



**1st Conference on
SUSTAINABILITY IN CIVIL ENGINEERING
CSCE - 2019
August 01, 2019**



Organized by:

Department of Civil Engineering

CAPITAL UNIVERSITY OF SCIENCE & TECHNOLOGY

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ABSTRACTS

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Abstract Book

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FOREWORD

We would like to welcome you all to the 1st Conference on Sustainability in Civil Engineering (CSCE'19) held in Department of Civil Engineering, Capital University of Science and Technology, Islamabad, Pakistan. The main focus of CSCE'19 is to highlight sustainability related to the field of civil engineering. It is a platform for civil engineers from academia and industry to share their experiences and different research findings in relevant specializations. The format of this conference is to have several parallel sessions of different specialties, where we (the researchers and engineers) can interact and improve our understanding of sustainability in the field of civil engineering.

We are lucky to have six wonderful and renowned keynote speakers for our opening edition of CSCE. This year, we have received 132 manuscripts for our conference from China, Pakistan, Saudi Arabia, Germany, Italy and UK. After the screening and review process, there are 59 papers to be presented in Conference. All papers under gone double-blind review process. The review committee has comprised of 46 PhDs serving in industry and academia of Australia, Malaysia, Hongkong, China, Pakistan, Saudi Arabia, UK and Chili.

With this opportunity, we would like to express many thanks to everyone, especially all the faculty and staff at the Capital University of Science and Technology for their great support and participation. We are also grateful to all the reviewers and keynote speakers who have dedicated their time to share their expertise and experience in this conference.

We give our greatest appreciation to all the participants of CSCE'19, as authors, presenters and audience, without whom this conference will have no positive interactive atmosphere. Last but not least, the greatest honor is given to our organizing committee whose hard work has made this day a success.

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Keynote Speakers

Prof. Dr. Muhammad Sharif Bhatti

Ex-Vice Chancellor - University of Engineering & Technology, Taxila - Pakistan

Talk Title: Time Management for Engineers

Dr. Attaullah Shah

Vice Chancellor, KaraKoram International University Gilgit - Pakistan

*Talk Title: Use of Supplementary Cementitious Material (SCM in Producing Suitable
Concrete*

Dr. Qazi Umar Farooq

Head of Civil Engineering Department, Islamic University, Madinah - Saudia Arabia

*Talk Title: A Dry Future: Prospective Water Scarcity in Islamabad Region and Its
Probable Solution*

Dr. Khurrum Iqbal

C.E.O. SHANON & Consultant, Islamabad – Pakistan

Talk Title: Sustainability through Materials and Design using Digital Concepts

Dr. Hassan Abbas

Head of Civil Engineering Department, SCET, Wah Cantt – Pakistan

Talk Title: Role of Civil Engineers in Sustainable Water Economy

Dr. Zia U. R. Hashmi

Head: Water Resources, GCISC, Islamabad - Pakistan

Talk Title: Civil Engineering in the Age of Climate Emergency

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Concrete Materials

Strength Properties of Multi-Scale Hybrid Fiber Reinforced Concrete

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Abstract

Recently, hybrid fiber reinforced concrete (HFRC) has gained popularity for its superior mechanical properties. The fiber hybridization in HFRC means the addition of two or more than two fibers in a suitable way to take full benefits from each fiber. The growth of cracks in concrete is multi-scale process from micro to macro scale. Also, the restriction of cracks with one dimension and length of fibers is limited at their particular scale and have no or little effects at other scales. Therefore, it is logical to combine various types and sizes of fibers in concrete for achieving optimized strength properties. In this study, the compressive and flexural strength of concrete with incorporation of calcium carbonate whisker, basalt fiber and steel fiber are evaluated. The mix design ratio of PC and HFRC is 1:2:1.5 (cement: sand: aggregate) with water cement ratio of 0.4. The HFRC, HFRC1, HFRC2 and HFRC3 were prepared with 5% steel fiber and 5% calcium carbonate whisker having basalt fibers content of 0%, 2%, 4% and 6%, respectively. The compressive and flexural strength tests are performed in accordance with the relevant ASTM standard. It is revealed that the compressive and flexural strength of HFRC are improved by 14% and 46%, respectively when compared with that of plain concrete. It is recommended to optimize the length and content of basalt fiber in hybrid fiber reinforced concrete.

Keywords: Multi-scale fibers, steel fiber, basalt fiber, calcium carbonate whisker, strength.

Incorporation of Bagasse Ash and Stone Dust in Cement Concrete

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Abstract

Nowadays, one of the main concerns of the researchers, is to control the increasing rate of pollution. Several studies are conducted to overcome the burden of environmental pollutants. The Sugarcane bagasse ash (SBA) being pollution needs proper disposal. In addition to SBA, the stone dust (SD) being remaining of the stone processing plants, also requires proper disposal. SBA due to cementitious nature and SD being inert nature can be used as a partial substitute to the cement and sand, respectively. Hence, the suitability of the partial replacement of the cement with SBA and sand with SD, needs to be explored. In this pilot study, the slump, compressive strength (CS) and splitting tensile strength (TS) of the normal strength concrete for partial replacement of cement with SBA and of sand with SD are examined. 9% of cement weight is replaced with the same amount of SBA. And 40% and 50% of sand weight is replaced with equal weight of the SD. The specimens are tested according to the ASTM standards. The highest slump is noticed for the normal concrete having zero percent of SBA and SD. The samples comprising of replacement of 9% SBA and 40% SD showed the highest CS as compared to other samples. The incorporation of 9% SBA and 50% SD gave maximum TS. Hence, the partial replacement of cement with SBA and sand with SD, can be employed for strength improvement of normal strength.

Keywords: Normal strength concrete, Sugarcane bagasse ash, stone dust, strength improvement.

Production of Low Cost Concrete using Waste Foundry Sand and Recycled Aggregate Concrete

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Abstract

Foundry sand consists primarily of clean, uniformly sized, high-quality silica sand or lake sand that is bonded to form moulds for ferrous (iron and steel) and nonferrous (copper, aluminium, brass) metal castings used by foundries. This sand can be recycled and reused three to five times before disposal. The disposed sand is known as Waste Foundry Sand (WFS). The opportunity to replace the natural fine aggregate with industrial by products embodies various technical, economic and environmental advantages resulting into a more sustainable construction sector. Different experiments have been carried out to assess the strength and characteristics of concrete using WFS. Proposed work is an effort to determine the strength and economic feasibility of using WFS and recycled aggregates an alternative to fine and coarse aggregate respectively in preparation of structural concrete. Concrete mixes were prepared with 0%, 10% and 15% replacement (by weight) of fine aggregate by waste foundry sand and 20% replacement (by weight) of coarse aggregate by recycled aggregate. Mechanical and physical properties of the materials were evaluated using various tests. It includes Fineness Modulus, Bulk Specific Gravity and Water Absorption test. These materials were used to cast the sample in a cylinder of dimensions 6"× 12" for compression testing. Testing was carried out at 7th, 14th and 28th day. From the tests it was found that WFS based concrete has acceptable working strength and can be used in civil structures.

Keywords: WFS: Waste Foundry Sand, CA: Coarse Aggregate, RA: Recycled Aggregate, F.M: Fineness Modulus

Suitability of Local Wood Ash for Concrete as a Partial Replacement of Cement

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Abstract

Natural resources of limestone, coal, and oil are depleting day by day due to its high usage in the production of cement. Researchers are searching for easily obtainable and economical materials, which can be used as a cement replacer in concrete. Bagasse ash, wood ash (WA), and rice husk ash are pozzolanic nature materials obtained as byproducts from agriculture and industry. These are pollutants for surrounding and utilizing them as cement substitution materials will lessen the contamination as well as expense of the cement. The overall aim of this study is to evaluate the performance of the concrete for cement replacement with WA. In the current research, the effect of replacement of cement with local WA on workability and compressive strength of concrete as well as chemical composition of ashes and strength activity index of WA samples were examined experimentally. ASTM C39/C39M-17, was adopted to cast and test concrete cylinders for evaluation of the compressive strength at the age of 7 days, 28 days, and 56 days. Wood ash of three different local sources i.e. boiler of Rado 80 textile mill, kiln of the Liaquat Hall mess, and Doce bakery was used. The chemical composition of each type of the WA was determined by using wet analysis method. The control mix consisted of cement, sand and aggregates in the proportions of 1, 2, and 4, respectively, with water to cement ratio of 0.60. The test specimens were also cast in the same proportion with 10% replacement of the cement by same amount of the WA. The workability of the test mix got reduced as compared to that of the control mix. The results of compression test showed that concrete containing WA of boiler of Rado 80 textile mill, was comparatively good as compared to that of other types of the WA samples used in the investigation. The incorporation of the WA showed the potential to achieve the required strength of the concrete with low cost wood ash as replacement for cement. But detailed optimization of the percentage of the replacement of the local wood ash with cement is required.

