



Engineering
DESIGN

DAY

PROJECTS
ABSTRACTS



12TH OF MAY
2022
COLLEGE OF
ENGINEERING
UNIVERSITY OF
DUHOK

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uod.ac/edd

About The College of Engineering

The College of Engineering is one of the biggest colleges at University of Duhok with a national reputation in engineering. It has established in 1994 with 40 students and 6 full-time academic members and has kept growing ever since. We have over 1350 undergraduate and graduate students and 134 academics across the seven academic departments, namely, Civil Engineering, Water Resources Engineering, Surveying Engineering, Electrical and Computer Engineering, Mechanical Engineering, Architectural Engineering and Biomedical Engineering, including 23 teaching and research laboratories.







About The Event

The Engineering Design Day (EDD) is an annual opportunity for undergraduate students in the College of Engineering departments to showcase their design projects. The activity allows students to put their core design concepts into practice during their study.

It also provides a place for a large meeting between businesses and designers. The aim of the event is to provide a platform for different stakeholders to have a dialogue on design related initiatives taking place at different community levels. More specifically, it is aimed to discuss the role of design in developing the public and private sectors and their services.



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Event Team



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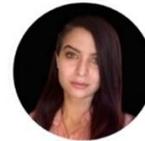
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ARCHITECTURAL ENGINEERING



GRADUATION PROJECTS

Supervisors of all projects: Dr. Rana Fathi, Mr. Hussein Yousif, Mr. Shorash Salam and Mr. Aram Omer

ARCH01 Psychosocial Treatment Center

By: [Malin Abass Halo](#)

The project is therapeutic center for all types of psychological treatment and mental illness. Include different types of psychotherapy and social and vocational training. Also aim to provide support, education and guidance to the community to reduce mental illness.

ARCH02 Indoor Sport Halls

By: [Mateen Muhammad Tahir](#)

My project consists of various types of indoor halls. Hall for gymnastics, hall for multipurpose sports, yoga hall, martial arts hall, recreation halls.

ARCH03 Gynecology and Obstetrics Hospital

By: [Dilman Dawod Ahmed](#)

I take the concept idea of my project from DNA shape And my project contains ambulance, Clinic and obstetric and laboratory units, which is located in Tenahi – Duhok.



ARCH04 Drug Factory

By: Halger Sidqi Ziyab

Aim of this project is product necessary drug for Duhok city also all Kurdistan region concept of project took from chemical function, the factory will have four line production are (eyedrops, capsule, tablet, phials).

ARCH05 Multi Story Residential Buildings

By: Thekra Zeyad Tariq

It's a luxury residential project located on Zawa mountain, it has 10 mid-rise buildings, with services for each building and public service as well, it also has a large central green area, semi and private area, 2 blocks types and 3 apartment types.

ARCH06 Dentistry College with Clinic

By: Sipan Ahmed Nidhamaldeen

The project consists of two main parts which are college and clinic, and the concept of the project is taken from the teeth structure with braces and combined with the plan of kawa school to shape an interesting form.

ARCH07 Plastic Surgery Center

By: Zehra Saleem Haji

Plastic Surgery is a medical operation to bring a damaged area of skin, and sometimes bone, back to its usual appearance, or to improve a person's appearance. The project includes the treatment of burns, hand surgery and also aesthetic surgery.

ARCH08 Luxury Shopping Mall

By: Jiman Shukry Omer

Shopping has always been a crucial part of everyday life and throughout history there have been many establishments housing this activity from simple Squares to modern commercial complexes. In our region's history we have had many such examples, but now the dominant form is shopping malls. People like to spend their leisure time at shopping malls. Even, when tourists come from out-of-town or from another country, they mostly visit popular shopping malls.so I decide to design the shopping mall for my graduation



thesis, especially a luxury shopping mall which we do not have such a project like in the Duhok city and it attracts my attention because of their functional variety.

I bring the main idea of the building from the plan of traditional khan bazaar and the logo of one of the most luxurious brand (Bulgari) because I want to realize the idea of connection between traditional and modern shopping world and then end the traditional bazaar with the most luxurious modern brands which I do it, and this connection between the modern and traditional shopping represent the main characteristics of (postmodern) style which is my style for my graduation project.

ARCH09 Carpet Factory

By: [Srou Muhsin Bahram](#)

The project is industrial infrastructure that will be located at Duhok, the project is about a carpet factory that will produce Kurdish rugs and carpets improving the economy and creating a cultural and art platform for designers.

ARCH10 Financial Complex (Stock Exchange and Bank)

By: [Noor Ibrahim Jalaluldeen](#)

This project explains in depth and detail the financial complex that contains the bank and stock exchange markets project with its many components. Further explaining the details of design and areas of spaces along with the site specifications and services used in the complex. The complex is located at the city center of Duhok, using the postmodern style. I wanted to build the complex in a modern developed methodology to attract representatives of foreign companies and banks to invest here and recognize and maybe work with our monetary papers and may it open the door for our monetary papers to be recognizable worldwide and to be entered into the international banks and stock markets, also I wanted to achieve the greatest degree of flexibility and take into account the possibility of future expansion with using modern ways of transaction to fasten the word and lessen the crowd.

ARCH11 College of Fine Arts

By: [Mohammed Shawkat Chato](#)

The project consists of 5 departments and a deanship serving 612 male and



female students. The concept of the project consists of two layers, the first is guitar strings, and the second is wave music.

ARCH12 Olympic Swimming Pool

By: [Lawk Khalil Lawk](#)

My project consists of swimming pools that are used for competitions (for events) and recreations also used for teachings.

ARCH13 Kurdish Multimedia Museum

By: [Laween Khudeeda Khudher](#)

My project talks about a visual and audio museum for the Kurds, and I used the idea from the Nowruz logo and an old musical instrument and combined it with the deconstructive style (Frank Gehry style) and I also used activities on a lake because the site is located in the Mosul Dam.

ARCH14 Faculty Of Architecture and Urban Design

By: [Sumaya Abdulaziz Ahmed](#)

Is an educational project, consisting of four departments with a deanship, library and gallery and other entertainment spaces. The concept of the project took form the design process of the black box and glass box with the modern style.

ARCH15 Kurdish Genocide Center

By: [Jisar Naif Ahmed](#)

My project is about our Kurdish cultural and history to show for the whole world and future generations about our history my project includes different zones such a main zones exhibitions and conferences hall with multi-purpose hall and also educational and administration zones with cafe and restaurants.

ARCH16 Agricultural Directorate and Research Center

By: [Nora Haje Taher](#)

My project consists of two main departments (administrative department) and (research center), with other secondary departments like (guidance and awareness dept, horticultural dept, animals wealth dept, land dept). The



project is located in Duhok city. The reason for choosing this project is that Kurdistan is an agricultural land, specifically Duhok city, that needed more value and solved many problems that we have today's about agriculture in Duhok.

ARCH17 Design School

By: [Layla Hassan Nayf](#)

My project is design school it consists of four departments (graphic design, jewelry design, fashion design, industrial design) ...I have taken the main idea for the project from

1. design's elements (point, line, shape...)
2. design principles (repetition, scale, rhythm).

ARCH18 College of Humanities

By: [Salar Sadeeq Rasheed](#)

The humanities are academic disciplines that study human culture and behavior. The humanities use methods that are primarily critical, or speculative, and have a significant historical element. The humanities include history, geography, Psychology, sociology and Islamic studies etc.

The style of project will be local, and the concept is taken from the historical heritage of Kurdistan buildings.

ARCH19 Municipality Directorate

By: [Milhim Kmo Qasim](#)

The municipality project is trying to find a building commensurate with the importance and objectives of the city of Dohuk and its ambition through a project that achieves the symbolism and status of the city, as well as the importance of such a project in terms of functionality and services).

ARCH20 Mechanical Engineering College

By: [Resan Jaafar Abdulmanaf](#)

The reason I chose this project is The Mechanical Engineering Department is located in a building that is meant to be used as laboratory and storage for other engineering departments. and the facilities we choose are the ones that we need in the city of Duhok and the Kurdistan region, The main

departments in college (1-Mechanical engineering, 2- Metallurgical Engineering, 3- Aeronautical Engineering and 4-Railway Engineering).

Also, the concept of the project is simulation from one of the famous mechanical engines which is the steam machine, which was one of the most important elements to start the industrial revolution. Also using repetition and rotation indication of motion specially because the concept is from a machine, also the style I choose to use in the project is futurism (modernism).

ARCH21 Commercial Bazaar

By: [Huda Naaman Omer](#)

Traditional Kurdish bazaar that my concept is (alxan) that have a courtyard and the second layer from the site in this project we will sell a traditional things and workshops and educational zone.

ARCH22 Four Seasons Hotel

By: [Rand Dindar Saleh](#)

Nowadays more people are getting to know our country experiencing and discovering our culture from all around the world. This is why bringing one of the most luxurious hotels to Duhok and building it in a site with the most beautiful view (Zawa mountain) is a must. since four seasons cherish each countries culture and reuse ancient building in some countries, I used the form of one of the most famous hotel in Duhok in 70s (stone hotel in Sarsink) while keeping the main form of the hotel and adding more parts to the hotel to make it more spacious and suitable for a stay in and a vacation.

ARCH23 Resort

By: [Chra Miroo Muhamedsalim](#)

The project is a tourism resort on Mosul dam the concept of project is derived from the shape of the peacock which is considered a sacred thing for people of the area in which the project is located.

ARCH24 Olympic Stadium

By: [Mohammad Qasim Hussein](#)

Olympic stadium: It includes summer games such as athletic and soccer games for Duhok and its surrounding, the project site is at New Duhok the

stadium capacity is around 60000 in soccer games and will be less for athletic gaming.

ARCH25 Directorate Of Heritage and Archeology

By: [Mahmood Ibrahim Atiya](#)

The archaeological record consists of artifacts, architecture, bio facts or Eco facts and cultural landscapes. Archaeology can be considered both a social science and a branch of the humanities. Archaeology has various goals, which range from understanding culture history to reconstructing past life ways to documenting and explaining changes in human societies through time.

So I saw in our society being indifferent to archeology and History of Kurdish and Iraqi also, so I chose my project to be The Directorate of Archeology in Kurdistan and all of Iraq as well as to contain training places to preserve the Archeology and not lose their precious value and all this after analyzing successful examples carefully and creating an appropriate Functional program that supports my goals with the appropriate structures and services.

