DEVELOPMENT OF AUSTRALIA’S FIRST HYBRID TESTING FACILITY, THE MULTI-AXIS SUBSTRUCTURE TESTING (MAST) SYSTEM

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Abstract

One of the major challenges facing the civil engineering community is to reduce the risk of catastrophic damage due to the extreme loads and enhance the resiliency of urban infrastructure. Experimental testing of large-scale structures is the most reliable means to assess and improve the resilience and performance of structural systems under extreme loads. The development and use of advanced cyber-physical systems, has paved the way to enhance the existing experimental methods in a suitable and cost-effective manner. Hybrid simulation is an innovative cyber-physical testing technique in which computational models and physical components are integrated at run-time. This method overcomes many of the limitations of conventional shaking table tests while using similar equipment used for quasi-static testing. A state-of-the-art hybrid testing facility, referred to as the Multi-Axis Substructure Testing (MAST) system, has been designed; assembled and validated that is capable of simulating the complex three-dimensional time-varying boundary effects on large-scale structural components. The MAST system is unique in Australasia and is capable to serve the research community and practice, nationally and internationally. The paper presents versatile capabilities of the MAST system that will greatly advance the current state of knowledge in large-scale experimental testing.

Keywords: Hybrid simulation, large-scale structures, extreme loads, 6-DOF system.
INVESTIGATING A NEW SPECIMEN GEOMETRY FOR STRENGTH CONTROL TESTS OF CONCRETE

Abstract

In this investigation, new specimen geometry with hexagonal cross-section is proposed to be used instead of cylinders and cubes as a control specimen for strength tests. This proposal will facilitate the ease of making a cube while avoiding the capping or grinding process which is necessary for cylinders and gives reliable and reproducible results. For the hexagonal specimen, two sizes A and B were selected to give approximately the same cross-sectional area of cylinders [150×300 mm (6×12 inches) and 100×200 mm (4×8 inches)]. The testing program includes compressive strength, splitting tensile strength, and modulus of elasticity.

Experimental results have shown that there were real similarities between the proposed and cylindrical specimens in behavior and values. The ratios of hexagonal to cylindrical specimen of compressive strength ranged between 0.95 and 0.96. Meanwhile, the overall ratio of tensile strength of hexagonal to cylindrical specimens was 0.972 and for the modulus of elasticity the ratio was 0.90 for all ages. Finally it was concluded that the proposed geometry gives conservative estimation for the investigated mechanical properties, thus giving a higher factor of safety for structural design purposes.

Keywords: Chord modulus, Compression, Hexagon, Split tension, Strength.
BEHAVIOR OF UHPC CORBELS- REINFORCEMENT RATIO EFFECT

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Abstract

A considerable amount of researches have been performed on normal and high strength concrete corbels. While, no researches in our hands on UHPC corbels has been performed. This paper confirms the effects of reinforcement ratio on UHPC Corbels through an experimental program adopted in this paper. The response variable was failure mode, deformation behavior, strain variations in the main reinforcement, concrete surface stresses and the shear capacity.
STRUT EFFICIENCY FACTOR FOR TWO-PILES CAP USING EMPIRICAL EQUATIONS

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Abstract

The appropriate evaluation of the effective capacity of a concrete strut is an important factor in the analysis and design of concrete members using the strut-and-tie model. This study involves analyzing two piles-caps together with other available tested pile caps in literature. Many expressions are proposed in the current study to evaluate the strength efficiency factor for strut $\beta_s$ of pile caps using the nonlinear multiple-regression analysis to the experimental data.

Based on strut-and-tie model technique of American Building Code ACI 318M-11, a new expression for strut efficiency factor $\beta_s$ is suggested to account for the effects of shear span to effective depth ratio ($av/d$), transverse-shear $\rho_{st}$ and longitudinal- flexural $\rho_s$ reinforcement ratios, concrete compressive strength $f'c$ and the newly considered parameter ($bw/lb/b_{ef}$).

The proposed expressions have minimum values of mean absolute error (MAE) and root mean square error (RMSE), while they have maximum values for coefficient of multiple determinations ($R^2$).

The proposed formula result in good agreement with the experimental results as it has ($R^2=0.91$) as a curve fitting accuracy.

Keywords: Strut-and-Tie Model; Strength; Efficiency; Concrete; Pile cap; Regression.
BEHAVIOR OF SELF-COMPACTING R/C SIMPLY SUPPORTED BEAMS STRENGTHENED WITH NSM CFRP COMPOSITES

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Abstract
The aim of the present research is to study the behavior of the reinforced concrete beams strengthened in flexure with carbon fiber composites techniques namely Near Surface Mounted (NSM) and External Bonded Reinforcement (EBR). In the present research, an experimental study have been devoted to investigate the behavior of self-compacting R/C simply supported beams strengthened with different types of CFRP composite products. The work consists of fabrication and testing of seventeen reinforced concrete beams with cross section of (200 x 250 m) and total length (1300 mm) which were tested under two-point loads. Two of them where not strengthened and tested as control beam and four beams were retrofitted after it has been loaded up to service load, other beams were strengthened and tested subsequently up to failure, where their failure mode was monitored and ultimate load capacity was recorded. Besides, the strains and crack width and crack pattern were measured in concrete at different load levels. The results showed a significant increase in ultimate load capacity ranging from (4.65% to 33.72%) which were recorded in all strengthened beams, as compared to the control beams. Also, the results showed higher flexural strength when using NSM technique by (rods) in comparison with others.

In addition, the current work included studying the effect of carbon fibers in the rehabilitation of reinforced concrete beams. The results reflected the good ability of the carbon fibers in the rehabilitation of the damaged beams by showing an increase in the flexural capacity of the beams ranging (18.6%-45.35%). The best rehabilitation was by using NSM technique by (plate).

Keywords: Self-compacting concrete, R/C beams, CFRP strengthening, NSM technique
SHEAR PREDICTION OF CRUSHED STONE REINFORCED CONCRETE DEEP BEAMS WITH WEB OPENINGS

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Abstract
Three series of deep beams were tested in order to know the shear strength of crushed stone reinforced concrete deep beams with web openings. Each series consisted of four beams, one solid and three with web openings. After carrying out the total tests on the entire beams and doing theoretical analysis it was found that for the case of presence of web openings, the beams failed in diagonal splitting mode of failure due to weakness condition located on the load path, and for those beams which had not been sufficiently reinforced in bending failed in a ductile manner, particularly in the beams with larger span for solid deep beams. After analyzing it was found that the horizontal and vertical web reinforcement below the openings do not effectively contribute in shear strength of the beam while the reinforcements above the openings have strong effect on their strength. After comprising the test results with the previous researchers, it was found that the proposed formula by Tan can give an accurate prediction of the load up to a/d ratio of 1.60. The formula presented by Matamoros is very consistent for design of reinforced concrete deep beams.

Keywords: Crushed stone, Deep beam, Shear strength, Openings
SHEAR CAPACITY OF RC BEAMS - REVISITED

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Abstract

Presently shear design of RC beams, both in codes and research has a very wide range on the influence of major parameters. For example, the influence of concrete compressive strength $f'_c$ (or $f_{cu}$) affects the shear strength of beams by varying power values: 2/3, 1/2, 0.38 and 1/3. It is well known that shear in RC beams is essentially based on empirical or semi-empirical formulae. 549 tests of beams failing in shear available from the literature are studied in this work. These include 423 ones without web reinforcement and 126 with stirrups. In this work the design involves two main design proposals - one with and the other without size effect.

The best available design method obtained from the literature leads to 24.4% increase in the coefficient of variation (COV) compared to the proposed design method in this work - essentially because the latter includes size effect, whose COV is 16.44%.

Keywords: shear capacity; size effect; span-depth ratio; web reinforcement.
DYNAMIC RESPONSE OF MACHINE FOUNDATION: A CASE STUDY

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Abstract  
This paper deals with the finite element modeling and dynamic analysis of machine foundation through evaluating its steady state harmonic response. A detailed finite element model for the foundation is constructed using three dimensional solid elements model available in software computer programming ANSYS (version 11). Where, in the last decades, analytical solutions based on simplified assumptions commonly used in project offices have been replaced by precise mathematical methods based on finite element modeling, bringing more reliability to the calculations. In this case study, the machine foundation for gas turbine generator with dimensions of (24x10.5x2) m is adopted, which is located in South Baghdad Power Plant in Iraq.

A parametric study is carried out to investigate the effect of several parameters, including foundation thickness, modulus of elasticity for the soil, and damping ratio. It can be noted that the finite element analysis agrees with the analytical results. It was showed that as the foundation thickness decreases, the maximum displacement increases due to geometrical damping induced by the foundation. And when the modulus of elasticity for soil is increased, the vertical displacement decreases, in which the soil is stiffer. While, by increasing the damping ratio, the oscillation for the vertical displacement with the time diminishes, which means that the foundation becomes more dynamic stable.

Keywords: Finite Element Method, Machine Foundation, Soil-Structure Interaction, Harmonic Loading.
Abstract

This research aims to study the possibility of using disk washers welded through reinforcement rebar instead of the ordinary reinforcement steel bars or strand used in concrete. This study also includes experimental work to cast 12 samples of full scale beams, dimensions 2515 mm length, 264 mm width and 212 mm height, which is the same model of the railway sleepers, with a concrete mix design of (1:2:4) (cement:sand:gravel) by volume, and the same water to cement ratio (W/C) of 0.5. The external diameter of the disc washer is 59 mm, the internal diameter of the disc hole washer is 17 mm and the thickness is 2 mm. Only the reference sample have no washers welded through the rebar, but the other samples, with disk washers welded either at the top and/or bottom side with different distance between welded discs vary (50, 100, 150 and 200) mm. For all samples the diameter of the steel deformed reinforcement is 12 mm, two at the top of the cross section and two at the bottom using simply supported beam test and rail seat distance of 1435 mm. The main conclusion from this investigation is, that the bearing capacity of the sleepers reinforced by disc washers is about twice the bearing capacity of the same sleepers using conventional mild steel bars.

Keywords: Rebar, concrete sleepers, washer disk, bearing capacity.
BEHAVIOR OF SELF COMPACTING CONCRETE DEEP BEAMS UNDER REPEATED LOADING

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Abstract

This research is devoted to investigate the experimental and numerical behavior of normal and high strength Self Compacting Concrete (SCC) deep beams under monotonic and repeated loading regimes. The experimental program consists of casting and testing 16 vibrated and SCC deep beams (1400 mm long, 150 mm wide and having an overall depth of 400 mm). Four deep beams were tested as control specimens for repeated loading test and the effect of various parameters such as; cracking load, load-midspan deflection response, compressive strength of concrete and average concrete surface strains have been studied. In these beams the amounts of longitudinal main reinforcements were kept constant the other twelve vibrated and SCC deep beams tested under repeated loading at levels of 90%, 80% and 60% of the ultimate load of reference beam for normal and high concrete strength. The objective of these tests was to evaluate the effects of repeated loads on the behavior and load carrying capacity of deep beams. It was found that for tested deep beam subjected to repeated loading (up to five cycles) and then to monotonic loading up to failure with levels 90%, 80% and 60% of monotonic control beams, the percentage decrease in efficiency of deep beam ranges from 14.2% to 2.7% for group LNC, 11.4% to 1% for group LSC, 8.4% to 2.6% for group HNC and 10.5% to 3% for group HSC.

Keywords : Deep Beams, Repeated Loading, and Self Compacting concrete
STRUT AND TIE MODEL FOR THE ANALYSIS OF FIBRE REINFORCED CONCRETE DEEP BEAMS

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Abstract
Shear failure is the most probable mode of failure for reinforced concrete deep beams. This failure is mainly controlled by the compressive strength of the struts in the strut and tie shear strength prediction model. The strength of the strut is controlled by many parameters among which is the efficiency factor of the concrete compressive strength. Different values of this factor are recommended by researchers and international codes of practice for conventional concrete. For fibrous concrete, this factor is influenced by the presence of steel fibres.

In this study, an efficiency factor for concrete in struts of fibre reinforced concrete deep beams is derived from the test results of 68 fibre reinforced concrete deep beams. It is shown that this factor depends on the fibres reinforcing index, the web reinforcement ratio and the shear span to effective depth ratio. The predicted shear strength using this efficiency factor gave closer match to the experimental results with higher accuracy than the methods proposed by Narayanan and Darwish or the strut and tie models proposed by some codes of practice.

Keywords: Deep beams, efficiency factor, fibres, strut, tie.
MOMENT DISTRIBUTION FACTOR MODEL OF HORIZONTALLY CURVED COMPOSITE GIRDER BRIDGES

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Abstract
The moment distribution factor of horizontally curved composite bridges has been derived from finite elements analysis using well known program (SAP2000). For each model series, the full data are given together with model results, and comparison is made with international AASHTO code in order to show the validity of the empirical equation derived from model results. The parameters included in the present study are the span to radius ratio, center to center spacing of the girders and span length of composite bridge. Empirical equation derived from models was developed to predict the moment distribution factor and show close agreement as compared with codes.

Key words: Structural Engineering, Composite Bridge, Girder Moment Distribution Factor, Shear Stud.
EXPERIMENTAL BEHAVIOR OF COMPOSITE DEEP BEAMS

Abstract

Experimental investigations were carried out to study the behavior of composite concrete deep beams. Eight simply supported deep beams were tested up to failure under the action of two point loads. The variables included are the compressive strength of the concrete ($f'_c$), shear span to depth ratio $a/d$ and web plate thickness. The study was focused on determining overall deformation and behavior on the concrete surface, strain measurement, inclined cracking and ultimate strength. It was found that the behavior of tested beams was significantly affected by ($f'_c$), $a/d$ and the steel web thickness. The results show that the variation of the type of steel reinforcement from steel bars to steel plate, the ultimate strength decreased by 9.13%. In addition, the ultimate strength and midspan vertical deformation were significantly affected by the variations in ($f'_c$) and changing of the steel plate web thickness on the behavior of tested beams.

Keywords: Composite Concrete, Deep Beams, Mechanical Properties, Shear Strength.
SHEAR BEHAVIOR OF PRECAST-PRESTRESSED CONCRETE BEAM WITH REACTIVE POWDER CONCRETE SLAB

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Abstract

The present experimental and theoretical investigation aims to study the shear behavior of composite concrete members which consisting from precast-prestressed concrete beams and reactive powder concrete slabs, as well as knowledge the impact and effectiveness of using the reactive concrete powder slab on the shear behavior of the composite member compared to conventional concrete slab for the same composite member, that was studied in this research as well. Experimental work included casting and testing seven composite concrete members and the only difference between them was the quality of the concrete slab either precast-prestressed concrete beam was similar for all of them. The results showed that the shear behavior has been improved when using the reactive powder in concrete slab compared with traditional concrete slab. The ultimate shear strength \( (V_u) \) and diagonal cracking load \( (V_{cr}) \) increased to (20.31%) and (13%) respectively with using the reactive powder concrete slab compared to composite concrete member with normal concrete slab (SB7). It was found that the increase of steel fiber volumetric ratio \( (Vf) \) % form (0 to 1%) increased ultimate shear strength \( V_u \) by (12.63 to 31.82%) respectively. Also, it was found that the increase of shear-span to depth ratio \( (a/d) \) from (2 to 3.5) decreased both diagonal cracking load \( V_{cr} \) by (7.15 to 28.57%) and ultimate shear strength \( V_u \) by (8.34 to 31.8%). For this analysis, a system of computer program (ANSYS V.12.1) is used for this study. The precast-prestressed concrete, reactive powder concrete and normal concrete slab were modeled by 8-noded isoparametric brick elements (Solid 65), while the steel reinforcing bars and prestressed strand were modeled as axial members (bar elements Link8) connecting opposite nodes in the brick elements with full interaction assumption. Good agreement with the experimental tests of some previous studies was obtained using ANSYS solution. The maximum difference with experimental test is found to be less than 6%.

Keywords: precast-prestressed concrete, reactive powder concrete, shear strength.
FLEXURAL PERFORMANCE OF COMPOSITE GFRP “I” SECTION UHF BEAMS

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Abstract
Using steel in bridges’ construction because of their desired tensile and compressive strength and light weight especially in large spans was widely popular. Disadvantages of steel such as corrosion, buckling and weaknesses in high temperature and unsuitable weld could be resolved using Fibres Reinforced Polymer (FRP) profiles. The FRP is a remarkable class of composite polymers that can improve structural elements behaviour like corrosion resistance, fir resistance with good proofing and electricity and magnetic non-conductor. In this paper, composite GFRP& UHF beams are studied and behaviour of I-shaped beam is discussed under point loads with numerical models and results has been compared and verified with experimental tests. Modelling performed with ABAQUS as a FEM base software. Two different beams are modelled and verified under static progressive loading.

Keywords: Glass Fibres Reinforced Polymer, Composite, I-section Beam, Durability, Finite Element Method, Numerical Model
EXPERIMENTAL STUDY FOR SCC BEAM STRENGTHENED BY EXTERNAL CFRP UNDER SHEAR FAILURE

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Abstract
This research is an attempt to provide more experimental test data for beams strengthened by externally bonded Carbon Fiber Reinforced Polymer (CFRP) and subjected to shear.

The experimental program consists of testing fourteen simply supported beams molded by using SCC with two point load.

All beams have the same dimensions, flexural and shear reinforcements. In this study three parameters were considered: Shear span to effective depth ratio (a/d), the shape of CFRP sheets (slides, U-shape and wrapped around) and CFRP amount and distribution. For every type of using CFRP two beams tested with (a/d) ratio equal to (2.5 and 3) respectively. The adopted parameters were chosen due to their importance in determination of SCC beams behavior and to fill the lack in studying this type of beams especially those constructed using this type of concrete.
LOAD CAPACITY AND DEFORMATION OF HIGH STRENGTH CONCRETE CORBELS WRAPPED WITH CFRP SHEETS

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Abstract

In this paper strength and deformation of reinforced concrete corbels made from high strength concrete, of compressive strength ranging from 73.85 to 77.6 MPa, wrapped with CFRP sheets were studied through experimental tests. For this purpose a total of twelve concrete corbels were cast and tested for the ultimate load capacity. Deformations of corbel deflection and strains in steel and CFRP sheets were measured. For bonding CFRP sheets to the corbels outer surface different configuration was followed. Results indicate that there is an enhancement in load capacity when undamaged reinforced concrete corbels is strengthened with CFRP sheets. Using the best CFRP configuration the load enhancement was reached 28.3%. Results also indicated that the strengthened corbels suffered from high deformations before collapse, and the tensile strain in steel and CFRP materials was high, and was larger than the strain corresponding to the proportionality limit.

Keywords: Concrete corbel, High strength concrete, Load capacity, Strengthening, Wrapping.
STRENGTHENING OF STEEL MEMBERS SUBJECTED TO IMPACT LOADING USING ULTRA HIGH MODULUS CFRP

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Abstract
Carbon fibre reinforced polymers (CFRPs) are commonly used for strengthening steel and concrete structures, with different types of CFRP used for strengthening different structural elements. A number of studies have focused on strengthening of steel members using low- and normal-modulus CFRP. However, there is a lack of understanding of the use of ultra-high modulus (UHM) CFRP for strengthening steel structures under impact loading. This paper presents an experimental investigation on the effect of high load rates on the bond strength, failure mode, effective bond length and strain distribution along the bond interface between CFRP and steel plates in double-strap joint specimens. Two methods of capturing strain were used in this program: image correlation photogrammetry was used for specimens tested under quasi-static tensile load, and foil strain gauges were used for specimens tested under impact tensile loading. UHM CFRP was used to strengthen the joints using Araldite 420 epoxy. The results show a significant increase in the bond strength and different failure modes were observed.

Keywords: Ultra-high modulus CFRP, impact loading, CFRP-steel joints, bond strength.
EFFECT OF CFRP LAMINATE DESIGN ON BLAST BEHAVIOUR OF RC COLUMNS

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Abstract.

The effect of CFRP laminate design on the dynamic behaviour of reinforced concrete columns subjected to blast loads is investigated in this paper. Three half scale RC columns were subjected to simulated blast load using a shock tube testing device. The columns were 150 mm x 150 mm in cross section and 2400 mm long. Concrete compressive strength was 33 MPa for all columns investigated. Columns were reinforced longitudinally with four 10M rebars, one at each corner, and laterally with 6.3 mm closed steel ties spaced at 100 mm c/c. Columns were axially loaded with 400 kN prior to the blast test. Advanced measuring techniques were employed for the first time in the present research. The time history of reflected blast pressure, impulse, mid-height displacement, and axial load were accurately measured using ultra-high speed data acquisition system. The results show that the CFRP laminate design has a major influence on the dynamic performance of RC columns subjected to the effects of blast.

Keywords: Blast load, RC columns, CFRP laminate design, jacketed column
STRUCTURAL PERFORMANCE OF SEISMICALLY VERSUS NON-SEISMICALLY DETAILED RC COLUMNS SUBJECTED TO SIMULATED BLAST LOADS

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Abstract

In this paper, the effect of seismic detailing on the behaviour of reinforced concrete columns subjected to blast loads was investigated. Two non-seismically detailed RC columns and two seismically detailed RC columns were subjected to simulated blast load using a shock tube testing device. The columns’ dimensions were 150 mm x 150 mm x 2400 mm. All columns were reinforced longitudinally with four M10 rebars, one at each corner. Non-seismic RC columns were reinforced laterally with 6.3 mm closed steel ties spaced at 100 mm c/c while in seismic RC columns the steel ties were spaced at 37.5 mm c/c. The columns were axially loaded to 54% of their axial capacity prior to the application of the blast pressure. Advanced measuring techniques were employed for the first time in the present research. The time history of reflected blast pressure, impulse, mid-height displacement, and axial load were accurately measured using ultra-high speed data acquisition system. The results show that when the spacing between the steel ties was reduced from 100 mm to 37.5 mm both the resistance and the deformability of the RC columns were marginally improved.

Keywords: Blast load, seismic RC columns, non-seismic RC columns
EVALUATION OF RESIDUAL LOAD CAPACITY OF RC STRUCTURES SUBJECTED TO REINFORCEMENT CORROSION

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Abstract
Evaluation of aging structures safety and estimation of their residual load capacity are of significant importance in regions affected by aggressive environment. A simplified nonlinear finite element analysis (NLFEA) is introduced. The proposed NLFEA takes into account different levels of geometrical, material, and bond damages due to reinforcement corrosion. At each load step of the nonlinear analysis process, the NLFEA establishes the instantaneous stiffness of the structure through effective transfer of the instantaneous axial and flexural rigidities from the sectional level to the element level. The model adopted a displacement field tuning convergence approach that involves single or multiple-phases of corrections satisfying equilibrium and a displacement tolerance. The efficiency and accuracy of proposed NLFEA is verified through two case studies where its results are compared with experimental and analytical results from previous studies on undamaged and corrosion damaged structures. The proposed NLFEA proves very high numerical stability and fast convergence that establish it’s adoptability in large structural analysis.

Keywords: Damaged RC structures, finite element.
DYNAMIC BEHAVIOR OF REINFORCED CONCRETE STRUCTURE SUBJECTED TO EXTERNAL EXPLOSION

Abstract

This study deals with the behavior of reinforced concrete structures subjected to external explosions by using a three dimensional nonlinear analysis program. The section design property is employed to model the reinforced concrete structural elements. The behavior of concrete is simulated by an elasto-plastic work.

Numerical study is carried out to evaluate the current international blast design guidelines like the US General Service Administration (GSA 2003), and the United Facility Criteria (UFC 2005) of the US Department of Defense (DoD). It is found that the building designed according to the (GSA 2003) guidelines would not satisfy the (UFC 2005) requirements to mitigate progressive collapse, while a building designed according to the (UFC 2005) requirements could withstand a blast loads resulted from detonation of (250 lbs) at (30 ft).

