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2nd International Conference of the College of Engineering-University of Duhok:
Recent Innovations in Engineering (ICRIE)
April 26th to 27th, 2017, Duhok City, Kurdistan Region – Iraq

Dr. Azad Abdulkadir Mohammed (University of Sulaimani)
Dr. Rizgar Ali Hummadi (Salahaddin University)
Dr. Shoukr Q. Aziz (Salahaddin University)
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Conference Sponsor

The ICRIE 2017 conference is sponsored by Darin Group.

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Useful Information

Website of the Conference: <http://uod.ac/icrie/>

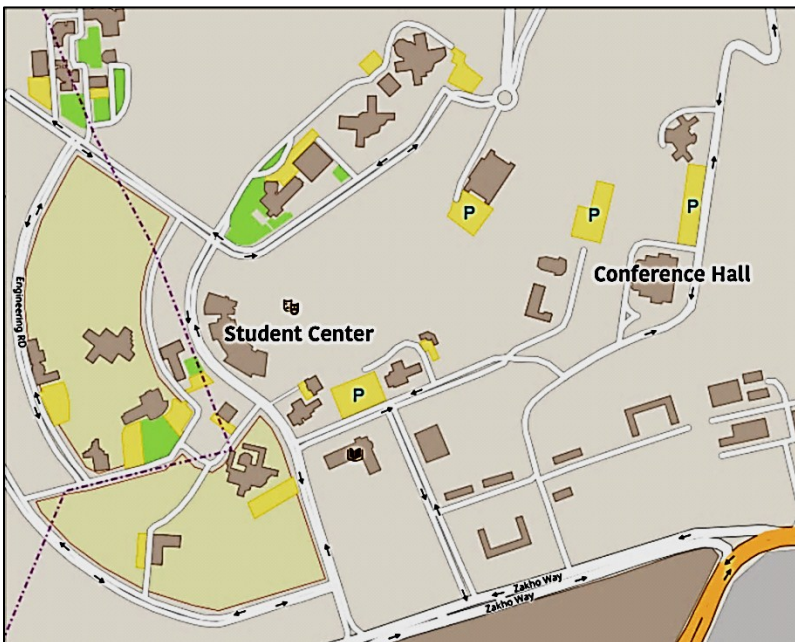
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Conference Lunch

Lunch will be served at 1:00 PM at the Student Center.



ICRIE 2017 Plenary Session Program

First Day (26, April 2017)

9:00 AM – 10:30 AM (Registration and Welcoming)
 10:30 – 1:00 PM (The opening Ceremony - Conference Building Hall)
 1:00 - 2:00 PM Lunch

Time	No. of Section	Place	No. of Section	Place	No. of Section	Place	No. of Section	Place
2:30 – 4:30 PM	Session 1 (Civil - <u>Structure</u>)	Conference Building Hall 1	Session 2 (<u>Water Rec.</u> & Environment Eng)	Conference Building Hall A	Session 3 (<u>Electrical</u> & computer Eng.)	Conference Building Hall B		

Second Day (27, April 2017)

9:00 – 11:00 AM	Session 4 (Civil - <u>Highway</u>)	Conference Building Hall 1	Session 5 (Arch Eng.)	Conference Building Hall A	Session 6 (Mech. Eng.)	Conference Building Hall B	Session 7 (<u>Water Rec.</u> & Environment Eng.)	Conference Building Hall C
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11:00 - 11:30 AM Coffee Break (Conference Building cafe)

11:30 – 1:00 PM	Session 8 (Civil – <u>Geot. Eng</u>)	Conference Building Hall 1	Session 9 (Electrical & <u>computer Eng.</u>)	Conference Building Hall A	Session 10 (Water Rec. & <u>Environment</u> <u>Eng.</u>)	Conference Building Hall B	Session 11 (Civil - <u>Structure</u>)	Conference Building Hall C
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01:00 – 01:30 PM Closing Ceremony

01:30 - 2:30 PM Lunch

3:00 PM Trip

Seminars Program

Session No.:	<u>Session 1</u>	Session Title:	Civil - <u>Structure Eng.</u>
Chairman	Prof. Mohamad Rauf Dr. Ali Ehsan	Date: 26 / 4 /2017	Time Period : 2:30 – 4:30 PM

Time	Author(s)	Title
2:30 – 2:45	Shireen T. Saadullah James H. Haido	WIND ANALYSIS OF TALL BUILDING IN DUHOK CITY, IRAQ USING COMPUTATIONAL FLUID DYNAMIC (CFD)
2:45 – 3:00	Abdulhameed A. Yaseen	THE ROLE OF SEISMIC POUNDING IN THE OPTIMAL SELECTION OF GROUND-MOTION INTENSITY MEASURES
3:00 - 3:15	Yaman S. S. Al-Kamaki Riadh Al-Mahaidi Ian Bennetts	STRAIN EFFICIENCY OF CARBON FIBRE REINFORCED POLYMER-CONFINED RC COLUMNS
3:15 – 3:30	Muthanna Abbu Riyadh Al-Ameri	NUMERICAL ANALYSIS OF GLUED LAMINATED TIMBER WITH UNEQUAL LENGTHS COMPONENTS
3:30 – 3:45	Youkhanna Zayia Dinkha James H. Haido Msheer Hasan Ali	FLEXURAL BEHAVIOR OF REINFORCED CONCRETE BEAMS MADE WITH ORDINARY AND HIGH STRENGTH CONCRETE: EFFECT OF INTERFACIAL ROUGHNESS BETWEEN OLD AND NEW CONCRETES
3:45- 4:00	Thamer Kubat Riadh Al-Mahaidi Ahmad Shayan	EFFECT OF CFRP CONFINEMENT ON AAR-INDUCED EXPANSION OF CONCRETE COLUMNS

Session No.:	<u>Session 2</u>	Session Title:	<u>Water Rec.</u> & Environment Eng.
Chairman	Prof. Bashir Thabit Dr. Rasol Mojbel	Date: 26 / 4 /2017	Time Period : 2:30 – 4:30 PM

Time	Author(s)	Title
2:30 – 2:45	Khalid M. Khidir Mohamad T. Al-Sha'ar	ESTIMATING STORM DIRECT RUNOFF USING SYNTHETIC UNIT HYDROGRAPH METHODS BY (WMS) MODEL (SOLAG BASIN AS A CASE STUDY)
2:45 – 3:00	Dilshad Abdul Jabbar Haleem George Kesserwani Aza Hani Shukri Alan Saheen Saifaldin	STUDY THE PERFORMANCE OF THE TWO WAVELET-BASED ADAPTATION SCHEMES FOR THE SHALLOW WATER FLOW MODELING
3:00 - 3:15	Hekmat M. Ibrahim Nawbahar F. Mustafa Haveen M. Rashid	HYDROLOGICAL TIME SERIES FORECASTING USING ANFIS MODELS WITH AID OF WAVELET TRANSFORM
3:15 – 3:30	Jowhar R. Mohammed Shamiran J. Shiba	SIDE WEIR FLOW INVESTIGATION IN A CIRCULAR CHANNEL USIN COMPUTATIONAL FLUID DYNAMICS (CFD) FOR SUBCRITICAL FLOW CONDITION
3:30 – 3:45	Basil Younus Mustafa Sarhang M. Husain Saud Ahmed Hussien	HYDROLOGICAL STUDY AND ANALYSIS FOR PROPOSED SARTIK DAM PART 1: STREAM FLOW DATA ANALYSIS & FLOOD DISCHARGE CALCULATION
3:45 – 4:00	Imran N. Alslevavni Kamel A. Almohsee	INTEGRATED APPLICATION OF (MODFLOW) AND (WEAP) MODEL IN NINEVEH PROVINCE
4:00-4:15	Basil Younus Mustafa	HYDROLOGICAL STUDY AND ANALYSIS FOR PROPOSED SARTIK DAM - PART 2: RESERVOIR CHARACTERISTICS, SIMULATION MODEL, AND FLOOD ROUTING CALCULATIONS

Session No.:	<u>Session 3</u>	Session Title:	<u>Electrical</u> & computer Eng.
Chairman	Prof. Hassan Bevrani Dr. Lokman H. Hadi	Date: 26 / 4 /2017	Time Period : 2:30 – 4:30 PM

Time	Author(s)	Title
2:30 – 2:45	Yasser A. Fadhel And Bayez K. Al-Sulaifanie	DESIGN OF A PLANAR UWB ANTENNA WITH BAND REJECTION
2:45 – 3:00	Mohammed Ahmed Shakir	COMPRESSIVE SENSING BASED SIGNAL RECOVERY WITH DIFFERENT TRANSFORMS
3:00 - 3:15	Omar S. Kareem Ahmed K. Al-Sulaifanie	REAL-TIME POWER MEASUREMENTS IN SMART BUILDING MONITORING SYSTEM
3:15 – 3:30	Yasser A. Fadhel Musa Ataş Revink M. Abdulhakim	MINIATURIZATION OF A PLANAR STRIP-SHAPED MONOPOLE ANTENNA FOR WLAN APPLICATION

Session No.:	Session 4	Session Title:	Civil - Highway Eng.
Chairman	Dr. Farsat Heto Dr. Bayar Najeeb	Date: 27/ 4 /2017	Time Period : 9:00 – 11:00 AM

Time	Author(s)	Title
9:00 – 9:15	Hamid Athab Al-Jameel	INVESTIGATED CHARACTERISTICS OF WEAVING SECTIONS FROM FIELD DATA AND DEVELOPED SIMULATION MODEL
9:15 - 9:30	Mohammed Abbas Al-Jumaili	CHARACTERIZATION ASSESSMENT OF RECYCLED EMULSION COLD MIXTURES CONTAINING HIGH PERCENTAGES OF RECLAIMED MATERIALS
9:30 - 9:45	Abdulhaq Hadi Abedali Gofran J. Qasim	TRAFFIC ASSIGNMENT MODEL OF AL-AMARAH CITY
9:45–10:00	Nahla H. Alaswadko	PREDICTION MODELLING APPROACH FOR CRACK PROGRESSION OF HEAVY DUTY FLEXIBLE PAVEMENTS
10:00–10:15	Sarhat Mustafa Adam	THE USE OF ONLINE AND OFFLINE PROCESSING TOOLS TO IMPROVE THE PRECISION OF A GPS PASSIVE STATION
10:15-10:30	Yousif Youkhanna Zaia Sarhat Mustafa Adam Sami Mamlook Gilyana	A COMPARISON OF RTK-GPS VERTICAL COMPONENT WITH PRECISE DIGITAL LEVEL FOR ESTIMATING VOLUMES
10:30–10:45	Mustafa Amami	ENHANCING STAND-ALONE GPS CODE POSITIONING USING STAND-ALONE DOUBLE DIFFERENCING CARRIER PHASE RELATIVE POSITIONING
10:45 -11:00	Mustafa Amami	SPEEDING UP SIFT, PCA-SIFT AND SURF USING IMAGE PYRAMID

Session No.:	<u>Session 5</u>	Session Title:	Architectural Engineering
Chairman	Dr. Mahmood Khayat Dr. Najeh Muhammad	Date: 27/ 4 /2017	Time Period : 9:00 – 11:00 AM

Time	Author(s)	Title
9:00 – 9:15	Najeh Mohammed Mohammed	PROCESS - ORIENTED ARCHITECTURE EFFECT OF A DESIGN METHODOLOGY ON OUTCOMES OF ARCHITECTURE STUDENTS
9:15 - 9:30	Raeed S. Ahmed Al-Numman	AN ANALYTICAL STUDY TO ARCHITECTURAL ITEMS (SPATIAL CONFIGURATION AND FORMALITY ELEMENT OF INTERIOR FACADES OF QUBAHAN SCHOOL)
9:30 - 9:45	Dr. Layla M. Raswol Jowan B. Khorsheed	REGENERATION OF OLD CITY CENTER - CASE STUDY OLD BAZAR IN ZAKHO CITY CENTER, KURDISTAN REGION- IRAQ
9:45– 10:00	Mahmood Ahmed Khayat Chra Hunar Ahmed	TRACES OF SUSTAINABILITY PRINCIPLES IN ARCHITECTURE TEACHING PROGRAMS AT SALAHADDIN UNIVERSITY - SURVEY AND ANALYSIS OF TEACHING COURSE BOOKS
10:00– 10:15	Armange Ismael Barakat	APPLICATION OF TEXTURE SCHEMES IN ARCHITECTURAL DRAWING - AN ANALYTICAL STUDY –FIRST YEAR STUDENTS’ DRAFTS IN DEPARTMENT OF ARCHITECTURE IN UNIVERSITY OF DUHOK
10:15– 10:30	Shaimaa M. Hamza Areej M. Abdulwahab	TRANSFORMATION STRATEGIES TOWARDS SUSTAINABLE CITIES SUSTAINABLE TRANSPORT STRATEGY IN KARBALA CITY

Session No.:	Session 6	Session Title:	Mechanical Engineering
Chairman	Prof. Safeen Yaseen Prof. Fayadh Mohammed	Date: 27/ 4 /2017	Time Period : 9:00 – 11:00 AM

Time	Author(s)	Title
9:00 – 9:15	Qasim Saleh Mahdi Hayder Mohammad Jaffal	EXPERIMENTAL STUDY WITH USING ANFIS TO EVALUATE THE PERFORMANCE OF A MODIFIED CLOSED WET COOLING TOWER
9:15 - 9:30	Sadoun Fahad Ahmed Kadhim Alshara Murtatha Saeed	NUMERICAL INVESTIGATION OF HEAT TRANSFER AND FLOW CHARACTERISTICS IN SHELL-AND U-TUBE HEAT EXCHANGER WITH BAFFLES
9:30 - 9:45	Arkan F. Said	EFFECT OF HYDROGEN ADDITION ON FLAME PROPAGATION CHARACTERISTICS THROUGH TUBE OF METHANE-AIR MIXTURES USING OPTICAL TECHNIQUE.
9:45 – 10:00	Tawfeeq Wasmi M. Salih	CALCULATING THE HEAT TRANSFER COEFFICIENT OF UNSTEADY HOMOGENEOUS OIL-GAS FLOW
10:00–10:15	Oday Adnan Abo Lokman H Hassan	THERMAL ANALYSIS OF A PENTAGONAL SOLAR AIR COLLECTOR
10:15-10:30	Adnan A. Abdel Rasool Dhaymaa Saad Khudhur	EXPERIMENTAL AND SMART (ANN) STUDY FOR TRANSIENT HEAT TRANSFER FROM A FLAT PLATE UNDER AIR IMPINGMENT
10:30 – 10:45	Mahde Akram Molan Idres Azzat Hamakhan Sarkar Jawhar M.Shareef	EXERGETIC ANALYSIS OF A SOLAR PHOTOVOLTAIC TRACKING SYSTEM IN ERBIL, IRAQ