ARCH26 Motel Complex

By: [Sitti Khalid Ismael](#)

The project contains 2 types of motels (a private and multi-storey motel) and its location in Zawa mountain. Our goal in this project is to show the characteristics of Kurdish architecture and how to deal with different levels on the site in the manner of Kurdish villages such as the village of Akri.

ARCH27 Urban Design Tourism Project

By: [Leena Jassim Mohamad Ali](#)

A tourist project, a complex of restaurants, cafes and a casino. This project includes various entertainment games, video game halls, gyms, table games, gambling halls, open and closed restaurants.

ARCH28 Aquarium Project

By: [Nora Sherzad Ali](#)

The site located in Mosul dam and the concept is the shape of fish and abstract it and another layers in postmodern used the details of Mario Botta building for elevation.

ARCH29 Northern Automobile Club

By: Saif Aldeen Sardar Mohammed Sharef

The project is a club that specializes in all cars of all categories. It includes a car museum, in addition to an event hall for companies that want to advertise their modern cars, as well as a car repair workshop, in addition to a racing circuit. The project is a club that specializes in all cars of all categories. It includes a car museum, in addition to an event hall for companies that want to advertise their modern cars, as well as a car repair workshop, in addition to a racing circuit.

ARCH30 Automotive Industry (Taxi Kurdistan Assembly Company)

By: Rayan Mousa Haji

It is an industrial project located in Kwashe near the old industrial area. The project contains two assembly lines.

ARCH31 Tourism Administration

By: Rithwan Ismaeel Abdulazeez

My project is a tourism administration that includes a tourist zone and administration zone with other services and my site is location in Etot.



CIVIL ENGINEERING



CIVL01 Rapid Method of Concrete Mix Design

By: Alind Hamdi Majeed • Osama Azad Jameel • Peyam Muhammed Muhammed Tahir • Alind Fattah Hassan • Araz Nizhyar Najeeb

Supervisor: Mr. Ghanim Hussein

Since the quality of concrete is calculated in terms of 28 - day compressive strength and this period is too long for either quality control of concrete construction or applying timely corrective measures particularly in today's fast construction practices . Therefore, it was found necessary to predict the strength of concrete within few hours instead of waiting 28 days by using accelerated curing methods.

Based on the above, the present project aims at using boiling water method to study the accelerated strength behavior and to present a correlation between accelerated strength and both 7 and 28 - days strength.

Five mixes were designed by ACI method of different strengths, and tried using two types of coarse aggregate having a slump range of (50 - 100) mm. The test results showed that:

- 1- A good correlation has been obtained between the accelerated curing compressive strength and 7 - day and 28 - day strengths.
- 2- Generally speaking, the ratio of the accelerated strength to the 7 - day strength is always higher than that of the accelerated strength to the 28 - day strength.

CIVL02 Spread sheets for design and analysis of earth retaining structures

By: Amad Azad • Salimkhan Mohammed • Kovan Loqman • Muslim Abdulsalam • Mohammed Osama

Supervisor: Dr. Najdat Sabri

This project contains the work carried out for the purpose of preparation of spread sheet using Microsoft Excel and VB associated with. Two spread sheets are created one is for the analysis and design of cantilever retaining wall and the other for the analysis and the design of mechanically stabilized earth wall. The sheets may be used sophisticatedly with ease entering the input data and automatically obtain the required analysis and design, it is time saving, reasonable accuracy and time saving. the soil backfill data is for cohesion-less shear strength parameter (for both sheets is used. To obtain the coefficients of lateral earth pressure, Rankin's formula is used for static analysis while Monobe-Ocabe formula is used for the seismic analysis.

The quality and reliability of the programs is verified by manually solving example problems and compare to automatic solution of the programs. the programs can be used in practical field and will help in design and analysis of earth retaining structures in more specific and economic way.

CIVL03 Behaviour and Strength of Reinforced Concrete Beams with Regular Openings

By: Amira Ibrahim • Muhammed Adnan Abdulrahman • Helan Adnan Abdulrahman Ali • Saman Salam M. Noori

Supervisor: Mr Jeger Khairy

In practice, transverse openings in Reinforced Concrete, RC, beams are a facility, which allows the utility line to pass through the structure such as a network of pipes and ducts (which is necessary to accommodate essential services like water supply, air-conditioning).

openings in the web of a reinforced concrete beam and therefore, the sudden changes in the dimensions of the cross section of the beam; the corners of the opening would be subjected to stress concentration and it is possible to induce transverse cracks in the beam. Also, it can reduce the stiffness, which lead to deformations and excessive deflections under service load and considerable distribution of forces and internal moments in a continuous beam. So, the effect of openings on the strength and behavior of reinforced concrete beams must be considered and the design of these beams needs special consideration. However, current codes of practice for design of RC structures do not provide provisions for design of RC beams with openings.

Ordinary beams with openings and deep beams with and without openings are considered disturbed regions where their strains within any section are significantly nonlinear. Therefore, it is not adequate to design those regions using either bending

theory or conventional shear design equations. Hence, it is essential to rely on a rational method such as the strut-and-tie model.

The behavior of theoretically tested reinforced normal strength concrete simply supported shallow beams (with and without openings) was studied also testes by software programs are involved (Idea Statica 2021).

To draw a complete picture of the response of the studied beams, a 3D

nonlinear finite element analysis is conducted. From which, the output results of cracking patterns, deflections, failure mode and strain and stress distributions (that can not be obtained using the strut-and-tie model) are obtained. In addition, a full design procedure along with numerical examples.

CIVL04 Soil stabilization of clay soil by using Glass Powder, Limestone Dust and Cement

By: Barzan Jerdo Eido • Haval Rashoo • Jwan Salih • Fatima Nawzad • Rojeen Khalil • Barzan Jerdo

Supervisor: Mr. Hussein Jalal

Glass wastes and limestone dust are two type of waste materials that are dumped-off in high amount causing a negative impact on the environment. Therefore, it is important to find methods to manage these waste materials without causing any ecological hazards. One of these methods is to use this waste as soil stabilizer materials. Traditional soil stabilizations (like cement) is considered expensive, because stabilizing soil with this additive requires large quantity of stabilizer. Therefore, utilization of waste materials as stabilizer provides new opportunities in economical soil stabilization.

This study attempted to investigate the effect of glass powder, limestone dust and cement on geotechnical properties of clayey soil. The effect of these stabilizers was evaluated by performing standard laboratory tests. These tests were consisted of: Atterberg limits, Linear Shrinkage, Standard Compaction, and Unconfined Compressive Strength. These tests were conducted on native and stabilized soil at varying amounts (3%, 6% and 9%) of soil weight.

Laboratory test results showed an improvement in Atterberg limits, Linear Shrinkage, Maximum Dry Density and Optimum Moisture Content of soil. Also, there was significant improvement in the Unconfined Compressive Strength of soil after addition of these waste materials as stabilizer.

CIVL05 Structural systems of tall buildings, case study in 10,20,30 floors

By: Dejin Abid • Rujhat Shukri • Loreen Ahmed • Ravand Ahmed

Supervisor: Mr. Jeger Zaki

New developments of tall buildings of ever-growing heights have been continuously taking place worldwide, the structural system of a high-rise building is designed to cope with vertical gravity loads as well as lateral loads

caused by wind or seismic activity. The structural system consists only of the members designed to carry the loads, and all other members are referred to as non-structural. The determination of the structural system for a high-rise building involves the selection and arrangement of the major structural elements to resist most efficiently the various combinations of gravity and lateral loading. A high-rise building needs to be stabilized for horizontal load and to achieve this, several different structural systems can be chosen. All of the different systems have evolved from the traditional rigidly jointed structural frame. The fundamental design for all these structural systems has been to place as much of the load-carrying material as possible around the building's external fringe to maximize its flexural rigidity.

Among all those structural systems, we have focused on using three of those systems:

1. Rigid frame structure: Refers to a system established with columns, beams and slabs joined together with rigid joints. Rigid Joints are also referred to fixed joints. These are joints with both moment resistance, shear resistance and axial force.
2. Shear wall system: A structural system that employs heavily reinforced concrete walls that resist horizontal forces along their length, it also acts as bracing for concrete frames. It acts as a narrow deep cantilever beam carrying both lateral and gravity loads.
3. Dual system: dual system is a structural system in which an essentially complete frame provides support for gravity loads, and resistance to lateral loads is provided by a specially detailed moment-resisting frame and shear walls or braced frames.

The purpose of the research: the purpose of the project is to compare between the 3 chosen structural systems, and determine which system is most economical to be used based on number of storeys (10,20,30) storeys

This will be provided by statical checking (dynamical is required) of the results obtained from etabs

Research Methodology

The research methodology was based on Quantitative research for selecting the data

Quantitative research is the process of collecting and analyzing numerical data. It can be used to find patterns and averages, make predictions, test causal relationships, and generalize results to wider populations.

Results

After the work has been executed by using etabs 2016 and comparing between the systems in terms of strength and economy, the results were as the following:

Rigid frame system is the most economy system for a high-rise building with 10 floors.

Dual system is the most economy system for a high-rise building with 20 floors

Shear wall system is the most economy system for a high-rise building with 30 floors.

CIVL06 Water Treatment For Rural Area By slow sand filtration.

By: **Dejin Muhammad Haji • Vian Obaid Muhammad • Prjin Saeed Tahit • Omer Ali Abdulkarim Abdulaziz • Asia Abdulmajid Fatah**

Supervisor: Mrs. Jwan Noori

The purpose of this project is to design a water treatment plant for Khanke town in Simele district of Duhok governorate in Kurdistan region. The population of town is 24000 and the area is about 3.36 hectare and it contains 21 villages.

In this project, slow sand filtration system is used for treatment process because it is characterized by high reliability and rather low lifecycle costs. Moreover, neither construction nor operation and maintenance require more than basic skills.

The design of the project based on a 15 year design period, 32780 capita and a maximum treatment capacity of 6638 m³/d. The raw water will be pumped to the treatment plant from a direct intake type to two rectangular sedimentation tanks in order to allow suspended particles to settle out of water, The water from the sedimentation tanks goes to slow sand filter which effectively removes turbidity. The clear water from slow sand filter flows to a storage tank in order to supply the network of the town.