A parametric study is carried out using SAP 2000 software to investigate the effects of column dimensions, beam depth, and reinforcing steel ratio on the safety of the structure. It is found that increasing column dimensions by (25%) to the (UFC 2005) design is enough to reduce the standoff distance, but increasing beam depth by (20%) is not enough.
Abstract
This paper presents preliminary results of an ongoing analytical study on the behavior of steel connections under fire. Steel beam-end connections play a crucial role in maintaining the integrity of structures during a fire. A series of finite element (FE) simulations is first developed to better understand the behavior of top-seat angle connections with and without double web angles. Second, the FE models are validated against experimental results from the literature at elevated temperatures. The results show that FE models are capable of predicting the behavior of such connections under fire and that the presence of web angles does not alter the connection failure mode but the angle thickness does. Third, FE models were developed to investigate the effect of beam length and load ratio on the behavior of such connections during a fire. Results provide important insights into fire-induced thermal forces and deformations and their implications on the design of top-seat angle connections under fire.

Keywords: Top-seat angle; Fire; FE; Steel; Resistance and Demand
STUDIES ON SHEAR TAB CONNECTION WITH COMPOSITE BEAM SUBJECTED TO FIRE

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Abstract  
The objective of this study is to investigate the behavior of simple shear tab connection with composite beam subjected to fire. A 3D finite element (FE) model is developed in ABAQUS to predict the strength and deformation capacities of shear tab connection during the heating and cooling phases of a fire. The results of the FE model are compared with experimental results available in the literature. Thermal retention factors are used to model the strength degradation of steel bolt and base material at elevated temperature. Also, concrete damage plasticity (CDP) is included to model the tensile cracking and compression crushing of concrete slab at elevated temperature. This paper is an initial step for future parametric studies on shear tab connection with composite beam to quantify the thermal induced axial forces and deformations in simple beam end connections.

Keywords: Shear tab; Composite beam; Fire; Finite Element; Thermal forces.
EXPERIMENTAL AND NUMERICAL STUDY FOR THE EFFECT OF FLANGE WIDTH ON THE POST BUCKLING BEHAVIOR OF PLATE GIRDERS LOADED IN SHEAR

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Abstract
Plate girders can often be loaded beyond the web buckling load predicted by the classical plate buckling theory. This is due to the fact that the web plate is framed by flanges and transverse stiffeners which allow for a redistribution of stress. The primary function of the bottom and top flanges in the plate girders is to resist the axial compressive and tension stresses caused by bending moment resulting from applying transverse loads on the plate girder. The primary function of the web is to resist the shear. In this study an experimental investigation was made to study the effect of flange width on the pre-buckling, post buckling and failure behavior, critical shear load and ultimate shear load for plate girders loaded in shear. This study includes four experimental tests which have been conducted considering two different flange width. The acquired experimental data were then used to verify the theoretical equations proposed by previous researchers. Good agreement between the experimental and the numerical results were observed. Results show increase of the ultimate load of about (14%) when duplicating the flange width of the plate girder.

Keywords: Plate Girders, Post Buckling, Shear
GROUND WATER ASSESSMENT AND MANAGEMENT AT KHANIQEEN AREA, DIYALA GOVERNORATE, IRAQ

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Abstract

The climate parameters data for more than sixty years for Khaniqeen meteorological station were studied. The results show good evidence of climate change indicated by the remarkable decrease of the average means annual rainfall in the studied stations, with the remarkable increase of the average mean annual temperature. MODFLOW program is applied. GIS, 3D spatial analyst is used to prepare future planning to Drill more water wells. The Storage and recharge measurements reflects that it is possible to Drill 330 wells in the future and it is considered of about 300-500 m to be very suitable distances more than the effective well radius. To simulate for 20 years, the stress period were divided to 40 stress periods, one year simulation divides into 2 period lengths, 1 for wet period represented by 60 days, while another for Dry period represented by 300 days. The calculated head values after 5, 10 and 20 years were indicated. Groundwater Flow Model of at Khaniqeen basin reflects that Well Module increase flow from Diyala River to the underlying aquifer, due to groundwater pumping near River. For these simulations, pumping is assumed to be from aquifer by wells, and the pumping rate is set to be continuous in Dry period, an up rise in head in the lower part of the basin, while Draw down in the upper part will happen. Therefore, It is recommended for Khaniqeen basin to Drill wells within the middle and western side of the secondary basin (below isopotential line 200 m) this will not leave bad impact on aquifer storage with keeping acceptable distance between wells at least 500 m.

Keywords: Climate change, Groundwater Modeling, Khaniqeen - Iraq.
GROUNDWATER AND SEAWATER INTRUSION SIMULATION AT BASRAH COASTAL AQUIFER

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Abstract
A simulation models to characterize groundwater flow and seawater intrusion in Um-Qasr coastal aquifer was constructed and calibrated by applying a 3-D SEAWAT model. SEAWAT was used for simulating the spatial and temporal evolution of hydraulic heads and solute concentration of groundwater in the southern part of Iraq at Basrah (Um-Qasr region). The work in this research was aimed to define the behavior of the seawater intrusion in the region and to assess its outcomes by applying the variable-density model using the 3-D finite difference discretization. In this way it was planned to clarify when and where most of seawater intrusion occurred and to predict its future behavior along the region. This model is a fully coupled flow and transport model, capable of simulating variable-density effects on groundwater flow. For calibration purpose, a comparison between the results of the simulation model and the actual observation data from 12 observation wells was done. The simulation result gave good agreement at comparison with actual observations with less parameters adjustments. Accordingly, the calibrated model was used for prediction of future changes in water levels and seawater transport in the aquifer for planning period of 20 years. The pumping from the aquifer was considered at continues to increase from the same pumping wells assuming that there are no new water resources for Um-Qasr city. The final simulation results show that seawater intrusion would occur in the aquifer at high levels if the current rates of groundwater pump age continue with increase at its current rate with future.
FABRICATION OF NANOCOMPOSITE MEMBRANE CONTAINING MWCNTS IN SUPPORT LAYER AND MCM-41 IN POLYAMIDE THIN LAYER FOR WATER PURIFICATION

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Abstract

In this work, a new type of nanocomposite membrane containing modified multi-walled carbon nanotubes (MWCNTs) in support layer and Mobile crystalline material (MCM-41) in thin film was developed. A thin film containing 0.05 % of MCM-41 was deposited on the polysulfone support layer containing (0.0, 0.05, and 0.4 w/w %) of MWCNTs, by interfacial polymerization. MCM-41 nanomaterial was synthesized by chemical reaction using TEOS as silica source. Particle and pore size distribution were determined by (N₂) gas adsorption, and specific surface area was conducted by BET test and found to be 958m²/gm. MWCNTs were modified by acid method and characterized by Raman test. Membranes were studied by SEM, AFM, and ATR FT-IR, morphological study showed that modified MWCNTs and MCM-41 were dispersed and well bounded in the polymer matrix, the synthesized membranes showed an increase in the surface roughness’s, hydroplicity and zeta potential by addition 0.05% of MCM-41. A comparison between synthesized conventional nanocomposite membrane without nanomaterial and a new nanocomposite membrane containing (0.4 w. % MWCNTs and 0.05 % MCM-41) are shown, that the pure water flux was increased from ( 36 L/m².h) to (61 L/m².h), which means that there is an increase of water flux about (69.4 %). Integration of MCM-41 in thin film was contributed in an increase in water flux about (47.2 %), while embedded MWCNTs in support layer was contributed an increase of (22.2 %). This proves that the type of support layers influences the membranes permeability. The salt rejection of new developed membranes were found to be 97.51 – 97.57 % for NaCl, and 98.59 -98.65 %for Na₂SO₄ of concentration (2000mg/L) and transmembrane pressure (TMP) 15 bars, this means that addition of nanomaterials not affected the selectivity of the membranes. Also the new membranes save TMP by (43.7 %) and this is the main objective of this work, to decrease the release of gasses and saving energy to reduce the global warming.

Keywords: Fabrication, Nanocomposite, MWCNTs, MCM-41, Purification
THE TREATMENT OF GREYWATER DISCHARGED FROM AL-SADEER HOTEL IN BAGHDAD

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Abstract
This research aims to investigate the physical, chemical, and biological characteristics of greywater discharged from Al-Sadeer Hotel and propose feasible methods of treatment to render it fit for reuse.

Samples were directly collected from lavatory in Al-Sadeer Hotel starting from November 2013 and terminating in March 2014. The values of TSS for greywater had a mean of 391.1mg/L and a range of 200-670mg/L. The COD values ranged between 140-350mg/L with a mean of 230.35mg/L. The pH values averaged 7.28 with a range of 6.4 - 7.9. Total coliform counts generally were high and exceeded our dilution ranges (>10⁶cfu/100mL).

The proposed treatment methods for greywater include: coagulation and flocculation, sedimentation, filtration and chlorination.

Ten runs were performed to treat the greywater. Polyelectrolyte of 10mg/L was as the optimum dose of a primary coagulant.

The results obtained from above experiments show removal efficiency of suspended solids of about (62.32 – 100%) and chemical oxygen demand of about (60.71 – 89.9%).

Physical, chemical, and biological parameters for the effluent of greywater from above treatment methods are: TSS (0-60mg/L), pH (7.5-8.3), COD (20-110mg/L), and TC (23-80cfu/100mL). These parameters satisfy for the agriculture reuse quality regulations set in the USEPA and Jordanian standards.

Keywords: Grey water, Al-Sadeer Hotel, TSS, COD, Coliform counts, Polyelectrolyte.
EFFECT OF WASTEWATER ON CONCRETE TANKS IN WASTEWATER PLANTS

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Abstract
Sulfates found in wastewater have a great effect on concrete properties in wastewater plants, concrete compressive strength adversely affected by sewage aggressive environment due to the sulfate attack. In order to investigate this action several concrete cubs has been made and cured with ordinary water as well as sewage water taken from different stages of Al-Rustamiyah wastewater plant (grit removal tank, primary sedimentation tank and secondary sedimentation tank). Cubes made in four groups, all samples cured by using ordinary water for 28-days followed by another 28-days curing with sewage water except the reference group.

Concrete compressive strength test shows a significant descending with concrete compressive strength of 20.1 MPa and 21.2 MPa for cubs curd with sewage water taken from grit removal and primary sedimentation tank respectively(descending ratio 25.6% and 21.5% respectively), in comparing with 27.0 MPa concrete compressive strength of reference group.

Keywords: Wastewater Plants, Salt effect, Sulfate, Concrete compressive strength.
POLLUTION STATUS ANALYSIS OF DIYALA RIVER, BAGHDAD, IRAQ

Abstract

The last part of the reach of the River Diyala just before its confluence with the river Tigris south of the capital city Baghdad is taken as a case-study. It is about 15 km in length. Its aquatic physicochemical characteristics are investigated and its pollution status is assessed in this study. This segment of Diyala River is exposed to multiple points of treated and raw municipal waste water discharges. These are represented by the outfalls and bypass of three wastewater treatment plants of Al-Rustimiyah. These discharges are overloading Diyala River's self–purification capacity.

Diyala River's aquatic parameters as represented by DO, BOD, COD, pH, and others were monitored and measured at nine stations along the river reach for a period of one year to assess seasonal variations.

The reaeration coefficient, $K_2$, was calculated from field data of DO concentration along the river reach. It ranged from $0.35 \text{ d}^{-1}$ to $1.1 \text{ d}^{-1}$ having its lowest value during the cold season while the highest occurred during the warm Dry weather season. The deoxygenation constant, $K_1$, was computed by monitoring the BOD of samples taken along the river segment. $K_1$ ranged from a minimum value of $0.16 \text{ d}^{-1}$, which occurred during the cold weather months while a maximum value of $0.63 \text{ d}^{-1}$ occurred during the warm Dry weather months. Based on the maximum value of $K_1$, the river may be classified within the untreated wastewater category during the warm Dry weather seasons, while its average values($K_1$) for the other months of the year categorize the river to be between the polluted river and the treated wastewater.

The self-purification factor, or Fair's factor, $(f)$ for the river Diyala was determined. It classifies the river as a sluggish during the summer.

The research results have shown that the natural self-purification process of the river water body is rather slow or absent due to the heavy pollution loads. It is concluded that full recovery of the river from pollution is only possible via human intervention.

The need for an urgent makeover of the water body characteristics of the river Diyala via mechanically assisted methods is necessary to restore its original usages and ensure public health safety.

Keywords: Diyala River, Self-purification, Reoxygenation, Deoxygenation
Abstract
This research presents the comparing between the Conventional Activated Sludge systems (CAS) and Moving Bed Biofilm Reactor (MBBR). An experimental campaign has been carried out at Al-Rustamiyah WWTP in Baghdad (Iraq); on a pilot plant consist of five reactors in series with Anoxic MBBR-1, Aerobic MBBR-2, Aerobic MBBR-3, Outlet chamber and the Flocculation part with dosing unit, that were operated continuously at different organic loading rates. The MBBR tank was filled with suspended carriers (AnoxKaldnes K5), with a 50% filling ratio. The obtained results showed a good treatment ability of the MBBR system, referring to the organic matter removal, the average BOD5 removal efficiencies for CAS and MBBR were 91% and 88% respectively. On the contrary the COD removal efficiency resulted alike (89% for both systems). The results demonstrate the higher treatment capacity of the MBBR adDressing such system as an effective technology for the upgrading of overloaded wastewater treatment plants.

Keywords: Moving bed biofilm reactor, Al-Rustamiyah wastewater treatment plant WWTP, Efficiency
ACCUMULATION OF SOME TRACE METALS IN TILAPIA FISH OREOCHROMIS AUREUS, WATER AND SEDIMENT IN MAIN OUTFALL DRAIN NEAR THE CENTER OF AL-NASSIRIYIA CITY-IRAQ

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Abstract

The present study was conducted to investigate the concentration and distribution of four trace metals (Cd, Pb, Cu and Zn) in different tissues (gills, liver, kidney, ovaries and muscle) of female Oreochromis aureus collected from main outfall Drain (MOD) during summer 2013, and in water (dissolved and particulate) phases also (exchangeable and residual) phases of sediment. Sediment texture and total organic carbon (TOC%) were measured in the sediment of the study area as a percentage.

Distribution of studied metals showed that, station 1 generally was polluted more than station 2 and 3, which may be attributed to the impact of pollution sources in this station among them domestic sewage effluents without treatment from the residual region near the mentioned. In sediment, trace metals was recorded higher concentrations in the residual phase compared to exchangeable phase with exception for Cd and Pb at all stations during the study period.

The mean concentrations of cadmium, lead, copper and zinc in dissolved phase of water were 0.03, 0.46, 0.08 and 11.54 µg/l respectively, whereas their concentrations in particulate phase were 9.84, 22.11, 17.37 and 63.75 µg/g Dry weight respectively. For sediment, the mean concentrations of these metals in the exchangeable and residual phases were as follows: Cd (4.40, 0.05), Pb (27, 1.64), Cu (5.54, 9.02) and Zn (2.65, 17.46) µg/g Dry weight respectively.

In the fish tissues, the mean concentrations were oscillated for the studied tissues. These concentrations appeared in tissues (liver, gills, kidney, ovary and muscle) of Oreochromis aureus as follows: Cd (0.13, 0.15, 1.53, 0.06 and 0.02), Pb (10.23, 14.19, 13.01, 0.7and 2.31) Cu (20.01, 15.61, 10.41, 9.10, and 16.00), and Zn (35.12, 25.01, 18.20, 70.71 and 20.11) µg/g Dry weight respectively.

Results showed a difference in concentrations of studied metal in different tissues of fish. The tissues of same species showed differences in concentration of studied metals. This due to the nature and the function of the tissues and ability of fish on regulating the level of their trace metals in bodies during the uptake and elimination processes

Keywords: Trace metals, Main Outfall Drain, Water, Sediment, Oreochromis aureus
A COMPARISON IN ACCUMULATIONS OF HEAVY METALS IN TWO SPECIES OF AQUATIC PLANTS IN AL-CHIBAYISH MARSH SOUTH OF IRAQ

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Abstract
The current study estimated the concentrations of heavy metals Zinc(Zn), Copper(Cu), Lead(Pb), Nickel(Ni) and Cadmium(Cd) in each of the dissolved and particulate phases water, sediments and in two species of plants (Typha domingensis and Vallisneria spirallis) in Al-Chibayish marsh in Thi-Qar province, southern Iraq. Samples were collected during the winter and spring of 2013 from two stations within the Al-Chibayish marshlands. Station one was exposed to various types of pollution, while the station two was not exposed to contaminated. Also the percentage of organic carbon in sediments as well as sediment texture were analyzed to identify their impact on the concentration of heavy metals. The results indicated that the mean concentration of heavy metals in all phases(water and sediment) and selected plants were highest at station one compared with station two , the results indicated that the accumulation patterns of heavy metals was greatest in the particulate phase followed by the sediment and plants respectively. Higher concentration of the studied heavy metals were observed in Typha domingensis is more than their concentration in Vallisneria spirallis the range of concentration were Zn(87-131),(64-93); Cu(1.1-1.7), (0.9-1.4); Pb (0.7-4.6), (1.8-3.3); Ni (42-69), (32-66); Cd (0.7-1.8), (0.4-1.5) µg/g Dry weight respectively, so it can be use this species in removing this type of pollutants from the aquatic environment. Metals accumulated by aquatic plants were mostly distributed in roots, suggesting that an exclusion strategy for metal tolerance widely exist in them. This technology involves efficient use of aquatic plants to remove detoxify or immobilize heavy metals. 

Keywords: Heavy metals, Metal accumulation, Phytoremdiation, Aquatic plants
THE EFFICIENCY OF ELECTROCOAGULATION IN THE TREATMENT OF TURBID WATER

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Abstract

The main aim of the present study is to test the ability of electrocoagulation process in treating of turbid raw water. In this study, an electrolytic cells device was manufactured and used to perform the experimental work. Many sets of experiments have been conducted to find the efficiency of electrocoagulation process in treating of raw water. It was found the electrocoagulation is very effective in removing water turbidity up to 97% depending on the voltage rate.

In addition because of the large number of variables associated with the electrocoagulation process so the present study aimed to differ from previous studies by finding a dimensionless function to describe and to know the effect of each variable clearly on the electrocoagulation process.

Keywords: Electrocoagulation, water, turbidity, current, voltage
EFFECT OF PARTICLE FLOC SIZE ON WATER TREATMENT BY COAGULATION–FLOCCULATION PROCESS

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Abstract  
Several experimental runs were carried out to investigate the effect of flocculation times (1, 6 and 20) min, coagulants dose and Camp No .on the residual turbidity or removal efficiency ,floc size or floc formation formed that have (greater Intensity, floc strength and recovery factor, largest volume, greater surface area and the most number)and properties of electrical particle such as (zeta potential ,mobility , frequency) . The floc growth, breakage floc size and regrowth of different type of coagulant were investigated by a laser diffraction particle sizing device (zeta plus) .The coagulants used were alum, FeCl₃, polyelectrolyte (PE), alone or in combination of them. Experiments were conducted using a sample of natural water 55NTU turbidity of Tigris River. Jar –test was used to carry out coagulation, flocculation and sedimentation.

The results were presented graphically in two dimensional co-ordinates showing the residual turbidity or removal efficiency as a function of coagulant dose to locate the appropriate coagulant type and coagulant dose which it gives higher efficiency (>91%, <5 NTU). The results are also plotted to show the required floc size, zeta potential (0 mv) and others parameters as a function of optimum coagulant dose and flocculation time (1, 6, 20) min., to locate the overall optimum working conditions.

Keywords: Water treatment, Particle size, Zeta potential meter
WETLAND SYSTEM FOR WATER QUALITY IMPROVEMENT IN RURAL AREAS

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Abstract
This paper highlights the use of a pilot-scale surface-flow constructed wetland (SFW) consists of a septic tank, and wetland cell, for removal of biochemical oxygen demand (BOD), chemical oxygen demand (COD), total suspended solids (TSS), nitrite (NO₂), nitrate (NO₃), ammonia (NH₃), phosphate (PO₄), hydrogen ion concentration (pH), oil and grease (O&G), sulfate (SO₄), hydrogen sulfide (H₂S), and temperature (T), from a pretreated residential wastewater. The primary treated wastewater in a household septic tanks hauled by a tank to the proposed site. The constructed wetland is a surface type consists of emergent and floating plants.

The scale plant was constructed at rural area (Alkhairat Village) of Al-Hilla province/Iraq. Two types of macrophytes, viz. Typha latifolia and Phragmites carca, were planted. The treatment wetland is composed of five rows of a 30 m long wetland channel. The BOD of the effluent concentrations was varied between 4 to 38 mg/l, with average concentration of 22 mg/l, and removal efficiency of 88.3%.

The average removal efficiencies of COD and TSS were 77.11 % and 80.8% respectively. As depicted from the results, the COD:BOD₅ ratio of influent wastewater was 1.44. The average measured concentration of in the effluent was 35.8mg/L with an average removal efficiency equal to 0.5.

As depicted from the results, it can be concluded that the wetland system utilized in this research could be a suitable solution for raw wastewater as a stand-alone treatment, although a pre-treatment in order to remove grit, heavy solids and floatable materials would be necessary.

Keywords: pilot-scale, SFW; septic tank; BOD; COD; TSS; nitrogen content; phosphate.
PROPERTIES STUDY OF A POLYSULFONE SUPPORT LAYER MEMBRANE CONTAINING MULTIWALL CARBON NANOTUBE FOR WATER PURIFICATION

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Abstract
In this research, we describe the preparation, characterization, evaluation of performance, and study of mechanical properties of polysulfone support layer membranes containing modified MWCNTs. The membranes were prepared by wet phase inversion method in which the acid oxidized multi walled carbon nanotubes (MWCNTs) embedded in polysulfone support layer as matrix polymer. The oxidized MWCNTs were added by a low mount (0.0, 0.05, 0.1, 0.2, 0.4, 0.6 and 1.0 wt. %). Raman spectra were used to identify that carboxyl group attached to MWCNTs after acid treatment. A SEM and AFM spectrum were used to study the morphology, surface roughness, and the dispersion of nanotubes in membrane. Large macro void were appeared in support layer by addition of low amount of MWCNTs. The membranes were characterized for water up take, contact angle, surface roughness, permeability, and mechanical properties. The results indicated that the addition of 0.4w. % of MWCNTs to the polysulfone support layer were enhanced the water uptake, hydrophilicity (by measuring contact angles) and roughness of the membrane due to migration of functionalized MWCNTs to membrane surface during the phase inversion process. The permeability test show an increase of pure water flux about (53%) at TMP 4 bars. The salt rejection for polysulfone support layer was not calculated since the nanopores of polysulfone  
structure did not allow significant salt rejection. Polysulfone support layer containing 0.4w. %MWCNTs suffered from weak stress preventing exploitation of the mechanical properties of the CNTs. transfer, the membranes tensile strength was not improved while the elongation decreased about (25.8%) compared with support layer without MWCNTs.

Keywords: Polysulfon, MWCNTs, Support layer, Purification
NOISE ACOUSTIC POLLUTION IN TIKRIT UNIVERSITY BUILDINGS

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Abstract

The present era is representing a noise era with excellence because of the spreading of communications media, music and visuals on a large scale, causing a state of negative disturbing and annoying, especially in buildings that need a large amount of relative calm, such as hospitals, libraries, schools and universities. In our research paper that has been selected (University of Tikrit) campus to make the measurements realistic and true to some vital buildings which are representing of selected classrooms to see how much the amount of acoustic noise affecting the functioning of the teaching process in those buildings, and also in the building reading halls of central library and several cafeterias inside university campus. It was observed that most of the buildings at the university suffers from an unacceptably high level of noise emitted from many sources. The results showed that the noise levels need for more attention to this phenomenon where it was found that the noise from the surrounding buildings exceeded all acceptable standards, as well as the ambient noise on the campus of colleges emitted from different sources continuously.