Keywords: Normal strength concrete, local wood ash, cement replacement, properties improvement.

Effect of PVA on Rubberized Concrete

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Abstract

Use of alternative aggregates has become a dire need of today's modern civilization, as they have significantly reduced the socio-economic stresses which the construction industry is facing nowadays. This research is dedicated to studying the behavior of concrete incorporating crumb rubber as a partial replacement of fine aggregate and polyvinyl alcohol fibers as the addition of cement. PVA dosages of 1% and 2% by mass of cement and rubber dosages of 5% and 10% by weight of fine aggregate were incorporated into concrete. The parameters of the study were slump test, the fresh density of concrete, water absorption and compressive strength. Test results show that the density, workability, and strength of concrete took a nosedive as the rubber content increases which is attributed to the fact that rubber is lighter in weight, has a rough texture, increases the viscosity and form a weak bond with cement. On the flip side, PVA has shown a positive influence on the engineering properties of concrete. Hence, PVA can be used to overcome the issues associated with the use of crumb rubber in concrete.

Keywords: Alternative aggregates, rubberized concrete, fiber reinforced concrete, polyvinyl alcohol fibers, crumb rubber, mechanical strength parameters, fresh properties of concrete.

Recycled Aggregate Concrete Filled Steel Tube (CFST) and Concrete Filled Plastic Tube (CFPT)

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Abstract

Recycled aggregates are used worldwide as the replacement of the natural aggregate in different ratios causing significant reduction on concrete strength and other properties. In this research recycled aggregate concrete filled tubes were used along with lumps of recycled aggregate taken from demolished waste. These lumps (50mm to 90 mm) of recycled aggregate were used as a replacement of coarse aggregate in different proportions (0%,10%,20% and 30%) for casting control specimen, CFST (concrete filled steel tube) and CFPT (concrete filled plastic tube) cylinders. Various tests were conducted such as slump test, water absorption test, fresh concrete density test, compressive and indirect tensile tests. Upon 30% replacement of the recycled aggregate reduction in concrete strength for recycled aggregate CFST, CFPT and simple cylinders (without any confinement) was to be found 9.22% ,43.2% and 54.14%, respectively when compared with control specimen.

Keywords: Recycled aggregate CFST, Recycled Aggregate CFPT

Two Stage Concrete using Recycled Coarse Aggregate and Bagasse Ash

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Abstract

In this experimental research, the effect of different ratios of bagasse ash and recycled coarse aggregates in Two-stage concrete (TSC) was evaluated. TSC is not quite the same as normal concrete. In TSC, coarse aggregates are set in formwork and after that grout or mortar is infused through a pipe with high pressure. Four mixes of TSC concrete were prepared. Control Mix-I was made with 100% natural coarse aggregates. Control Mix-II was prepared with 100% recycled coarse aggregates (RCA). The third mix was made with 10% bagasse ash (BA) as a fractional substitution of cement and 100% RCA. Fourth mix was prepared with 20% bagasse ash as a fractional substitution of cement and 100% RCA. 1% super plasticizer by the weight of cement was added in concrete mixes with 10% and 20% bagasse ash. Water to cement ratio (w/c) was 0.5 and used for all mixes. Different tests like compressive strength test and split tensile strength test were performed on samples made from all four mixes. Compressive strength and tensile strength of Control Mix-I was highest among all mixes. Results indicate that tensile strength and compressive strength was increased with the addition of bagasse ash in mixes having RCA. The maximum increase in compressive strength and tensile strength was in 20% BA mix.

Keywords: Two- stage concrete (TSC), Recycled coarse aggregates (RCA), Natural coarse aggregates, Bagasse ash (BA)

Effect of Hybrid Fiber Reinforced Concrete on Strength of Concrete

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Abstract

The major chunk of construction is covered by concrete construction. Concrete is a mixture of cement, sand, crush and water in appropriate ratio. It is good in compression but weak in tension. In order to improve these strengths of concrete, this research was conducted to evaluate the effect of Hybrid Fiber Reinforced Concrete (HFRC) on strength of concrete. Steel reinforced fibers were used to improve the compressive and tensile strength of concrete and also to control the progress of cracks in concrete. Steel reinforced fibers concrete (SFRC) was produced having 5000 Psi as target strength. Two types of steel wires having 25mm and 18mm fibers were used. 1.25% of concrete volume was replaced with steel fiber having aspect ratio for 25mm fiber was 60 and for 18mm fiber it was 40. Different proportions of steel fibers from 25% to 100% for both types of fibers were used to evaluate their effect on strength of concrete. The main purpose of introducing fiber steel concrete is to eliminate the traditional shears stirrups in concrete members. Cubes and prisms were casted to test for compressive strength and tensile strength on concrete. It was observed that there is no significance effect of steel fibers on compressive strength of concrete while around 58.33% of tensile strength was improved because short length steel fibers controlled the propagation of cracks in concrete. The maximum results were achieved at 100% replacement of 18mm fibers. The results are helpful for building stakeholders to improve strength of concrete by using steel fibers in concrete. Further studies can be carried out to find out other properties of steel fiber reinforced concrete.

Key words: Hybrid steel fibers, compressive strength, flexural strength, Mechanical properties, Aspect ratio

Effect of Locally Available Water and Admixture on Compressive Strength of Concrete

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Abstract

Construction industry is considered as one of the biggest industries in the world. It mainly covers construction of roads, dams, highways, bridges, residential and commercial and high-rise buildings. Some useful construction materials including steel, concrete and wood are used for the construction of all the structures. Concrete is widely used construction material all over the world for the construction of different structures. Concrete usually contains cement, sand, crush and water which collectively regulate its strength and other properties. Water is the most important ingredient of concrete which takes most of the part in the functional properties that is why it is necessary to evaluate the quality and availability of water. In this study, the effect of quality of locally available water on the properties of concrete has been identified. The locally available water from Tap, Spring, Nula and Marble waste sources were used for the sampling. In first run the effect of water quality on strength of concrete was determined. In second step of sampling, the sample having maximum compressive strength in stage one was considered as benchmark and other samples were made by adding admixture to get the benchmark strength. In the first stage 120 concrete samples including 60 cubes and 60 cylinders were casted to check the effect water quality on compressive strength of concrete at different stages like 7 days, 14 days and 28 days. In this stage concrete made up of spring water yielded the maximum strength and concrete made up of Nula water yielded minimum strength. In the second stage fly ash was added as an admixture in concrete and casted same number of samples to check the effect of fly ash on concrete strength. It was observed that with addition of admixtures, concrete with Nula water and marble waste water yielded maximum strength as compare to that of tap water and spring water. Therefore, it is recommended that at the site where water is not easily available these types water can be used to prepare concrete by using some suitable admixture.

Keywords: Concrete Ingredients, Water sources, Water Quality, Compressive Strength and Admixture.

Effect of Hybrid Carbon Nanotubes/Graphite Nano Platelets on Mechanical Properties of Cementations Composite

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Abstract

Nanomaterials and its application in construction industry attracted researchers to explore their effect due to exceptional properties in term of mechanical and have the potential of reinforcing within cementitious matrix. Among them carbon based nanomaterial exhibit tremendous advantages in the construction industry. In this study hybrid intrusion of carbon nanotubes with graphite nanomaterials were added with small dosage/concentration ranging from 0-0.08% to surfactant ratio of 1:1 in the cement matrix, to explore mechanical properties in term of flexural and compressive strength is explored. The result reveals that using a small percentage of nanomaterials enhances the flexural strength and compressive strength up to 185% and 70% respectively.

Keywords: carbon nanotubes, graphite nanoplatelets, flexural strength, compressive strength

Effect of Water to Cement Ratio and Curing Condition on Compressive Strength of Recycled Aggregate Concrete

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Abstract

The waste material produced from the demolition of concrete structures every day throughout the world. This concrete waste includes the recycled aggregates and the best way of use of this waste is to use as coarse aggregates in the production of fresh concrete. The millions of tons of coarse aggregates is use for the production of concrete and the rocks are the source of aggregates (whether natural or broken). In the new production of concrete the recycled aggregates is used as the coarse aggregates. In this research work from the experimental work performed on the recycled aggregates concrete and the compressive strength of the recycled aggregates was determined by using the different water to cement ratios. For to determine the compressive strength of the recycled aggregate concrete the Lawrancepur sand is used as a fine aggregate, from a demolished concrete the recycled aggregates is collected and used as coarse aggregates and the DG Cement is used as a binding material. The different water to cement ratios has a effect on the recycled aggregates concrete compressive strength. W/C 0.50, 0.55, 0.60 was examined in our research work and the results found that W/C 0.50 gave greater compressive strength. The results show that submerged treatment gives greater compressive strength compared to the coagulant because in the case of submerged treatment, there is no loss of moisture from concrete samples and enhances water reaction. Therefore, to achieve high pressure is recommended submerged treatment. The properties of recycled aggregates was determined and compared with the properties of natural aggregates. After the experimental work it was determined that the water absorption capacity of the recycled aggregates was more as compare to fresh aggregates due to the attachment of cement particles.

