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ABSTRACT BOOK

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CAPITAL UNIVERSITY OF SCIENCE AND TECHNOLOGY, ISLAMABAD,
DEPARTMENT OF CIVIL ENGINEERING

Foreword

Welcome to the CSCE 2023, 5th Conference on Sustainability in Civil Engineering (CSCE'23) is held by Department of Civil Engineering, Capital University of Science and Technology, Islamabad, Pakistan. The main focus of CSCE'23 is to highlight sustainability related to the field of civil engineering. It aims to provide a platform for civil engineers from academia as well as industry to share their practical experiences and different research findings in their relevant specializations. We hope all the participants experience a remarkable opportunity for the academic and industrial communities to address new challenges, share solutions and discuss future research directions. The conference accommodates several parallel sessions of different specialties, where the researchers and engineers interact and enhance their understanding of sustainability in the civil engineering dynamics.

This year, we have nine wonderful and renowned keynote speakers for this edition of CSCE. We have received 133 manuscripts from different countries around the world including UK, Ireland, Canada, Australia, Italy, Cyprus, China, Kazakhstan, Nigeria, Malaysia, KSA, and Pakistan. All papers have under gone a comprehensive and critical double-blind review process. The review committee is comprised of 57 PhDs serving in industry and academia of UK, Ireland, USA, Australia, New Zealand, Singapore, Hong Kong, Poland, Italy, Chile, Malaysia, China, Oman, Bahrain, KSA, and Pakistan. After the screening and review process, 56 papers are to be presented in conference.

We are grateful to all the reviewers and keynote speakers who have dedicated their precious time to share their expertise and experience. With this opportunity, we would also like to express our gratitude to everyone, especially all the faculty and staff at the Capital University of Science and Technology for their great support and participation. In this regard, the participation and cooperation of all authors, presenters and participants are also acknowledged, without whom this conference would not have been possible. Last but not least, an appreciation to our advising and organizing committees whose hard work and dedication has made this day possible.

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Dr. Hossein Derakhshan *QUT, Australia*	*Seismic Vulnerability Assessment of Unreinforced Masonry Buildings*
Dr. Anwar Khitab *MUST, Mirpur, Pakistan*	*Carbon Storage in Building Materials for a Greener Future*
Dr. Imran Muhammad *Massey University, New Zealand*	*Prosperous Cities Transition - How Do Pakistani Cities Thrive in Future by Adopting Transit Oriented Development (TOD) Model?*
Dr. Mizan Ahmed *Curtin University, Australia*	*Sustainable Use of High-Performance-Fiber-Reinforced Cementitious Composites.*
Dr. Robert Evans *Nottingham Trent University, UK*	*The Use of Ground Penetrating Radar (GPR) to Improve Sustainability in Pavement Engineering Projects*
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Capital University of Science and Technology, Islamabad Pakistan

IMPROVEMENT OF MECHANICAL CHARACTERISTICS OF CEMENTITIOUS MORTAR AT INITIAL AGE BY ADDING BIO-CHAR OF SANTA MARIA FEVERFEW PLANT

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Abstract- Present study deals with the application of nano/micro sized fibers obtained from pyrolysis of santa maria feverfew (bio-char) in cementitious mortars. The bio-char was added in amounts of 0, 0.05, and 0.1 percent by mass of cement. The mechanical characteristics were determined at the age of 3 and 7 days and matched with those of the control samples. The strength against compression remains almost unaffected by the bio-char addition. The flexural strength was observed to enhance with bio-char addition. The study revealed that the addition of the bio-char of Santa Maria Feverfew plant improves the mechanical performance of the cementitious mortars at initial stage. Bio-char are Carbon-rich materials and their use in building materials adds to Carbon sequestration which is in accordance with the sustainable development goals of UNO.

Keywords- Mortar, Bio-Char, Santa Maria Feverfew, Mechanical Performance

Paper ID. 23-104

EFFECT OF BIO-CHAR OF SANTA MARIA FEVERFEW PLANT ON PHYSICAL PROPERTIES OF FRESH MORTAR

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Abstract- Present study deals with the application of nano/micro sized fibers (bio-char) obtained from pyrolysis of santa maria feverfew (bio-char) in cementitious mortars. The bio-char was added in amounts of 0, 0.05, and 0.1 percent by mass of cement. The characteristics of the mortar in fresh state were determined and compared with those of the control specimens. The addition of bio-char did not affect the setting times and consistency. The fresh density was reduced by 11%, while the followability decreased by 50%. It is concluded that the bio-char of the plant results in a light-weight cementitious materials without affecting the setting time and consistency. Bio-char are Carbon-rich materials and their use in building materials adds to Carbon sequestration which are in accordance with the sustainable development goals of UNO.

Keywords- Mortar, Bio-Char, Santa Maria Feverfew, Performance

Paper ID. 23-105

5th Conference on Sustainability in Civil Engineering (CSCE'23)
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SYNTHESIS AND DISPERSION MECHANISM OF NANOMATERIALS IN CEMENT-BASED COMPOSITES: A STATE-OF-THE-ART REVIEW

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Abstract- Nanomaterials have emerged as a promising avenue for enhancing the reinforcement of cementitious materials, revolutionizing the concrete industry. Incorporating nanoparticles into concrete has shown significant improvements in mechanical performance, including increased strength and resilience. This paper provides a comprehensive overview of recent studies on the synthesis and dispersion of nanomaterials in cementitious materials, encompassing graphene oxide, graphene, nano-titanium oxide, CNTs, nano-alumina, nano-clay, nano-kaolin, nano-silica, and nano-ferric oxide. The findings highlight the advancements in nanomaterial integration and their profound impact on concrete properties. Additionally, the review identifies the challenges associated with nanoparticle dispersion and discusses techniques such as ultrasonication and the use of surfactants to improve dispersion in cement composites, thereby enhancing mechanical and photocatalytic properties.

Keywords- Nanomaterials, Synthesis, Dispersion Mechanism, Cementitious Composites

Paper ID. 23-106

IMPROVED COMPRESSIVE PERFORMANCE OF BIO-INDUCED SISAL FIBERS REINFORCED CONCRETE

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Abstract- The use of calcite-precipitating bacteria and fiber reinforcement has the potential to enhance the strength and crack-healing characteristics of cementitious materials. However, their impact on the compressive response of concrete is uncertain. This study evaluates the compressive response of Sisal Fiber (SisF) reinforcement in combination with *Bacillus Subtilis* (B.St) in concrete. The results demonstrate that SisF inclusion improves ductility, peak compressive strain, post-peak compression energy, and total compression energy, leading to a 1.43 increase in the toughness index. Direct incorporation of B.St due to the Microbial-Induced Carbonate Precipitation (MICP) process results in an 8.1% increase in compressive strength compared to the control mixture. Furthermore, combining fiber reinforcement and MICP leads to a substantial 14.0% increase in compressive strength while maintaining a toughness index of approximately 1.59. The successful synthesis of MICP is confirmed through Fourier Transform Infrared analysis. These findings establish the effectiveness of SisF and B.St, in enhancing concrete's compressive performance, thereby promoting the development of more resilient and sustainable construction materials.

Keywords- Bacillus Subtilis, Compressive Response, Concrete Composites, Sisal Fiber

Paper ID. 23-107

DEVELOPING HIGH PERFORMANCE CONCRETE USING JUTE FIBERS

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Abstract- Jute fibers can be effective material to increase the strength of concrete. In Pakistan jute is easily available and cheap. To verify this aim, an experimental investigation of the flexural, tensile, compressive, rebound hammer and UPV test was performed to check the potential of jute fibers in enhancing the strength of concrete. To perform these test and to check the effect of these parameter, standard cylindrical and cube shaped specimens were prepared with different mixing ratios, and then those test results were compared to normal plain concrete. Also it had been observed that using larger cut length and higher amount jute fibers. content has ability of making round (balling) type of formation. Hence it decreases the mechanical properties of jute fibers reinforcement of concrete cement. However, shorter fiber lengths and lower fiber content led to strong structure and improved mechanical properties. Also, it had been observed that the presence of jute fibers with high amount of cement and well graded coarse aggregate resulted in greater strength of concrete.

Keywords- Concrete, Economical, Jute Fibers, Specimens, Strength

Paper ID. 23-108

RESPONSE SURFACE METHODOLOGY BASED OPTIMIZED MIX DESIGN FOR SELF-COMPACTING CONCRETE BLENDED WITH METAKAOLIN WASTE

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Abstract - This study explored the fresh and hardened properties of self-compacting concrete (SCC), which is enhanced with an active combination of Metakaolin (MK) and Limestone Powder (LP). This led to the development of a method for achieving the ideal ratio of ingredients during the mix design process using optimization technique. An analysis of 16 mixing schemes is conducted using the response surface method (RSM). There are two categories of input variables: mixture variables and process variables. As mixture constituents the three ingredients of cement, metakaolin, and lime were constrained to a total of 100%. While coarse aggregate, fine aggregate, and the water-to-binder ratio were considered as process variables. By adding metakaolin and limestone powder to the SCC, the cement replacement level can range from 40 to 55%. In order to find the perfect combination, RSM optimization was employed. To understand the rheological properties of the mixture some tests like slump flow, L-box, and sieve segregation were performed. And to measure the mechanical strength, the samples were examined for the compressive strength at both 7- and 28-days. According to experimental findings, adding metakaolin at a higher concentration decreases both its workability and hardened properties.