Session No.:	<u>Session 7</u>	Session Title:	<u>Water Rec.</u> & Environment Eng.
Chairman	Dr. Khalid Khedir Dr. Adil M. Raheem	Date: 27/ 4 /2017	Time Period : 9:00 – 11:00 AM

Time	Author(s)	Title
9:00 – 9:15	Nawbahar F. Mustafa Salam M. Sulaiman Akram M. Abdulrahman Bahman A. Abdulaziz Jamal H. Khdir	EFFECT OF DIFFERENT IRRIGATION SYSTEMS ON IRRIGATION WATER USE EFFICIENCY, GROWTH AND YIELD OF POTATO UNDER BAZIAN CLAY LOAM SOIL CONDITION
9:15 - 9:30	Mohammed Sadiq Muhsen Dilshad Abdul Jabbar Haleem Rick Munro	EFFECT OF FRICTION SOURCE IN THE HYDRAULIC TRANSIENT IN A PIPELINE SYSTEM USING METHOD OF CHARACTERISTICS
9:30 – 9:45	Shaker A. Jalil Bshkoj S. Hussein	EXPERIMENTAL AND MODELING OF FLOW OVER LABYRINTH AND PLAIN STEPPED FALLS
9:45 – 10:00	Jowhar R. Mohammed Bahzad M. A. Noori Ihsan A. Hussein	MODELING OF THE HYDRAULIC PERFORMANCE OF OGEE SPILLWAY USING COMPUTATIONAL FLUID DYNAMICS (CFD)
10:00– 10:15	Shaker A. Jalil Sarhan A. Sarhan Siyamand M. Ali	CHARACTERISTICS OF HYDRAULIC JUMP ON A STRIPED CHANNEL BED
10: 15–10:30	Sarhang M. Husain Shahin S. Ahmed	EXPERIMENTAL STUDY TO EVALUATE THE HYDRAULIC PERFORMANCE OF BASTORA DAM STEPPED SPILLWAY
10:30-10:45	Khairi Ali Omar	PREDICTION OF DISSOLVED OXYGEN IN TIGRIS RIVER BY WATER TEMPERATURE AND BIOLOGICAL OXYGEN DEMAND USING ARTIFICIAL NEURAL NETWORKS (ANNs)

Session No.:	Session 8	Session Title:	Civil - Geotechnical Eng.
Chairman	Dr. Rafii Dr. Adnan Jaeed	Date: 27/ 4 /2017	Time Period : 11:30 – 1:00 PM

Time	Author(s)	Title
11:30 – 11:45	Najdat Sabri Abdulkhaliq	EVALUATING THE SCALE FACTORS OF PEDO-TRANSFER MODELING THE SOIL WATER CHARACTERISTIC CURVE OF ZAKHO SOILS.
11:45 – 12:00	Bestun Shwan	THE EFFECT OF SOIL WATER RETENTION CURVE HYSTERESIS ON THE STRENGTH OF UNSATURATED SOILS.
12:00 - 12:15	Mohammed S. Hussain Akbar A. Javadi Mohsen M. Sherif	ASSESSMENT OF DIFFERENT MANAGEMENT SCENARIOS TO CONTROL SEAWATER INTRUSION IN UNCONFINED COASTAL AQUIFERS
12:15 – 12:30	Yahya K. Atemimi Fauziah Binti Ahmed	IMPROVEMENT THE COMPRESSIBILITY IN RESIDUAL SOILS BY USING STYRENE BUTADIENE RUBBER
12:30 – 12:45	Malik Habeeb Al-Lami	ANALYTICAL AND NUMERICAL INVESTIGATIONS OF A LATERALLY LOADED SINGLE PILE EMBEDDED IN A COHESIVE SOIL

Session No.:	<u>Session 9</u>	Session Title:	Electrical_& <u>Computer Eng.</u>
Chairman	Dr. Laith Al Any Dr. Khalid Khalil	Date: 27/ 4 /2017	Time Period : 11:30 – 1:00 PM

Time	Author(s)	Title
11:30 – 11:45	Ali Nabi Saleh Ahmed K. Al-Sulaifanie	REAL TIME VLSI IWT DENOSING ARCHITECTURE
11:45 – 12:00	Sagvan Saleh Mhand Hifi	A FAST METHOD FOR OPTIMIZING THE K- CLUSTERING BI-CLIQUE COMPLETION PROBLEM IN TELECOMMUNICATION
12:00 - 12:15	Fars Esmat Samann	SIMPLE AND ROBUST EYE MOVEMENTS DETECTION METHOD
12:15 – 12:30	Faris Ketii	COMPUTER NETWORKS VIRTUALIZATION COST EFFECTIVE AND DISTANCE LEARNING ACHIEVEMENT
12:30 – 12:45	Batool Abdulsatar Abdulghani Ahmed Khorsheed Al- Sulaifanie	EAR RECOGNITION USING LOCAL BINARY PATTERN
12:45 – 1:00	Fayyadh H. Ahmed	PATTERN-RECONFIGURABLE ANTENNA FOR 5.5-GHZ WIMAX APPLICATIONS

Session No.:	<u>Session 10</u>	Session Title:	Water Rec. & <u>Environment Eng.</u>
Chairman	Dr. Shakir A. Jalil Dr. Raad Hobi	Date: 27/ 4 /2017	Time Period : 11:30 – 1:00 PM

Time	Author(s)	Title
11:30 – 11:45	Nashwan Shawkat Mizzouri Maha Mohammed J. Algabban Hassan Mohammed Hassan	ASSESSMENT OF GREY WATER DISPOSAL AND DIFFERENT TREATMENT OPTIONS FOR DOMIZ CAMP IN DUHOK CITY
11:45 – 12:00	Shawkat Ahmed Yaseen Kochary Bahzad Mohammad Ali Noori Tom D. Byl	HEAVY METALS CONTAMINATION OF SHALLOW GROUNDWATER IN DIRECT CONTACT WITH FAILED SEPTIC TANKS
12:00 - 12:15	Jwan N. Hassan	PERFORMANCE EVALUATION OF DOHUK WATER TREATMENT PLANT
12:15 – 12:30	Nashwan Shawkat Mizzouri	KINETIC PARAMETERS OF PHENOL BIODEGRADATION WITH DIFFERENT MICROORGANISMS: A REVIEW
12:30 – 12:45	Shawkat Ahmed Yaseen Kochary Bahzad Mohammad Ali Noori Tom D. Byl	ASSESSMENT OF SELECTED PHYSICO-CHEMICAL PARAMETERS OF GROUNDWATER IN DIRECT CONTACT WITH SEPTIC TANKS: EXPERIMENTAL MODELING

Session No.:	<u>Session 11</u>	Session Title:	Civil - <u>Structure Eng.</u>
Chairman	Dr. Ali Flayeh Dr. James H. Haido	Date: 27/ 4 /2017	Time Period : 11:30 – 1:00 PM

Time	Author(s)	Title
11:30 – 11:45	Hayder Al-Khafaj Nameer Alwash Sabeeh Al-Sarraf,	NON-LINEAR POST-BUCKLING LARGE DISPLACEMENT ANALYSIS FOR PLANE STEEL NON-PRISMATIC MEMBERS FRAMES WITH FLEXIBLE CONNECTIONS
11:45 – 12:00	Ali H. Nahhab Mehmet Gesođlu Erhan Güneyisi Halit Yazici	MICROSTRUCTURE OF ULTRA-HIGH PERFORMANCE CEMENTITIOUS COMPOSITES WITH AND WITHOUT EXCESSIVE SULFATES
12:00 - 12:15	Ismaeel H. Musa Albarwary Ziyad N. Sh. Aldoski Lawand K. Askar	EFFECT OF AGGREGATE MAXIMUM SIZE UPON COMPRESSIVE STRENGTH OF CONCRETE
12:15 – 12:30	Ghanim Hussein Qoja Youkhanna Zayia Dinkha	PERFORMANCE OF CONCRETE MADE WITH CRUSHED CLAY BRICKS AS COARSE AGGREGATE
12:30 – 12:45	Yousif S. Saeed	SAFETY MANAGEMENT IN CONSTRUCTION PROJECTS
12:45 – 1:00	F Mohammad And P Shawnim	MECHANICAL PROPERTIES OF A DEVELOPED FOAMED CONCRETE

STRUCTURAL ENGINEERING TOPICS

**WIND ANALYSIS OF TALL BUILDING IN DUHOK CITY,
IRAQ USING COMPUTATIONAL FLUID DYNAMIC (CFD)**

SHIREEN T. SAADULLAH and JAMES H. HAIDO

Dept. of Civil Engineering, College of Engineering, University of Duhok, Kurdistan
Region-Iraq

Present article is devoted to study wind flow around concrete buildings. Computational fluid dynamic (CFD) model was performed in three dimensional (3D) commercial packages ANSYS CFX 14.0. utilizing finite volume technique to predict the wind pressures on tall buildings using specific boundary conditions. RNG $k-\epsilon$ turbulence model was used in the program to consider the wind turbulence. Current numerical approach was verified by comparison the outcomes with experimental wind tunnel tests. This valid CFD model was applied in the simulation of the wind analysis for Rixos Hotel which is located in Duhok City, Iraq. Analysis outputs of Rixos building were compared to those calculated by some international building codes; reasonable agreement was observed with using ASCE 2010 code. It is concluded that the stagnation point at which the wind streamline velocity comes to rest is located at $2/3$ of the building height above the ground surface.

KEYWORDS: tall buildings, finite volume method, computational fluid dynamic, RNG $k - \epsilon$ turbulence model, wind pressure on buildings

STRUCTURAL ENGINEERING

**STRAIN EFFICIENCY OF CARBON FIBRE REINFORCED
POLYMER-CONFINED RC COLUMNS**

YAMAN S. S. AL-KAMAKI ¹, RIADH AL-MAHAIDI ² and IAN BENNETTS ³

¹ PhD, University of Duhok (UoD), Duhok, Kurdistan Region, Iraq & Faculty of Science, Engineering and Technology, Swinburne University of Technology, Australia.

² Professor of Structural Engineering, Faculty of Science, Engineering and Technology, Swinburne University of Technology, Australia.

³ Adjunct Professor, Faculty of Science, Engineering and Technology, Swinburne University of Technology, Australia.

Fibre reinforced polymer (FRP) composite materials in the form of FRP wraps provide one of the most effective means of confining existing reinforced concrete columns where the strength of these columns must be enhanced. Such wraps are often formed in a wet layup process with the fibres being mainly in the hoop (lateral) direction. Numerous studies have found that the nominal properties published by the manufacturer are different from the properties of materials obtained from testing the combination of CFRP and epoxy (i.e. CFRP coupons) as tensile coupons. Research studies have also shown that the CFRP wraps when applied to reinforced concrete columns have a lower ultimate hoop strain (and therefore a lower ultimate hoop stress) compared to the failure strain measured from direct tensile tests of the CFRP coupons. This is the result of differences in the fabrication processes and the in-situ forms. It was also noted that it is possible to repair or even restore the lost strength of columns damaged by elevated temperature, depending on the performance of the CFRP material. This paper presents also the results of a study that reports and compares the ultimate tensile strains of CFRP obtained from flat coupon tensile tests and CFRP-confined concrete columns tests using an innovative digital image correlation (DIC) technique. It was found that the CFRP lateral rupture strains in CFRP-confined RC columns are reduced below the ultimate tensile strains from flat coupon tests. Based on comparisons of these test results, for all columns wrapped with 1 or 2 CFRP layers, the strain efficiency was found to be in the range of 0.54 to 0.9 or 0.54 to 0.94 respectively.

KEYWORDS: Carbon fibre reinforced polymer, Confining RC columns, Heating, Strain efficiency, Structural testing.

STRUCTURAL ENGINEERING

SAFETY MANAGEMENT IN CONSTRUCTION PROJECTS

YOUSIF S. SAEED

Department of Civil Engineering, University of Kirkuk

The aim of this research is to identify and evaluate the safety management in construction projects to minimise and control health and safety (H&S) of construction workers. Questionnaire is used to collect a wide range of opinions from experienced professionals working in different construction sites for comparison between them. The reviews of the related literature are the first step in obtaining information from previously related studies.

The literature reviews provide a theoretical background about safety management that guided the design of the questionnaire. This research concludes that the construction industry has a high number of fatalities and long-term injuries. This is unacceptable in a modern society and it also makes the industry inefficient, with days lost due to injuries. This research shows that the high rates of accidents are due to several common factors, such as poor construction planning, lack of safety in design, inadequate safety training, worker behaviour, inherent safety H&S risk of construction and lack of knowledge of site rules.

KEYWORDS: H&S risk management, Construction project, Health and Safety (H&S), Employee/Worker, Accident, Injury, Questionnaire.

STRUCTURAL ENGINEERING

**PERFORMANCE OF CONCRETE MADE WITH CRUSHED
CLAY BRICKS AS COARSE AGGREGATE**

GHANIM HUSSEIN QOJA¹, YOUKHANNA ZAYIA DINKHA²

1, 2 Department of Civil Engineering, University of Duhok

Because of economic considerations and thermal insulation requirements, it seems necessary therefor to produce lightweight concrete obtained by crushing an enormous tons of building demolition wastes have been produced. In this study, it is gintended to investigate smashed and the possibility of using crushed clay bricks to replace the coarse aggregate (gravel) in concrete mies. Four nominal normal concrete mixes and four more mixes of crushed clay brick aggregate were prepared and tested. The crushed clay brick aggregates were produced by crushing the brick units (locally available and manufactured in Iran) manually and collected into described size (20 mm). From the analysis of the results, it was found that the unit weight of the crushed brick concrete ranged from (1685-1760) kg/m³ and its compressive strength was about 61% of that of the natural aggregate concrete while the flexural strength was 70% of natural aggregate concrete. Also, the relation between compressive and flexural strength for the lightweight concrete produced is similar to that of normal concrete. Moreover, the results indicated the suitability of the crushed clay brick aggregate concrete to be used in buildings.