In this paper several criteria are studied to identify those specifications. These criteria are represented by the outdoor and indoor noise sources of classrooms and also the manner of measurement of direct mathematical calculations, as well as properties that affect the receipt of the concept of lecturer diction, including the Signal to noise ratio (SNR) and the distance between the Lecturer and students. It has been recommended, that it can be obtained a quiet classrooms using modern technology (construction materials, proper equipment, and design appropriate), as well as to give more attention to treat the noise sources with appropriate recommendations to reduce it like the noise emitted from diesel electrical generators, traffic noise and loudspeaker of cafeterias.

Key words: Noise, internal sources, external sources, voices.
Aerobic granular activated sludge is an attractive and promising process for intensive and high-rate biological nutrient removal from wastewater. This work reports the effect of air superficial velocity and type of carbon source on the granulation process using synthetic wastewater. Four sequential batch reactors (SBR) have been used. The range of air superficial velocity was 1-5 cm/s. Sodium acetate and sucrose were used as carbon source. The influent COD was 1000 mg/l. The results showed that the maximum granules size was achieved in the reactor with superficial velocity was 3.5 cm/s and fed with sodium acetate. After 100 days, the dominant granules size was 5-9 mm. The removal efficiency of COD, NH₄ and TN was 97%, 98% and 92%, respectively. Sludge volume index (SVI), MLSS and granules settling velocity was 26 ml/g, 4,900 mg/l and 50 m/h respectively. After 100 days the reactor fed with sucrose achieved smaller granules size and less removal rates in comparison with that of reactors fed with sodium acetate under same operating conditions due to bulking and instability. Optical microscope images showed that the surfaces of granules fed with sodium acetate were rich with ciliates and rotifers while those fed with sucrose was rich with yeast and ciliates.

**Keywords:** Granular sludge, Activated sludge, Wastewater, SBR
COMPARISON OF THE EXPERIMENTAL RESULTS WITH THE LANGMUIR AND FREUNDLICH MODELS FOR COPPER REMOVAL ON LIMESTONE ADSORBENT

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Abstract
The purpose of this study was to investigate the possibility of the limestone as a adsorbed media and low cost adsorbent. Batch adsorption studies were conducted to examine the effects of the parameters such as initial metal ion concentration $C_o$, particle size of limestone $D_L$, adsorbent dosage and equilibrium concentration of heavy metal $C_e$ on the removal of the heavy metal (Cu) from synthetic water solution by limestone. The removal efficiency is increased with the increase of the volume of limestone (influenced by the media specific area). It has been noted that the limestone with diameter of 3.75 is the most effective size for removal of copper from synthetic solution. The adsorption data were analyzed by the Langmuir and Freundlich isotherm model. The average values of the empirical constant and adsorption constant (saturation coefficient) for the Langmuir equation were $a=0.022$ mg/g and $b=1.46$ l/mg respectively. The average values of the Freundlich adsorption constant and empirical coefficient were $K_f= 0.010$ mg/g and $n= 1.58$ l/mg respectively. It was observed that the Freundlich isotherm model described the adsorption process with high coefficient of determination $R^2$, better than the Langmuir isotherm model and for low initial concentration of heavy metal. Also, when the values of amount of heavy metal removal from solution is predicted by the Freundlich isotherm model, it showed best fits the batch study. It is clear from the results that heavy metal (Cu) removal with the limestone adsorbent appears to be technically feasible and with high efficiency.

Keywords: Limestone, Heavy metal (Cu), Langmuir, Freundlich, Batch studies.
EVALUATION OF GASES EMISSIONS FROM AUTOMOBILES EXHAUST IN BAGHDAD CITY

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Abstract
The increasing numbers of non-thoughtful imported automobiles to Baghdad city in Iraq especially after year 2003, in view of the poor quality of many of these vehicles because reformatted for service in developed countries and imported by developing countries, including Iraq, as well as others which is a modern-made but characterized by poor technical specifications and commercial licenses because of the low price of production and sale, a lot of importing cities has become a moving graveyard for these automobiles. The emitted gases from the automobiles exhaust are an important source of air pollutants, especially in congested traffic intersections in Baghdad city. Given the lack of quality control of the relevant authorities in the reduction of import these vehicles, especially in the past decade and the lack of activation of environmental legislation in addition to the absence of the green belt in the city, we'll prepare of this analytical study on the evaluation of gaseous pollutants namely (NO2, %LEL, CO, CO2, H2S, SO2, O3 and VOCs) resulting from vehicles exhaust to enrich researchers in the future in order to reach the task of engineering solutions and come up with optimal recommendations to service of Baghdad city.

Keywords: gases emissions, gaseous pollutants, automobiles exhaust, environmental legislation.
EVALUATION OF THE RADIOLOGICAL CONTAMINATED AREA IN AL TUWAITHA NUCLEAR SITE, IRAQ

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Abstract
In this paper, the authors aim to introduce contaminated area in Al Tuwaitha nuclear site, Iraq using GIS and statistical techniques. This contamination problem draws attention to the new result of radioactive contamination found in part of the country. The area are characterized into equivalent dose (effective dose), $^{40}\text{K}$, $^{234,235,238}\text{U}$, $^{60}\text{Co}$, $^{137}\text{Cs}$ and $^{90}\text{Sr}$. the represent area contaminated by equivalent dose that directly reflect measured values of contaminants in mrem/hr and percentage of contaminated area and by Bq/g as radionuclide concentrations activity in Al Tuwaitha soil. Most areas have value around (0.01) mrad/hr or less do not appear as effective level The results show that 35% from contaminated area (7 km$^2$) has value from (0.01-0.1) and only 2% found in the range between (40-105) mrem/hr. The contaminated area above normal concentration of U sum in soil having about 65% from total contaminated area (0.87 km$^2$) Where for $^{40}\text{K}$ found near to the background level and UNSCEAR (2000), between (0.2-0.4) Bq/g have area about 74% . Serious contamination with $^{137}\text{Cs}$ found in total area of about (0.29 km$^2$). While the area classified as 57% from (0.02-2) Bq/g, 21% for (2-8) Bq/g, 9% for (8-16) Bq/g, 7% for (16-28) Bq/g and 6% for (28-56) Bq/g. The total estimated contaminated area with $^{60}\text{Co}$ is about (0.14 km$^2$) while 33% from contaminated area have concentration level between (0.05-10) Bq/g. The Strontium-90 (90Sr) having almost the same contaminated area with $^{60}\text{Co}$ and $^{137}\text{Cs}$ (0.21Km$^2$) as 6% from contaminated area having concentration level between (0.005-0.10) Bq/g.

Keywords: Al Tuwaitha nuclear site, Iraq, GIS, Contaminated Area.
UPGRADING OF AN EXISTING IRAQI SEWAGE TREATMENT PLANT TO ACHIEVE NITROGEN AND PHOSPHORUS REMOVAL

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Abstract
A typical design accomplished by German consultants (H&F) had been considered for many Iraqi wastewater treatment plants in eighties. This design had been analyzed by using GPS-X 6.1 software to evaluate nitrogen and phosphorus removal and the results shows that the effluent quality exceeds the new acception limits for streams disposal. Therefore two sets of modifications have been examined using the same software to upgrade the removal efficiency for both nitrogen and phosphorus into biological treatment units. The results show the ability to achieve nitrogen removal biologically while the accepted limit of phosphorus couldn't be reached biologically because of limited available space.

Key words: upgrading, BNR removal, wastewater treatment
THE FATE OF SOME EMERGING CONTAMINANTS IN CONVENTIONAL WASTEWATER TREATMENT PLANTS

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Abstract

Over the past decade, the occurrence and removal of emerging contaminants in the environment has received much attention. Both natural and synthetic progestogens are two examples of such emerging contaminants. Sewage treatment works are recognised as one of the main routes of these compounds to the environment. Low concentrations (nanograms per litre) of biologically active chemicals may exhibit an impact on aquatic organisms and human health. This study was undertaken to determine the occurrence and removal of these chemicals at sewage treatment works. Therefore, field-based sampling campaigns were undertaken at a sewage treatment works, to achieve this study. Solid phase extraction and LC/MS/MS were used in order to analyse the samples from these different locations.

The results have demonstrated that progestogens are in the sewage system; the natural hormone (progesterone) was the most predominant compound (46.9 ng/l) among the progestogens in the influent. The conventional sewage treatment works were, to some extent, able to remove these compounds from wastewaters. However, this may not be adequate to afford protection to the environment.
SUSTAINABILITY AND BUILDING INFORMATION MODELING

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Abstract  
This paper describes, through a critical review of the literature, the areas where and how Building Information Modeling offers a platform for implementing sustainability principles in design, bidding, and construction processes. The paper has two major outcomes: 1) a framework to improve the intricate relation between BIM and sustainability, and 2) a research agenda on integrating BIM and sustainability.
Abstract

Basrah refinery is located 15 km west of Basrah governorate south of Iraq. The main structures in the refinery and the storage tanks were subjected to several air attacks during the first and second gulf wars causing many environmental problems. The problems were generated from the release of heavy metals due to oil industrial processes and spillage of oil waste in the vicinity of the complex, in addition to the widespread of uncontrolled emission of particulates and gases from stacks. The main concern in evaluation the degree of pollution in soils is the determination of the concentrations of heavy metals Cd, Pb, Ni, Cu, Cr and Zn as their higher values cause heavy metal poisoning. Soil samples were taken from the area (6km x 6km), keeping the source of contamination in the center using grid method (1km x 1km). 24 samples were collected from the ground surface, 100 mm and 500 mm below N.G.L. Concentrations of heavy metals Cd, Pb, Ni, Cu, Cr and Zn were determined in addition to soil constituents, soil pH and iron oxide Fe2O3. The results demonstrate that the range of concentrations of Cd is between 4 to 11.7 mg/kg, Pb between 8 to 54 mg/kg, Ni between 23 to 110 mg/kg, Cu between 6 to 35 mg/kg, Cr between 23 to 68 mg/kg and Zn between 8 to 49 mg/kg. Furthermore the results also exhibit a decreasing trend in metals concentration with increasing clay content. Higher adsorptions of heavy metals were noticed when pH values exceed 7.

Keywords: soil pollution, heavy metal, contaminated soil, Polyaromatics, soil adsorptions
Abstract

Irrigation efficiency is one of the most important inputs for agricultural production, since water scarcity is turning into a severe problem worldwide, affecting mainly arid and semi-arid region. Recently, there is an increase in the need to produce more output per unit of water that means it is required to increase the Water Use Efficiency (WUE).

Al-Hussainiyah Irrigation Project in the province of Karbala- Iraq is one of the most important irrigation projects in the central region of Iraq, which suffers from a deficiency of water.

The objective of this study is to improve the WUE of Al Hussainiyah Irrigation Project through evaluating the present state of agriculture and deficit in water resources during the Drought season and reducing the effect of this deficit on the total yield.

This objective was achieved through correlating the deficit irrigation with yield reduction and estimating the WUE for seven crops (Maize, Cotton, Small Grain, Summer Vegetable, sunflower, Sesame and Alfalfa) under different irrigation deficit levels (5,10,15,20 and 25%) as a function of all crop growth for heavy soil.

All the required data were collected from number of related Iraqi ministries. CROPWAT 8.0 software was used to solve the model and test its application sensitivity by changing deficit levels. The results of the model show that the yield reduction of Maize is the highest, while the Cotton has the less yield reduction for all deficit levels. The estimated WUE for the considered crops show that the maximum WUE obtained at different deficit level for each crop.

Keywords: Efficiency, deficit, yield and Irrigation.
OPERATING A DRIP IRRIGATION SYSTEM IN DIFFERENT TYPES OF SOIL

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Abstract

Drip Irrigation Method is the best method that has been used in the world among the other irrigation methods because of its good and high uniformity. This method distributes water to the field using a pipe network and transforms it to the plant by emitters. In spite of the advantages of Drip irrigation method, the system has many problems, such as the impact of soil type, silt and discharges distribution. To achieve the goals of using a Drip irrigation system, it must be designed and operated properly so that rates and location of delivery of water to the root zone is suitable for crop requirements.

The objective of this study is to develop an approach to operate the Drip irrigation system in sandy and clay soils by a computerized method regarding the type of crops, its consumptive use, type of soil, frequency of irrigation and water distribution in the network, physical and chemical properties of the soil which affect the soil quality as well as its suitability for growing plants are determined. For the theoretical approach the well known software CROPWAT is used for the calculation of crop water requirements and irrigation requirements depending on soil, climate and crop data. Measurements of the consumptive use, discharge, velocities, wetted soil width, wetted soil depth, frequency of irrigation for the two types of soil with silt content calculated. The designed discharge was found to be higher in clay soil than sand soil because it saves the water for a long time through a small area as it is little porous. Increasing silt rate for each type of soil, cause to increases the amount of irrigation water requirement. As the wetted soil width depends on emitter discharge and soil type, it will be increase with soils in high silty clay compared with the low silt and bigger as compared to sandy soils.

Keywords: Drip irrigation, soil type, CROPWAT, discharge, wetted depth, wetted width, frequency of irrigation.
DEVELOPMENT OF NEW FORMULA FOR COMPUTING TOTAL SEDIMENT LOADSAT UPSTREAM OF AL- SHAMIA BARRAGE

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Abstract
This research was conducted to estimate the total amount of Sediment Load at the upstream of Al-Shamia Barrage, which is located in the middle of Iraq within the province of Diwaniya. Twenty four cross-sections were selected along the reach of Euphrates River to study the characteristics and the rate of transport of sediments. The measured data included: cross-sections of the channel, average velocity, discharge, water surface width, slope, sediment concentration, bed material samples as well as the specific gravity of bed sediments.

For the purpose of estimating the real and accurate amount of total sediment discharge, technical dimensional analysis has been used to find the relationship to calculate the transition sediment discharge that fit with the hydraulic condition sand properties of bed materials in the Euphrates River in the extension fact at the upstream of Al-Shamia Barrage. A new formula was obtained fit with the hydraulic condition sat the upstream of Al-Shamia Barrage and it was good formula.

Finally, the estimation of the average predicted annual total sediment discharge was made by using the new formula to be (111000) ton.

Keywords: Sediments, Total load, Al-Shamia Barrage, Dimensional analysis.
DETERIORATION OF WATER QUANTITY AND QUALITY IN IRAQ DUE TO STORAGE

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Abstract

Iraq is currently facing a serious water shortage problem. This problem is expected to be more severe in the future where the supply is predicted to be decreased up to about 50% of the currently estimated demand.

Construction of dams to store water have a big benefits but the process of water storage has negative effects in the quantity and quality of the store water, where the most effective factor is the evaporation which leads to lose considerable amount of water every year that may affect and deteriorate the water quality via increasing the concentration of the pollutants and increasing the salinity of water.

This work aims to examine the effect of storage level on the volume of water losses and water quality in the reservoirs, lakes and marshes in Iraq at different storage conditions.

The mass conservation law was applied to determine the water and salt budget considering the geometrical properties and hydrological conditions of each reservoir, lake or marsh.

The results show that the volume of water loss due to evaporation is about 7%, 18% and 32% of the volume of the stored water at the condition of minimum, average and maximum storage level, respectively. According to these conditions the TDS concentration of the stored water was increased to about 11%, 20% and 34%, respectively. Therefore, it is important to get maximum benefit of all the available water during the period of high flow.

It is very important to try to consistency with the nature and stimulate the activities that depend on the exploitation of water resources during the periods of high flow and development of the sectors that do not depend on the exploitation of large amounts of water during the periods of high evaporation and low flow.

The effects of storage water on the rivers morphology and the impact of storage plan on the deterioration of water qualities and its impact on the salinization of arable lands and deterioration of water consuming sectors should be studied.
REDUCTION OF SCOUR BY USING TAPERED PIER

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Abstract
The reduction of scour around bridge piers is the main target of designers. Different countermeasures methods and facilities have been adopted by researchers in field and experimental programs. The results are presented in papers and manuals for design and in field rehabilitation. This study work has been concerned by adopting a single circular tapered-shape bridge pier fixed at a center of mobile bed laboratory flume to show the advantage of this shape on reducing a scour depth around traditional circular pier. The experimental program which has been conducted was a preliminary attempt to show the percentage enhancement of local scour problem around bridge pier at clear water flow condition. The results show that the average reduction in scour depth was 32%.

Keywords: local scour, bridge piers, clear water scour, flow intensity, horseshow vortices
ADVECTIV TRANSPORT OF TRACE ELEMENTS POLLUTANTS IN THE SHALLOW GROUNDWATER OF BAGHDAD AREA

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Abstract

Groundwater flow of the shallow aquifer of Baghdad area was simulated by a mesh of 2096 non-uniform cells in order to use it later for tracing the advective transport of some trace elements. Two potential waste dumping sites at both sides of Baghdad area were used as a point source pollution spots. Numerical flow model results show good matching between the observed and calculated heads for both steady and unsteady state stages. Advective transport model based on particle tracking scheme of Fe, Mn, Pb and Br elements shows that the possible pollutant plume extension of these elements was slight where the maximum travelled distance after 25 years of the model operation are 1000 and 750 m for Rasafa and Karkh sides respectively. This is mainly due to the low velocities of the groundwater in the study area. Proximity of Karkh pollution site to the River Tigris make the problem more series and all the required measurements should be taken to prevent polluted groundwater approaching River Tigris at this area.
VARIATION EFFECT OF DISCHARGE ON TOTAL DISSOLVED SOLID IN SHATT AL-ARAB RIVER

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Abstract

There is a water shortage problem in Shatt al Arab River in addition to the water quality problem because the total dissolved solid (TDS) values are higher than the permissible. The quality of Shatt al Arab river water is high in salinity because the annual average of TDS is greater than 1500 mg/L. Therefore its water is considered impermissible for irrigation and Drinking because it is brackish water. The aim of this study is to explain the effect of the discharge of Shatt Al-Arab River on total dissolved solid. Six water years have been chosen to study this effect (from October of 2009 up to end of 2014). Also the study includes a comparison between the TDS of Tigris and Euphrates in relation to that of Shatt Al Arab River. The results display that the Ebb discharge is higher in comparison to Flood discharge. The high values of TDS in Shatt Al-Arab River are due to: the low river water discharge of the sources, the Drainage water from agricultural and industrial lands beside Shatt Al Arab River that discharge into it and the sewage and polluted water that pour into it. Also, TDS seems almost higher in case of Flood because of the effects of Arabian Gulf. There are also differences in the yearly and monthly averages of these characteristics because of the water balance effect from river sources of Shatt Al-Arab River in addition to the progress of salt wedge intrusion from the Arabian Gulf. The study concludes that the greatest rate of the discharge that comes to Shatt al Arab River was from Tigris and that the rivers of the source were not responsible of Shatt al Arab high TDS values.

Keywords: TDS, Discharge, River, Shatt Al Arab
Abstract

Estimation of runoff volume and analyzing quantity of water is needed to aid the engineers and researchers for knowing the quantity of water harvesting and determined the potential of utilization the collection water for irrigation or Drinking and other uses.

The main objective of this study is to estimate the runoff volume for Wadi-Al Naft watershed with an area of (8820 km²), which is located inter the geographic coordinates (45° 00’ 00” to 46° 00’ 00”) E, (33° 00’ 00” to 34° 00’ 00”) N at the North-East of Diyala city in Iraq republic, by using Soil Water Assessment Tool (SWAT).

SWAT requires three basic data for delineating the basin into sub basins, a digital elevation model (DEM), soil map and land use/land cover (LULC) map.

Soil Conversation System (SCS) was used with Geographic Information System (GIS) to develop the land use, soil type and soil texture maps from Landsat-8 (ETM+) satellite image. Also, Digital Elevation Model (DEM) is used to delineate the watershed and for computing watershed properties.

Keywords: Runoff, Water harvesting, Land sat 8, SWAT
ANALYSIS AND DESIGN OF INFILTRATION BASINS IN AGRICULTURE AREA OF BAHR AL NAJAF

Abstract
During the last decade, Iraq experienced gradual shortage in the volume of water flowing in Tigris and Euphrates rivers as a result of many natural and environmental effects. Shortage in rainfall in the basin areas, lack of snow cover over the catchment areas and reduction in water released downstream from dams constructed in the riparian state in Turkey are the major causes of the current shortage. The present paper focuses on the possibility of constructing an infiltration basin in a rural area in Najaf governorate, to benefit from the recharged overflow water in agricultural areas and to sustain ground water. The design of the infiltration basin was depended on field and laboratory geotechnical and hydrological tests in Bahr Al Najaf agriculture area. These tests included field infiltration, field permeability and soil classification. Accordingly the selected site is found to match with the requirements of the infiltration basins. Design charts and equations were developed to facilitate the design process of infiltration basin starting from the estimation of runoff water and ending with dimensions of the basin. The recommended area of the infiltration basin is found to be 5.6% of the irrigated area with depth of 35cm.

Keywords: Infiltration, Bahr Al-Najaf, Al-Najaf, Infiltration rate, Agriculture Area, infiltration basin.
DETERMINATION OF DISCHARGE COEFFICIENT OF RECTANGULAR BROAD-CRESTED WEIR BY CFD

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Abstract

The hydraulic characteristics of flow over rectangular broad-crested weirs with varying upstream shape were studied. A large number of these studies are physical model tests of rectangular weirs. In this study, Computational Fluid Dynamic (CFD) model together with laboratory model of rectangular broad-crested weir were used to improve the performance of broad crested weirs. The performance of broad crested weir was improved by introducing an upstream face slope, varying from 90 to 23 degree in order to reduce the effect of flow separation. Analysis of numerical results showed that introducing an upstream slope face to square edge broad crested weir improved the performance and gave higher values of discharge coefficient. Two empirical equations were obtained to estimate the value of discharge coefficient in terms of effective head to crest height ratio, and upstream slope face of weir with high correlation coefficients of 0.976 and 0.985. The discharges performances obtained from CFD analyses were compared with the observed results for various upstream face slopes. The results obtained from all face sloes are in a good agreement.

Keywords: CFD, Laboratory Model, Rectangular Broad-Crested Weir, Discharge Coefficient.
REUSE OF TREATED WASTEWATER FOR IRRIGATION

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Abstract

Reusing of treated wastewater effluent is normally reliable alternative solution for water scarcity. The effluent from municipal wastewater treatment plants is an increasing attention as a reliable water resource. Wastewater reuse for agriculture needs to be planned with attention to target crops and existing water delivery methods. Domestic and municipal wastewaters contain the macronutrients nitrogen, phosphorous, zinc, boron and potassium, and micronutrients such as calcium and magnesium, all of which are vital to plant and soil health. Its use can supplement or even replace commercial fertilizer inputs, saving farmers money. Wastewater reuse also benefits the environment because it allows these valuable nutrients to be diverted from the waste stream and recycled, instead of released into watercourses where they can become significant pollutants.

This research studied the possibility of using treated wastewater for irrigation purposes, AL Rustumiya station as a case study, laboratory tests were then compared to the special determinants of water allowed to be used for irrigation. On the whole all the results of treated water were fall in the allowable limitations, and the effluent from AL Rustumiya station certain for irrigation using.

