBLIC WORKS DEPARTMENT

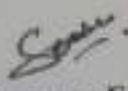
Date 25-07-25

CERTIFICATE

This is to certify that **Mr. Rahul kumar singh** student of B.Tech. 6th semester (civil engineering) of Guru Ghasidas Vishwavidyalaya, bilaspur (C.G.) has successfully completed his vocational training under P.W.D. N.H(130A Package-III Bypasses) for duration of 30 days from 16.05.2025 to 15.06.2025.

During the above period, we found him to be sincere and hardworking.

We wish him every success in all future endeavours.


Highway Engineer
(Project Training Officer)
NH130A Package - 3
P.W.D.(N.H.) Division Bilaspur.


Sub Divisional Officer
P.W.D. N.H. Sub Division
Bilaspur (C.G.)

OFFICE OF THE EXECUTIVE ENGINEER
P.W.D. N.H. DIVISION BILASPUR (C.G.)

Date: 27/07/2025

CERTIFICATE

This is to certify that Mr. Rahul Kumar Singh, student of B.Tech. 6th semester (civil engineering) of Guru Chaudas Vishwavidyalaya, Bilaspur (C.G.) has successfully completed his vocational training under P.W.D. for duration of 30 days from 16.05.2025 to 15.06.2025.

During the above period, we found him to be sincere and hardworking.

We wish him every success in all future endeavours.



Highway Engineer
(Project Training Officer)
NH 30A Package - 3
P.W.D. (N.H.) Division Bilaspur



गुरु घासीदास विश्वविद्यालय, बिलासपुर
Guru Ghasidas Vishwavidyalaya, Bilaspur
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A COMPREHENSIVE TRAINING REPORT

[UNO ROBOTICS TECH & RESEARCH PVT. LTD.]

[16TH MAY 2025 - 15TH JUNE 2025]

RAJESH KUMAR

22024131

[2022 -2026]

[7TH SEMESTER]

Session 2025-26

Submitted to:

DEPARTMENT OF CIVIL ENGINEERING

School of Studies, Engineering & Technology

GURU GHASIDAS VISHWAVIDYALAYA

Bilaspur (C.G.)-495009

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D

Report

WLC
Submission
11 AUG 2025

AKNOWLEDGEMENT

I sincerely thank my faculty mentor, **Mr. Suraj Kewat**, for his invaluable guidance and support throughout the course of this industrial training. I am grateful to the entire team at **UNO ROBOTICS TECH & RESEARCH PVT. LTD.** for their mentorship, cooperation, and the opportunity to gain hands-on experience in the field.

I extend my heartfelt appreciation to our Hon'ble Dean, **Prof. Shallendra Kumar**, the Head Of the Department **Prof. M.C RAO**, and all concerned faculty members of the Department of Civil Engineering, **Guru Ghasidas Vishwavidyalaya**, for their continuous encouragement.

Lastly, I am thankful to the **Central Training & Placement Cell** for facilitating and coordinating this training initiative, which has greatly contributed to my professional development.

font mis match

ABSTRACT

During my civil engineering internship, I had the opportunity to visit a live construction site and observe various practical aspects of the field. This internship helped me understand how different civil works are carried out in real life, which I had only studied in theory before. I learned about site supervision, material handling, and the step-by-step process of construction. I observed how mix designing of concrete is done to achieve the required strength and quality for different structural elements. I also gained knowledge about pavement design and how roads and base layers are prepared before final surfacing.

Abstract in new page³.



गुरु घासीदास विश्वविद्यालय, बिलासपुर

केंद्रीय विश्वविद्यालय अधिनियम 2009 संख्या 25, 2009 द्वारा केंद्रीय विश्वविद्यालय

Guru Ghasidas Vishwavidyalaya, Bilaspur

A Central University established by the Central Universities Act 2009 No. 25 of 2009

A COMPREHENSIVE TRAINING REPORT

"DISCHARGE PREDICTION IN RECTANGULAR OPEN CHANNEL FLOW USING
PINN MODEL"

NATIONAL INSTITUTE OF TECHNOLOGY, PATNA, BIHAR
(6 WEEKS)

Submitted by

Rintu Kumar

Enrolment No.: GGV/22/01032

4th Year, 7th Semester

Session: 2025-26

Submitted to:

DEPARTMENT OF CIVIL ENGINEERING

School of Studies, Engineering & Technology

GURU GHASIDAS VISHWAVIDYALAYA

Bilaspur (C.G.) 495009

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जनपदीय अभियांत्रिकी विभाग/ CIVIL ENGINEERING DEPARTMENT

राष्ट्रीय प्रौद्योगिकी संस्थान पटना/ NATIONAL INSTITUTE OF TECHNOLOGY PATNA

अशोक राजपथ, पटना - 800005, बिहार/ ASHOK RAJPATH, PATNA - 800005, BIHAR

विश्व मंडाल, भारत सरकार के अधीन एक राष्ट्रीय महत्व की संस्थान/ An Institute of National Importance under Ministry of Education, Govt. of India

Web site: www.nitp.ac.in

संदर्भ/Ref.:CED/003

दिनांक/ Date: 01/07/2025

CERTIFICATE

This is to certify that **Mr. Rintu Kumar** (Roll No. 22024132), a student of Civil Engineering Department, Guru Ghasidas Vishwavidyalaya, Bilaspur, Chhattisgarh, has successfully completed his internship work on the topic of **"Discharge Prediction in Rectangular Open Channel Flow using PINN Model"** dated from 19/05/2025 to 30/06/2025, in the Department of Civil Engineering, National Institute of Technology (NIT) Patna, under the supervision of Dr. Bhabani Shankar Das. During this internship work, the student has performed the machine modeling activity related to discharge estimation in compound channel in which he learned about PINN model, statistical error analysis, and conference paper writing skill.

Dr. Bhabani Shankar Kumar

Assistant Professor

Dept. of Civil Engineering,

National Institute of Technology Patna

Patna- 800005, Bihar (India)

सहायक प्राध्यापक/Assistant Professor

जनपदीय अभियांत्रिकी विभाग

Civil Engineering Department

राष्ट्रीय प्रौद्योगिकी संस्थान पटना-5

National Institute of Technology Patna-5

ABSTRACT

This project focuses on calculating the discharge of an open channel using a Physics-Informed Neural Network (PINN) model. Discharge, which is the amount of water flowing through a channel per second, is a key factor in managing rivers, designing canals, and predicting floods. Traditionally, discharge is estimated using formulas or numerical simulations that require a lot of field data and can be complex to set up. In this work, a new approach is used where PINNs combine the power of machine learning with the physical laws of fluid flow. Instead of just learning from data like a regular Artificial Neural Network (ANN), the PINN model also follows the Saint-Venant equations, which describe how water flows in open channels. This helps the model make predictions that are not only accurate but also physically realistic. The PINN was trained using data for position (x), time (t), water depth (h), and velocity (u). Once trained, it could predict how discharge (Q) changes along the channel over time. The model was tested at different time intervals, and its predictions were compared with those from an ANN model. The results showed that the PINN gave smoother, more reliable, and physically consistent discharge curves, especially during sudden changes in flow. The study proves that PINNs are a strong AI/ML model for calculating discharge in open channels, especially when real data is limited. This approach can be useful for real-time river monitoring, flood forecasting, and future hydraulic studies.

Keywords: Physics-Informed Neural Networks (PINNs), Open Channel Flow, Shallow Water Equations, Discharge Prediction, Scientific Machine Learning.



गुरु घासीदास विश्वविद्यालय, बिलासपुर

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Guru Ghasidas Vishwavidyalaya, Bilaspur

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A COMPREHENSIVE TRAINING REPORT

On

“Applying Theoretical Concepts to Practical Construction”

M/s. Kumar Shanu Singh & Company

(1st June 2025 – 30th June 2025)

Rishabh Kumar

GGV/22/01033

Of

VIIth Semester, Civil Engineering

Session 2025-26

Submitted to:

DEPARTMENT OF CIVIL ENGINEERING

School of Studies, Engineering & Technology

GURU GHASIDAS VISHWAVIDYALAYA

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DECLARATION

I Rishabh Kumar, the student of **B.Tech, Civil Engineering, Guru Ghasidas University**, hereby solemnly declare that the report entitled “**Applying Theoretical Concepts to Practical Construction**”, is a genuine and original record of the industrial training/internship undertaken at **M/s. Kumar Shanu Singh & Company** during the period from **1/06/2025 to 30/06/2025**.

The work presented in this report is entirely my own and has not been copied, reproduced, or submitted elsewhere for any academic or professional purpose. I affirm that:

- All information and observations recorded were made during my tenure at the above-mentioned organization.
- No part of the report has been plagiarized or duplicated from any other source.
- Proper references and acknowledgments have been made wherever external information has been consulted.

We understand that any violation of this declaration may result in academic or disciplinary action as per the rules and regulations of the institution.

Place: GGV,Bilaspur

Date: [1/08/2025]

Signature of the Student

Name: Rishabh Kumar

Enrollment No.: GGV/22/01033

ACKNOWLEDGEMENT

I sincerely thank my site engineer, **Er. Rakesh Ranjan**, for his invaluable guidance and support throughout the course of this industrial training. I am grateful to the entire team at **M/s. Kumar Shanu Singh & Company** for their mentorship, cooperation, and the opportunity to gain hands-on experience in the field.

I extend my heartfelt appreciation to our **Hon'ble Dean, Prof. Sharad Chandra Srivastava** the **Head of the Department Prof. M. Chakradhara Rao**, and all concerned faculty members of the Department of Civil Engineering, Guru Ghasidas Vishwavidyalaya, for their continuous encouragement.

Lastly, I am thankful to the **Central Training & Placement Cell** for facilitating and coordinating this training initiative, which has greatly contributed to my professional development.

Place: GGV,Bilaspur

Date: [1/08/2025]

Signature of the Student

Name: Rishabh Kumar

Enrollment No.: GGV/22/01033

ABSTRACT

As a part of the Bachelor of Technology (B.Tech) curriculum in Civil Engineering, I completed a one-month internship at *M/s. Kumar Shanu Singh & Company*, under the supervision of *JMS Mining Pvt. Ltd.* at Bhaskhala, Kotma, District Anuppur (M.P.). The internship provided valuable hands-on exposure to civil construction activities, particularly focusing on the early-stage development of a G+2 residential structure with a floor area of 17,000 sq. ft. per level. Major activities observed included excavation up to a depth of 1.8 meters, shuttering setup, and reinforcement detailing for footings and columns. The experience allowed me to apply theoretical concepts in a practical setting, understand real-world challenges in fieldwork, and observe how technical tasks are executed with precision and safety. I also gained exposure to construction equipment, material management, and site supervision practices. This internship enhanced my technical competence and professional confidence, preparing me for a future career in construction and site engineering.

