FINAL YEAR PROJECTS

FYP

ABSTRACTS BOOK

2024

DEPARTMENT OF

CIVIL ENGINEERING

UNIVERSITY OF ENGINEERING & TECHNOLOGY, LAHORE

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FINAL YEAR PROJECTS

FYP

ABSTRACTS BOOK

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PREFACE

The ***Library Student Advisory Committee*** (LSAC) proudly presents the final year projects abstract book for year-2024. Publication of the abstract book for third consecutive year shows commitment of the committee and the department to present BSc level research for info of the community and the future students. The book serves as a valuable resource for prospective students and alumni, offering insights into the diverse range of FYP topics available within the department.

The ***Final Year Design Project*** (FYP) is an integral part of the BSc degree program at the Civil Engineering Department, where students annually engage in a diverse array of topics to showcase their cognitive/psychomotor/affective domains skills, comprehensively.

This year, a total of ***40 projects*** were successfully completed: 21 from the Structural Engineering division, 12 from Geotechnical Engineering division, and 7 from Hydraulic and Irrigation Engineering division.

Projects in the ***Structural Engineering division*** explored cutting-edge trends such as: artificial intelligence applications, building information modeling, material science advancements, multi-criteria decision analysis, finite element modeling, computer-aided design for structures, and cost-effective housing solutions.

Geotechnical Engineering projects addressed industry demands with focus on soil stabilization techniques, numerical modeling of bored piles, the impact of weather on rock fall hazards, and the design of excavation support systems.

Hydraulics & Irrigation division projects focused on practical issues such as the installation of small turbines at irrigation outlets, extreme events analysis at dam sites, numerical modeling of canal falls and stilling basins and review of current mega urban development project in context of groundwater recharge.

Review of the topics shows that the department is covering most of the research topics related to the field of civil engineering, however, there is need to enhance focus on topics such as 3D printing of building and bridges components, application of AI, ML, and IoT, providing solutions for mitigation of disasters, etc.

The Editor and Chief Editor are highly thankful to all faculty members for their contributions and to ***LSAC student members***, particularly ***Ghulam Mujtaba***, for their efforts in compiling this valuable booklet. Comments and suggestions for future improvements are always welcome.

DR. RIZWAN AZAM
DIRECTOR LIBRARY / INCHARGE LSAC

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CONTENTS

STRUCTURAL *ENGINEERING*

DIVISION

GEOTECHNICAL *ENGINEERING*

DIVISION

HYDRAULICS & IRRIGATION *ENGINEERING*

DIVISION

STRUCTURAL ENGINEERING DIVISION

FYP ABSTRACTS BOOK 2024

Investigating Strength and Durability Characteristics of Geopolymer Concrete

Project Advisor	*Group Members*	
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	Sidra Iqbal	**2020-CIV-03**
	Zukhruf Ejaz	**2020-CIV-04**
	Aleena Tayyab	**2020-CIV-06**

Abstract

Climate change caused by global warming has become one of the most pressing issue facing by the today's world. Emissions of greenhouse gases (GHGs), especially carbon dioxide (CO2), into the atmosphere as a result of human activity are the main causes of global warming. Construction industry is a significant contributor to CO2 emissions. Because of favorable qualities of concrete, accessibility to raw resources and affordability, concrete is still the material of choice for construction.

The durability performance of low calcium fly ash-based geopolymer concrete (FA-GPC) that has been cured at room temperature is being methodically examined in this study. Fly ash was sourced from thermal coal power plants in Sahiwal, Hub, Thar, and Port Qasim, while the aggregates were obtained from the local region. The concrete mix design included the use of 12M & 14M NaOH solution, with a target compressive strength of 21 MPa accomplished by optimal proportions of fly ash, a ratio of sodium silicate solution (Na2SiO3) to NaOH solution of 1.5, and fly ash to alkaline activator ratio (AA/FA) of 0.5.

A total of 124 samples were casted, with 31 samples for each combination of fly ash and aggregates. These tests encompass water absorption, shrinkage, sorptivity, acid resistance and efflorescence, providing comprehensive insights into FA-GPC's durability behavior. The mechanical properties of raw materials were assessed to predict their durability and performance effectiveness.

The results have important inferences towards the construction industry, offering an insight into possible applications of FA-GPC while keeping in view its durability characteristics. By investigating the performance of FA-GPC based on various durability parameters, this study will attempt to guide the professionals and decision-makers toward adopting eco-friendly materials in construction practices. The importance of the study lies in the fact that the effectiveness of substitute materials, like FA-GPC, should be investigated to meet the objectives for sustainable development, particularly related to combating climate change.

Hub Fly Ash

Port Qasim Fly

Sahiwal Fly Ash

Thar Fly Ash

Development of Nonlinear Regression and Artificial Neural Network Models for Predicting the Compressive Strength of Self-Compacting Concrete

Project Advisor	*Group Members*	
Prof. Dr. Asif Hameed	Tayyab Afzal	2020-Civ-73
	Qalb e Abbas	2020-Civ-76
	Saif Ullah	2020-Civ-108
	Muhammad Amir	2021P/2020-Civ-110

Abstract

Self-Compacting Concrete (SCC) is an emerging form of concrete that has great workability, a large volume of paste that contains cement replacement elements such as slag, natural pozzolana, and silica fume. Cement substitute materials offer a variety of advantages, including lower costs, less consumption of natural resources, lower carbon dioxide emissions, and enhanced fresh and hardened properties. SCC is employed in a variety of applications, including sections with congested reinforcement and high-rise shear walls etc. Artificial neural networks (ANN) are commonly used in civil engineering to forecast the performance of certain engineering materials, such as compressive strength and durability. This research is concerned with the development of predictive models for evaluating the compressive strength (CS) of Self-Compacting Concrete (SCC) using Nonlinear Regression (NLR) and Artificial Neural Network (ANN) models. A dataset of 205 data points collected from various credible publications was used to investigate the relationship between seven key variables and CS, including water to cement ratio (w/c), cement content (C), gravel content (G), sand content (S), fly ash content (FA) and superplasticizer content (SP). The constructed model revealed a nonlinear relationship between constituents (input) and SCC compressive strength (output). To assess the predictive abilities and generalize the produced model, other researchers' experimental data were compared to the model prediction, and good results was discovered. The model's performance was assessed using statistical tools such as coefficient of determination (R2), root mean squared error (RMSE), mean absolute error (MAE), and scatter index (SI). The ANN model had better prediction ability than the NLR model, as seen by lower SI values. This study advances predictive modeling tools for assessing SCC performance, providing useful insights for optimizing concrete mix designs.

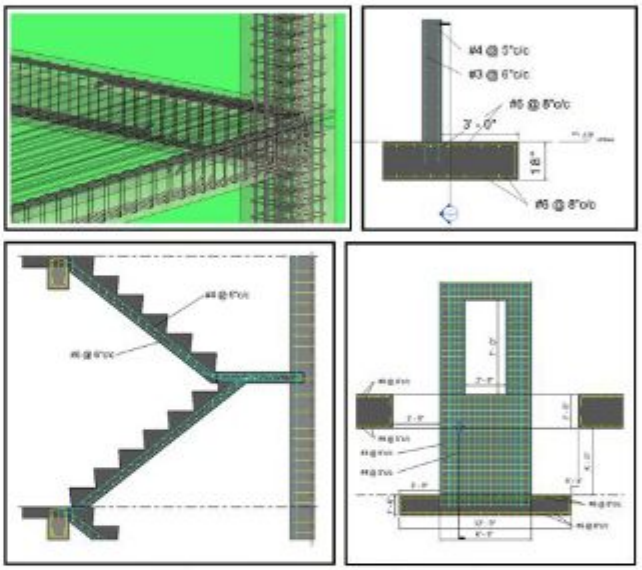
Design of 6 Storey Commercial Building and Development of Reinforcement Detail using BIM Application

Project Advisor	*Group Members*	
Prof. Dr. M. Burhan Sharif	Saqlain Tariq	2020-CIV-195
	M. Ahmad Zafar	2020-CIV-166
	Roshaan Akram	2020-CIV-186
	M. Awais Ali	2020-CIV-188

Abstract

This project focuses on the "Design and reinforcement detail development of a six-storey commercial building using Building Information Modeling (BIM) applications". The objective of this project is to provide a comprehensive understanding of computer-aided analysis and design of structural systems, following the guidelines of ACI 318-19 and UBC 97, and to promote the use of BIM applications in construction projects.

The scope of our work includes the analysis and design of the commercial building using ETABS, including the design of the raft foundation using SAFE. After performing all necessary design checks and ensuring all members passed, we created a 3D model of the building in REVIT, a leading BIM software, based on the same member dimensions as in ETABS. Utilizing the steel ratios obtained from ETABS, we developed the reinforcement detailing of the structure. We then compiled these details into a PDF format, containing all structural drawings and details interlinked in a manner similar to BIM software, allowing for remote access and visualization on mobile devices without the need for personal computers or laptops, especially on actual construction sites.



Reinforcement Detail Drawings

Design and Evaluation of Rammed Earth Material for Residential Building

Project Advisor	*Group Members*	
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	Hafsa Saleem	**2020- CIV-57**
	Mobeen Zubair	**2020-CIV-77**
	Muhammad Hussnain Bashir	**2020-CIV-81**

Abstract

The construction industry of Pakistan is facing challenges such as resource exploitation, environmental degradation and economic instability due to the use of huge volume of natural aggregates and cement to produce concrete. As an alternative to concrete and burnt-clay bricks, the stabilized rammed earth has emerged as a sustainable local construction material. This study investigates the design and evaluation of rammed earth, aiming address the challenges posed by environmental pollution and the depletion of traditional construction materials. In this research, the focus was on assessing the structural performance and sustainability of rammed earth material through a series of experimental tests and analyses. Six rammed earth mixtures were prepared with varying cement content (0%,3%,6%,9%,12%,15%). Total twelve (12) mix compositions were made six (6) with fiber and six (6) without fiber. Cylindrical samples of 75 mm diameter and 150 mm height along with prisms of 60 mm by 60 mm by 20 mm were casted. Unconfined compression test on cylindrical sample and Direct shear test on prim samples were performed. The casting and testing were carried out under ordinary laboratory conditions, where recycled aggregates were utilized. The use of locally sourced materials reduces carbon footprint and promotes eco-friendly practices, aligning with the Sustainable Development Goals (SDGs) related to industry, innovation, and infrastructure, sustainable cities and communities, and climate action.