CIVL07 Modelling, Analysis And Design Of Multi-Story Building Using Autodesk Revit And Robot Structural Analysis Professional

By: Dereen Mohammed Hassan • Majid Matte Shlimon • Setare Sabah • Hala Talib • Niveen Sleman

Supervisor: Mr. Youkhanna Zayia

A structural engineer needs to save time to compete in the ever-growing competent market. As a sequel to this, an attempt is made to analyze and design a residential multistoried building by using the software package Autodesk Revit and Autodesk Robot structural professional. For analyzing a multi-storied building, one has to consider all the possible loadings and see that the structure is safe against all possible loading conditions. The link between Autodesk Revit or Autodesk Revit Structure software and Autodesk Robot Structural Analysis Professional software helps make this workflow smoother by facilitating the coordination of design documentation with structural analytical design information. The present project deals with the design and analysis of a multi-storied residential building of G+11 consisting of 4 apartments on each floor. The gravity loads (dead & live) and lateral loads (Seismic & Wind) are applied to the structure following the ASCE 7-10 requirements and the design for the slab, beams, columns, shear wall, and the footing is obtained according to ACI 318. We conclude that Autodesk Revit and Robot structural professional are very powerful tool that can save much time and is very accurate in Designs. The integration between Revit software and Robot Structural Analysis Professional facilitates the coordination of design information and construction documentation. Additionally, Revit offers many tools and modeling practices to prepare a model for smoother interoperability with Robot Structural Analysis Professional and other widely used structural analysis software applications.

CIVL08 Analysis of the Contributory Factors to Road Traffic Accidents and Identifying High Accident Locations in Duhok City

By: Hndav Gohdar • Warjin Mahmud • Nareen Ageed • Rayan Taib • Binar Farsat

Supervisor: Dr. Nasreen Ahmed

Ensuring safety on roadways and controlling conflicting and merging streams of traffic at signalized intersections has become a major concern for transportation engineers and road users globally and locally. There is a substantial number of accidents that occur every year in Duhok city and has not been decreased considerably over the last years. Many factors contribute to accident occurrence at road segments and intersections with driver

behavior being the major contributor. Other factors include those related to the vehicle and the road. Reduction of road accidents is based on accurate identification of High Accident Locations (HALs) by suggesting suitable solutions and countermeasures. The primary aim of this study is to understand the impact of different factors causing traffic accidents at signalized intersections and identifying HALs in Duhok city and ranks the signalized intersections and road segments using frequency method, critical accident rate method and GIS tool. To achieve this objective, 22 signalized intersections and 70 road segments were selected. Assessing the effects of geometric characteristics and driver behavior on safety performance of the sites has been achieved through developing a descriptive study of the traffic accident data, observations of trends from graphs and use of appropriate advanced statistical analysis such as Generalized Estimating Equation (GEE) with Negative Binomial distribution and log link function. The results show that approach width, driver inattention, red light running and surface moisture condition are the significant contributors to accident occurrence. Furthermore, identifying HALs indicated that, of intersections, Tax, Benavi 1, Benavi 2, Chamber of Commerce and Etite intersections are hazardous locations. Of road segments, two segments of Qazi Mohammed road, Daniel Meteran road and Zakho way are high-accident segments. The study results are helpful for understanding how to improve geometric characteristics and educate and aware drivers to reduce accident occurrence.

CIVL09 Identify Buildings Potential Weaknesses in Duhok-city: a Review and Survey

By: **Jamela Waleed Aqeed • Dyana Khalid Nassir • Lolav Awni Sabre • Mustafa Azad Shawkat • Reveng Hussin Khalil**

Supervisor: Dr. Abdulhameed Abdullah

For the purpose of providing a study to Identify Buildings Potential Weaknesses of buildings in Duhok-city by surveying and reviewing masonry concrete buildings, reinforced concrete and hybrid concrete buildings that have been classified each one of them into under construction or in-use structure using civil engineering principles and concepts, taking into account the characteristics of the studied area. The study and review were carried out using a rapid visual inspection method, to identify the weaknesses and the degree of that based on their sources, which are relying on factors that caused them to be based on a design, implementation and or external factors. The data was collected to include a total of more than (450) building units distributed in different areas, the characteristics of each area, and

randomly places within Dohuk. It includes the analysis of this data in a form of a model using graphs to represent the weaknesses of each unit classification, and the percentage of buildings that are exposed to it. These results are discussed according to the percentage of the danger that they cause and how common they are, and solutions are provided in general to some of these to be processed in general, whether these defects are local and common, appropriate to the capacity of the studied area, and taking into account that the treatment is to fit the limits according to which the weak point was measured. A detailed study is provided for the most dangerous of these vulnerabilities to be analyzed using Etabs_2017 and an appropriate solution is provided for the purpose of processing.

CIVL10 Structural analysis and design of a steel multi-story frame building

By: Lawk Jaafar • Marrwa Sadulah Abdulmalik • Lana Ahmed • Huda Jamil • Rayan Abdulrahman

Supervisor: Dr. Abduljabbar Abdy

Steel frame is typically consisting of vertical column and horizontal beams which are riveted, bolted or welded together in a rectilinear grid. One of the advantages of steel while using it in structure is high strengths and light weight nature, toughness which is let it to deform without fracturing and also the steel is ductile which gives a warning before the failure, and a lot of other advantages. The purpose of this project to designing one steel frame building for our college of engineering including all scientific departments, also it's a guideline for everyone who decided to design and build a steel structure. This structure is designed at the base of being built in Duhok city, therefore the environmental conditions of this city are taken into consideration. At first we calculated the load. The load calculations include dead loads, live loads, snow loads, wind load which we calculated by hand according to the Iraqi standards (IQ.301), ASCE7-10 Standards and International Building Code (IBC 2003), and seismic loads we calculated by using engineering software (Staad Pro) according to the Standards and International Building Code (IBC 2003). Preliminary design for the steel frame members such Beams, Girders and Columns following the AISC standards and using the AISC Manual (according to LRFD method), in order to have an initial condition of the section before presenting the structure into the program. Then for the Structural modeling of the steel frame building and conducting structural analysis using engineering software (Staad Pro). Also structural final design of the steel frame members (Beams, Girders and Columns) using engineering software (Staad Pro) and according to AISC standards. Structural design of Steel Bolted

Connections and Steel welded Connections using engineering software (RAM Connections) and according to AISC standards. Structural design of footings and base plates using engineering software (RAM Connections) and according to AISC standards.

CIVL11 Studying the maintenance and management of rural roads in Duhok.

By: [Mateen Khaled Muhammad](#) • [Rayan Saeed Ibrahim](#) • [Aras Safar Obaid](#) • [Abdullstar Sadiq Taib](#) • [Bayar Nawkhosh Abdullah](#)

Supervisor: Mr. Baran Omar

The goal of maintenance is to preserve the quality, not to upgrade it, maintenance must be done regularly. Road maintenance covers “activities to save pavement, shoulders, grades, drainage facilities and all other structures and property within the road margins as near as possible to their as constructed or renewed condition. It contains insignificant repairs and enhancements to eliminate the reason of defects and to avoid excessive repetition of maintenance efforts. Road maintenance is characterized as routine, periodic, and urgent. Roads are exhibit to several troubles that need to fix as soon as possible such as Cracks, Raveling and Rutting etc.

In our study we take a section of a road within 4km and divided it into section within 40m. Then we analyzed each section if needed the maintenance and which problem we have in that section like cracks with its type, raveling, and rutting. Then we calculated the length, depth and width of each problem and calculated their damaged area and density. Finally, we compared this density with different codes to know the best way for maintenance.

As a result we considered that in the case of having issues in constructing, executing in the field, mixing during manufacturing, weather changing throughout the different seasons and load repetitive of dissimilar types of vehicles there will also be problems in the road such as cracks with their types, raveling and rutting etc. as there were difficulty in the highways and especially in rural roads Solutions must be present, at least, to reduce the proportion of problems in the roads.

CIVL12 2D and 3D Free Vibration and Earthquake Analysis of High-Rise Building Using PLAXIS Softwares

By: Noor Salih Salih • Sazan Mahmood Muhammed • Ronahi Bapir Ahmed • Dilveen Bishar Faidullah • Malika Haji Jangir

Supervisor: Dr. Rafi' Mahmoud

This project presents a series of 2D and 3D analyses of the free vibration and earthquake of a high-rise building using Plaxis software v20 under plane strain conditions. The building consists of twenty floors and one basement. The first floor of the building is 4 m high, and the other floors are 3 m high, whereas the basement is

3.5 m high. So the total height of the building above the ground level is $4 + (19 \times 3) = 61$ m. A value of 5 kN/m^2 is taken as the weight of the floors and walls. The building is constructed on a raft foundation of $20 \text{ m} \times 30 \text{ m}$ resting on a soil profile consisting of two layers of different properties, which are modeled as a hardening soil model with small strain (HSSM) under drained conditions. The ground water table is encountered at about 15m from the ground surface. A static wind load of 40 kN/m is applied laterally at the top left side of the building. Whereas the El Centro earthquake is applied to the building as a dynamic load with 5% and 10% damping ratios.

The results show that both vertical and lateral displacement decrease as the damping increases, with the vibration decaying with time even in the case of no damping. Also, the fundamental natural periods of the damped structure were less than the corresponding values of the un-damped one. This is evident due to the effect of damping that decreased the flexibility of the building structure, and as a result, the fundamental natural periods decreased and the structures became stiffer. In addition, if the natural period of the structure corresponds to the predominant period, the structure subjected to the selected earthquake and specific soil condition is in resonance, i.e., the system oscillates with very high amplitudes, which can cause great damage to the building.

CIVL13 Construction and Design of Multi-Story Building

By: Samal Mihyaddin Abdulrahman • Abdalbary Ahmed Abdalkareem • Mihammed Abdulwahid • Amina Husny • Dilhat Muhammad

Supervisor: Dr. Ahrar Hussien

As a theme of the bachelors project are a design and mainly a project

documentation of a residential multistory building in Duhok city. Our work consists of architectural plans which is constructional details and structural design. This building consists of six story above ground and basement below the ground. The basement floor for storage and technical services, such as central heating. All the building is constructed over raft foundation. We have tried to choose a modern design that keep pace with evaluation as well as taking in consideration the methods of comfort inside the building in terms of distribution and division of parts. The structural system of building is beam-floor system. The horizontal loadbearing structural elements are designed as one way ribbed slab with 50 mm thick. The vertical loadbearing elements are designed as transversal primary beams, girder and columns. The external load wall of building is a cavity wall to save energy.