Keywords- Mix Design, Optimization, Response Surface Methodology, Self-Compacting Concrete.

Paper ID. 23-109

5th Conference on Sustainability in Civil Engineering (CSCE'23)
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RELIABILITY OF CORES TEST RESULT AT ELEVATED TEMPERATURE IN CASE OF NORMAL STRENGTH CONCRETE

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Abstract- In the last decades the assessment of in situ quality of concrete and integrity of concrete elements have been tested through non-destructive approaches. Under the constant fire and earthquake risk it is very mandatory to determine the seismic performance of the existing structure and consequently, the strength of the concrete used in the construction should be known to decide for repairing and strengthening. In this instance concrete cores are taken from different places of structure and their compressive strength is determined by a test carried out on these core specimens. The core test is usually involved in the area of the concrete industry to evaluate strength and occasionally it develops a unique tool for safety assessment of concrete structures. In this study, the effect of temperature has been investigated and the reliability of the core test has been evaluated. For this purpose, the cylindrical core was extracted from Normal strength concrete (NSC) specimens that were exposed to the temperature ranging from 300 ℃ to 900 ℃ with a constant duration of 4 hr. This study compares the difference between the heated actual cylinder and the core taken from them after curing of 90 days. The difference of cylindrical control and binary mix samples and extracted core revealed that there is a 6.67% and 7.81% difference at 300 ℃, while this difference was found to increase up to 8.72%, 9.81% at 500 ℃ Furthermore this value is recorded as 10.47%, 11.81%, and 11.97%, 13.56% at 700 ℃ and 900 ℃ respectively, whereas a total number of four (4) equation to developed through regression model for predicted strength of concrete for both cylindrical and extracted core whose R square value is 0.9666, 0.9794 and 0.9103, 0.8957 respectively.

Keywords- Normal Strength Concrete (Nsc), Core Test, Temperature, Multiple Regression Model

Paper ID. 23-110

STRUCTURAL PERFORMANCE OF E-WASTE CONCRETE REINFORCED WITH DIFFERENT FIBRES

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Abstract- E-waste is growing at a pace of 3-4% a year, and it is estimated that by the year 2025 its production will be increased to 55 million tons. The production of concrete in the year 2022 stood at 4.4 billion tons if we consider the percentage of aggregate at 60%-70% it comes out to be approx. 3 billion tons. The consumption of natural aggregates at this massive scale has put enormous pressure on mining resources and excessive mining has led to serious environmental and socio-economic problems. The studies so far have shown that addition of e-plastic waste as plastic aggregates results in deterioration of mechanical properties of concrete. This study aims to study the effect of addition of carbon and steel fibers on the mechanical properties E-waste concrete. Two sets of four types of concrete mixes were produced with substitution of manufactured plastic aggregate with natural concrete aggregate (NCA) up to 40% replacement levels. One set was added with carbon fibers and the other one with steel fibers. Both fibers were added in the fixed quantity of 1% by weight of binder material for each sample. The results indicated that the compressive strength of both sets of samples reduced in the range of 4-55% and 20-33% for e-waste concrete with carbon fibers and steel fibers respectively. The splitting tensile strength was reduced in the range of 5-47% and 13-32% for e-waste concrete containing carbon and steel fibers respectively.

Keywords- Fibre Reinforced Concrete, Plastic Aggregates, Natural Concrete Aggregate (NCA) Steel Fibres, Carbon Fibres

Paper ID. 23-111

EFFECT OF INDIGENOUS VOLCANIC ASH AS PARTIAL REPLACEMENT OF CEMENT ON MECHANICAL PROPERTIES OF CONCRETE AT ELEVATED TEMPERATURE

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Abstract- This study examines the repercussions of indigenous volcanic ash (IVA) as a partial substitution of cement on the concrete's mechanical properties when exposed to elevated temperatures. The study aims to explore the potential benefits and limitations of utilizing volcanic ash in concrete mixtures for applications in high-temperature environments. The research includes varying percentages of volcanic ash replacements (10%, 20%, 30% and 40%) to assess their impact on concrete's mechanical properties. The experimental program consists of conducting compressive strength tests, splitting tensile strength tests, and strength activity index tests on concrete and mortar specimens respectively. The concrete specimens are subjected to elevated temperature conditions using a controlled heating system for 2hr. The specimens mechanical properties are evaluated and compared to those of the control specimens without volcanic ash. Lower percentages of IVA replacement (10%) show better strengths as compared to the control specimens at different temperatures. However, as the volcanic ash content increases, a gradual reduction in compressive strength and splitting tensile strength is observed with increasing temperature. The findings from this research provide valuable insights into the behavior of concrete incorporating IVA at elevated temperatures. The outcomes contribute to the broader understanding of sustainable and durable concrete production using locally available volcanic ash resources.

Keywords- Compressive Strength, Elevated Temperature, Indigenous Volcanic Ash, Splitting Tensile Strength

Paper ID. 23-112

THE EFFECT OF PLASTIC FIBERS ON THE MECHANICAL PROPERTIES, DUCTILITY AND ENVIRONMENTAL PERFORMANCE OF CONCRETE – A REVIEW

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Abstract- Concrete is a common building material due to its strength and durability, but it is essentially brittle, which can lead to cracking and reduced ductility under tensile loads. To enhance the ductility of concrete, different studies have done on various fiber, including plastic fibers. This paper explores the impact of plastic fibers on the mechanical properties, ductility and environmental performance of concrete. This review paper includes different studies on plastic fiber reinforced concrete under compressive, split tensile and flexure, focusing on the effect of plastic fibers on the ductility and environmental effect of it. Different studies show that plastic fibers significantly improve the compressive, split tensile, flexure, ductility and it will also help in reducing the plastic waste. These findings have important implications for the design of concrete buildings and their construction., particularly in earthquake-prone regions, where improved ductility capacity can amplify the seismic performance of structures additionally decrease the risk of catastrophic failure. Furthermore, the use of plastic fibers as reinforcement provides a sustainable solution for managing plastic waste. Plastic fibers have low cost, high availability, and favorable mechanical properties, making them an attractive alternative to traditional fiber reinforcement materials. The use of plastic fibers into concrete can reduce the environmental impact of plastic waste. The results of this study demonstrate the potential of plastic fiber reinforced concrete to improve the ductility and concrete structure's capacity to absorb energy while providing a sustainable solution for managing plastic waste.

Keywords- Plastic Fiber Concrete, Mechanical Properties, Ductility of Plastic Fiber, Environmental Effect

Paper ID. 23-113

5th Conference on Sustainability in Civil Engineering (CSCE'23)
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BEHAVIOR OF RETROFITTED GPC COLUMNS UNDER ECCENTRIC LOADING

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Abstract- Geopolymer concrete has been the subject of ongoing research as a suitable substitute for conventional concrete production because of its benefits for the environment. The use of conventional cement may be completely avoided with the use of geopolymer concrete (GPC), which also supports the efficient utilization of waste resources. However there is a little research regarding retrofitting the structural part if a GPC member fails. The current study thus concentrates on the damaged GPC structural members/columns. For this purpose 12 columns which include 4 CC columns, 4 GPC Columns and 4 FRGPC columns were retrofitted with CFRP sheets and tested in the electrohydraulic testing apparatus (5000 kN). The results showed significant improvement in the ultimate load value of all 12 columns. Axial strain in all 12 columns also increased significantly. The ductility index of the columns were also calculated using axial strain values. The axial load-displacement behavior, ductility, and loading capacity of the evaluated columns are all significantly improved by the addition of steel fibers.

Keywords- Carbon Fiber Reinforced Polymer (CFRP), Eccentricity, Fiber Reinforced Geopolymer Concrete (FRGPC)

Paper ID. 23-114

EXPLORING THE POTENTIAL OF MOSS CONCRETE AS AN ECO-FRIENDLY SOLUTION TO MITIGATE URBAN HEAT ISLAND EFFECT

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Abstract- This paper explores the potential of moss concrete as an eco-friendly solution to mitigate the Urban Heat Island (UHI) effect. To mitigate UHI effects, various approaches can be implemented, such as energy efficiency improvement, green roof construction and utilization of high reflectivity materials. Moss concrete is a type of concrete that incorporates moss into its mixture to create a natural, eco-friendly building material. Mosses are known for their ability to retain moisture, and they can help regulate surface temperatures and reduce the UHI effect. Moss concrete is a type of biological concrete that is developed by growing moss on the surface of structures. The construction of moss concrete involves a conventional concrete layer that serves as the structural component of the building, a waterproof layer that acts as a barrier, and an outer layer of moss concrete designed to allow rainwater to penetrate and boost the growth of the organisms. Moss concrete has the potential to purify the air by absorbing excess carbon dioxide from the atmosphere along with storm-water management, improved water run-off quality and extension of roof life.