Revival of Pre-industrial Construction Materials and Techniques

Project Advisor	*Group Members*	
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	Hafiz Hamza Hussain	**2020-CIV-112**
	Hammad Hussain Virk	**2020-CIV-127**
	Moeed Ahmed	**2020-CIV-120**

Abstract

This project explores the benefits and potential uses of natural materials such as lime, mud, stones, and timber in construction, presenting a sustainable and cost-effective alternative to modern materials like concrete and steel. The study focuses on developing durable and strong interlocking mud bricks to minimize the carbon footprint in construction. The only carbon emissions come from material transportation and testing machinery, as all other processes (batching, mixing, grounding, and casting) are performed manually.

The project's goals align with several Sustainable Development Goals (SDGs): SDG 1 (No Poverty), SDG 9 (Industry, Innovation, and Infrastructure), SDG 11 (Sustainable Cities and Communities), and SDG 13 (Climate Action). The aim is to provide sustainable, affordable construction materials for underdeveloped and developing countries.

Five mixtures containing different natural and waste materials, along with a control mixture, were used to create interlocking unburnt mud bricks. The mixes included combinations of clay, fly ash, jute fibers, lime, rice husk, and marble waste. After casting, the bricks were sun-dried for 28 days. Various tests, such as compressive and flexural strength tests, durability tests, and absorption tests, were performed according to ASTM C67 standards.

Results showed Mix-05 (clay, jute fibers, marble waste) had the highest compressive (1.47 MPa) and flexural strength (0.29 MPa), while Mix-04 (clay, rice husk, lime) had the lowest (0.37 MPa and 0.07 MPa, respectively). Mix-02 and Mix-04 displayed good durability but poor absorption properties. Further research is needed to enhance the strength and durability of these mixes for practical construction use.

Mechanical and Durability Performance of Cement-less Concrete For Spun-Cast Pipes

Project Advisor	*Group Members*	
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	Qura Tul Ain	2020-CIV-01
	M. Abdullah Khan	2020-CIV-25
	M. Zain Kashif	2020-CIV-40

Abstract

A feasible and cost-effective way to reduce the carbon footprint in the building industry is to utilize cementless concrete mixtures that contain fly ash (FA). The current study investigated cementless concrete mixtures incorporating several kinds of fibers that are used in the manufacturing of spun-cast pipes. The steel fibers investigated were plain, bundled, and wavy fibers having doses of 25, 50, and 75 kg/m3. Additionally, research was done on micro-polypropylene (PP) fibers at 5, 10, and 25 kg/m3. The performance of cementless concrete mixes with fibers was analyzed by water absorption tests, splitting tensile strength, compressive strength, and flexural strength tests. Moreover, full-size precast pipes were made from the cementless concrete mixture using the spun cast process to investigate its broader-scale applications. It was found that the addition of steel fibers to the tested cementless concrete mix decreased the slump. The use of steel fibers also improved the mechanical performance of the cementless concrete mixture. For instance, the combination containing 50 kg/m3 of wavy steel fibers showed a 35% gain in flexural strength compared to the mixture without fibers at 56 days. A reduction in water absorption was also observed in the steel fiber-incorporated cementless concrete mixtures. The wavy steel fiber mixtures performed better than the similar bundled and plain steel fibers cementless concrete mixtures. The wavy steel fiber mixtures performed better than the similar bundled and plain steel fibers cementless concrete mixtures. However, micro-PP fibers have poor fiber-matrix interfacial characteristics, resulting in decreased water absorption and compressive strength in tested mixtures. Additionally, a pilot test using the actual size of precast cementless concrete pipes with wavy fibers was carried out. The three-edge bearing tests revealed flexural fractures at the spring-lines, invert, and crown. Fibers in cementless concrete pipes enhance cracking and ultimate loads through bridging and crack arrestment phenomena. This research demonstrated the possible application of fiber-based FA-based cementless concrete mixes in the spun-cast method of producing precast pipes (PCP), offering a viable and environmentally friendly alternative for the development of civil infrastructure.

Samples Testing

Development of Cement-Less Recycled Aggregate Concrete Using Hub Coal Power Plant Fly Ash: A Sustainable Approach

Project Advisor	*Group Members*	
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	Obaid Ur Rehman Aziz	2020-CIV-34
	Shahwez Khan	2020-CIV-35
	Faiq Ur Rehman	2020-CIV-37

Abstract

One of the biggest challenges faced by the world today is climate change due to global warming. Global warming is caused by increasing emissions of greenhouse gases (GHG). Carbon dioxide (CO2) is a GHG that contributes more than 50% towards global warming, and GHG is released into the atmosphere due to human activities. Concrete is extensively used in construction industry with cement as its major constituent. The production of clinker in the cement production releases large amount of CO2 emissions. Moreover, the cement production is an energy intensive process. The Global Cement and Concrete Association estimated that cement production averages about 4 billion metric tons each year.

This research study intends to address rising GHG emissions by reducing the production of cement in construction industry by using fly ash as 100% replacement for cement, thus serving as an alternative sustainable solution of cement and reducing its environmental impact. Moreover, recycled aggregates (RA) produced from construction and demolition waste (CDW) were used as varying percentage replacements of natural aggregates (NA) to preserve natural resources and efficiently dispose off the CDW.

This study addresses three Sustainable Development Goals (SDGs) i.e. Industry, Innovation and Infrastructure (SDG No.9), Sustainable Cities and Communities (SDG No.11), and Climate Action (SDG No.13). The study involves the preparation of 30 cement-less recycled aggregate concrete (CRAC) mixes containing 100% fly ash with varying percentage replacements of recycled aggregates i.e. 0%, 20%, 40%, 60%, 80% and 100% of natural aggregates, with varying alkaline activator (AA) to fly ash (FA) ratios i.e. 0.5 and 0.6, and varying molarities of sodium hydroxide (NaOH) solution i.e. 12M, 14M and 16M.

Each mix comprises three cylinder specimens for compression testing and three prism specimens for flexural testing. The cylinder specimens were 100 mm in diameter and 200 mm in height, whereas prism specimens comprised 75 mm x 75 mm cross section and 300 mm length. Samples were ambient cured at room temperature (23 ±

Samples For Testing

Mechanical Performance of Various Interlocking key Profiles in Compressed Fly Ash Bricks

Project Advisor	*Group Members*	
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	Roma Naz	2020-CIV-59
	Maria Ashraf	2020-CIV-60
	Zohaib Hassan	2020-CIV-117

Abstract

This research study examines the prospect of using low-cost interlocking fly ash bricks without mortar for construction purposes. The study aims to evaluate the characteristics of interlocking bricks and compare them with conventional masonry bricks in terms of sustainability, stability, mechanical properties, and economics. Various mixtures containing fly ash and bagasse ash were investigated, revealing reductions in unit weight and compressive strength when using waste ashes. Despite being less robust than standard bricks, interlocking bricks conform to building codes and offer advantages such as lightweight construction, easy installation, and structural integrity. Recommendations include longer curing periods to enhance strength, proper design of key profiles for stability, and further investigation into bond strength. In conclusion, this study provides meaningful insights into the viability of interlocking bricks as an effective and sustainable construction method in the sector.

Mechanical Characterization of Textile Reinforced Cementitious Matrix

Project Advisor	*Group Members*	
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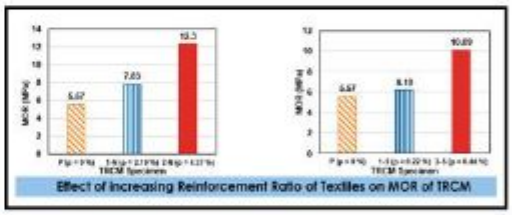
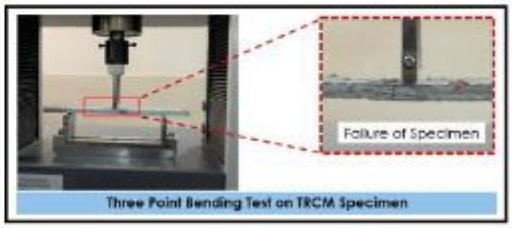
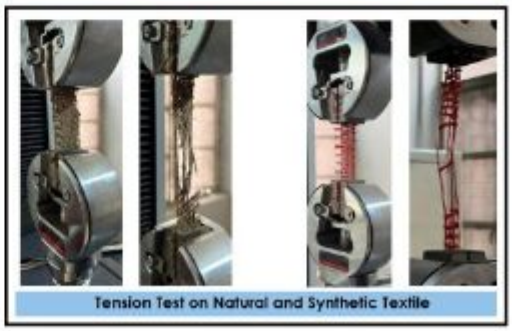
	Abdullah Zaheer	2020-CIV-74
	Syed M. Asjal Bukhari	2020-CIV-80
	Hafiz Hammad Cheema	2020-CIV-92

Abstract

Textile reinforced concrete (TRC) is a composite material that consists of woven textiles embedded in concrete to impart it with tensile strength. Since concrete is strong in compression but weak in tension, it is traditionally reinforced with steel to resist tensile stresses. However, due to scarcity of iron ore, a major constituent of steel, its extensive use is unsustainable. Steel is also susceptible to corrosion, which causes durability issues. Furthermore, manufacturing of steel results in emission of large quantity of CO2, which is a greenhouse gas. On the other hand, high strength, non-corrodibility and low cost of textile fabrics make them an excellent alternative to steel. This study focuses on the use of local waste textiles to resist tension induced due to bending in Textile Reinforced Cementitious Matrix (TRCM). Two textiles, natural jute textile and synthetic polypropylene textile, were selected for this study. These textiles are primarily used in vegetable bags and were utilized in this study to help achieve Sustainable Development Goal 10 (Sustainable Cities and Communities) and 11 (Responsible Consumption and Production). The objectives of the study are to evaluate the tensile properties of local waste textiles and the flexural properties of textile reinforced cementitious matrix specimens with varying reinforcement ratios by performing three-point bending tests on them. The natural jute textile and synthetic polypropylene textile both possess significant tensile strength (55.17 MPa and 255.25 MPa) to be used as tensile reinforcement in cementitious matrix. It was noted that upon doubling the reinforcement ratio of textile, the load bearing capacity of TRCM specimens increased, indicated by an approximate 60% increase in the value of modulus of rupture. Therefore, TRCM made using local waste textiles has potential to be used commercially as a structural material.