Keywords: Recycled concrete, Water cement ratio, Aggregate, Compressive strength.

Use of Banana Fibres in Concrete to Mitigate Shrinkage-Crack Propagation in Concrete Roads

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Abstract

Sustainable development of nation's infrastructure in developing countries is a major challenge in this era. There is an emerging trend of using locally available natural fibres in structural applications to support sustainable development in these countries. Banana fibre is abundantly available and can be utilized in concrete roads. These roads are prone to hair line micro cracking i.e., shrinkage cracking, instigated by drying shrinkage due to volumetric changes in concrete during the curing. The overall aim of this study is sustainable development of concrete roads by using Banana Fibre Reinforced Concrete (BFRC). And the specific aim is to investigate the tensile behaviour of BFRC in comparison with conventional plain concrete (PC). Mix design of 1:2:4 is adopted and 0.5% banana fibre by mass of concrete is used in BFRC specimen. Standard cylinder specimens (100mmx200mm) of PC and BFRC each are casted and cured for 28 days. Split tensile test is performed on these specimens. BFRC depicted decreased tensile strength and energy absorption as compare with PC. On the other hand, BFRC showed an immense increase in toughness value. This improved behaviour of BFRC toughness can help in reducing the resulting shrinkage cracking propagation. It is recommended that, mechanical properties of BFRC in addition with so other strengthening admixtures and its usage as a commercial product should be explored in depth.

Keywords: Shrinkage cracking, Crack propagation, Banana Fibre Reinforced Concrete, Split tensile strength, Tensile energy absorption, Bridging effect.

Study of Mechanical Properties of Concrete developed using Metamorphosed Limestone Powder (MLSP), Burnt Clay Pozzolana (BCP) & Wood Ash (WA) as Partial replacement of Cement

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Abstract

In this growing era of advancements and infrastructural growth, concrete has become one of the most utilized construction material across the globe. The environmental issues may be caused by direct discarding waste materials into the environment. Waste materials are now being employed to develop eco-friendly products and can be directly used as effective additives in many materials to develop efficient characters and durability in them. Stone slurry and solid marble waste are the two most produced waste materials of Metamorphosed limestone industry. Because of growing inflation in prices of raw materials researches are being made to replace the expensive materials with a low cost or waste materials in order to achieve eco-friendly yet cost-effective materials. In this paper, cement is being replaced by the metamorphosed limestone powder, burnt clay pozzolana, and wood ash. The tests are carried out for concrete developed in combination with the replacement of 0, 5, 10, 15 and 20% cement by metamorphosed limestone powder, burnt clay pozzolana, and wood ash. The main focus of the current study is to effectively identify the optimum range of percentage replacement that can be practically useful to achieve high-performance mechanical properties of concrete.

Keywords: Concrete; Waste Materials, Cement; Mechanical Properties; Strength

Dispersion of Multi Wall Carbon Nano Tubes using Hybrid Surfactants.

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Abstract

Carbon Nano Tubes adhere together due to strong Vander wall forces, so it is inevitable to disperse Carbon Nano Tubes before using them in the cement matrix. In this paper, the dispersion of MWCNTs with Arabic gum, Polycarboxylate ether (PCE) based superplasticizer and both acting concurrently are described. The initial sonicated suspensions were too concentrated; they were diluted according to Lambert beer law to molarity of 0.18, 0.14 and 0.1mg/ml. Ultra Violet-Visible spectrophotometry technique was used to check the dispersion of diluted samples. The peak absorbance values of Arabic gum, superplasticizer, and their synergistic suspension were measured respectively and a graph of these different surfactants was plotted according to Lambert beer law which depicts maximum dispersion in case of synergistic suspension of both surfactants.

Keywords: Multi-walled carbon nanotubes, Ultraviolet-visible spectrophotometry, Dispersion, Surfactants, dilution.

Use of Steel Mill Slag in Concrete as Fine Aggregates

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Abstract

Waste materials and some industrial by-products are hazardous to environment and health of living beings. But many of these waste materials can be recycled or reused. Some of these can be used in concrete as a construction material, that can reduce land filling expenses and protect the environment from injurious effects. In this study, natural fine aggregates were replaced with steel mill scale, which is produced as a waste material in steel industries. A detailed experimental study was carried out to determine the effect of replacement of fine aggregates in high strength concrete with steel waste. Three grades of fine aggregates and steel waste were used for attaining optimum packing density. Compressive strength test was conducted on specimens with varying steel waste content. Flow and dry density tests were also performed on these mixes. It was observed that an increase in the percentage of steel scale waste increased the flow as well as the dry density of the concrete mixtures. The compressive strength of concrete mixtures also increased due to steel scale waste content up to a certain percentage.

Keywords: Steel scale waste, recycling, packing density, compressive strength test.

Effect of Various Combination of Aggregates from Different Sources on Properties of Concrete

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Abstract

Concrete is a fundamental constitute of construction industry across the globe. The bulk of concrete is made up of aggregates, hence structural behaviour of concrete significantly relies on the quality and properties of aggregates. This paper presents best combination of fine and coarse aggregates that yields the maximum compressive and tensile strength. A research is carried out on coarse and fine aggregates from different sources in Pakistan. Primary laboratory analysis was conducted to establish the suitability of the aggregates from various sources in construction work. Tests conducted include sieve analysis, bulk density, and specific gravity. Nominal mix (1:2:4) was adopted for this work and mix compositions were calculated by absolute volume method were cast to compute the compressive strength to be monitored at 28 days. Test result show that concrete made from has the highest workability followed by and crushed granite aggregates. Experiments were conducted on eighteen different combinations concrete and a constant W/C ratio of 0.59 for each batch sample. Highest compressive strength at all ages was noted with concrete made from Margallah crush with blend of 50% Lawrencepur sand and 50% Kashmore sand. Also, the combination of Haripur crush with Kashmore sand yields second best value. A common practice is to mix Chenab sand with Lawrencepur sand to attain good strength and workability.

Keywords: Concrete, Aggregate, Potential Sources in Pakistan, Strength.

Development of Structural Concrete via Waste Hair Fibers

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Abstract

Concrete is weak in tension due to micro cracks, the inherent property of concrete, which cannot be fully prevented in the hardened concrete. However, the occurrence of micro cracks can be mitigated by introducing human hair as an organic fiber. Human hair being a waste material, cause environmental pollution and badly disturbed the aquatic life. It is a cheap material and works as a function of steel reinforcement due to its contribution in the tensile strength of concrete. Hair also increases the compressive strength of concrete to some extent and reduces the permeability and volumetric expansion of concrete. For the purpose of this research, hair fibers have been collected from the barber shops near UET Taxila. The size of the hair fibers used ranges from 1.5 to 2 inches and added in the concrete mix by weight of the cement. Concrete mix of 1:2:4 were prepared for the target mean strength of 3000 psi. Cement was replaced with human hair weight of 65 grams, 130 grams, 195 grams and 260 grams in different batches. Compressive Strength Test, Splitting Tensile Strength Test, Permeability Test and Slump test were performed on 6 x12 inches cylinders for each batch at the age of 14 and 28 days. As a result, the tensile and compressive strength of concrete decreased at replacement of cement with 260 grams of hair by same amount. Water Permeability test performed on concrete for 3 days at 30 psi pressure showed that the permeability of concrete decreases by increasing the percentage of hair fiber.

Keywords: Hairs, Permeability, Compressive strength, Tensile Strength, Concrete,

Structural Analysis and Design

Lateral Resistance of Interlocking Stabilized Soil Block Walls with Different Geometrical Wall Configurations

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Abstract

Interlocking masonry walls exposed to lateral loads have reduced lateral resistance due to lack of its tensile strength, as reported in the literature. Different techniques have been used to enhance the lateral resistance of such structure which include use of reinforcement, grout within interlock, plastering and rendering etc. In this study 1500 mm high interlocked masonry walls mostly used in poor developing countries are experimentally tested. The research focus was to evaluate the structural parameters like stiffness, load at first crack and toughness by changing the geometrical plan of walls. Two walls of 3000 mm length were tested which include straight wall and non-straight wall. It was noted that first crack lateral stiffness of non-straight wall as compared to straight wall was improved by 800%. Non-straight wall also undertook twice the load than straight wall failure load without occurring failure.

Keywords: Interlocking stabilised soil wall, mortar-less, non-straight wall, lateral load, lateral stiffness.