Keywords: Civil Engineering, Internship, Excavation, Shuttering, Reinforcement, Construction Site, G+2 Building, Foundation, Field Training, Practical Experience



गुरु घासीदास विश्वविद्यालय, बिलासपुर
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Guru Ghasidas Vishwavidyalaya, Bilaspur
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A COMPREHENSIVE TRAINING REPORT

**Upgradation of Bilaspur -Takhatpur- Mungeli - Pandariya –
Pondi Road On NH-130A**

Public Works Department

BILASPUR (C.G.)

4 Weeks Vocational Training

RISHI KESH HARSH

(GGV/22/01033)

2022-26 & 7th semester

Session: 2025-26

Submitted to:

DEPARTMENT OF CIVIL ENGINEERING

School of Studies, Engineering & Technology

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ABSTRACT

This report summarizes a one-month summer internship focused on the upgradation of National Highway 130A. Conducted under the supervision of the Public Works Department (PWD) Bilaspur division, the training provided an immersive experience into the practical application of civil engineering principles. The primary objective was to gain hands-on knowledge of road construction, quality control, and project management within a government infrastructure project. The report contains the development process of the highway project, up, Bilaspur - Takhatpur- Mungeli - Pandariya – Pondi Road, having total length of 25.695 km.

The internship involved observation and participation in construction stages. A significant portion of the training was dedicated to understanding and assisting in on-site quality control tests for materials such as soil, aggregates, and bitumen, ensuring adherence to Indian Standard codes like IS 456. Furthermore, the experience offered insight into the administrative aspects of the project, including project documentation, progress reporting, and team coordination.

In addition to technical skills, the internship fostered the development of essential soft skills, including effective communication, teamwork, and a heightened sense of professional punctuality and observation. This practical exposure has been invaluable, bridging the gap between theoretical knowledge and professional practice and has reinforced a strong understanding of highway engineering principles.

Key words: National highway, GSB, Culvert, Road construction, Tests.



गुरु घासीदास विश्वविद्यालय, बिलासपुर

केंद्रीय विश्वविद्यालय अधिनियम 2009 संख्या 25, 2009 द्वारा केंद्रीय विश्वविद्यालय

Guru Ghasidas Vishwavidyalaya, Bilaspur

A Central University established by the Central Universities Act 2009 No. 25 of 2009

A COMPREHENSIVE TRAINING REPORT

An Insight into Fieldwork in Road Construction

PUBLIC WORKS DEPARTMENT (PWD)

B/R division Rajnandgaon, C.G.

(Training period: 16th May to 15th June 2025)

Submitted by – Riya Dewangan

Roll no- 22024135

Enrollment no-GGV/22/01035

Batch 2022-26, 7th semester

Session 2025-26

Submitted to

DEPARTMENT OF CIVIL ENGINEERING

School of Studies, Engineering & Technology

GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G)

Bilaspur (C.G.) 495009

(A Central University established by the Central Universities Act No. 25 of 2009)

Accredited with NAAC A⁺⁺

Abstract

I undertook my internship with the Public Works Department, a government body responsible for constructing and maintaining roads, buildings, and other essential public infrastructure, focusing on road construction at 8th Battalia, Rajnandgaon (C.G.) from 16th May to 15th June. The primary objective of the project was to develop a proper roadway in an area as the colony has gradually expanded and more residential structures have been added, there arose a growing need for constructing a well-planned road to improve accessibility, ensure smoother transportation, and support the ongoing development of the area. The project commenced in February 2025 and is anticipated to require approximately one year for its completion.

During my one-month internship in road construction, I gained practical exposure to various stages involved in the development and maintenance of road infrastructure. I was assigned to a construction site where I observed and tried to assist with several key activities, and laying of different pavement layers. I was introduced to the use of heavy machinery like pavers and understood their roles in achieving proper alignment, compaction, and smoothness of the roadway. I also learned about the importance of drainage systems, road safety features and quality control measures carried out through regular material testing in the site laboratory. Overall, the internship helped bridge the gap between classroom knowledge and real-world applications in civil engineering.

Office Of The Executive Engineer, Public Works
Department, Rajnandgaon (C.G.)

Certificate

Certified that Miss Riya Dewangan Student of Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.) attended vocational training from 16th May 2025 to 15th June 2025 at Various construction site of road/building under this division.

She completed the training programme sincerely. We wish her a bright future.


Sub Divisional Officer
P.W.D. (B/R) Sub Division
No. 1 Rajnandgaon (C.G.)


Executive Engineer
P.W.D. (B/R) Division
Rajnandgaon (C.G.)



गुरु घासीदास विश्वविद्यालय, बिलासपुर
केंद्रीय विश्वविद्यालय अधिनियम 2009 संख्या 25, 2009 द्वारा केंद्रीय विश्वविद्यालय
Guru Ghasidas Vishwavidyalaya, Bilaspur
A Central University established by the Central Universities Act 2009 No. 25 of 2009

A COMPREHENSIVE TRAINING REPORT

Personal Protective Equipment Detection Model

[UNO ROBOTICS TECH & RESEARCH PVT. LTD.]

[16TH MAY 2025 - 15TH JUNE 2025]

SAMIR KUMAR

22024136

[2022 -2026]

[7TH SEMESTER]

Session 2025-26

Submitted to:

DEPARTMENT OF CIVIL ENGINEERING

School of Studies, Engineering & Technology

GURU GHASIDAS VISHWAVIDYALAYA

Bilaspur (C.G.) 495009

A CENTRAL UNIVERSITY

(Established under the Central Universities Act, 2009 No.25 of 2009)

ABSTRACT

This project presents a Personal Protective Equipment (PPE) Detection System designed to enhance safety on construction sites by automatically identifying whether workers are wearing essential protective gear such as helmets and safety vests. The system is built using the YOLOv8 object detection model, which has been trained on over 500 real-world images collected from construction areas in the college. The model detects four classes: Helmet, No Helmet, Safety Vest, and No Vest.

The detection system processes real-time video feeds from either a laptop webcam or a mobile camera stream using OpenCV. Bounding boxes of different colours are used for easy visual recognition: red for violations (No Helmet or No Vest), blue for Safety Vest, and green for Helmet. The project also integrates an alert system using Telegram Bot API, which captures a screenshot whenever a violation is detected and immediately sends it to the supervisor's Telegram chat.

This solution demonstrates how AI and computer vision can improve workplace safety by providing instant detection and alerts. The system is efficient, easy to implement, and can be extended to monitor larger construction sites or integrated into a mobile app for real-time safety management.



गुरु घासीदास विश्वविद्यालय, बिलासपुर

केन्द्रीय विश्वविद्यालय अधिनियम 2009 संख्या 25, 2009 द्वारा केन्द्रीय विश्वविद्यालय

Guru Ghasidas Vishwavidyalaya, Bilaspur

A Central University established by the Central Universities Act 2009 No. 25 of 2009

A COMPREHENSIVE TRAINING REPORT

CONSTRUCTION OF EDUCATIONAL AND PUBLIC UTILITY BUILDINGS

PUBLIC WORK DEPARTMENT BALAODA BAZAR

6 weeks vocational training

Satyaajeet Aadil

GGV/22/01037

2022-26 & 7th semester

Session 2025-26

Submitted to:

DEPARTMENT OF CIVIL ENGINEERING

School of Studies, Engineering & Technology

GURU GHASIDAS VISHWAVIDYALAYA

Bilaspur (C.G.) 495009

A CENTRAL UNIVERSITY

(Established under the Central Universities Act, 2009 No.25 of 2009).

Accredited with NAAC A⁺⁺



ABSTRACT

This report summarizes a 45-day vocational training program undertaken at the **Public Works Department (PWD), Balaoda Bazar**, from **16 May 2025 to 30 June 2025**, as part of the B.Tech (Civil Engineering) curriculum of **Guru Ghasidas Vishwavidyalaya, Bilaspur**. The training aimed to provide practical exposure to civil engineering practices in real construction environments. The nature of the training was field-oriented, involving observation and participation in various stages of construction and supervision.

Key activities included excavation, footing and column layout, reinforcement detailing, shuttering, slab construction, plastering, staircase execution, and masonry works. Additionally, quality control techniques and material testing for cement, sand, aggregates, and steel were observed, reinforcing theoretical concepts with practical understanding.

The training provided insight into site execution methods, construction sequencing, safety protocols, and effective teamwork. It significantly enhanced technical skills, professional discipline, and on-site decision-making abilities. This hands-on experience bridged the gap between academic learning and field application, laying a strong foundation for future professional roles in civil engineering.



गुरु घासीदास विश्वविद्यालय, बिलासपुर
Guru Ghasidas Vishwavidyalaya, Bilaspur
A Central University established by the Central Universities Act 2009 No. 25 of 2009

A COMPREHENSIVE TRAINING REPORT

On

CONSTRUCTION OF A GUEST HOUSE

M/s. Kumar Shanu Singh & Company
(1st June 2025 – 30th June 2025)

Shivam Kumar

GGV/22/01039

Of

VIIth Semester, Civil Engineering

Session 2025-26

Submitted to:

DEPARTMENT OF CIVIL ENGINEERING

School of Studies, Engineering & Technology

GURU GHASIDAS VISHWAVIDYALAYA

Bilaspur (C.G.) 495009

A CENTRAL UNIVERSITY

(Established under the Central Universities Act, 2009 No.25 of 2009).

Accredited with NAAC A⁺⁺

Resubmitted
26 Nov 2025

All subject to the jurisdiction Bilaspur (Chhattisgarh)

M/s. Kumar Shanu Singh & Company

A Complete Solution of Mining Development & Civil Engineering works

C.G. Office : E-202, Saket Apartment Nachiketa Block, Agrasen Chowk, BILASPUR 495 001 (C.G.)
M.P. Office : Sarwangi Colony, Ward-1, Amarkantak Road, Post: Dhanpuri, Dist: SHAHDOL 484 114 (M.P.)
E-mail : kssinghandco@gmail.com

KSS/BUH/CERTIFICATE/2025/38

Date: 30/06/2025

CERTIFICATE

This is to certify that Shivam Kumar Singh (B.Tech Civil), studying in VI semester in Branch Civil Engineering of Institute - Guru Ghasidas Vishwavidyalaya, Bilaspur has successfully and satisfactorily completed training in JMS MINING PVT. LTD Guest House Gohandra, VILLAGE BHASKHALA, KOTMA, DIST. ANUPPUR (M.P.) from 01.06.2025 to 30.06.2025. (30 Days)

Kumar Shanu Singh And Company

M/s Kumar Shanu Singh & Co.