KEYWORDS: Recycled aggregate, Lightweight concrete, Crushed clay brick, Demolition waste.

STRUCTURAL ENGINEERING

**NUMERICAL ANALYSIS OF GLUED LAMINATED TIMBER
WITH UNEQUAL LENGTHS COMPONENTS**

MUTHANNA ABBU¹, RIYADH AL-AMERI²

¹ Building & Construction Engineering Technology Department, Northern Technical University

² School of Engineering, Deakin University

An innovative study has been carried out on timber beams strengthened mechanically by two external layers attached to their tension and compression sides with glue. This study is based on the individual behavior of each component of the laminate section. An approach has been developed to simulate the behavior of such beams. The equations are formulated and solved numerically using finite difference method and computational analysis.

The interaction efficiency indicated by slip and deflection calculations between the three layers in a timber beam has been considered thoroughly, from which the effect of some parameters such as layer length upon the behavior of such beams are studied.

New equations are proposed for such system to calculate the deflection of laminated timber beams.

KEYWORDS—Laminated Timber; interaction between wooden layers; Finite Deference; Epoxy.

STRUCTURAL ENGINEERING

**EFFECT OF AGGREGATE MAXIMUM SIZE UPON
COMPRESSIVE STRENGTH OF CONCRETE**

ISMAEEL H. MUSA ALBARWARY ¹, ZIYAD N. SH. ALDOSKI ²,

LAWAND K. ASKAR ³

1 Dept. of Road Construction, Duhok Technical Institute, Duhok Polytechnic University

2 Dept. of Building and Construction, Duhok Technical Institute, Duhok Polytechnic University

3 Dept. of Highway and Bridges, Technical College of Engineering, Duhok Polytechnic University

Aggregates form 60% to 75% of concrete volume and thus influences its mechanical properties. The strength of normal concrete is affected by the maximum size of a well-graded coarse aggregate by two opposing ways. Concrete mixes containing larger aggregate particles needs less mixing water than those containing smaller aggregates. On the other hand, the smaller size aggregates give larger surface area for bonding with the mortar matrix.

Current study is a trial to cover these two points with testing three different useable concrete mixes in Kurdistan Region–Iraq which are 1:1.5:3, 1:2:4 and 1:3:6 (Cement: Sand: Gravel). In each mix, five maximum aggregate sizes were used which are 9.5mm, 12.5mm, 19mm, 25mm and 37.5mm, the consistency of the all mixes is fixed for slumps of 25-50mm.

According to the test results it is concluded that in general the compressive strength of concrete increases when the maximum size of aggregate decreases and the maximum aggregate size strongly influences the concrete strength.

Test results also show that the optimum concrete strength is reached by using aggregates of 9.5mm maximum size. Furthermore, it is concluded that for a specified strength, an economical mix can be produced by decreasing the amount of cement and using an appropriate maximum aggregate size.

KEY WORDS: Concrete, aggregate size, compressive strength, coarse aggregate, Models

STRUCTURAL ENGINEERING

**FLEXURAL BEHAVIOR OF REINFORCED CONCRETE
BEAMS MADE WITH ORDINARY AND HIGH STRENGTH
CONCRETES: EFFECT OF INTERFACIAL ROUGHNESS
BETWEEN OLD AND NEW CONCRETES**

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Present endeavor is devoted to investigate the flexural strength of beams fabricated by ordinary concrete (OC) and retrofitted with high strength concrete (HSC). Old part of beams is represented the deteriorated concrete; while the new part is referred to retrofitted portion of the deteriorated beam. Bond strength between two concrete parts of beam was enhanced via preparing rough interfacial surface in various ways, namely, sand blast, holes, grooves and steel brush. Experimental measurements are given in terms of flexural load – deflection relationship and cracking pattern of the beams. It is demonstrated that the beams with sand blast interfacial surface show reasonable performance with high flexural toughness and safer cracking at collapse.

KEYWORDS: Beam toughness, Bond between old and new concrete, Hybrid concrete beams

STRUCTURAL ENGINEERING

**EFFECT OF CFRP CONFINEMENT ON AAR-INDUCED
EXPANSION OF CONCRETE COLUMNS**

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Some researchers use the expression “concrete cancer” to describe the effect of the alkali-aggregate reaction (AAR) in concrete, which has an adverse effect on its durability. In order to extend concrete’s service life-span it is necessary to find a novel material to reduce or limit AAR-induced expansion and improve the strength capacity of the affected concrete. Carbon fibre reinforced polymers (CFRPs) are one of several materials used to rehabilitate affected concrete members. Twenty circular concrete columns 200 mm in diameter and 500 mm in height were cast from reactive (AAR) concrete. During six months of storage at 38° C and 98% relative humidity, several ages of 15, 30, 45, 60, 90 and 120 days after casting to represent different levels of expansion during AAR development were selected to confine the affected columns using CFRP composites. Strain behaviour in concrete and steel were monitored, before and after confinement, for different wrapping times. The results indicate the efficiency of using CFRP to reduce the rate of expansion in both steel and concrete. The results show also show that the efficiency of reducing AAR-induced expansion depends on the time of wrapping and the number of CFRP layers applied to the affected columns.

KEYWORDS: Alkali aggregate reaction (AAR), Carbon fibre reinforced polymer (CFRP), Strain, Expansion, Confinement

STRUCTURAL ENGINEERING

**THE ROLE OF SEISMIC POUNDING IN THE OPTIMAL
SELECTION OF GROUND-MOTION INTENSITY MEASURES**

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To grant quantitative estimates of the expected levels of seismic ground motion as the primary input to seismic hazard assessments, it is vital to characterize the complicated nature of strong motion accelerograms using simple indices. Over the years, numerous ground-motion parameters have been suggested by researchers for that purpose, and to be used as indices of a ground motion's damage potential. Finding a best correlated ground-motion parameter with the damage index, is a main goal of such type of studies. Minimizing the variability in this correlation is of great importance to determine the expected damage with a higher degree of accuracy. This paper presents an analysis of different ground-motion intensity measures (IMs) that can be used in assessing the performance of reinforced concrete buildings to test the impact of pounding on the optimal selection of ground-motion IMs. The occurrence of structural pounding in metropolitan cities is caused by the inadequate gap between adjacent buildings. Identifying the function in which the seismic pounding performs in selecting the most appropriate ground-motion IM, as an illustration of seismic action in a region of interest, is a main objective of the current study. Special cases of typical two-dimensional adjacent multi-story reinforced concrete buildings are analyzed using a number of natural earthquake time histories. The results indicated that, based on the number of records, the variability in the gap distance between buildings may lead to the selection of different IMs.

KEYWORD: Seismic Assessment, Time History Analysis, Structural Pounding, Ground-Motion Intensity Measure, Reinforced Concrete Building

STRUCTURAL ENGINEERING

**NON-LINEAR POST-BUCKLING LARGE DISPLACEMENT
ANALYSIS FOR PLANE STEEL NON-PRISMATIC
MEMBERS FRAMES WITH FLEXIBLE CONNECTIONS**

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Although the joints constitute a small proportion of the total weight of the structure, but they have a comparatively large work ratio, thus the accounted is represent a large percentage of the total cost of framing. In addition, the contact region deformation is sometimes responsible for a significant proportion of the total deviation of the structure and often has a large impact on the distribution of internal distribution of the forces. All real structures show nonlinear behavior when loads and deformations become large enough and the tapered members are also used in several locations in the structural applications such as aerospace structures, bridges, as well, in many mechanical components. It is used to try to meet the architectural requirements for the shape of buildings and to achieve a suitable division of strength and weight. So, the nonlinear post-buckling behavior of plane steel frame under loads was a major research topic. A general formulation of Eulerian is used to analyze the plane frames and it is clear that this method of analysis are be good to use within theory of beam-column. This study is shown that a polynomial modeling of the non-linear moment-rotation curve of steel connection gives excellent results with the exact non-linear moment-rotation curve with a difference not more than (1%) and the effect of the flexible connections must be considered in the analysis because it has significant effect on the behavior of the steel structures and the new modified tangent stiffness matrix which takes into account the two types of non-linearities at the same time (i.e. geometry and connection) and non-prismatic members efficient in giving accurate results of analysis of different types frames with difference not more than (0.5%) compare with the other finite element methods for analysis.

KEYWORDS: large Displacement Analysis, Post Buckling, Flexible Connections, Non-Prismatic Steel Members, Geometrical Nonlinearity

STRUCTURAL ENGINEERING

**MICROSTRUCTURE OF ULTRA-HIGH PERFORMANCE
CEMENTITIOUS COMPOSITES WITH AND WITHOUT
EXCESSIVE SULFATES**

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Advances in the science of cement-based materials have resulted in the development of a new generation of material, namely ultra-high performance cementitious composite (UHPCC). The primary improvements of UHPCC are achieved by the removal of coarse aggregate, limiting the water-to-binder ratio and introducing micro fine materials such as silica fume.

The present study aimed to investigate the microstructure of UHPCC with and without additional sulfates. For this purpose, two groups of UHPCC were designed at a constant water/binder ratio of 0.174. The first group of UHPCC mixtures was designed with binary blends of Portland cement and silica fume and was reinforced with 2% micro steel fibers by volume. The other group was also designed with binary cementitious blends but without fibers. Each group consisted of five mixes with different SO₃ contents of between 0.11% and 4.5% by weight of natural sand. For each mix, the UHPCC samples were either standard cured or steam cured at 80 °C over a 48 h. Besides, UHPCs were compared to Portland cement mortars. The microstructures of the UHPC were examined using scanning electron microscopy (SEM). Energy dispersive X-ray analysis (EDX) was also performed. SEM observations showed the existence of non-expansive ettringite in the UHPCC samples containing excessive sulfates.

KEYWORDS: Ultra-high performance concrete; Microstructure; Silica fume; steam curing; Sulfates.

MECHANICAL PROPERTIES OF A DEVELOPED FOAMED CONCRETE

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This paper investigates the mechanical properties at a fresh and hardened states of a new foamed concrete. The aim is to develop and produce a hydrophobic lightweight foamed concrete with enhanced properties for structural use. Foamed concrete generally is made of ordinary Portland cement (OPC), fine aggregates, foaming agent, admixtures and water. Metakaolin (MK) and water reducing admixture were used with the mix in this study. The physical properties of the mixes in their fresh state, mainly the consistency of the mixes was determined. All the mixes prepared were undergone rheology test at fixed water/cement (w/c) ratio of 50%, testing for flowability and spreadability. Compressive strength testing was carried out on 100 mm cubes and the results revealed that the compressive strength of foamed concrete decreases with a reduction in density. Flexural strength and flexural modulus, which were tested on 100 x 100 x 500 mm prisms, were also found to decrease with the reduction in density. The use of MK improved compressive strength as well as flexural strength development for normal and foamed concrete. Higher improvement was noted for the flexural strength with the use of a higher dosage of MK.

KEYWORDS: Compressive strength; Flexural modulus; Flexural strength; Foamed concrete; Metakaolin; Water reducing admixture

ENVIRONMENTAL ENGINEERING

**ASSESSMENT OF GREY WATER DISPOSAL AND
DIFFERENT TREATMENT OPTIONS FOR DOMIZ CAMP IN
DUHOK CITY**

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The objectives of this study are to characterize the grey water from Domiz refugee camp, to evaluate the impacts of grey water on the properties of soil, and to suggest different treatment options. Grey water produced in this camp is about 1380 m³/d. The average grey water generation was estimated about 42 L/c.d. Grey water and soil samples were collected from stream channel at three different places. The results show concentrated grey water because of the water consumption was low inside the camp. Average Chemical Oxygen Demand (COD), Total Dissolved Solids (TDS), Total hardness, Calcium, Magnesium, Sodium, Potassium, Chloride, Sulfate, Nitrate, and phosphate values for the most polluted point were 1700, 1096, 540, 127, 65, 151, 29, 153, 232, 31 and 17 mg/L respectively. Impact of grey water on the properties of soil shows that Sodium Adsorption Ratio (SAR) values of soil samples increased compared to the control sample. Different treatment options were discussed for reusing the produced grey water. Because of the high level of TDS, availability of land, and low cost, construction wetland (CW) was selected as best option.

KEYWORDS: Grey water, Refugee Camp, Soil contamination, SAR, Grey water treatment.

PERFORMANCE EVALUATION OF DOHUK WATER TREATMENT PLANT

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Dohuk water treatment plant supplies drinking water to duhok city with 11000 m³/hr capacity and serving around 650000 capita. In this study, the plant performance evaluated through studying the turbidity efficiency removal of each unit in the plant as well as the overall removal efficiency. The data were collected from daily laboratory water quality analysis reports covering the period from 1-10-2010 through 31-10-2013 with total number of samples 825 (excluding the days were the plant was out of duty or samples did not taken). Statistical Analysis techniques shows that the water treatment plant performance was acceptable and about (97.82 %) of the supplied water match the Iraqi drinking water standards. All units are efficient except the pre-sedimentation tank which is insufficient.

KEYWORDS: Water Treatment plant, turbidity, raw water.