Keywords: raw, effluent, BOD, COD, SS, Ph, TDS.
SUSTAINABLE HOUSE AND ITS RELATION WITH RESIDENTS’ COMFORT A STUDY IN SELECTED REGIONS IN THE CITY OF KUT

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Abstract

This research dealt with the sustainable house and its relation with residents’ satisfaction, which is the research problem. Therefore, the research aims to build a base of knowledge for sustainable housing. The research assumes that sustainability standards and controls for houses achieve the comfort of residents. The research defined the sustainable architecture as an architecture that directs designer towards designs requires less materials to preserve the natural resources. Therefore, it is an environmentally conscious design. Whereas, the sustainable design is a style focuses on the importance of the relation of buildings with the environment and aims to create integration with the environment. A theoretical scope for the criteria of sustainable house was drawn. This framework was applied on different localities in the City of Kut to measure the satisfaction of the residents. The most prominent findings of this research were: firstly, residential houses rely enormously on artificial energy for various activities such as heating, cooling and illumination, which poses a thread for the reserves of natural resources. This is because of the inconvenient temperature inside the house that is resulted from improperly designed spaces of the houses and other reasons related to not appropriate urban planning that should take into account the climate conditions.

Keywords: sustainable buildings, energy conservation, Kut city, natural lighting.
MICROSTRUCTURAL CHARACTERIZATION OF IRAQI GYPSEOUS SOILS

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Abstract  
As large areas of Iraq are covered with gypseous soils causing serious damages to foundation built on, three site locations (Baiji, Tikrit and Samarra) in northern Iraq characterized by their high gypsum content were chosen. In this research, the direct shear test was used to obtain shear parameters (cohesion and internal friction angle) for the soils in both natural and water soaked conditions. The laboratory test results showed a decrease in soil shear parameters when soaked in water particularly in its cohesion value. Soaking of soils reduced cohesion by approximately (12-17) folds, while the internal friction angle exhibited a slight reduction. A microstructural study of such soils was also performed using Scanning Electron Microscope (SEM) technique carried out on selected soil thin sections in their natural state and after soaking and/or loading. SEM micrographs reflect appreciable microstructural changes which were observed and identified such as voids, solid domains (gypsum fibers as binding materials). The micrographs of soils subjected to short term soaking showed the occurrence of large voids which are responsible for the higher collapsibility in such soils due to high solubility of gypsum in water.

Keywords: Gypseous soil; Soaking Effects; Shear Parameters; Collapsibility; Microstructure; Scanning Electron Microscopy (SEM)
IMPLEMENTATION OF ELECTRICAL RESISTIVITY IMAGING (ERI) TECHNIQUE FOR NEAR SURFACE INVESTIGATION

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Abstract  
The present study deals with field implementation of 1D and 2D Electrical Resistivity Imaging (ERI) survey to investigate the subsurface resistivity distribution related to near surface features. The three common arrays (Wenner, Wenner-Schlumberger and dipole-dipole) were used for 2D survey, while Schlumberger array was used for 1D vertical electrical sounding (VES). The length of each spread was 40 m with depth of penetration was 5-8 m. The study stated that the pseudosections are useful to present the measured apparent resistivity, while the inversion sections represent the final picture of the true subsurface resistivity. The two-dimensional inversion was used to invert the apparent resistivities to their corresponding true values. Different arrays strength and also different depth of investigation have been obtained according to their resolving power and ability for detecting lateral and vertical variations which is clearly represented by different contour shapes in the pseudosections that map the same region. The resistivity distribution of the inversion models for the study site reflects the highly inhomogeneous subsurface soil with a wide variation of soil resistivity at different depths. Three main geoelectric layers have been distinguished with resistivity range values <1-50 ohm.m representing silty clay with some sand and gravel with relatively higher resistivity values; silty clay with some amount of sand with a value of about 5 ohm.m; and saturated silty clay-clayey soil with low resistivity (<1 ohm.m). In addition to the presence of pockets of some anomalous areas related to the existing organic materials (date palm roots).

Keywords: 1-DVES; 2D Electrical Resistivity Imaging; Soil; Near Surface Investigation
THE BEHAVIOR OF CONICAL SHELL FOUNDATION UNDER DYNAMIC LOADS

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Abstract

Shell foundations present an economical alternative solution to the conventional plane foundations in case of heavy loads to be transmitted to low–bearing capacity soil. Shell foundations reveal high bearing capacity values which make them suitable in soft or weak soils. At the same time, these foundations are thin which makes the failure in concrete preceding the soil failure. Therefore, it is intended to improve concrete quality to increase its load carrying capacity and develop the shell foundation behavior to be close to conventional foundations.

Reactive Powder Concrete (RPC) is an ultra-high strength, low porosity material with high cement and silica fume contents and steel fibers. In this study, conical shell footings are prepared which are composed of reactive powder concrete. Five values of steel fiber volume fractions of 0, 0.5%, 1.0%, 1.5%, and 2.0% were used in casting the shells, in order to study the effect of steel fiber content on the shear strength. Taking into consideration the aspect ratio of the fibers used and the type of concrete mix, a maximum of 2.0% fiber content was used in which the fibers were found to achieve a practical and uniform distribution within the fresh and hardened concrete. The finite element software ANSYS-Ver. 11 is used in the analysis. Harmonic option is used as a type of load that is applied as a function of time. It was concluded that the increase of thickness of the conical footing with and without ring beam will reduce vertical displacement due to increase the rigidity of footing but the footing with ring beam has more rigidity than footing without ring beam. The vertical displacement decreases with the increase of shell foundation thickness by about (4, 5, 6)% for (15 mm) shell thickness and for the three amplitudes of dynamic load (30 kN, 40 kN, 50 kN) and then increases obviously in the case of (20 mm) thickness by about (6, 11, 15) more than the (10 mm) thickness; the reference case, for the three amplitudes of dynamic load due to increase of self-weight of the shell foundation.

Keywords: Conical shell, footing, reactive powder concrete, dynamic, finite elements.
PREDICTION OF UNCONFINED COMPRESSIVE STRENGTH OF SOIL USING ARTIFICIAL NEURAL NETWORK

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Abstract

The limiting shear resistance beyond which the soil collapses or becomes unstable is called the ultimate bearing capacity (UBC). This is also referred to as soil shear failure and results in distortions in the superstructure leading to collapse. The foundation sinks into the ground as if there is no resistance from the soil below. This type of failure is also called bearing capacity failure.

Therefore, in this paper, Artificial Neural Networks (ANNs) are used in an attempt to predict unconfined compressive strength of clay soil based on a database comprising a total 150 case records of laboratory measurements for unconfined compressive strength of Iraqi soils which are considered more relevant to cohesive soils.

Three parameters are fed to ANN models which have the most significant impact on (UCS). These include the (liquid limit, Dry unit weight and clay percentage), hence they represent the model inputs. On the other hand, the model output is UCS.

The comparison between results obtained from neural network model and the actual results of USC of cohesive soil showed clear superiority and accuracy of neural network technique to predict UCS of cohesive soils. Results also proved that the liquid limit has a significant impact on USC.

Keywords: Artificial Neural Network, ANN, cohesive soil, compressive strength, bearing capacity.
IMPROVEMENT OF EXPANSIVE SOIL PROPERTIES USING METAKAO LIN AND RICE HUSK ASH

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Abstract
Expansive soil spreads in Iraq and some countries of the world. But there many problems can be occurred to the structures that built on, so we must study the characteristics of these soils due to the problems that may be caused to these structures which built on these kinds of soil and then study the methods of treatment. The present study focuses on improving the geotechnical properties of expansive soils by treating it with mix of Rice Husk Ash and Metakaolin. The soil used in the present study can be classified according to the Unified Soil Classification System as clay with high plasticity (CH). Rice Husk Ash (R) is well-known material for stabilizing the expansive soils. In this study Rice Husk Ash was prepared by simply burning rice husk, collected from the locally available mill. In this arrangement, rice husk has been burned in control oven for two hours at 600°C. The produced R contains more than 80% silica which is a key factor for improving the properties of soil. Metakaolin is a pozzolanic material. It’s obtained by calcination of kaolinite clay at temperatures from 700°C to 800°C. Kaolin chemical composition is basically aluminous silicates hydrates associated with Mn, Fe, Ca, K, Na. Its crystal has a lattice structure of tetraheDral and octaheDral layers with interplanar distance of 7.2 Å. The soil sample R11M4 gives the maximum reduction in swelling and swelling pressure about 97% and also increase the shear strength parameters about 155% for the soil therefore, it can be considered the best percentage of the combined replacement materials in improving the properties of expansive soil.

Keywords: Expansive Soil; Improvement; Swelling; Swelling Pressure; Metakaolin; Rice Husk Ash
IMPROVEMENT OF BEARING CAPACITY OF FOOTINGS ON SOFT CLAY BY PARTIAL SOIL REPLACEMENT TECHNIQUE

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Abstract

Remove and replace is widely used in construction practices and engineers have proved that it can be an effective technique. Further, several researchers have considered the mechanisms of remove and replace mitigation in the past. This study represents an investigation on the efficacy of remove and replaces methods for mitigation of soft clays in that the analyses are based on fundamental stress -deformation principles.

A total number of 8 models tests represents two series was carried out in models of soft clays of different values of undrained shear strength $c_u$ varying from 7 to 17 kPa. The first series consists of 4 models of a square pattern of soil replacement; the second series consists of 4 models of a trench pattern of soil replacement both of the two series are carried out with different depths and widths of replacement, in addition to one model of untreated soil.

The bearing capacity of the soil improved by the soil replacement has been measured. It was noticed that ability of soft soil replacement by granular soil to improve the bearing capacity of footing on soil showed that the maximum degree of improvement is achieved when the soil is treated by partial replacement with a trench pattern of soil replacement of dimensions $B$ (where $B$ is the width of the footing) with extension of $B/2$ all sides to a depth of 1.5 $B$. Soil replacement method is more effective in improving the bearing capacity in case of the increasing the width of replacement compared with the increasing of the depth of replacement. It was found that the stone used as a replacement material help to increase the undrained shear strength of the soft soil by lowering the water content. The undrained shear strength is increased by about $(5.5 \sim 15) \%$ due to the implementation of soil replacement.

Keywords: Soft Clay, Bearing Capacity, Soil Replacement, Improvement.
Abstract:

Construction of embankments over soft clay is a great challenge because these soils may be too weak to support the entire load of an embankment. The analyses were carried out to review and estimate the excess pore water pressure, the total and rate of consolidation settlement in embankments constructed on soft soils. Methods of improving stability in these cases include constructing the embankment in stages. Furthermore, establishment of vertical Drains is a standout amongst the most generally utilized methods for enhancing the characteristics of soft clays. All these Aspects of the study were carried out by using Soft ware computer program, Geo slope using Coupling Sigma-Seep to perform consolidation analysis.

The results are presented in the analysis of the basic problem which is conducted on the proposed embankment over soft clay in south of Iraq, specifically, in Basrah region. The main conclusions can be Drawn are as follows: the maximum settlement occurs under the center of the embankment, this settlement is reduced as moving towards the toe of the embankment. The vertical settlement increases by 38% using sand Drain while the horizontal displacement decreases by 52%. The excess pore water pressure reduces by 83% via using sand Drain. Toeberm causes increase in maximum vertical displacement to reach 25% while the horizontal displacement decreases by 10%.

Keywords: Embankment, Soft clay, Stage construction, Sand Drain, Toeberm, Finite Element (Sigma-Seep soft ware).
EXPERIMENTAL STUDY OF SINGLE PILED RAFT MODEL EMBEDDED WITHIN PARTIALLY SATURATED COHESIONLESS SOILS

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Abstract

This paper presents an experimental study to investigate load carrying capacity of piled raft embedded within partially saturated sandy soil and investigate the effect of matric suction on the load carrying capacity. Piled raft is a geotechnical composite construction consisting of three elements: pile, raft and soil. The influence of matric suction (i.e., capillary stresses) in partially saturated zone is typically not taken into account in the conventional design for both shallow and deep foundations so that, the present research study the determination and contribution of metric suction towards the load carrying capacity of piled raft.

The experimental work consists of 3 models of footing "single model pile (2.0cm dia.x40cm embedded length), raft only (25 x 5) cm and single piled raft. All these models are loaded and tested under both fully saturated condition (i.e., metric suction equals to 0 kPa), and unsaturated conditions (i.e., matric suction value equals to (6, 8 and 10kPa), which are achieved by predetermined lowering of water table. The relationship between metric suction and depth of ground water table was measured in suction profile set by using three Tensiometers (IRROMETER). The soil-water characteristic curve (SWCC) estimated by applying fitting methods through the program (Soil Vision).

The results of experimental tests demonstrate that the matric suction has a significant influence on the load carrying capacity for all the tested models and the variations of load carrying capacity with respect to matric suction are similar to that of the shear strength of unsaturated soils. The increasing values of the ultimate bearing capacities for raft foundation only, single pile and single piled raft under unsaturated conditions is approximately (2.3-3.7) , (2.0-3.0) and (2.36-3.8) times higher than that at saturated condition respectively. The results of the experimental program show that the conventional bearing capacity theory used in the engineering practice is highly conservative when it is applied for unsaturated soils.

Key words: Partially saturated soil, SWCC, soil suction, Piled Raft Foundation, sand.
Abstract

For decades, the advantageous effects of using reinforcement to enhance the property of soil have been established. Lately, the use of geogrid reinforcement has increased enormously in geotechnical application. Soil reinforcement techniques have become constructive and economy to handle several complications in geotechnical engineering practice, such as improve the bearing capacity and settlement characteristics of the footing. A comparative large scale experimental and numerical study of the behavior of a strip footing under eccentric and inclined loading resting on a sandy soil reinforced with geogrid is presented. Several patterns of geogrid arrangement with number of geogrid layers, vertical spacing of layers, depth to the topmost layer of geogrid, distance between the layers and up to 280 experimental tests were investigated. A finite elements numerical study on a plane strain and fully 3-D conditions were performed. Test results specify that the footing performance could be appreciably enhanced by the presence of layers of geogrid. Nevertheless, the efficiency of the sand-geogrid system is dependent on the load eccentricity ratio and reinforcement parameters. Precious agreement between the experimental and 3-D numerical analysis is observed. Based on the numerical and experimental results, detailed values of the geogrid parameters for maximum reinforcing effect is created.

Keywords: strip footing, reinforced soil, geogrids, experimental study, FE analysis.
Abstract

The present work is focused towards the evaluation of bearing capacity improvement ratio $q_r$, determined through the confined compression tests carried out on stone column penetrating into soft clay soil. The investigation was carried out using model tests of stone column performed inside cylindrical containers of 300 mm in diameter and 350 mm in height. The undrained shear strength of the soil prepared in the containers ranged from 5.5 kPa to 13.5 kPa. The models were tested immediately after preparation and some of the models were left to cure 10 days after preparation. It can be noticed from results that the treated soil loaded after 10 days shows an increase in bearing improvement ratio more than that of treated soil loaded immediately.

Keyword: Bearing Improvement, Stone column, Clay, Confined Condition
SUPPORTING A MULTI-STORY BUILDING RAFT FOUNDATION BY BORED PILES TO PREVENT COLLAPSE FAILURE

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Abstract

A geotechnical site investigation is the process of collecting information and evaluating the conditions of the site for the purpose of designing and constructing the foundation for a structure, such as a building, plant or bridge. Good planning and management of a geotechnical site investigation is the key to obtaining sufficient and correct site information for designing a structure in a timely manner and with minimum cost for the effort needed.

In this paper, a case study of a multi-story building in Baghdad city is analyzed. The building was originally designed to be supported by a raft foundation. During construction, unexpected settlement was recorded before completion of the tenth floor. It was then decided to stop the work and make the required calculations to check the adequacy of the raft foundation.

The calculations based on the soil investigation report showed that the allowable bearing capacity of the shallow foundation does not exceed 50 kN/m² which makes the raft unable to sustain the load imposed by eight stories.

The decision was to increase the foundation load carrying capacity by introducing a piled-raft system through construction of a number of bored piles 400 mm in diameter and 15.0 m long beneath the raft distributed around the column locations at spacing of 2.5 pile diameters.

As a result, monitoring of the building settlement showed that the settlement ceased after construction of piles. Finishing works were then continued and constructed safely.

Keywords: Bored pile, raft, support, settlement, collapse.
EXPERIMENTAL STUDY OF THE BEHAVIOUR OF PILED RAFT FOUNDATION IN EXPANSIVE SOIL

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Abstract

The piled raft is a geotechnical composite consisting of three elements: piles, raft and soil. A small scale “prototype” model was tested in a box with load applied to the foundation through a compression jack and measured by means of a load cell. The settlement was measured at the raft by means of dial gages, strain gages were attached on piles to measure the strains and to calculate the load carried by each pile in the group by the strain indicator. Four configurations of pile groups were tested in the laboratory (the raft is not in contact with the soil) and as a piled raft (the raft is in contact with the soil), in addition to tests for a raft (unpiled) with different sizes. This study also included the effect of parameters on the behavior of piled raft foundation, such as (number, length, and diameter).

It is found that the load carrying capacity of the unpiled raft increases with increasing size of the raft. For the piled raft models with (single, two, three, four piles), the total carrying capacity of the model increased with the increasing of raft size and number of piles in the group. The load carried by piled raft in Dry state is more than the load carried by piled raft in saturated state. The piles were affected by swelling pressure in expansive soil more than the raft. In two states (Dry and saturated), the load carried by piled raft increases with increase of diameter, and length of piles, while it decreases with increase of the spacing between piles.

Keywords: pile raft, expansive soil, pile raft foundation in expansive soil
CONTRIBUTION OF EMULSIFIED ASPHALT IN STRENGTH AND PERMEABILITY BEHAVIOR OF GYPSEOUS SOIL

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Abstract

This paper deals with stabilizing Gypseous soil obtained from Husaibah with emulsified Asphalt. A laboratory-testing program was conducted through two phases. In the first phase, the optimum fluid content (emulsion and water) was determined using the unconfined compression test mold and testing procedure. 40- Asphalt stabilized soil samples have been constructed and tested using combinations of different percentages of emulsion and water content. The maximum dry density and optimum fluid content was selected for further testing in the next phase.

In the second phase, the effect of emulsion on the behavior of Gypseous soil in permeability was studied using constant head permeability technique. Stabilized soil samples were prepared, and divided into two groups; the first group was subjected to aeration before compaction while the second group was directly compacted in the permeability cell without aeration. The compaction was conducted using a tamping rod to the maximum dry density at optimum fluid content in three layers. The coefficient of permeability of both groups was determined and compared with that of pure soil.

It was concluded that emulsified asphalt has a positive effect on strength improvement, waterproofing and reduction of permeability potential of compacted Gypseous soil.

Index Terms: Asphalt emulsion, Gypseous soil, unconfined compression strength, permeability, stabilization.
ANALYSIS OF DEEP SUPPORTED EXCAVATION IN ELASTO-PLASTIC SOIL USING BOUNDING SURFACE MODEL

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Abstract
The behavior of a three-dimensional deep-supported excavation system in saturated cohesive soils has been investigated in this study using the finite element method. The finite element analyses were carried out using the linear elastic model for the support material, while the Mohr-Coulomb and elasto-plastic bounding surface models were used for representing the cohesionless and cohesive soils, respectively. Also, a sequential excavation has been rigorously modeled in the analysis, together with the transient effects through a fully coupled Biot formulation.

The models and the excavation technique together with the consolidation process were implemented into the finite element program (MOD-3D-EXCON) modified for the purpose of these analyses. Then, the results of a finite element parametric study are conducted to define the effects of excavation geometry (i.e., length, width and depth of excavation), wall length, depth of embedment layer, and bounding surface parameters, on the three-dimensional wall displacements and ground movements caused by excavation through a fully saturated Iraqi soil, within Baghdad city.

The result showed that the ratio of corner to center movements perpendicular to a wall is less than 1.0, and the ratio of the maximum horizontal displacement to the depth of excavation is ranged between 1 to 2 %. Also, the ratio of the maximum ground settlement to the depth of excavation is obtained to be in the range of 0.2 to 0.9 % with an average value of 0.5%. The results also indicated that $\lambda$ and $\kappa$ are the most effective bounding surface parameters on the values of displacements than others.

Keywords: Bounding surface model, Deep excavation, Finite element method.
EFFECT OF PARTICLE SIZE DISTRIBUTION ON THE BEHAVIOR OF SINGLE MODEL PILE SUBJECTED TO STATIC LATERAL LOADS EMBEDDED WITHIN COHESIONLESS SOILS

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Abstract

The behavior of laterally loaded single pile under applied static lateral loads, studied in the laboratory on small scale model. The purpose of this research is to investigate the effects of grain size distribution of cohesionless soils with different densities on the behavior of single pile subject to static lateral loads. The experimental program consist of nine tests of single model pile of 15mm dia. and 450mm embedment length, within coarse , medium and fine sand, each type with three different densities (dense, medium and loose state). Lateral static load was achieved by special device designed to apply lateral loads at top of pile model in two directions with eccentricity of 5cm above soil surface. Eight strain gages of 5 mm length type FLA-5-23 were fixed on both sides along the model pile with equal distances to investigate the bending moment introduced from lateral loads along the pile model under applied lateral load. Lateral displacement of pile head was measured by a dial gage fixed laterally on both sides on the pile head. The results emphasized that the behavior of single pile was highly affected by the study parameters. It is found that the increasing static load level, produce an increase of pile head displacement and bending moment of the single pile. But these increments varied depending on the grain size distribution and the density state. The results show that the fine sand yielded higher displacement and bending moments than the other types with a lower resistance under the same lateral loads.

Keywords: Model Pile, Lateral Pressure, Grain size Distribution
USING RICE HUSK IN IMPROVING SOIL PROPERTIES

Abstract
Rice husks ash having high potential and suitability in so many well established papers but uses of rice husk has been limited. In north of Iraq, they transform this agricultural waste material made from rice paddy replacement into an economic use of it after being mixed into the soil in the construction of economic houses. This study concerns with using cheap materials (rice husks) to improve soil properties and produce soil stabilization.

The effect of Rice Husks on some geotechnical properties of soil brought from Al-Jadiriya site with three different percentage of Rice Husks (4%, 8%, and 12%) by weight of Dry soil was studied. The study included evaluation of their properties such as compaction, consistency limit, consolidation and unconfined compressive strength. It was found that the liquid limit of soil has been increased with the addition of Rice Husks as well as the plasticity index while, the plastic limit decreased. Treatments with Rice Husks show a general reduction in the maximum dry unit weight with increase in the Rice Husk content. The optimum moisture content generally increased with increase in Rice Husk content. The increases in the unconfined compressive strength with increase in Rice Husk content for the soil to its maximum at rice husk less than 4%. The relationships between void ratio and logarithm pressure for different percentage of rice husk are the same such as without rice husk except at 12% which deviated from traditional one.
THE CHARACTERISTICS OF COLLAPSIBILITY AND COMPRESSIBILITY OF GYPSEOUS SOILS IN IRAQ

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Abstract
The gypseous soils are distributed in many regions in Iraq and other countries. Therefore, it is necessary to study the geotechnical properties of such soils upon wetting due to the large damages that affect the structures founded and constructed on it. In this study, Compressibility and shear strength Characteristics are studied for three soils used in this work, were brought from three different areas in Iraq (Karbla, Kirkuk and Al-Ramadi) and taken at depth ranging from (1-1.5) m below ground level after excavating the upper soil strata. All fundamental tests were performed on these soils.

Laboratory tests results showed that these soils have high collapsibility and that shear strength parameters of (C,φ) decrease when soaked in water but the main decrease was in (C) value. Also the study includes the influence of the initial void ratio and the water content on the modules of the collapsibility. The value of Collapse Potential seems to depend mainly on the natural water content and initial void ratio. The Collapse Potential increases with the increase of void ratio and decreases with increase of water content.