Keywords- Urban Heat Island Effect, Moss Concrete, Albedo, Durability, Eco-Friendly, Stormwater Management

Paper ID. 23-116

UTILIZING CORN COB ASH AND BAUXITE AS ONE PART GEOPOLYMER: A SUSTAINABLE APPROACH FOR CONSTRUCTION MATERIALS

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Abstract- This research was based on preparation of sustainable geopolymer mortar using waste materials like corn cob ash (CCA) and bauxite. The corn cob was burnt first in an uncontrolled open environment and ashes obtained from uncontrolled burning were burnt at 600 ºC for 2 hours in an electric muffle furnace with target of achieving CCA that is rich in silica content and free from carbon impurities. Then this ash was grinded to get a better specific surface area for increase reactivity. The grinded ash that passed through sieve # 200 was used as binder. Sodium Silicate was used as geopolymerization activator in this research. The geopolymer prepared in this research was one part geopolymer or "just add water" geopolymer. So, activator was added in powdered form to the mix of fine aggregate, grounded bauxite and CCA. The proportions used in this research were CCA / Bauxite = 10/90, 20/80, 30/70. Binder to sand ratio of 1:1 was used for each proportion of Bauxite/CCA. The curing was conducted by keep the samples in oven at 70ºC temperature for 24 hours and then at ambient temperatures for rest of the time till testing. The results of both the curing methods on strength of geopolymer mortar were assessed later during compression testing. The tests were conducted on 7 days, 14 days, and 28 days. The tests included strength tests and durability tests. ASTM standards were followed for testing and compilation of results.

Keywords- Bauxite, Corn Cob Ash, Geopolymers, Green Concrete

Paper ID. 23-117

COMPOSITE FIBERS IN CONCRETE: PROPERTIES, CHALLENGES, AND FUTURE DIRECTIONS

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Abstract- Composite fibers are an essential component of modern concrete structures, providing enhanced mechanical properties and durability. This paper provides a comprehensive review of the current state-of-the-art advancement in composite fibers in concrete. There are different types of fibers commonly used in concrete such as steel, glass, carbon, and polypropylene fibers etc. Composite fibers include combination of two or more of these fibers. Composite fibers are discussed in detail, along with their properties and benefits. The paper also highlights the effects of composite fibers on the various properties of concrete, such as compressive strength, tensile strength, toughness, and durability. Furthermore, the paper discusses some of the challenges and limitations associated with the use of composite fibers in concrete, including issues related to fiber dispersion, fiber-matrix interaction, and cost-effectiveness. Finally, the paper concludes with a discussion of future directions in research on composite fibers in concrete, focusing on potential advancements in fiber technology, improved manufacturing techniques, and the development of new fiber-matrix systems. Overall, this paper provides a comprehensive overview of the current state-of-the-art in composite fibers in concrete and serves as a valuable resource for researchers and practitioners in the field.

Keywords- Fiber Composites, Concrete Matrix, Tensile Strength, Tensile Stress, Durability

Paper ID. 23-119

EFFICIENCY AND SUSTAINABILITY: ENHANCING MORTAR MIXTURES WITH WASTE PAPER SLUDGE ASH

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Abstract- The study aims to increase the efficiency of Mortar mixes and improve their necessary qualities such as strength, density and durability by using waste paper as a cement substitute in the form of Wastepaper Sludge Ash (WPSA). Due to less use of cement and greater usage of WPSA, CO2 and SO2 emissions can be reduced and the depletion of natural resources can also be decreased. The chemical and physical properties of WPSA were compared to those of Ordinary Portland Cement (OPC). Testing showed that WPSA had similar cementitious properties. Three types of destructive and non-destructive tests were performed to determine the compressive strength of Mortar specimens containing varied ratios of cement replacements. Mortars with 20, 25, and 30% cement replacement were tested. It had a good ultimate strength of 19.05 MPa when 25% of cement by weight was replaced with WPSA. By utilizing WPSA in proportions of 25%, the density and water resistance of samples were also increased. Acid attack test results showed that in 20 and 25 % of WPSA Mortar samples, the loss of strength is almost similar to that of ordinary mortars. Results demonstrate the potential applications of this mortar in a variety of settings where increased toughness and equivalent characteristics are needed while still preserving the environment.

Keywords- Wastepaper Sludge Ash; Mortar; Density; Water Absorption; Acid Attack

Paper ID. 23-122

ENHANCED PERFORMANCE OF BRICK AGGREGATE CONCRETE USING PARTIAL SUBSTITUTION OF SAND WITH WASTE GLASS AND FLAX FIBER INTRUSION

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Abstract- This paper addresses the growing concern over the depletion of natural resources and the environmental impact of their extraction in the construction industry. The study examined the impact of incorporating flax fiber (FF) and waste glass fine aggregates (WGFA) on the mechanical properties of recycled brick aggregate concrete. The investigation focuses on the compression, split-tensile and flexural strength of the modified concrete. The results demonstrate that the incorporation of FF and WGFA substitution can enhance the mechanical properties of brick aggregate concrete, with the 1% fiber and 50% WGFA mix showing promising results in terms of compressive strength, and the 2% fiber and 50% WGFA mix showing promising results in terms of split tensile and flexural strength.

Keywords- Concrete, Flax Fiber, Mechanical Properties, Recycled Brick Aggregate, Waste Glass

Paper ID. 23-124

ASSESSING THE FLEXURAL STRENGTH OF A BEAM USING WASTE PLASTIC AS A PARTIAL SUBSTITUTE FOR COARSE AGGREGATE

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Abstract- In order to promote resource conservation, recycling plastic waste is crucial as it is durable and does not decompose. Nowadays, the concrete industry worldwide is constantly seeking to develop effective materials that are lightweight, cost-effective, and eco-friendly. To achieve the desired properties in concrete while reducing its negative effects on the environment, plastic waste can be utilized as a partial substitute for coarse aggregate. Previous research has suggested that a 10-20% replacement of coarse aggregate with plastic aggregate is ideal. This study comprised of two phases. During initial phase, concrete cylinders were examined, each containing with different proportion of plastic aggregate as a partial replacement, and favorable outcome were achieved with 20% replacement. In the second phase, three Reinforced Concrete (RC) beams were built, with two beams using 20% replacement of coarse aggregate with plastic aggregate and the third as a control specimen for comparison purposes. All beams were designed according to the ACL code and tested under third-point loading in accordance with ASTM C78/C78M to investigate their flexural behavior at midspan. The beams with partial plastic aggregate replacement exhibited almost identical flexural behavior while reducing their self-weight by 14%.

Keywords- Flexure Strength, Coarse Aggregate, Waste Plastic, Concrete

Paper ID. 23-125

BACTERIAL SELF-HEALING FOR SUSTAINABLE CONCRETE: A COMPARATIVE STUDY OF VEGETATIVE AND SPORE-FORMING BACTERIA

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Abstract- Affordability and availability of concrete is driving its use in building. Hence, sustainable, and durable concrete is needed. Cracks from excessive water, creep, or shrinkage cause concrete to fail. Crack creation reduces strength, and moisture alone or with a toxic chemical like sulfur can induce steel corrosion and concrete degradation, reducing the longevity of concrete. Hence, cracks must be filled, but mechanically repairing cracks, especially micro and deep cracks, is laborious and expensive and cannot be done in structural members that are not apparent. MICCP has been studied for concrete durability. This research covers self-healing characteristics using bacterial species; the effect of bio-concrete in prisms; and a comparative study using alkali-resistant spore-forming bacteria and vegetative bacteria. For concrete to self-heal, Bacillus subtilis and other alkali-resistant bacteria are added during mixing. This research indicates that Spore-forming bacteria performed better than vegetative bacteria. The crack remediation due to bacterial action was confirmed by performing SEM analysis.

Keywords- Self-Healing Ability of Concrete, Vegetative Bacteria, Spore Forming Bacteria, MICCP

Paper ID. 23-126

EFFECT OF BENTONITE & POLYPROPYLENE FIBERS ON FRESH AND HARDENED PROPERTIES OF FLY ASH BASED GEOPOLYMER CONCRETE

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Abstract- Geopolymer concrete is developed by alkaline activation of waste materials and industrial byproducts rich in silica and alumina. Bentonite is one such pozzolanic clay material that is rich in SiO2 content. It has been extensively used as a supplementary cementitious material in conventional Ordinary Portland cement (OPC) concrete resulting more cheaper, environment friendly and durable concrete. However, a little research is reported so far to assess the performance of bentonite modified geopolymer concrete. This study investigates the individual and combined incorporation of bentonite and polypropylene (PP) fibers on the workability and mechanical properties of fly ash based geopolymer concrete. Fly ash (FA) was used as precursor to develop geopolymer concrete (GPC) mixtures. FA was replaced with bentonite at 10% wt content and PP fibers were added at three different proportions i.e., 0.5%, 0.75% and 1%. Both raw (untreated) and heat-treated (up to 200 degrees Celsius) forms of bentonite were used. The intention was to ascertain whether heat-treated bentonite can perform better than untreated bentonite when combined with various PP fibers concentrations. The mechanical properties of bentonite modified, and PP fiber reinforced GPC mixtures were evaluated. The findings showed that addition of bentonite and PP fibers significantly increased the mechanical properties of GPC mixtures. However, the contribution of heat-treated bentonite in combination with PP fibers to mechanical properties of GPC mixtures is more significant.

Keywords- Geopolymer Concrete, Bentonite, Polypropylene Fibers, Mechanical Properties

Paper ID. 23-128

THE BEHAVIOR OF PRE-TREATED CRUMB RUBBER AND POLYPROPYLENE FIBERS INCORPORATED MORTAR SUBJECTED TO ELEVATED TEMPERATURES

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Abstract- Rubber is a waste produced by the industrial sector in large quantities. Due to its non-degradable nature, it has been a serious threat to the environment. Thus, it is recommended to develop concrete or mortar containing rubber, so that it can save our environment, and is economical too. Crumb rubber, when incorporated in mortar, reduces its strength, so it can be used along with some fibers to enhance its strength. This study examines the effect of elevated temperatures, i.e., 150, 300, 450, 600, 750˚C, on mortar samples, containing 5% crumb rubber replacement of fine aggregate by volume, and 1% PPF being added to it. The findings indicated a rise in compressive strength up to 300˚C, followed by a subsequent decline. It is also observed that the weight loss of the samples increased with an increase in temperature.