ENVIRONMENTAL ENGINEERING

**HEAVY METALS CONTAMINATION OF SHALLOW
GROUNDWATER IN DIRECT CONTACT WITH FAILED
SEPTIC TANKS**

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Improper use of septic systems has shown to contribute in ground water contamination by heavy metals, toxic chemicals, and organic chemicals typically found in septic tank cleaning products. Therefore, it suggested evaluating the implication of heavy metals on shallow ground water contamination with direct contact of failed septic tanks. In conducting this research, a laboratory physical vadose model with a vertical flow direction was designed and packed with Silt-Clay soil, which was modified by replacing (20% by weight) of fine sand to satisfy the desired hydraulic conductivity to collect water samples, using a new packing technique other than the ordinary compaction procedure. The model was then fully saturated, well-drained, and run using raw filtered septic water. The model was run for three months and water samples were collected on daily basis at 12.5cms from top of model representing 6.25m underground (model scale was 1:50). Collected samples were analyzed weekly for any pollution occurrence in ground water quality with reference to heavy metals including Fe, Pb, Cu, Cd, Zn, Cr, Al, and Mn. Analytical results used to identify trends of contamination and predict future trends. Results revealed that Fe and Mn were much higher than the permissible limits of world health organization (WHO, 2008) then Al and Cd. Cr fluctuated around the permissible level, Zn precipitated and disappeared within the soil while both of Pb and Cu were safe and at very low level. This study helps the local government in establishing precaution strategies for ground water management to protect public health.

KEYWORDS: Ground Water , Septic Tank, Heavy Metals, Physical Vadose Model (PVM)

ENVIRONMENTAL ENGINEERING

**ASSESSMENT OF SELECTED PHYSICO-CHEMICAL
PARAMETERS OF GROUNDWATER IN DIRECT CONTACT
WITH SEPTIC TANKS: EXPERIMENTAL MODELING**

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The purpose of this study was to assess the effect of non-regulated (and directly contacted) septic tanks on ground water quality through designing a laboratory physical vadose model (PVM) with a vertical flow direction. The model was packed with silt-Clay soil using a new packing approach other than the ordinary (standard, modified and static) compaction methods, which was adopted upon its homogeneity and efficiency approval. The effect of septic tanks as an exclusive source of contaminants was represented by supplying the designed model with newly collected septic water (black water from a septic tank). Preliminary in-situ soil tests were conducted to better represent the lithology of area of this study. The model was run for a period of three months and water samples were collected on daily basis however, weekly analyzed. Selected physical and chemical parameters were studied for assessment including pH, Temperature, Dissolved Oxygen (DO), Electrical Conductivity (EC), Total Hardness (TH), Ammonium (NH₄-N), Nitrate (NO₃⁻N), and Phosphorus (P). Analytical results were used to identify and model trends to estimate and predict future trends, which mostly led to a conclusion of bad category and very low ground water quality as a result of its direct contact with non-regulated septic tanks. This study helped the local government in establishing precaution strategies for ground water management in order to protect the public health.

KEYWORDS: Septic Tanks, Ground Water, Physical Vadose Model (PVM), Physico-Chemical Parameters

ENVIRONMENTAL ENGINEERING

**KINETIC PARAMETERS OF PHENOL BIODEGRADATION
WITH DIFFERENT MICROORGANISMS: A REVIEW**

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Most industries release wastewater contains high concentrations of phenol which is toxic and contaminating the environment. Biological treatments are preferable for the phenolic compounds treatment. This review aims to investigate the impacts of temperatures, pH, and concentration of substrate on the phenolic compounds biodegradation, to compare the kinetic parameters of different microorganisms, and to discuss the different between the kinetic parameters of aerobic and anaerobic treatment. The review showed that most of the phenol biodegrading bacteria are *P. Putida* species and mixed cultures but *P. Putida* has a better adaptation to phenol biodegradation. The values of μ_{max} and K_s in anaerobic process are smaller than the values attained in aerobic process. The optimum temperature to acclimatize bacteria to the phenol substrate is 30 °C while the optimum pH condition is between 6.5 and 7.5. As the phenol concentration was increased, there was an increase in the values of the K_s and even when concentration is low; phenols have a significant inhibitory impact on (μ). The values of K_i for phenol degradation for *P. putida* species were higher than the values of K_i of mixed cultures. The highest K_i value for the phenol degrading among *P.Putida* species was 1185.8 mg/L and the highest K_i value among mixed cultures was 648.1 mg/L and the highest K_i value among the other species was 2434.7 mg/L.

KEYWORDS: kinetic parameters, Phenol, different microorganisms, and biological treatment.

GEOTECHNICAL ENGINEERING

ANALYTICAL AND NUMERICAL INVESTIGATIONS OF A LATERALLY LOADED SINGLE PILE EMBEDDED IN A COHESIVE SOIL

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Finite element analyses have become routine for geotechnical engineers, allowing them for more realistic representation of the actual scenarios. In this article, a 3D nonlinear numerical analyses were conducted to examine the response of a free head single concrete rigid pile, driven in a hypothetical clayey soil and exposed to a lateral load under undrained conditions. Three cases were considered for the soil. In the first case, the soil was taken as one layer of clay whose undrained shear strength is constant with depth. In the second case, however, the soil consisted of two layers of clay. The undrain cohesion of the upper soil, whose thickness is smaller than that of the lower layer. In the third case, the conditions were taken exactly, yet, opposite to the second case. The results of the numerical analysis were compared with the acquired analytical results from Broms' theory. Further, soil resistance along the shaft of examined pile has been obtained from the numerical analysis and compared with the distributions suggested by other studies.

KEYWORDS: Finite element analyses; Lateral load; pile; CAM Clay; Broms' Theory.

GEOTECHNICAL ENGINEERING

**EVALUATING THE SCALE FACTORS OF PEDO-TRANSFER
MODELING THE SOIL WATER CHARACTERISTIC CURVE
OF ZAKHO SOILS.**

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The soil-water characteristic curve is the basis for estimating unsaturated soil properties. The negative pore pressure measurement is costly, time consuming, and needs accurate techniques to be measured. However, the pedo-transfer modeling of Arya and Paris introduces solution for the problem. The constant, linear, and Vaz scaling techniques in association with Arya and Paris model was used to predict SWCC from particle-size distribution. A total of 48 soil suction vs. volumetric water content experimental tests representing the SWCC for five different regions of Zakho district was processed for this purpose. The scaling parameters were obtained and the results show that linear and constant techniques have interpret the experimental results of the SWCC with appreciable confidence, however Vas scaling method is not recommended to be used for Zahko soil for the relatively weak correlations obtained.

Keywords: Unsaturated soils, Pedo-transfer, Soil-water characteristic curve.

GEOTECHNICAL ENGINEERING

**IMPROVEMENT THE COMPRESSIBILITY IN RESIDUAL
SOILS BY USING STYRENE BUTADIENE RUBBER**

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A new stabilizing agent was sophisticated to improve the geotechnical performance and applicability of residual soils. The laboratory test includes specific gravity, sieve analysis and hydrometer test with consistency limits test to classify the used soils and standard compaction test with compressibility tests to evaluate the stabilizer effect on engineering soil properties. Two types of soils MH and SM were mixed with various amount of polymer SBR (Styrene Butadiene Rubber) 2.5, 5, 7.5, 10, and 12.5 % by weight and compacted at the optimum moisture content (OMC) and maximum dry density (MDD). The virgin soil and the stabilized samples were subjected to consolidation test to determine their compressibility at different curing times 1,3,7,14,28 days. The results of the test show that the SBR significantly improved the compressibility of residual soil. Where the plasticity index decreasing in both soils used by 81% and 77% in MH and SM soil respectively. While Increase in the pre-consolidation pressure (P_c) about 62.5% and 300% at MH and SM respectively. The compression index (C_c) decreases 256% and 200% at MH and SM soils respectively. Curing time had an effect on all geotechnical soil properties were tested after 14 days curing

KEYWORDS: Chemical stabilization, Polymer additives, Consolidation, SBR, Curing time.

GEOTECHNICAL ENGINEERING

**THE EFFECT OF SOIL WATER RETENTION CURVE
HYSTERESIS ON THE STRENGTH OF UNSATURATED
SOILS.**

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A modification of an existing soil water retention curve (SWRC) equation is presented in this paper which takes into consideration the effects of the soil capillarity (parameter a) and air entry value (s_o). The reformulated equation then was incorporated into the research version of the LimitState:GEO software to perform two parametric studies on the bearing capacity of a strip footing placed on the surface and total passive earth pressure for a frictional wall of 1 m height. The parametric analyses were to study the effect of SWRC hysteresis on the strength of unsaturated soils through parameter a and air entry value (s_o). The numerical bearing capacity and the passive earth pressure results were compared with the experimental data and the derived Rankine equations which take into account the effect of capillary rise, respectively. The numerical results showed that the effect of SWRC hysteresis has significant influence on the strength for both parametric studies.

KEYWORDS: SWRC, Evaluation, Modification, Unsaturated Soil.

GEOTECHNICAL ENGINEERING

**ASSESSMENT OF DIFFERENT MANAGEMENT SCENARIOS
TO CONTROL SEAWATER INTRUSION IN UNCONFINED
COASTAL AQUIFERS**

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The present study examines the capability of different hydraulic barriers to control seawater intrusion in coastal aquifer systems. Different management scenarios including abstraction of intruded saline water near the coast, artificial recharge of the aquifer with the good quality water, and combination of abstraction and recharge are simulated in unconfined aquifers and optimally analyzed using a simulation-optimization (S/O) approach. In each scenario of control, the trade-off between two objective functions: minimization of costs of management processes and minimization of total amounts of salinity in the aquifer, was obtained using the developed S/O framework. The recharge is implemented using a surface basin and therefore unsaturated flow theory is utilized in the simulation. Comparison of the developed management models suggests that the pumping of brackish water near the coast and its use for human and industrial consumption after desalination is an efficient method to control saltwater intrusion in deep aquifers. However, for aquifers with shallow hydrogeological settings, a new combined methodology is found to be the most cost-effective method in controlling saltwater intrusion. In this combined approach, the recharge by pond water is coupled with continuous pumping of intruded saline water near the coast followed by its desalination and use.

KEYWORDS: Seawater intrusion; Hydraulic barriers; Multi-objective optimization; Unsaturated zone.

HIGHWAY ENGINEERING

**INVESTIGATED CHARACTERISTICS OF WEAVING
SECTIONS FROM FIELD DATA AND DEVELOPED
SIMULATION MODEL**

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Weaving sections widely spread among other traffic facilities. Different types of weaving section have been recognized through various editions of Highway Capacity Manual (HCM). However, the HCM has suffered from inability to represent driver behaviour at these sections. Therefore, for each type, there is a specific behaviour. This study has focused on investigating weaving characteristics using more than 60 hours of field data and also MIDAS data have involved. The observed characteristics include merging and diverging points for weaving vehicles, how drivers react to weaving sections in terms of changing their speed, cooperative and aggressive behaviour of drivers and effective length for each type of weaving sections. Seven different sites have been investigated in the UK through this study. The results of this study indicate that the effective length is equal to full weaving length for weaving length less than 300m and 200m for the weaving length higher than 300m. Moreover, specific limits for merging and diverging points have been investigated through this study. Then, the simulation model has been developed to find out other characteristics from the simulation model such as applying new effective management by changing weaving section from Type A to Type B with significant increase in the capacity of the new section.

KEYWORDS: weaving section, simulation model, driver behaviour

A COMPARISON OF RTK-GPS VERTICAL COMPONENT WITH PRECISE DIGITAL LEVEL FOR ESTIMATING VOLUMES

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In this research, RTK GPS (Real time Kinematic GPS) was used to compare with precise Digital Level for estimating earthwork volumes. Any volume calculation process has to pass through two stages. Firstly, data collection using surveying instrument, for instance, level instrument, total station, Global Positioning System (GPS), or laser scanning. In the second stage, carrying out measurement of figuring volumes using either manual or computerized method. In this paper, the field test was conducted to gather data for estimating earthworks using two technologies; Digital Level (DNA 03) and RTK GPS. Two sites have been chosen; open to the sky and partially obstructed to satellites in order to evaluate RTK GPS technique. The main aim is to compare the RTK manufacturer claimed accuracy (height component only) with trusted data. The comparison has been carried out using two different categories; first, through using the volume calculation and second via statistical testing through the cloud to cloud comparison. Finding revealed that the mean differences for the test01 and test02 are about -20mm and 16mm, respectively. The Root Mean Square (RMS) and maximum error were found to be about ± 63 mm, 45cm and ± 56 mm, 25cm for test01 and test02, respectively.

KEYWORDS: Earthworks, RTK GPS, Accuracy, Digital level, Cloud to cloud comparison

HIGHWAY ENGINEERING

TRAFFIC ASSIGNMENT MODEL OF AL-AMARAH CITY

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The initiation of this study was made with the objective of loading or assigning the flow of traffic in the base and target year (expressed as a matrix identifying the number of trips generated and distributed in the previous study from each Traffic analysis zone (TAZ) to every other within the study area) on a road network of Al-Amarah City.

The traffic assignment process is usually implemented in two steps. The first step is constructing the network dataset of road network of Al-Amarah city for obtaining the optimal route between each node to all other nodes depending on two criteria; distance and time for evaluation the accessibility of all nodes in the road network. The second step uses stochastic user equilibrium and system optimum assignment models to assign the traffic distributed between all possible origins and destinations to the road network itself. The analysis is done using TransCAD software ver. 4.5 and Network Analysis/Arc GIS 10.3 for Al-Amarah City.

Results showed that in the base year, The results of the stochastic user equilibrium assignment model there is no link in Al-Amarah network has v/c ratio between the range (0.81-1.00) and over which represent level of service equal to or more than D. The overall evaluation of Al-Amarah road network is level of service (LOS) equal to B and there is an improvement in the work of Al-Amarah road network by using the system optimum model.

In the target year, the results of two assignment models are proximally similar. The black color ($v/c > 1.0$) is appeared clearly in the assignment result map especially on the two main bridges in the city (Al-Yugoslavi Bridge and Al-Jumhuriyah Bridge). When the red color (LOS E) is appeared in the links in near the centers of sectors (1,2, and 4). The most links ranges between (LOS D and LOS C) with v/c ratio Range (0.70-0.90).

KEYWORDS: Traffic Assignment Models, TransCAD, Al-Amarah city, Network Analysis.