CIVL14 Numerical evaluation of the eco-friendly slope stabilization technique

By: Sedra Tahir Sadiq • Payam Adil Tofiq • Adar Mahmood Ali • Mina Ayman Muslih Aldin • Hiwa Emad Ali

Supervisor: Dr. Mohammed Salih

The slope stability is one of the main concerns in geotechnical engineering. The focus of this study is the numerical assessment of the reinforcement using planting (vegetation) as an environmentally- friendly technique to increase the safety factor of slopes against failure. For this purpose, the physical interaction of the vegetation root with the soil structure, known as apparent root cohesion, is introduced in the Mohr-Coulomb failure model. Therefore, and using parametric study, the effects of root cohesion (C_r) and root depth (Z_r) corresponding to different types of plants/trees on safety of different slopes are analysed using both Numerical and Limit Equilibrium methods. The considered C_r and Z_r values are (0,5,0,15,20 and 25 kPa) and (0,0.5,1.0,1.5 and 2.0 m) respectively, which are examined in various cases of slopes with slope angles (B°) of 18.4° , 26.6° , 33.7° , 39.8° , 45° and 55° . Also, the effects of the areas of the slope that possibly can be covered by vegetation are simulated in different scenarios and the results are compared with no root reinforcement approach. The results show that the stability of the slope increased by increasing both the root cohesion and the depth. This increase is significant even in cases with the steep slopes. In terms of the area covered by vegetation, the results found that the scenarios that the vegetation is incorporated on slope surface possess a larger factor of safety than crest and toe covered zones.

CIVL15 R.C building response under earthquake ground motion in Duhok governorate

By: Shokrya Khalid • Dejin Majid • Helan Haval • Hana Nazir • Rondk Mahdi
Supervisor: Dr. Yassamin Khalid

Earthquakes are considered the most dangerous natural phenomena that can cause structural damage to buildings. Many of the mistakes that could lead to the failure of structures were made by the construction industry. This project study the response of high-rise buildings in Duhok city which have been in huge demand due to the increase in population and decrease in availability of land in the heart of the city. An example of high-rise buildings are Kayar City, Signature Towers, Duhok Tower, Lalav Golden Park, Arya city... etc.

In these building due to their height, lateral forces due to seismic excitations becomes predominant and it is more susceptible to earthquake and damage. Therefore, one building is prepared for this project, the building is a residential high rise (Signature towers) . using the engineering software (e-tabs) program. By conducting dynamic analysis (time history analysis) and considering the effect of the earthquake that occurred in 2017, which is one of the strongest earthquakes in the region with a strength of (7.1), which greatly affected many regions in Kurdistan. Furthermore, numerical calculations are used as we through following the equivalent lateral force method for lateral load distribution to investigate the difference in response.

CIVL16 Logistic regression model for the slope stability analysis

By: Zewar Shaaban Ahmed • Lelav Fawzi Jalal • Zaynab Hussein Yousef • Suaad Hussein Ghazi • Nafila Yousef Ismail
Supervisor: Dr. Najdat Sabri

Slope instability and land sliding is one of the challenges that geotechnical engineer face, the problem encounters many aspects which includes the geometrical of the slope, the shear strength parameters and some other parameters like the environmental and climate conditions. The rain water may decrease the shear strength of the soil expansion and shrinkage in a ride regions may play defective roll as well.

However, this project in limited with the effect of geometrical design of the manmade slopes and the geotechnical properties of the soil used in the construction of the slope.

Artificial Neural Network (ANN) used utilized to inspect the effect of this parameters in the factor of safety values and regression equation using Mat-lab Program was found by the weights and bias values, the data used for the network is gained from finite element analysis using Geo-Studio (Slope/W) Program.

It was found from the regression equation that the values of factor of safety match very well the values from the Slope/W program. The equation may validate using other range of parameters used.

CIVL17 Site Investigation and Exploration of Soil Response for High Rise Building: Case Study Duhok City.

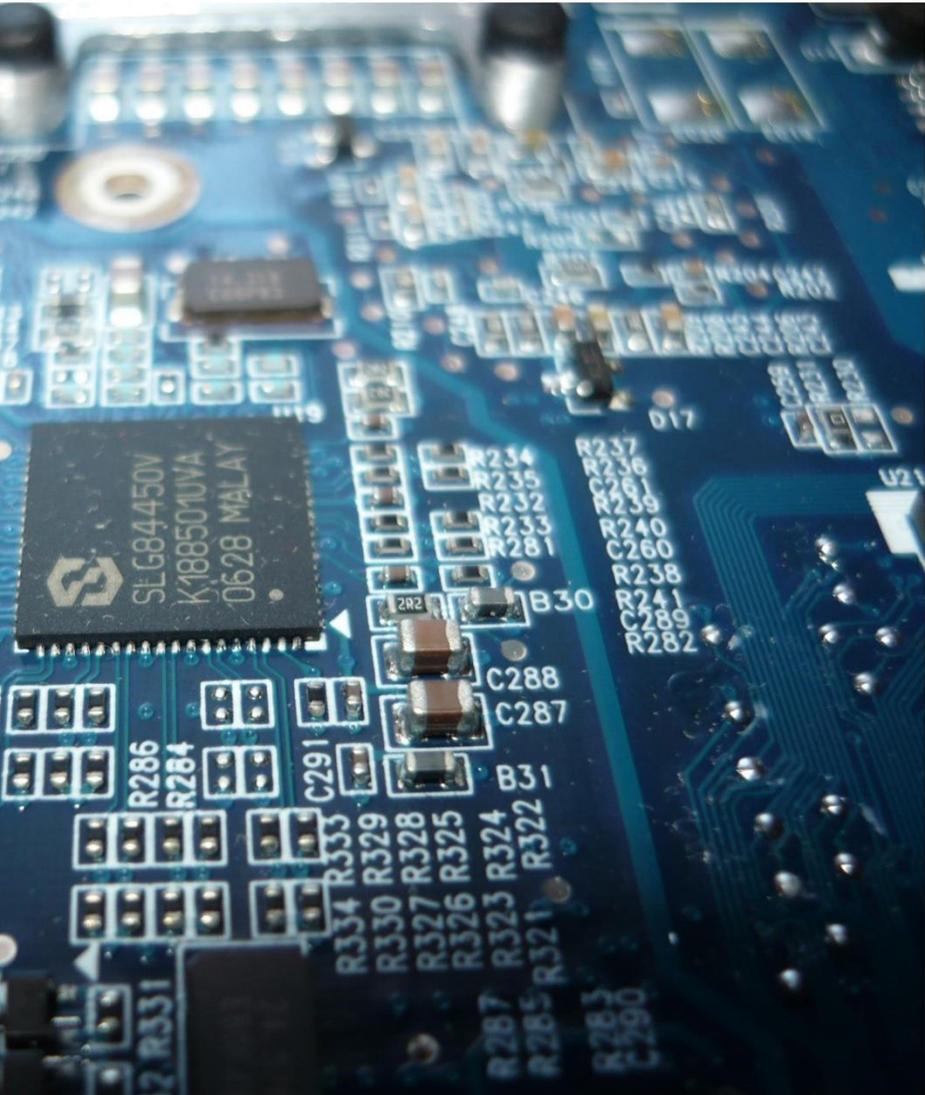
By: **Dunya Jamil Safuk • Sipal Salim Yahya • Jivan Ibrahim Majeed • Umaran Ramadhan Othman • Alin Muhammed Qasim Muhammed**

Supervisor: **Dr Jaafar Abdullah**

As a result of the increase in population density in urban cities, the demand for high-rise buildings, avoiding traffic density and the protection of the environment, has increased. This is also the case in Duhok city, where the government has started to focus on high-rise buildings or vertical construction. Site investigation is considered as a start step toward a safe construction of such engineering constructions. As a result of the bad conditions that the whole world has experienced, namely the Coronavirus disease (COVID-19), and due to the lack of funds and various other reasons to carry out on-site and laboratory investigations and experiments, the study used the data provided by the "Constructions Central Laboratory in Duhok". In this project, two cases of high-rise buildings that have been constructed previously at Etot, which is called Case A, and Tenahi, which is called Case B, district in Duhok city, are re-checked and discussed in terms of site investigation, and their necessary procedures for laboratory and field tests are reported. (SPT, index properties, consolidation, strength tests) have been completed. From the bore log profile of Case A, it shows the soil consists of subsequent layers of clayey silty sand mixture with a significant amount of calcium carbonate, and for Case B, it shows the top soil is largely clay and silt with a light brown color, resulting in homogeneous clay layers with a few small bits of hard stone crystals and little or no gravel. After assessment of both case studies, the suggested bearing capacity values for Case A and B are 128 kN/m² and 190 kN/m², respectively. The suggested type of foundation for both cases is a Raft (Mat) foundation, which is consistent with what they are currently designed for.



ELECTRICAL AND COMPUTER ENGINEERING



ELEC01 IoT Based Garbage Monitoring System

By: Dilma Sabah Muslim • Rejeen Ramzi Hassan • Sedra Yousif Abdulrahman
• Jiyen Abdulrahman Abo • Niroj Haji

Supervisor: Dr. Mohammed Ahmad Shahr

Smart garbage waste management is essential to develop an efficient and dynamic waste management system. This research presents the implementation and execution of an integrated sensing system for solid waste bin to automate the solid waste management process. The Internet of Things (IoT) is shaping and touching our lives in every sphere. IoT based garbage monitoring system is an innovative project idea for maintaining the clean environment of the city. The smart garbage bins have Ultrasonic Sensors placed on the lid which detects the garbage level in the bins. By this, the garbage bins can be monitored and the monitoring information can be obtained through the webpage. The level of the garbage is compared with the depth of the bins. This system comprises of an AVR family Microcontroller (ESP32), Wi-fi modem, IOT cloud with firebase.