Effect of Lift Core Wall Location in High Rise Buildings

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Abstract

High Rise buildings are designed as frame structures with shear walls to provide sufficient strength, stability and stiffness against these lateral earthquake forces acting on the building. For the convenience of users, a Lift Core wall (LCW) is provided instead of shear wall which serves the same function as that of shear wall. In this study an attempt is made to study the different locations of the LCW in a 10 storey building, analysed using ETABS 2016 Static Force Method as per UBC-97 in Seismic Zone-3 of Pakistan. A LCW is provided at 4 different locations and the results are compared on the basis of displacement, Storey drift and Storey stiffness to select the best location of a LCW. It was found that LCW offers maximum seismic resistance at the centre of the building.

Key Words: Lift Core Wall (LCW), Lateral Stiffness, Storey Drift, Torsional irregularity, Static force method.

Effect of Fundamental Period on Seismic Design of Reinforced Concrete Structures

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Abstract

Seismic design of reinforced concrete structures is becoming more important in high seismic areas of developing countries, because of increased seismic activity. There are number of well defined design codes like Uniform Building Code (UBC) 1997, Federal Emergency Management Agency (FEMA), Washington, 1997, and International Business Code (IBC) 2000, etc. which are used in developed countries for seismic design. Seismic design depends on the base shear (V) of the building which acts on the building when any seismic activity happens. UBC 1997 gives empirical equations for calculation of ' V '. The coefficients involve in calculation of (V) depend upon the construction practices and design technique prevailing in the developed countries. Similarly this code gives two methods for the calculation of fundamental period ' T ' of the building. This paper describes the influence of structure's fundamental period on the seismic design characteristics. Two different methods define by UBC 1997 have been used in the paper to estimate the fundamental period of the structure. Based on the analytical findings, the research concludes the ineffectiveness of method B for structures with large fundamental period in high seismic zones. T_A and T_B are discussed in detail along with the factors on which T_A & T_B depend. Graphs between base shear coefficient (V_c) and period (T) are developed and discussed for all seismic zones. Moreover, a regular high rise reinforced concrete building is analyzed, designed and compared for both fundamental periods. Comparison shows an ample variation in the forces, design and civil cost of same building for the two cases.

Keywords: Uniform building code, seismic design, fundamental period, building height, reinforced concrete structures

To evaluate the effect of Synthetic polymers to control Dampness in Structural Members

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Abstract

The quality of construction projects can be enhanced by reducing the defects in the projects during and after construction. Some defects in the construction projects are harmful for the durability and structural stability and some of them are harmful for the indoor air quality and building aesthetic. Dampness is main defect that reduces the life of building as well as the comfort level for the resident of the building. Bitumen coating has been used for number of years to control dampness. But this technique is not efficient and not good for the health as it produces hazardous gases which are harmful for the human health. In this study synthetic polymers were used to control the dampness by improving the water proofing quality of the material. The effect of the polymers on the compressive strength of concrete was also checked by adding these polymers into concrete during concrete mixing. Structural members like wall footing, concrete slab, concrete cubes and septic tank were casted and tested to check the efficiency of synthetic polymer against seepage or leakage of water. The precast concrete slabs were also tested by using these polymers. The crack was produced along the length of the sewerage pipe and also tested for water leakage after applying multiple coats of polymers. It was found that these polymers are equally efficient for water proofing, crack filling and also improving the compressive strength of the concrete. The water absorption of brick and concrete was also tested by applying multiple coats on each side of the brick and concrete cube. These polymers reduced the water absorption of both bricks and concrete to almost zero. So, these polymers are highly recommended to the construction industry to improve the project life, durability, strength and aesthetic.

Key Words: Defects in concrete, Dampness, Water Absorption, Strength Improvement, Crack Filling and Aesthetic.

Retrofitting of Damaged Gravity Designed Reinforced Concrete Exterior Connection using Energy Dissipating Haunch

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Abstract

This research aims to compare the seismic response parameters of gravity designed model tested by Rizwan et. al (2018) by introducing novel haunch retrofit technique in already damaged exterior reinforced concrete connection. The model tested by Rizwan et. al was 1/3rd scale bay 2 story RC frame with deficient connection design. Scaled testing was performed on a quasi-static assembly installed at Earthquake Engineering Centre (EEC), UET Peshawar. Dissipating haunches were installed by first removing damaged concrete from the joints. Afterwards, damaged portion was replaced with rich concrete and haunches were anchored in them to reduce demand on beam-column joints. The Quasi static cyclic load was applied to damaged beam-column assembly by deforming the structure from elastic to inelastic state under displacement control condition. The ACI ITG-5.1-07 protocols were used as loading history, in which different target roof displacements equivalent to target drifts were applied. The structure force deformation capacity curve was derived, for the computation of Response Modification Factor (R) and global structure ductility (μ). The comparison of the retrofitted and as-built model shows that the retrofitted model not just regained its capacity but increased its stiffness, ductility, strength and response modification factor by 70%, 20%, 40% and 70% respectively.

Keywords: beam-column joint, haunch retrofit technique, response modification factor, quasi-static.

Repair and Retrofit of Beam-column Joints of a Damaged Two Story RC-frame

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Abstract

A 1/3rd reduced scale two story reinforced concrete frame tested on shake table was repaired and retrofitted using steel haunches, to check the efficiency of haunch retrofitting in restoring seismic capacity. Repairing was done by removal of damaged concrete from the joints and replacement with rich concrete. Haunches were installed at each joint to change the hierarchy of strength from brittle shear damage in joints to ductile flexure damage in the beam. Testing was performed using quasi-static cyclic loading setup. From the comparison of the tests it was observed that the repaired and retrofitted frame showed a ductile failure mechanism of beam flexure cracking as compared to joint shear cracking in as-built frame. Also a substantial increase in the seismic response parameters of the retrofitted frame was noted showing the effectiveness of the repair and haunch retrofitting technique.

Keywords: Haunch retrofit technique, quasi-static cyclic loading, seismic response parameters.

Seismic Performance Assessment of Existing Mid-Rise RC Buildings in Pakistan

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Abstract

Recent disastrous earthquakes reveal the vulnerability of the existing reinforced concrete (RC) buildings in Pakistan. The increased level of awareness about possible seismic hazard raises serious concerns about the structural performance of RC buildings. Most of the RC buildings in Pakistan are not in compliance with the prevalent stringent seismic requirements. In the current study, a 13-story RC shear wall building, located in the capital city of Pakistan, is considered as case study to evaluate the structural performance of existing buildings. The case study building is categorized as mid-rise RC building. Nonlinear response history analysis (NLRHA), as per ASCE-41-06, is used to evaluate the seismic performance of the case study building. The result shows that the case study building will be severely damaged In the case of an event of an earthquake. This study concluded that more studies are needed to access the seismic performance of the existing RC buildings in Pakistan so that suitable retrofitting measures can be devised.

Keywords: Seismic Evaluation, NLRHA procedure, RC Shear walls

Estimation of Material Properties of SDOF Structures using Visual Vibrometry

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Abstract

In order to evaluate the present status of aging structures, destructive and non-destructive testing (NDT) techniques are employed. Visual testing, as one of the oldest methods for NDT, plays a great role in the inspection of civil infrastructure. As NDT has evolved, more quantitative techniques have emerged, such as vibration analysis. New computer vision techniques for analyzing the small motions in the videos have been recently developed, allowing quantitative measurement of the vibration behavior of structures from videos. Video cameras offer the benefit of long-range measurement and can collect a large amount of data at once because each pixel is effectively a sensor. This work presents a video camera-based vibration measurement methodology for civil infrastructure. By projecting the vibrations of objects, we offer cameras as low-cost vibration sensors. The work includes the estimation of material properties for a variety of rods with known geometry by passively observing their motion in a regular frame rate video. Centering on the case where geometry is known or prepared, we indicate how information about an object's mode of oscillation can be excerpted from video and used to calculate the object's material properties.

Keywords: Visual Vibrometry, Material properties, Vibration analysis; Image processing

Assessment of Existing Concrete Half-Joint Structures using Strut and Tie Analysis and The Development of The Yield Assumption Method

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Abstract

During the 1960s, half joints were commonly used in the design of concrete bridges. Due to the age and condition of such structures, it was necessary to carry out assessments of structural resistance of the half joint structures. The most commonly used method of assessment for half joint structures is the Strut & Tie Method (STM). However in many cases a simple application of the STM without further iteration can result in an underestimate of the structural resistance. For this reason, other analysis methods were developed over the period. Alternative methods include the upper bound collapse mechanism approach (CMA) and the development of the yield assumption method (YAM) as described in this paper. Experimental work was carried out by Desnerck et. al 2016 on a series of half joint beams. The aim of this paper is to compare the experimental results with analytical methods and to ascertain the efficiency of recently developed assessment method YAM. The reinforcement layout and details are taken from the experimental work and analysed using STM and YAM. It was found that the resistance obtained from YAM matches the experimental work within an error of 7%.