Structural and Economic Perspective of Application of Recently Developed Construction Composites and Techniques

Project Advisor	*Group Members*	
Dr. Muhammad Irfan-ul-Hassan	Abdullah Mustafa	2020-CIV-118
	Muhammad Haris Nauman	2020- CIV-126
	Muhammad Zeeshan Babar	2020-CIV-132
	Waseem Abbas Turi	2020-CIV-149

Abstract

In this project, systematic investigation has been carried out on the Economic, Structural and Environmental perspectives of Sustainable Construction Composite materials, focusing on bricks, mortar and concrete developed in the laboratory. Waste materials such as fly ash, sugarcane bagasse ash, metakaolin and red mud were used to replace cement in optimal ratios. Economic viability was assessed by comparing overall costs of the newly developed Composite materials and the conventional materials. Detailed cost analysis was performed – which included unit, transportation, calcination, filling, loading/unloading and labour costs. Structurally, the performance of the composites was evaluated through compressive and flexural strength tests conducted at 7, 28, and 56 days for both the control (cement at 0% replacement) mix and the cement-replaced mixes. Environmentally, the study assessed the global warming potential (GWP) by comparing the CO2 emissions associated with the production and transportation of conventional cement and the new sustainable composites.

The results indicate that the sustainable composite materials are economically favorable, with lower overall costs compared to conventional materials. Structurally, the 7, 28 and 56 day test results for the sustainable composites meet the standard requirements for concrete and mortar strength. Environmentally, the new materials show a decrease in CO2 emissions, in accordance with the percentage of cement replaced. Transportation of the waste products show a minute contribution to CO2 emissions. These new materials prove to be environmentally friendly and contribute in mitigating the environmental impact of construction activities. These findings confirm that sustainable composite material offer a viable alternative to conventional cement-based products, balancing cost effectiveness, structural integrity, and environmental sustainability.

Applications of Artificial Intelligence in Structural Engineering

Project Advisor	*Group Members*	
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	Mustafa Ahsan	2020-CIV-28
	Hamza Ashiq Sial	2020-CIV-29
	Chakar Khan	2020-r/2019-CIV-53

Abstract

Artificial intelligence (AI) is revolutionizing all fields; however, its potential in the field of structural member design is not yet fully explored. This study aims to highlight the potential of AI-based optimization algorithms to achieve economical solutions. In this study, the evolutionary algorithm available in the MS Excel Solver tool is used to obtain optimized design alternatives for steel structural members (I-shaped beams subjected to flexural loading). The evolutionary algorithm is used to identify cross-sectional parameters with the goal of minimizing costs while ensuring compliance with relevant technical standards. To demonstrate the effectiveness of the developed procedure, examples from the literature have been optimized.

Two examples are taken from the "Companion to the AISC Steel Construction Manual Volume 1: Design Examples Version 15.1," and one example is taken from "Steel Structures" by Zahid Ahmed Siddiqi. The results showed that up to 35% more economical solutions can be obtained compared to the original design while fulfilling all the design constraints.

Computer Aided Design of a Concrete Frame Structure

Project Advisor	*Group Members*	
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	Obaidullah Ibrahimzada	**2020-CIV-209**
	Saad Ayoub	**2020-CIV-199**
	Abdullah Rahman	**2020-CIV-180**

Abstract

This project focused on the computer-aided analysis and design of a multi-story reinforced concrete frame structure consisting of four stories. It addressed the UN's Sustainable Development Goal No. 9 by promoting resilient infrastructure and sustainable development. The primary objective was to utilize modern software to ensure a resilient, safe, and economical design in accordance with international design codes and practices. ETABS was employed for the analysis and design of the superstructure, while SAFE was used for the foundation design. Detailed drawings, including longitudinal and cross-sectional details of structural components, were generated using AutoCAD.

The design was carried out as per the following American Codes and Standards:

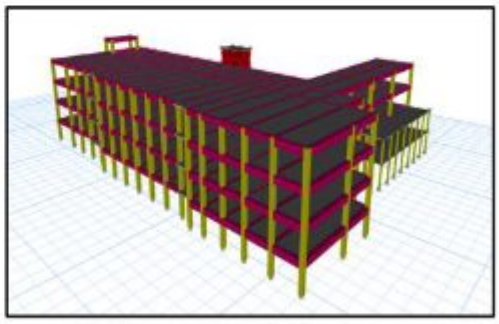
ACI 318-19, Building Codes Requirements for Structural Concrete

UBC 1997, Uniform Building Code

ASTM, American Standards for Testing and Materials

ASCE 7-16, Minimum Design Loads for Buildings and Other Structures

Various load combinations were considered, incorporating all the self-weight, superimposed dead, live, and seismic loads, ensuring the structure's stability under all anticipated loading conditions. The concrete cylinder strength of 5000 psi was considered for columns and the lift well, whereas 4000 psi was used for beams, slabs, and foundations. Grade-60 steel was used as reinforcement for all the structural components. After the analysis and design of the superstructure, the analysis results were exported from ETABS to SAFE. A detailed mat foundation design was carried out in SAFE. The foundation was checked against pressure, settlement, and punching shear. Detailed drawings of the mat foundation showing all the reinforcement details were prepared in AutoCAD.



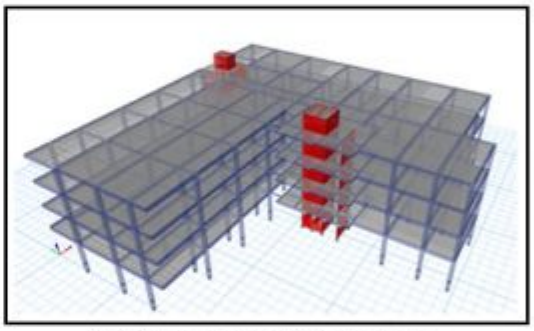
Software Simulation Image

Structural Design of a Hospital Building

Project Advisor	*Group Members*	
Dr. M. Mazhar Saleem	**Adnan Haider**	**(2020-CIV-21)**
	Allah Ditta	**(2020-CIV-30)**
	Muhammad Nadeem	**(2020-CIV-32)**
	Muhammad Usman	**(2020-CIV-33)**

Abstract

This project centered on the computer-aided analysis and design of a four-story reinforced concrete hospital building. It aligned with the UN's Sustainable Development Goal No. 9 by promoting resilient infrastructure and sustainable development. The primary goal was to leverage modern software to ensure a resilient, safe, and cost-effective design in accordance with international design codes and practices. The superstructure was analyzed and designed using ETABS, while SAFE was employed for the foundation design. Detailed drawings, including longitudinal and cross-sectional details of structural components, were created using AutoCAD. The design adhered to American Codes and Standards, including ACI 318-19 (Building Code Requirements for Structural Concrete), UBC 1997 (Uniform Building Code), ASTM (American Standards for Testing and Materials), and ASCE 7-16 (Minimum Design Loads for Buildings and Other Structures). Various load combinations were considered, incorporating self-weight, superimposed dead, live, and seismic loads to ensure the structure's stability under all anticipated conditions. The concrete cylinder strength was set at 5000 psi for columns and the lift well, and 4000 psi for beams, slabs, and foundations. Grade-60 steel was used as reinforcement for all structural components. Following the analysis and design of the superstructure, the results were exported from ETABS to SAFE for a detailed mat foundation design. The foundation was checked against pressure, settlement, and punching shear. Detailed drawings of the mat foundation, showing all reinforcement details, were prepared using AutoCAD.