ELEC02 Adaptive ventilation system (Smart Kitchen)

By: Aya Ayad Abdullah • Asma Fakhir Hassan • Dunya Fakhiredin Asis

Supervisor: Dr. Adnan Ismail Alsulaivany

In the evolving smart home architectures, the issues such as gas leakage, imbalance of temperature, and humidity are still remaining as a significant hindrances for designing a safe and comfortable kitchen. In urban areas, most of the kitchens are very small and it doesn't contain a proper ventilation system. In such cases, Spillage of gas increases the risk of fire accident, suffocation, or a blast and also because of high temperature that feels uncomfortable when it begins to rise. In this project, an Arduino-based microcontroller was utilized to build a smart gas detection system with many usable sensors (MQ2 Sensor) and actuators (air fan, buzzer) and also using a temperature and humidity sensor type DHT11 to measure temperature and humidity levels in the kitchen. Then the measurement is displayed on the LCD screen. The proposed system can detect gas leakage and temperature rising. It also has the ability to respond to an abnormal condition by decreasing gas concentration or temperature level via auto air ventilation.

ELEC03 Automatic Bottle Filling and capping System Using PLC Based Controller

By: Jwan Jumaa Drbas • Iman Ismail Ali • Nahla Othman Shaaban • Ali Akram Ahmed • Nabaz Qasim Abbas

Supervisor: Mr. Rafid Salih Sarhan

The field of automation includes a notable impact in a very wide selection of industries on the far side producing. Within the standard technique main half is system which has 'C' program, Ardiuno or microcontroller to regulate entire system. The matter arrested in manual filling method like spilling of water whereas filling it in bottle, equal amount of water might not be crammed, delay thanks to natural activities could happens. To rectify the higher than mentioned issues the projected system in designed. In projected system the advanced technology of PLC is employed. With this technique that operates mechanically, each method may be swish and therefore the method of replenishment will scale back employee price and operation price.

ELEC04 Distance meter with Dot matrix Display for parking

By: Heelen Hessib • Orfa Nadir • Midiya Abdulghfar • Zaid Ahmed Hussein

Supervisor: Mr. Namiq Sultan

Today's the developing world shows various adventures in every field. In each field the small requirements are very essential to develop big calculations. By using different sources, we can modify it as our requirements and implement in various field. In earlier days the measurements are generally occur through measuring devices. But now a day's digitalization as is on height. Therefore, we use a proper display unit for measurement of distance. We can use sources such as sound waves which are known as ultrasonic waves using ultrasonic sensors and convert this sound wave for the measurement of various units such as distance, speed. This technique of distance measurement using ultrasonic in air includes continuous pulse echo method, a burst of pulse is sent for transmission medium and is reflected by an object kept at specific distance. The time taken for the sound wave to propagate from transmitter to receiver is proportional to the distance of the object. Arduino board is used as the microcontroller. LED's are used to indicate the respective zones of the vehicle while parking, LCD is used to display the distance between the vehicle and obstacle. A buzzer is used to warn the driver and the people present around the vehicle when the vehicle is too close to the obstacle. So The main objective of this project is to build a system which is used to avoid the collision between a vehicle and an obstacle while parking in a blind spot area like garage.

ELEC05 ECG monitoring with arduino

By: Viyan Jafer Abdulhamid • Lava Abdulsitar Salih • Dlveen Hussein Ali • Xadija Hanm Hameed Hussein • Shareen Hussein Othman

Supervisor: Dr. Serwan Ali Muhammed

Electrocardiography is the process of recording heartbeat. The output is typically represented as a scaled graphical figure called Electrocardiogram (ECG). In this study, we present an experimental device that obtains ECG signal using AD8232 sensor board. The device operates real-time and transmits data wirelessly using nRF24L01+ RF modules located on Arduino Mega2560 I/O boards. The received ECG data was filtered and processed with Matlab.

The system gets the pulse input using Ag/Cl 3-lead electrodes placed on the arms and right leg of the patient under inspection. The model comprehends ECG module(AD8232) which is used for signal conditioning of the input pulse from the patient's body and viewed on Serial Monitor Window as the ECG waveform. Thus conditioned signal is also processed by the microcontroller Arduino Uno to control and transmit the function of ECG wave to monitor and Displaying the condition of the ECG wave in LCD display whether it is a normal ECG or Abnormal.

ELEC06 Isolated Solar Photovoltaic Power Generation System

By: Saman Hussein Hamid • Zhiman Majeed Sa'Dullah • Rewan Nadir Shaheen • Ajam Sheikhmus Rajab • Kavi Salman Sadiq

Supervisor: Mr. Hasan H. Shengalie

A photovoltaic system, also known as PV system or solar power system, is an electric power system designed to supply usable solar power by means of photovoltaics. It consists of an arrangement of several components, including solar panels to absorb and convert sunlight into electricity, a solar inverter to convert the output from direct to alternating current, as well as mounting, cabling, and other electrical accessories to set up a working system. It may also use a solar tracking system to improve the system's overall performance and include an integrated battery solution, as prices for storage devices are expected to decline. Strictly speaking, a solar array only encompasses the ensemble of solar panels, the visible part of the PV system, and does not include all the other hardware, often summarized as balance of system (BOS). As PV systems convert light directly into electricity, they are not to be confused with other solar technologies, such as concentrated solar power or solar thermal, used for heating and cooling. PV systems range from small,

rooftop-mounted or building-integrated systems with capacities from a few to several tens of kilowatts, to large utility-scale power stations of hundreds of megawatts. Nowadays, most PV systems are grid-connected, while off-grid or stand-alone systems account for a small portion of the market.

ELEC07 Network troubleshooting and maintains of College of Engineering

By: Ashur Sameer • Alan Yonis • Mohammad Nizar • Wafaa Salih

Supervisor: Dr. Ismail Amin Ali

Network troubleshooting means recognizing and diagnosing networking problems with the goal of keeping your network running optimally. as a network administrator your primary concern is maintaining connectivity of all devices (a process often called fault management) you also continually evaluate and improve your networks performance because serious networking problems can sometimes begin as performance problems paying attention to performance can help you address issues before they become serious about Connectivity Problems connectivity problems occur when end stations cannot communicate with other areas of your local area network (LAN) or wide area network (WAN) Using management tools.

ELEC08 Restaurant billing system

By: Zana Sulaiman M.A • Masood Ramadhan Rashid • Sadeeq Yaseen Sedeeq • Younis Nesret Younis

Supervisor: Dr. Sagvan Ali Saleh

Information technology is a term we are hearing it daily, and the functionality behind it, is used to help humanity and make real life problem or interaction easier, and it is something that you can't, move an inch without it in some discipline, we have mentioned real life interaction, so here and in this work we have tried by taking advantage from IT to make the work of restaurant easier, and that is by providing some simple interface for customer so that freely and comfortably they can look at the menu and choose there order without having anyone waiting them, There will be a bar code on table which will give customer easy access to site that will be menu in it, a customer will request what he want from the menu in that site. The Request from customer will be sent to kitchen, at kitchen all the food been requested from customers will appear for them to be made. The cost and the food request from customer will appear at cashier to get money from customer.

ELEC09 Smart Car Parking system

By: Nura Salih Hassan • Yusra Ibrahim Kalash • Veen Bangeen Hassan • Nour Hassan Sofi • Banan Mohammed Mustafa

Supervisor: Dr. Sagvan Ali Saleh

Nowadays congestion of traffic level increases with the increasing development of population rapidly. With respect to the amount of population, the utilization of personal vehicles also increased. Due to more use of cars the traffic congestion occurred on the road. Most of the people chooses personal vehicles than public transportation. It is very difficult and time consuming to find parking space in most metropolitan areas, commercial areas, especially during the rush hours. It is often costly in almost every big city in all over the world to find proper and secure parking space. Finding a vacant parking space nowadays is time and fuel consuming. This problem may cause drivers to get frustrated and eventually improper parking will appear. The universities, in particular, are one of these places, which needs more attention for providing parking services. The proposed project is a smart parking system that use to solve those problem.

ELEC10 Smart heavy traffic traffic lights

By: Yequb Ibrahim Hussain • Muhammedsalih Fakhry Muhammedsalih • Muhammed Ahmaed Yassen Isa • Dilzan Muhammed Abdulrahman • Muhammed Hussain Ali Ramadan

Supervisor: Dr. Omer Mobasher Salih

The increase of population produces an increase of the number of automobiles on the road, which generates heavy traffic in the streets and that causes many problems for the Citizens and traffic policemen an additional two emergency cases therefore it's important with development technology of embedded systems to solve this problem. In this project new traffic light controller was built to optimization using the Arduino UNO microcontroller board. The system tries to reduce traffic jams, caused by traffic lights, as possible. The system is based on microcontroller, which represent the brain of the system. The system contains ultrasonic sensors on the side of the roads. The ultrasonic sensor system gets activated when vehicles go along the road against it.

Microcontroller controls the traffic light by driver circuit using the sensor network to determine the level of jam in the road. Also, a remote control is used to make a light green when an Ambulance or any emergency vehicles

are come. Different ranges of traffic light delay time intervals according to jam level are configured by microcontroller and updated regularly.

ELEC11 Social Network Application “Co-linker”

By: Bayav Ni'Matullah • Eman Salam Saleem • Asia Ahmed Hamd • Honer Farhad • Yusif Mutelb Zahir

Supervisor: Dr. Omer Mobasher Salih

One of the greatest developments in technology is the invention of applications that help us to discover and learn new information, share ideas, and interact with new people. For the Department of Electrical and computer engineering, such an application is essential to share and grow the world of ECe. The social application network under the name of “Co-linker” is an abbreviation of colleagues linker, is a free service for readers and posting questions, that feels part search engine and part social network, EC engineers will have their online community, simply by installing an application, Create the optimal profile, Track topics with notifications, Find the best questions to answer, and Re-answer questions you've answered. We Co-linker, You and me, make it valuable.

ELEC12 Toward Automated Robotic Crane for Construction Erection

By: Alyas Ibrahim Khalil • Dawood Suleiman Yassin • Sinar Sudqi Rasheed • Shmal Hameed Ahmed • Sabah Hassan Mahmud • Sahmi Mohamed Yousef

Supervisor: Dr. Serwan Ali Muhammed

This paper summarizes ongoing research aimed at developing knowledge and tools required to implement automated robotic crane erection processes in construction. In the proposed approach, construction cranes are treated as multi-degree-of-freedom robots and modeled in a virtual environment. The virtual cranes are then provided with motion planning algorithms that enable them to find collision-free and time-efficient paths for each piece that needs to be erected. Inverse kinematics then determines the crane motions required to move elements in previously computed paths. The virtual crane model provides realistic visualizations of erection processes and detailed erection schedules. An effective method to coordinate the motions of multiple cranes on larger construction sites is also developed.