Keywords- Muffle Furnace, Polypropylene Fibers (PP Fibers), Compressive Strength, Elevated Temperature

Paper ID. 23-129

PERFORMANCE OF SELF-COMPACTING CONCRETE WITH INCORPORATION OF SILICA FUME AND COAL BOTTOM ASH

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Abstract- With increasing emphasis on sustainable construction practices, supplementary cementitious materials (SCM's) used in the production of concrete has gained a lot of attention. In current study, the effects of partial Portland cement (PC) replacement with Silica Fume (SF) and Coal Bottom Ash (CBA) on the mechanical and fresh characteristics of self-compacting concrete (SCC) are investigated. By replacing PC with SF and CBA, which are industrial by-products, the environmental impact of concrete production can be reduced while improving its performance. Ten SCC mixes were examined, with varying replacement percentages: SF at 5%, 10%, and 15%; and CBA at 15%, 20%, and 25% by weight of cement content. The investigation of mechanical characteristics through compressive strength and split tensile strength tests, as well as the examination of fresh properties using the slump flow and J-ring tests, gives insightful data. The results shows that combined incorporation of SF & CBA at 5% & 15% shows a better slump as compared to high replacement level of both the SCM's. The slump of mixes with different ratio goes on decreasing with the increasing percentage of CBA and SF although it falls in acceptable limit. Due to fineness, enhanced surface area and porosity of CBA the water demand increases which cause the decrease of workability. The 28-days Compressive strength and Spilt tensile strength are 28.56 MPa & 2.75 MPa at optimum dosage M-1(5 % SF & 15 % CBA) respectively which are less than control but significantly near control sample strength. The strength decreases with the increase of CBA & SF ratios due to slow pozzolanic reaction of CBA at early ages which however improves at later stages. Moreover, the CBA has enough potential to be employed in SSC production along with SF.

Keywords- Fresh Properties, Self-Compacting Concrete, Compressive Strength, Coal Bottom Ash, Split Tensile Strength

Paper ID. 23-130

MICRO STRUCTURAL STUDY OF CONCRETE WITH INDIGENOUS VOLCANIC ASH

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Abstract- Extraordinary efforts should be carried out in Pakistan for the preparation of green concrete from using waste materials. This will cause the reduction of Global warming and protection against the natural ecology. The intrusion of these waste materials in concrete will produce the utmost effects. Thus, utilizing Volcanic Ash (VA) in concrete will make sustainable concrete that will produce lesser carbon dioxide (CO2) emissions and give positive outcomes. Three mixing regimes of VA concrete with changing concentrations ranging from 0, 10, and 20% replacement was cast. W/C was kept constants for all the mixes. Compressive strength were carried out to check its effect in cementitious composite, and the result is evaluated by scanning electron microscopy. The analysis of results reveals that VA with 10% replacement gives an adamant response. Thus, its intrusion can enhances the strength of overall matrix.

Keywords- Compressive Strength, Scanning Electron Microscope, Volcanic Ash, Chemical Composition

Paper ID. 23-131

EFFECT OF HEAT ON SELF-COMPACTING CONCRETE WITH PARTIAL SUBSTITUTION OF FOUNDRY SAND AS FINE AGGREGATE AND ADDITION OF PROPYLENE FIBERS

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Abstract- Foundry sand mainly consists of silicates, and it is used as a replacement of fine aggregate to make self-compacting concrete that is cheaper, better for the environment, and sustainable. This research study looked at how at elevated temperatures foundry sand and propylene fibers (PPF) changed the mechanical properties of self-compacting concrete. 25% cement was replaced with fly ash, fine aggregate with foundry sand at different proportions (0%, 20%, 30% & 40%) and propylene fibers in 0.75% were added. The goal was to determine the mechanical properties of above-mentioned mixes of self-compacting concrete at 25oC, 300oC, 400oC and 500oC and to compare them with normal mix self-compacting concrete. The ratio adopted for the testing is of 1:1.56:2.60 (Binder: Fine Aggregate: Coarse Aggregate). For examining the mechanical characteristics of concrete the tests carried out were splitting tensile strength, compressive strength and Flexural strength tests. Experimental results show that the mix with 25% fly ash, 20% foundry sand replacement with addition of 0.75% of propylene fibers has performed better than all other samples including the control mix at all elevated temperature

Keywords- Foundry Sand, Elevated Temperature, Heat Effect, Propylene Fibers, Mechanical Properties

Paper ID. 23-133

CONCRETE EVOLUTION: AN ANALYSIS OF RECENT ADVANCEMENTS AND INNOVATIONS

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Abstract- This comprehensive review article aims to provide a detailed overview of the significant advancements in concrete development over the past decade. It covers a wide range of aspects within concrete technology, including the emergence of novel materials, sustainable practices, durability enhancements, advanced manufacturing techniques, and emerging trends. By examining these key areas, the review aims to offer a critical analysis of the advancements, evaluating their benefits, limitations, and potential avenues for further research and improvement. Through this comprehensive exploration, the article serves as a valuable resource for researchers, engineers, and industry professionals, enabling them to stay updated on the latest trends and make informed decisions in the field of concrete technology.

Keywords- Concrete Development, Sustainability, Durability, Advanced Manufacturing Techniques, 3d Printing

Paper ID. 23-135

DURABILITY CHARACTERISTICS OF SELF-COMPACTING CONCRETE WITH PARTIAL SUBSTITUTION OF FOUNDRY SAND AS FINE AGGREGATE AND ADDITION OF PROPYLENE FIBERS

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Abstract- Foundry sand mainly consists of silicates, and it is used as a replacement of fine aggregate to make self-compacting concrete that is cheaper, better for the environment, and more durable. This research study looked at how foundry sand and propylene fibers (PPF) changed the mechanical and durability properties of self-compacting concrete. 25% cement was replaced with fly ash, fine aggregate is replaced with foundry sand in different proportions (0%, 20%, 30% & 40%) and propylene fibers in 0.75% were added. The goal was to determine the mechanical and durability properties of above-mentioned mixes of self-compacting concrete and to compare them with normal mix self-compacting concrete. The ratio adopted for the testing is of 1:1.56:2.60 (Binder: Fine Aggregate: Coarse Aggregate). For examining the mechanical characteristics of concrete the tests carried out were splitting tensile strength, compressive strength, and Flexural strength tests. And to examine the durability properties water absorption, acid attack and abrasion resistance tests were conducted. The normal self-compacting concrete shows less resistance towards environmental effects. Experimental results show that the mix with 25% fly ash, 20% foundry sand replacement with addition of 0.75% of propylene fibers has performed better than all other samples including the control mix against environmental effects

Keywords- Durability Properties, Foundry Sand, Fly Ash, Propylene Fibers, Viscocrete, Mechanical Properties

Paper ID. 23-137

PREDICTING THE RESIDUAL FLEXURAL CAPACITY OF FIRE EXPOSED REINFORCED CONCRETE BEAMS USING GENE EXPRESSION PROGRAMMING

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Abstract- Reinforced concrete (RC) structures are the most commonly used ones in the construction industry; however, they exhibit a tendency of getting damaged when subjected to fire, which can cause significant deterioration and compromise their overall safety. Considering their fire susceptibility, it is critical to predict the residual flexural capacity of their structural elements especially the immediate load distributing elements i.e., RC beams in order to ensure their safety and reliability in fire hazard situations. In an effort to do so, a novel methodology was introduced by this research, utilizing gene expression programming (GEP) to accurately forecast the remaining flexural strength of RC beams after being imperiled to fire. For the evolution of GEP model, a comprehensive database consisting of 280 datapoints as reported in the past literature was used. The database incorporated seven input variables corresponding to the predetermined remnant flexural capacity output of the given beams. The performance of the proposed model was assessed using three widely recognized performance metrics: the mean absolute error, the coefficient of determination, and the root mean squared error. From the performance evaluation results, a robust correlation was found to exist between the target and predicted results with minimum error. Therefore, the proposed model can be assuredly recommended for quickly, accurately, and dependably forecasting the remnant flexural strength of RC beams after being subjected to fire.

Keywords- Fire, Gene Expression Programming, Prediction, Reinforced Concrete Beams, Residual Flexural Capacity

Paper ID. 23-201

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STRENGTH PREDICTION OF VARIOUS BEAMS THROUGH THE ARTIFICIAL NEURAL NETWORK

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Abstract- This study aims to compare of first crack load and flexural strength of reinforced concrete beams without stirrups obtained from the conventional model developed using the current design code (ACI building code) with the non-conventional problem solver, i.e., an Artificial Neural Network (ANN). For this purpose, 110 sample data of reinforced concrete beams without stirrups reinforcement obtained from published research data are used to train Multilayer Backpropagation Neural Network through MATLAB. This work enables the development of a knowledge-based structural analysis model capable of predicting RC structural responses. The results obtained from the ANN model are closer to the experimental results of the conventional model. The coefficient of determination obtained from the comparison of these results is 0.945.