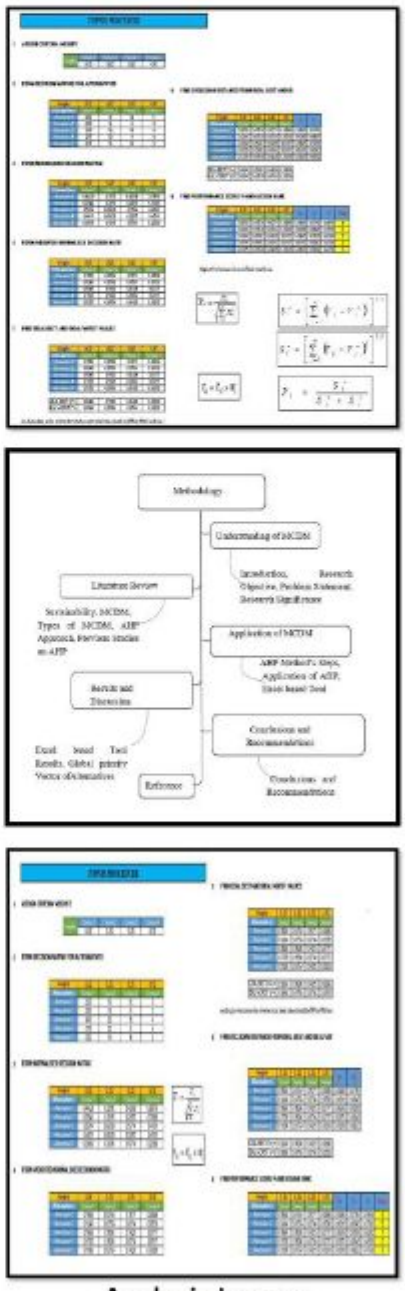
Software Simulation Image

Application of Multi-Criteria Decision Analysis in Civil Engineering

Project Advisor	*Group Members*	
Dr. Muhammad Rizwan Riaz	Jawad Ahmad	2020-CIV-70
	Mudasir Bashir	2020-CIV-71
	Shahzaib Rafi	2020-CIV-86
	Hafiza Mushata Nazir	2020-CIV-62

Abstract

This project focuses on the application of Multi-Criteria Decision Making (MCDM) in civil engineering, highlighting its significance and various uses. It emphasizes the importance of MCDM, particularly the Analytical Hierarchy Process (AHP), for selecting the best possible alternatives based on already published data. The methodology for applying AHP is detailed, and previous research is reviewed to provide context. An Excel-based tool was developed to facilitate the quick application of AHP and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS). Two examples are solved using AHP: one comparing natural aggregate concrete with recycled aggregate concrete (0-100% range), and another optimizing rubber content in concrete by integrating technical, environmental, and economic perspectives. The thesis explains how to set preferences, develop pairwise comparison matrices, and decision matrices. It also provides a detailed explanation of the Excel tool, showing how to use it to obtain final priority vectors. The project aimed to select the best option based on technical, environmental, and economic criteria. Final decision matrices and graphical presentations of the priority vectors are included, along with a comprehensive discussion of the results. The thesis concludes with recommendations for further improvements and future research directions.



Analysis Images

Effect of Molasses as an Admixture on Concrete Durability

Project Advisor	*Group Members*	
Dr. Muhammad Yousaf	Aman Ullah	2020-CIV-206
	Sameer Khan	2020-CIV-45
	M Younas	2020-CIV-44
	Hussain Altaf	2020-CIV-31

Abstract

Self-compacting concrete (SCC) is a type of high-performance concrete that is designed to flow and fill formwork without the need for mechanical vibration. Achieving high flowability involves using Superplasticizers (S.P) and/or high-range water reducers (HRWA), while segregation is controlled by Viscosity Modifying Agents (VMAs). Sugarcane molasses, a locally sourced material, constitutes one of the four sugar by-products generated in factories. Molasses contains organic compounds and residual sugar, which can function as a water reducer (plasticizer) and retarding admixture. A detailed experimental study was execuetd to explore the performance of self-compacting concrete incorporating molasses as a water-reducer and superplasticizer replacement.

Nine different concrete mixes were produced, including a control mix made by superplasticizer only (0% molasses) and four mixes with incremental molasses additions (@ 0.25% by wt. of cement) alongside a constant superplasticizer content. The remaining mixes replaced the superplasticizer with molasses at various levels (25%, 50%, 75%, and 100%). To evaluate fresh performance, Filling Ability, Passing Ability, Segregation Resistance, and Fresh Density tests were conducted. For each mix, 3 cylinders and 3 PCC beam prisms were prepared to evaluate hardened state performance through compressive and flexural strength tests.

Results illustrate improved SCC performance with molasses when used in conjunction with a superplasticizer but S.P. replacement impairs the performance as the replacement level with molasses increases. Optimal performance is observed at 0.75% molasses content when it is used in addition to S.P.

Lab Performance Images

Impact Resistance of Lightweight Recycled Brick Aggregate Concrete Incorporating EPS Beads

Project Advisor	*Group Members*	
Dr. Syed Asad Ali Gillani	Muhammad Soban	2020-CIV-131
	Sohail Abbas	2020-CIV-116
	Adnan Mujahid	2020-CIV-128
	Jawad Shakir	2020-CIV-150

Abstract

This study investigates the use of EPS beads in lightweight concrete incorporating recycled brick aggregate derived from construction and demolition waste. The inclusion of EPS beads aims to reduce the concrete's density.

The results demonstrated that the incorporation of EPS beads decreased the concrete's compressive strength. However, the impact resistance results were not promising due to less increase in energy absorption capacity. The study recommends the use of EPS wastes in lightweight concrete for sustainable concrete for non-load bearing members.

Conclusions include:

A significant decrease in the density was observed due to the incorporation of EPS and recycled brick aggregates.

The compressive strength of EPS concrete is significantly lower than normal concrete, but is still within the limits of non-load bearing members.

The energy absorption capacity of normal concrete exceeds that of EPS Concrete. Consequently, EPS concrete demonstrates less favorable outcomes in terms of impact resistance

Performance investigation of Engineered Cementitious Composites used as Tunnel Lining.

Project Advisor	*Group Members*	
Dr. Umbreen-Us-Sahar	Muhammad Hashaam Bin Aamir	2020-CIV-170
	Hassaan Mehmood Butt	2020-CIV-181
	Momin Ishfaq	2020-CIV-183
	Muhammad Hamza	2020-CIV-191

Abstract

Tunnel lining appear to be one of the most complex topics under consideration in the construction industry all over the globe. This project encompasses the use of polypropylene fibers to create a sustainable composite for tunnel linings which offers improved durability while being economical. In addition to that, it also evaluates mechanical properties of ECC by varying fine aggregates. This engineered composite is budget friendly and innovative solution to critical structures experiencing hoop stresses furthermore provide ongoing maintenance, repair, and upgrade services for existing industrial facilities to ensure they continue to operate efficiently and safely in Pakistan.

Conclusions include:

Optimal Strength Mix: Replacing 30% of silica sand with local sand increases 28-day compressive strength by 50%. Further replacement reduces strength, with 100% local sand being the weakest

Strength Trend: Strength decreases up to 50% replacement, then increases up to 70%, showing a non-linear trend.

Crack and Post-Crack Strength: The mix with 90% silica sand has the highest crack strength, but 30% silica sand has better post-crack strength, influenced by fiber orientation and bonding.

Study of Construction Quality Standards and Control in Pakistan: A critical review

Project Advisor	*Group Members*	
Dr. Aqsa Shabbir	Saad Mahmood	2020-CIV-114
	Tayyab Amjad	2020-CIV-122
	Muhammad Shabbir	2020-CIV-124
	Sohaib Shams	2020-CIV-130

Abstract

The construction industry is pivotal in driving global economic growth, contributing significantly to employment and GDP in many countries. However, it is often marred by quality control issues and safety concerns, which can lead to significant economic and human losses. This study aims to critically review construction quality standards and control practices in Pakistan as we as on a global scale, providing a comprehensive understanding of the current landscape and identifying areas for improvement.

A thorough literature review was conducted, analyzing 50 of the most relevant reports on construction quality standards and control practices from various countries. This qualitative study explores the effectiveness of these standards and practices, identifying common challenges and best practices across different regions.

Key findings reveal significant variations in the implementation and enforcement of construction quality standards worldwide. Factors such as regulatory frameworks, industry practices, and cultural attitudes towards construction safety and quality play crucial roles in shaping these outcomes. The study highlights the importance of robust regulatory oversight, industry accountability, and the adoption of innovative practices to enhance construction quality.

Recommendations are proposed to address the identified gaps and improve construction quality standards globally. These recommendations emphasize the need for stronger regulatory frameworks, enhanced training and education for construction workers, and the adoption of advanced technologies and best practices.

This research aligns with Sustainable Development Goals (SDGs) 9 (Industry, Innovation, and Infrastructure) and 11 (Sustainable Cities and Communities), contributing to the development of safer, more sustainable infrastructure and urban environments worldwide. By providing a critical review of global construction quality standards and control practices, this study aims to foster a safer and more efficient construction industry, benefiting economies and communities around the world.

The 3D Finite Element Modeling of early-age cracking in continuously reinforced Concrete Pavement slab

Project Advisor	*Group Members*	
Dr. Muhammad Kashif	Osama Mahmood	2020-CIV-129
	Saad Bin Tariq	2020-CIV-138
	Muhammad Yousaf	2020-CIV-143
	Saiqib Ullah	2020r/2019-CIV-156

Abstract

Continuously Reinforced Concrete Pavement (CRCP) is a type of pavement in which steel is continuous throughout the pavement length, with no transverse joints as found in Jointed Plain Concrete Pavement (JPCP), which has no steel but does have transverse construction joints. Due to the continuity of steel in CRCP, the steel tightly holds cracks together which may be Early-Age Cracks or Structural Cracks after Loading. And it offers long-term performance, durability, and effective crack control, Although the initial cost of construction may be high, the maintenance cost is very low.

One of the Main Demerit of CRCP is its Early-Age Cracking with Non-Uniform Pattern i.e. Random Cracking. As For JPCP which have Traverse Joints and Early-Age Cracking occurs at that Traverse Joint. But in CRCP, Due to Continuity of Steel, and Absence of Traverse Joints, the Random Cracking occurs in the form of Narrowly-Spaced Cracks, Dividing Cracks, Y-Cracks, and Meandering Cracks. These Cracks trigger the development of Punch-outs in CRCP. Hence the Analysis and Control of this Random Cracking is main concern.

The Results of the Model are Illustrated both Graphically or in the form of Color Contours of CRCP. The Variations of Temperatures, Stresses in Slab & Reinforcement, Strength Development, and Cracks, Crack Strains, and Crack Pattern are observed with time after placement and along the Depth, Width, & Length of CRCP. The Results indicate that, at the Bottom of CRCP, the Temperature, Strength, Stress Development is High than at Exposed Top Surface. The Reason is the Bottom of CRCP is Completely enclosed by surrounding concrete which results into higher hydration and simultaneously high temperature and stresses. The Heat Produced, evolved out from Concrete through Top Exposed Surface, Resulting in Temperature Gradient, which causes Thermal Stresses, and Cracks occurred on Top Exposed Surface. Most of Cracks occurred on Top Surface of CRCP which is directly Exposed to External Environment. The Cracks with Different Patterns, and different strains or widths are observed. The concrete class, Model Code, and Aggregate Type mostly influence its patterns. The Thermal Stresses are also Observed in Reinforcements. The Main bars have low values of Thermal Stresses while Traverse bars have high stresses because they are placed above Main bars.