ELEC13 Visualization of COVID -19 Data in Kurdistan Region of Iraq Using Python

By: Zainab Luqman • Shnyan Mustafa • Avahi Avraz • Zina Sameer • Diana Nadr

Supervisor: Mr. Faris Alyas Ketti

COVID-19 has spread to several countries around the world in a very short period and has had a huge impact on many countries. As of February 2021, more than 100 million people worldwide have been diagnosed and more than 2 million have died. Now that a vaccine has been developed, there are still many problems with the spread of vaccination, we still need to minimize the spread of the disease through making policies, such as isolation, keeping a social distance and wearing a mask, Therefore, predicting the future trend of the epidemic, helping relevant departments and personnel to develop policies to control the spread of the epidemic, and producing medical supplies are still extremely important.

The purpose of this project is to show the coronavirus statistics in 2021 for Duhok, Sulaimanye and Erbil via different graphs using Python

ELEC14 Pulse Oximeter & Temperature Measurement using Arduino

By: Mohammed Jamal Hassan • Kamal Rayan Kamil • Heeshamm Ramadan Mohammed • Aveen Hussein Ibrahim • Dlin Samad Ahmad • Baez Nazim Ismail

Supervisor: Prof. Dr. Ahmed Khorsheed

Diseases are usually associated with changes in some physiological parameters in the human body such as heart rate, oxygen saturation, body temperature, blood pressure, etc. Doctors use various kind of medical apparatus like thermometer for checking fever or body temperature, pulse oximeter monitor for heart rate measurement and oxygen saturation. The project is a portable device for continuous heart rate, oxygen saturation and body temperature monitoring, which counts the number of heartbeats in a minute with oxygen saturation in percentage and temperature sensor to measure the body temperature. Such a device is more essential in a situation where there is no doctor or clinic nearby (e.g., rural areas) and patients are unable to recognize the urgency of their condition.

ELEC15 Improving static stability of Duhok distribution network

By: Habil Yousif Sheen • Rojan Salih Shaban • Akhink Ibrahim Islam • Helin Ammr Abdulrahman • Hilbeen Ali Hammed • Thamir Akram Hassan

Supervisor: Mr. Melat K. Abdullah

Instability of the voltage may result in the gradual rise of buses voltages, load loss, transmission lines tripping and voltage collapse in the grid and may lead to power failure. In this thesis, two static techniques are used to assess the voltage stability of the power grid, Power flow technique is used to identify the weakest buses and test the stability of the system under nominal load condition. On other hand, Continuation Power Flow (CPF) technique is used to identify the weakest buses and test the stability of the system under heavy load condition, we implemented both these techniques using PSAT simulation on MATLAB. Solar Photovoltaic Generator (SPVG) is used, it plays a great and vital role in providing clean and enough energy to meet power loads. The best location of SPVG is obtained according to voltage stability using static techniques mentioned above. The proposed techniques are applied to the Duhok distribution network. The results reveal that choosing a proper location for the SPVG will improve the voltage stability of the system. Optimum location is connecting the SPVG at the nearest bus to the weakest bus provides better performance than when it connected to the weakest bus.

MECHANICAL ENGINEERING



MECH01 Experimental analysis of Forced- Convection over Finned-Plate Array using Different Materials

By: Aryan Salam Ismael • Ahmed Guhdar Ali • Bilind Nechirvan Salih • Sarbast Issa Omar • Nojdar Nawzat Ahmad • Haron Diab Muhammed

Supervisor: Dr. Arkan Fawzi Saeed

The effect of increasing heat from the electronic devices such as smartphones, computers, can be diminished by calculating generated heat transfer variables of finned-plate using a laboratory wind tunnel used as an enclosure for this purpose. Heat dissipaters are not only chosen for their thermal performance; but also, for other design parameters that includes weight, cost and reliability, depending on application.

The present work reports an experimental test on a standard heat sink prototype TD1005 free and forced convection, manufactures by TecEquipment LTD. UK. The aim is to investigate the forced heat transfer enhancement over horizontal flat surface with rectangular fin arrays with different materials (Stainless steel, Aluminum, and Brass). The cross-sectional area of the rectangular duct was 128 mm x 75 mm. The data will be collected to analyze the performance for fin arrays for the three types of materials, by varying the most two dominant parameters of Nusselt and Reynolds numbers. The difference will be investigated between the three different types of materials. It will be noticed that the change in thermal conductivity is clear which affect the convective heat transfer coefficient of the heat sink, which yield at the end to find a new correlation for the Nusselt number variation with other parameters like Prandtl, and Reynolds numbers.

MECH02 Evaluation of the energy produced by the Parabolic Trough Solar Energy Collector

By: Eman Shaaban Salman • Jwan Farman Abdulaziz • Sara Rafe Nazm • Sawsan Hamid Mohammad • Mohammed Hashim Wazir • Hogir Jalal Simo

Supervisor: Dr. Sherzad T. Tahir

The growing global warming matter and its effect on the plant is getting to a dangerous level. This is pushing many countries, governments, and scientists around the world to find methods or solutions in reducing the impact of the global warming. One major factor that contributing to this crises is the using of fossil fuel as a source of energy. So a lot of efforts spent in replacing those sources with renewable energy that is safer for the environment. Here at the University of Duhok a project was developed to concentrate the solar arrays on a glass tube by half circle alloy plate. A copper tube was inserted inside

the glass tube which carried water inside it. The results indicated the operation of the system and a temperature of 57°C was attained inside the glass tube when the atmosphere temperature was 18°C. However some modifications were conducted on the system to improve it. The half circle plate was replaced by Parabolic one, the glass tube was switched into double wall glass, and the straight copper pipe was changed to coil one. Results reviled major improvements and water transferred into steam during the early spring season.

MECH03 Thermal conductivity of Concrete mixed with recycle plastic PET flake

By: Dizhar Mahmood Hassan • Dileen Mustafa Saadon • Roj Bassam Mohammed Baqir • Sherhad Azizkasn Hasan • Maryana Yourash Malko • Mavin Majid Salih • Nazik Ghazi Shukri

Supervisor: Dr. Oday Adnan

The use of plastics polyethylene terephthalate (PET) has increased over the years, thus resulting in a large volume of waste being generated and affected in the environment. Due to its non-biodegradability and persistence, recycling processes have become one of the sustainable solutions for preventing environmental deterioration. Were collected from industrial sector and used as additional ingredients to improve concrete properties. Prior to concrete processing, an increase in wettability of plastic fibers using nonionic surfactant, Porosity was found to increase with higher volume fraction of plastic fibers, whereas decreases in workability, bulk density and thermal conductivity In our project we developed a procedure to find Thermal conductivity with 25%, 50 % for PET and compare it's with last literature so as to satisfy the precast concrete wall requirements.

MECH04 Investigating the effect of the aspect ratio on the dynamic characteristics of plates using ANSYS software

By: Aya Ismael Ali • Berivan Jamal Hasan • Danella Darweesh Omer • Sami Sabri Qassim • Maryam Danial Youkhana • Nada Hamde Salih

Supervisor: Dr. Haval Kamal Asker

This project intends to study, understand and investigate the effect of aspect ratio such as length, width and thickness on the dynamic behaviour of a plate in terms of frequency and mode shapes.

The project will involve simulating and building plate models using ANSYS software. In addition, the study includes generating MATLAB code to

calculate the natural frequencies mathematically. A comparison study will be conducted between the mathematical and numerical results. A total of 72 ANSYS models will be built. The study has investigated up to 6 modes of the plate's dynamic behaviour.

MECH05 Slurry Jet Erosion Tester and the Effect of Slurry Erosion on Target Material

By: Bahjat Khider Muhammed • Hasan Waheed Zubair • Ali Mohammed Saleh • Farida Dawd Sliman • Veen Salah Hazm • Norshan Serwan Shawkat • Warven Shikre Sleman

Supervisor: Mr. Mahdi Khidar Saadan

A Slurry Erosion Test Rig is normally used to study the relative erosion behaviour of different material at moderate solid concentration, velocity, particle size and impact angle....etc. In many application like, techniques of mining, food processing, power generation and other sectors erosion problem is serious in transportation of slurry as pipes of liquids. Erosion is a critical parameter for design, selection and operation of the hydraulic transportation system. Engineering interest is to estimate the service life of equipment subjected to slurry erosion & to investigate their efficiency.

MECH06 Analyzing steel rebar's mechanical properties from stress-strain diagram using MATLAB

By: Amad Abdulamir Ibrahim • Ahmad Nawzad Ali • Arsalan Jamal Hussein • Aiman Hassan Pirmos • Abdi Hssen Abdi • Mohammad Salah Abdullah

Supervisor: Miss Sundis M. Salih

The steel rebars are the significant material for modern Reinforced concrete structures. The mechanical properties of rebar are crucial parameters for the safe, durable and reliable concrete structures. Therefore, this project aims to predict the mechanical properties of steel rebar by using MATLAB involving the analysis of the engineering stress-strain curve measured using uniaxial tensile test. Two grades of steel bars 60 (420) and 72 (B500) with different sizes were selected for the experimental work. The results were conformed to ASTM standards. The associated mechanical properties i.e. yield strength, modulus of elasticity, ultimate strength, elongation, toughness... were obtained by analyzing this bilinear stress-strain curve. In this study, a MATLAB code for analyzing the stress-strain curve of steel rebar of different grades and different sizes for quantifying the associated mechanical properties is provided, such that the readers can use this computer code to

perform the analysis directly. In addition to being applied to steel rebar, the information provided by this study can also be applied to other ductile materials.

MECH07 Performance of Modified Triangular Plan Form Weirs

By: Osama Ghzi Hassan • Binel Janan Isho • Delir Sulaiman Younis • Robin John Nessian • Shindar Abdulqadir Asaad • Mawaa Hassan Issa

Supervisors: Prof. Dr. Bahzad M. A., Noori, Ms. Naeema T. Aaref and Mrs. Khamleen A.Mahmoud

In the present project, a modified shape of triangular plan form weir is recommended in order to improve the discharge capacity and performance by providing upstream slope to the weir to streamline the flow over the weir and to reduce head losses during overpassing. This modified shape of the weir is examined and tested through the experimental program of this study. For this aim, twelve triangular plan form weir models have been manufactured and tested, six of them were non-modified and the other six were modified. In these weir models, three vertex angles are tested ($\Theta = 45^\circ, 60^\circ$ and 75°) and the weir height is changed two times as: ($P = 20$ and 25 cm) for both non-modified and modified weir models in order to show how the modification will improve the performance and overpassing capacity of the modified weirs. A total of eighty-four test runs are conducted on all weir models during the testing program.