Director

Partner

Abstract

As a part of the Bachelor of Technology (B.Tech) curriculum in Civil Engineering, I completed a one-month internship at *M/s. Kumar Shamu Singh & Company*, under the supervision of *JMS Mining Pvt. Ltd.* at Bhaskhala, Kotma, District Anuppur (M.P.). The internship provided valuable hands-on exposure to civil construction activities, particularly focusing on the early-stage development of a G+2 residential structure with a floor area of 17,000 sq. ft. per level. Major activities observed included excavation up to a depth of 1.8 meters, shuttering setup, and reinforcement detailing for footings and columns. The experience allowed me to apply theoretical concepts in a practical setting, understand real-world challenges in fieldwork, and observe how technical tasks are executed with precision and safety. I also gained exposure to construction equipment, material management, and site supervision practices. This internship enhanced my technical competence and professional confidence, preparing me for a future career in construction and site engineering.

Keywords: Civil Engineering, Internship, Excavation, Shuttering, Reinforcement, Construction Site, G+2 Building, Foundation, Field Training, Practical Experience



गुरु घासीदास विश्वविद्यालय, बिलासपुर

केंद्रीय विश्वविद्यालय अधिनियम 2009 संख्या 25, 2009 द्वारा केंद्रीय विश्वविद्यालय

Guru Ghasidas Vishwavidyalaya, Bilaspur

A Central University established by the Central Universities Act 2009 No. 25 of 2009

A COMPREHENSIVE TRAINING REPORT

"PREDICTION OF SCOUR DEPTH AROUND BRIDGE PIERS USING
MACHINE LEARNING MODELS"

NATIONAL INSTITUTE OF TECHNOLOGY, PATNA, BIHAR
(6 WEEKS)

Submitted by

Shubham Kumar

Enrolment No.: GGV/22/01041

4th Year, 7th Semester

Session: 2025-26

Submitted to:

DEPARTMENT OF CIVIL ENGINEERING

School of Studies, Engineering & Technology

GURU GHASIDAS VISHWAVIDYALAYA

Bilaspur (C.G.) 495009

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(Established under the Central Universities Act 2009 No.25 of 2009)

Accredited with NAAC A⁺⁺



जनपदीय अभियांत्रिकी विभाग/ CIVIL ENGINEERING DEPARTMENT
राष्ट्रीय प्रौद्योगिकी संस्थान पटना/ NATIONAL INSTITUTE OF TECHNOLOGY PATNA
अशोक राजपथ, पटना - 800005, बिहार/ ASHOK RAIPATH, PATNA - 800005, BIHAR
विश्वविद्यालय, भारत सरकार के अधीन एक राष्ट्रीय महत्व का संस्थान/ An Institute of National Importance under Ministry of Education, Govt. of India
Web site: www.nitpatna.in

संदर्भ/Ref: CED/001

दिनांक/ Date: 01/07/2025

CERTIFICATE

This is to certify that **Mr. Shubham Kumar** (Roll No. 22024141), a student of Civil Engineering Department, Guru Ghasidas Vishwavidyalaya, Bilaspur, Chhattisgarh, has successfully completed his internship work on the topic of "**Prediction of Scour Depth Around Bridge Piers Using Machine Learning Models**," dated from 19/05/2025 to 30/06/2025, in the Department of Civil Engineering, National Institute of Technology (NIT) Patna, under the supervision of Dr. Bhabani Shankar Das. During this internship work, the student has performed the machine modeling activity related to scour depth estimation in around circular bridge pier in which he learned about different ML models, statistical error analysis, and conference paper writing skill.

Dr. Bhabani Shankar Kumar
Assistant Professor
Dept. of Civil Engineering,
National Institute of Technology Patna
Patna- 800005, Bihar (India)
सहायक प्राध्यापक/Assistant Professor
जनपदीय अभियांत्रिकी विभाग
Civil Engineering Department
राष्ट्रीय प्रौद्योगिकी संस्थान पटना-5
National Institute of Technology Patna-5

Abstract

Scour around bridge piers is a significant cause of bridge failure globally, threatening infrastructure safety and requiring accurate prediction tools. Traditional empirical models often fall short due to their inability to account for complex interactions between flow velocity, sediment transport, and structural geometry. With the growing capabilities of machine learning (ML), this study explores the use of Artificial Intelligence (AI) and ML models to enhance scour depth prediction accuracy around bridge piers. A novel approach integrating Self-Adaptive Physics-Informed Neural Networks (SPINNs) was employed, combining physical knowledge and data-driven modeling. Three deep learning models NLinear (fully connected neural network), LSTM (Long Short-Term Memory), and CNN (Convolutional Neural Network) were trained and evaluated using normalized hydraulic data. The input parameters included flow velocity, pier diameter, sediment characteristics, and Froude number, while the output was the dimensionless scour depth. Evaluation metrics such as Mean Squared Error (MSE), Mean Absolute Error (MAE), and R-squared (R^2) score were used to assess performance. The models were trained on data preprocessed using MinMaxScaler. The SPINN framework improved the model's learning by enforcing consistency with physical laws (e.g., HEC-18 formula). The results showed that the NLinear model achieved the best accuracy with an R^2 score of 0.9012, MSE of 0.0206, and MAE of 0.0951. CNN closely followed with an R^2 of 0.8819, MSE of 0.0247, and MAE of 0.1098. The LSTM model, although effective for capturing temporal patterns, recorded a slightly lower R^2 of 0.7131. Graphical analyses including line plots and 45-degree scatter plots demonstrated good agreement between predicted and actual scour depths. This study confirms that hybrid models combining physics and AI can significantly enhance predictive performance in hydraulic engineering. Such models have strong potential applications in infrastructure monitoring, early warning systems, and digital twin framework for smart bridges.

Keywords: *Scour Depth, Bridge Pier, Neural Networks, LSTM, CNN, SPINN, Physics-Informed Learning*



गुरु घासीदास विश्वविद्यालय, बिलासपुर
केन्द्रीय विश्वविद्यालय अधिनियम 2009 संख्या 25, 2009 द्वारा केन्द्रीय विश्वविद्यालय
Guru Ghasidas Vishwavidyalaya, Bilaspur
A Central University established by the Central Universities Act 2009 No. 25 of 2009

A COMPREHENSIVE TRAINING REPORT

On

“ On-Site Learning and Practices in Infrastructure Construction ”

VVS Realinfra Private Limited.

Six Weeks Internship

Sidharth Kumar

GGV/22/01042

B.Tech, VII Semester, Civil Engineering

Session 2025-26

Submitted to:

DEPARTMENT OF CIVIL ENGINEERING

School of Studies, Engineering & Technology

GURU GHASIDAS VISHWAVIDYALAYA

Bilaspur (C.G.) 495009

A CENTRAL UNIVERSITY

(Established under the Central Universities Act, 2009 No.25 of 2009).

Accredited with NAAC A**

[1]

Handwritten signatures and dates:
18/08/25
18/08/25



VVC REALINFRA PVT. LTD.

ISO Certification : 9001:2015, 14001:2015, 45001:2018
Regd. Office : Madan Mohan Leholi Auto Complex,
Transport Nagar, A.B. Road, RAGHOGARH - 473226
Dist - Guna (M.P.) Ph: 07544-274692
Email : vvcrealinfra383@gmail.com
CIN : U74110MP2013PTC030424
GSTIN : 23AAECV3881D12G

Date : 01/07/2025

INTERNSHIP CERTIFICATE

This is to certify that Mr. Sidharth Kumar, a student of B.Tech in Civil Engineering Department at Guna Ghasidas Vishwavidyalaya, has completed a four-week long internship from 19/05/2025 to 30/06/2025 at our construction site under VVC Realinfra Pvt Ltd.

During the internship period, he was actively involved in various site activities related to construction of infrastructure projects. He gained practical knowledge in areas such as site supervision, construction planning, safety protocols and material management. His performance was found to be sincere, dedicated, and enthusiastic throughout the internship.

We wish him all the best for his future endeavors.

Date: 01/07/2025

Place: Guna, Madhya Pradesh



Authorized Signatory

Issuing Authority: VVC Realinfra Pvt Ltd.
(CIN: U45200MP2013PTC030424)

ABSTRACT

This report presents a comprehensive overview of the six-week internship undertaken at the construction site of the State Highway (SH-18) and flyover project executed by VVC Realinfra Pvt. Ltd., between Makshudangarh and Janjali. The internship provided valuable on-site exposure to various civil engineering practices and processes involved in large-scale infrastructure development. Each week focused on a specific area of construction work to ensure practical learning and holistic development.

The initial week covered site orientation, safety protocols, and a complete walkthrough of the project site. In the second week, material testing such as aggregate, concrete, and soil analysis was performed under the guidance of the quality control lab, aligned with IS codes. Week three focused on reinforcement detailing. The fourth week involved hands-on experience with foundation layout, shuttering, and column casting. Project planning, material estimation, and scheduling using basic software tools were carried out in the fifth week. The final week was dedicated to documentation, including Daily Progress Reports (DPRs) and internship report preparation.

This internship not only strengthened technical skills but also improved understanding of construction sequencing, material quality control, and documentation standards—bridging the gap between classroom learning and field application.



गुरु घासीदास विश्वविद्यालय, बिलासपुर

केंद्रीय विश्वविद्यालय अधिनियम 2009 संख्या 25, 2009 द्वारा केंद्रीय विश्वविद्यालय

Guru Ghasidas Vishwavidyalaya, Bilaspur

A Central University established by the Central Universities Act 2009 No. 25 of 2009

A COMPREHENSIVE TRAINING REPORT

**Upgradation of Bilaspur -Takhatpur- Mungeli - Pandariya –
Pondi Road On NH-130A**

Public Works Department

BILASPUR (C.G.)

4 Weeks Vocational Training

Sumit Ratre

(GGV/22/01044)

2022-26 & 7th semester

Session: 2025-26

Submitted to:

DEPARTMENT OF CIVIL ENGINEERING

School of Studies, Engineering & Technology

GURU GHASIDAS VISHWAVIDYALAYA

Bilaspur (C.G.) 495009

A CENTRAL UNIVERSITY

(Established under the Central Universities Act, 2009 No. 25 of 2009)

Accredited with NAAC A++

*D. is
like certificate
22/06/2022*

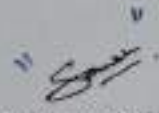
OFFICE OF THE EXECUTIVE ENGINEER
P.W.D. N.H. DIVISION BILASPUR (C.G.)

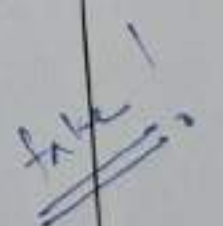
Date 02/07/2025

CERTIFICATE

This is to certify that **Mr. Sumit Ratre**, student of B.Tech. 6th semester (civil engineering) of Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.) has successfully completed his vocational training under P.W.D. for duration of 30 days from 16.05.2025 to 15.06.2025.

During the above period, we found him to be sincere and hardworking. We wish him every success in all future endeavours.