Development and validation of predictive models for material performance

Project Advisor	*Group Members*	
Engr. Bilal Anwar	Muhammad shehroz saleem	2020-CIV-88
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	Rizwan Ullah	2022-CIV-109
	Farasat Ali Aon	2020-CIV-91

Abstract

Concrete is a widely used material in civil engineering. Understanding the mechanical properties of concrete, such as compressive and tensile strength, is crucial for effective planning and performance assessment. In recent years, machine learning (ML), a subfield of artificial intelligence, has gained prominence for its ability to model real-world problems across various scientific fields, including construction materials. ML offers significant advantages over traditional statistical and experimental methods, including improved accuracy, speed, and cost-effectiveness. Using python, this project explores the application of ML and deep learning techniques in predicting the mechanical properties like compressive and tensile strength of concrete.

Numerical Simulation of a Masonry Structure using Finite Element Analysis

Project Advisor	*Group Members*	
Dr. Ubaid Ahmad Mughal	Sohaib Ali Safdar	2020-Civ-119
	Muhammad Ahmad Azhar	2020-Civ-121
	Muqeet Maqbool	2020-Civ-134
	Muhammad Usama Tarar	2020-Civ-136

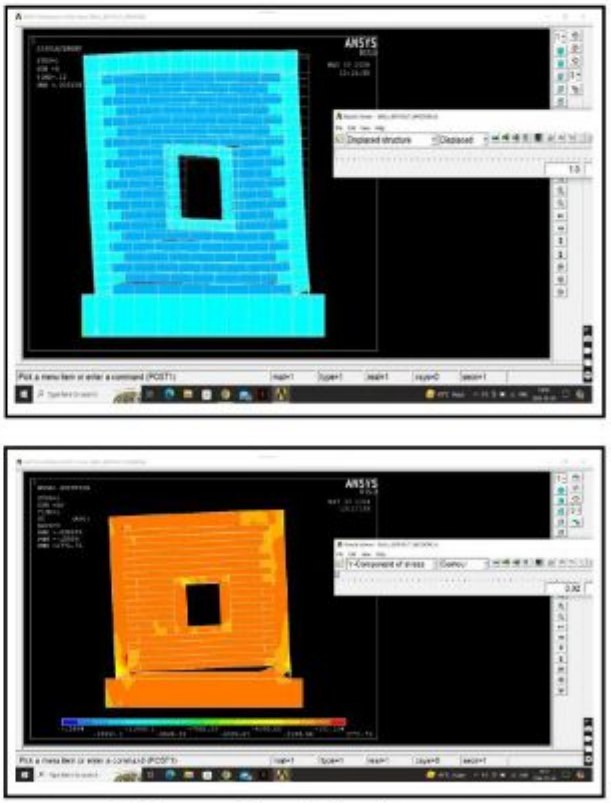
Abstract

Finite-Element Analysis (FEA) is used for an extensive numerical simulation of masonry construction in this project. Historically significant for their strength and majesty, masonry buildings are an age-old addition to the annals of construction history. However, they are susceptible to a variety of other problems such as wind loads, seismic activity, and long-term structural decay. Understanding how brick-constructed response is subjected to these types of forces, not only ensures its longevity, safety, and cost-effective maintenance.

The focus of this study is to model masonry construction under different loading conditions using Finite Element Analysis techniques. Discretized the structure during modeling: It is respectively behavioral prediction of materials, boundary conditions, and other aspects of the preform through mathematical equations for each finite element.

To achieve this, the thesis begins with an examination of the theoretical basis for masonry structures, which includes a description of masonry materials and structural elements together with relevant design rules and standards. The Finite Element Method (FEM) is a powerful computational method that has been successfully implemented in masonry simulations to investigate complex structures with irregular geometries, as well as those constructed with multiple materials.

The research conclusions contribute to the knowledge of structural Masonry and provide Recommendations for Masonry Structure Design, Reinforcement Measures, And Risk Mitigation Strategies. The use of FEA allows us to predict and assess the behavior of the structural performance masonry structures enabling built environments that are highly endurance and safety.



Software Simulation Images

GEOTECHNICAL ENGINEERING DIVISION

FYP ABSTRACTS BOOK 2024

Sustainable Green stabilization of Expansive Clays using Natural and Synthetic Fibers with Rice Husk Ash

Project Advisor	*Group Members*	
Prof. Dr. Khalid Farooq	**Ayesha Zubair**	**2020-CIV-02**
	Musfirah Tamkeen	**2020-CIV-07**
	Areeba Asif	**2020-CIV-05**

Abstract

The expansive clays pose severe geotechnical challenges due to low strength and high compressibility. This research investigates the environmentally-friendly stabilization of expansive clay using synthetic fibers (polyester fibers), natural fibers (wheat fibers) and rice husk ash (RHA). Geotechnical properties of treated and untreated clay were studied in this research. Geotechnical tests like sieve analysis, hydrometer analysis, Atterberg limits, specific gravity, unconfined compressive strength (UCS), consolidation, swell potential and unconsolidated undrained (UU) triaxial tests were conducted for the evaluation of enhancement in strength and elastic modulus (Es) and compressibility characteristics.

The expansive soil exhibited plasticity index of 31% and swell potential of 5.8%. All the samples were prepared at maximum dry density and optimum moisture content for the purpose of comparison of strength and stiffness properties. Wheat fibers (WF), polyester fibers (PF) and rice husk ash (RHA) were optimized for optimization of geotechnical properties for expansive clay stabilization. It was observed that optimal content of fibers and stabilizer i.e., 1.5% wheat fibers, 1.2% polyester fibers and 15 % RHA enhanced UCS as 53 %, 76 % and 220 %, enhanced angle of internal friction (ϕ) as 71 %, 87 % and 135 %, reduced swell potential as 47 %, 50 % and 78 % and reduced compression index (Cc) as 15 %, 20 % and 46 %, respectively.

The results present an eco-friendly approach for the stabilization of expansive clay meeting the Sustainable Development Goal (SDG) No. 11 to protect the environment by using waste materials in subgrade construction.

Sustainable use of Road Waste Materials for Stabilization of high Plasticity Clay

Project Advisor	*Group Members*	
Prof. Dr. Khalid Farooq	Laiba Abrar	2021-M/2019-CIV-11
	Ahmed	2020-CIV-24
	Waqar	2020-CIV-39
	Faizan	2020-CIV-40

Abstract

High plasticity clay usually undergoes drastic volume changes in response to moisture fluctuations and poses a significant threat to structures. Uncontrolled expansion and subsequent drying result in damaging cracks and uplift pressures to the foundations. In Pakistan, high plasticity clay has affected numerous buildings and pavements, necessitating sustainable stabilization of high plasticity clay. Use of Reclaimed Asphalt Pavement (RAP) is the innovative solution for clay stabilization. This sustainable material, collected from old and deteriorated road surfaces, proved to be an effective material in stabilization. By mixing high plasticity clay with RAP, enhancement in strength and reduction in swell potential was observed. The stabilized soil emerges as an ideal subgrade material for road construction, paving the way for safer and more resilient pavement infrastructure.

These groundbreaking efforts embody Sustainable Development Goals (SDGs) 9 and 11, supporting effective solutions for robust, eco-friendly industries and sustainable urban road infrastructures. By implementing this innovative approach, we can reshape the landscape of sustainable road construction industry.

Evaluation of Axial Compressive Capacity of Concrete Bored Piles Using Numerical Modelling

Project Advisor	*Group Members*	
Prof. Dr. Hassan Mujtaba Shahzad	Muhammad Arqam	2020-CIV-15
	Faiz Ul Hassan	2020-CIV-19
	Farrukh Shabbir	2020-CIV-42
	Abdul Rafay	2020-CIV-46

Abstract

The study centered around Evaluation of Axial Compressive Capacity of Concrete Bored Piles using Numerical Modelling that is crucial for innovative infrastructure development. Despite extensive literature, a lack of clarity persists on aligning methods with load settlement curves generated from numerical modelling (PLAXIS 2D) to minimize the need of expensive Pile Load Tests (PLT).This study evaluates the axial compressive capacity of concrete bored piles at Imamia Colony Railway Crossing near Shahdara, Lahore, characterized by clayey silt (CL-ML) upto 4.5 m with average undrained cohesion around 40 kPa followed by well graded sand (SW) to a termination depth of 40.5 m with angle of internal friction around 31-34 degrees.

Theoretical methods (Meyerhof, 1976; Terzaghi; α method; Coyle and Castello, 1981) and codes (AASHTO; NAVFAC DM 7.2) were employed to evaluate tip capacity and skin friction. PLAXIS 2D generated load settlement curves, interpreted using methodologies (Berggren, 1981; Canadian Manual, 1978; Commission on Pile Research, 1980; Davisson, 1973; NAVFAC DM 7.2). Findings indicate the Canadian Manual method (1980) exhibited the least mean absolute deviation across various pile sizes to predict Ultimate Axial Compressive Capacity from PLAXIS generated load settlement curves. Overall comparison of theoretical and Numerical modelling results indicates NAVFAC DM 7.2 exhibits 10% conservatism, AASHTO overestimation by 12%, and numerical modelling deviating by 20% from actual Pile Load Test Reported capacity of 400 tons for 32 m deep and 1.2 m diameter bored pile.