Analysis of the water surface profile results showed that the nearest distance for the upstream water depth above crest to become horizontal was $X = 5.84 h$ for non-modified weir models and $X = 4.77 h$ for modified weir models measured upstream the crest, where, h is the upstream water depth above crest. From the relationships of overpassing discharges, it was realized that the modified weir models overpass higher discharges compared with those of non-modified weir models for the same vertex angle and the same weir model height and weir models of small vertex angle have higher discharge capacity because they have longer crests to overpass flow rates. The variations of discharge coefficient (C_d) with relative upstream water depth (h/P) showed simple power equations for both non-modified and modified weir models. These Power equations illustrate that the value of (C_d) decreases with the increase of (h/P) values and weir models of small vertex angles give lower values of (C_d), while, weir models of low heights offer higher values of (C_d).

Results of discharge magnification (Q_T / Q_N) showed that values of (Q_T / Q_N) decrease with the increase of (h/P) values for all non-modified and modified weir models and weir models of small vertex angle and small heights offer high discharge magnifications. The highest percentage increase in discharge is found for weir model of vertex angle ($\Theta=45^\circ$) and weir model height ($P=20\text{cm}$) ranging between 110% and 215% compared with the discharge overpassing normal sharp crested weirs.

MECH08 Evaluation of the Improved Solar Energy Powered Fruits and Vegetables Dehydration Box

By: Shaker Ahmad Abdulwahab • Ammar Yaseen Abdullah • Muhammad Younis Hassan • Rayan Zaki Abdullmanaf • Romario Romel Khoshaba

Supervisor: Dr. Sherzad T. Tahir

The ever growing global warming issue and the crises that this planet is facing will impact everyone's life and can lead the world to a total dark future. Thus it is vital that everyone participate in doing their part in order to reduce the effect of this issue. One way that can help to reduce the impact is to use the renewable energy instead of fossil fuel as a source of energy which it has been used currently widely around the world. One way to help in reducing the effect of global warming is to check the community and find an issue or a case that can be worked on. From observation of the local community in Duhok town last year, it was noticed that a lot of fruits and vegetables are produced every year and large chunks went to waste. Thus an idea of solar energy powered dehydration box was established to save some of the fruits and vegetables from being thrown away. However, there were some issues with the box last year and improvements were made on it and results were quite impressive.

SURVEYING ENGINEERING



SURV01 A comparative study using different geomatics tools for topographic maps production.

By: Alind Bahjat Majeed • Ahmed Yousif Jasim • Salim Rasul Muhammadamin • Safeen Shahr Ahmed • Hind Mohammad Salih • Noor Yousif Ahmed

Supervisor: Dr. Sarhat Mustafa Adam

Topographic land survey is important for many civil engineering applications. A topographic land survey uses advanced technology (i.e. an EDM instrument, leveling instrument paired with a surveying-quality GPS unit or total station, UAV aerial survey) to map the man-made and natural features of a given land parcel. In this research, RTK GPS (Real time Kinematic GPS) was used to compare with other survey instruments such automatic Level, total station, and UAV aerial survey. A case study of 35,500-meter squares located inside UoD Malta campus has been decided to survey for the purpose of this study. Comparison of various topographic land survey products will carry out using statistical testing and via the cloud-to-cloud comparison. Another aim of this research is to visualize topographic land survey using augmented reality via a model of TOPO-sand-BOX prototype.

SURV02 Assigning Horizontal Position for Existing Control Points in Duhok University Campus

By: Zilan Ahmed Yaseen • Bajdar Zubair Saeed • Solin Faysal Hussein • Midya Masood Hussein • Khaery Abdulrahman Muhammed • Monther Bashar Taha

Supervisor: Mr. Yousif Youkhanna Zaia

Land surveyors measure horizontal positions in geographic or plane coordinate systems relative to previously surveyed positions called Horizontal Control Points (CPs). The accurate CPs are of two types: some are temporarily built and used in local works, while others are permanently established using concrete structures that are available worldwide, and their coordinate are precisely determined based on principles of GNSS positioning systems and statistics calculations of the specific points. The project is about assign horizontal control points to existed vertical control points located at the main campus of the University of Duhok. In this research, CPs will be measured at least 2 hours known static mode and processed using online tools (OPUS, AUSPOS, and CSRS-PPP) and statistically evaluated to obtain the best possible value.

SURV03 Topographic Survey and Design of Road 30m in Duhok City

By: Yousif Sherzad Jameel • Alan Khaleel Ahmed • Diyar Ayad Khalid • Tanya Zaki Jameel • Jiwan Ibrahim Abdulsatar

Supervisor: Mr. Baran Omer

Consuming time and cost of transportation is one of the major issues that most of people are facing, this issue has been included and solved in this project by designing the road 30m of Duhok city from (shakhke) to (kevla) that there has no way to make the mobility easier, Duhok city people are facing traffic and time problems to get to their destination. Our team as 4th year students of surveying engineering, associated with Duhok city municipality to do a topographic survey and design of road 30m to reduce the traffic and serve our beloved city. despite of hill terrain and obstacles, there will be a lot of cut and fill that has to be done for the land. Design of road has been done with an optimum and safety way which its length is approximately 6000m with 22 horizontal curves and speed of 60 km/hr, every required points in that land have been measured by GNSS Leica Viva GS10/15 with real time kinematic (RTK) Method with accuracy of (10mm+1ppm for horizontal components and 20mm+1ppm for vertical components) and measuring two types of points (auto and manual) , and the Civil 3D software is used for point processing, creating curves , grades and calculating the volume of cut and fill of each stations. As a result there will be a full topographic survey and best design of the road with the total details, and We will be able to hand it over to the municipality to be implemented in the best case and without deficiencies.

SURV04 Evaluation of interpolation methods of measured points with GS10 / 15GPS receiver and geostatistical function in ArcGIS software.

By: Aveen Star Ibrahim • Viyan Chalo Ahmed • Nora Rauoof Muhammed Salih • Hizirvan Ferset Ahmed • Issa Hasan Salih

Supervisor: Mr. Solieman Farohy

Accurate height calculation is one of the most important tasks for surveyors. Elevation surface are one of the most important spatial data that can be used to perform a wide range of geo statistical and spatial analyzes, on this basis, this paper tries to evaluated elevation surface interpolation methods such as IDW, Ordinary kriging, Spline, Natural Niebuhr, Polynomial. for achieving this goal: mild slope area, Steep slope area are tested. The location of case study is inside of Duhok university campus, the hills and valleys to the east are the faculty of fine Arts. area is in the. The ellipsoidal height of hotspot point

measured by DGPS Leica VivaGS10 instrument. Then hot spot point transferred to Arc GIS software in order to Interpolation and creating elevation surface, finally Interpolated pixels of surfaces are compared with true value of GCP point on the ground that measured with DGPS. And total RMS error for each area calculated for every Interpolation types. Finally, all derivatives of DEM Such as contour line, Contour with barrier, slope, aspect, hill shade and view shed created. The evaluation results can be used to understand the impact of the slope on interpolation methods and to select the most appropriate method according of Ground relief.

SURV05 The effects of ground control Points number and distribution on the accuracy of photogrammetric models

By: Mohammed Nadhim Mohammed • Rabar Osman Xdr • Iman Nadhim M.Salih • Kani Hishyar Hamad • Iman Adil Salih

Supervisor: Dr. Raad Awad

To obtain 3D ground models like orthophoto mosaic or dense cloud using photogrammetric technique and software like agisoft photoscan, Control points have to be located on the model space and on the image. The coordinates of these ground control points have to be measured accurately using (total station or GPS system).

The aim of this project is to visualize the effects of the number and distribution of ground control points on the model geometric accuracy.

For this purpose (678) images for the university campus were collected using (UAV) drone vertical images and the total of (60) ground control points were identified on the image and their ground coordinates were measured using (GPS) system.

Different trials on the effect of the distribution of the number and locations of the ground control points were carried out.

The first trial were carried out to process the image using (10) control points located on one corner of the site. The other (50) points were used as check points, the result shows that the mean error of:

$$x = 0.36652244\text{m}, y = 0.03618552\text{m}, z = 10.27904\text{m}$$

The second trial were carried out to process the image using (10) control points distributed on the site. The other (50) points were used as check points, the result shows that the mean error of:

$$x = 0.00090982\text{m}, y = 0.00607214\text{m}, z = 0.14054\text{m}$$

The third trial were carried out to process the image using (20) control points distributed on the site. The other (40) points were used as check points, the result shows that the mean error of:-

$$x = 0.02839\text{m}, y = 0.00995\text{m}, z = 0.03323077\text{m}$$

There will be more trials to be conducted using 30, 40 and 50 GCPs.

SURV06 The Precision Performance of UAV Images for Building's Crack Length Measurements.

By: [Aya Ashqar Hasan](#) • [Suleen Dilovan Ahmed](#) • [Bewar Bashar Ali](#) • [Darya Adil Jaafer](#) • [Ramsina Sheeba Sada](#)

Supervisor: Dr. Farsat Heeto

This project uses Unmanned Aerial Vehicles (UAV) as a platform to inspect and monitor a building. It concentrates on the inspection of defects in buildings, especially cracks. The objective of this research is to investigate cracks in a building by using UAV photogrammetry.

The building was used as an object for this project because there are demands from the building maintenance team to assess cracks in the building in an effective way, where it can help to provide reliable crack information. The selected building for this study will be a building with cracks, making it suitable for this purpose. The methodology and procedures will be used to take the images of cracks in the building. From the image taken by using UAV, measurement of the cracks can be identified by using the software. The 3D model of the building will be created by using Agi soft Photoscan software to receive an overview of building dimensions. The measurement of cracks will also be processed by using Eardas image or Photomodeler software. The accuracy of the output of the UAV images will also be addressed. The result will be showed that the capability of UAV photogrammetry can help the current surveying work, especially on building maintenance. Moreover, it can also will shows the optimum altitude of the UAV on the crack detection in the building.