Keywords: Half joint, strut and tie method, yield assumption method.

Seismic Isolation of RC Bridges using Low-Cost High Damping Rubber Bearings

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Abstract

This paper presents a simplified seismic design procedure for the seismic analysis and design of HDRB isolation for reinforced concrete (RC) bridges. Reduced-scale HDRBs were locally fabricated in Pakistan, which were investigated through shake table tests at the Earthquake Engineering Center of UET Peshawar. A natural acceleration time history of 1994 Northridge earthquake was used for multi-levels excitations from 0.10g to 1.0g. The essential mechanical properties of HDRB were obtained; including shear moduli, shear stress-strain relationship and hysteretic response curves. A simplified Bi-Linear hysteretic model was calibrated, which was incorporated within the fiber-based nonlinear finite element numerical model of representative bridge, for nonlinear time history analysis. An example bridge studied for seismic isolation design is presented, which was verified through nonlinear time history analysis procedure using design spectrum compatible natural acceleration time histories. This preliminary research have shown promising behavior of the locally fabricated HDRBs in limiting chord rotation demand on bridge piers, essential for controlling damage, under representative design basis earthquakes.

Keywords: Seismic isolation, reinforced concrete bridges, HDRBs, risk mitigation

Influence of Earthquake Direction on Nonlinear Seismic Response of Plan-Asymmetric Structure

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Abstract

This research presents the influence of varying orientations of ground motions on the global seismic demands of a mono-symmetric structural model using a validated numerical model. The considered structure is a ¼-scaled frame shear-wall model. The numerical model was established based on the response validation with the experimental findings. Based on the validated numerical model, seismic response variation at the flexible and stiff edges were compared to present the influence of stiffness eccentricity. It has been concluded in this research that such kind of structures are more sensitive towards rotational response variability compared with the translational response variability. Finally, a conclusion pertaining to the non-conservatism of the principal axis excitation is established from statistical viewpoint.

Keywords: Varying seismic orientation; Asymmetric structure; Seismic response; statistical evaluation

Seismic Performance of Multi-Storey Torsionally-Unbalanced Torsionally-Stiff (TU-TS) Structures

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Abstract

Aesthetics and functionality requirements have turned most of the building structures to be asymmetric in recent times. These asymmetric structures have demonstrated poor seismic performance while experiencing major earthquakes in the past. Such buildings exhibit complex vibration characteristics under seismic shaking as there is coupling between the lateral and torsional components of vibration. These coupled vibrations tend to cause weak locations under torsional distress, which eventually lead towards local damage in the asymmetric structures. The identification of such weak locations is critical in nature when an asymmetric structure experiences seismic shaking. In this regard, this research demonstrates damage characteristics and global seismic behaviour of torsionally unbalance torsionally-stiff (TU-TS) systems with planar and vertical irregularities and evaluated the potentially vulnerable behaviour of TU-TS systems.

Keywords: Shake table test; Asymmetric structures; Local damage response; Global seismic response

Seismic Performance of Multi-Storey Torsionally-Unbalanced Torsionally-Flexible (TU-TF) Structures

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Abstract

Asymmetric structures have demonstrated poor seismic performance under coupled torsional vibrations. These vibrations tend to induce stress concentration at weak locations and eventually cause damage to the structural components. From seismic performance perspective, such weak locations are challenging to be determined in advance. However, with effective monitoring of the local deformation behaviour correlated with the global response of the structure, such estimations can be a possible realization. In this regard, this research experimentally evaluates the potential weak locations and damage characteristics under stress concentration in 1/6-scaled torsionally-unbalanced torsionally-flexible (TU-TF) systems. It has been concluded that TU-TF systems are vulnerable to damage appreciably at both flexible and stiff edges under sudden changes in the seismic demands under higher-mode effects.

Keywords: Shake table test; torsionally-flexible structures; local seismic damage; Global seismic response.

Construction **Management**

Use of Digital Engineering in Ancillary Civil Design

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Abstract

Word is changing in the digital Era characterized by the technology which increases the speed and breadth of knowledge turnover within the economy and society. There was always a need to develop a digital plan to assist engineering design process. This paper particularly discusses the digital plan implemented on East West Rail re-signalling scheme. East West Rail Phase 2 (EWR2) is progressing from GRIP4 (optioneering) into GRIP5 (detail design), during this cross-over period there is an opportunity to make the Ancillary Civils' team processes more efficient and streamlined. Lessons learnt at GRIP4, the need for an Ancillary Civils Digital Engineering delivery plan become apparent. The purpose of the digital plan is to define the requirements and processes that all Ancillary Civils design and station design teams adhered. Jawaid Malik is Alliance Responsible Engineer, he is delivering the ancillary civil design packages digitally.

Keywords: Digital Plan, Digital Engineering, Ancillary civil design, Platform extensions.

4D BIM modeling of Insulated Concrete Sandwich Panel Building

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Abstract

Unexpected disadvantages occur in construction industry due to deviation from planned schedule of a project. However, adjustment of these delays and deviation can be made by early assessment of the delays and deviation in the construction phase which is achieved by investigation of any possible delays and deviation that may occur and providing a planned schedule for the client. Adopting Building Information Modeling (BIM) in the construction industry can help in identifying and planning the different challenges faced by construction industry in phase of construction. This paper aims to develop BIM for the early planning, management and scheduling of construction of Concrete insulated sandwich panel building to avoid the wastage of time and resources during the construction phase. 3D model of Concrete insulated sandwich panel building is created in Autodesk Revit and the model is linked with MS Project scheduling using Naviswork Manage. 4D BIM modeling of the model is carried out which helps in identifying delays and reduce sequencing and delays problems.

Keywords: BIM, Resource management, Revit, Naviswork, MS Project, Sequencing, Planning.

Proposed method for Risk Management of small size residential housing construction projects – A Case Study

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Abstract

Risk Management is an organized process used to identify, analyze, and proactively respond to the risks that directly or indirectly affect the project objectives. This process focuses to increase the chances and benefits of positive events and to minimize the likelihood and severity of undesirable events. Risk management has been widely discussed by different researchers. But unfortunately it is not commonly practiced in real life projects. There are various excuses that Construction Managers show to avoid proper risk management. One of the most common excuses is, “RM is just scaremongering”. This paper focuses to propose a solution and make it easy to work out Risk Management during project initiation phase. Construction of a residential bungalow has been taken as a case study. A model is developed and explained through a practical example that can be applied to any small scale building construction.

Keywords: Risk, Risk Management, Risk Score, Probability, Impact

Challenges in the adoption of Unmanned Aerial Systems (UAS) for health and safety in construction industry of Pakistan

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Abstract

The rate of accidents, fatality & injuries in construction industry are more frequent than any other profession, which causes time delays and cost overruns in the project due to the compensations paid to the injured workers. As there is no authority or organization which monitors health and safety e.g. OSHA in the construction industry of Pakistan, the conditions of health and safety for the well-being of labours are not satisfactory. Adoption of new technology can reduce the number of accidents that occur on construction sites but the rate of adoption of new technology in the construction industry is very slow paced and even slower in area of health and safety. This study provides an insight to the challenges faced by the construction industry of developing country like Pakistan, by promoting innovating technology like unmanned aerial system (UAs) for the purpose of health & safety. Technology such as Unmanned Aerial System (UAS) is being used to identify, report hazards to make zero-accident jobsite & the access the inaccessible areas but this technology is not being adopted in developing countries like Pakistan. A conceptual framework was developed for the adoption of UAS in the construction industry of Pakistan to improve health and safety.

Keywords: Unmanned Aerial Systems, Technology adoption, Health and Safety

Adoption and Awareness of Building Information Modelling (BIM) in Pakistan

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Abstract

During 2016-2017, a higher growth rate of 9.05 % is achieved by Pakistan construction industry. It is observed that the construction industry has a poor reputation of accomplishing the projects in required time, cost, and quality. It is because of using the traditional management techniques that can be easily minimized with the implementation of new technologies like Building Information Modeling (BIM). In this study, a questionnaire survey is performed, which helps in finding the present state of BIM in Pakistan and also highlights the barriers in the successful adoption of BIM in Pakistan. Out of 105 responses received, 68 % of Architecture, Engineering, and Construction (AEC) professionals are aware of BIM and among them, only 12% had utilized BIM in their projects, which is a very low percentage and has to be increased. This research helps in the awareness of BIM in Pakistan as 83 % of the respondents responded that it helps us in clearing our minds about BIM.

Key Words: Building Information Modeling (BIM), 2D CAD, BIM in Pakistan, Barriers in Adopting BIM in Pakistan.