Theoretical methods (Meyerhof, 1976; Terzaghi; α method; Coyle and Castello, 1981) and codes (AASHTO; NAVFAC DM 7.2) were employed to evaluate tip capacity and skin friction. PLAXIS 2D generated load settlement curves, interpreted using methodologies (Berggren, 1981; Canadian Manual, 1978; Commission on Pile Research, 1980; Davisson, 1973; NAVFAC DM 7.2). Findings indicate the Canadian Manual method (1980) exhibited the least mean absolute deviation across various pile sizes to predict Ultimate Axial Compressive Capacity from PLAXIS generated load settlement curves. Overall comparison of theoretical and Numerical modelling results

Field Image of Piles

Design of an excavation support system using PLAXIS-2D

Project Advisor	*Group Members*	
Prof. Dr. Hassan Mujtaba Shahzad	**Sajid Ali**	**2020-CIV-174**
	Ijaz Ahmad	**2020-CIV-177**
	Waleed Abdullah	**2020-CIV-172**
	Talha Zahid	**2020-CIV-190**

Abstract

Soil mechanics and foundation engineering have developed rapidly during the last fifty years. Intensive research and observation in the field and the laboratory have refined and improved the science of foundation design. In the present era, scarcity of land exponential increase in population has forced engineers,architects,owner,and builders to think about high rise structure in most part of the world. In developing countries like Pakistan high rise buildings are the need of time in major urban centers. Businesses and industries are growing rapidly, and towers and skyscrapers are being designed in these cities. These high-rise towers have multilevel basements, and to construct them, deep excavation is required.

So far, in Lahore, the designed excavation support system is generally not considered to be cost-effective, as much expertise is not available locally. So, the aim of this research is to design earth retaining structure using the verified code. For the design purpose,PUNJAB LOCAL GOVERNMENT ACADEMY building was selected. The site was situated near LDA Avenue Johar Town Lahore. The building was surrounded by Bahria University, Madrasa, plots and road. The building was of 8 stories with 2 basements. The excavation was required up to 7.2m below the road level.

All the likely forces/pressure have been considered e.g., surcharge pressure, active pressure,passive pressure.The aim of study is to design the earth retaining structure using Federal Highway Administration (FHWA) and Plaxis 2D.

Field Images

Use of Lingosulfonate to Reduce Compressibility and Enhance Shear Strength of Fine Soils

Project Advisor	*Group Members*	
Dr. Jahanzaib Israr	Omar Hadil	2020-CIV-250
	Muhammad Abu Algasim	2021R2020-CIV-247
	Rabea Mohammed Sharaf Al Mahgari	2020R2019-CIV-292

Abstract

This thesis investigates the novel application of lignosulphonate in addressing the challenges of shear strength in fine soils. Fine soils, such as silts and clay, are known for their high impressibility and low shear strength, which pose significant challenges in geotechnical engineering and construction projects. Traditional methods for mitigating these challenges, such as using chemical additives and mechanical stabilization techniques, have limitations in terms of cost, effectiveness, and environmental impact.

The use of lignosulphonate, a byproduct of the paper and pulp industry, presents a promising alternative for improving the engineering properties of fine soils. Lignosulphonate is a natural polymer with unique chemical properties that make it suitable for modifying the behavior of fine soils. This thesis aims to explore the potential of lignosulphonate as a sustainable and cost-effective solution for reducing compressibility and enhancing shear strength in fine soils. The research methodology involves laboratory testing and numerical modeling to evaluate the effectiveness of lignosulfonate in different soil types and conditions. The laboratory testing includes standard geotechnical tests such as Atterberg limits, compaction tests, and unconfined compression tests to assess the changes in soil properties with the addition of lignosulfonate. The modeling aims to provide insights into the mechanisms by which lignosulfonate interacts with fine soils at the microstructural level, leading to improvements in compressibility and shear strength.

The findings of this research are expected to contribute to the understanding of lignosulfonate as a soil stabilizer and its potential applications in geotechnical engineering. The implications of using lignosulfonate extend beyond technical performance to include economic and environmental considerations, as the utilization of a byproduct material offers a sustainable solution with potential cost savings and reduced environmental impact compared to traditional soil stabilization methods. In conclusion, this thesis presents a novel approach to addressing the challenges of compressibility and shear strength in fine soils by leveraging the unique properties of lignosulphonate.

Development of a Non-destructive Testing approach to Quantify In-situ density of Soils

Project Advisor	*Group Members*	
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	Faiqah Chaudhry	2020-CIV-09
	Fatima Asad	2020-CIV-10
	Muhammad Abdul Rehman	2020-CIV-135

Abstract

In response to the critical need for precise and non-invasive soil testing, this study introduces a groundbreaking non-destructive testing (NDT) approach for quantifying in-situ soil density. Soil testing is crucial in industries such as construction, infrastructure, and environmental monitoring. Existing methods often face challenges in accuracy and practicality.

NDT methods for in-situ soil density measurement leverage physical and geophysical principles to estimate density without damage. These include electrical resistivity, seismic wave velocity, gamma radiation attenuation, ground-penetrating radar (GPR) dielectric properties, and acoustic wave travel time, each correlating with soil density. Calibration against traditional methods ensures reliability across diverse soil conditions.

Our study presents a comprehensive NDT approach, integrating compaction, compression, and permeability tests. By correlating soil resistance, measured via a digital multimeter, with soil density, we provide a holistic and efficient solution. The validity of this correlation was confirmed by comparing its outcomes with conventional tests, and subsequent calibration allows for assessing soil density using soil resistivity.
This thesis highlights the potential for improved in-situ density assessment through non-destructive means, emphasizing the importance of continuous innovation in soil testing methodologies for enhanced accuracy and practical effectiveness in geotechnical investigations.

Field & Lab Performance Images

Evaluation of Various Properties of Soil Reinforced with Polypropylene Fibers

Project Advisor	*Group Members*	
Dr. Imtiaz Rashid	**Ebrahim Lahim**	**2020-Civ-243**
	Ahmad Bilal	**2020-R/2019-Civ-203**
	Jacfar Farhan	**2020-R/2019-Civ-290**
	Abdullah Ahmad Farah	**2020-R/2019-Civ-299**

Abstract

The main focus of this research work is to establish the viability to enhance the weak clay soil engineering properties by incorporating polypropylene fibers. Soil sample was collected from the Narowal District of the Punjab province and survived through several tests to isolate its original properties and the soil was found as non-swelling soil. The effect of incorporating polypropylene fibers in the soil was studied using geotechnical properties of the stabilized soil.

Laboratory tests were conducted like sieve analysis, hydrometer analysis, liquid limit and plastic limit tests, modified Proctor compaction test, unconfined compression test and California Bearing Ratio test. The test results are analyzed for understanding of the impact of polypropylene fibers on the mechanical properties of the stabilized soil. CBR and unconfined compressive strengths were determined for the stabilized and untreated soil samples to draw a comparison.

This research reveals that weak clay soils can be enhanced using polypropylene fibers for engineering properties, which suggests that it could be a feasible way of enhancing soil strength and stability.

This research is relevant to Sustainable Development Goal (SDG) No. 9 on Industry, Innovation and Infrastructure as the research aims at addressing issues to do with sustainable construction practices. Therefore the study on polypropylene fibers for soil stabilization brings into the ability to establish new methodologies, approaches on the improvement of weak soils.

Potential use of Brick Kiln Dust in stabilization of soil

Project Advisor	*Group Members*	
Dr. Imtiaz Rashid	M. Laraib Abbas	2020-R-2019-CIV-125
	Muzamil Ahmad	2020-R-2019-CIV-183
	Hamza Ashraf	2020-R-2019-CIV-207
	Abdullah Hassan	2020-R-2019-CIV-198

Abstract

This research explores Brick Kiln Dust, a by-product of firing clay bricks at high temperatures, as a soil stabilizer to enhance the strength of weak soil. Laboratory experiments were conducted to assess the effectiveness of different proportions of brick kiln dust as a soil additive. The results demonstrated that adding brick kiln dust significantly improved the strength. The findings suggest that using brick kiln dust as a soil stabilizer is a promising and cost-effective approach for enhancing the stability of soils, which could have practical implications in the construction industry. The study has important implications for sustainable construction practices and the efficient utilization of waste materials.

An assessment of brick kiln dust (BKD) utilization for soil stabilization was the goal of the study. Soil samples from Lakhodiar and BKD were analyzed at a kiln facility in Lahore. The soil had a maximum dry density of 18.35 kN/m^3 and was categorized as Lean Clay (USCS) and A-7-6(14) as per AASHTO. The California Bearing Ratio (CBR) and Unconfined Compression Tests (UCT) were performed after varying the percentages of BKD (5%, 10%, 20%, and 40%) when mixed with the soil. Increasing BKD from 0% to 40% increased the soil's CBR from 5% to 13%, adding 7.8% BKD resulted in 7% CBR. The unconfined compressive strength (UCS) climbed from 91.10 kPa (0% BKD) to 138.79 kPa (20% BKD) and at 40% BKD, UCS reduced to 107.27 kPa. Soil stability is generally increased by adding BKD, with 20% BKD producing the best results.

This research aligns with Sustainable Development Goal (SDG) No. 9 (Industry Innovation and Infrastructure) by promoting sustainable construction practices and the efficient utilization of waste materials. By exploring the use of brick kiln dust, by-products of brick kiln plants, as soil stabilizers, the study contributes to the development of innovative solutions for enhancing the strength of weak soils.