Highway Engineer
(Project Training Officer)
NH130A Package - 3
P.W.D.(N.H.) Division Bilaspur



ABSTRACT

This report summarizes a one-month summer internship focused on the upgradation of National Highway 130A. Conducted under the supervision of the Public Works Department (PWD) Bilaspur division, the training provided an immersive experience into the practical application of civil engineering principles. The primary objective was to gain hands-on knowledge of road construction, quality control, and project management within a government infrastructure project. The report contains the development process of the highway project, up, Bilaspur - Takhatpur- Mungeli - Pandariya - Pondi Road, having total length of 25.695 km.

The internship involved observation and participation in construction stages. A significant portion of the training was dedicated to understanding and assisting in on-site quality control tests for materials such as soil, aggregates, and bitumen, ensuring adherence to Indian Standard codes like IS 456. Furthermore, the experience offered insight into the administrative aspects of the project, including project documentation, progress reporting, and team coordination.

In addition to technical skills, the internship fostered the development of essential soft skills, including effective communication, teamwork, and a heightened sense of professional punctuality and observation. This practical exposure has been invaluable, bridging the gap between theoretical knowledge and professional practice and has reinforced a strong understanding of highway engineering principles.

Key words: National highway, GSB, Culvert, Road construction, Tests.



SCHOOL OF STUDIES OF ENGINEERING AND TECHNOLOGY
GURU GHASIDAS VISWAVIDYALAYA, BILASPUR (C.G.)
(A Central University Established by the Central University Act 2009 No. 25 of 2009)

VOCATIONAL INTERNSHIP REPORT

"Mini Secretariat Commercial Building"

Under

PUBLIC WORKS DEPARTMENT (PWD)

Supriya Kumari (22024146)

Enrollment no. :- GGV/22/0146

B.Tech VII Semester

Session 2025-26

Submitted to:-

DEPARTMENT OF CIVIL ENGINEERING

SCHOOL OF STUDIES OF ENGINEERING & TECHNOLOGY
GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.)

Bilaspur (C.G.) 495009

(Established under the Central Universities Act No. 25 of 2009)

Accredited with NAAC A++

font mismatch

late submission
25 AUG 25

OFFICE OF THE ASSISTANT ENGINEER, P.W.D. SUB DIVISION CITY SIKAR
No 100

19/6/25

TO WHOM IT MAY CONCERN

This is to Certify that Miss. Supriya Kumari (B.Tech) student of Guru Ghasidax University Bilaspur Chhatisbgarh has undergone a vocational/Practical training and completed the same successfully with effect from 16.05.2025 to 15.06.2025.

During the training Period Miss. Supriya Kumari gathered experiences in different type of PWD Building works at active site.

We wish him all the best for his Bright Future.


(S.K. Choudhary)
(असिस्टेंट ए.ई.सी.)
P.W.D. Sub Division, Sikar
सा.नि.वि. उपखण्ड ग्राम, सीकर

Abstract

This report documents the details of my one-month internship undertaken at the Mini Sachivalaya Building construction site in Sikar, Rajasthan, under the guidance of the Public Works Department (PWD), Government of Rajasthan, from 16th May to 15th June. The objective of the internship was to bridge the gap between theoretical knowledge and real-time field experience in civil engineering and project management. The Mini Sachivalaya Building is a multi-storeyed RCC-framed public administrative structure designed to house various government departments and offices. It is being constructed using modern construction practices while ensuring compliance with relevant IS codes and PWD specifications. The structure comprises multiple floors (G+2), with components such as office rooms, waiting lounges, service areas, corridors, and washrooms, all designed for high public utility. During the course of the internship, I was actively involved in observing and understanding several critical construction activities. These included:- Site surveying and layout marking. Excavation and PCC work for foundation. Reinforcement cutting, bending, and placing as per structural drawings. Concreting using mix design and quality control measures. Brick masonry and plastering work.



गुरु घासीदास विश्वविद्यालय, बिलासपुर
केंद्रीय विश्वविद्यालय अधिनियम 2009 संख्या 25, 2009 द्वारा केंद्रीय विश्वविद्यालय
Guru Ghasidas Vishwavidyalaya, Bilaspur
A Central University established by the Central Universities Act 2009 No. 25 of 2009

A COMPREHENSIVE TRAINING REPORT

"INTERNSHIP REPORT ON SITE SUPERVISION AND QUALITY CONTROL IN HIGHWAY CONSTRUCTION: A CASE STUDY OF NH-32 PROJECT, PURULIYA"

DINESHCHANDRA R. AGRAWAL INFRACON PVT. LTD
(6 WEEKS)

Submitted by

Tarun Kumar

Enrolment No.: GGV/22/01047

4th Year, 7th Semester

Session: 2025-26

Submitted to:

DEPARTMENT OF CIVIL ENGINEERING

School of Studies, Engineering & Technology

GURU GHASIDAS VISHWAVIDYALAYA

Bilaspur (C.G.) 495009

A CENTRAL UNIVERSITY

(Established under the Central Universities Act 2009 No.25 of 2009)

Accredited with NAAC A⁺⁺

[Signature]
18 AUG 25

[Signature]
18.8.25

[Signature]

[Signature]



Dineshchandra R. Agrawal
Infracon Pvt. Ltd.
Infrastructure Builder

401, The Grand Mall, S.M. Road, Ambawadi, AHMEDABAD - 380015, Gujarat, INDIA
Phone : 91-79-30008789, 26309789, Fax : 91-79-40022556
E-mail : drainfra89@gmail.com / draiplcorpe@gmail.com Website : www.draipl.com

INTERNSHIP CERTIFICATE

This is to certify that Mr. Tarun Kumar, a student of Guru Ghasidas Vishwavidyalaya, has successfully completed a one-month internship from 20/05/2025 to 30/06/2025 at Dineshchandra R. Agrawal Infracon Pvt. Ltd., assigned to the NH-32 Highway Project.

He served as a Site Supervision Trainee, gaining exposure to highway & structures construction practices, site management, and quality control procedures.

We found him sincere and eager to learn. We wish him all the best for his future endeavors.

Date: 31/06/2025

Place: Puruliya (West Bengal)



[Signature]

Engineer / Internship Coordinator

Dineshchandra R. Agrawal Infracon Pvt. Ltd.

Regional Office : Dineshchandra R. Agrawal Infracon Pvt. Ltd., 2nd Floor, Premises no. 01-0676, Office No - 205-206, Eco Suite Business Tower, Plot No. IID 22, Block No IID, Street No. 676-775, Newtown, Kolkata- 700157, West Bengal

Project Office : Vill- Kourang, KM Stone - 110+815, NH-32, P.O - Puara, Kantadih, PS - Arsha, Dist - Purulia, Pin - 723163, West Bengal

ABSTRACT

This report presents a comprehensive summary of the six-week internship undertaken at Dineshchandra R. Agrawal Infracon Pvt. Ltd., focusing on the NH-32 Highway Project in Puruliya, West Bengal. As a Site Supervision Trainee, the primary goal was to gain practical exposure in highway and structural construction practices, site management operations, and quality control procedures. The internship emphasized two key technical components: Field Density Test (FDD) using the sand replacement method for subgrade and GSB compaction verification, and Bituminous Concrete (BC) laying, involving mix design, layer placement, and surface compaction. Throughout the six-week period, I was actively involved in activities such as site orientation, safety enforcement, material testing, bitumen mix monitoring, documentation of Daily Progress Reports (DPR), and technical inspections. The training enhanced my understanding of IS and IRC standards, MoRTH specifications, and the collaborative dynamics between quality control, execution, and site supervision teams. This internship served as a bridge between academic learning and professional field experience, helping me build a strong foundation in technical procedures, site operations, and communication skills necessary for a future career in civil infrastructure development.



गुरु घासीदास विश्वविद्यालय, बिलासपुर
Guru Ghasidas Vishwavidyalaya, Bilaspur
A Central University established by the Central Universities Act 2009 No. 25 of 2009

A COMPREHENSIVE TRAINING REPORT

Road construction and maintainence at NH-130

[UNO ROBOTICS TECH & RESEARCH PVT. LTD.]

[16TH MAY 2025 - 15TH JUNE 2025]

UDIT KUMAR NISHAD

22024148

[2022 -2026]

[7TH SEMESTER]

Session 2025-26

Submitted to:

DEPARTMENT OF CIVIL ENGINEERING

School of Studies, Engineering & Technology

GURU GHASIDAS VISHWAVIDYALAYA

Bilaspur (C.G.) 495009

A CENTRAL UNIVERSITY

(Established under the Central Universities Act, 2009 No.25 of 2009)

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Ref No: UNO/1010

Date: 14/06/2025

TRAINING CERTIFICATE

This is to certify that Mr. UDIT KUMAR NISHAD (Roll No: 22024148), a student of 6th Semester, B.Tech in the Department of Civil Engineering, School of Studies of Engineering and Technology, Guru Ghansidas Vishwavidyalaya, Bilaspur (C.G.), has successfully completed his Vocational Training from 16th May 2025 to 15th June 2025.

During this period, he was found to be punctual, hardworking, and eager to learn. He has gained valuable practical knowledge and experience in the field related to his academic-curriculum.

We wish him all the best in his future endeavors

UNO ROBOTICS
TECH & RESEARCH PVT. LTD.
Sury Kant
DIRECTOR

New Sarkanda, Krishna Complex, Flat No.- 200, Bilaspur (C.G.) 495001

unoroboticspvtltd@gmail.com

20 Days

ABSTRACT

During my civil engineering internship, I had the opportunity to visit a live construction site and observe various practical aspects of the field. This internship helped me understand how different civil works are carried out in real life, which I had only studied in theory before. I learned about site supervision, material handling, and the step-by-step process of construction. I observed how mix designing of concrete is done to achieve the required strength and quality for different structural elements. I also gained knowledge about pavement design and how roads and base layers are prepared before final surfacing.

Additionally, I learned about foundation works, reinforcement placement, curing of concrete, and the importance of safety measures on site. Seeing the use of construction machinery and tools in real-time gave me a better understanding of project execution. This internship improved my practical knowledge and made me more confident in understanding how civil engineering projects are planned and completed on-site.