Keywords- Reinforced Concrete, Soft Computing, Artificial Neural Network, Ultimate Limit State, Finite Element

Paper ID. 23-202

LINEAR AND NON-LINEAR REGRESSION ANALYSIS ON THE PREDICTION OF COMPRESSIVE STRENGTH OF SODIUM HYDROXIDE PRE-TREATED CRUMB RUBBER CONCRETE

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Abstract- Cement, sand and aggregate are major needs of any construction industry. Sand is a basic material used in mortar and concrete for construction. Many researchers are finding different materials to replace river sand and one of the major material is crumb rubber. Using different proportion of these crumb rubber along with sand, the required mortar mix can be obtained. This research focuses on the statistical modelling of compressive strength of NaOH pretreated crumb rubber concrete at 28 days with the help linear and nonlinear regression analysis. By the dataset development using sodium hydroxide treatment period (NaTP) ,sodium hydroxide concentration (NaCon), coarse aggregates (gravel), fine aggregates (sand), water, water to cement ratio (w/c),crumb rubber percentage (CR%) the equations are made for the predication compressive strength of concrete. The evaluation criteria used for the models accuracy includes coefficient of regression (R2), mean absolute error (MAE) and root mean square deviation (RMSE). In this study the multiple non linear regression (MNLR) performs better as compare to multiple linear regression (MLR).The MNLR gets the value for R2 , MAE and RMSE of 0.8791,4.642 and 6.15 and MLR gets the value of 0.8177, 5.855 and 7.43 for R2, MAE and RMSE respectively.

Keywords- Regression Analysis, Multiple Linear Regression, Pretreatment, Compressive Strength

Paper ID. 23-204

EXPLORING VIBRATION MEASUREMENT PRECISION: A COMPARATIVE ANALYSIS OF A DIY, LOW-COST ACCELERATION MEASUREMENT UNIT VERSUS A PREMIUM STANDARD ACCELEROMETER SYSTEM

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Abstract- This study focuses on the fabrication and utilization of a low-cost acceleration measurement unit in the construction industry. The ADXL 345 Accelerometer is integrated with an Arduino Mega 2560 microcontroller to facilitate monitoring and recording of readings. The accelerometer captures acceleration along three axes and is connected to the microcontroller. While the low-cost acceleration measurement unit offers approximate measurements, it is subject to certain limitations. The research highlights the importance of creating affordable sensors in scenarios where premium sensors are not readily available or cost-effective. To evaluate the accuracy of the developed prototype, a comparison is made against a premium acceleration measurement unit (AMUs) comprising MEMS type accelerometer 4030 by TE Connectivity controlled by the DAQ System7000 by Vishay Intertechnology, Inc. USA. The relative error is calculated with respect to a finite element model. The obtained results demonstrate that the relative error is not significantly high, thereby indicating the potential reliability of the acceleration measurement unit.

Keywords- Accelerometer, Arduino, Dynamic Response, Monitoring and Recoding

Paper ID. 23-206

EVALUATION OF SEISMIC RESPONSE OF 3D BUILDING FRAME WITH AND WITHOUT BASE ISOLATION USING FINITE ELEMENT ANALYSIS

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Abstract- An earthquake is a force which is unpredictable and can cause serious damage to a structure and its structural components. For a higher safety, the seismic design of the building should be adequate, and measures should be taken for vibration control. In order to mitigate effects, isolation techniques must be provided to counter seismic loads. Base isolation is a seismic isolation technique in which the substructure is decoupled from the superstructure to dissipate and reduce the effect caused by seismic forces. This prevents the transfer of energy from the base of the structure to the upper stories. In the research, two similar 3D frame models were modelled with and without base isolators, and analyzed following the provisions of the Uniform Building Code 1997 (UBC-97). The real ground motion data of the earthquake i.e. Northridge-Lassen & Reseda was selected. It was matched to the UBC-97 design spectrum to obtain the matched time history. Which was then applied to check the structural response of the frame with fixed and isolated base. The seismic responses of both frames were compared and a significant reduction in storey drifts, storey displacements and storey shear, were observed. Moreover, the stiffness of the frame was also increased, consequently, reducing the seismic effects on the building. The storey response plots obtained after the time history analysis indicate that base isolation is a reliable and effective technology to improve the seismic performance of the building, particularly with inadequate seismic design or retrofitting needs.

Keywords- Base Isolators, Seismic Base Isolation, Lead Rubber Base Isolator, Time History Analysis

Paper ID. 23-208

COMPARATIVE SEISMIC RESPONSE ANALYSIS OF A MULTI-STOREY BUILDING WITH AND WITHOUT BASE ISOLATORS UNDER HIGH MAGNITUDE EARTHQUAKE

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Abstract- Earthquakes can induce structural failure, the vertical collapse of a structure, or can result in the breaking and falling of non-structural components of the structure. Therefore, earthquakes possess a serious threat to the safety and integrity of buildings. Most of the region of Pakistan lies in a high risk of seismic activity and the country lacks seismic-resistant structures. The effectiveness of base isolation technique has been studied by many researchers, but significant research has not been conducted particularly for high earthquake prone regions of Balochistan lying in zone 3 and zone 4. This study includes the comparative seismic response analysis of the two multi-storey reinforced concrete 3D frames, with and without base isolation under the effect of seismic loads. The seismic analysis was carried out following the provisions of the Uniform Building Code 1997 (UBC-97). The comparison of seismic responses of both models showed a significant reduction in responses. This study indicates that base isolators are highly effective in reducing the seismic response of a building and can be used to enhance the seismic performance of the buildings in high earthquake prone regions of Balochistan.

Keywords- Base Isolation, Finite Element Modelling, Seismic Analysis, Uniform Building Code (Ubc-97).

Paper ID. 23-209

FLEXURE RESPONSE OF STAINLESS STEEL REINFORCED CONCRETE (SSRC) BEAMS SUBJECTED TO FIRE

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Abstract- This paper examines the behavior of stainless steel reinforced concrete (SSRC) flexural members during a fire. Stainless steel (SS) reinforcement has gained popularity due to its corrosion resistance and long maintenance-free life. However, there is an insufficiency of performance data and design guidance in the present literature. The paper presents a numerical assessment of SSRC structural elements using a material model based on experimental tests. A finite element model is utilized to simulate and analyze the response of SSRC beams under fire, validated with available data, and used to investigate the influence of key parameters on fire behavior. The study compares the behavior of SSRC beams with traditional carbon steel reinforced concrete (CSRC) beams, demonstrating that SSRC members have higher load carrying capacity and can sustain fire exposure for longer durations. Additionally, SSRC beams exhibit higher deflections during fire exposure compared to CSRC beams.

Keywords- Abaqus, Finite Element Modelling; Stainless Steel; Reinforced Concrete

Paper ID. 23-210

INNOVATIVE SOLUTIONS FOR SUSTAINABLE BUILDING STRENGTHENING: GLASS FIBER REINFORCED CONCRETE

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Abstract- Steel-reinforced Glass Fiber Reinforced Concrete (SGFRC) is a promising alternative to conventional construction materials, offering enhanced structural performance and sustainability. This paper presents a review of recent research on SGFRC in construction. By integrating fine glass fibers (GF) into steel-reinforced concrete matrix, SGFRC demonstrates remarkable tensile strength, flexural performance, and durability, enabling resilient and long-lasting structures. The eco-friendly nature of glass fibers further contributes to construction sustainability by reducing carbon footprints. This study explores manufacturing techniques and formulation strategies to optimize SGFRC properties for strengthening, energy-efficient, and environmentally conscious buildings. Experimental examinations, including flexural strength (FS), pre- crack/post-crack/total energy absorption, and toughness index, compare SGFRC with steel-rebar-reinforced plain concrete (SPC). Both adopt a mix design ratio of 1:2:4 (Cement: Sand: Aggregates) with a water-cement ratio of 0.7. GFRC incorporates 5% of 5cm lengthy GF by mass of cement, leading to reduced density and slump. Findings highlight SGFRC's superiority in FS and other flexural strength properties, emphasizing GFRC's significance for enhancing structural performance and promoting sustainable construction practices.

Keywords- Construction Sustainability, Enhanced Structural Performance, SGFRC, Strengthening Building Structures

Paper ID. 23-214

CRITICAL FACTORS INFLUENCING THE ADOPTION OF THE BUILD OPERATE TRANSFER (BOT) SYSTEM IN THE GULF AREAS: A COMPREHENSIVE REVIEW

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Abstract- The Build-Operate-Transfer (BOT) model has gained significant attention worldwide as a solution for major public infrastructure development. The Gulf Cooperation Council (GCC) countries, renowned for their government surpluses and oil reserves, are particularly interested in implementing the BOT model to drive economic development and diversification and transform the region into a trade and financial center. However, there is a research gap in understanding the critical factors influencing the adoption of BOT in the GCC region. This paper aims to address this gap by identifying these factors, assessing their impact on project performance, and proposing measures to ensure the success of BOT systems. Through a comprehensive literature review, this study identifies government support, risk allocation, local financial market conditions, project selection, and a strong private consortium as crucial factors for BOT project success. The research methodology involves data collection through a systematic literature review and data analysis using the Likert Scale method. The results of this study provide valuable insights for decision-makers in both the public and private sectors, enabling them to make informed decisions and improve the efficiency of BOT projects in the construction industry. By understanding these critical factors, stakeholders can optimize project outcomes and contribute to the overall development and diversification goals of the GCC region.