SPEEDING UP SIFT, PCA-SIFT AND SURF USING IMAGE PYRAMID

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Scale Invariant Feature Transform (SIFT), Principal Component Analysis (PCA)-SIFT and Speeded Up Robust Features (SURF) are common robust feature detection methods used in photogrammetry and computer vision applications. The performance of these methods have been widely investigated and compared. In terms of processing time, results show that SURF is relatively the fastest due to utilizing integral image. However, these techniques are still slow and need to be improved for nearly real time applications, such as those based on vision navigation. This paper works on speeding up SIFT, PCA-SIFT and SURF using image pyramid. The images are firstly resampled and matched to detect the interest points. Then, the approximate locations of the matched points are determined on the original images from similar triangles. These points are surrounded by small searching windows and matched again with the corresponding searching windows in the other image. As a result, instead of matching the whole two images, a number of tiny images are matched together. The results show that the idea is powerful for reducing the processing time of such techniques significantly. The performance of this idea is affected by the resampling level and method, the image size, and the selected number of matching points.

KEYWORDS: SIFT, PCA-SIFT, SURF, Image Pyramid, Automatic Image Matching, Speeding Up Processing Time.

HIGHWAY ENGINEERING

**THE USE OF ONLINE AND OFFLINE PROCESSING TOOLS
TO IMPROVE THE PRECISION OF A GPS PASSIVE
STATION**

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Founding Founding of local geodetic points is very crucial for many purposes such as surveying and mapping. In 2011, a control marker was established at the engineering college, University of Duhok (UoD). A survey campaign was carried out to collect GPS raw data of roughly 121 h using Leica Viva GNSS tool at 1-second epoch. The aim was to install an accurate and dependable geodetic point which usually known as the passive station. The accuracy of the established point cannot be reliably checked or compared due to unavailability of any reliable and precise geodetic point near the survey marker. In this paper, investigating the accuracy of that recognized position using the statistical testing is aimed. For that reason, 121 h of raw data was broken into 36 sub-files covering five days of observations, each containing a full of 24 h, 12 h and 6 h of data at 1-second epoch. The data was separately processed utilizing different processing solutions such as free available online PPP services and post processing desktop tool. The aim is to compare the position of each of the subsamples with the most probable value. The results showed that the last recognized and dependable point coordinates are 314075.7788, 4080892.2610, and 525.1899 (m) with RMSE ± 3.7 , ± 3.9 , ± 6.2 (mm), respectively.

KEYWORDS: Online processing services, GPS, Accuracy, Precise Point Positioning, Gaussian Normal Distribution

HIGHWAY ENGINEERING

**ENHANCING STAND-ALONE GPS CODE POSITIONING
USING STAND-ALONE DOUBLE DIFFERENCING CARRIER
PHASE RELATIVE POSITIONING**

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Pseudo-range GPS code observables can provide absolute stand-alone positioning with accuracy of a few meters, which may not be suitable for a wide range of engineering applications. Differencing GPS observations (DGPS) can be used for reducing or removing some of GPS errors based on the high correlation between these errors over short baselines providing accurate relative positioning. Stand-Alone Double Differences Carrier Phase (SADDCP) is an accurate velocity estimation method based on single frequency stand-alone GPS observables. Precise GPS relative positioning can then be achieved by integrating the velocity over epoch. SADDCP is a double differencing technique including two epochs, two satellites and one receiver. In SADDCP, the ambiguity and receiver clock errors are removed, whereas satellite clock error, orbit errors, and ionospheric and tropospheric delays are reduced significantly. Multipath remains and can be reduced based on the multipath correlation over time, and receiver noise is increased.

In this paper, SADDCP will be used to enhance the performance of stand-alone GPS code positioning, where the two positioning techniques are integrated using Kalman filter. The precise relative positioning provided by SADDCP will be utilized to smooth the absolute low accurate stand-alone GPS code positioning, providing enhanced absolute single frequency stand-alone GPS positioning. Tests in different GPS environments will be carried out for reliable investigations and the results will be discussed in details showing the advantages and limitations of this integration.

KEYWORDS: GPS, Code positioning, Single frequency, Double differencing, Kalman filter, Relative positioning.

HIGHWAY ENGINEERING

**CHARACTERIZATION ASSESSMENT OF RECYCLED
EMULSION COLD MIXTURES CONTAINING HIGH
PERCENTAGES OF RECLAIMED MATERIALS**

PROF. DR. MOHAMMED ABBAS AL-JUMAILI¹

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Cold recycling (CR) is a partial recycling process through which a portion of the existing recycled asphalt pavement (RAP) material is rejuvenated and placed back on the road as a new surface course without introducing heat during the recycling process for low volume roadways. Recycling cold mixtures produced by incorporating milled old asphalt runway pavement into some new aggregate and cement as a filler material. During the past few years, the utilization of new processing machines has created expanding measures of reclaimed asphalt materials (RAP). These quantities of RAP have been obtained by milling of in-service and deteriorated flexible pavement in Najaf city located to south of Baghdad city by 160 km. While numerous agencies all around the world have adopted the practice of recycling, only a rare number of research studies have been performed to characterize and examine the strength, durability, and suitability of recycling techniques on local materials in Iraq. Comparison have been achieved between curing time effect in lab (1, 7, 14, 28, 56 and 90 days) on soaked stability, air voids moisture absorbed (%) and rut depth, and effect of accumulated service time (14, 28, 56, 90, 120, 150, 180 and 240 days) on those properties. The rut depth of test road at service time of 240 days gave value is similar to that at curing time of 28 days.

KEYWORDS: Cold recycling, Recycling cold mix, Reclaim asphalt pavement and Rut depth.

HIGHWAY ENGINEERING

**PREDICTION MODELLING APPROACH FOR CRACK
PROGRESSION OF HEAVY DUTY FLEXIBLE PAVEMENTS**

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Pavement management at a network level requires reliable accurate performance prediction models to help road agencies make useful complex decisions about highways maintenance and rehabilitating activities. The purpose of this paper is to report the approach adopted for model development and validation for heavy duty flexible pavements representing by seven rural freeways segments. Hierarchical generalized linear modelling approach has been applied to predict multilevel model to capture the effect of variations among time series data, among road sections and among highways with same duty pavements. The estimation of pavement cracking progression has been based on longitudinal dataset contain cracking data (reported as a percent of the affected area) as dependent variable and cumulative traffic loading, pavement strength and environmental conditions as independent variables.

The study illustrates how panel data can be nested to predict the probability of crack progression to capture the effect of significant unobserved heterogeneity. The significance of relevant contributing factors in predicting crack progression were presented and elucidated. The validation results indicate that the model replicates the pavement behavior well, and that the inclusion of additional factors in addition to time is improving the model prediction.

KEYWORDS: Cracking model, Heavy duty pavement, Prediction model, Crack progression, Flexible pavement

WATER RESOURCES ENGINEERING

**EXPERIMENTAL AND MODELING OF FLOW OVER
LABYRINTH AND PLAIN STEPPED FALLS**

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The characteristics of flow over plain and labyrinth stepped falls is investigated experimentally and simulated numerically using commercial package ANSYS CFX. The aim is to verify the numerical model by assessing its accuracy and dependence in modeling the flow over this kind of hydraulic structures. Eight physical models of rectangular labyrinth stepped fall cycles with general slope (1V:1H and 1V:2H), different step numbers (5 and 10) and two different cycle widths (0.06 and 0.1 m) were tested and simulated in laboratory flume. For the purpose of comparison four models of plain stepped falls are constructed with the same number of steps and slopes as the labyrinth ones, they were tested and simulated. The simulation is based on the RNG $k-\epsilon$ turbulence model, three dimensional volume of fluid method (VOF) and incompressible flows. To verify the numerical models, all experimental data including water surface profile, hydraulic head and total calculated energy dissipation were compared with the corresponding results predicted by the numerical model. The comparison showed good agreement between experimental and numerical results via applying statistical tests. The new labyrinth stepped fall model was more effective for dissipating the relative energy as compared with plain stepped falls. The results showed that with decreasing number of steps, downstream slope and increasing the length magnification ratio, the relative energy dissipation is increased. The numerical results illustrated that the local direction of flow depends on the depth of water on the steps and the width of the labyrinth cycle. Also it was observed that the local flow directions, which are occurred on streamlines and contours, are dependent on impingement angle of water velocity vectors which varies between 74 and 62.5 degree.

KEYWORDS: Ansys CFX, Energy dissipation, Labyrinth stepped falls, Plain stepped falls, RNG $k - \epsilon$ turbulence model, VOF model

WATER RESOURCES ENGINEERING

**STUDY THE PERFORMANCE OF THE TWO WAVELET-
BASED ADAPTATION SCHEMES FOR THE SHALLOW
WATER FLOW MODELLING**

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This work proposed a new adaptive method which avails from the wavelets theory for transforming the local single resolution information into multiresolution information. This information became accessible and by deactivating or activating them, the spatial resolution adaptation was achieved. The adaptive technique was combined with two standard numerical modelling schemes (i.e. finite volume and discontinuous Galerkin schemes) to produce two new adaptive schemes for modelling one dimensional shallow water flows so-called the Haar wavelets finite volume (HWFV) and multiwavelet discontinuous Galerkin (MWDG) schemes. Both adaptive schemes were tested using hydraulic test cases. The results demonstrated that the proposed adaptive technique could serve as the foundation on which to construct complete adaptive schemes for simulating the real problems of shallow water flow.

KEYWORDS: Finite volume method, Discontinues Galerkin method, Haar wavelets, multiresolution one-dimensional (1D), shallow water modelling

WATER RESOURCES ENGINEERING

**ESTIMATING STORM DIRECT RUNOFF USING
SYNTHETIC UNIT HYDROGRAPH METHODS BY (WMS)
MODEL (SOLAG BASIN AS A CASE STUDY)**

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The Storm Runoff Volume and its Peak are important for designing and operating dams and different hydraulic structures.

Watershed Modeling System (WMS) version (8.1) and The HEC-1 v (4.1) hydrological models were used in this study to estimate the Synthetic runoff hydrograph resulting from two storm events over Solag Basin which is located in Sinjar District north of Iraq, making use of available recorded storms rainfall and Synthetic unit hydrograph technique. Direct runoff hydrographs are determined using Natural Resources Conservation Service (NRCS), Snyder Synthetic Unit Hydrograph and Clark methods.

Nash model was used to compare the efficiency of the Synthetic runoff Hydrograph using both Synthetic and recorded discharge data for Solag basin which were available for two storms within water years 1991-1992. Synthetic unit hydrographs are important in flood studies and water resources management.

KEYWORDS: Solag, Basin, WMS, Synthetics, Hydrograph, Runoff.

WATER RESOURCES ENGINEERING

**HYDROLOGICAL TIME SERIES FORECASTING USING
ANFIS MODELS WITH AID OF WAVELET TRANSFORM**

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The precise and accurate models of hydrological time series that are embedded with high complexity, non-stationarity, and non-linearity in both spatial and temporal scales can provide important information for decision-making in water resources management and environmental related issues. Hybrid wavelet transform (WT) and adaptive neuro-fuzzy inference system (ANFIS) has been used in this study to improve the forecasting capability of ANFIS model by decomposing the time series into sub-time series (approximation and details) using wavelet transform then combining the effective and significant time lags of sub-time series to form a set of input variables. The present study attempts to add the effective and significant time lags of original time series as extra variables to the input variables set. In addition, different combinations of variables, 1-3, from the set of input variables as inputs to the ANFIS model were used to forecast the time series.

To examine the potential of the approach for practical applications, the model is applied to forecast, one step-ahead, the monthly data of hydrological time series (rainfall, evaporation, minimum and maximum temperature, average wind speed and reservoir inflow) for Kirkuk, Sulaimani, Dokan and Darbandikhan meteorological stations in Iraq. The best fit models were selected using the coefficient of determination (R^2) and root mean square error ($RMSE$). Based on the results, the proposed model has high performance in forecasting the monthly minimum and maximum temperature, evaporation and reservoir inflow with R^2 values ranged from 0.93 to 0.99 and relatively good performances in forecasting the monthly rainfall and average wind speed with R^2 values ranged from 0.77 to 0.93.

KEYWORDS: Forecasting, Time series, Wavelet, ANFIS

WATER RESOURCES ENGINEERING

**PREDICTION OF DISSOLVED OXYGEN IN TIGRIS RIVER
BY WATER TEMPERATURE AND BIOLOGICAL OXYGEN
DEMAND USING ARTIFICIAL NEURAL NETWORKS
(ANNS)**

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Iraq

The purpose of this study is to develop a feed-forward neural network (FFNN) model with back-propagation learning algorithm to predict the dissolved oxygen from water temperature and 5 days-biological oxygen demand in the Tigris River, Baghdad-Iraq. The Artificial Neural Networks model was implemented utilizing measured data that were gathered from laboratories of water treatment plant, Baghdad-Iraq, during the year 2008. The correlation analysis between dissolved oxygen and dependent parameters were utilized in selecting the major inputs from water quality parameters for commencing of ANN models. The performance of ANN models were tested utilizing the coefficient of correlation (R), the efficiency coefficient of Nash-Sutcliffe (NS), mean square error (MSE) and mean absolute errors (MAE). The outputs revealed that the feed-forward neural networks using back-propagation learning algorithm which was prepared by temperature and biological oxygen demand offered a relatively high correlation coefficient of 0.885, and efficiency coefficient of 0.782, meanwhile a reasonably low mean square errors of 1.133, and mean absolute errors of 0.369 values for whole array period. The results of the present study demonstrate that the artificial neural networks using FFNN model is capable to forecast the dissolved oxygen values with acceptable accuracy. This is suggesting that the artificial neural network is a useful tool for Tigris River management in Baghdad-Iraq.

KEYWORDS: feed-forward neural network (FFNN), water quality modeling, dissolved oxygen, Tigris river.