Stabilization of Expansive Soils using Fly Ash and Sawdust

Project Advisor	*Group Members*	
Dr. Muhammad Ali Falak	Muhammad Abu Bakar Sohail	2020-CIV-99
	Muhammad Abubakar Arqam	2020-CIV-89
	Usman Uddin Khan	2020-CIV-90
	Arslan Anwar	2020-CIV-93

Abstract

Expansive soils have proven to be problematic in construction because of the following characteristics; swell-shrink allowance, bearing allowance, and plasticity allowance respectively. These characteristics put them in a bad stead as far as direct applications in engineering are concerned. Hence, there is a need to go for both physical and chemical stabilization processes. This research aims to determine the impact of fly ash and sawdust as suitable admixtures that would enhance the properties of expansive soils. Methodology involved the samples collected from the field were subjected to oven drying at a temperature of 105 ± 5 °C for 24 hours. Therefore, some of the initial tests to classify the soil such as acquiring specific gravities results, Atterberg's limits, sieve and hydrometer analysis, modified Proctor compaction and tests for unconfined compression strength (UCS) tests were performed. Samples of fly ash was obtained from a local concrete laboratory while that of sawdust was obtained from a wood cutting shop. Fly ash in the range of 4 – 16% and saw dust in the 2.5-10.0% levels were incorporated into the soil matrix. The compaction test achieved by using modified Proctor, UCS and Atterberg's limits tests on the soil with different percentages of fly ash to find out the best percentage of fly ash. Experiments were carried in different stages, where fly ash and sawdust were mixed with soils at varying proportions to see which proportions yields the best results. The investigations showed that appreciable reduction in liquid limit, plastic limit, and plasticity index of the soil and lesser optimum moisture content obtained when fly ash and sawdust were incorporated. On the other hand, the maximum dry density and compressive strength were observed to have slightly increased. When the two materials were incorporated into the soil at the given proportions (12% fly ash and 7.5% sawdust), the fly ash with sawdust worked on the soil by filling voids and improving on aggregation hence increasing the strength of the soil and decreasing the tendency to expand. In summary, this paper has provided evidence that the combination of fly ash and sawdust as additives, presents a viable solution to improving on the expansive soil so as to be fit for construction.

Sawdust Clay Fly Ash

Coir Fiber and Cellulose Composite use in Soil Stablization

Project Advisor	*Group Members*	
Dr. Muhammad Ali Falak	M. Junaid Zia	2020-CIV-178
	Bilal Arif	2020-CIV-184
	M. Imran Rao	2020-CIV-179
	Hamza Riaz	2019-CIV-91

Abstract

Expansive soils carry a high risk because they are inherently capable of experiencing large volume fluctuations in response to differences in moisture. If these soils are not adequately managed, they can become a serious natural hazard and seriously harm buildings. Expansive soils expand as they get wet, then contract and crack when they dry. These soils expand and put significant pressure on structures, especially lightly loaded ones like homes, pavements, floors, and canal linings, causing serious damage like uplift and cracking. Such soils are widely present in Pakistan, according to geotechnical studies, and they seriously harm different kinds of structures. Expanding soils can be identified early in the study phase to help lessen their negative consequences. One possible remedy was investigated that the soil can be stabilize through the use of cellulose and coir fiber.

This study's principle is to stabilize expansive soil through the application of cellulose and coir fiber. According to the report, Narowal, Dera Ghazi Khan (DG Khan), Sialkot, Gujranwala, and Chakwal are the five districts in Punjab where soil swelling is mostly a problem. Soil samples were taken from the University of Engineering and Technology's Narowal campus to perform a thorough investigation. Numerous studies, such as the Atterberg limit test, the California bearing ratio test, unconfined compressive tests, compaction tests, basic classification tests, X-Ray analysis, and Life Cycle assessment, were performed to characterize these soils geotechnically. After that, the test results were examined and compared with the typical soil index properties. Cellulose and coir fiber were added in amounts of 0.25% and 0.75%, respectively, to stabilize them. Stabilized soil was utilized for the road's subgrade after it was determined to be the least sensitive to the structures above. The addition of 0.25% cellulose and 0.75% coir fiber, according to the results, raised the UCS value at zero days from 221 kPa in virgin soil to 408 kPa . The UCS of the additive-treated soil rose to 619 kPa after 14 days, while the virgin soil's UCS was just 358 kPa.

Coir Fiber & Cellulose

Laboratory Simulation of Wind Induced Rockfall along Karakorum Highway

Project Advisor	*Group Members*	
Dr. Ehtesham Mehmood	Usman Khurshid	2021-P/2020-CIV-105
	Muhammad Sheharyar	2020-CIV-83
	Wakeel Ahmad	2020-P/2019-CIV-107
	Sher Ali	2021-P/2020-CIV-163

Abstract

This study focuses on the rock slope stability analysis of the Karakorum Highway from Thakot to Dassu, Pakistan. Wind can trigger landslides, rockfalls, and slope failures, leading to road blockages and endangering travellers' safety. In this Case study firstly, we have Compared practical rockfall hazard that is going to happen by wind and Rockfall hazard that is going to be occurred under controlled condition in Wind Tunnel Machine. In testing we have made temporary slope by the Perspex materials to create field scenario and Rains is going to be happen by above hole in wind tunnel machine. In this case study we want to compare the results of actual that we got through field visit and those Result we got through experimental testing in wind tunnel machine. We have also arranged exact sample from the field and sample prepared exactly like field in the form of cube, cuboid, and ellipsoid. Effect of wind on rock create a huge rockfall hazards. We also see how different classification of rocks such as Igneous, Metamorphic, and Sedimentary rocks are disturbed by Wind. We have collected observation such as crack in boulders, cobbles and gravels, depth of cracks, cracks width in field visit. We have compared the wind speed that are measure in field by Digital Anemometer and measured by wind tunnel machine. In this case study we have used Arc GIS Map for establishing map of highly active wind prone area. In this case study, we will also compressive tests, compaction tests, basic classification tests, X-Ray analysis, and Life Cycle assessment, were performed to characterize these soils geotechnically. After that, the test results were examined and compared with the typical soil index properties. Cellulose and coir fiber were added in amounts of 0.25% and 0.75%, respectively, to stabilize them. Stabilized soil was utilized for the road's subgrade after it was determined to be the least sensitive to the structures above. The addition of 0.25% cellulose and 0.75% coir fiber, according to the results, raised the UCS value at zero days from 221 kPa in virgin soil to 408 kPa . The UCS of the additive-treated soil rose to 619 kPa after 14 days, while the virgin soil's UCS was just 358 kPa.

Field & Lab Performance Images

Use of Demonstration Model in Geotechnical Engineering Education

Project Advisor	*Group Members*	
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	Shah Zain-ul-Abidin	**2020-R/2019-CIV-138**
	Mujtaba Shabir	**2020-R/2019-CIV-202**
	Raja Khaldoon	**2020-CIV-147**

Abstract

One of the challenges in geotechnical engineering education is getting students to understand complicated ideas and real-world applications. When it comes to offering concrete experiences that connect theory with real-world situations, traditional teaching approaches sometimes fall short. The use of demonstration models as a potential way to improve geotechnical engineering education is examined in this thesis. The first part of the study examines the state of geotechnical engineering education today and the drawbacks of conventional instruction. After that, it explores the idea of demonstration models, going into their different kinds, methods of construction, and approaches to use. An extensive analysis of previous research and hands-on testing are used to assess how well demonstration models enhance student learning results. To illustrate the advantages and drawbacks of integrating display models into geotechnical engineering curricula, a number of case studies and instances are looked at. According to the results, demonstrative models are a useful technique for grabbing students' attention and helping them comprehend geotechnical concepts more deeply. But when putting them into practice, issues like cost, upkeep, and scalability need to be taken into account. This thesis adds to the current discussion about cutting-edge methods of instruction in the field of geotechnical engineering education. Educators can enhance the quality of education and better equip students for the demands of the workplace by having a greater understanding of how demonstration models are used. This allows educators to make well-informed decisions about how to include these tools into their teaching practices.

Lab Performance Images

HYDRAULICS & IRRIGATION ENGINEERING DIVISION

FYP ABSTRACTS BOOK 2024

Hydrological Drought And Flood Frequency Analysis of Naran Dam Site

Project Advisor	*Group Members*	
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Abstract

Floods and droughts are critical hydrological phenomena that significantly impact the socio-economic and environmental landscape of countries across the globe. This research project focuses on the hydrological drought and flood frequency analysis of the Naran Dam site, located on the Kunhar River. The objective of the proposed dam is to generate and add cheap hydro energy to the system to meet the current shortfall and increasing demand for electricity in the region through economical and sustainable means. Understanding the pattern and frequency of hydrological extremes at this site is crucial for effective water resource management and disaster mitigation.

In this study, drought analysis using the mean annual flow (MAF) method, the low-frequency analysis method, and streamflow drought index (SDI) were performed. By using the MAF approach, it was found that from 1990 to 2000, there were 4, 5, and 2 wet years, normal years, and moderate drought years respectively. From 2000 to 2010, there were 1, 5, 1, and 3 wet years, normal years, slight drought years, and moderate drought years respectively. Also, from year 2010 to 2020, there were 4 wet years, 2 normal years, 3 slight drought years, and a severe drought year. It shows that noticeable drought conditions are expected to prevail shortly in the region of the Naran dam site which could have an impact on the water resources and will require management actions.

Hydrological drought analysis every month from the year 1990 to the year 2020 using the streamflow drought index (SDI) revealed that there were 10 extremely wet months, 16 severely wet months, 40 moderately wet months, 44 slightly wet months, 144 normal months, 53 mild drought months, 47 moderately drought months, 14 severely drought months, and 4 extremely drought months in this period.