Keywords- Build Operate Transfer (BOT) System, Contractual Agreements, Infrastructure, GCC

Paper ID. 23-303

A REVIEW ON EFFECTS OF PROJECT MANAGEMENT PRACTICES ON COST OVERRUN IN CONSTRUCTION PROJECTS

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Abstract- Cost overruns have long been a significant source of worry in the construction sector, offering serious obstacles to the profitability and financial viability of projects. It happens when the actual costs of a building project are higher than the initial budget estimate, which can cause financial hardship, project delays, and even stakeholder disagreements. This paper investigates how project management techniques affect construction project cost overruns. The goal of the study is to recognize different project management techniques used at various stages of construction projects and their effects on cost performance. It also looks into the reasons behind cost overruns and suggests solutions to stop them from happening in the future. The research also focuses on how project management techniques and cost overrun are related, highlighting efficient methods to manage and prevent cost overruns. The results add to the body of knowledge on project management in the construction sector and offer project managers useful tips for improving cost performance and project success. Overall, this research provides valuable insights that can help project managers and stakeholders navigate the challenges of cost overrun, promote efficient project management practices, and contribute to the successful delivery of construction projects. With diversified nature of projects, applicable approaches to cost management are directly related with project management applicability with respect to planning, deployment and control of funds allocation and budget-based constraints. Future researches should explore context sensitive issues related to cost over-run in construction projects and their aspects of robust, adaptive and agile cost management strategies based on project management skillset.

Keywords- Cost Overrun, Project Management Practices, Construction Projects, Remedial Measures

Paper ID. 23-304

FRAMEWORK FOR ENERGY PERFORMANCE MEASUREMENT OF RESIDENTIAL BUILDINGS CONSIDERING OCCUPANTS' ENERGY USE BEHAVIOR

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Abstract- Buildings' contribution to global final energy use is about 30%, which makes them a primary focus for implementing energy-efficient measures. Building energy efficiency is an important consideration for residential buildings due to the significant environmental impact of energy consumption and the rising cost of energy. Estimating and optimizing a building's energy performance is one of the efficient methods to reduce its environmental impact and cost. There exists a lack of accuracy in estimating the energy performance of a building due to approximations in the monitored data as well as non-consideration of occupants' energy use behavior. This study aims to develop a comprehensive framework that assists in accurately estimating building energy performance considering occupants' energy use behavior. The framework proposed a scheme to collect occupant behavior data such as occupancy patterns, appliance usage, lighting conditions, through living-lab setup and developing an occupants' behavior model that is utilized for more accurate building energy modeling and performance analysis.

Keywords- Building Energy Performance, Occupants Behavior Modeling, Living-Lab Concept

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PROJECT MANAGEMENT PRACTICES IN CONSTRUCTION PROJECTS AND THEIR ROLE IN ACHIEVING SUSTAINABILITY - A COMPREHENSIVE REVIEW

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Abstract- Effective project management practices are crucial in the construction sector, providing a struc-tured approach to planning, executing, and controlling projects. They set clear objectives, define scopes, allocate resources efficiently, and manage risks effectively. However, challenges can arise throughout all project phases. This study focuses on literature from reputable journals over the last decade and considering the post-Covid scenario for inadequate scope definition, poor commu-nication, resource mismanagement, and regulatory barriers were identified as major barriers to project success. To achieve sustainable construction projects, specific targets like energy efficiency, waste reduction, water conservation, and social responsibility must be set. Integrating project management with sustainability involves incorporating green building design, sustainable ma-terials, waste management, water conservation, biodiversity promotion, smart technologies, and performance measurement systems. By adopting sustainable approaches and effective project management practices, construction projects can achieve successful outcomes while ensuring en-vironmental responsibility, social equity, and economic viability. Future research should explore identified barriers, their local implications and project management practices for successful project outcomes.

Keywords- Construction Projects, Sustainability, Project Management, Sustainability Targets, Project Phases

Paper ID. 23-306

APPLICATION OF NONSTATIONARY IN CLIMATE VARIABILITY – A CASE STUDY OF SOUTH PUNJAB, PAKISTAN

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Abstract- The rate of change in the planet's environment has been inconsistent. One of the main reasons is believed to be vital changes caused by human in the climate. Recent innovations in time series investigation of hydro-climatological parameters have contributed to the belief that the effects of nonstationarity are considerable enough to call the validity of conventional stationary methods into question. The goal of this study was to assess the nonstationary variability in Southern Punjab using nonstationary parameters for the historical era (1970-2015). Generalized Extreme Value, GEV, Gumbel, GUM, Normal, NOR and Lognormal, LOGNOR were used as the frequency analysis probability functions. The findings of the nonstationarity variability influences across the Southern Punjab showed a variety of variations, such as an increase or reduction in the return level of extreme rainfall. Upon an evaluation of NLLH value, GEV offered the best match compared to other distributions. In Bahawalnagar, Bahawalpur, Multan, Rahim Yar Khan, and DG Khan, the yearly nonstationary consequences for the 100-year return level were 15.2, 8.7, 58.3 18.7 and 20% respectively. The evidence also showed that extreme precipitation appears to be increasing during the historical period, which increases floods. Overall, nonstationarity variations demonstrated the importance of adopting climate change into hydraulic structure design.

Keywords- Climate Change, GEV, Nonstatioinarity, Precipitation, Probability Distributions

Paper ID. 23-401

DESIGNING THE REMOTE AND SUSTAINABLE WATER MANAGEMENT SYSTEM

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Abstract- Freshwater availability is a huge issue for downstream areas but the mismanagement practices and exploitation of freshwater leading towards scarcity is an absolute crisis right now and if the mismanagement practices continue to be like that, then by the end of 2047, the world would be left with less than 500 cubic centimeters per capita of water availability leading towards absolute scarcity. To solve the water mismanagement of the capital city, National University of Science and Technology (Nust) as the case study was chosen. A pilot scale prototype was made for this project which was basically a monitoring system and can be expanded to a controlling system with few sensors and a microcontroller (Arduino UNO) was installed which was used to monitor the water level in the overhead tank, water flow from the taps and water leakage from any tap. It stored the data and calculated the total water usage and was aligned with mobile application for data viewing and storage with just an internet connection. The user was able to analyze the real-time data and the stored data anytime and anywhere just by using the mobile application and internet connection. SONAR Sensor was installed to check the water level in the tank. It showed the water in percentage. Water flow sensor was installed to measure the water flow from the tap. These sensors directly sent the data to the microcontroller which was programmed according to the sensors and then the microcontroller interpreted the data and send it to the user to its application. Prototype resembled the complete water system of a house or any commercial building. Cost benefit analysis was done to check the feasibility of the project which showed that it was the most suitable system in the conservation of the water. Hostel building was selected for this project which had 4 floors. Two SONAR sensors and 140 water flow sensors were installed. Every single tap was attached to a water flow sensor. User was able to see each tap and its data and can monitor even single tap. This study addresses SDG 6 which is clean water and sanitation and SDG 12 which is responsible consumption and production.

Keywords- Mobile Application, Remote Sensing, SDG 6, SDG 12, Sustainable Solution, Water Management.

Paper ID. 23-402

SCOUR REDUCTION AROUND BRIDGE ABUTMENTS USING INDUSTRIAL BY-PRODUCTS AS A COUNTERMEASURES-AN EXPERIMENTAL APPROACH

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Abstract- Due to the three-dimensionalities of the flow and sediment movement, the scour process around bridge elements such as piers, abutments, and spur dikes is complicated. In the present study, a laboratory investigation was carried out to determine the scouring around the bridge abutment without and with countermeasures. A wooden model of bridge abutment was embedded in a sand bed under two different values of discharge. Each experimental case was run for the time duration of two hours. The result showed that scouring around bridge abutment increases by increasing the flow discharge. The maximum scouring around the bridge was observed to be 17.92cm which was 9% greater than scouring at a flow discharge of 0.016m3/s. By providing an industrial by-product as a countermeasure, it was observed that scouring around the bridge abutment decreases compared to without placing any countermeasures but scouring increases by increasing the flow discharge. The maximum reduction in scouring around the bridge abutment was observed to be 33% for two different values of flow discharge compared to the without placing countermeasures cases. It was concluded that industrial by-products reduced scouring around the bridge abutment up to the maximum level and provided protection to the bridge abutment from failure.

Keywords- Scouring, Bridge Abutments, Countermeasures, Sand Bed, Flow Discharge

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VALIDATION OF CHLORINE DECAY EQUATION FOR WATER QUALITY ANALYSIS IN DISTRIBUTION NETWORKS

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Abstract- Although chlorine is added to the water network as a disinfectant to maintain the quality of water and keep it safe against organic contamination including microorganisms, however maintaining its concentration level in the water is one of the major concerns in monitoring water quality performance of a system. This article discusses the extent of the spread of contamination in water distribution networks which may enter through a pipe leak and the decay rate of chlorine for a specified design duration. A comprehensive water quality analysis is performed using EPANet 2.2 for the spread of contamination and chlorine decay for a water supply network. The results show that a contaminant entering at the start and the highest point of the network would pollute the whole network whereas the effect of such a contaminant would be limited if it enters at the lowest location. Also, the initial chlorine concentration is found to be more for such critical nodes which are higher in the elevation, although the decay rate remains the same. The concentration of chlorine in the network at any point after time t was found to be an inverse exponential function of the initial chlorine concentration with a value of 0.016. The research proves to be beneficial for the management of water distribution through pipe networks against contaminants for maintaining public health.