To Investigate Utility of Building Information Modelling (BIM) to Improve Productivity of the Construction Industry

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Abstract

Productivity of construction industry is lower in contrast to other industries. The industry is also lacking behind to adopt technology as equivalent to other industries. Building Information Modelling (BIM) is a revolutionary development in the Architecture, Engineering and Construction (AEC) industry. There are numerous factors that contribute to reduce efficiency of the industry. This study aims to investigate the potential of BIM to solve issues that can reduce productivity of the construction industry. A questionnaire survey is conducted for this purpose from the practitioners of the construction industry of Pakistan. The results of 171 valid responses greatly support the hypothesis that BIM has the potential to solve issues that can cause loss of productivity of the sector. Linear regression analysis is also conducted. The analysis shows that collaboration, elimination of rework and conflicts are significant factors. This research will be beneficial for academics, as well as, industry to enhance productivity of the construction industry by identifying factors and mitigating them with the help of BIM.

Keywords: Construction Industry, Productivity, BIM, AEC

To Investigate Potential of Building Information Modelling (BIM) to Mitigate Disputes in the Construction Industry

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Abstract

Disputes are part and parcel of construction industry due to the complex nature of the industry, as well as, the uniqueness of construction projects. These disputes not only damage the industry monetarily, but also waste time and strain working relationships. There are alternative dispute resolution techniques to solve disputes rather than to avoid disputes at the first place. Additionally, the industry is also slow in adopting technology when compared with other sectors. Building Information Modelling (BIM) is recognised as a “revolutionary development” and “game-changer” for Architecture, Engineering and Construction (AEC) industry. The purpose of the present study is to investigate if BIM has potential to mitigate disputes in the construction industry. A questionnaire survey is conducted from the practitioners of the construction industry of Pakistan; 190 valid responses were collected and analysed. The majority of the respondents agree with the potential benefits of BIM to mitigate disputes. Additionally, linear regression analysis also showed that co-ordination among project participants, collaboration to clear scope of work at the outset of the project and availability of accurate design drawings would mitigate disputes among the stakeholders. The present study would yield benefits to academia for further investigation, as well as, to the industry to avoid potential causes of disputes by utilizing BIM.

Keywords: Disputes, BIM, construction industry, AEC

Incident Reporting Tool

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Abstract

Safety is one of the effective factors on the operation of construction projects and plays a key role in success of a project. Incident reports aid in identification of problems and accidents can be reduced based on corrective actions taken, thus improving the safety. Incident reporting systems are a good source to analyse, track and document all incidents that have taken place on a job site. Unfortunately, most incident reports are generally unstructured, providing little or no guidance to the reporter. Therefore, most reports contain information only about what happened, as opposed to why an incident happened, making identification of possible hazards and prevention strategies extremely difficult. The study tries to address that the complexity of processes involved in construction can affect safety because of unpreventable workplace injuries. By understanding the situational elements of the prior incidents through incident reporting systems helps in developing preventative safety procedures. This paper aims to achieve the objectives of safe and transparent practice in our industry by developing a framework Safety Reporting Tool (SRT) which will help in apposite reporting as well as management of accidents. This data can be further compiled and can be used for developing an organizational safety plan as a proactive approach to prevent recurrence of unwanted incidents and also continuous improvement of safety operation of projects.

Keywords: Construction Safety, Incident Reporting, Reporting Framework, Reporting Tool.

Analysis of Lahore Development Authority (LDA) Construction By-Laws

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Abstract

Currently, Pakistan is facing water scarcity and energy deficiency. In future, the problem can further escalate with increase in its population and development of infrastructure. So, it is a need of an hour to revise its construction by-laws, to improve them to have a sustainable development. For this purpose, an attempt has been made to analyze the construction by-laws of LDA. In this study, LDA by-laws are analyzed on the basis of LEED (Leadership in Energy & Environmental Design), which is a widely used green building rating system in the whole world. It is concluded that LDA by-laws are lacking in clauses to generate water efficiency, energy efficiency and indoor environmental quality in the buildings. At the end, some suggestions are made which can be incorporated in LDA by-laws to make them green up to some extent.

Keywords: Infrastructure, Construction By-laws, LEED, LDA By-laws, Green Building.

Exploring Building Information Modelling (BIM) Readiness in Islamabad Capital Territory (ICT) of Pakistan

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Abstract

Building Information Modelling (BIM) is a significant development in Architecture, Engineering and Construction (AEC) industry. It is a collaborative way of working among stakeholders of a project underpinned through technology, i.e. shared data rich virtual model of a construction facility. Governments, round the world, are steering the process of BIM adoption to achieve value for public money spend on infrastructure. Different studies are carried out, throughout the world, on different focus groups to find out their readiness of BIM. The present study is the first ever study to explore an overall awareness and readiness of BIM in the construction sector operating within the vicinity of Islamabad Capital Territory (ICT), Pakistan. A survey is conducted in the study area; 190 valid responses are obtained. The results show that 59% of the respondents are aware of BIM, however, only 39% are currently utilizing BIM. Nevertheless, 62% respondents are willing to adopt BIM in the near future. Therefore, awareness and the willingness to adopt BIM is on an upward trend, while, the adoption of BIM is a bit low at present. The government should steer the process of BIM adoption, like the United Kingdom (UK) Government, to achieve value for public money in developing infrastructure.

Keywords: BIM, BIM awareness, BIM readiness, BIM adoption

Environmental **Engineering and** **Water Resources**

Reduction in Fresh Water Consumption by Grey Water Reuse for Flushing and Irrigation - A Case Study of a Multistorey Hotel Building

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Abstract

Over time the concern of amount of water consumption has gained strength with depleting water resources each day all over the world. Saudi Arabia with already minimal surface and sub-surface water resources is on alert for future planning and management of water use in the Kingdom. Large scale water conservation projects are in line for future constructions. But as a matter of fact, the old buildings must also be rehabilitated according to the sustainability standards. This study has been taken up for an operational hotel building where there are no water conservation techniques in practice. Grey water recycling being the most common method for water reuse has been studied for its feasibility in this building. Various calculations were performed for water usage facilities including water required for flushing and irrigation as compared to the volume of grey water being generated by the building. It was found that the hotel building releases almost 75% of grey water daily of its average daily water requirement whereas the requirement of water for flushing and irrigating green areas came out to be 26%. A grey water treatment unit of 12,000 gallons per day (gpd) capacity was recommended to be installed at the hotel which shall replenish the water for flushing and irrigation resulting in a reduction of fresh water usage by 26% in addition to various other economic and environmental benefits. This research shall be useful for the construction industry and shall motivate the concerned authorities to rehabilitate the older buildings to make them sustainable along with new construction.

Keywords: grey water recycling; sustainability; water conservation; water reuse; flushing; irrigation

Analysis of Existing Hydraulic Structures with Crack and Pore Water Pressure using Reliability Methods

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Abstract

The safety and reliability of German hydraulic structures, like ship locks, weirs, etc., have to be verified from time to time or for the decision of rehabilitation or renewal. This contribution presents a probabilistic methodology for the uncertainty quantification of relevant parameters and failure mechanisms for the evaluation of reliability levels of existing hydraulic structures. For a ship lock chamber wall, a gravity wall construction, a dominant action crack and pore water pressure is considered and its influence on the structural reliability is discussed. The case study is benchmarked for requirements posed by the latest European standards and German guidelines. For the application of the proposed methodology a typical structural geometry, material and load system for a ship lock wall is considered. Overturning and compressive strength have been investigated as the exemplary limit states. The results indicate a decrease in reliability levels in case of crack and pore-water pressure as an externally applied force. The differences are mostly influenced by the difference of levels of water within the chamber structure. Additional reliability based sensitivity analysis indicates that friction angle and concrete weight have the highest impact on the reliability for the considered parameter uncertainties and the limit states. The investigations are part of a research project in which probabilistic analyses for existing hydraulic structures shall promote a decision instrument so as to rehabilitate existing hydraulic structures and to support sustainability aspects in structural engineering.

Keywords: Hydraulic structures, Reliability analysis, Probabilistic modeling, Structural analysis, crack-pore water pressures.

Impact of Raising Mangla Hydropower Dam on Rural Land and Crop Production Pattern

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Abstract

Dam induced displacements causes several damages to the life of inhabitants in different areas of the world. Many people lose the ability of returning towards their lives. It is necessary to establish mandatory policies for the dam induced affected people. This study presents the consequences of raising Mangla Dam, mainly the after effects on land and crop production pattern. In order to attain the required information, different approaches were employed like questionnaire, in-depth interviews, focused group discussions and direct and indirect observations. After going through analysis of the conducted field work and collected data, the obtained results indicate that around 803 acres of residential land, 4,358 acres of agricultural land, and 4,299 acres of barren land was affected due to this project. The crop production also decreased due to the land becoming less fertile and the people started preferring to grow different kinds of vegetables more than the congenital crops like millet, wheat and maize.