In this study, drought analysis using the mean annual flow (MAF) method, the low-frequency analysis method, and streamflow drought index (SDI) were performed. By using the MAF approach, it was found that from 1990 to 2000, there were 4, 5, and 2 wet years, normal years, and moderate drought years respectively. From 2000 to 2010, there were 1, 5, 1, and 3 wet years, normal years, slight drought years, and moderate drought years respectively. Also, from year 2010 to 2020, there were 4 wet years, 2 normal years, 3 slight drought years, and a severe drought year. It shows that noticeable drought conditions are expected to prevail shortly in the region of the Naran dam site which could have an impact on the water resources and will

Review of Ravi Urban Development Project in Context of other Similar Development in the World

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Abstract

River Ravi which was Lahore's main water source is almost dead and dry. The main causes are the construction of Thein Dam and Madhopur headworks which have greatly reduced average annual flows of River Ravi in Pakistan. Pakistan Govt. aims to reinvigorate the dying River Ravi by turning it into a perennial freshwater body and urban development on both sides of the riverbank. For its channelization a design discharge of 586,000 cusecs (16594 cumecs)has been proposed by consultants. A total of 46 km length of the river will be channelized from Ravi Siphon to Mohlanwal. The maximum temporary storage volume based on a 1000 m wide, 46 km long water body is estimated at 0.22 million-acre feet (271.5 million cubic meter). This Final Year Project focuses on review of similar urban development projects worldwide such as the Sabarmati Riverfront Urban Development Project and the Victoria and Alfred Waterfront Development Project. Secondly, it also investigates the effect on groundwater recharge due to ponding in river Ravi because of the construction of three barrages in River training. VISUAL MODFLOW FLEX was used as a Groundwater Modeling software. The model is calibrated from the year 2003 to 2014 keeping pumping rate constant. Analysis has been carried out to see impact of ponded river on groundwater as compared to current non-ponding condition with rising river stage. It is concluded that there will be the declination of groundwater table at a rate 0.56m/year in 10 years after construction of barrages and channelizing.

Physical and Numerical Modeling of Canal Fall For Performance Improvement

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	Habib Akbar	2020-CIV-212
	Adeel Sarwar	2020-CIV-182

Abstract

The canal falls are provided at almost every canal system whether large or small and has direct bearing on the performance of these canal systems. Due to change in bed elevation the head above the crest changes into kinetic energy causing high velocity downstream side of the fall, to dissipate this high hydraulic energy having high velocities an energy dissipation structure is always required. There are two methods of energy dissipation either by hydraulic jump or by directing the jet of water by deflecting bucket. In case of canal falls the energy is dissipated by using hydraulic jump phenomenon.

This project investigates the performance of a canal fall provided at RD 304-985 on QB Link canal system, the QB link canal offtakes from Chenab River at Qadirabad barrage. Design discharge at QB- link canal was originally set as 14500 cusecs in 1960's. The canal was remodeled with increased discharge to 25000 cusecs out of which 4000 cusecs diverts to branch canal and the canal is run at 18000 cusecs due to backing up effect.

However, the structure of the canal fall was not remodeled causing energy dissipation problems at the downstream of the fall. In the current study canal fall of RD 304-985 was investigated to improve the hydraulic performance, using physical and numerical modelling techniques.

The numerical modelling of canal fall was done by HEC-RAS. Considering the same scenario of discharges and basin length as followed in physical modelling. The results of numerical modelling are in agreement with the physical modelling. Based on both physical and numerical modelling it is recommended that the improvement of hydraulic performance of the canal fall, the stilling basin length should be increased to 70 ft.

Lab Performance Images

Flood Inundation Mapping of River Ravi Considering Future Land Use

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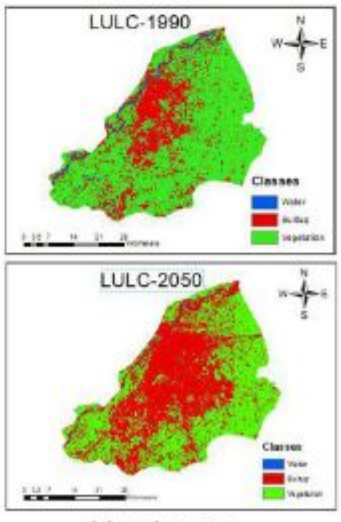
	M. Sharjeel Khan	2020-CIV-176
	Hamza Asghar	2020-CIV-187
	Adeel Hassan	2020-CIV-193

Abstract

This thesis presents a comprehensive study on flood inundation mapping considering future land use change scenarios. The research integrates advanced geospatial and hydrological modeling techniques to assess how projected land use changes impact flood risks. The research was carried out in Lahore, Pakistan's second-largest city, to examine the Land Use and Land Cover (LULC) changes. Four Landsat satellite images of Lahore district were obtained for the years 1990, 2000, 2010, and 2020, each with a resolution of 30 meters, to analyze these changes over time. The study begins with an analysis of current land use using ArcGIS, followed by future land use change predictions using TerrSet. These land use scenarios are then incorporated into hydrological modeling conducted with HEC-HMS, calibrated for the period 1999-2000 and validated for 2004-2005. Subsequent flood inundation mapping is performed using HEC-RAS.

The analysis shows a significant increase in built-up areas, with an 18.15% rise from 1990 to 2020, and an anticipated further increase of 31.7% from 2021 to 2100. The hydrological model calibration demonstrates good performance ,evidenced by an R-squared value of 0.85 and a Nash-Sutcliffe Efficiency (NSE) of 0.87. Validation results also indicate high model accuracy, with an R-squared value of 0.83 and an NSE of 0.89. These findings underscore the critical impact of urbanization on flood dynamics and highlight the importance of integrating future land use scenarios into flood risk management and urban planning strategies.

Flood mapping was done on the HEC-RAS extension Ras-Mapper by considering the three flood discharges i.e. Design discharge of RUDA 16593m3/sec,1000year flood with land-use change 11038.5 m3/sec and 1000year flood without land use change 10660.1 m3/sec. The result of flood mapping show that the maximum inundation depth for RUDA is 3.48m, for with land use depth is 2.95m and for without land use change depth is 2.91m.



Map Images

Installation of Gravitational Vortex Flow Turbine Generator on an Irrigation Outlet

Project Advisor	*Group Members*	
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Abstract

The project titled "Installation of Gravitational Vortex Flow Turbine Generator on an Irrigation Outlet" aimed at setting up and assessing the performance of a Gravitational Vortex Flow Turbine (GVFT) generator at an irrigation outlet. It also focused on creating a renewable energy source utilizing a Gravitational Vortex Flow Turbine. The project began with submitting an application to the Punjab Irrigation Department (PID) for the allocation of an outlet. Initial site evaluations at Khaira Distributary and Governor House premises were found unsuitable due to mismatched dimensions and insufficient water head, respectively. A third site, featuring a small waterfall on Sunderdas Road, met the necessary criteria after modifications, including the use of sandbags to elevate the water level, ensuring optimal turbine function. The experimental setup included measuring watercourse discharge via the moving boat method and recording turbine RPM with a tachometer. The methodology also involved applying brakes to measure torque and calculating power output and efficiency. Characteristic curves were generated to demonstrate relationships between power, torque, discharge, and efficiency, achieving a maximum output power of 81.31 watts and an efficiency of 93.02% at 140 RPM and 5.55 Nm torque. Comparative analysis with laboratory results confirmed the turbine's robust performance under real-world conditions. This study highlights the practical applications of GVFTs in renewable energy generation and their role in promoting sustainable development.

Analysis of Flow in a Stilling Basin For Low Froude's Number using Physical and Numerical Modeling

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	Haider Khan	**2020-R/2019-CIV-200**

Abstract

This study investigates the flow in a stilling basin. Flow in stilling basin is very important for making sure that whether the hydraulic structure is structurally sound and working well. This study focuses on the examination of flow for the Chashma Barrage using low Froude's number.

Main objective is to understand the behavior of hydraulic jump and the downstream scouring and erosion for different flow conditions. Froude's model law was used to scale down the model and flow characteristics up to sixty times according to the hydraulic flume present in the laboratory. The model was a replica of the prototype which was tested for scaled down discharges of different states to measure the depth of the hydraulic jump and the turbulence associated with the hydraulic jump was noticed. For the numerical modelling ANSYS software, a widely used computational fluid dynamics CFD program was employed. This software helps to create a visual representation of the stilling basin geometry and shows the flow pattern, reduced parameters were used in the geometry and discharge accordingly.

Combined physical and numerical modelling approach provides better results which show the behavior of Chashma barrage stilling basin for different flow conditions using low Froude's number.

The results obtained from both the physical model and the numerical model indicates that a sweeping hydraulic jump is formed within the existing retrogressed state of Chashma barrage stilling basin. Sweeping jump is a gradual transition from the super critical to sub critical flow while a normal hydraulic jump is an abrupt transition. As compared to normal jump a sweeping jump provides energy dissipation up to an extent but not as a normal hydraulic jump. While the reduced energy dissipation could lead to lowering of downstream water levels and downstream scouring and erosion which can reduce the life of the barrage. Information from this study can be utilized for informed decision making regarding remedial strategies for Chashma barrage.

Next step in the project could be exploring methods to improve energy dissipation within the basin which can be done through modification of the geometry or by providing energy dissipation devices. Additionally, studying the impact of sediment characteristics on the flow behavior at low Froude's number would provide a detailed understanding of challenges associated to Chashma Barrage stilling basin.

Analysis of Flow in a USBR Stilling Basin using Physical and Numerical Modeling

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Abstract

Water is a vital resource, and its effective management is crucial for sustainable use and the protection of downstream structures and dams. Stilling basins, essential hydraulic structures, dissipate energy from high-velocity flows to minimize erosion and downstream scour. This Final Year Design Project focuses on the design and analysis of stilling basins, particularly the techniques employed by the United States Bureau of Reclamation (USBR). By studying USBR stilling basins, we aim to understand their design principles, structural performance, and the numerical modeling tools used for their analysis.

The project consists of two main components: constructing a physical model and numerical modeling with ANSYS software. We prepared a miniature model of a USBR Type-II stilling basin. This hands-on approach helps us analyze physical interactions and energy dissipation processes. Lab experimentation was performed in S-6 Tilting Flume with three cases i.e. Horizontal floor without chute blocks and dentated sill, Stilling Basin with chute blocks and dentated sill & Stilling Basin with submerged jump. Without chute blocks and dentated sill, Energy dissipation was observed at around 53% while with these features, Energy dissipation was observed at around 70%. Using ANSYS, we created a model, generated the mesh, and prepared a surface profile to see how a stilling basin works under different conditions.

The experimental results were compared with the USBR monograph by A.J. Peterka. While there were some discrepancies, the results were generally in close alignment with USBR guidelines.

FINAL YEAR PROJECTS

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