Keywords- Scouring, Bridge Abutments, Countermeasures, Sand Bed, Flow Discharge

Paper ID. 23-406

BRIDGE PIER SCOUR REDUCTION INVESTIGATION USING DIFFERENT VEGETATION ELEMENTS AS COUNTERMEASURE

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Abstract- Due to climate change extreme weather conditions like increased heat, droughts, glaciers melting affected the natural ecosystem of our country. Flash floods mostly occurred in hilly areas of Pakistan. Scouring occurs when the flow of water around bridge piers erodes the bed material, potentially undermining the foundation of the structure. To mitigate this problem, various countermeasures have been proposed and studied. This research investigates the effectiveness of different vegetation elements as countermeasures for reducing bridge pier scour. The study comprises a comprehensive examination of two types of rigid vegetation, including wooden and steel cylinders around bridge pier in experimental flume setups. These cylinders were of circular cross- section and were installed upstream of the bridge pier, which is of circular shape. The aspect ratio (AR-ratio of width to length) of wooden and steel cylinders and the spacing between the cylinders (G/d) were changed against two different flow conditions (where G is spacing between each cylinder and d is the diameter of each cylinder). The experiments were conducted under sub critical flow conditions i.e at Froude number 0.136 and 0.187. The results showed that by decreasing the aspect ratio of cylinders, scour hole reduces effectively. The denser arrangement of cylinders obstructs the flow and results in a greater reduction of scouring on the bridge pier. Maximum scour reduction at pier is 71.7% by using vegetation cylinders of 7.46 aspect ratio and G/d ratio of 0.71. Thus, vegetation significantly contributes to scour reduction on the bridge pier. Hence, sacrificial piles with a denser arrangement are recommended for scour reduction at pier facing high river flow.

Keywords- Scouring, Pier, Vegetation Cylinders, Clear Water Condition, Scour Countermeasure

Paper ID. 23-407

EXPERIMENTAL INVESTIGATION OF SQUARE-SHAPED SACRIFICIAL PILES ON SCOUR DEPTH OF COMPOUND BRIDGE PIER

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Abstract- A non-uniform pier, also known as a compound A pier, is characterized by varying cross-sectional dimensions along its length. Depending on the exposure of their foundation to the flow field, the behavior of many bridge structures is non-uniform. There are numerous causes for the bridge's failure, including design flaws and construction errors. In contrast, scouring is the most hazardous reason. The primary objective of this experimental research is to reduce the scour depth around a compound bridge pier by using a square-shaped sacrificial pile as its countermeasure in clear water scour conditions. A constant flow rate of 30 l/s. was maintained throughout the experiment. and each trial was run for about 3 hours. Scour depth was measured using a point gauge as the measurement tool. Three experimental sets were carried out by using two, four, and six sacrificial piles on the front side of the pier in different locations for each case. The results show that by using sacrificial piles, scour depth was reduced significantly. With an increase in the number of piles and varying distances from the pier, the reduction in scour depth became increasingly noticeable. Case C-4 exhibited the most significant percentage reduction in scour depth among all the cases studied, which was 47.6%. In this case, six sacrificial piles were installed u/s of the pier at a distance equal to between 5,5.67 and 6.33 times the diameter of the pier (Dp = 76.2 mm).

Keywords- Compound Bridge Pier, Countermeasures, Sacrificial Piles, Scour Depth

Paper ID. 23-408

INVESTIGATING THE EFFECT OF SHEAR RATE IN THE SHEAR THINNING BEHAVIOUR OF WASTE PLASTIC-MODIFIED ASPHALT BINDER

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Abstract- The major goal of this study was to determine how shear rate influences the shear-thinning properties of asphalt binder treated with waste plastic. The blending of asphalt and waste plastic was accomplished using a melting process. Asphalt binder is a non-Newtonian fluid that exhibits shear-thinning behavior, and the dependence of shear viscosity on shear rate is a key characteristic of its pseudo-plastic behavior. The addition of waste plastic as a modifier to asphalt binder at percentages of 16%, 18%, and 20% was found to increase the performance of the asphalt. The shear-thinning behavior of two types of bitumen grades, ARL 60/70, and ARL 80/100 was assessed through rotational viscometer testing. The experimental results demonstrated that shear rate and viscosity are inversely proportional, with an increase in the shear rate leading to a decrease in apparent viscosity. These findings indicated that waste plastic modification can impact the viscosity and shear-thinning behavior of asphalt binders.

Keywords- Brookfield Rotational Viscometer, Modified Asphalt, Shear Thinning, Shear Rate, Shear Stress, Viscosity

Paper ID. 23-501

CONSTRUCTION, CONFLICT, CLAIM, AND COMPENSATION (4C) – CASE STUDY – FAIZABAD HIGHWAY INTERCHANGE PROJECT ISLAMABAD, PAKISTAN

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Abstract- Each individual case of construction industry dispute between the contractor and the employer is unique in its nature, but the dilemma of delays, additional costs, and claims for compensation by the contractor and disputes between the parties have been persistently perpetual, leading to further numerous, administrative, financial, contractual, technical, and contractual issues. The common factors may be aggregated under three (3) groups, namely, group-a: faulty contract documents; group-b: contractor's deficiency and failure; and group-c: beyond the control of parties (force majeure, employer's risk). reasons/common factors under group-a are attributable to the employer/client and can be mitigated at the onset of projects, the author takes the opportunity to address them briefly through the case study of one of the projects, highlighting the salient features, in a humble attempt if it could be more wisely handled by the stakeholders and beneficiaries of the construction project. A construction project of Faizabad Interchange between Islamabad and Rawalpindi has been taken up as a case study to highlight the construction industry disputes and challenges both for the contractor, client, and consultant resulting in delay, and heavy financial compensation.

Keywords- Arbitration, Construction Management, Compensation Disputes, Delay, Technical and Contractual Issues

Paper ID. 23-502

EFFECTS OF DIFFERENT AGGREGATE GRADATIONS ON RUTTING SUSCEPTIBILITY OF HOT MIX ASPHALT (HMA)

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Abstract- This study focuses on the development of optimum job mix formula (JMF) with lower susceptibility. The effect of change in aggregate gradation in hot mix asphalt (HMA) was investigated for rut depth behaviour in flexible pavement. Samples were prepared at optimum asphalt content (OAC) which was found to be 4% through Marshall Mix Design (MMD). This optimum value was then used to find out the MMD parameters and rut resistance for various gradations. Changes in gradation were done by increasing and decreasing the percentages of coarse and fine particles. The result of this study showed that rut susceptibility increases with the change in coarser or finer aggregate percentage as compared to the control gradation, which is NHA Class A for wearing course. For a constant OAC, the sample with equal amount of coarser and finer particles showed the least rut depth. However samples that showed greater stability experienced higher rut depth which needs to be explored further.

Keywords- Hot Mix Asphalt (HMA), Marshal Mix Design (MMD), Rutting, Wheel Tracking Device (WTD)

Paper ID. 23-504

ROAD ACCIDENT PREVENTION USING SUSTAINABLE METHODS

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Abstract- Road accidents are the major cause of fatalities, injuries and property damage worldwide. The implementation of sustainable road accident prevention methods is essential to reduce the risk of accidents, promote safety and protect the environment. This research paper investigates road accidents in Karachi, particularly the impact of open manholes. Focusing on the disruptive effect of open manholes on road safety, the study addresses the issue and its implications. The paper analyzed onsite data on traffic volume and accidents, providing insights into vehicle flow rates during peak hours. The effect of open manholes on accident frequency is examined. The traffic mix at the study location comprised of 57.9% motorcycles, 28% cars and 12.4% rickshaws, while buses, tankers and trucks constituted the rest. It was found that there have been approximately 105 road accidents due to open manhole at the study location. After the recycled rubber tire has been placed, no accident occurred. This is a remarkable finding. The placement of recycled rubber tires over open manholes is a sustainable solution that is cost-effective, durable, easy to install, slip proof, more theft-proof then conventional reinforced concrete manhole covers and eco-friendly.

Keywords- Manhole, Rubber Tire, Traffic Volume, Peak Hour Factor

Paper ID. 23-505

MODEL-BASED RELATIONSHIP BETWEEN RISK-TAKING BEHAVIOR OF MOTORCYCLISTS AND ITS CORRESPONDING FACTORS. A CASE STUDY AT SRINAGAR HIGHWAY ISLAMABAD AFTER MAKING IT SIGNAL-FREE ALIGNMENT

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Abstract- This study examines the factors affecting the risk-taking behavior (RTB) of motorcyclists on the Srinagar Highway in Islamabad. The reason for studying this specific area is that an abrupt change in driving behavior was observed, especially in motorcyclists. Instead of taking U-Turns, illegal crossing through the median and the use of the wrong side of the road were observed after the provision of protected U-Turns on the highway. Questionnaire-based data was collected from 350 respondents in the vicinity of the targeted area. The SPSS software was used for data screening to handle missing data. This study uses partial least squares structural equation Modelling to develop a relationship between one endogenous variable (RTB) and eight exogenous variables (demographics, arrival on time, Stress, Road Characteristics, Peer influence, special pathway for bikes, traffic rules violations, and vehicle conditions). The findings of the study show that road characteristics, peer influence, and arrival time are the most significant factors that influence the risk-taking behavior of a motorcyclist. It is suggested that instead of at-grade U-turns at the Srinagar Highway, there should be an overpass or underpass, according to the requirement. If this solution is not possible, a steel footbridge must be provided where U-Turns have been provided so that motorcyclists can cross the road easily instead of taking U-Turns. To validate the results, multinomial logistic regression was used with SPSS software. The results showed that the results obtained using the structural model were satisfactory and reliable.