WATER RESOURCES ENGINEERING

**SIDE WEIR FLOW INVESTIGATION IN A CIRCULAR
CHANNEL USING COMPUTATIONAL FLUID DYNAMICS
(CFD) FOR SUBCRITICAL FLOW CONDITION**

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The 3D flow over side weirs is investigated using Computational Fluid Dynamic (CFD). The study aims to assess the capability of ANSYS CFX code for modeling flow characteristics in a circular channel with side weir for subcritical flow condition. Twelve models were studied for some ranges of variables such as discharge, length and height of side weir. The numerical simulation was based on the solution of continuity and momentum equations for three dimensional, incompressible, steady and turbulent flow. The volume of fluid (VOF) method was used to predict the free surface changes and the RNG $k-\epsilon$ model was employed for simulating the flow field. The experimental data of Uyumaz and Muslu (1985) were used for verification. For all models, the specific energy is obtained and the average energy difference at the upstream and downstream side of the weir was very small and the assumption of constant energy in the circular channel was acceptable. The numerical results predicted the changes in the water surface profile at the main channel central axis and indicated that the water level rises from upstream to downstream end of the weir. The discharge coefficient (C_d) variation with the upstream Froude number (Fr_1) for different weir height and length were studied and it was found that the value of (C_d) decreased with the increase of (Fr_1) value. For each side weir length, the variation of (C_d) with the ratio of the weir height to channel diameter (P/D) were studied and it was observed that with the increase of (P/D) ratio the value of the (C_d) increased. The relation between the (C_d) and the ratio of the side weir length to channel diameter (L/D) for different weir height were also investigated. It was noticed that the (C_d) value increased gradually as the (L/D) ratio increased. The combined effects of (Fr_1), (P/D) and (L/D) on the (C_d) were studied for all models and an empirical expressions for describing this relation was obtained and it was found that (C_d) was a function of all the above parameter.

KEYWORDS: Subcritical flow, Side weir, Circular channel, turbulence model, VOF model

WATER RESOURCES ENGINEERING

**MODELING OF THE HYDRAULIC PERFORMANCE OF
OGEE SPILLWAY USING COMPUTATIONAL FLUID
DYNAMICS (CFD)**

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Computational fluid dynamics (CFD) is a type of numerical modeling that is used to solve problems involving fluid flow. Since CFD can provide faster and more economical solution than physical modeling, hydraulic engineers are interested in verifying the capability of CFD software. This study has examined the ability of the commercial CFD software (Flow-3D) to model an ogee-crested spillway by making data comparisons to physical models (experimental data). Three spillway models of different heights (20cm, 25cm, and 30cm) were fabricated and tested for design heads of (5cm, 7cm, 10cm), respectively. The study was conducted to compare flow parameters over a standard ogee-crested spillway using physical and numerical models. The physical models were fabricated from a rigid foam and placed in a test flume. Pressure taps were installed along the entire length of the spillways. Water surface profiles and pressure data were recorded for five different flow conditions (1.2Hd, 1Hd, 0.75Hd, 0.5Hd, and 0.25Hd). The results of this study showed that there were good agreements between the results of physical and numerical models for water surface profiles and there were some discrepancies in pressure results.

KEYWORDS: Ogee Spillway, Modeling, CFD, Surface Profiles, Pressure Measurements.

WATER RESOURCES ENGINEERING
CHARACTERISTICS OF HYDRAULIC JUMP ON A STRIPED CHANNEL BED

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The substantive conditions are affecting the subjective process of creating rapid turbulent changes in flow. Such character happens in hydraulic jump phenomenon, which depends on how much of flow kinetic energy changes into potential energy. During this process part of the kinetic energy is dissipated by taking other types of energy in the channel. The quantity of energy dissipated reflects on the height and length of the jump. The effects of lowering the bed of channel by means of square strips of six different spaces (2, 3, 4,5,6,7 cm) respectively are studied experimentally with additional smooth bed. The investigation leads that bed strips increases the energy dissipation by 6%. The energy dissipation increases with the increase of strips spacing, the best spacing is between 5 and 6 cm. Consequently jump height decreases which is reflected by the reduction of the relative sequent depth value by (6%-15%). While the relative length of jump decreases by 22% and 28% compared with the smooth bed. The mean dimensionless depth deficit is 0.15 and normalized jump length is 2.5. Within the limitations of this work, different relationships are suggested to predict hydraulic jump characteristics with coefficient of determination more than 0.9.

KEYWORDS: Energy Dissipation, Hydraulic Jump, Jump Length, Sequence Depth,

WATER RESOURCES ENGINEERING

EXPERIMENTAL STUDY TO EVALUATE THE HYDRAULIC PERFORMANCE OF BASTORA DAM STEPPED SPILLWAY

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This study aims to evaluate the performance of proposed design for Bastora dam stepped spillway project. Experiments are conducted on a physical model, which is constructed at the laboratory of hydraulic engineering/ college of engineering/ Salahaddin University, Erbil- Iraq using an appropriate scale to avoid potential effects governing the model. The evaluation includes determining the flow regime passing the structure, length to and flow depth at the inception point, the efficiency of the structure to dissipate the energy at the toe, the height of side wall required for both the spillway chute and stilling basin at the downstream of the spillway and discharge coefficient. The results presented in the design report are compared with those measured/determined in this study and the design formulae of stepped spillway available in the literature. Although the comparisons show few discrepancies between the results, especially in terms of the energy dissipation rate and chute side wall dimension, the design report can be said acceptable and reliable.

KEYWORDS: Physical Modelling, Bastora Dam Stepped Spillway, Discharge Coefficient, Energy Dissipation.

WATER RESOURCES ENGINEERING

**EFFECT OF DIFFERENT IRRIGATION SYSTEMS ON
IRRIGATION WATER USE EFFICIENCY, GROWTH AND
YIELD OF POTATO UNDER BAZIAN CLAY LOAM SOIL
CONDITION**

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A field experiment was conducted at Bazian Agricultural Research Center, Sulaimani governorate in clay loam soil to investigate the effect of different irrigation systems (Furrow "F", Sprinkler "S", Drip "D", and Sub-surface drip irrigation system "SD" with three different depths (10cm-SD₁₀, 25cm-SD₂₅, and 40cm-SD₄₀) on irrigation water use efficiency, growth and yield of potato (SYLVANA c.v). Results showed that the total amount of water delivered from the source was significantly smaller for (SD₂₅) and (SD₄₀). Maximum water used by potato root and the higher application efficiency were observed by (SD₂₅). There are no significant differences between (SD₂₅) and (SD₄₀) in irrigation water use efficiency IWUE, while the both systems were superior significantly on the other irrigation systems in this trait.

(SD₂₅) recorded the highest value and significantly dominated on other irrigation systems in many growth characteristics of potato. As well as this irrigation system (SD₂₅) was significantly increased potato yield and the percentages of yield increase were 35.5% and 27.6% compared to (F) and (S) respectively. There were no significant differences between (SD₂₅) and (D) in the average of tuber weight, while both treatments were superior significantly on the other irrigation systems. No significant different recorded between (S) and (F) for all growth and yield characteristics. Generally (SD₂₅) gave better results in water use and potato production.

KEYWORDS: Irrigation System, Subsurface-drip, Water use, Potato growth, Yield

WATER RESOURCES ENGINEERING

**EFFECT OF FRICTION SOURCE IN THE HYDRAULIC
TRANSIENT IN A PIPELINE SYSTEM USING METHOD OF
CHARACTERISTICS**

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Numerical modelling is real need to analyze transients, since the system of equations representing the phenomena does not have an analytical solution because of the nonlinear term of friction losses. Consequently, the presents study applies the method of characteristics to determine the pressure change variation along a simple pipeline system resulted from hydraulic transient, along with using two different approaches in approximating of the friction term. The performance of numerical scheme is verified, considered against many scenarios and different parameters in the simple pipeline system. It was found that the two models gives slightly different results in terms of simulating the velocity and the pressure wave velocity in the undertaken scenario of pipe filled system. But follow the same scheme. Also it was approved that the first approach is linear while the second one is not. The effect of wave speed was proven to be a significant influence on the transient state. The study also shows that Flow velocity and pipe frictional coefficient also affects on pressure head proportionally. The computational time interval which gives stable results was proven to be chosen according to Courant stability condition. A MATLAB code has been written and then used in the simulation of test cases.

WATER RESOURCES ENGINEERING

**HYDROLOGICAL STUDY AND ANALYSIS FOR PROPOSED
SARTIK DAM - PART 1: STREAM FLOW DATA ANALYSIS
& FLOOD DISCHARGE CALCULATION**

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This research is the part1 of hydrological study and analysis for proposed Sartik dam which located on the Lesser Zab River, the second largest tributary of Tigris River at 18 km northeast of Altun Kopri town, within Erbil governorate of Iraqi Kurdistan Region. In this part all collected meteorological data for the dam catchment area are presented and analyzed, also the mean monthly recorded stream flow data at the dam site for the period (1960-1999) were analyzed to find monthly and annual inflow into dam reservoir. The maximum flood of lesser Zab river at the dam site was studied and probable maximum flood (PMF) value was predicted in accordance with the obtained relation catchment area - specific runoff for all left Tigris river tributaries and was equal to (9100 m³/sec). Enough data necessary for calculation of flood flows at the Sartik dam site was not available, therefore the flood flow values for return periods (25, 50, 100, and 1000) years for the Sartik Dam catchment were predicted in accordance with the obtained relation catchment area - specific runoff for different return periods prepared by (ITSC), and were (1990, 2330, 2850, and 4100) m³/sec respectively. Hydrographs for PMF, and (25, 50, 100, and 1000) years return periods were prepared.

KEYWORDS: Meteorological Data, Stream Flow, Catchment Area, PMF, Specific Runoff, Flood Flow.

WATER RESOURCES ENGINEERING

**HYDROLOGICAL STUDY AND ANALYSIS FOR PROPOSED
SARTIK DAM - PART 2: RESERVOIR CHARACTERISTICS,
SIMULATION MODEL, AND FLOOD ROUTING
CALCULATIONS**

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This research is the part 2 of hydrological study and analysis for proposed Sartik dam which located on the Lesser Zab River, the second largest tributary of Tigris River at 18 km northeast of Altun Kopri town, within Erbil governorate of Iraqi Kurdistan Region. In this part water demand from the dam is calculated, the dam power generating facility with an installed capacity amounting to 156 MW with a maximum discharge of 300 m³/sec. The characteristics of the dam reservoir were calculated, from reservoir sedimentation calculation the dead storage level and capacity was determined and was equal to (309 m.a.s.l., and 104,304,031 m³) respectively. The monthly and annual water losses due to evaporation were calculated from daily recorded evaporation using an equation based on area, volume and elevation curve, and the annual losses were equal to (51,132.366 m³), also the normal reservoir water level (NWL) was fixed at 325 m.a.s.l. which gives live storage capacity equal to (384,846,885), and flooded area equal to (34.184 km²). The simulation model of the dam reservoir, prepared from the calculation of water inflow into the reservoir and water demand including evaporation losses. The inflow was taken for different types of water years, dry (deficit) years (1984, and 1999), average water years (1981, and 1995) inflow, and maximum (flood) water years (1969 and 1988) inflow. From the curves, it is clear that the reservoir starts full at month April and ends full at month March during one year taking into account that the maximum water storage in the reservoir is (489,150,916)m³ and minimum storage is (104,304,031) m³. The flood routing study was done using the (PMF, 1000, 100, 50, and 25) years return periods inflow hydrographs, and stage and volume curve by fixing the crest level of ogee spillway will at 320 m.a.s.l., choosing the number of gated spans equal to 7, the length of each span equal to 12m, and the initial water level of the reservoir was 325 m.a.s.l. The results of this routing will be used to determine the design parameters of the spillway and to determine the actual need of the emergency spillway.

KEYWORDS: Reservoir Characteristics, Water Demand, Sedimentation, Evaporation Losses, Simulation Model, Flood Routing

WATER RESOURCES ENGINEERING
INTEGRATED APPLICATION OF (MODFLOW) AND (WEAP)
MODEL IN NINEVEH PROVINCE

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The province of Nineveh is considered one of the areas that began affected by the waves of drought, so it became necessary to find additional water resources. Consequently, groundwater is considered a good candidate to bridge the gap between water supply and demand. The current study included the construction of a conceptual groundwater model, then this model is converted to a numerical model by means of (MODFLOW) and after a proper calibration of the model it was linked to a surface water model using (WEAP) tool to reduce the shortages in supply of different water requirements. It was noted that when relying on groundwater as an extra resource to the surface water resource, there is a substantial improvement in the reliabilities of meeting the various demands. Additionally, the simulation results revealed that the possibility of adding groundwater as a dependable resource is helping to meet the requirements and to substitute the future shortages of water. The main contribution of the present research is unifying the surface water system with groundwater system in such a way that could be used interchangeably whenever it is necessary. The proposed mechanism could predict the states of supply and demand through virtual scenarios which could be of a great help in development of preparedness and proactive plans to face future challenges in issue of water supply.

KEYWORDS: WEAP, GMS, MODFLOW, LinkKitchen

ELECTRICAL AND COMPUTER ENGINEERING

**COMPRESSIVE SENSING BASED SIGNAL RECOVERY
WITH DIFFERENT TRANSFORMS**

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Kurdistan Region-Iraq

Compressive sensing (CS) is a new technique that give an approach to reconstruct the signal with few numbers of observations or measurements. The CS is based on L_1 -norm minimizations to find the sparse solutions and it is known as basis pursuit.

In this investigation, CS scheme with different transforms is proposed. The three utilized transform techniques are: Discrete Fourier Transform(DFT), Discrete Cosine Transform(DCT) and Discrete Wavelet Transform(DWT) with daubechies1(DB1) and coiflets1(coif1) basis. The proposed system is tested by employing the following signals: Blocks, Heavy Sine, 'Bumps' and 'Doppler' which cover wide range of applications. The four testing signals are represented in sparse domain using different transforms. In order to threshold the coefficients of the signals in sparse domain, the universal threshold is utilized in the case of CS with FFT and DWT whereas, the universal threshold is modified to prune the DCT coefficients.

The main aim of this study is to investigate the differences among CS with DFT, CS with DCT and CS with DWT, and consequently a suitable transform domain used with CS to be selected. The comparative study is established by assessing the performance of the proposed system using Root Mean Square Error (RMSE), output SNR, and the time required to reconstruct approximated signals.

Simulation results have shown that the CS with DWT outperforms the CS with FFT and DCT. CS with DWT has achieved good RMSE values about (0.0014 to 3.359e-8) even when half of the signal elements are removed. CS with FFT and DCT enhanced the noisy Blocks and Bumps signals by 3dB and 1dB respectively, while it is failed to enhance noisy Heavy Sine and Doppler signals. CS with DWT of two basis and for single decomposition level have improved the noisy Blocks, Bumps, Heavy Sine and Doppler signals by 5dB, 4dB, 3dB, and 3dB respectively.