Key words: Gypseous soils, Collapsibility, Compressibility, Shear Strength,
STABILIZATION OF DUNE SAND USING FLY ASH AND CEMENT DUST

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Abstract
Accumulation of sand grains shaped into a mound or ridge by the wind under the influence of gravity is called Sand dune. Dunes are found wherever loose sand is windblown, in deserts, on beaches, and even on some eroded and abandoned farm fields in semiarid regions, such as south of Iraq. In this paper, dune sand stabilization was studied. Two materials which are industrial byproducts (fly ash and cement dust) were used as stabilizers. The geotechnical properties of dune sand before and after stabilization were investigated. Good results were obtained in stabilization process.

Keywords: dune sand, stabilization, fly ash, cement dust
NUMERICAL ANALYSIS FOR THE EFFECT OF CONTAINER SIZE ON MODEL BORED PILE CAPACITY IN SAND

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Abstract
Scaling process for the small model piles essentially is forced by the influences of stress levels and soil particles size. So, carrying out a series of model pile tests must be taken into account the effect of container size. Since, the shear mechanism at the pile-soil interface is approximated by means of direct shear test; different boundary conditions have been investigated on the test results. However, a pronounced link was seen between the base boundary and the formation of plastic zone below the pile tip. This research aims to quantitatively evaluate the appropriate container dimensions at which there no further boundary effects are appeared by the assistance of statistically derived equations. Numerical simulation using (Plaxis 3D Foundation) program was employed to model vertically loaded piles positioned in sand. The test results demonstrate that the container size has a predominant effect in dense and medium states of sand in the contrast with loose state. However, a container size effect approaches to be non-existent for loose sand, and as the size of container increases, the pile capacity decreases. The coefficient of determination ($R^2$) for the derived equation is (95.4%) which indicates the accuracy of output results in specifying the required target of this analysis.
CIRCULAR PLATES ON NONLINEAR COMPRESSIONAL AND FRICTIONAL WINKLER FOUNDATION

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Abstract
This research deals with the linear elastic behavior of circular plates on nonlinear Winkler foundations. The analysis is based on thick and thin plate theories. In the theory of thick plates the transverse shearing deformation is considered. These theories are extended to include circular plates with isotropic elastic properties under axisymmetric behavior. The normal line to the middle plane will have two degrees of freedom. These are the transverse deflection and rotation of the normal line to the middle plane. Thus, two expressions of the governing differential equations in terms of the displacements are derived using polar coordinates with nonlinear Winkler foundation. The finite difference method in polar coordinates was used to solve the governing differential equations. Besides, the finite elements in polar coordinates are formulated using three node isoparametric elements to compare and check the accuracy of the solutions. Good agreements are found between these two explicitly different and indicate the efficiency of these two methods.

Keywords: Circular plates, finite difference, finite elements, friction, nonlinear Winkler foundation.
EFFECT OF SURFACE AND SUBSURFACE STRUCTURE DUE TO UNDERGROUND TUNNELLING IN A MEGA CITY

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Abstract
This paper gives the idea of the settlement occurrence at the surface of soil due to tunnelling. The trough formed due to the tunnelling at various depths in Greenfield ground condition is compared with the formation of trough due to the presence of building at the top of tunnel. The tunnel section adopted is a modified horseshoe tunnel section, were this is taken from the Bharbai-Aizawl Railway Project Tunnel No.1. The soil settlement at top of surface is tried to reduce to minimum with the help of varying depths and varying lengths of construction stages. The prediction was that the settlement can be controlled by increase in depth of tunnel, but the experiment done shows the new path to control this formation of troughs. The soil profiles selected are the medium soil & the soft rock. The study has its importance to check the building effect due to the tunnel and what kind of possible damages could occur to existing structure. The building can face the minor-major cracks in the infill and minor cracks to the main structural elements, this could be controlled if settlement or differential settlement occurrence lies in allowable limits.

Keyword: Trough, Greenfield ground, construction stages, modified horseshoe
PERFORMANCE OF SAND-CEMENT DUST MIXTURE REINFORCED BY NATURAL FIBER

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Abstract
This study investigates the effect of including randomly spaced palm fibers in a soil matrix and soil-cement dust mixture. Cemented specimens were prepared with cement kiln dust (CKD) contents of 5% by weight of Dry sand and cured for seven days. The length of fiber used is 12 mm, with contents of 0%, 0.5%, 1%, and 1.5% by weight. Direct shear and CBR tests were carried out for samples at maximum Dry density and optimum moisture content obtained from standard Procter test. The shear strength test results indicated that the inclusion of fiber within the soil increase the shear strength significantly, while it is decreasing for cemented reinforced soil. Palm fiber changes the soil and soil-CKD mixture to be more ductile. The CBR tests show that the value increase with palm fiber reinforcement of the sand and the optimum fiber content is 1% while, the CBR value of soil-CKD mixture decrease with palm fiber reinforcement.

Keywords: palm fiber, cement kiln dust, CBR test, direct shear
EFFECT OF CRUDE OIL CONTAMINATIONS ON SOME GEOTECHNICAL PROPERTIES OF AL-SAMAWA-DEPOT SITE

Abstract

Most of the southern Iraqi areas are polluted by oil due to the multiple oil wells, oil exploration, damage storage tanks and pipelines. Therefore it is necessary to investigate the geotechnical properties of soil contaminated by crude oil for engineering purposes.

An extensive laboratory testing program was performed on fine grained soil brought from Al-Samawa-Depot site. The program consist of laboratory tests to investigate physical and engineering properties carried out on clean and contaminated soil samples with crude oil at different percentages of 4, 8, 12, and 16% by weight to the Dry weight of the soil to determine, index properties, compaction, permeability and compressibility characteristics.

The results show that the moisture content required to achieve maximum Dry density has decreased when oil content increased in contaminated soil. The crude oil contamination decreased the liquid limit and plastic limit values and indicated a lower of maximum Dry density (MDD) and optimum moisture content (OMC).

Two groups of contaminated soil samples were tested for permeability and compressibility characteristics. The first group was compacted at its MDD and OMC for uncontaminated and contaminated soil samples with different crude oil content and the second group was compacted at the optimum water content for natural soil samples for all the uncontaminated and contaminated soil samples with the same different crude oil content at the compacted energy of the standard Procter test. The results show that the permeability for both groups are reduced as oil content increased. The initial void ratio for the first group of soil samples is less than that of the second group. The compression index slightly increases with increasing crude oil content for the first group while for the second group increases with the increase crude oil content. Swelling index values decreases for the first group, while it increases for soil samples of the second group with the increase crude oil content. Volume compressibility with respect to crude oil contents for the two groups increase with the increase crude oil content for the second group of specimens, but for first group of specimens the relation is not uniform. Coefficient of consolidation with respect to crude oil content for the two groups of specimens shows an increase up to 8% of crude oil content then decreased for the first group, while for the second group a decrease at 4% of crude oil content then slight increase for the other crude oil percents.
CEMENT – LIME ADDITIVES TO STABILIZE IRAQI SOILS

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Abstract

Chemical stabilization has been used for the soft clayey soils in order to enhance the shear strength and limiting deformation behavior. Cement is widely used as a stabilizing material for soils, but increasing cost causing economic concerns among practitioners. In this paper two types of materials were used as soil stabilizer such cement and lime. Cement was used in (3, 5, 7 and 10) %. Lime also used as stabilizer in four percent representing (3, 5, 7 and 10) %. Combination of 50% of cement and 50% of lime used as stabilizer in four percent representing (3, 5, 7, and 10) %. The clay specimens were taken from Baladroz East –North of Iraq.

The experiments were carried out in University of Technology /soil mechanics Lab. The physical properties were measured by conducting standard laboratory test such as Atterberg limits (L.L., P.L.) and specific gravity. A standard compaction on natural and improved soils were carried out, the maximum Dry density and optimum moisture content were measured for different % of lime and cement content. The results revealed that as the cement content increases, the maximum Dry density increases too. Whileas the lime content increases, the maximum Dry density decreases. The results of unconfined compressive strength test for natural and improved soil reveal, that the shear strength increases as lime and cement content increase with increasing the curing period (3, 7, 14 and 28) days.

Keywords: Soil Stabilization, Cement Stabilization, Lime Stabilization, Unconfined Compression Test, Curing Period, Soil Strength
IMPROVEMENT OF EXPANSIVE SOIL BY SILICA FUME

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Abstract
Expansive soils exhibit significantly high volumetric deformations and so pose a serious threat to stability of the structures and foundations. Thus, determination of their swelling properties (i.e. swelling and swell pressure) becomes essential. However, measurement of the swelling properties is time-consuming and requires special and expensive equipment. With this in view, efforts were made to study treatment of expansive soil using different types of additives cement, steel fibers, stone dust, fly ash and silica fume.

A treatment of swelling/shrinkage using silica fume was studied in this work. The soil selected for the present investigation prepared in laboratory by mixing natural soil (Nahrawan soil) with different percentages of Bentonite (30, 50 and 70% by weight). The test program included the effect of Bentonite on natural soil then study the effect of silica fume (SF) on prepared soil by adding different percentage of silica fume (3, 5, and 7 by weight) to the prepared soils and the influence of these admixtures were observed by comparing their results with those of untreated soils (prepared soils). The results show that, with the addition of silica fume the liquid limit and plasticity index have decreased. However, the plastic limit increased with increase in the silica fume contents. With the increase in silica fume percentage the maximum Dry unit weight values decreased, and the optimum water contents increased. The compressive shear strength is improved by using silica fume.

It is concluded that silica fume stabilization may be used as a successful method for the treatment of expansive clay.

Keywords: Improvement; Expansive Soil; Silica Fume; Swell Pressure; Free Swelling
EQUIVALENT PRESSURE TO RESIST SWELLING OF SUBGRADE SOIL UNDER FLEXIBLE PAVEMENT

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Abstract
To prevent swelling pressure of subgrad under flexible road pavement one of the following methods may be used (Replacement, Compaction, Pre wetting, Chemical Stabilization, Geosynthetics, and Moisture Barriers). Pavement thickness not taken into consideration, this research focusing applied pressure from the pavement thickness to resist swelling pressure of subgrade soils. To investigate the effect of swelling pressure on road pavement, two different apparatus (Oedometer cell and CBR mold) were adopted to predict directly swelling percent and swelling pressure of sub grade soil under pavement at different moisture contents. CBR tests were carried out to investigate the strength of soaked subgrade soil. The effect of subgrade moisture contents on soil strength, and swelling pressure were investigated for soaked samples. Flexible pavement was design to resist swelling pressure predicted from the subgrade soil. The results show that a significant increase in pavement thickness to resist swelling pressure can be used to prevent swelling the above mentioned methods.

Keywords: Expansive soils, swell pressure, flexible pavement, Stabilization, CBR, subgrade
ANALYSIS OF MACHINE FOUNDATION SURROUNDED BY DIAPHRAGM WALL USING OPENSEES PROGRAM

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Abstract

Machine foundations require special attention of a foundation engineer. In some cases, if changes in size of the foundation and mass do not lead to a satisfactory design, a machine foundation surrounded by diaphragm walls may be used. The Finite element method is one of the most popular numerical methods used for obtaining an approximate solution for complex problems in various fields of engineering.

In this paper, 3D finite element model is used to investigate displacement response and acceleration of machine foundation to resting on cohesionless soils and surrounded by diaphragm walls. The effective distance of diaphragm wall to width foundation, on the displacement response of machine foundation is calculated. Many tests are conducted to determine vertical and horizontal displacement and acceleration of machine foundation surrounded by diaphragm wall within different diaphragm walls depth (D/B) ratio (diaphragm walls depth to foundation width) ranged between (0.0-3.0). The analysis of machine foundation is performed for foundation rests on finite isotropic elastic homogenous soil. The results indicate that, the dynamic response (displacement and acceleration) generally decreases with increasing of diaphragm walls depth. In addition, the increase in distances between diaphragm wall and width of foundation will lead to decrease in the vertical displacement and vertical acceleration, but the horizontal displacement and horizontal acceleration will be increased in same case. The maximum amplitude of displacement and acceleration of foundation under dynamic loads can be occurred in loose sand in comparison with the other types of sand.

Keywords: dynamic analysis; finite element method; diaphragm wall; machine foundation skirted foundation
THE LABORATORY STUDIES ON ANISOTROPY OF GYPSEOUS SOIL

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Abstract
An isotropic material is one in which the elastic properties are the same in all directions. Almost all naturally occurring soil deposits are anisotropic and nonhomogeneous. The anisotropy is produced from a combination of particle placement during deposition/formation and from overburden pressures. Gypseous soils occupy about 1.865 million km² in the world; the percent of gypseous soils in Iraq is 6.7% of the total world gysiferous area and about 28.6% of the total area of this country. The gypsum percent may be reached 70% in some Iraqi soils. This property of anisotropy has been well known for soils but no attention has been made on the gypseous soils. In this paper several laboratory tests were conducted in order to discover how anisotropy can qualitatively affect the engineering properties of Gypseous soils. The gypseous soil used was brought from Tikrit city, (Al-Qadissia district) which is located in Salah-Aldeen governorate, from depth ranging (2.5-3.0) m. The gypsum content was 27.8% - 31.45 and the soil classified as highly gypseous poorly graded sand with little or no fines (SP). Series of laboratory tests on undisturbed samples including direct shear, collapsibility, and Permeability tests were conducted on samples, in both vertical and horizontal axes of the samples. The main results indicate that the method of the gypsum accumulation in those soils was the major effect on the property of anisotropy, and the difference in the angle of internal friction may be reached 15%, while the difference in the coefficient of permeability was 50%. These results explained that the effect of soaking on gypseous soils is more dangerous than leaching.

Keywords: gypseous soils, anisotropy, laboratory tests.
GEOTECHNICAL PROPERTIES OF SOFT CLAY SOIL STABILIZED BY REED ASHES

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Abstract

Problematic soil, particularly soft clay, is widespread in southern Iraq which is characterized by its low bearing capacity and strength besides its low California bearing ratio (CBR). The aim of this research is to investigate the suitability of some local natural material to be used as a stabilizer for soft soil such as reed ash (RA), which is available in Iraq with low cost. The immediate effect of the addition of such organic material ashes (biomass ashes) to the soil much like Portland cement is to cause flocculation and agglomeration of the clay particles. This study is carried out on soft soil brought from Maysan Governorate, southern Iraq. Different percentages of reed ash (RA) in incremental order of 3% up to 12% by Dry weight of soil were added to natural soil sample. Physical and mechanical properties that have been studied before and after addition are specific gravity, consistency limit, unconfined compressive strength, California bearing ratio (CBR), consolidation, in addition to scanning electron microscope (SEM) and mineralogical analysis by X-ray diffraction (XRD). Testing results show that RA improved the consistency, strength, and deformation characteristics. It was found that the plasticity index of the natural soil has been decreased by about 22% with the addition of 12% RA. Treatment with RA showed a general reduction in the maximum Dry unit weight with increase in the RA content to minimum values at 12% RA content. The optimum moisture content generally increased with increase in the RA content. There was colossal increase in the unconfined compressive strength value by about 86% and in the CBR value by about 227% with increase in RA content to 12%. A reduction in the compressibility index $C_c$ from 0.196 to 0.073 was observed with increasing RA up to 12%. The angle of internal friction for soil-RA mix increased from 4° to 19° with 12% RA addition. Thus, it can be concluded that reed ash was an effective stabilizer for improving the geotechnical properties of soft soil samples and this will encourage the use of such matter as stabilizer in road building and obtaining a cheaper and effective replacement for the conventional soil stabilizers.

Keywords: Soil Stabilization, Soft Clay, Reed Ash.
BEHAVIOR OF MODELING PILED-RAFT SYSTEM IN SANDY SOIL UNDER VERTICAL LOAD

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Abstract  
The piled raft system is a geotechnical complex structure composed of three elements; soil, piles and raft. The foundations of piled raft provide an economical foundation where the raft isolated does not satisfy the requirements of design. Under these situations, the addition of a limited number of piles may increase the ultimate load capacity and decrease the settlement of piled raft system. The study discusses the behavior of load-settlement of piled-raft foundation on sandy soil under vertical load by means of both full scale tests and finite element analysis. The effects of number of piles, ground water level, spacing between piles and raft thickness are discussed. The full scale test (compression loading) for piled raft 1.8m×1.8m×0.6m contains 4 piles of 6 m length. A vertical load of 500 tons (simulated as a uniform surface load) and a pile spacing of 3 pile diameters have been used in this study for verification purpose using PLAXIS-3D software to show compatibility of the numerical analysis with field test results. 9 finite element models have been prepared and run on the basis of the analyses performed with verifications. It is noticed that the bearing capacity of piled raft system increases with increasing the number of piles and spacing without any significant effect of the raft thickness. The presence of water is found to increase settlement.

Keywords: Piled raft; Pile foundation; Bearing capacity; Settlement; Plaxis-3D
AN EXPERIMENTAL INVESTIGATION OF RELATION BETWEEN BEARING CAPACITY OF FIBER REINFORCED POLYMER PILED RAFT AND STRESS DISTRIBUTION OF SANDY SOIL

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Abstract

Engineers are use piled raft as foundation for centuries. Driven piles are generally used for transmit building loads to the stiff soil layer. Moreover they can be used as friction pile. Because of long life in water, wooden piles are preferred for centuries. In 20th century steel used as pile material, because of advances of pile Driving technology and economical difficulties. Nowadays, decreasing natural resources prompt to discover alternative pile materials. Fiber-reinforced polymer (FRP) is a economic material and it has very long life span in harsh environment. In this study, FRP model piles are vertically loaded in sand soils which prepared 10%, 40% and 65% relative density. As a result of the experiments conducted, bearing capacity and settlement graphics of the FRP piled raft foundation were obtained. Also, stress variations occured within the soil mass with loads and settlements were determined.

Keywords: FRP, Relative Density, Piled Raft, Bearing Capacity, Pressure Bulb
EVALUATION OF STATISTICAL DERIVED EQUATION FOR CALCULATING DRIVEN PILE CAPACITY IN SAND

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Abstract

Until now days, the challenge in scale model tests is how these results can be translated to the behavior of prototype structure. In geotechnical applications, (i.e. pile load test) the model tests may present a more economical option than corresponding to full scale test, and the ability to quantitatively recognize the mechanism of these systems. The objective of this study is, to derive a statistical equation which may be utilized to expect as possible as the actual behavior of structure. In this research, different parameters have been considered as the model pile dimensions and others related to the driving process as the driving energy and pile to hammer weight ratio (P/W).

The statistical data of the model tests are grouped using (STATISTICA) program. It was employed as a beneficial tool to predict the ultimate capacity of driven piles based on model test results, and to correlate them to the full scale tests. Thus, to check the reliability of the statistical analysis, a comparison has been made between the results obtained from the derived equation and field load tests results taken from (Al-Russafa water treatment plant). The analysis of experimental work showed that the number of blows is affected by diameter more than with pile length when two piles have same total areas are driven by the same constant driving energy.

Statistical analysis demonstrated a good agreement between the models and actual results. Also, the results indicated that, the observed capacities obtained from the statistical equation are slightly more than the capacities computed from the field tests. Moreover, the coefficient of determination ($R^2$) for driven pile equation is about (93.3%) which may give a remarkable visualization about the quality of the output data represented with pile capacity.

Keywords: statistical analysis, driven pile, scale model, driving energy, pile capacity.
THE EFFECT OF SULFATE IN SAND ON SOME MECHANICAL PROPERTIES OF NANO METAKAOLIN SELF COMPACTING CONCRETE

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Abstract
The aim of this study is to investigate the effect of internal sulfates on some mechanical properties of self-compacting concrete containing Nona Metakaolin. Tests were conducted on mixes with varied Nona Metakaolin ranged between (1-3%) by cement weight. Two types of sand were used one with artificial SO₃ content ranged between (0.35-1%) by weight of sand, other sand is with natural SO₃ of 1%. Nano Metakaolin and SO₃ contents were the only variables among the mixtures. Results indicated that there were harmful effect of sulfates on all the mechanical properties of the self-compacting concrete. Reduction in compressive, tensile, and flexural strength were about 13.15, 4.21, and 12.42 MPa respectively at 90 days age for the artificial sand. While the reduction for natural SO₃ sand were more than of the artificial sand by about (15-34%). Mixes containing Nano Metakaolin showed less reduction in its mechanical properties by about 10% compared with reference mixes.

Keywords: concrete, metakaolin, sulfate and mechanical properties
STRENGTH AND TIME-DEPENDENT BEHAVIOUR OF SELF COMPACTED REINFORCED CONCRETE COLUMNS

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Abstract

In this study, eight self-compacted reinforced concrete columns were cast, and subjected to axial sustained load and tested to failure to investigate their strength and behaviour. All columns have identical square cross section of 150×150mm and a length of 1200mm. The main variables considered in the test are, longitudinal reinforcement ratio (0.0194 and 0.0340), and the time of sustained load (62, 100 and 200) days. The columns were subjected to the same unit stress. As in normal reinforced concrete columns, the test results showed that both concrete and steel strains were increasing with time at a reduced rate, and the steel strain for columns with high reinforcement was lower than that for low reinforcement. Due to creep and shrinkage phenomena of concrete, the axial strength of the columns is reduced by about 11.4% and 13.6% in 200 days for columns with longitudinal reinforcement of 4-15.6 mm and 4-11.8 mm respectively.

Keywords: Behaviour, column, self compacted concrete, strength, time-dependent
Application of internal curing for concrete using locally available Porcelinite as a lightweight aggregate has received increasing attentions in recent years. The main aim of this study is to investigate the combined effect of steel fiber and internal curing on the strength characteristics of Self-Consolidating Concrete (SCC). The experimental work includes two stages. First stage involved conducting several trial mixes and then choosing the one that conform to international standards in terms of fresh properties. The second stage was carried out to investigate the ability of internal curing method by replacing 15% of sand with saturated fine lightweight aggregate (LWA) as internal curing material to study the change in the fresh and hardened properties of SCC. Four concrete mixes were used with different volume fractions of hooked steel fibers were incorporated 0%, 0.5%, 1%, and 1.5%. Results showed that adding steel fibers adversely affect SCC workability and thus more dosage of SP should be added to stay within the standard limits. The presence of steel fibers provides slight increase in compressive strength while significant enhancement in tensile properties was observed. Furthermore, replacement of fine aggregate by pre-wetted fine LWA causes an increment in hydration which leads to higher compressive and tensile strengths. Results of rate of absorption (sorptivity) revealed that the implementation of steel fibers has beneficial effects, while the presence of fine LWA has adverse negative effects.

**Keywords:** Self-consolidating concrete, flexural, toughness, lightweight aggregate, steel fiber.
FLEXURAL BEHAVIOR OF HIGH STRENGTH HYBRID FIBER LIGHTWEIGHT AGGREGATE CONCRETE

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Abstract
The aim of this study is to improve the flexural behavior of high strength porcelain lightweight aggregate concrete by incorporating hybrid fibers in different dimensions and types. High strength lightweight aggregate concrete (HSLWAC) mix with compressive strength 41 MPa at 28 day age was prepared. The fibers used include macro hooked steel fiber with aspect ratio of 100 (type S1), macro hooked steel fiber with aspect ratio 60 (type S2), micro polypropylene fiber (pp) and micro carbon fiber (CF). Seven HSLWAC mixes were prepared including, one plain concrete mix (without fibers), two mono fiber reinforced concrete mixes (1% volume fraction of steel fiber type S1 and 0.25% carbon fiber) and four double hybrid fiber reinforced concrete mixes [0.5% steel fiber type S1+ 0.5% steel fiber type S2 (HSF1), 0.75% steel fiber type S1+ 0.25% steel fiber type S2 (HSF2), 0.75% steel fiber type S1+ 0.25% pp fiber (HSPPF) and 0.75% steel fiber type S1+0.25% CF (HSCF)].