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Guru Ghasidas Vishwavidyalaya, Bilaspur

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A COMPREHENSIVE TRAINING REPORT

"PREDICTING WATER SURFACE ELEVATION IN
COMPOUND CHANNELS:
A COMPARATIVE STUDY USING GAUSSIAN PROCESS
REGRESSION AND EXTREME LEARNING MACHINE"

NATIONAL INSTITUTE OF TECHNOLOGY, PATNA, BIHAR
(6 WEEKS)

Submitted by

Vishal Kumar

Enrolment No.: GGV/22/01049

4th Year, 7th Semester

Session: 2025-26

Submitted to:

DEPARTMENT OF CIVIL ENGINEERING

School of Studies, Engineering & Technology

GURU GHASIDAS VISHWAVIDYALAYA

Bilaspur (C.G.) 495009

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जनपदीय अभियांत्रिकी विभाग/ CIVIL ENGINEERING DEPARTMENT
राष्ट्रीय प्रौद्योगिकी संस्थान पटना/ NATIONAL INSTITUTE OF TECHNOLOGY PATNA

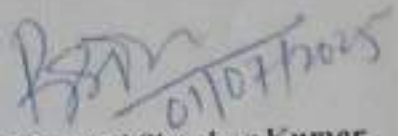
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शिक्षा सचालय, भारत सरकार के अधीन एक राष्ट्रीय महत्व का संस्थान/ An Institute of National Importance under Ministry of Education, Govt. of India
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दिनांक/ Date: 01/07/2025

संदर्भ/Ref.:CED/004

CERTIFICATE

This is to certify that **Mr. Vishal Kumar** (Roll No. 22024149), a student of Civil Engineering Department, Guru Ghasidas Vishwavidyalaya, Bilaspur, Chhattisgarh, has successfully completed his internship work on the topic of "**Predicting Water Surface Elevation in Compound Channels: A Comparative Study Using Gaussian Process Regression and Extreme Learning Machine**" dated from 19/05/2025 to 30/06/2025, in the Department of Civil Engineering, National Institute of Technology (NIT) Patna, under the supervision of Dr. Bhabani Shankar Das. During this internship work, the student has performed the machine modeling activity related to water surface elevation estimation in compound channel in which he learned about different ML models, statistical error analysis, and conference paper writing skill.


Dr. Bhabani Shankar Kumar

Assistant Professor
Dept. of Civil Engineering,
National Institute of Technology Patna
Patna- 800005, Bihar (India)

सहायक प्राध्यापक/Assistant Professor
जनपदीय अभियांत्रिकी विभाग
Civil Engineering Department
राष्ट्रीय प्रौद्योगिकी संस्थान पटना-5
National Institute of Technology Patna-5

Abstract

Accurate prediction of water surface elevation (WSE) in compound channels is essential for effective flood risk management. This study investigates two machine learning techniques Gaussian Process Regression (GPR) and Extreme Learning Machine (ELM) to model WSE in diverging compound channels using laboratory data and published datasets. The input features include hydraulic and geometric parameters such as divergence angle, relative depth, aspect ratio, and width ratio. GPR, with optimized kernel functions, achieved exceptional predictive accuracy and provided uncertainty quantification through confidence intervals. In contrast, ELM offered faster training but lower precision, making it suitable for real-time applications where speed is critical. The models were evaluated using standard performance metrics and visualization tools. Findings suggest that GPR serves as a high-fidelity benchmark, while ELM offers a practical trade-off for rapid forecasting. These insights can enhance adaptive flood forecasting in complex, non-prismatic river channels.



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केंद्रीय विश्वविद्यालय अधिनियम 2009 संख्या 25, 2009 द्वारा केंद्रीय विश्वविद्यालय
Guru Ghasidas Vishwavidyalaya, Bilaspur
A Central University established by the Central Universities Act 2009 No. 25 of 2009

A COMPREHENSIVE TRAINING REPORT

Upgradation of Rajasthan-P.W.D Sub. Division Mandawar

Public Works Department

Mandawar(Rajasthan)

45 Days Vocational Training

Vivek Kumar Meena

(GGV/22/01050)

2022-26 & 7th semester

Session: 2025-26

Submitted to:

DEPARTMENT OF CIVIL ENGINEERING

School of Studies, Engineering & Technology

GURU GHASIDAS VISHWAVIDYALAYA

Bilaspur (C.G.) 495009

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DECLARATION BY THE STUDENT

I, **Vivek Kumar Meena**, a student of **B.Tech, Department of Civil Engineering, Guru Ghasidas Vishwavidyalaya**, hereby solemnly declare that the report entitled “**P.W.D SUB. Division Mandawar Mahwa Rajasthan**” is a genuine and original record of the industrial training/internship undertaken at **Public Works Department** during the period from **16/05/2025 to 30/06/2025(45 days)**.

The work presented in this report is entirely my own and has not been copied, reproduced, or submitted elsewhere for any academic or professional purpose. I affirm that:

- All information and observations recorded were made during my tenure at the above-mentioned organization.
- No part of the report has been plagiarized or duplicated from any other source.
- Proper references and acknowledgments have been made wherever external information has been consulted.

I understand that any violation of this declaration may result in academic or disciplinary action as per the rules and regulations of the institution.

Place: Mahwa

Date: 4/08/2025

Signature of the Student

Name: Vivek Kumar Meena

Enrollment No.: GGV/22/01050

ACKNOWLEDGEMENT

I sincerely thank my mentor, **Executive Engineer, Shri. Chandraprakash Pandey**, for his invaluable guidance and support throughout the course of this industrial training. I am grateful to the entire team at **Public Works Department** for their mentorship, cooperation, and the opportunity to gain hands-on experience in the field.

I extend my heartfelt appreciation to our **Hon'ble Dean, Prof. Sharad Chandra Srivastava** and the **Head of the Department, Prof. M. Chakradhara Rao**, and all concerned faculty members of the Department of Civil Engineering, Guru Ghasidas Vishwavidyalaya, for their continuous encouragement.

Lastly, I am thankful to the **Central Training & Placement Cell** for facilitating and coordinating this training initiative, which has greatly contributed to my professional development.

Name: Vivek Kumar Meena

Enrollment No.: GGV/22/01050

OFFICE OF THE ASSISTANT ENGINEER PWD SUB-DN-MANDAWAR

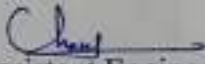
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DATE: 02.07.2025

CERTIFICATE

It is certified that Mr. Vivek Kumar Meena S/o Sh. Rambharosi Meena B-Tech. Civil Student of Guru Ghasidas Vishwavidyalaya Bilaspur has attended Practical Training under P.W.D Sub.Division Mandawar From 16.05.2025 to 30.06.2025 (45 Days)

His over all performance during the training period is excellent. I wish him for bright future.


Assistant Engineer
PWD Sub.Dn.- Mandawar

ABSTRACT

This report summarizes a one-month summer internship focused on the upgradation of National Highway 130A. Conducted under the supervision of the Public Works Department (PWD) SUB Division mandawar, the training provided an immersive experience into the practical application of civil engineering principles. The primary objective was to gain hands-on knowledge of road construction, quality control, and project management within a government infrastructure project. The report contains the development process of the highway project, up, **P.W.D SUB. Division Mandawar Mahwa Rajasthan**, having total length of 25.695 km.

The internship involved observation and participation in construction stages. A significant portion of the training was dedicated to understanding and assisting in on-site quality control tests for materials such as soil, aggregates, and bitumen, ensuring adherence to Indian Standard codes like IS 456. Furthermore, the experience offered insight into the administrative aspects of the project, including project documentation, progress reporting, and team coordination.

In addition to technical skills, the internship fostered the development of essential soft skills, including effective communication, teamwork, and a heightened sense of professional punctuality and observation. This practical exposure has been invaluable, bridging the gap between theoretical knowledge and professional practice and has reinforced a strong understanding of highway engineering principles.

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INTRODUCTION

1.1 PURPOSE OF TRAINING

The purpose of this summer internship is to provide a hands-on learning experience for civil engineering students. The training aims to bridge the gap between theoretical knowledge gained in academics and the practical application of civil engineering principles in real-world road construction and maintenance projects. The internship will focus on exposing students to the various stages of project execution, quality control, and administrative procedures within a government-led infrastructure organization.

1.2 COMPANY OVERVIEW

The Public Works Department (PWD) is a key government department responsible for the planning, construction, and maintenance of public infrastructure. The PWD Mandawar division operates under the larger framework of the Rajasthan state PWD. Its primary role is to execute civil works projects within the Dausa district and surrounding areas, as directed by the state government.

The department's core functions include:

- **Planning and Execution:** Developing and implementing plans for various construction projects.
- **Maintenance and Repair:** Ensuring the upkeep and repair of existing infrastructure to maintain its quality and safety.
- **Advisory Role:** Providing technical advice to the state government on matters related to civil works and infrastructure development.

The division's activities are crucial for the region's development, as they directly contribute to improving connectivity, public facilities, and overall quality of life.

1.3 ORGANISATIONAL STRUCTURE

The organizational structure of the PWD, including its Mandawar division, follows a hierarchical model common in government departments. The structure is designed to facilitate the efficient flow of authority and responsibility from the top to the project level.

The general hierarchy is as follows:

- **Chief Engineer:** The Chief Engineer is the head of a zone, such as the Mandawar Zone, and is responsible for controlling the activities of multiple circles.
- **Superintending Engineer:** Circles are under the charge of Superintending Engineers. The Mandawar Circle is led by a Superintending Engineer who oversees several divisions.
- **Executive Engineer (Divisional Officer):** The Mandawar division is headed by an Executive Engineer. This officer is responsible for managing all aspects of the division's work, including finance, administration, and project execution.
- **Assistant Engineer (Sub-divisional Officer):** Divisions are further divided into sub-divisions, each managed by an Assistant Engineer. They report to the Executive Engineer and are directly involved in the day-to-day supervision of projects.
- **Sub-Engineer:** Sub-Engineers work under the Assistant Engineers, carrying out on-site supervision, measurements, and other technical tasks.

1.4 MAJOR PROJECTS UNDERTAKEN

The PWD Mandawar division is involved in a range of infrastructure projects, primarily focusing on roads, bridges, and government buildings. Based on available public records and government tender information, some of the major projects and types of work include:

- **Road Construction and Rehabilitation:** A significant portion of the PWD's work involves the construction, widening, and rehabilitation of roads. The division is also responsible for the general maintenance and repair of various roads within its jurisdiction.

- **Bridge Construction:** The division undertakes the construction of new bridges and the repair of existing ones to improve connectivity and facilitate transport across rivers and other obstacles.
- **Construction of Government Buildings:** This includes the construction of various public facilities, such as government colleges, offices, and residential quarters.
- **ADB-funded Projects:** The Mandawar division has been involved in projects funded by organizations like the Asian Development Bank (ADB), which focus on large-scale infrastructure development, particularly road projects. For example, a "Rajasthan Road Development Project" under the ADB has been executed by the PWD Mandawar.
- **Sports Infrastructure:** The PWD Mandawar division has also been responsible for projects related to sports infrastructure, such as the construction of synthetic athletic tracks and other facilities at a state-level sports training Centre.

1.5 TRAINING OBJECTIVES

By the end of the summer internship, we will be able to:

- Understand the standard procedures for road construction, including earthwork, sub-base, base course, and pavement laying.
- Identify and understand the function of various construction materials and equipment used on site.
- Learn about quality control measures and tests for materials like soil, aggregate, and bitumen.
- Familiarize themselves with project documentation, including daily progress reports, measurement books, and material procurement records.
- Gain an appreciation for the safety protocols and environmental regulations followed on a government project site.