Keywords Resettlement- Mangla Dam- Dam Induced Displacement- Raising of Dam- Rural livelihoods- Population- River Jhelum- Pakistan

Evaluating the Change of Water Table Position for Sustainable Development: “A Case Study of Ghazi Barotha Hydropower Project”

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Abstract

The primary objectives of this study was to evaluate the effects of the construction and subsequent operationalization of 1450 MW power generation facility “Ghazi Barotha Hydropower Project”, on water table position in the surrounding areas. To assess the effects, the data comprising of elevation values of water column in open wells set up at different locations in vicinity of the facility have been collected. For a precise and comprehensive analysis, the study area was divided into 12 clusters. The hydrograph of each cluster between average water column elevation values and years (from 1997 to 2008) have been analysed. By comparing the values, before and after building the facility, it has been concluded that there are significant effects on positions of water table on some area, whereas in other areas, no substantial effects have been observed.

Keywords: Ground water, Ghazi Barotha Hydropower Project, Hydropower, Water depth, Dam, Water Table.

Transportation **Engineering**

Determining Optimum Proportion of Fly Ash as Partial Replacement of Asphalt for Flexible Pavements

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Abstract

Fly ash is a by-product obtained from the combustion of coal. It is a pozzolanic material and has been used as a binder for different types of construction application such as concrete mix, and soil stabilization. However, the studies related to exploring its behaviour when it is used in combination with bitumen are scarcely found. The focus of this research was to determine the optimum proportion of fly ash to be used as partial replacement of bitumen in flexible pavement design. The evaluation is made based on Marshall Stability and flow of Hot Mix Asphalt samples. Specimens were prepared using bitumen with and without fly ash. Varying percentages of fly ash were used as a partial replacement of bitumen. Based on the experimental work carried out during this study, it was observed that flow decreased with the increase in proportion of fly ash. On the other hand, stability was found to be maximum when the proportion of fly ash was at 10% by weight of bitumen. The result has shown that 10% replacement of fly ash with bitumen resulted in the highest stability and acceptable value of flow.

Keywords: Fly ash, hot mix asphalt, Marshall Stability, flow

Performance of Cement Treated Base Course in Composite Pavement

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Abstract

The importance of highway in modern transportation systems cannot be overstated. Pavements are one of the major subsystem of the highway system. Today, pavement management system has been increasingly employed by many state agencies to assist in highway pavement management. One of the key component of the management system, which is also the most challenging part, is the pavement deterioration prediction models. The development of any country depends upon the transportation system. In Islamabad when precipitation occurs and proper drainage system is not available then water precipitates into the pavement layers and finally reach to the sub grade. Due to that settlement of sub grade take place that fails the pavement. The base course of asphalt pavement effects the durability of wearing surface. The variation in thickness of base course change the strength of pavement. The use of CTB (Cement Treated Base) under the wearing surface protects the asphalt pavement better than normal base course. But one issue arises when CTB is used that is the cracks produced in CTB. The main focus of our research is to reduce these cracks by introducing the layer of chip stones or open graded asphalt or crushed aggregates between CTB and wearing surface and choose best suitable option for future recommendations. The CTB provides best design of composite pavement for HTV. This design will enhance the durability and design life of pavement structure. It is more resistant against the heavy traffic loads. This composite pavement design is best suitable where subgrade soil strata have insufficient capability to bear the traffic loads.

Keywords: Design & analysis, Composite pavement, Cement treated base course

Operational Performance Analysis of Signalized Intersections: A Case Study of Lahore

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Abstract

Owing to ever-increasing motor vehicle population, congestion at intersections is a major problem. Effective control mechanism at intersections can help manage traffic and reduce its adverse effects significantly. City of Lahore, having the highest number of vehicles in Punjab, Pakistan faces enormous congestion issue. Consequently, vehicles face delay and enhanced travel times at signalized intersections. In this regard, this study is carried out to evaluate operational performance of two major signalized intersections in urban centre of Lahore. SIDRA Intersection, a traffic analysis tool widely used for traffic performance evaluation studies, is used for analysis.

Keywords: Operational Performance, Signalized Intersection, SIDRA intersection, Delay.

Controlling Shrinkage Cracks Propagation in Rigid Pavements Using Banana Fibre Reinforced Concrete

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Abstract

Cracking in Rigid Pavements is a common issue. Out of different types of cracking, drying shrinkage causes visible cracking in Plain Cement Concrete (PCC) as it shrinks and the developed stresses exceeds its tensile strength capacity. Movement of heavy traffic cause propagation and widening of cracks. This ultimately reduce the serviceability and durability of Pavements. The overall aim of the research program is to improve the performance and durability of rigid pavements exposed to heavy traffic loading. The specific goal is to use Banana Fibre in Reinforced Concrete to improve the post cracking behavior of concrete in rigid pavements and limit the propagation and widening of shrinkage cracks. Cylinders of diameter 100 mm and height 200 mm are prepared using mix design ratio of 1:2:4 having water cement ratio 0.6 and fibre content 0.5% by mass of concrete. Specimens are kept in water for 28 days and then tested using ASTM standard C496/C496M-17. The splitting tensile strength of BFRC specimen turned out to be 44% less than that of PCC. The fibres caused a strong bridging effect that shows fibres have a good tensile and bond strength to improve the post cracking behavior of concrete, also the percentage of fibre content has a direct relation with the splitting tensile strength. The advantage of Bridging effect can be utilized to increase the splitting tensile strength of BFRC over PCC by optimizing the percentage of fibre content.

Keywords: Banana Fibre Reinforced Concrete, Rigid Pavements, Shrinkage Cracking, Bridging Effect, Tensile Strength.

Evaluation of the Rheological Characteristics of Asphalt Modified with Nano Material

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Abstract

Nano technology is using in all over the world and it has a great effect on characteristics of asphalt. A Nano technology is one of the active research areas in a number of disciplines like Civil Engineering and Construction Materials. A modifier Nano silica (NS) is used by different researchers to start focus on the modification of Pavement materials. The objectives of this study were to enhance the role of Nano technology in Pavement Engineering applications on the basis of its rheological parameters. This paper focus on how to improve the conventional and rheological characteristics of modified binder using Nano Silica (NS). Incorporating of Nano silica (1%, 3%, and 5% by weight of binder) in binder had improved the physical properties of bitumen. Frequency sweep test was performed by using Dynamic Shear Rheometer (DSR) to evaluate complex modulus, phase angle and rutting resistance characteristics of binder. The result showed that by adding 3% NS, penetration and ductility had decreased by 18.29% and 30.1% respectively while the softening point had increased 7.53%. The test result of the DSR showed that rutting resistance had improved 35% by using 3% NS. The optimum percentage of 3% NS was recorded on the basis of rutting resistance values.

Keywords: Nano Silica (NS), Dynamic Shear Rheometer, Rheological and Rutting Resistance.

Analysing the Public transport passenger satisfaction in Abbottabad

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Abstract

Passenger satisfaction is considered as one of important factor to shift the commuters from the private transport to public transport. Recent estimations show that the mode share of public transport in metropolitan cities in Pakistan ranges between 16% to 20% and the situation is more critical in other cities. This paper provides the subjective evaluation of the public transport system by means of satisfaction in the Abbottabad city, Pakistan. Research designed a questionnaire and field survey was conducted to evaluate the responses of public transport passengers. Nineteen service attributes regarding public transport service attributes were investigated in the survey. The results indicated that passenger's satisfaction from the overall quality of public transport system and nineteen explanatory variables. The findings of this paper draw the attention of government authorities and service provider towards the performance indicators where the satisfaction lag and that need to be improved to shift the modal ship towards public transportation.

Keywords: Public transport, Passenger Satisfaction, Travel Behaviour, Regional Survey.

Geotechnical **Engineering**

Effect of Addition of Granular Soils on Physical Properties of Clayey Soil

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Abstract

The experimental work is performed to improve the geotechnical properties of available clayey soil by adding admixtures or granular soil i.e. Sand up to some suitable proportion. The suitable proportion to form the optimum mix in which the granular soil can be added in the clay soil was decided after performing the proctor compaction test. These optimum mixes obtained by the experimental investigation were carried further and checked for index properties of clayey soil. Materials has been used to improve the geotechnical properties of soil, in this regard experimental work was performed and it is studied that the change in properties of clayey soil by adding granular soil sand up to suitable selected proportion. After this we were able to check the change in geotechnical properties of clayey soil. To understand the effect of granular soil on clayey soil different samples were made. To compared properties of these samples different tests were performed on these soil samples. To Check and understand the effect of the addition of granular soil on the engineering properties of a clayey soil, almost forty groups of different soil specimens were prepared and tested at different percentages of granular Soil i.e. 0%, 5%, 10%, 15%, 20%, 25% by weight of the parent soil. In this experimental work the compaction properties of clayey soil with the addition of different percentage of granular soil i.e sand from standard proctor test of sample S_A, it is determined that the value of maximum dry density is increased from 18.30 KN/m³ to 19.55KN/m³ (6.45% increased) and sample S_B, it is determined that the value of maximum dry density is increased from 18.00 KN/m³ to 19.30KN/m³. From Modified proctor test the two soil sample S_A & S_B, it is observed that the value of maximum dry density is increased from 19.40 KN/m³ to 20.30KN/m³ and 19.05 KN/m³ to 19.90KN/m³ (4.44% and 4.27% increased).