The experimental results indicate that the inclusion of fibers significantly increases the flexural strength in mono and hybrid fiber mixes. The percentage of increase in modulus of rupture for mono fiber HSLWAC containing 1% steel fiber type S1 and 0.25% carbon fiber are 29.52% and 60.64% respectively, while the percentage of increase for hybrid mixes HSF1, HSF2, HSPPF and HSCF are 36.4%, 61.56%, 34% and 65.43% respectively. The results also show that the inclusion of fibers improves the load-deflection behavior and consequently enhances the flexural toughness of HSLWAC. Specimens prepared from hybrid fiber HSLWAC containing a combination of 0.75% steel fiber type S1+ 0.25% steel fiber type S2 (mix HSF2) show the highest flexural toughness.

Keywords: Mono Fibers, Hybrid Fibers, Macro Fiber, Micro Fiber, Flexural Toughness.
MECHANICAL PROPERTIES OF DATE PALM LEAF – STEM FIBERS REINFORCED CONCRETE

Abstract
Nowadays, most countries are looking forward at reducing pollution; one of the best solutions is using waste products as recycled materials. This not only can develop sustainable environmental management, but also presenting new materials for general use.

A study has been conducted to look into the performance of date palm Leaf stem fiber for enhancing concrete characteristics. Leaf stem fiber was used in three percentages (0.4, 0.8 and 1.2) % volume fraction with curing ages of 7, 28, 90 and 120 days. A comparison was carried out for both untreated and 1% NaOH- treated date palm leaf stem fiber. Results demonstrated that TLS 0.4, at age 120 days improved compressive strength with 4.76% maximum increase, while using ULS0.4 at 120 days cause decrease in compressive strength. However, it improved flexural and splitting tensile strength by 6.86 % and 10.23% for ULS0.4 and TLS0.4, by 7.62 % and 3.59% for ULS0.4 and TLS0.4, by 42.1% and 57.89% for ULS0.8 and TLS0.8, respectively at age 120 days.

Keyword: Leaf-stem Fiber; Concrete; Mechanical Properties.
USING SLAG AS A PARTIAL REPLACEMENT OF SAND CONTAIN HIGH SULFATE IN CONCRETE MIXES

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Abstract
Steel slag is a byproduct obtained either from conversion of iron to steel in a Basic Oxygen Furnace (BOF), or by the melting of scrap to make steel in the Electric Arc Furnace (EAF). The local slag is produced from the Electric Arc Furnace (EAF) by slow cooling. Damping away this by product represents a waste of the material and causes serious environmental pollution problems. In this research, concrete mixes were prepared by using deferent percentages of fine slag such as (15, 30, and 45) % by weight of cement as a partial replacement of sand. The using aggregates (sand and gravel) contain high sulfate higher than the limitations of I.Q.S 45. Compressive, flexural strengths and shrinkage tests were performed to evaluate the concrete mixes.

Results showed that the use of slag as a partial replacement of sand improve compressive strength up to 18% comparing to reference concrete. Slag also improves the workability of concrete without need to admixtures. Expansion and shrinkage decreased for concrete containing slag, which means more stability and less micro cracking in concrete. Due to the low content of sulfate in slag, this fact means that contaminated sulfate sand can be used when partially replaced by slag.
REHABILITATION AND STRENGTHENING OF REINFORCED SELF-COMPACTING CONCRETE EXPOSED TO ELEVATED TEMPERATURE

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Abstract
Exposure of reinforced concrete buildings to an accidental fire results in cracking. In this study, has been conducting laboratory tests on samples of slabs of reinforced concrete to indicate the effect of rehabilitation slabs using fiber carbon polymer armed retrieval tolerability after exposure to direct flame temperature (700) °C on the bottom surface of the slabs exposed to the forces of tension during the examination periods of burning variable (120, 60, 30) minutes and rehabilitation and reduce the load failure. The result of the repair reinforced concrete slabs show that exposed to direct fire temperature level (700)° C at the lower surface of slabs for exposure duration of (30,60,120) min leads to decreasing in strength by(20.58%,32.4%,45.28%) comparing with control slabs , and the slabs retrofitting using CFRP sheets restored flexural strength values by (23.07%,32.8%,42.23%) comparing with slabs were tested after burning without retrofitting.

Keywords: Self- Compacting Concrete, Elevated Temperature, Fire flume
CORROSION OF STEEL REINFORCEMENT IN HIGH PERFORMANCE CONCRETE CONTAINING LOCAL SLAG

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Abstract
In this research, high performance concretes (HPC) were prepared using high range water reducing admixture (HRWR) with 10% local grounded slag as a partial replacement by weight of cement individually or synergistically with 50% granulated slag by weight of fine aggregate. The electrochemical behavior of reinforcing steel in these concretes was studied. The specimens were partially submerged in saline solution at concentrations similar to those present in the soil and underground water of the south of Iraq. Corrosion of embedded steel was monitored electrochemically by measuring the half–cell potentials and corrosion currents. The result indicated that, under the action of aggressive solution, HPCs showed considerable improvement in compressive strength and reduction in corrosion activity over those of HRWR-concrete.

Keywords: Reinforcing Steel, Corrosion, Ground slag, Granulated slag, high performance concrete
SORPTIVITY INDEX OF SELF-COMPACTING CONCRETES WITH NANO-SILICA AND FLY ASH

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Abstract

This experimental study covers the investigation of effect of nano-silica and fly ash utilization on the sorptivity index of self-compacting concrete. Therefore, the total binder content and water-to-binder ratio were kept constant in all self-compacting concrete mixtures. Four different self-compacting concrete series were designed with a total binder ratio of 570 kg/m³ and at a water-to-binder ratio of 0.33. Both nano-silica and fly ash were replaced with cement by weight. In all self-compacting concrete series, the nano-silica was incorporated to concrete with replacement levels of 0%, 2%, 4%, and 6%. First self-compacting concrete series were produced without fly ash whereas second, third, and forth self-compacting concrete series were produced at fly ash replacement levels of 25%, 50%, and 75%, respectively. In the total, 16 self-compacting concrete mixtures blended with nano-silica and fly ash were produced and they were tested for the sorptivity index at the age of 28 and 90 days. The results indicated that utilization of nano-silica enhanced the sorptivity index of self-compacting concrete mixtures at both ages. The sorptivity indexes of mixtures at both ages were improved by fly ash replacement level at 25% and 50%.

Keywords: Permeability; Fly ash; Nano-silica; Self-compacting concrete.
PRODUCTION OF HIGH PERFORMANCE LIGHTWEIGHT FERROCEMENT PLATES

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Abstract
The research is concerned with a new type of ferrocement characterized by its lower density and enhanced physical properties such as compressive strength and impact strength. A compressive strength of 43 MPa was obtained using suitable proportion of cement and lightweight porcelenite aggregate.

The compressive strength of the mortar mixes using 10% feldspar was increased by (91.1, 66.6) % at 28 and 90 days age respectively compared to (82.2,60)% at the same ages respectively for microsilica.

Using calcined feldspar powder caused a clear drop in water absorption indicating a decrease in volume of open pores.

Include, the impact resistance which was deduced from the free falling weight experiments was found to increase as the volume fraction of reinforcement increased.

Keywords: ferrocement, impact strength, lower density, microsilica, porcelenite
BEHAVIOR OF LIGHT WEIGHT CONCRETE USING POLYMER MATERIALS

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Abstract

Most of the recent works in construction industry in Iraq were focused on investigating the validity of local raw materials as an alternative to the imported materials necessary for some practical applications especially in thermal and sound insulation. Therefore, this research aimed to investigate the possibility of using polyurethane as a foaming agent with different percentages by weight of cement for the production of lightweight concrete. This can be used in different structural applications to obtain required advantage in reduction of dead load and giving the best thermal insulation for concrete structure.

The experimental work included various types of lightweight mortars were produced by using foaming agent as a percentage by weight of cement with natural sand. Mechanical properties of the products were studied. Wet and Dry density, compressive strength, tensile strength, flexural strength, water absorption, volume change and thermal conductivity were investigated for all types of lightweight mortars.

Results indicated that the wet and Dry density of various types of mortar mixes decreased with increasing foaming agent content. The Dry density for foamed mortars was ranged between (1780-2066) kg/m3. Also, compressive strength for all mixes decreases with increasing foaming agent. The compressive strength at 28 days age was ranged between (12.5-29.24) MPa for foamed mortars. The results also show that the flexural strength, tensile strength and thermal conductivity decreases with increasing foaming agent. Drying shrinkage and swelling increases with increasing foaming agent.

Keywords: light weight concrete, foaming agent, compressive, flexural, tensile, thermal conductivity
Abstract

Diffusion of carbon dioxide through the pores structure in the cementitious matrix promote carbonation reaction with the calcium hydroxide Ca(OH)$_2$ produced from the cement hydration. Such manufacturing procedure which accelerates the setting time may adversely affect the higher pH value and decrease the alkalinity of the cement matrix leading to break down the steel fiber passive film and then corrosion process to initiate. The present work investigates the suitability of utilizing synthetic fibers (glass or carbon fibers) in manufacturing CO$_2$ cured fiber reinforced cementitious boards. Two types of synthetic fibers were implemented and evaluated: glass and carbon fibers with volume fractions up to 0.625%. Comparisons were made between the flexural strengths, stiffness and toughness of the produced boards which fabricated with conventional and different concentrations of CO$_2$ curing (i.e. 0%, 50%, and 100%). This paper is an attempt to fabricate sustainable eco-composites that re-integrate the pollutant CO$_2$ again with cementitious boards. Flexural performance results suggested the preferred fabrication conditions. In glass and carbon fibers boards, chamber duration, fiber content, fiber lengths and CO$_2$ concentration have significant effects on the board’s flexural performance. Higher volume fractions (i.e. 0.26% to 0.25% for glass fiber and 0.375 to 0.635 for carbon fiber) and shorter fiber lengths resulted better boards flexural strengths when compared with boards reinforced with fibers of lower contents or longer lengths, even at half the CO$_2$ concentration.

Keywords: accelerated curing; carbon dioxide gas; carbon fiber; glass fiber; cement composites; flexural strength.
COMPARISON AMONG SULAIMANI, IRAQ CEMENTS WITH LOCAL NEIGHBOUR COUNTRIES CEMENTS: IMPLICATION OF LOCAL CLIMATE ON MORTAR

Abstract
The notable changes of weather are caused visible influences on buildings in Iraq. These manifest both external and internal parts of buildings. Mortars are facing the local weather continuously and found to be impacted in Iraqi cities. This research simulates hypothesised conditions of mortars uses cements manufactured locally and cements from Turkey and Iran, where cracks appear and mortar weakness is a recognised problem. Three cements from Sulaimani and two from Iran and Turkey were used to prepare a set of mortar cubes in size of 5.0 x 5.0 x 5.0 cm. cubes are cured for 1, 3, 7 and 28 days and then were divided into three groups with the same treatment format. These groups are only cured, saturation-affected and temperature-affected groups. the second and third groups are lasted for 10 weeks. The continuous local climate variations showed an effect on compressive strength compare to the first group.

Keywords: Cements, Mortar, Stress-Strain Relation, Compressive Strength, Local Climate.
EXPERIMENTAL AND THEORETICAL STUDY OF TEMPERATURE DISTRIBUTION OF HIGH STRENGTH CONCRETE EXPOSED TO FIRE FLAME

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Abstract  
The mechanical and physical properties of concrete depend mainly upon the micro ponds between mixed constituents of hardened concrete members. Accordingly a great attention should be focused to the exposure of hardened concrete members to high temperature to conceptualize a good understanding of burned members. Two mathematical 3d models are developed to investigate and conceptualize the distribution of burning temperature in concrete models moreover a measured laboratorial burning temperature readings are obtained by using a special burner manufactured for this purpose. Two types of models are prepared; they are cubic (150mm*150mm*150mm) and prismatic (150mm*150mm*550mm) models are heated from one face to 400ºC, 600ºC and 800ºC. The mathematical models and the practical burning system are justified for unique boundary conditions in steady state condition. The mathematical and measured temperatures are matched. It is found that the Thermal differences of all matched nodal point are less than ±10%.
EFFECT OF INTERNAL CURING ON THE COMPRESSIVE STRENGTH OF HIGH PERFORMANCE CONCRETE SUBJECTED TO INTERNAL SULFATE ATTACK

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Abstract

Internal curing, IC, refers to the process by which the hydration of cement occurs because of the availability of additional internal water that is not part of the mixing water. The additional internal water is typically supplied by using relatively small amounts of saturated particles in concrete.

In the present study the effect of internal curing on resistance of high performance concrete, HPC, to internal sulfate attack, ISA, is investigated. Two saturated curing agents, Limestone dust and Porcelanite filler, were used to facilitate internal curing for concrete. These agents were used as partial replacement of fine aggregate (sand) in two volumetric percentages (20 and 30 %). Three percentages of $\text{SO}_3$ in fine aggregate were adopted (1, 2, 3 %) by adding natural gypsum to the fine aggregate. The testing program included compressive strength tests and was extended till the age of 240 days.

The test results showed that internal curing has a negative effect in limiting the rate and magnitude of destructive reaction of sulfates.
INFLUENCE OF COARSE AGGREGATE SIZE, TYPE AND CONTENT ON MECHANICAL PROPERTIES OF MODIFIED REACTIVE POWDER CONCRETE

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Abstract

The objective of this search is to study the impact of the maximum size, type and content of coarse aggregate (CA) on mechanical properties of Modified Reactive Powder Concrete (MPRC) in terms of compressive (fcu) and flexural (fr) strengths. Thirty-two mixes of MPRC were designed, and tested. The difference in the mixtures was based on several variables. Four different maximum sizes of CA (5mm, 8mm, 10mm and 12mm), four CA/Total aggregate percentage (40%, 45%, 47.5% and 50%), and two types of CA (rounded and crushed) were selected to be the variables.

The results showed that high (fcu) can be achieved by involving the CA in the mixes of MPRC; this outcome is in contrast with the model offered (by others) to relate the high compressive strength level of Reactive Powder Concrete (RPC) to the absence of CA. Increasing the maximum size of CA leads to decrease the values of (fcu). The results of MPRC mixes with crushed CA were better than these mixes with rounded CA. The optimum CA/Total aggregate percentage in MPRC mixes is 45% for (fcu). In addition, it was observed that increase of CA content increases (fr).

Keywords: RPC, MRPC, Compressive, Flexural, strength.
PERFORMANCE OF REINFORCEMENT BEAMS MADE WITH SELF-COMPACTING CONCRETE IN AGGRESSIVE ENVIRONMENT

Abstract

Self-Compacting Concrete mixes (SCC) is increasingly being used in many application some of which are susceptible to an Aggressive Environment such as sulfuric acid solution. In this study SCC incorporating silica fume, chalk powder and hybrid fibers were used in casting 16 beams in two groups. The beams in the first group were cured in normal environment for 28 days, while those in the second group were subjected to sulfuric acid solution of 0.5% for six months. The flexural behavior of the beams was evaluated by testing the specimens under two-point loading until failure. It included cracking, failure pattern, deflection, ductility, and flexural strength measurements. The results indicated that the SCC mixes showed comparable structural behavior with respect to the corresponding control mixes in a normal environment. Different SCC mixes in an aggressive environment yielded a different structural performance, depending on the composition of the fillers and the main reinforcement ratio. The experimental results show that after chemical exposure, the load that produced first crack for beams with hybrid fiber increased 150% to 12. 5% and the ductility index increased 9.5 % to 10% comparable with beams before chemical exposure while for beams with non hybrid fibers, the cracking load decreased 25% and the ductility index decreased 9.4 % to 11% compared to the corresponding control beams

Keywords: self-compacting concrete, silica fume, sulfuric acid, hybrid fibers, flexure
The present paper investigates the ability of using Iraqi Attapulgite clays of 10%, 20%, and 30% as partial replacement by weight of the clay used in the manufacturing local clay bricks, to produce the laboratory bricks with dimensions (75×38×25) mm & (175×38×25) mm laboratory extrusion device was used. Then they were dried in laboratory temperature and fired in electrical furnace with different degrees (750, 800, 850, 900, 950, &1000) °C.

Some of the mechanical properties of that clay bricks (longitudinal shrinkage, bulk density, compressive strength, efflorescence, water absorption, and modulus of rupture) has been studied. The results showed that the addition of Attapulgite clays with 20% by weight of clay noteworthy improvement in the mechanical & physical properties of laboratory bricks.

**Keywords:** Clay bricks, firing temp. , attapulgite, mechanical properties of clay bricks
NEW APPROACH PREDICTION OF COMPRESSIVE STRENGTH OF NORMAL AND PORCELANITE AGGREGATE LIGHTWEIGHT CONCRETE BY NON-DESTRUCTIVE TEST

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Abstract
In this paper the compressive strength and modulus of elasticity of structural normal and lightweight aggregate concrete mixes is evaluated by the non-destructive ultrasonic pulse velocity method and rebound hammer method.

The experimental program consists of five different concrete mix proportions ranging from lightweight to normal weight concrete density.

It is found that lightweight and normal weight concretes are affected differently by mix design parameters. The prediction of the concrete's compressive strength by means of the non-destructive ultrasonic pulse velocity test is studied. Based on the dependence of the ultrasonic pulse velocity on the density and elasticity of concrete, a simplified expression is obtained using nonlinear regression of power fit with R2 = 1.0, correlation coefficient (0.9999) and Standard Error (0.0196) to estimate the compressive strength, regardless the type of concrete and its composition.

Keywords: Lightweight concrete, Porcelanite, Cylinder compressive strength, NDT compressive strength relationship, UPV modulus elasticity relationship
Abstract
Concrete has a good durability in different natural environment, however, concrete durability Drops under effect of petroleum products and the deterioration of concrete tanks of petroleum products is still a problem. So, it's necessary to protect concrete against this effect to increase its service life. The present research is adopted to study mechanical properties and durability of normal weight concrete, self-compacted concrete (SCC), and concrete coated with epoxy, under effect of kerosene with period of subjecting of four months and comparing the test result with concrete cured for 28 days in water as reference mix to show the impact of kerosene. The experimental program includes, test of fresh concrete, compressive strength, splitting tensile strength, density, absorption and percentage of voids. The result show bad effect of kerosene on all types of mixes but with less percentage on SCC than other two mixes.

Keywords: Oil Products, Kerosene, Self-compacted Concrete, Durability, Epoxy.
USE OF RECYCLED AGGREGATES AND RECYCLED GLASS IN MANUFACTURING PRECAST CONCRETE HOLLOW BLOCKS

Extended Abstract

Objective

The demolished concrete is a major component of the construction and demolition (C&D) waste. The recycled aggregates obtained by crushing the demolished concrete can be used as a substitute of natural aggregates in new concrete mixes. Another major C&D waste is the flat glass. This glass can be also recycled and used as an aggregate substitute in concrete.

The objective of this study is to determine the influence of the use of recycled aggregates and recycled glass on the compressive strength and the behavior in fire of precast concrete hollow blocks. Tests are carried out on four series of blocks manufactured using concrete mixes with different percentage replacement of natural aggregates with recycled aggregates and recycled glass, and one series of reference blocks manufactured using concrete mixes not containing any recycled materials.

Materials and methods

The materials used to manufacture the concrete blocks are the following:

- Ordinary Portland cement with specific gravity 3.15.
- Natural aggregates 0/12.5 mm consisted from crushed stones.
- Recycled aggregates 6.3/12.5 mm obtained by crushing demolished precast concrete elements (beams, lintels and paving blocks) made with mixes containing limestone aggregates and having various values of compressive strength.
- Recycled glass 6.3/12.5 mm obtained by crushing demolished flat (windows) glass.
- Water from potable fresh water source free from deleterious materials.
- High range water reducing superplasticizer Viscocrete 20HE provided by Sika.

Five series of four blocks each are tested. Four of these series are fabricated with partial replacement of natural aggregates with recycled materials; the recycled aggregates and recycled glass are used with a replacement rate of 30%. The fifth series (reference blocks) does not contain any recycled materials.

The following characteristics of aggregates are determined: the acid soluble chloride according to BS EN 1744 P5, acid soluble sulphate content according to BS EN 1744 P1, the potential alkali-silica reactivity (chemical method) according to ASTM C289, the density, specific gravity and water absorption according to ASTM C127 and ASTM C128, the content of material finer than 75 mm according to ASTM C117, the sand equivalent of soil according to ASTM C2419, and the Dry unit weight according to ASTM C29/C29M.
The manufactured concrete hollow blocks are tested according to ASTM C140 to determine their compressive strength. The blocks are weighed, and their dimensions, volume, density and compressive strength are determined. The compression tests are performed at 7 days; the load is applied with a constant speed of 3 kN/s. A non-standardized test method is used to examine the behavior of the blocks in fire. This test method consists of applying a direct butane flame on the block surface with duration of two hours in order to identify the effect of the fire on the appearance of the blocks.

**Results**

The analysis of results is done based on a comparison of the characteristics of blocks containing different rates of recycled aggregates and recycled glass, as well as on a comparison of the characteristics of these blocks with the characteristics of reference blocks. The test results show that all blocks have a density between 1398 kg/m$^3$ and 1488 kg/m$^3$. The blocks not containing recycled materials have the highest density (1488 kg/m$^3$) while the blocks containing 30% recycled aggregates have the lowest density (1398 kg/m$^3$).

The blocks not containing recycled materials and the blocks containing 30% recycled aggregates have the highest compressive strength, i.e. 3.66 MPa and 2.90 MPa respectively.

The blocks containing different replacement rates of recycled materials have almost similar compressive strength values: 2.90 MPa for blocks containing 30% recycled aggregates, 2.86 MPa for blocks containing 20% recycled aggregates and 10% recycled glass, 2.77 MPa for blocks containing 10% recycled aggregates and 20% recycled glass, and 2.75 MPa for blocks containing 30% recycled glass. The loss in the compressive strength compared to the reference blocks is equal to 21%, 22%, 24% and 25% respectively.

The fire test shows hair cracks of less than 1 mm thickness on the surface of blocks after five to fifteen minutes and no damage occurs after two hours.

**Conclusions and recommendations**

The tests show that the use of recycled aggregates (without recycled glass) as replacement of natural aggregates with a percentage of 30% could allow the production of concrete blocks having a compressive strength similar to those of concrete blocks containing only natural aggregates.

According to the research results, it can be clearly concluded that using both recycled aggregates and recycled glass along with natural aggregates will decrease the compressive strength of the blocks compared to the blocks which do not contain any recycled materials.

Moreover, using recycled glass (without recycled aggregates) along with natural aggregates will cause also a decrease of the compressive strength of the blocks.

The replacement of 30% of natural aggregates with recycled aggregates and recycled glass with different combinations will decrease the compressive strength of blocks by 21% to 25% compared to blocks not containing recycled materials. This replacement does not affect the behavior of blocks in fire.