Keywords- Endogenous & Exogenous Variables, Footbridge, Multinomial Logistic Regression, Protected U-Turns

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APPLICATION OF PLASTIC AGGREGATES IN ASPHALT MIX PAVING FOR SUSTAINABLE ENVIRONMENT

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Abstract- Flexible pavements use bitumen as a binder and aggregate as filler. One of the key elements of a road structure is aggregate. Researchers are looking towards alternatives to natural aggregates due to the depletion of natural resources. In this approach, plastic aggregate can be quite useful. The results of tests on asphalt mixtures using plastic aggregate derived from electronic waste as a partial replacement at 0-15% with 5% intervals demonstrate a significant result. Testing in this area revealed that while marshal stability gradually declines, performance against rut resistance significantly improves, leading to a decrease in rutting depth to from 4.78mm to 1.89mm, which demonstrated the best results at 10% partial substitution of Electronic waste plastic aggregate. Using that much percentage of Electronic waste in Flexible pavement will gradually decrease the pollution created from the Electronic waste and also contributes to the sustainability of Natural aggregates to some extent.

Keywords- Plastic Aggregate, Electronic Waste, Modified Asphalt Mix, Artificial Aggregate

Paper ID. 23-508

OPTIMIZING TRAFFIC FLOW AT SANGJANI TOLL PLAZA IN ISLAMABAD: A SIMULATION STUDY USING DIFFERENT LANE PATTERNS

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Abstract- Pakistan is a developing country experiencing rapid urbanization and migration of people from rural to urban areas for their daily business activities. To improve transportation for people, Pakistan constructed a Toll Plaza on the National Highway. However, toll plazas can sometimes cause traffic jams because vehicles have to stop to pay the toll, leading to a decrease in traffic flow and longer waiting times. The study aimed to reduce waiting times at toll plazas by creating a simulation model to determine the best lane pattern. Data was collected between 1:00 PM-3:00 PM in March of 2023, and VISSIM software was used for the simulation. Results showed that changing the lane pattern can significantly reduce waiting times and queue length, with waiting times being reduced by up to 95.06% and queue length by up to 67.45%. This study can be helpful in determining the best lane arrangement to reduce traffic delays at toll plazas.

Keywords- Lane Pattern, Simulation Model, Toll Plaza, Traffic Flow, VISSIM Software

Paper ID. 23-510

IMPACT OF SILICA FUME AND BIOCHAR TREATMENT ON THE MECHANICAL CHARACTERISTICS OF LOW PLASTIC SOILS

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Abstract- Bio-cementation soil treatment technique has shown significant strength improvement in the soils. Low plastic silt soils are present in many areas of Pakistan, making the need for acceptable engineering properties to support construction activities necessary. In the current study, silica fume and biochar were used in an attempt to test the unconfined compressive strength (UCS). Several tests including the liquid limit, plastic limit, compaction test and unconfined compressive strength, were carried out on two types of soils with various additions to access the strength parameter. This study aimed to assess the impact of silica fume and biochar treatments on soil UCS results. According to the results, adding silica fume raised the UCS strength by up to 52.85%, while adding biochar enhanced it by up to 117%. Overall, this study highlights that silica fume and biochar have the potential to improve soil properties as a cost-effective and efficient solution for enhancing soil characteristics, particularly in construction projects that require compaction.

Keywords- Biochar, Unconfined Compressive Strength, Silica Fume, Compaction Test

Paper ID. 23-601

SLOPE STABILITY ANALYSIS AND DESIGN USING NUMERICAL TECHNIQUES: A CASE STUDY

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Abstract- This case study analyses kilometer 28th of Islamabad-Murree Dual Carriage Way (IDMC) also known as National Highway (N-75) of Pakistan for its stability. The slope has high gradient, irregular shape and no vegetation cover which makes this slope susceptible to failure. The slope was analyzed with software Rocscience Slide 6.0. Based on the analysis, it was found that slope has a low factor of safety and might be unsafe. The slope was then designed using active design method. For analysis, different numerical methods i.e. Bishop's method, Janbu method simplified, Janbu method modified and Spencer method were used. Various types of supports were used individually and in combination to design the slope. Three different models were designed and analyzed having improved factor of safety from each other. From all the models, one model was finalized and declared as safest models having factor of safety greater than 2.0.

Keywords- Slope Stability, Rocscience Slide 6.0, Active Design, National Highway-75 (N75)

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SOIL IMPROVEMENT USING WASTE POLYETHYLENE TEREPHTHALATE (PET)

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Abstract- This study investigates the use of waste Polyethylene Terephthalate (PET) bottle strips for soil stabilization in the Potohar region. Uncontrolled filling during housing society development has led to settlement issues and structural cracking. By incorporating PET bottle strips in varying compositions, the engineering properties of the soil were improved, including increased maxi-mum dry density, bearing capacity, and unconfined compression strength. This research offers an innovative technique to mitigate settlement problems and presents an eco-friendly waste management solution for sustainable development.

Keywords- Bearing Capacity; Maximum Dry Density; PET Bottle Strips; Plate Load Test

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EFFECTIVENESS OF MONO SAND PILE IN SOFT COHESIVE GROUND

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Abstract- Soft cohesive formations are extensively distributed across the earth's land mass. They mainly comprise medium to high plastic clays deposited by thousands of years of geological activity. In Pakistan, the upper and lower plains of the Indus Valley have several square kilometers of cohesive ground. The cohesive soils are vulnerable to moisture variations and lack friction. Hence, not considered an ideal ground for foundation support. The raft foundation and traditional reinforced concrete piles are effective solutions but are uneconomical. Sand piles can replace these expansive foundations for moderately loaded structures; however, their effectiveness is required to be supported by field and research investigations. This study presents FEM-based numerical investigations on the performance of a single sand pile on soft cohesive ground. The pile is loaded with the 100-kPa pressure representing a moderately loaded structure. The stress-strain behaviors and overall pile settlement results are graphically presented. The sand pile, the stiffer material, could hold most of the stresses while maintaining the volumetric strains up to 10%. Hence, allowing better load transfer to the natural soft ground.

Keywords- Cohesive Soil, Foundation Settlement, Numerical Modeling, Sand Pile, Stress Distribution

Paper ID. 23-607

EVALUATION OF STRENGTH PARAMETER OF INDIGENOUS SOIL UNDER VARYING SURCHARGE LOAD

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Abstract- The study examined the result of surcharge load on subgrade soil commonly used in pavement construction in Pakistan. Soil samples of A-6 and A-2-6 types were collected from six locations in KPK and Punjab Division and classified based on AASHTO Soil Classification System. The laboratory tests were performed to define the index properties of soil samples. The ultrasonic pulse velocity technique was used to measure the resilient modulus and swelling, and CBR values were determined using overburdan loads going from 2.27 to 13.8 kg. The study found that increasing surcharge weight led to an increase in ultrasonic pulse velocity and CBR values, and a decrease in soil swelling. The study also developed improved relationships for predicting the resilient modulus values based on CBR measurements, showing strong correlation with equations developed by Green and Hall and Powell et al. from the TRRL. Overall, the study provides insights into the behavior of subgrade soil under different surcharge weights and proposes improved relationships for predicting resilient modulus values, contributing to the design and construction of more reliable and efficient flexible pavements.

Keywords- CBR, Surcharge Weight, Resilient Modulus, Ultrasonic Pulse Velocity, CBR-MR Relationship

Paper ID. 23-609

TREATMENT OF DOMESTIC WASTEWATER WITH ANAEROBIC FLUIDIZED MEMBRANE BIOREACTOR (AN-FMBR) AND CONTROL OF MEMBRANE FOULING WITH ADDITION OF GAC

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Abstract- A lab scale Submerged Anaerobic Fluidized Membrane Bioreactor (An-FMBR) setup having Granular Activated Carbon (GAC) fluidization medium was used for the treatment of synthetic domestic wastewater and to control membrane fouling. The performance of An-FMBR having chemical oxygen demand (COD) of 517 ± 21 mg/L was investigated at various hydraulic retention times (HRTs) i.e., 12, 8, and 4 hours (h) utilizing different amounts of GAC starting with 5 g/L and increasing the concentration of GAC up 10 g/L. First, the system was optimized in-terms of HRT without GAC addition. The optimum efficiency of the system was found at 8 h HRT in comparison with all the operating conditions tested. The COD removal of 88% ± 1.06%, 84% ± 0.3%, 63% ± 1.3% was achieved at respective HRTs of 12, 8, and 4 h. At shorter HRT, membrane's transmembrane pressure increased more rapidly as compared to longer HRT indicating that fouling of membrane was increased at shorter HRT. After optimization of An-FMBR at 8 h HRT, GAC was added to improve the effluent quality standard and to control membrane fouling. The GAC added mainly decreased the protein in the cake layer hence helped in controlling membrane fouling for longer time. The COD removal up to 96% was achieved at 8 HRT with 10 g/L of GAC dosage. The result revealed that at optimized condition of 8 HRT and 10 g/L of GAS dosage enhanced the effluent quality and removal efficiency contributing low membrane fouling propensity.

Keywords- Anaerobic Fluidized Membrane Bioreactor, Chemical Oxygen Demand, Hydraulic Retention Time

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