KEYWORDS: *Compressive Sensing, Sparsity, DCT, DFT, DWT, L1-Norm.*

ELECTRICAL AND COMPUTER ENGINEERING

**MINIATURIZATION OF A PLANAR STRIP-SHAPED
MONOPOLE ANTENNA FOR WLAN APPLICATION**

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Recently the demand for compact size devices has been increased whether being used for sensor networks, smart phones, smart watches or RFID tags etc. One of the most important parts of these systems is its antenna which facing a big challenge of having a low profile that meets the required size of these wireless communication devices. This paper presents a design of a simple planar strip monopole antenna for WLAN application. Miniaturization has been performed on this antenna via two different techniques. Firstly corrugations were added to both side edges of the radiating strip that reduced the size with 10.7% of the original size. Secondly the radiating strip has been meandered to increase the size reduction to about 14.28%. Both simulation and measured results shown that meandering technique was more efficient in miniaturizing the size of the designed antenna due to forcing the current to follow a meandered path that rise up with shorter height.

KEYWORDS:–Miniaturized Antennas, Strip-Shaped Antenna, Meandering, Corrugation.

ELECTRICAL AND COMPUTER ENGINEERING

**DESIGN OF A PLANAR UWB ANTENNA WITH BAND
REJECTION**

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This paper is oriented on the design of a planar Ultra-Wideband (UWB) antenna covering the entire UWB frequency range with band-rejection of (5.18 – 6.10 GHz) to avoid the interference with other existing wireless communication systems like WLAN and WiMAX. The band-rejection has been performed by adding a slit to the circular radiating patch transversely to the direction of current flow with a length tuned to the effective half-wavelength which is opposite to the center of rejected band (5.5 GHz). The length of the added slit has been chosen according to a suggested formula unlike other previous works done by trial and error method. CST software package has been used to simulate the designed antenna. Simulation results have shown that this antenna obeys the UWB requirements with a reduction in its gain at the rejection band. Practical implementation has also been performed and measurements confirm the design and simulation results.

KEYWORDS:– UWB Antenna; Band Rejection; PCMA; Microstrip Antenna.

ELECTRICAL AND COMPUTER ENGINEERING
SIMPLE AND ROBUST EYE MOVEMENTS DETECTION
METHOD

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The aim of this research is to develop a signal processing method to detect four eye movements, such as looking up, down, left, right and blinking. This new method has a couple of features in comparison with the recent eye movement detection algorithms. Most of the recent algorithms require a De-noising stage, which is not required in this work. In addition, the suggested algorithm can be considered simple and robust in noisy environment in contrast with other algorithms. In this paper, short-time averaging method is proposed to process and to extract parameters from EOG signals. Moreover, adaptive threshold is applied to classify EOG pulses. The purpose of the adaptive threshold is to enhance the performance of the algorithm in a noisy background. Simulation results are based on real-life EOG signals, where these signals were recorded using an Electrooculography system. The results show that the proposed algorithm has a stable performance HR=100 % and FR=0% with SNR greater than 2dB. The average performance with SNR=0.5 dB is about HR= 90.21% and FR= 4.88%.

KEYWORDS: Electrooculogram (EOG), Short-Time Averaging (STA)

ELECTRICAL AND COMPUTER ENGINEERING
COMPUTER NETWORKS VIRTUALIZATION COST
EFFECTIVE AND DISTANCE LEARNING ACHIEVEMENT

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In the curricula of higher education faculties, computer networking is a main topic in computer Science courses. Previous methods of teaching a subject like Computer Networks has consisted of a face to face proposal, high cost labs and static and complex configuration of real networking devices restricted by in location attendance for experiment purposes and in lab work.

With computer networks virtualization, Students and researchers are allowed to do tests on real world networking configuration scenarios and to configure various and complex network scenarios by configuring virtualized equipments, such as routers and switches, through virtual consoles and Network virtualization and simulation tools .

In this paper an evaluation of the concept of computer networks virtualization and Software Defined Networks is conducted which can be used by the students to improve the learning process of computer networks subject in engineering studies. Emulating the same physical networks as in the laboratory, at home or remotely from anywhere with more flexibility and lower cost, all that through emulation tools installed on students computers.

Keywords- Emulation, Virtualization, Software Defined Networking, Remote Labs.

ELECTRICAL AND COMPUTER ENGINEERING

REAL TIME VLSI IWT DENOSING ARCHITECTURE

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In the last decade many efficient VLSI architectures were designed to implement the discrete wavelet transform using the lifting scheme. Most of these architectures do not operate in real-time. This paper presents a scalable real time VLSI architectural to compute an integer wavelet transform (IWT) using the lifting scheme for (5/3) biorthogonal filter. The proposed architecture is projected on (XC3S700A FG484) FPGA chip embedded on a Spartan 3A starter kit board. An efficient formula is driven for controlling the delay introduced between tandem architectures that are adapted to work in real-time. The layout of the integrated VLSI structure is simple and can be connected easily in tandem for computing IWT in real time.

A hard threshold module is designed and attached with proposed architecture to implement real time denoising application. The achievement of the proposed architecture along with supplement hard threshold module is assessed by denoising a four benchmarks signals corrupted by adding white Gaussian noise. The result outcomes show that the proposed IWT architecture has powerful performance in the real time wavelet based signal denoising process. The architecture data word length is selected as 11-bits to avoided arithmetic overflow for two's complement 8-bit integer data input. The maximum operating frequency of the proposed architecture varies from 26 MHz in 1-level to 14MHz in 5-level for decomposition/ reconstruction with hard threshold module in an FPGA implementation. The hardware utilization varies from (50%) in 1-level to (97%) for 5-level.

KEYWORDS: Integer wavelets transform, VLSI architecture, signal denoising, Wavelet thresholding.

ELECTRICAL AND COMPUTER ENGINEERING

**REAL-TIME POWER MEASUREMENTS IN SMART
BUILDING MONITORING SYSTEM**

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The concept of a smart building or a home automation system is often characterized by the ability to control and monitor various household appliances to provide improved convenience, energy efficiency and security. In this paper a smart building real-time power monitoring system is proposed. The system targeted at enhanced safety and user awareness about power consumption with reduced cost. The consumed power can be instantaneously measured. The system can be programmed such in the case increasing power consumption, and start to turn off some insignificant appliances. Consequently, power consumption is reduced down and the cost is reduced. The general-purpose microcontroller (Arduino) available in market with low price. An interpolation technique is proposed to reduce the time of data acquisition. The experimental power load measurements achieved by proposed system are compared in the Lab with the precision and commercial power meters. The comparison shows good results, and the typical time required to measure the real power load and power factor is 42.8 ms for one cycle measurement with 192 samples of data acquisition. The maximum error in measurements are 6% W for real power and 4% for PF.

KEYWORDS—Home Automation System; ZigBee; Smart Node; Overload Protection; Power Consumption; Interpolation

ELECTRICAL AND COMPUTER ENGINEERING
A FAST METHOD FOR OPTIMIZING THE K-CLUSTERING
BI-CLIQUE COMPLETION PROBLEM IN
TELECOMMUNICATION

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In this work, we present a fast approximate method for solving the k-Clustering Minimum Bi-clique Completion Problem (KBCP), a problem belonging to the telecommunication and transportation domains. In KBCP, we are given a set of demands of services from customers and its goal is to determine a subset of k multicast sessions that is able to partition the set of the starting demands. Each of the considered service has to belong to a multicast session while each customer can appear in more sessions. The KBCP is tackled by using a fast approximate method which is based on the principle of neighborhood search techniques. The method can search several solutions belonging to diversified sub-spaces aiming to find the best solution. The performance of the presented method is evaluated on benchmark instances taken from the literature, whereby the provided results are compared to those reached by the Cplex solver and recent methods described in the literature. The results show that, the proposed method is fast and competitive and it is able to reach new bounds.

KEYWORDS: Bi-clique; heuristic; neighborhood; optimization.

ELECTRICAL AND COMPUTER ENGINEERING
PATTERN-RECONFIGURABLE ANTENNA FOR 5.5-GHZ
WIMAX APPLICATIONS

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Pattern reconfigurable antenna, which is based on multi-switchable radiators with rectangular reflectors, is presented. The antenna utilized the self-similarity double ring configuration property in the form of rectangular and a Wilkinson power divider feeder, to exhibit wideband and radiation pattern reconfiguration characteristics. The pattern reconfiguration is achieved by feeding these self-similarity double rings of antenna in two directions. A few switches and power divider is used in order to change the feeding direction.

The antenna is capable of steering the beam in the four directions 25° , 52° , 155° and 158° in the azimuth plane and, four directions 20° , 10° , 5° , and 51° in the elevation plane, depending on the state of switches loaded on the rectangular rings. Initial results were obtained by using short and open circuits to represent ON and OFF for switches respectively.

The proposed reconfigurable antenna has the advantage of miniaturization, simple reconfigurable, low profile, light weight, and easy fabrication.

For verification of simulation results, the proposed antenna is fabricated and the prototype is measured using R&S ZVL 13 Vector Network Analyzer. The results show a good agreement between simulated and measured results.

KEYWORDS: Pattern reconfigurable, Switch, self-similarity, Wilkinson power divider, WiMAX.

ELECTRICAL AND COMPUTER ENGINEERING

EAR RECOGNITION USING LOCAL BINARY PATTERN

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In this paper an efficient complete Ear Recognition System (ERS) has been proposed based on the Local Binary Pattern (LBP) approach that can investigate maximum recognition rate; hence it can be used for surveillance applications. The feature extraction is based on calculating the LBP feature for the ear image and dividing the resultant LBP image into several overlap regions, and then extracts the histogram from each region. These histograms are considered as a similarity measure in the classification phase. To evaluate the proposed approach, the Indian Institute of Technology (IIT) Delhi processed ear image dataset has been considered, which contains 125 individual, each with at least three images acquired in the age group between 14 and 58 years. Practical experiments are employed on the proposed ERS to find the best image division regions at best LBP parameters (radius and neighbors) that lead to maximum recognition rate. Detailed experiments show that the proposed system achieved 93.75 % rank-one recognition rate. Furthermore, an experimental study is achieved to examine the less Equal Error Rate (EER). Some identities from the database are considered as imposters. In a verification scenario, the system achieved an Equal Error Rate (EER) of 14.94 %. The Receiver Operating Characteristics (ROC) curve showed that the Genuine Acceptance Rate (GAR) is about 84%.

KEYWORDS: Biometric, Ear Recognition, Local Binary Pattern, Feature Extraction, Histogram.

ARCHITECTURAL ENGINEERING

**AN ANALYTICAL STUDY TO ARCHITECTURAL ITEMS
(SPATIAL CONFIGURATION AND FORMALITY ELEMENT
OF INTERIOR FACADES OF QUBAHAN SCHOOL)**

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In recent years, trends have emerged focusing on exploration the architectural identity through the study of the domestic architecture properties, as a result appeared a large number of architectural studies that have targeted the crystallize the privacy of every society. The most striking feature in the Kurdistan architecture are the buildings that express cultural identity of the Kurdish community, also they are basis upon which the architectural identity, which represented the cultural identity to the Kurdish community, in various fields (social, cultural, political, historical, humanitarian, immigration and defensive tactics and Immunization). All of these elements and others represented the cultural identity of the Kurdish society and reflected directly on the architectural identity of the community, the pattern of local architecture in Kurdistan region is real reflection of the nature of the society. Culture and level of economic and social status, therefore architecture formed an original part of the cultural identity as a responsive basic need of society and the nature of the living conditions. The lack of attention to local architectural character of the mountains regions, led to the appear buildings do not belong to the identity of the local architecture, and due to the lack of research for local architecture Characteristics, it will study the architectural style (the principles form of traditional face) in ancient amadiyah city buildings, and the design characteristics of its buildings, so that architects benefit from it in modern buildings design.

KEYWORDS: architectural identity, spatial configuration, principles form, local architecture, Qubahan School.

ARCHITECTURAL ENGINEERING

**TRANSFORMATION STRATEGIES TOWARDS
SUSTAINABLE CITIES SUSTAINABLE TRANSPORT
STRATEGY IN KARBALA CITY**

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Transportation is the most sector vitality in the city, and represents more sectors polluting, as it represents the ratio of pollution resulting from it by more than 65% of the total pollution in the city, and has negative effects on human health and community and other organisms, as well as their impact on the degradation, distortion and extinction urban interfaces especially heritage and archaeological buildings. Sustainable transport is one of transition strategies towards sustainable cities that adopt modern trends such as Smart Growth and New Urbanism etc., which aims to provide:

- Providing quality of life for urban environment and free of polluting emissions. - Providing suitable transportation modes, and taking into account the social, environmental, economic and physical dimensions of society. - Sustainable transport gives priority to use of non-motorized transport modes (pedestrians, cyclists) in mobility as well as public transport (metro, tram, and bus etc.). The search study of Mexico City experience, which adoption of sustainable transport to solve the pollution problem in the city by applying the policies most important to increase the number of lanes metro and public transport buses, and replacement of transport modes by other non-polluting and accommodate larger numbers of passengers and other policies, where application of these policies to improve the city's environment by providing and improving public transport, reduce number of private cars, and encourage transport modes is automated. Suggested search sustainable transport adoption in Karbala city to importance of religious and historical city and prepare a set of proposals to reduce pollution in the city and organize and coordinate proposals plan and a design. the most important proposals are: city center proposals by emphasizing pedestrian traffic and use of public transport in transfer of visitors to city center and use of intelligent transport. As well as public transport proposals to establish a special public transport pathways inside residential neighborhoods.

KEYWORDS: Sustainable Transportation, Strategy, Karbala City, Sustainable City.

ARCHITECTURAL ENGINEERING

**TRACES OF SUSTAINABILITY PRINCIPLES IN
ARCHITECTURE TEACHING PROGRAMS AT
SALAHADDIN UNIVERSITY - SURVEY AND ANALYSIS OF
TEACHING COURSE BOOKS**

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The rising importance of the theory and principles of sustainability, and its high influence on architecture practice and education is very clear in a way that the term sustainable has been mentioned many times in the UIA\ UNESCO charter for architectural education (UIA, 2015), it is clearly stated (Architecture for a Sustainable Future) as one of its aims for architecture education.