**Keywords:** recycled aggregates, recycled glass, precast concrete hollowblocks, compressive strength, behavior in fire.
OPTIMIZATION OF GEOPOLYMER CONCRETE BASED ON LOCAL METAKAOLIN

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Abstract
Geopolymer concrete is one of the building materials that has become more popular in recent years due to the fact that it is significantly more environmentally friendly than normal concrete. Geopolymer is manufactured by using aluminate and silicate compounds that react with alkaline material (sodium hydroxide and sodium silicate or potassium hydroxide with potassium silicate). This paper presents an optimization for mix design purposes for Iraqi Metakaolin based Geopolymer concrete. The concentration of the alkaline solution used was 10 Molar. Two ratios of sodium silicate to sodium hydroxide solutions by mass were adopted. They were 3.5 and 1.0. Naphthalene sulphonate-based superplasticizer was used. Specimens were cured by different methods inside and outside the laboratory. The optimum mix proportions of Geopolymer concrete based on compressive strength at 7 days were 400 kg Metakaolin, 180 kg alkaline solution (sodium hydroxide and sodium silicate), 40 kg extra water, 1100 kg coarse aggregate and 720 kg fine aggregate. The results show that the optimum dose of superplasticizer was 12 kg/m³. By increasing this content, the compressive strength will be decreased by 32.5%. Results indicated also that the fineness of Metakaolin has an important role on strength development of the Geopolymer. Compressive strength at 7 days age for the optimum mix was 27.53 MPa. This result was recorded for specimens made with Metakaolin had a specific surface area of 23 m²/g and cured under sunlight in ambient environment outside the laboratory in summer season.

Keywords: alkaline solution, compressive strength, Geopolymer concrete, Metakaolin.
OPTIMIZATION PROCESS FOR USING PREPARED NANO SILICAIN CONCRETE

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Abstract
This study has been devoted to apply the optimization technique involving central composite rotatable design to seek on the optimum conditions for using novel nanosilica (NS) in concrete; this nano silica has been previously prepared from Iraqi sand. Nano silica sand has been shown to improve workability and strength. This research presents the compressive strengths and the microstructure photographs (SEM) of concrete containing nanosilica particles with various sizes of 50, 80 and 100 nm, then compared it with those for control mixture (without nanosilica). Tested results indicated that nanosilica sand significantly improved compressive strength of concrete. The strength improvement was also dependent on the particle size and concentration of nanosilica particles (replacement content). Concrete containing (NS) with 50 nm gave higher compressive strength compared with (NS) of 80 nm and 100 nm. The optimization results proved that the enhancement in compressive strength is 30.149% at optimum conditions. By varying the replacement contents of NS as 2%, 6%, and 10% by weight of cement, the optimum replacement content was shown to be 8% for all nanosilica particle sizes used.

Keywords: Silica nanoparticle, Silica sand, Optimization, Portland cement.
SELECTING AN APPROPRIATE PROCUREMENT SYSTEM FOR THE CONSTRUCTION INDUSTRY IN IRAQ USING PROCUREMENT SYSTEM SELECTION (PSS) METHOD

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Abstract  
Procurement system defines the overall framework for executing a project, including the responsibilities and authorities of the participants in the construction process. An appropriate procurement system is a key factor that contributes to the success of a project and overall client satisfaction. In this paper, procurement system selection (PSS) method is discussed in detail as an approach to identify appropriate procurement systems that can be used in a particular construction sector. This method is composed of two tasks. One is analytic hierarchy process (AHP), which is used to determine the importance weights of the criteria. The other task is building Procurement System Selection (PSS) software to find an appropriate procurement system for the projects. The proposed method was applied in the projects of Baghdad University, Iraq. In the first task, computerized decision support software based on AHP, namely, Expert Choice version 11.0, was used for the criteria weights. The PSS program under the second task was built using Visual Basic language. Result shows that a two-stage tendering system is appropriate to use in the projects of the university.

Keywords: Procurement system, analytic hierarchy process (AHP), Expert Choice, Iraq
IMPROVING CONSTRUCTION SAFETY PERFORMANCE FOR IRAQI CONTRACTING COMPANIES

Abstract
The construction industry has long been regarded as one of the most dangerous industries, as it has a history of poor safety performance.

A literature survey has been done, and the methods and techniques for measuring safety performance in construction projects have been identified. Therefore, in this study, from the field survey, the Iraqi construction contracting companies are investigated for the safety measures of their projects. A questionnaire survey has been conducted for a selected sample of the Iraqi contracting companies consisting of a significant number of questions focusing on each company safety policies and practices.

Statistical analysis of the questionnaire shows that there are great weaknesses in Iraqi construction companies in controlling the safety for all employees in the projects in all parts of the questionnaire.

As a result of what has been concluded, solutions and recommendations and proposals given in the research to obtain the ideal condition of safety for the Iraqi companies.

Keywords: Construction safety; system of safety; safety performance; safety evaluation
IMPROVING WORK FLOW IN CONSTRUCTION PROJECTS IN GCC COUNTRIES

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Abstract
Productivity problems often lead to time and cost over-runs on construction projects. These problems manifest themselves in a lack of coordination, unidentified scope leading to poor planning, lack of monitoring and control, unrealistic schedules, poor implementation, and incorrect resource allocation. There it is a concern about how to best plan and control projects, and what is the optimised strategy to be followed depending on type and size of projects and the culture surrounding them. Large scale construction projects are particularly vulnerable to cost and time overruns, as a result of productivity problems. Therefore methodologies have been developed to reduce the risk of overruns and improve project outcomes; a number of these methods are based upon lean production. Integration of Last Planner Systems (LPSs) and Location-Based Management Systems (LBMSs) aims to achieve lean goals through a social process, by trying to make planning a collaborative effort and by improving the reliability and commitments of team members. The method for the study was a quantitative questionnaire supported by qualitative interviews with practising professionals in GCC countries. It was found that implementation of LPS within projects created predictable and reliable project plans in full detail, identified and removed constraints before they became obstacles, improved logistics at sites and supported the completion of projects within agreed durations and cost.

Keywords: Construction, Time, Cost, LPS, LBMS
THE IMPACT OF USING BIM-BASED BUILDING PERFORMANCE ANALYSIS FOR HOUSING PROJECTS IN IRAQ

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Abstract
The development of computer application for engineers and architects from the basic Computer Aided Drawing system (CAD) to Building Information Modeling system (BIM) not only allowed designers and architects to visualize buildings but also to analyze and estimate their performance in a virtual environment. This enabled designers to maximize building’s efficiency, performance and reduce building’s carbon footprint along the whole building lifecycle.

This research is looking at the potential impacts of using BPA and BIM technologies to achieve better building performance with special focus on the housing system in Iraq. The impact, nevertheless, applies to other types of buildings as well. The research will achieve its goal via the following objectives:

• What is BIM?
• How could BPA be applied through BIM? And the main differences compared to the traditional methods.
• What are the main advantages and disadvantages of using BIM for building performance?
• The Impact of using BIM for building performance analysis of affordable housing projects.

Keywords: Building Information Modeling (BIM), Building Performance Analysis (BPA), Housing in Iraq, Environmental Impacts, Affordable Housing.
CAUSES OF DELAY ON LARGE BUILDING PROJECTS IN QATAR

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Abstract

The construction industry is of high importance to the economy of most countries. However, it is notorious for projects overrunning time and cost. Several studies have been conducted to define causes of delay in completing construction projects. This research has employed a wide variety of analytical methods to conclude the most precise statistical ranking of causes of delay. Moreover, the delays for construction projects differ from one country to another and even between types of project within the same geographic location. The aim of this study is focused on identifying the causes of delays in large building projects in Qatar. A comprehensive literature review was carried out in neighbouring Gulf countries. The causes of delays are identified from literature and assessed in exploratory interviews with industry experts in Qatar to investigate the relevance of each cause. A survey questionnaire was prepared and was subject to pilot interviews prior to issuing it to practitioners, including clients, consultants, and contractor organisations. Results reveal that the top five factors causing delay to large building projects are: slow decision-making; discrepancies between specifications and drawings; major changes in design during construction; delay in the settlement of contractor claims; and unreasonable project time frames.

Keywords: Construction Management; Delay Causes; Project Management
EXPERIMENTAL INVESTIGATION OF VOLUMETRIC MIX DESIGN METHOD FOR PERVERIOUS CONCRETE

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Introduction

Optimizing the performance of construction materials is a growing area of research, particularly with the increasing interest in new sustainable concepts. As such, efficient use of porous pavements including pervious concrete, porous asphalt, plastic grid systems, or concrete interlocking blocks is increasingly gaining momentum. Such efficient use in the construction industry requires an optimum balance of two opposing aspects: porosity and strength. This project focuses in particular on pervious concrete pavements which are desired to carry traffic load and drain rainwater. The main objective is to present a method that optimizes the performance of pervious concrete based on mortar type, aggregate size, and required porosity. This was achieved through studying the effect of different components of the mortar on the properties of the mix. Improved understanding of the behavior of porous pavements is fundamental to the wide use of this promising material in driveways, parking lots, residential streets, alleys, walking paths, sidewalks, playgrounds, tennis courts, and swimming pool decks. Pervious concrete exhibits characteristics that make it highly advantageous by providing road safety in wet conditions, absorbing the noise through its open structure, reducing the heat island effect, and introducing a new method to harvest rain water.
PREPARATION AND CHARACTERIZATION PVC/PS/PVA HOLLOW FIBER NANOFILTERATION COMPOSITE MEMBRANES

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Abstract

Nanofiltration composite hollow fiber membranes (NF) was synthesized by using dip-coating method in order to use it for the separation of NaCl and CaCl2 from salt solution. Effects of poly (vinyl alcohol) (PVA) concentration in coating solution on the morphology and separation performance of the NF hollow fiber composite membrane was studied. Cross-sectional structure of the NF membranes was characterized by using scanning electron microscope (SEM). The permeation and rejection results demonstrated that the NF membranes had a significant ability to the separation of NaCl and CaCl2 from salt solution. From the experimental work it was found that the permeation flux and solute rejection results of the NF membranes prepared from different concentration of PVA (0.5, 1, and 1.5 wt% PVA solution) and dip-coating process for 90 minute at 60 ºC could be considered as a good candidate for the separation of NaCl and CaCl2 from salt solution with good performance.

Keywords: NF membranes; Composite NF membranes; Rejection performances; phase inversion; polysulfone; poly(vinyl alcohol)hollow fiber membrane
EFFECT OF INCORPORATION TECHNIQUES OF NANOMATERIALS ON STRENGTH OF CEMENT-BASED MATERIALS

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Abstract
The attractive properties of nanomaterials have motivated the development of advanced cement-based materials with unique properties. Despite the superior properties of nanoscale materials, the incorporation method of such materials into cementitious matrices is a critical issue which strongly influences the final properties. In this paper, various inclusion methods (B, MW, MP and S) were employed to introduce two different types of nanomaterials into cement-based-matrix. Different concentrations of Halloysite Nanotubes (HNT) (up to 2.5wt%) and low load concentrations of Nano Al₂O₃ (NAI) (up to 0.1 wt%) were used to replace partially the cement in (cement:sand) mortar. The water-to-cement ratio (0.4) was kept constant for all samples. The effectiveness of each incorporating method of HNT and NAI was evaluated by means of compressive strength test. Samples of cement mortars (with and without nanomaterials) were tested in compression and for different periods of curing (7, 14 and 28 days). It was found that the adoption of the most practical mixing procedure B leads to highest gain of compressive strength when compared with other procedures. Highest enhancement (36%) in compressive strength was recorded for samples with 2.5 wt% of HNT at 14 days using procedure B when compared with control samples. In terms of samples with NAI, it was observed that the introduction of very low concentration of NAI (0.02 wt%) using procedure MW results in higher values of compressive strength at age 28 days when compared with other procedures as well as with control samples.

Index Terms: cement mortar, halloysite nanotubes, incorporation technique, nanomaterials
COMPARISON OF HIGH SPEED RAILWAY BRIDGE FOUNDATION DESIGN

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Abstract
This project discussed the design and analysis of bridge foundation subjected to load of train with three codes, namely AASHTO code, British Standard BS Code 8004 (1986), and Chinese code (TB10002.5-2005). The study focused on the design and analysis of bridge’s foundation manually with the three codes and found which code is better for design and controls the problem of high settlement due to the applied loads. The results showed the Chinese codes are costly that the number of reinforcement bars in the pile cap and piles is more than those with AASHTO code and BS code with the same dimensions. Settlement of the bridge was calculated depending on the data collected from the project site. The vertical ultimate bearing capacity of single pile for three codes was also discussed. Another analysis by using the two-dimensional Plaxis program and other programs like SAP2000 14, PROKON many parameters were calculated. The maximum values of the vertical displacement were close to the calculated ones. The results indicate that the AASHTO code was economics and safer in the bearing capacity of single pile. The purpose of this project is to study out the pier on the basis of the design of the pile foundation. There is a 32m simply supported beam of box section on top of the structure. The pier of bridge is round-type. The main component of the design is to calculate pile foundation and the settlement. According to the related data, we choose 1.0m in diameter bored pile of 48m. The pile is lain out in the rectangular pile cap. The dimension of the cap is 12m × 9 m. Because of the interaction factors of pile groups, we must check the load-bearing capacity of simple pile, the punching resistance of pile cap, the shearing strength of pile cap, and the part in bending of pile cap, all of them are very important to the structure stability. Also, checking soft sub-bearing capacity is necessary under the pile foundation. This project provides a deeper analysis and comparison about pile foundation design schemes. Firstly, here are brief instructions of the construction situation about the Bridge. With the actual construction geological features and the upper load on the Bridge, this project analyzes the bearing capacity and settlement of single pile. In the paper the Equivalent Pier Method is used to calculate and analyze settlements of the piles.
The yield energy (the energy required to fracture covalent molecules) can be used to describe the relative performance of bituminous materials, and the stress-strain curve can be useful in identifying the presence of polymer modifiers in the material.

The complex shear stress and complex shear strain of pure and modified local asphalt binders were measured at temperatures between 25º C and 50º C by Dynamic Shear Rheometer. The stress-strain graph of each sample was used to analyse the experimental data and calculate the yielding energy required to starting fracture of the asphalt binders.

Yield energy required to failure ranged from 2.98*10^5 Pa to 1.1*10^6 Pa for DAB and 2.67*10^6 Pa to 4.43*10^6 Pa for NAB. The values of toughness energy are 9.67*10^5 Pa to 2.53*10^6 Pa for DAB and 1.06*10^6 Pa to 1.0*10^7 Pa for NAB. The effects of test temperature, asphalt type, polymer content, and type on the yield energy for Failure were studied. The results indicate that the yield energy for Failure can be used as a good design parameter of a flexible pavement. The yield energy increases with complex shear strain rate and decreases with increased temperature.

**Keywords:** Yielding energy, elastic energy, toughness energy, fracture energy, modified asphalt, DSR.
OPERATIONAL ANALYSIS OF CROSS SECTION INTERSECTION BY USING AASIDRA SOFTWARE FOR TRAFFIC FLOW

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Abstract

Safety is a prime concern of transportation engineers. Traffic volumes have increased tremendously over the past years especially in Baghdad city. A computer simulation is more sophisticated for the analysis of freeways and urban street systems through simulation, transportation specialists can study the formation and dissipation of congestion on roadways. Intersection is one of the main reasons that have a significant effect on travel time. The aim of this paper is to analysis operational the traffic flow of the intersection to provide useful information for engineers to design the roads with the shortest travel time, The analyses Operational of existing in Al-Jadryia intersection, near University of Baghdad by Utilization aaSIDRA and field measurements show that they can perform adequately despite relatively high traffic volumes in peak hours, The data required for the study were mainly collected through video filming technique also the calculation and evaluation are constructed with the aaSIDRA software. For general analyzing, this intersection is marked worst. This analyzing is indicated by “F” level which is mean the lowest value for the quality and quantity of this intersection.

Keywords: Analysis, Traffic, Intersection, simulation, aaSIDRA.
EVALUATION OF GEOTECHNICAL AND COLLAPSIBLE CHARACTERISTICS OF DIFFERENT TYPES OF IRAQI SOILS DURING THE LEACHING PROCESS

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Abstract  
Gypseous soils are distributed in many regions in Iraq. The dissolution and leaching of gypsum by the action of water flow through soil masses cause several problems. Such problems are observed in soils underneath foundations of many buildings and engineering structures due to continuous changes in engineering properties of soils with time. The main purpose of this study is to evaluate the behavior of three types of gypseous soils 59.5, 41 and 2.3 % Gypsum Content brought from different sites in Iraq during leaching under variable hydraulic gradients. From the interpretation of test results, it is found that conventional testing is inapplicable to gypseous soils due to the effect of gypsum dissolution and leaching due to soaking or/and flowing of water through porous media. Therefore, a new special large diameter modified Soil Leaching Apparatus was adopted to study the effect of leaching on the behavior of gypseous soils under different leaching stresses with two flow directions. These are upward flow (UWF) and downward flow (DWF) conducted under different hydraulic gradients, as well as to study values of the permeability coefficient of such soils under leaching. Results show that the leaching strain and accumulative dissolved gypsum increase with time, while a gradual decrease can be observed in permeability coefficient (k) with time and with the increase in the leaching stress. Moreover, permeability obtained by upward flow direction (UWF) is less than that obtained by downward flow one (DWF). In addition, the leached samples show an increase in the collapse potential (Cp) especially for soils that contain high percentages of gypsum. Results also show that the collapse potential (Cp) decreases as diameter to height ratio (D:H) increases. Finally, direct shear tests are carried out on the soils before and after leaching and results show that shear strength parameters (c & Ø) decrease after leaching them.

Keywords: Gypseous soils; Leaching process; Permeability; Collapsibility; and Direct shear test.
CONSEQUENCES OF FREIGHT VEHICLES ON TRANSPORT CORRIDORS IN KOGI STATE, NIGERIA

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Abstract
Studies of the characteristics of freight transport are robust in the literature. However, research on the negative impacts of freight transport on Nigerian roads is not well documented in the literature. It is on this background that this study examines the consequences of freight vehicles on transport routes in Kogi state, Nigeria. Both primary and secondary data were used for this research. An average of one hundred set of questionnaires was administered randomly to public transport operators and other road users. Similarly, another one hundred set of questionnaires was administered to freight transport operators about the challenges encountered on their transit. Data on the road traffic crashes between 2006 and 2012 were obtained from the Federal Road Safety Corps in Lokoja. Descriptive statistics were used. The finding reveals that approximately 22% of road traffic crashes result in injuries and death of innocent citizens in the state, caused by freight vehicles. Okene-Lokoja route recorded the highest number of traffic crashes by freight vehicles in the state. The behaviour of freight transport operators requires much to be desired as they harass other road users and intimidate them through indiscriminate use of horns. More than 50% of other road users claimed that the size, weight and the speed of freight vehicles are the principal factors threatening them on the road, despite the fact that only 3.72% of freight vehicles ply the study area. The study recommends that the operations of heavy duty vehicles should be restricted mainly to inter-city highway as these may likely reduce traffic congestions and accidents on urban routes.

Keywords: Freight, transport Routes, Transport Externality, Safety and Planning,
RUNWAY ORIENTATION PROBLEMS – A CASE STUDY OF MIDDLE EUPHRATES INTERNATIONAL AIRPORT MEIA

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Abstract
It has been planned to design and construct a major international airport at the middle Euphrates region of Iraq to support the commercial development plan and serve the pilgrim’s occasional visit to the holly shrine at Holly Karbala and Najaf provinces. The airport site is 30 km west of Karbala at the edge of the great western desert. The design includes construction of two parallel runways of 4500 m length, and 2300 m center to center apart. Metrological data regarding the wind intensity, duration, direction and speed have been obtained for the site, and the wind rose diagram has been drawn. The selected project area practices a calm wind speed throughout the past 25 years. The runway orientation of maximum coverage was designed to be NW-SE (315 – 135). The site was adjacent to power station plant and problems arise with the interference of the 35 m height chimney of the plant with the air field. Four alternatives have been considered to solve such problem based on a comparative analysis. The first one was to move the location of the runways system to the North West in order to reduce the portion of OLS approach surface above the power plant. The second alternative was to increase the center to center distance between the runways to 3000 m in order to have the power plant out of the OLS approach surface. The third alternative was to increase the spacing between runways to 3000 meters and shift the second Runway to the extreme north. The fourth alternative was to change the orientation by 15 ° clockwise to a new one of (330 – 150) with minimal effect of 3% on wind coverage.

The paper presents the details of such alternatives and finalizes the decision on runway orientation based on economic justification and site condition.

Keywords: comparative analysis; metrological data; orientation; runway; wind coverage.
PROSPECT OF USING RCA IN HOT MIX ASPHALT WITHIN FLEXIBLE HIGHWAY PAVEMENT

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Abstract
Since the last decide, Iraq various economic and environmental campaign especially in the construction field, witnessed wide development industry to reduce costs and improve the quality of our environment. For achieving that both goals at the same time, this research focused on utilization of recycled concrete aggregate (RCA) in hot mix asphalt (HMA) for base layer.

RCA is aggregate resulting from the processing inorganic material previously used in construction and properly comprising crushed concrete. Also, concrete pavement can be broken in place and used either as base layer for HMA by process called rubblization, or as previously replacement of aggregate in HMA. But reinforcing steel and other embedded items, if any, must be removed and care must be taken to prevent contamination by other materials that can be trouble same.

The use of (RCA) in (HMA) is a sustainable construction proactive, provided that the addition of (RCA) does not adversely affect the (HMA) characteristics.

However, for this research four percentages (0, 10, 20 and 30) % of free manually crushed concrete obtained from the control test specimen in the central laboratory, are used as replacer of virgin aggregate in HMA base coarse. The results confirm that the Marshall stiffness and indirect tensile strength as an indication for rutting and cracking problems respectively are largely perform well and agree with local specification with replacement rate reach to 30% of RCA.

Keywords: Recycled Concrete Aggregate, Hot Mix Asphalt, Marshall Stiffness, Indirect Tensile Strength.
INFLUENCE OF SELECTED ADDITIVES ON WARM ASPHALT MIXTURES PERFORMANCE

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Abstract

Warm Mix Asphalt (WMA) is a technology that allows significant lowering of the mixing and compaction temperature of conventional Hot Mix Asphalt (HMA). This research presents the results of laboratory tests conducted to evaluate the properties and performance of warm mix asphalt. The WMA has been prepared from two asphalt grades and one aggregate source with two additives (Aspha-min® and Sasobit®). The crumb rubber is also added to WMA which is prepared with Aspha-min® and Sasobit® to evaluate effect of crumb rubber on WMA properties. The results of the study indicated that the two additives to the warm asphalt affected the mixture properties differently. When the mixture properties were compared, it was observed that Aspha-min® reduced the indirect tensile strength and resilient modulus values of the mixes, the two WMA additives increased the rut depths of the mixes, and both the additives reduced the tensile strength ratio of the mixes. WMA contains crumb rubber appears.

Keywords: Aspha-min®, indirect tensile strength, indirect tensile resilient modulus, indirect tensile fatigue, rut depth, Sasobit®, crumb rubber and warm mix asphalt (WMA).
IMPACT OF GRADATION AND MODIFIER ON MOISTURE SUSCEPTIBILITY OF IRAQI HOT-MIX ASPHALT USING SUPERPAVE GYRATORY COMPACTOR

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Abstract

Moisture damage in asphalt mixtures refers to loss in strength and durability due to the presence of water. Iraqi road network is showing severe deterioration such as raveling and stripping because the bond between aggregates and asphalt film is broken due to water intrusion.

The primary objectives of this research are evaluating the factors influencing on susceptibility of pavements to moisture damage and assessing the effect of additives on asphalt concrete mixtures which has been assessed through moisture damage resistance. To meet the objective of this research, available local materials were used including asphalt binder (40-50) grade, aggregate with nominal maximum size of 12.5 mm, and mineral filler, two anti-stripping additives are used (Portland cement and Styrene Butadiene Styrene polymer SBS) in this research.

The Superpave mix design system was adopted with varying volumetric composition. The Superpave Gyratory Compactor was used to compact 24 asphalt concrete cylindrical specimens. The impact of moisture damage was evaluated by indirect tensile strength test.