PROJECT INFORMATION

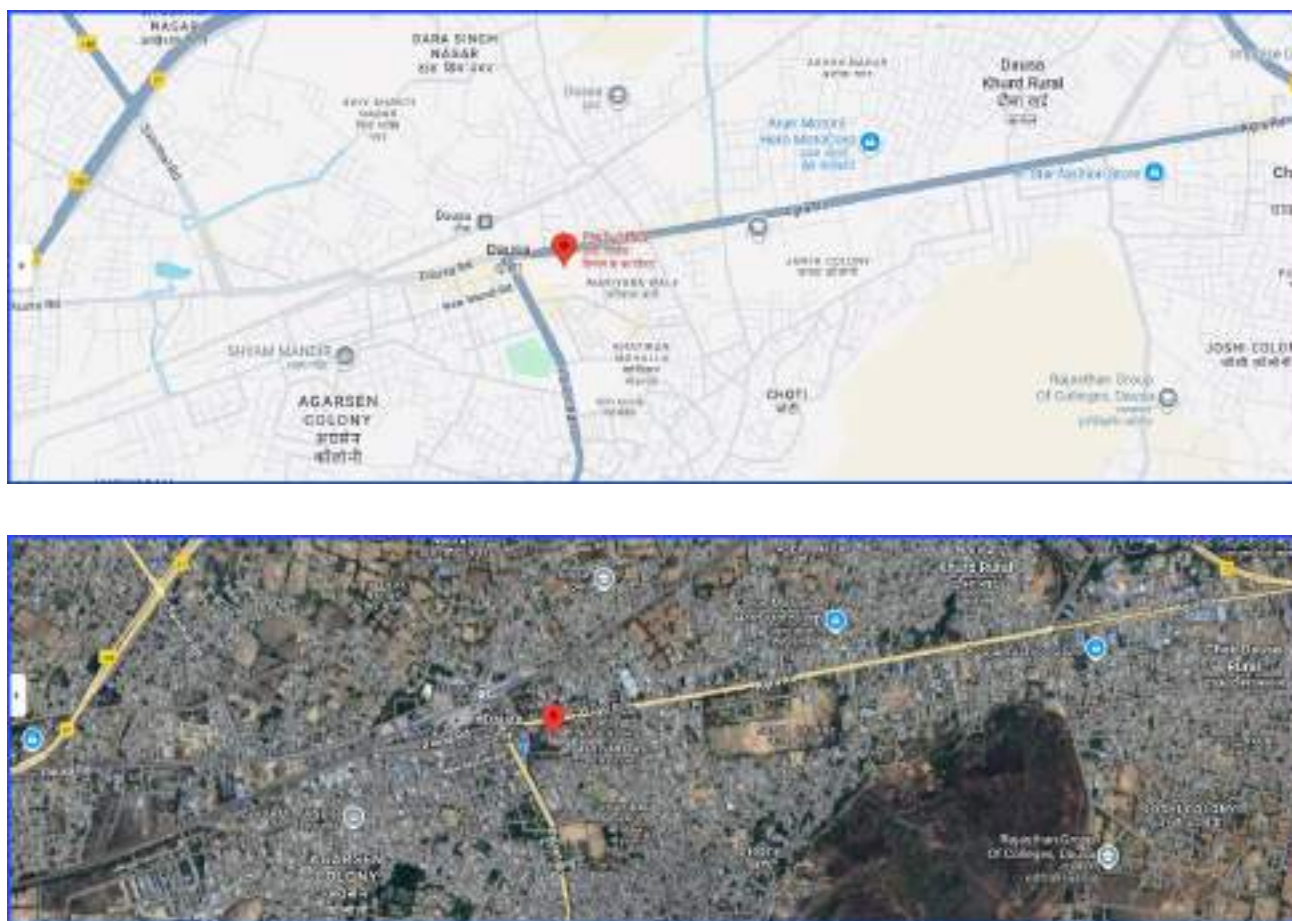
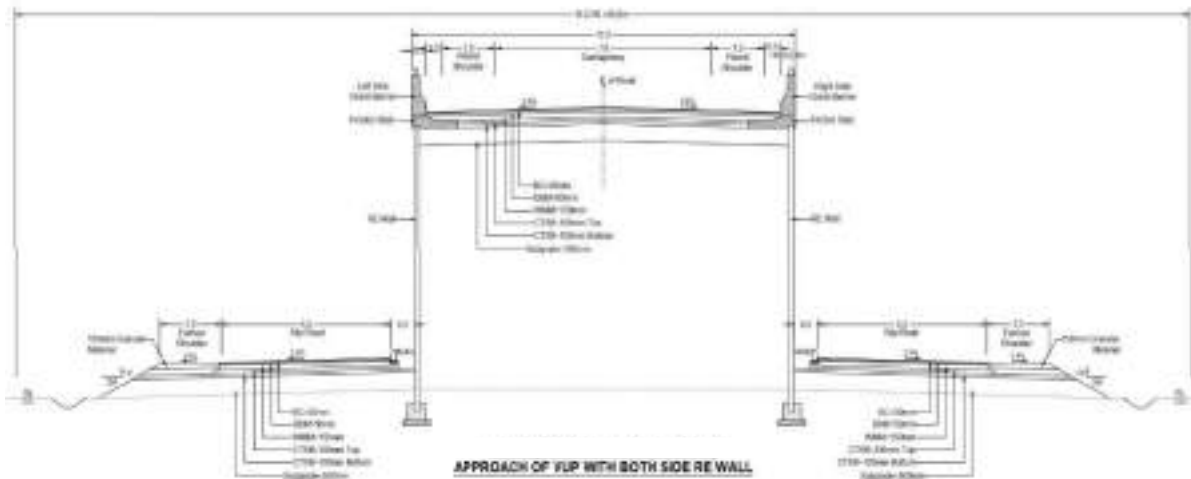


Fig. 2.1 Highway route

2.1 SUMMARY OF THE PROJECT

Name of Project	Upgradation of P.W.D SUB. Division Mandawar Mahwa in the state of Rajasthan Two/Four with Paved Shoulder Configuration from Ch: 18.700 to Ch: 25.900(Mahwa road), Ch: 39.600 to Ch: 51.600 (Mahwa road), Ch: 77.900 to 81.000 Mahwa road) and Ch: 97.000 to Ch: 100.395(Mahwa road).
Scheme phase	Corridor scheme
Mode of execution	EPC
No.of lanes	2 lane with paved shoulder
Length of project	25.695 km
Total project cost	351.19 Cr.
Total civil project cost	174.53 Cr.
No. of major bridge	3
Toll plaza	Nil
No. of Bypass	4
Contractor name	Chandraprakash Pandey
Date of agreement	05.04.2023 Agreement No.-R070276
Appointed date	24.01.2024
Construction period	1 year 6 months
Date of Complition	-
Provisional COD Date	-

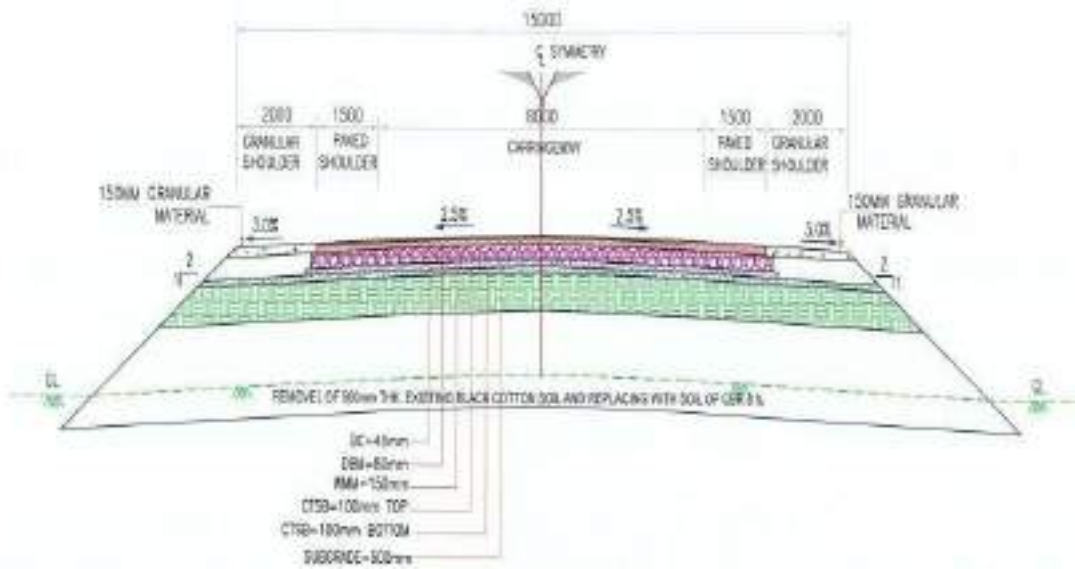
2.2 DETAILS OF HIGHWAY PROJECT



SCHEDULE OF TYPICAL CROSS SECTIONS (TCS)

S. No.	Design Chainage		TCS Type	Length
	From	To		
TAKHATPUR BYPASS				
1	18680	21280	TCS-1	2600
2	21280	21330	TCS-2	50
3	21330	21490	Major Bridge	160
4	21490	21540	TCS-2	50
5	21540	25880	TCS-1	4340
MUNGELI BYPASS				
6	39600	46130	TCS-1	6530
7	46130	46180	TCS-2	50
8	46180	46200	Minor Bridge	20
9	46200	46250	TCS-2	50
10	46250	46436	TCS-1	186
11	46436	46676	TCS-3	240
12	46676	46688	WJP	12
13	46688	46928	TCS-3	240
14	46928	47080	TCS-1	152
15	47080	47130	TCS-2	50
16	47130	47170	Minor Bridge	40
17	47170	47220	TCS-2	50
18	47220	47610	TCS-1	390
19	47610	47660	TCS-2	50
20	47660	47780	Major Bridge	120
21	47780	47830	TCS-2	50
22	47830	50246.5	TCS-1	2416.5
23	50246.5	50296.5	TCS-2	50
24	50296.5	50321.5	Minor Bridge	25
25	50321.5	50371.5	TCS-2	50
26	50371.5	51600	TCS-1	1228.5
PANDARIYA BYPASS				
27	72900	79099	TCS-1	1199
28	79099	79149	TCS-2	50
29	79149	79189	Minor Bridge	40
30	79189	79239	TCS-2	50
31	79239	80370	TCS-1	1131
32	80370	80420	TCS-2	50
33	80420	80530	Major Bridge	110
34	80530	80580	TCS-2	50
35	80580	81000	TCS-1	420