Traces of this influence can be detected by examining teaching course books of any architecture teaching institution, many western teaching institutions has developed tools for detecting these influences, the (STAUNCH tool) is used to trace the level of engaging sustainability principles in Salahaddin University teaching program.

The paper managed to elaborate an assessment of Salahaddin University architecture teaching program status in terms of availability of sustainability principles, and raised some notes and recommendation on how to develop teaching programs to go with UIA\UNESCO aim (architecture for a sustainable future)

KEYWORDS: Sustainability, Architecture, Education, UIA, UNESCO.

ARCHITECTURAL ENGINEERING

**REGENERATION OF OLD CITY CENTER - CASE STUDY
OLD BAZAR IN ZAKHO CITY CENTER, KURDISTAN
REGION- IRAQ**

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Zakho is one of the oldest towns in Iraqi Kurdistan Region. It is distinguished for its rich and diverse Architectural heritage. It has many cultural and historical sites and a city center that date back to the ancient time. The rapid urban development of the inner city has changed the historical character of the Old city with its cultural value. The additional new buildings have transformed the historical city area without any respect to its traditional structure and surrounding landscape. The main objectives of the research are protecting the architectural heritage and its historic value to bring life to Zakho old bazar as a case study, and regenerate the physical - and socio-economic environment through attractive mix use activities and public space.

This research will firstly identify and analyze the existing heritage components in old Zakho Bazar, which require protection and development in different aspects. It will highlight the challenges facing the built-up area and the decline of the historic places. Furthermore, it will explain the importance of adopting the regenerating concept to balance between the dynamic urban development and the architectural conservation of historical and cultural heritage as well as improving the infrastructure and the built environment.

KEYWORDS: Urban regeneration, Architectural heritage, Case study, Historic city center, Old bazar Zakho

ARCHITECTURAL ENGINEERING

**APPLICATION OF TEXTURE SCHEMES IN
ARCHITECTURAL DRAWING - AN ANALYTICAL STUDY –
FIRST YEAR STUDENTS’ DRAFTS IN DEPARTMENT OF
ARCHITECTURE IN UNIVERSITY OF DUHOK**

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The determination of schemes of texture considered an essential need to get a full understanding of the research problem which represented by the lack of clarity about the role of texture characteristics which adopted in forming the texture schemes in architectural drawing. In architectural design the texture strengthens our understanding of quality of form, in addition to that texture can help students acquire unique visual features in their drafts. Accordingly, this paper focuses on studying the texture characteristics in architecture and how the students can use these characteristics to create their textures. So this paper aims to explore the possibilities of texture schemes that used in architectural drawing. The first year students’ drafts in the department of architecture have been analyzed using geometrical methods to define the strategies for putting texture schemes of these drafts. The results showed that the students adopted a set of characteristics of texture more than others in their schemes. The characteristics have been used on two levels: the first one is the micro level related to texture motifs, which work to generate the texture structure that represents the macro level of the scheme. This paper provides a vision about the importance of texture characteristics such as motifs shape, motifs scale, the natural pattern of motifs and directionality of motifs, at the first level and at the second level the types of texture, the roughness of texture, texture reflection and texture relation that have been used. The focus has been on forming the texture wheel, which in turn gives the students ideas about other characteristics of texture and helps to use them in their work.

KEYWORDS: Architecture, Design, Texture Scheme, Texture Characteristics, Texture Structure, Texture Motifs.

ARCHITECTURAL ENGINEERING

**PROCESS - ORIENTED ARCHITECTURE EFFECT OF A
DESIGN METHODOLOGY ON OUTCOMES OF
ARCHITECTURE STUDENTS**

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The research presents a comparative investigation of two teaching approaches for architectural design studio: process oriented verse product driven. The processes oriented approach can be defined as a series of actions or steps that are directed toward a specific aim, while product driven is an approach that sets the form of end product as the main guidance for design processes. The research aims at answering the key question of whether the process oriented approach leads to better learning outcomes for architecture students than the product driven one. The study will investigate outputs of design exercises from several architectural design studios at the department of architecture, which are applying either of the two approaches independently. The attempt is to examine the research hypothesis that the process oriented design can be a successful teaching methodology in any architectural department regardless the academic context of the department.

KEYWORDS: Process oriented, Product driven, Design process

MECHANICAL ENGINEERING

**EXERGETIC ANALYSIS OF A SOLAR PHOTOVOLTAIC
TRACKING SYSTEM IN ERBIL, IRAQ**

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This paper investigates exergy analysis of a solar photovoltaic system that is designed, constructed and tested in Mechanical engineering department, Salahaddin University-Erbil 36°14"N, 44°01'E.

Exergy analysis is used to estimate the exergy destruction losses during the PV module conversion process by using the second law of thermodynamics and to refine and predict the variations in solar photovoltaic behaviour. The electrical and operating considerations of a photovoltaic module include total solar irradiation, maximum generated power by the system, voltage, open-circuit voltage, current, short circuit current, cell temperature, and ambient temperature.

To find sun's position in the sky LDRs (light dependent resistors) are used as an input feedback and rotate the PV module to track the sun using motors and actuators. Quantity of four LDRs mounted on the solar tracking system frame used to find the light intensity difference between all four directions north, south, east and west. The system is automatically controlled by PLC system and is able to rotate the photovoltaic module to follow altitude angle of the sun between 0o to 90o using a 24 inches 36V DC actuator and a 12V high torque DC motor is used to rotate the photovoltaic module toward east and west to follow the sun's azimuth angle for 360 degrees.

The results show that most of the solar irradiance value is dissipated and not entered to the PV module. However, this dissipation of energy results in decreasing the value of the energy and exergy input to the system. The increase in the value of the energy and exergy losses from the morning to about the noon time is because of increasing of the surface temperature of the solar module. From the output of this work, the authors suggested that the module should be reconstructed and redesigned which is suitable for the Kurdistan environment. The suitable one of the PV is to be designed in a way that the temperature rise within the module is not increased the standard level which is 25 °C, however the temperature rise is will reach about 50 °C in the summer. That is why the authors prefer to reconstruct the module.

KEYWORDS: Solar PV; Solar Tracking System; Electrical Energy; Energy Efficiency; Exergy Efficiency

CALCULATING THE HEAT TRANSFER COEFFICIENT OF UNSTEADY HOMOGENEOUS OIL-GAS FLOW

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It is important to compute the heat transfer coefficient in a phase-change flow and enhance the empirical correlations to approximate the performance in many applications. In this work, the heat transfer coefficient of homogeneous two-phase flow with unsteady-state in vertical tube has been studied. The model that used to predict the flow pattern and the heat transfer coefficient for various flow velocities is determined theoretically. Some empirical relations are enrolled in order to find the fluid properties. The results are compared with that obtained experimentally and show responsible values. It is observed that the variation of heat transfer coefficient have been more oscillated and complicated as the flow velocity is increasing. This behavior could not be observed if the flow assumed as single flow, especially when the fluid seems to be gas. However, the theoretical value of void fraction has an average percentage difference ranges between (10-22) % to that obtained experimentally. While, the theoretical value of heat transfer coefficient has an average percentage difference ranges between (10-15) % to that obtained experimentally.

KEYWORDS: Heat transfer, Two-phase flow, Unsteady flow, Homogenous flow, Oil extraction

MECHANICAL ENGINEERING

**EXPERIMENTAL STUDY WITH USING ANFIS TO
EVALUATE THE PERFORMANCE OF A MODIFIED
CLOSED WET COOLING TOWER**

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The present study involves experimental and computational analysis to investigate the thermal performance of modified closed wet cooling tower in perspective of first and second law of thermodynamics (analysis of energy and exergy) according to Iraqi weather. The experimental study includes design, manufacture and testing prototype of a modified counter flow forced draft closed wet cooling tower. The modification based on addition packing to the conventional closed wet cooling tower. To assess the thermal performance of cooling tower a progression of tests was done at various operational and conformational parameters. The theoretical study included developed six models by an Adaptive Neuro-Fuzzy Inference System to anticipating various execution parameters of the tower including the cooling range, tower approach, thermal efficiency, cooling capacity, evaporation losses and exergy destruction. After simulating, three dimensional surface viewers obtained for future behavior of the thermal performance of cooling tower involves interactions between all operational parameters. Comparison of the output values obtained using the Adaptive Neuro-Fuzzy Inference System model and those obtained experimentally for other cases not included in the training data, indicates high compatibility with maximum percentage error of (5%).

KEYWORDS: Closed Wet Cooling Tower (CWCT), ANFIS, packing, exergy, thermal performance, heat exchanger

MECHANICAL ENGINEERING

**NUMERICAL INVESTIGATION OF HEAT TRANSFER AND
FLOW CHARACTERISTICS IN SHELL-AND U-TUBE HEAT
EXCHANGER WITH BAFFLES**

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In this paper the numerical model of cylindrical coordinates, three dimensional of a laminar heat transfer and fluid flow inside shell and tube heat exchanger is examined. The thermo-hydraulic performance of heat exchangers is predicted with finite volume method by CFD simulations using ANSYS 15.0 code. Shell-and-tube heat exchanger is consisted of one pass of warm water laminar flow at the shell side and two passes single tube of laminar cold water. The annular baffles are inserted on shell side, and on the facing distances of the length of tube from the outer surface. Baffles are inserted with staggered position on the shell and tube to achieve good fluid circulation. Also baffles on the tube side are varied with angle inclination, number and diameter while only number and length on the shell side. The tube baffles angle inclination as (45°, 0° and -45 °) and without baffles and the range of Reynolds number from 100 to 2000. The results show high effect of baffles angles on the heat exchanger performance at high Reynolds number. Maximum heat transfer from hot fluid occurs at baffle with angle 0° and high 30mm. Also baffles number increases Nusselt number at high fluid flow rate while a little effect of baffle height and number on the fluid pressure drop is absorbed as obtained by Mica et.al.

Keywords: Shell-and-tube; Numerical simulation; baffle inclination angle.

MECHANICAL ENGINEERING

**EFFECT OF HYDROGEN ADDITION ON FLAME
PROPAGATION CHARACTERISTICS THROUGH TUBE OF
METHANE-AIR MIXTURES USING OPTICAL TECHNIQUE.**

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The effect of Hydrogen addition on laminar flame speed (U_f) of Methane – Air premixed mixtures using optical technique has been experimentally investigated inside a tube. The flame front location had been positioned by a photocell. The (U_f) measured at a laboratory conditions for an extensive range of equivalence ratios (Φ). In order to use density ratio method for the calculation of laminar burning velocity (U_L), all experimental work was carried out at constant pressure (Pre-pressure period). The flame temperature (T_b) has been calculated theoretically. Mixture strength (Φ) and hydrogen content (R_H) dependence of (U_L) is represented by empirical correlation over the ranges $\Phi = (0.6-1.4)$, $R_H = (0, 0.1, 0.2, 0.3, 0.4)$, all at initial unburned mixture temperature $T_u = 298$ K and a pressure of (1 atm). In overlapping ranges, the results were found in satisfactory agreement with those previously published.

KEYWORDS: Premixed flame, Methane, Hydrogen, Laminar Burning Velocity, Flame speed.

MECHANICAL ENGINEERING

**EXPERIMENTAL AND SMART (ANN) STUDY FOR
TRANSIENT HEAT TRANSFER FROM A FLAT PLATE
UNDER AIR IMPINGEMENT**

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An experimental study is conducted to verify the transient heat transfer characteristic for a target plate under air impingement jet. This investigation has been carried out with different sizes of orifice diameters included ($D=5, 10, 15$ and 20mm). Air jet velocity is varied using a control valve and piping system designed for this purpose. Air leaves the orifice and impinges the constant flux heated plate orthogonally. Reynolds number is varied in the range ($Re=7100 - 11900$) representing air jet velocities in the range ($U_j=18 - 40\text{ m/s}$). The orifice to plate distance ratio is in the range ($H/D=2, 4, 6$ and 8). The transient heat transfer coefficient is calculated using the semi-infinite solid equation. The local heat transfer coefficients and local variation of Nusselt number are measured for the transient and steady state case, represented by the time period ($\tau_o=0$ to 1) which represent the a dimensionless parameter for the the time elapsed from start of cooling process ($\tau_o=0$) till the end of the transient cooling process ($\tau_o=1$) (i.e. reaching the steady state condition and $\tau_o=1$) in addition to its variation with distance from the centre. The values are compared to that at the steady state condition. An artificial neural network (ANN) is a computational model or a mathematical model based on biological neural networks. It consists of an interconnected groups of artificial neurons and processes information using a connection approach to computation.. Artificial Neural Network using back propagation with transient and steady state has been used. Five different ANN-models, using two algorithms: one for transient state type and steady state type. Correlation was developed for the prediction of Nusselt number in stagnation region, along the distance from plate center region and average Nusselt number using the package MATLAB version (R2014a). Developed correlations of Artificial Neural Network models are based on experimental data for the prediction of Nusselt number. Results show that the Nusselt values are maximum at state of impingement process and decays with time on proceeding of the cooling process and also with space reaching the plate edge.

KEYWORDS: Transient, Impingement, Jet cooling, Heat transfer, Flat plate, ANN

THERMAL ANALYSIS OF A PENTAGONAL SOLAR AIR COLLECTOR

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In this paper, a pentagonal shaped Solar Air Collector (SAC) is proposed. The pentagon design is used to improve the incident radiation angle. The SAC is tested in University of Duhok campus, Kurdistan Region, Iraq in a stand facing south. The absorber made from the sandwich steel panel plate with an area of $0.9 \times 1.5 \text{ m}^2$ and thickness of 0.4 mm. The collector is covered with a Plexiglas of thickness 5 mm. The effect of the air flow channel on the collector efficiency is studied. Experimental studies are carried out for different tilt angles to show the improvement in the collector performance. The collector is tested for four sunny days in the same atmospheric conditions in December as the worst month. The results demonstrate that the optimum tilt angle of the day will substantially enhance the thermal efficiency comparing to latitude tilt angle. In addition, the proposed SAC with closed channel and open channel shows different performance during the day time.

KEYWORDS: Solar Air Collector, Heat Transfer, Tilt Angle, Renewable Energy