From the results it can be concluded that using cement as filler, tensile strength ratio TSR is increased by 5 and 3.5 percent for coarse and fine gradation at opt. design asphalt binder content, while TSR increases by 2.07 and 2.5 percent for coarse and fine gradation at modified opt. design asphalt binder content.

Also it can be concluded that TSR is increased by 6.1 and 4.5 percent when using the SBS polymer modifier for coarse and fine gradation at modified opt. design asphalt binder content for lime filler respectively, while TSR increases by 3.2 and 3.4 percent for coarse and fine gradation at modified opt. design asphalt binder content for cement filler respectively.

Based on laboratory results that are judged to be simulative of field loading conditions, models were developed to predict the resistance to moisture sensitivity of compacted local asphalt concrete mixtures after considering the local material properties, stress level and environmental impacts variables. In general, laboratory results were analyzed using statistical analyses by the aid of (SPSS V22) software. Moisture sensitivity model for superpave asphalt concrete wearing course mixtures was developed.

Keywords: Moisture sensitivity; Stripping; Superpave; anti-stripping additives; and SPSS software
LANE CHANGING AND LANE UTILISATION BEHAVIOUR IN THE UK: EMPIRICAL STUDY

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Abstract
Discernment of driver behaviour is the key to understanding dynamic driver behaviour for lane changing (LC) and lane utilization (LU). The LC and LU parameters are critically important for the calibration and validation of a traffic simulation model and therefore, this study focuses on LC and LU behaviour. Field data has been collected from examples of three typical motorway cross-sections types: two-lane (M602), three-lane (M60) and four lanes (M60). All are located in the City of Manchester in the UK. Video cameras have been installed at suitable vantage points in order to observe traffic in these sections. The data analysis for these locations indicated that there is a relationship between volume of flow and the frequency of LC. As the flow increases, the number of instances of LC increases up to a certain flow but then declines if the traffic flow increases further. The value of flow for maximum LC depends on the section, whether two lane, three lane or four lane. The LU behaviour has also been investigated for each type of cross-sections under study. A number of empirical equations have been derived from this study which will be used in the calibration and validation of a simulation model for subsequent stage of this project.

Keywords: Driver behaviour, lane changing and lane utilisation.
PROGNOSIS INFLUENCE TRAFFIC FLOW: A CASE STUDY IN UNIVERSITY HOSPITAL PROJECT BASRAH

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Abstract
Traffic congestion has recently become a growing problem in many countries. In this work the historical development of traffic and their benefits have been described, the data required for the study were mainly collected through in the Ministry of Health statistical. As regarding the road network, main principles for the accessibility have to be mentioned: The access to public roads has been checked for an advances secure and easy connection to existing main roads (perfect and promiscuous to understand access for cars) and capable for peak hour traffic, public transport and Taxi may get drop off area in front of the plot, Beside, bus stops adjacent to entrance area of the complex, The results showed that the perfect and promiscuous access for pedestrians and cyclists, Avoid of bad effects on neighbor sites and housing development areas, which is not a big issue on plot to causes only small housing areas around.

Keywords: Hospital, Prognosis, Influence, Traffic congestion, Statistica
EVOLUTION THE TRANSPORTATION MODE FROM PRIVATE CARS TO PUBLICS BY LOGIT METHOD: A CASE STUDY IN BAGHDAD

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Abstract  
This paper is an attempt to understand people's behavior and modal choice and try to shift them to means of public transportation. A survey of mode choice between cars users in a neighborhood in Baghdad was conducted. This study is highlighted two models to improve the travel time reduction and travel cost reduction. The sensitivity analysis result showed that the main some attraction that might converse private car users is travel cost and travel time which they would lead to less traffic jam on the roads contributing to less pollution and greater safety.

Keywords: Travel time, switch, reduction, sensitivity analysis, mode of transport, Baghdad
IMPROVING THE ASPHALT CONCRETE SURFACE LAYER BY USING RANDOM FIBERGLASS POLYMER

Abstract
Random fiberglass polymer is a type of fiber reinforced plastic where the reinforcement fiber is specifically glass fiber. In this research, random fiberglass polymer was used and mixed with the surface layer asphalt mixture as a percent of asphalt content weight. Four percentages by weight of asphalt content has been used 2%, 4%, 6% and 8%. The specimens were tested in Marshall Device in order to obtain Marshall Stability and flow. The results show that the stability decreases with percent of fiberglass polymer additives increase so carbon fiber composite polymer was added in a same percentages (2, 4, 6 and 8) % in order to improve the stability of asphalt concrete surface layer mixture. The results show that the stability increases with percent of carbon fiber composite polymer additives increase.

Keywords: Asphalt concrete, Fiberglass polymer, Carbon fiber composite polymer.
LIFE-CYCLE EVALUATION OF PAVEMENTS: A CRITICAL REVIEW

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Abstract

With the spread of the notion of sustainability, evaluating alternative roadway design options in terms of economic factors solely has become trivial, and a need has risen to incorporate environmental and social dimensions. In response to this need, life-cycle evaluation (LCE), which consists of assessing the impacts of certain product/project from cradle to grave, has gained popularity among the pavement community. In its broad sense, LCE encompasses three main evaluation methods that are discussed thoroughly in this paper: life-cycle cost analysis (LCCA), life-cycle assessment (LCA), and social life-cycle assessment (SLCA). An integration of all three LCE methods is known as life-cycle sustainability assessment (LCSA).

This paper presents a review of the evolution of LCE through each of these evaluation methods with a focus on pavement methods, applications, and tools. The authors attempt to identify gaps in research and practice of pavement LCE, and to suggest enhancements. Incorporating the social dimension of sustainability in pavement LCE and relying on accurate performance prediction and traffic characterization are examples of such improvements. The authors also give suggestions for LCSA scope definition and multi-objective decision making. The paper concludes with recommendations for future research and applications.

Keywords: Sustainability, Life Cycle Evaluation, LCCA, LCA, SLCA, LCSA, Pavement
3D PRELIMINARY SURVEY PLANNING AND DESIGN ROUTE ROAD USING GEOMATIC TECHNICAL AND DATA

Abstract
The problem of determining the route between two locations is one of the important applications in highway engineering for determine the purpose like topography and land use. Based on utilizing, geomatics eng. including field survey remote sensing and GIS techniques to prepay the digital details map to study and evaluate the route location. The presented work including different stages the first one required image processed of high resolution satellite from(quick bird) for region under study (Karbala province). The process image include geometric correction using the selected (18) ground control point GCPs from field survey and the next stage using DEM for Karbala of the export point (x, y, z) to AutoCAD for drawing alignment of road and built profile with cross section finally calculated volume (cut& fill)to determine the best rout and export route to GIS to determine the land use from cadastral map and produce the digital map of study area.

Keywords: satellite image, preliminary survey, design road
GIS MODEL FOR PRODUCING HYDRAULIC SOIL GROUP CLASSIFICATION DIGITAL MAP OF BAGHDAD CITY

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Abstract

The Geographical Information System (GIS) was used to produce a major United States Department of Agriculture (USDA) textural soil classification digital map and subsequently produce the Hydrologic Soil Groups (HSG) classification digital map for Baghdad City. The produced map can be baseline data for estimating runoff using the Natural Resources Conservation Service (NRCS) runoff curve number (CN) method.

Soil investigations reports for the 23 years (1990 to 2013) were adopted as a reference for 362 boreholes spread randomly within Baghdad City. The soil data of these boreholes and a digital map of Baghdad City were used for estimating HSG.

GIS techniques were integrated with the geo-statistics to analyze the spatial variability in soil properties within the city, where the shape files of soil separates are interpolated using kriging combined with semi-variogram parameters to generate digital maps of sand, silt and clay which are used in preparing major USDA textural soil model.

Digital maps of soil separates were used for applying percentage criteria of the twelve major USDA textural soil classes as rules within knowledge based classification model in ERDAS Imagine 11.2 software to predict the required soil characteristics digital map.

The Soils within the city were assigned to HSG according to Technical Release 55 (TR55) of USDA-NRCS criteria, by using knowledge based classification model to predict the HSG map.

The overall accuracy of HSG model produced from knowledge-based classification is 97.93 % with Kappa coefficient of 0.916 indicate that the produced HSG map was at high level of accuracy.

The produced soil textural map shows that among twelve classes, seven classes of soil texture appeared within the area of study which were: Loam, Silt Loam, Sandy Clay Loam, Clay Loam, Silty Clay Loam, Silty Clay and Clay. The produced HSG digital map shows that the most of area of study covered with D class (89%) followed by B class (10%) and very small part of C class (1%). The results of accuracy assessment and the produced digital maps show that the implemented model and the produced digital maps can be effectively used for estimation runoff within Baghdad City.

Keywords: GIS, HSGs model and USDA textural soil classes
Abstract

In the last two decades Terrestrial Laser scanning (TLS) was found to be the best digital technology to provide an effective solution to preserve and sustain heritage buildings. This can be achieved by monitoring and identifying any differential movements, deflection, cracks in such structures and deliver an applicable scientific solution and avoid extinction to this valuable heritage. The data delivered from this technique are required to study and further analyze the behavior of these structures from construction and geomatics point of view in order to assess its stability by allowing detecting a very huge number of information with relatively short time and high accuracy. This research is aiming to preserve Al-Kadhimiya Holy Shrine in Baghdad/IRQ by monitoring the deflection in constructed Minarets and cracks holds due to engineering works followed building expansion project, ground water and time factor effects. The project was hold for 12 months with monthly observation monitoring using Stonex X300 TLS device and traditional field surveying techniques. The scan was made using fine resolution and camera close-range coverage. The data have been processed using 3D Reconstructor software/ Survey 2014 Module resulting three-dimensional model represents what often is of concern. The geometry of the structure was described through the analyses of the captured point clouds along the monitoring period of time. The Minarets’ deflection and available cracks were the main focus of this study. The observations were run alongside traditional surveying techniques and photogrammetric modeling. The validation process were accomplished with the aide of traditional measuring instrument whereas the photogrammetric work and their accompany results will be presented in a separate paper work in near future with comparison study of the three used techniques. The overall motivation of this research is to preserve the cultural heritage in IRAQ using new laser techniques for the first time for such important applications by aiming to deliver high accurate results and saving both time and efforts as compared with available traditional process.

Keywords: Terrestrial laser scanning, Cultural heritage, 3D reconstructing, Deformation, Monitoring.
ENVIRONMENTAL CHANGE DETECTION OF THE MAIN DRAIN AREA, IRAQ

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Abstract

The Main Drain is a longest canal constricted from the middle to the southern parts of Iraq for transporting the agricultural and saline waters of the areas between Tigris and Euphrates Rivers via well-linked drainage networks. Multi-temporal satellite Images of the periods, 1990, 2001 and 2013 are used for assessment the environmental change detection of the area restricted between Tigris and Euphrates Rivers, where the used indicators includes: Normalized Differential Vegetation Index (NDVI), Normalized Differential Water Index (NDWI), and Salinity Index (SI). ERDAS V. 11.1 and ARC GIS-10 software’s are used to conduct and process all the required calculations. NDVI and NDWI results show similar behavior where they explain decreasing patterns at the year 2001 and then slightly increasing at the year 2013, this is due to the decreasing of the available water quantities and hence the vegetation cover at 2001 due to the drought condition at that year. Salinity Index (SI) shows growing increase reflecting the continuous deterioration of agricultural land in the study area. The drought conditions, misuses of the irrigation water, and mismanagement of some secondary drains considered as the main degrading factors affecting the Main Drain area. Protecting of the Main Drain and surrounding areas by completing the lands reclamation plan in association with a proper operation scheme of the Main and secondary drains is of prime importance in this regard.

Keywords: Iraq, Main Drain, Change detection, NDVI, NDWI, SI.
EVALUATION OF TIGRIS RIVER POLLUTION USING GIS TECHNIQUES

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Abstract
Tigris River nowadays suffering from pollution because of heavy population and increasing water demands in the region. Also, there are many sources of pollution discharge their wastes into the river from both sides, like industrial waste water, sewage waste water and hazardous waste water. The heavy pollution and the deterioration of water quality are becoming big threats to Iraq. Therefore, the Iraqis are facing a serious problem, which is Tigris river pollution which has bad effects on increasing the possibility of diseases breakout and lack of suitable water for drinking and other uses.

This research included evaluation of Tigris River pollution using GIS techniques, through collecting the data of ten pollutants parameters which are pH, Biochemical Oxygen Demand, Chemical Oxygen Demand, Sulfate, Phosphate, Nitrate, Total Dissolved Solids, Total Suspended Solids, Chlorides, and Oil from eleven stations along Tigris River for the year 2013. The results are compared with the maximum permissible limits of Iraqi Specifications. The results indicated that most of these parameters are above the maximum permissible limits except pH , Nitrate, Chlorides and Oil where they are within the permissible limits of Iraqi Specifications. But the minimum values for most of the above parameters were at South Electrical Power Plant, because there is waste water treatment unit also their wastes are considered as thermal pollutants.

Keywords: Tigris River, GIS, Pollution, Iraqi Specifications.
PRODUCT THREE DIMENSIONAL MODEL BY USING CLOSE RANGE PHOTOGRAMMETRY AND PLANE SURVEYING

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Abstract

In this study, a combination of close range photogrammetry techniques and plan surveying techniques are used to produce the three dimensional model, which is one of the important topics at the present time because it is used in many engineering applications, industrial, medical and other applications. The study area was in the University of Baghdad, specifically for the building of the university tower this research has been produced the three dimensional model of the tower depending on the overlapping ground images captured by digital camera and the distance between the exposure stations was 10 m and then the total stations device was used for measuring the coordinates of ground points distributed on the University of Baghdad Tower. The mathematical model used in this study is the direct linear transformation method to intensify ground points which are used to produce the three-dimensional model of the University Tower.

Keywords: close range Photogrammetry- plan surveying -DLT-Matlab-RMSE
DEVELOPMENT OF AN ENVIRONMENTAL DATABASE MANAGEMENT SYSTEM WITHIN GIS ENVIRONMENT

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Abstract
From the later half of the 20th Century, human population movement, land development, and rapid increase in the usage of harmful chemicals have led to destruction of the Groundwater System. Practical environmental research is necessary to solve these issues. In order to promote interdisciplinary research among a wide range of different fields, it is important to create a unified database capable of integrating, managing and transmitting research results. In particular, techniques for constructing a database for supporting geospatial analysis have not been developed for interdisciplinary environmental and groundwater quality research, where sharing information among various fields is very important. Specially, Sharing of information quite is important about the environment that is various research areas. But the technique about construction of the spatial database and the spatial database, which supports interdisciplinary research, is not established yet. A Geographic Information System (GIS) associated with a Relational Database Management System (EDBMS) can make an important contribution to environmental modeling. Together they can be used to manage and provide necessary input data and to analyze and visualize the model results.

The article describes a class system that forms a GIS/EDBMS interface to the Groundwater Quality model developed at the Indian Institute of Technology Roorkee for PhD Research in Environmental studies in Roorkee, Indian. Its ability to develop a database specifically for the purpose of groundwater quality modeling, and at the same time to keep it as flexible as possible to eventually use the data for a variety of purposes. The database was developed using Visual FoxPro 6.0.

Keywords: Environment, Groundwater, water quality management, GIS data model, EDBM , Visual FoxPro database, Hydrogeological studies
THE USE OF GIS TO DETERMINE THE BEST ROUTE FOR HIGH VOLTAGE POWER TRANSMISSION TOWERS

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Abstract
Selecting best route location and high voltage power transmission towers alignment process is a complicated one, due to the many variables that must be taken into consideration for achieving the best results. Geographic Information Systems (GIS) can easily model such variables, including topography, environment, built-up areas, and geology variables. This study took advantages of GIS capabilities that offer the ability to overlay maps, merge them, and perform spatial analysis on various layers of information in either two or three dimensions. In this study, a GIS model for route location and highway alignment was developed and used to generate alternate highway route applications, the model was used to analyze, evaluate, and then select the alternative with least impacts on environmental and economical aspects.

In this application, the advantage of the developed model was clear in the preliminary stage of alternatives generation where it was possible to avoid impacting of the different sensitive areas. The research aims to build a database to find a path to power lines to Balad city, north of Baghdad transport. I have requested an assessment of the work economically and technical factors to reduce environmental constraints and construction costs. The final maps have shown optimal path for power transmission lines, which it has been compared with the old track was found that the proposed path in this study is the best being a shorter and less expensive.

Keywords: Route Selection, Geographical Information System (GIS), DEM, Multi Criteria.
ESTIMATED CONVERGENCE OF QUANTITATIVE METHODS IN ESTIMATING LAND USE TRANSPORT - AN EMPIRICAL STUDY IN THE CITY OF FALLUJAH

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Abstract
Transport is one of the infrastructure important services in the city, which shares its land uses several different and sizes and often have to use transport a significant impact on the formation of these uses that save time, effort and be the cause of accessibility. Accessibility to achieve efficiency in the functional interdependence Connection toward the formation of installation city ordinance.

With the increase in population numbers in the cities and the emergence of social and economic developments produced a dramatic increase in the number of cars that came require additional network be able to accommodate these changes and organization as required, which gives the city the possibility of urban growth in the right direction processions of the evolution of population sizes and uses of the land. So now it requires techniques and methods have the ability to determine the size of these developments, if correct and revised estimates adopted where possible that the results of the style of the other estimates differ to varying degrees, which requires the adoption of a style results closest to the real application.

Perhaps the typical use of linear regression and time series may lead to the first glance that the alleged disparity if adopted these models in urban land uses estimates for the purposes of transport, especially since the first model belongs to the static models Static while the second model belongs to the dynamic models Dynamic.

Therefore comes this research in order to detect the extent of convergence estimated these two models when calculating the size of land use for transportation in the city of Fallujah, which was waiting required for the transport network in which expansion in line with population growth and the expansion of residential neighborhoods that spanned the edges over recent years.
DELINEATION LANDFILL DEPTH USING 2D ELECTRICAL IMAGING TECHNIQUE IN KUT CITY, EASTERN IRAQ

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Abstract

Electrical resistivity surveys were carried out at a site of mosque construction in Kut city, Wassit Governorate, Eastern Iraq. The aim of this work is to identify the landfill depth in the site for engineering decisions. The resistivity survey was carried out by using 2D imaging techniques. Five 2D imaging sections were applied using Wenner - Schlemberger array. The data collected from 2D ERI, by Terrameter SAS 4000, generated profiles of the acquired data helped to map the landfill depth, which was delineated as an area of high interpreted resistivities. These profiles obtained from 2D inversions that collected by RES2DINV software. The depth of investigation was 23.2 m, and resistivity values range from 1 to 1000 Ω.m. The landfill layer was recognized as the upper layer with high resistivity ranging from 30 Ω.m to more than 1000 Ω.m. This layer appears at different depths starting from ground surface and sometimes from 2 m to a depth of 8 m. The sections also show a layer with medium resistivity (5-30 Ω.m) represents the clayey sand layer overlapping with layer by very low resistivity (< 5 Ω.m) that represents the silty clay. One of these sections shows deeper anomalies reaching a depth around 23 m. The outputs interpretation is in agreement with borehole logs available in the site of the study.

Keywords: 2D Resistivity Imaging Technique, Landfill, RES2DINV
SELECTION OF THE BEST MATHEMATICAL MODEL TO CALCULATE THE INTERNAL ORIENTATION PARAMETERS OF THE NON METRIC CAMERA FOR ENGINEERING APPLICATION

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Abstract

Due to the development in the digital technology, particularly the production of high-resolution digital non metric cameras with low relatively cost compared to standard cameras so this research was selected to calculate the internal orientation parameters of the non metric camera thus be used for the engineering application.

In this study, a number of mathematical models have been used and then choose the best model by computing the root mean square errors, the triangulation technique that be used is the bundle adjustment to compute the coordinates of targets prepared for the purpose of self-calibration of the non metric camera a test is done on these targets by taking a pair of overlapping images and then calculate the ground coordinates based on the equations of the collinearity condition equations after adding the additional parameters to the collinearity equations, which is represented by the internal orientation parameters by using Matlab program.
USING REMOTE SENSING TO HINDCAST WATER QUALITY IN A SEMI-ARID RESERVOIR

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Abstract:  
Landsat 7 ETM+ images were used to predict and hindcast the summer trophic status and peak surface area of Qaraoun Reservoir in Lebanon between 1999 and 2012. Trophic status was determined using an empirical algorithm developed for detecting chlorophyll-a content in the reservoir using near-infrared, red, blue, and green bands. The results show that over the study period, the reservoir has oscillated between mesotrophic and eutrophic states, with indications of a slight shift towards a more eutrophic status over time. Peak reservoir surface area was found to vary inter-annually, a typical feature of semi-arid reservoirs. The maximum annual surface area ranged between 6.7 and 10.2 km². No consistent and statistically significant changes were found over time.
THE EFFECTIVENESS OF FOURIER ANALYSIS IN SPECKLE REDUCTION FOR SAR IMAGE WITH TWO POLARISATION BEFORE AND AFTER APPLYING PRINCIPAL COMPONENTS TRANSFORMATION

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Abstract
The contribution of digital image processing especially Fourier Analysis and Principal Components to SAR data in speckle reduction is significant because this technique offers specific features in frequency domain which spatial domain cannot attain. Generally, despeckling methods trade spatial details for noise reduction. The complexity of the speckle in Cosmo-SkyMed imagery with (HH and VV) polarisation where speckle is a real electromagnetic measurement, which is exploited in particular in SAR interferometry therefore the speckle elimination must be submit to the purpose of case study. The accuracy of the result strongly depends on the scattering mechanisms at the time of the data takes. This paper aims at linking the potential of Fourier Analysis with regard to speckle and at automatically reducing the noise intrinsic to such processing.

Keywords: Synthetic Aperture Radar (SAR), Speckle, Fourier Analysis.
REAL-TIME CALIBRATION OF CLOSE RANGE DIGITAL NON-METRIC CAMERA WITH PRECISE PORTABLE CONTROL SYSTEM

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Abstract
Now a day, two type of cameras are used for data acquisition in analytical photogrammetry, metric and non-metric (digital) cameras. Metric cameras are designed and manufactured for photogrammetric data acquisition, they have very well defined, precise and stable Interior Orientation Parameters “IOP”. On the other hand non-metric (digital) cameras are designed and manufactured for commercial use, which are mainly interested in the image resolution inexpensive of lens distortion accordingly, non-metric digital cameras suffer from unstable and Interior Orientation Parameters “IOP” with significant lens distortion, consequently there is no “permanent” calibration of non-metric (digital) camera.

In this research a numerical approach with a portable control system will be used to determine the IOP for each photographing seasons with zoom [changeable focal length] digital camera.

Keywords: Analytical Photogrammetry, Camera calibration, IOP.
Abstract

According to the importance of maps and images in this days which considered a multipurpose database spatially and environmentally around us, there are many programs to rectify processing maps and images to utilize them for different purposes. GIS (Arc Python) is one of the map georeferencing program at the moment to, which contains the mathematical models designed to rectify processing the maps and images. ArcPython was done used it to provide plenty of effort and time in georeferencing process, suitable for large projects, can be convert the scripts language to tool and considered new georeferencing method of maps and images.

The aim of this paper is map georeferencing using GIS (Arc Python) program was done using three register points (points intersection of latitude and longitude for the same map) to map georeferencing process. The purpose assessment map resulting was done conformity with the Quickbird satellite image 60 cm spatial resolution and the results showed that the matching accuracy for all study area objects almost to 95%.

Keyword: Map, Rectification, GIS (ArcPython), Georeferencing, Quickbird.