Keywords: SPT: Standard Procter Test, S_A: Sample A, S_B: Sample B, CS: clayey soil.

A Semi-Analytical Framework for Suction Caisson Installation in Sand

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Abstract

Controlling the installation procedure for a caisson foundation requires a preliminary design phase. For suction assisted installation of caisson foundations in sand, such a design phase is important to predict the force required to overcome soil resistance as caisson is pushed into the seabed, and to identify the limits to a safe installation process such as the occurrence of seepage induced piping. The present paper provides a framework where analytical expressions are obtained for the required suction magnitude to overcome soil resistance to caisson penetration, these analytical expressions are derived for a normalized caisson geometry, based on compiled results obtained from finite element analysis of seepage around a caisson wall. The proposed suction predictions for the whole process of caisson installation in sand are validated against field trials reported in the literature.

Key-words: Suction caisson, normalized seepage problem, polynomial regressions, suction profile.

Effect of Sugar-Cane Bagasse Ash on Engineering Properties of Low Plastic DGK Soils

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Abstract

Soft cohesive soils that contain the significant percentage of montmorillonite, illite and mica in their mineralogical composition may undergo volume changes upon interaction with water. Pavements and building foundations constructed on such soils may fail due to change in volume with variation in the seasonal moisture content. If encountered, treatment is essential to improve the shearing strength and enhance the load carrying capacity of such foundation/subgrade soils. Numerous studies have been done to improve such soils by adding various materials such as cement, lime, bitumen, rubber and plastic etc., or by chemical, thermal and electrical stabilization.

In chemical stabilization, soil stabilization is achieved by chemical reaction of stabilizer (cementitious material) and soil minerals (pozzolanic material). The use of bagasse ash created by sugar cane industries is ideal for chemical stabilization of soft soils as it is economical, environmental friendly and offers a potent solution for weak soil particle bonding. This study has been carried out to examine the stabilization potential of the subgrade soil of D. G. Khan. Bagasse Ash is a by-product of sugar-cane industry, where bagasse is burnt to produce electricity. Bagasse ash contains high silica and alumina contents and is therefore a pozzolanic material, that reacts with calcium to form cementitious calcium silicate and aluminate hydrates. This study shows an increase of almost 30 times in soaked unconfined compressive strength of stabilized soil and a significant increase in CBR values of subgrade soils. One dimensional swell potential of treated soil also found to decrease from 2.5 percent to almost zero.

Keywords: Low Plastic Soil, Sugarcane Bagasse Ash (SCBA), CBR, MDD, OMC, Atterberg's Limits, Minerals

Physical and Strength Characteristics of Fly Ash Stabilized Soft Soil

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Abstract

The engineering properties of soft soils can be improved by mixing with suitable agents and one of them is fly ash. The sole object of this research is to check the effect of varying dosage of fly ash class C on physical and strength characteristics of soft soil. To check the result of fly ash contents on soil properties, a varying dosage from 0-10% was mixed with virgin soil. Soil mineral identification, specific gravity, consistency limits, compaction characteristics, California bearing ratio (CBR) and unconfined compressive strength (UCS) tests were performed on treated as well as untreated samples according to the related ASTM procedures. In addition, UCS tests were performed over an extended period of 0, 3, 7, 14 and 28 days to check the impact of curing period on strength development. The test results showed that California bearing ratio (CBR) and unconfined compressive strength (UCS) increased while plasticity reduced with the increment in fly ash contents.

Keywords: California bearing ratio, fly ash, plasticity, soft soils, unconfined compressive strength

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Experimental Determination of Capacity of Pile Group and Pile Raft Foundation

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Abstract

Pile raft foundation is a type of foundation that can be used to support heavier structures over a soil of moderate to low bearing capacity through its complex soil-structure interaction. Researchers have carried out numerical studies on the analysis and design of pile raft foundation and pile group and it is proved that pile group and pile raft foundation have difference in load carrying capacities. R. Katzenbach et. al (2005) said that the raft in pile raft foundation increases the stress between the soil and piles and hence contributes to the load capacity of piles in comparison to pile group when piles are free standing. This paper basically provides an experimental verification of their behavior. This paper is aimed to calculate the settlement behaviors of pile group and pile raft foundation experimentally. For this small-scale model is prepared for experimentation, where pile is made up of copper and raft is of aluminum. Experimental model is placed in a soil box and vertical loading is applied through a hydraulic straining frame at a very slow rate. It is found that load carrying capacity of the pile raft is much greater than that of the pile group and vertical settlement is also reduced substantially in case of pile raft foundation.

Keywords: pile group and pile raft foundation, small scale model, settlement

Optimum Values for Mixing Ratio and Tire Shred Size of Sand Tire Mix

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Abstract

The increase amount of scrap tire is becoming an enormous concern. The large stockpiles causes an environmental issues, contamination and cause health issues, due to their non-biodegradable nature. So the effective use of scrap tire required a great concern .If these scrap tire is cutted in pieces of appropriate sizes called tire shred, then it can be used for increasing shear strength of sand which is used in mechanically stabilized Earth walls (MSE), earth embankments and for land fill . But using scrap tire for increasing shear strength of sand require a sound knowledge of size of tire shred, mixing ratio of tire shred with sand as well as size of tire shred. The sand gradation also effect the shear strength behavior. This paper present a number of modified proctor compaction test results and gradation test performed on sand of specified specific gravity mixed in different proportion with tire shred of different sizes range from 50mm to 100mm, from which then optimum water content, maximum dry density as well as the size of tire shred is determined. Using that optimum moisture content ,mixing ratio and tire shred size , the increased dry density and hence the increase shear strength can be achieved .If the above optimum characteristics are compromised, the tire mixed with sand will not effectively play its role in increasing the shear strength of sand.

Keywords: tire shred, mixing ratio, optimum compaction ratio, optimum mixing ratio

Experimental Study of Comparison of Settlement Behavior of Pile Raft Foundation with Batter and Vertical Piles

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Abstract

Lateral forces on the high-rise buildings and infrastructures causes them to topple down. A simple deep foundation of vertical piles is not enough to full fill the design requirement for lateral forces on these structures. Pile raft foundation is found to be efficient in high rise buildings by reducing the settlement produce in the foundation and increasing its load carrying capacity but in some cases the pile raft foundation with vertical piles is unable to sustain the structure for the lateral load. Therefore, batter piles are used in pile raft foundation which has greater load carrying capacity in both vertical and horizontal direction. Batter piles with different angle with vertical are used to resist lateral load accordingly. This paper presents the experimental study of the comparison of the settlement and load carrying capacity of the pile raft foundation with vertical and batter piles, this study is divided into two parts, first part is experimental study of pile group foundation model having vertical and batter pile in which raft is not active to take load and in second part the pile raft foundation model having vertical and batter piles is studied in which the raft is active to take load. Vertical load is applied on all these foundation type separately and load settlement curves are plotted. It is concluded that pile raft foundation having batter piles has greater load carrying capacity and less settlement than that of pile raft foundation with vertical piles.

Keywords: Pile Raft foundation, Pile group foundation, settlement, batter piles.

Development and Application of Land Cover Map for Urban Planning and Development Using Geographic Information System and Remote Sensing

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Abstract

The urban land of Abbottabad city is constantly changing due to population growth and migration of people from other regions. It causes major problems of depletion of natural land resources. The main objective of this research work was to study the urban land change in the past 17 years. The other objectives were to quantify landcover classes transformed from one type into other. The methodology include: (i) acquisition of satellite images from Google Earth; (ii) digitization of land covers classes for both years of 2001 and 2018 using the satellite images and (iii) GIS analysis for quantifying the land cover changes. The result indicated 40.02% increase in built-up area, 51.65% increase in forestation, 28.46% increase in open land and 120.93% increase in recreational area in the last seventeen years. There were 40.02% decrease in barren land and 69.33% decrease in agriculture. This study could be utilized for urban planning development and management of urban land of district Abbottabad.

Keywords: Geographic Information System (GIS); Remote Sensing (RS); Urban Land Change; Google Earth Pro; urban sprawl; transformation of classes; landscape study.