APPROACH TO 2-LANE BRIDGE



APPROACH OF VUP WITH BOTH SIDE RE WALL

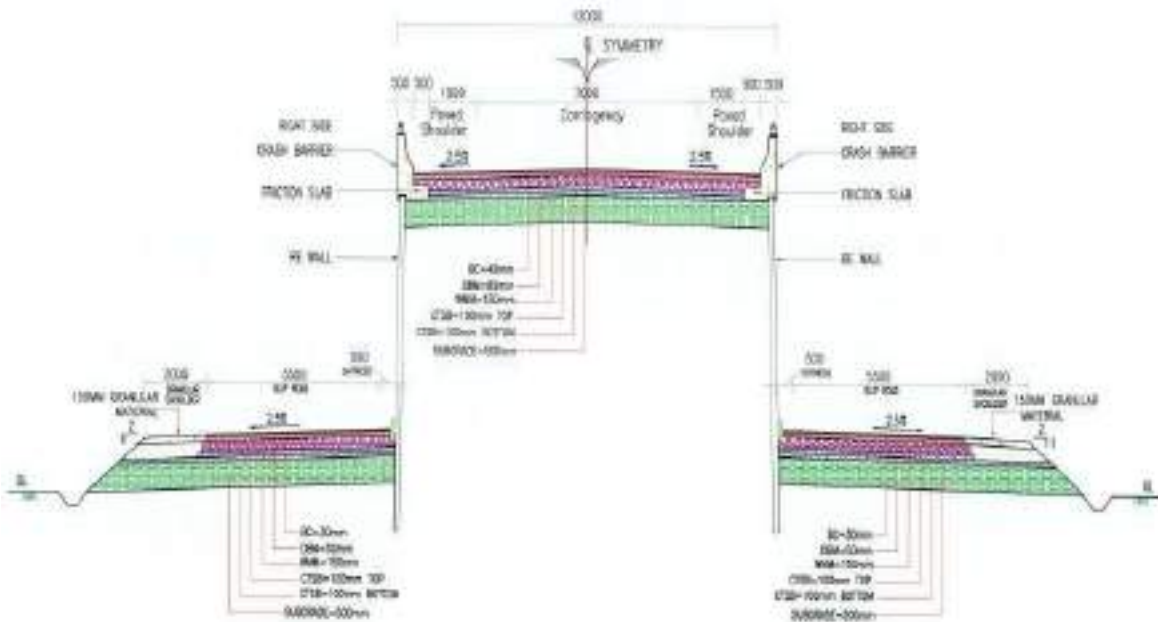


Fig. 2.2 Road Profile

MACHINERY AND EQUIPMENTS

Some of the construction equipment /machines which I came across during my internship period include the following among others:

1. EXAVATING MACHINE:

This is among the function of a bulldozer plant,primarily used to excavate rocks and soil in the site, for drainage excavation, also used in loading loose materials.



2. ROLLER/COMPACTION MACHINE:

This machine is designed to consolidate filling materials to compact surface finishes. Roller vibrators are also used for compaction and consolidation of granular soil in the site.

3. LORRIES/TRUCK:

These are used for transporting the site aterials. Materials such as aggeregates, excavated material, GSB, WMM, DBM,etc. are transported to and away from site with these.

4. TIPPER:

This is a truck that is used for the conveying of materials to be used on site such as asphalt, stone-base, sand, etc.

5. GRADER:

A grader, also known as a motor grader or road grader, is a heavy construction machine used to create flat and level surfaces. Its main feature is a long blade located between the front and rear axles, which can be adjusted to different angles and depths to cut, shape, and spread materials.



6. PAVER:

A paver, also known as an asphalt paver or paving machine, is a piece of construction equipment used to lay asphalt concrete or Portland cement concrete on roads, bridges, parking lots, and other surfaces. It is designed to lay the material flat and provide initial compaction before a road roller performs the final compaction.

7. RMC PLANT:

An RMC (Ready-Mix Concrete) plant is a sophisticated facility designed to produce concrete in a controlled, centralized environment. Unlike traditional on-site mixing, which can be

inconsistent, an RMC plant uses a computerized system to precisely measure and mix the raw materials—cement, water, sand, gravel, and chemical admixtures—according to a specific mix design. The final product, a "ready-to-use" mixture, is then transported to the construction site in a special truck known as a **transit mixer** or **concrete mixer truck**. These trucks are equipped with a rotating drum that keeps the concrete agitated during transit, preventing it from hardening and ensuring it remains in a workable state for placement.

8. AUTOLEVEL:

An auto level, also known as a dumpy level or an automatic level, is an optical surveying instrument used in construction and surveying to establish or verify points on the same horizontal plane. It is a fundamental tool for measuring differences in elevation, transferring heights, and setting up level surfaces.



TESTING INFORMATION

During the internship period we performed some test on materials that are necessary for the other stages. We had to do the following works:

- Identifying types of tests conducting at site or laboratory
- Identifying procedure of each test
- Carrying out the test conducted

1. SIEVE ANALYSIS:

This test was performed on GSB, WMM, aggregate in concrete , etc. and result of the percentage of passing material should lie between the MORTH acceptance limit.



SIEVE ANALYSIS					
SIEVE SIZE(MM)	WEIGHT RETAINED (GM)	% WEIGHT RETAINED	CUMULATIVE WT. %	%PASSING	MORTH ACCEPTANCE LIMITS
75	0	0	0	0	100
63	802	802	3.41	96.59	80-100
25	2833	9635	14.08	85.69	55-90
9.5	7626	11261	43.62	56.38	35-65
4.75	1910	13171	51.02	48.98	25-50
2.36	4901	20916	81.02	18.98	
0.006	2582	23498	91.07	8.93	
0.003	1375	24874	96.35	3.65	0-5
SAMPLE TAKEN =25817 GM					

2. TEST ON CEMENT:

- Initial and final setting time
- The fineness of cement by dry sieving
- Soundness test
- Field test

FINENESS OF CEMENT BY DRY SIEVING				
TEST NO.	WT. OF CEMENT TAKEN FOR TEST(A)	WT.OF CEMENT RETAINED ON SIEVE(B)	%FINENESS (C=B/A X100)	AVG.
1	100	2	2	2.5
2	100	2.5	2.5	
3	100	3	3	
TYPE OF CEMENT= OPC-43				

3. TEST ON CONCRETE:

- Workability by slum cone test
- Compressive strength of concrete.

Workability test performed on-site in the presence of independent engineer if test passes then we will go ahead with construction , if fails then all material should be thrown away.

The cube should fill on-site and after 21 days test will be performed, if cube fails then we have to break the structure.





COMPRESSIVE STRENGTH OF CONCRETE CUBES					
WEIGHT	VOLUME	DENSITY	MINIMUM LOAD	COMP. STRENGTH	AVG.
8878	3375	2.688	297	13.3	12.5
8808	3375	2.609	279	12.4	
8865	3375	2.68	268	11.91	
GRADE OF CONCRETE - M-15					

4. COMPACTION TEST ON THE SUBGRADE, GSB AND WMM:

It is done by sand replacement method in this we calculated field dry density (FDD) it should be between 97-100% for good compaction.

First we have to calculate maximum dry density and optimum moisture control in a laboratory then on-site by sand replacement method.

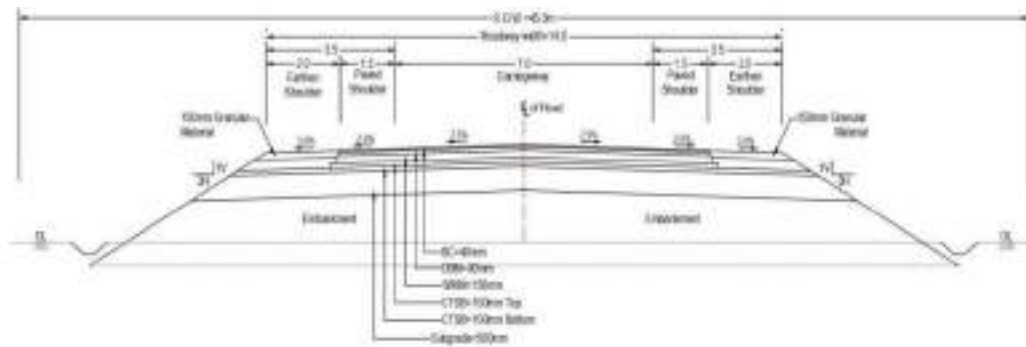


5. BITUMEN EXTRACTION TEST:

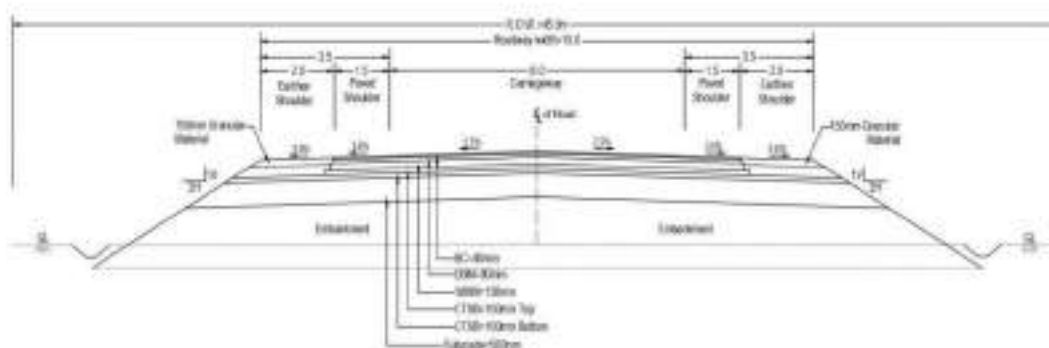
This test is used to determine the percentage of bitumen content present in the asphaltic pavement by cold solvent extraction. The properties of flexible pavement such as durability, compactibility, and resistance from bleeding, raveling, and aging of flexible pavement are majority dependent on the percentage of bitumen used with the aggregate to lay the pavement.



LAYERS OF ROAD



NEW CONSTRUCTION OF 2-LANE CARRIAGEWAY WITH PAVED SHOULDER



APPROACH TO 2-LANE BRIDGE

1. NATURAL GROUND LEVEL:

On which the pavement structure is laid on, if the organic materials are in excess first clearance of the site is necessary, first cleared, remove the top soil and excavate the soil. Deep removing of layer from 15 cm to 20 cm.

Capping layer is the layer in which if the subgrade materials are used of poor quality, then capping layer which is cheap, but strong one to be used to cap the weak sub grade. In this way the thickness of expensive sub grade is not required to be increased.

2. SUB - GRADE:

Laterite soil (murum) is used for the construction of the bottom most layer of the pavement,

i.e. subgrade which is the layer whose main function is to support the upper layers of the pavement and to provide the good drainage facility to the infiltrating rain water. It has to act as a single structure along with the other layers of pavement.

3. GRANULAR SUB-BASE LAYER:

A granular sub-base (GSB) is a critical layer in road construction, positioned directly on top of the subgrade (the prepared natural soil) and beneath the base course. As its name suggests, this layer is composed of granular materials, typically crushed stone, gravel, sand, or other hard, durable aggregates. The materials used for a granular sub-base are carefully selected and graded to meet specific requirements for strength, permeability, and compaction. It's laid in layers and heavily compacted to achieve a high density, which ensures its long-term performance and resistance to deformation.

4. WET MIX MACADAM:

WMM is a road-building material composed of a mixture of clean, crushed, well-graded aggregates (like stone and gravel) and a controlled amount of water. This mixture is prepared in a specialized plant (a "wet mix plant") to ensure a consistent and uniform blend. The mixed material is then transported to the construction site, spread evenly, and compacted to form a dense, strong, and stable layer.

5. PRIME COAT:

A prime coat is a thin layer of low-viscosity liquid asphaltic material applied to a prepared, non-bituminous granular base course (like a Wet Mix Macadam or a crushed stone sub-base) before the first layer of asphalt pavement is laid.

6. DENSE BOUND MACADAM:

Dense Bituminous Macadam (DBM) is a type of road-building material used for the binder or base course of flexible pavements, particularly on high-volume roads and highways. As its name implies, it is a dense, high-quality mix that is bound together with a significant amount of bitumen.

DBM is known for its high strength, durability, and resistance to deformation and cracking. The low void content (typically 3-5%) makes it highly impermeable, preventing water from reaching the lower layers and causing damage. This makes it suitable for roads with heavy commercial vehicle traffic and in areas with a wide range of temperature and weather conditions.

7. BITUMINOUS CONCRETE MIX:

Bituminous concrete, often referred to as asphalt concrete or simply "asphalt," is a high-quality, hot-mixed construction material widely used for the final wearing surface of roads, airports, and parking lots. It is the topmost layer of a flexible pavement and is designed to provide a smooth, durable, and skid-resistant riding surface.

8. SEAL COAT:

A seal coat, also known as a pavement seal or surface dressing, is a protective layer applied to the surface of an existing road. Unlike a prime coat which prepares a new granular base, a seal coat is a maintenance treatment designed to protect and extend the life of an existing asphalt or bituminous surface.

CONSTRUCTION OF CULVERT

A culvert is a structure, typically a tunnel, that allows water to flow under a road, railway, or other obstruction. It is a crucial part of infrastructure, designed to manage water flow, prevent flooding, and maintain the integrity of the surrounding infrastructure. Culverts can be made from various materials like concrete, steel, or plastic and come in different shapes, including round, box, and arch.

The construction of a culvert is a systematic process that begins with meticulous planning and site preparation. Following a detailed survey, the site is cleared of all vegetation and the required trench is excavated. The subgrade at the bottom of this trench is then leveled and compacted to create a stable foundation. A bedding layer of granular material is placed and shaped to provide uniform support for the culvert itself. The culvert sections are then carefully lowered into the trench, aligned to the correct slope, and securely joined to prevent leaks. The most critical step is backfilling, where suitable material is placed in compacted layers simultaneously on both sides of the culvert to ensure it is securely held in place and to prevent future settlement. Finally, headwalls and wing walls are constructed at the inlet and outlet to protect the embankment from erosion and guide water flow, completing the process.



Fig. 6.1 Culvert Design

OBSERVATION AND REFLECTIONS

1. EXPERIENCE GAINED:

My summer training, which spanned nearly a month, provided an invaluable, hands-on experience in the field of civil engineering, specifically focusing on the upgradation of National Highway. The training was a deep dive into the practical aspects of road construction and project management, far beyond the scope of textbook knowledge. Here's a detailed account of the experience and the key skills and insights I gained:

- **Project Understanding and Planning:** I gained a comprehensive understanding of a large-scale government infrastructure project. I learned about the multi-faceted process of project initiation. I was able to correlate the theoretical phases of a project lifecycle with the real-time activities on the ground.
- **On-Site Execution and Construction Techniques:** I was directly involved in observing and understanding various stages of highway construction. This included:
 - **Earthwork and Subgrade Preparation:** I learned about soil testing, compaction techniques, and the importance of achieving the required density for a stable foundation.
 - **Sub-base and Base Course Laying:** I gained practical knowledge of laying and compacting granular sub-base (GSB) and wet mix macadam (WMM). I understood the role of these layers in distributing the load and preventing pavement failure.
 - **Pavement Technology:** I observed the process of Prime Coat and Tack Coat application, followed by the laying of Dense Bituminous Macadam (DBM) and Bituminous Concrete (BC). I learned about the importance of maintaining the correct temperature and rolling pattern to achieve a durable and smooth surface.
 - **Drainage Systems:** I witnessed the construction of side drains, culverts, and cross-drainage structures, understanding their critical role in preventing waterlogging and ensuring the longevity of the road.
- **Quality Control and Material Testing:** One of the most significant takeaways was the importance of rigorous quality control. I spent a considerable amount of time at the site

laboratory and on the field, where I learned to perform and understand various tests:

- **Field Density Test (Core Cutter & Sand Replacement Method):** I assisted in measuring the compaction of the soil and sub-base layers.
- **Aggregate Tests:** I learned about the tests for aggregate properties like crushing value, impact value, and abrasion value.
- **Bitumen Tests:** I observed tests for penetration, ductility, and softening point of bitumen, understanding their importance in selecting the right grade for different climatic conditions.
- **Daily Quality Assurance:** I learned how to fill out the Quality Assurance and Quality Control (QA/QC) checklists and understand the documentation process for ensuring that all work meets the specified standards.
- **Project Management and Documentation:** Beyond the technical aspects, I was exposed to the administrative side of a PWD project.
 - **Measurement and Billing:** I shadowed the engineers as they took measurements of the completed work, which are recorded in the Measurement Book (MB). This gave me an insight into the process of contractor billing and payment.
 - **Daily Progress Reports:** I learned how to prepare and analyze daily progress reports, which are crucial for tracking the project's timeline and identifying potential delays.
 - **Communication and Coordination:** I observed how engineers communicate with contractors, laborers, and other stakeholders to resolve on-site issues and ensure smooth workflow.
- **Safety and Environmental Awareness:** The training instilled in me a strong sense of safety protocols. I learned about the importance of using Personal Protective Equipment (PPE) and the need for proper signage and traffic management on a live highway project. I also gained awareness of the environmental regulations, such as dust control measures and the proper disposal of construction waste.

2. SKILLS ACQUIRED:

- **Good Communication:** I improved my ability to clearly convey technical information and project updates to team members, supervisors, and on-site workers.
- **Leadership:** I took initiative in specific tasks, guided fellow interns, and helped organize on-site activities to ensure smooth workflow.
- **Punctuality:** I understood the critical importance of adhering to schedules and deadlines, both for personal work and for the overall project timeline.
- **Observation:** I developed a keen eye for detail, allowing me to spot potential issues on the construction site and understand the nuances of various engineering processes.
- **Teamwork:** I collaborated effectively with a diverse group of engineers and workers, contributing to a cohesive team environment to achieve project goals.

CONCLUSION

This summer internship was a transformative and great educational experience. The practical exposure gained on a live project site, under the guidance of experienced PWD engineers, was instrumental in bridging the gap between my academic knowledge and its real-world application.

I not only gained a solid understanding of highway construction techniques, quality control measures, and project management principles but also learned some crucial soft skills. My ability to communicate effectively, lead small tasks, maintain punctuality, make keen observations, and work as a cohesive team member was significantly enhanced.

This internship has solidified my passion for civil engineering and provided me with the confidence and foundational skills necessary to pursue a successful career in infrastructure development. It was an invaluable month of learning, growth, and professional development that will undoubtedly shape my future endeavors in the field.

APPENDICES



-: Kamalpur, Rajasthan India

Rajasthan India Kamalpur

Lat 22.11615 long 81.276306

17/06/2025 02:31pm GMT +5:30



-: Kamalpur, Rajasthan India

Rajasthan India Kamalpur

Lat 22.1636155 long 81.44363065

17/06/2025 03:31pm GMT +5:30

CODES AND MANUALS:

- IS 456: Plain and Reinforced Concrete — Code of Practice.
- IS 10262: Concrete Mix Proportioning — Guidelines.
- SP 34: Handbook on Concrete Reinforcement and Detailing.
- MORTH: Ministry of Road Transport & Highways.



गुरु घासीदास विश्वविद्यालय, बिलासपुर

केन्द्रीय विश्वविद्यालय अधिनियम 2009 संख्या 25, 2009 द्वारा केन्द्रीय विश्वविद्यालय

Guru Ghasidas Vishwavidyalaya, Bilaspur

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A COMPREHENSIVE TRAINING REPORT

“CIVIL CONSTRUCTION: BUILDINGS AND ROADS”

PUBLIC WORKS DEPARTMENT

Duration of Training : 30 Days

Harsh Vardhan Banjare

GGV/23/01049

2022-2026 & VIIth Semester

Session 2025-26

Submitted to:

DEPARTMENT OF CIVIL ENGINEERING

School Of Studies, of Engineering and Technology

GURU GHASIDAS VISHWAVIDYALAYA

Bilaspur (C.G.) 495009

A CENTRAL UNIVERSITY

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ABSTRACT

This report presents an overview of the industrial training undertaken at the Public Works Department (PWD), aimed at bridging the gap between theoretical knowledge and practical field experience. The training provided a comprehensive exposure to civil engineering practices, including construction management, site supervision, estimation, and quality control. Trainees were involved in a variety of ongoing projects such as road construction, public building maintenance, drainage systems, and rural infrastructure development. Through on-site observations and interactions with engineers and contractors, a deeper understanding of government procedures, tendering processes, and project execution was gained. The program emphasized the importance of planning, resource allocation, and adherence to safety and environmental standards. Additionally, trainees were introduced to relevant software tools and documentation methods used in public sector projects. This hands-on experience significantly enhanced our technical competence and provided insights into the administrative functions and responsibilities of the PWD. Overall, the training served as a valuable foundation for future professional growth in the field of civil engineering.

PUBLIC WORK DEPARTMENT

Memo No. 3970

Dhamtari Date 03/07/2025



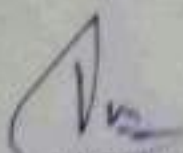
TO WHOMSOEVER IT MAY CONCERN

This is to Certify That Mr. HARSH VARDHAN BANJARE Studying in GURU GHASIDAS VISHWAVIDYALAYA BILASPUR in Civil Engineering 6th semester has Taken training at PUBLIC WORKS DEPARTMENT DIVISION DHAMTARI for 30 DAYS in construction of building & road work Under P.W.D. DIVISION DHAMTARI.

His Enthusiasm towards work is great and he was dedication for all the work given.

wishing him a Great Future.

Ref :- As per your letter no. 148/CS/SOS,E&T/GGV/BSP/2025


Sub Engineer
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Dhamtari


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P.W.D. Sub-Division
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