SURV07 Updating and Densification the Exist second-order vertical control for university Campus

By: [Omeed Abdulrazaq Salih](#) • [Hozan Sabri Mustafa](#) • [Avan Mohammed Khalid](#) • [Darya Salah Hassan](#) • [Imad Saado Ahmed](#)

Supervisor: Mr. Sami Gilyana

Any project needs accurate control points either horizontal, vertical or both.

The purpose of this project is the establishment of second order vertical controls for Duhok University campus, which there are several control points of second order previously established for Engineering campus, where the reference point of these points is a first order vertical control point established by the (PolSERVICE-PPG), which named (ID "45-16") is located in Aloka (45 mean number of line and 16 is point number), in this project we will update these existing points and densify them to 22 points around the Duhok University campus, to serve as a base for further survey works. Depending on the accuracy requirements of second order, vertical control survey may be done by the most accurate and widely applied method which is precise differential levelling with digital level DNA10 instrument.

In this project, the study area is divided to 9 loops, start from known point then closed back on the same point. The closing error must be with specifications of second order or better with error not more than (8.4 mm) for each loop, then applying least square adjustment method to reduced closing error to zero.

SURV08 3D modeling of Historic Building using UAV images: Nezarke Castle in Kurdistan Region as a case study

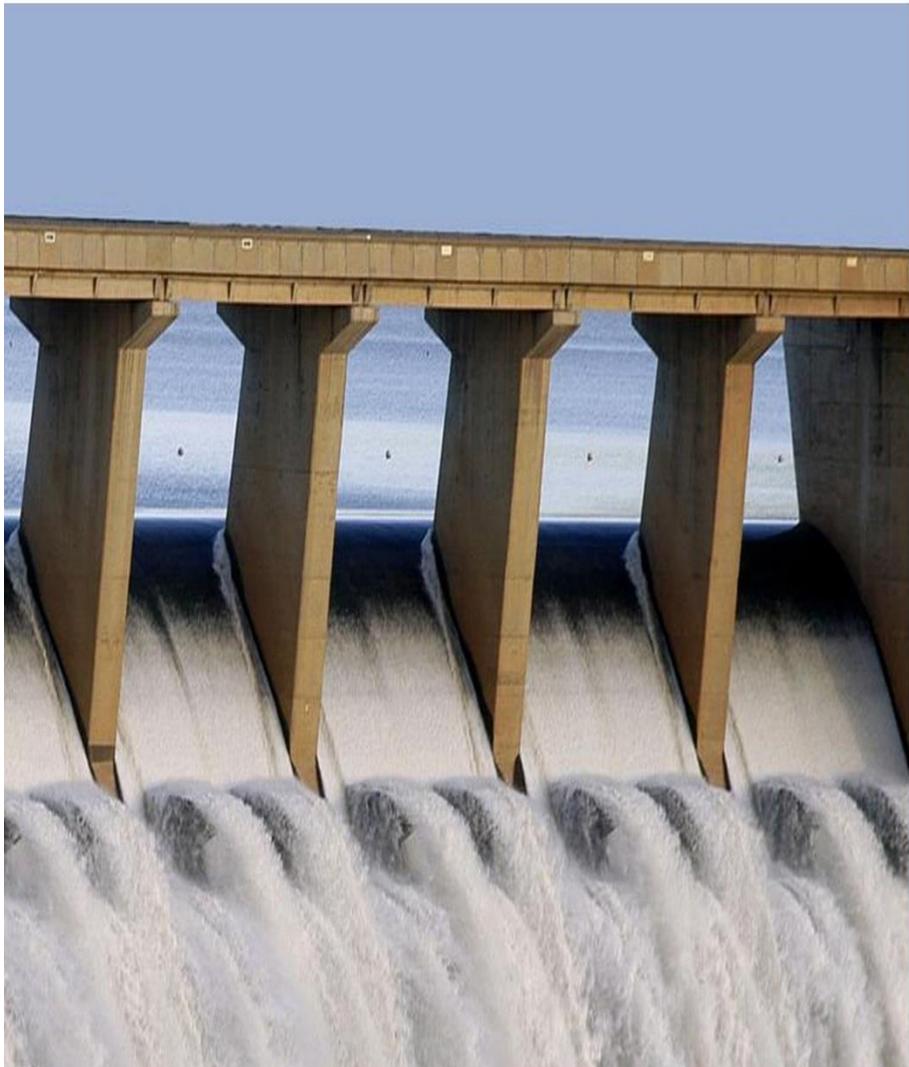
By: Dilveen Saadi M.Salih • Laila Ramadan Dewali • Sundis Sabri Mho • Ahmed Khalid Abd Ali • Resun Barwary

Supervisor: Dr. Shireen Ismael

Today Heritage uses such as (Surveying, Documentation, Monitoring and Presentation) are one of the main applications of the UAVs (Unmanned Aerial Vehicle). Documentation of heritage site (Historical area, historical building, and archaeological site) is a very important step for any heritage protection and revitalization project. This project has taken Historical building Nizarke castle as a case study to produce (DEM) Digital Elevation Model and Orthomosaic for the historic area, and 3D Model. Fifteen GCPs have been distributed in the area of the study considering the topography and the visibility. The project intended three flights were conducted for the purpose of the study, using (DJI phantom 4pro). These three flights were pre-planned carefully to identify the number and direction of the flight stripes and also the landing point, Map Pilot for DJI Business software was used to manage the flight altitude. Moreover, Agisoft Metashape Professional Software has been used for analysis and manages the collected data. The result was producing point cloud. Orthomosaic, DEM of the historic area and 3D modeling for Nizarke castle. Keywords: Heritage site, Documentation, UAVs, Nizarke Castle Historic Building, Agisoft Program.



WATER RESOURCES ENGINEERING



WRES01 Pipeline design using AutoCAD Civil 3D

By: Ammar Muhammad Abdullah • Muhammad Abdul Kareem Muhammad
• Chinar Wahad Khorsheed

Supervisor: Mr. Mahdi Salih Yaseen

Pipe network design in the AutoCAD Civil 3D software is divided into two types: gravity networks and pressure networks. Because the performance requirements for these two types of systems are so different, the approach to designing and constructing them is also quite different. In this project, gravity pipeline design was covered.

Civil 3D able to create objects that represent structures and pipes. It also establishes relationships between the structures and pipes as well as other important design elements such as surfaces, alignments, profiles, profile views, and pipe size that meet the discharge in any pipe.

WRES02 Hydrological study and analysis for proposed Khanas Dam in Duhok, Iraq

By: Veen Bshar Ibrahim • Aveen Muhammad Hassan • Silav Reber Ihsan

Supervisor: Mrs. Zahraa Mahmood Klari

Hydrologic design is the process of assessing the impact of hydrologic events on a water resource system and choosing values for the key variables of the system so that it will perform adequately. The entire precipitation water does not reach the stream as runoff since a portion of precipitation is always lost due to various causes such as interception, depression storage, evapotranspiration and infiltration. In order to find the peak flows for any desired structure, it is important to analyze rainfall or stream flow data series for different return period using frequency analysis method.

The hydrological study and analysis for the proposed Khanas Dam, the study area starts from north Bodul to Khanas village. The proposed Dam is Located on Gomal River south west of Duhok City.

WRES03 Estimation of runoff hydrograph for ungaged watersheds (Bandawa Watershed as Case Study)

By: Alaa Abdulaziz Anwar • Hawjeen Luqman Mohammed • Hilin Kamil Faris

Supervisor: Dr. Khalid Khidir

The study area, named Gali Bandawa, is located in Duhok city (North of Iraq). The watershed outlet coordinate has a Latitude (N) is $36^{\circ}46'28''$ and a Longitude (E) is $43^{\circ}04'30''$.

The watershed has a geographical area around 92Km²; the Basin slope is 18.2% and the maximum slope length is 16.1km. The area, in general, has a moderate slope around the dam and a steep slope in some higher parts of the basin, especially in the mountains. The maximum, mean, and minimum elevations are correspondingly 1330m, 502m found by GIS tool. The area occupies a valley of seasonal streamflow, and the source of runoff is the rainfall.

Soil Conservation Service (SCS) will be used for estimating effective rainfall for the maximum daily rainfall which fall during the period (2003-2018), then Nash model will be used for estimating direct runoff hydrograph for this day of maximum daily rainfall.

SCS method will be used for estimating hourly rainfall from daily rainfall for converting daily rainfall to hourly rainfall for the maximum daily rainfall:

Nash IUH model has two parameters: (n) the number of reservoirs and (k) the storage coefficient.

An empirical relations will be used for estimating Nash model coefficients (n,K)

1-hrUH can be estimated from Nash Instantaneous unit hydrograph ,then this 1hr-UH can be used for estimating direct runoff hydrograph of the basin under study.

WRES04 Design Storm System for Selected Area in Duhok

By: Aleen Lazgin Aziz • Dilan Amel Muhammed • Lailan Esmail Ibraheem

Supervisor: Mr. Fawaz Khaleel Aswad

This project investigates the best solution for the problem of rainfall storm system water in the Hawshik area at Duhok City. This project aims assessed through investigating the objective of design storm in such area. To fulfill the above objective the following research methodology is considered to be necessary such as surveying, hydrological design, hydraulic design and construction. The project was divided into two main parts. Part 1: Analysis the topographic survey of the area of interest through the GPS technique. While the part 2, design of the storm sewer system in such area. After the

data were collected, the topographic surface of the entire area of interest was created, also the storm system designed by using AutoCAD civil 3D.

WRES05 Determination of infiltration rate around Duhok city by using double ring infiltrometer

By: Sabah Baitallah Ismail • Bangen Jomaa Abosh • Azad Haji Mohammad
Supervisor: Mr. Bewar H. Arif

The infiltration means the downward movement of water entering the soil from its surface. The study measurements and results of infiltration rate is great demand for the planning and design of hydraulic structures, agricultural projects, and hydrology studies of runoff to avoid flooding and transfer of contaminants to surface water sources. The present study is a field work to measure and determine the infiltration rate by using a double ring infiltrometer with falling head. Field experiments were carried out at four different locations of the soil around Duhok city within the borders of Duhok governorate in Kurdistan region of Iraq. Repeated water depth readings were taken at intervals of (1, 1, 1, 2, 5, 5, 5, 10, 10, 10, 10, 20, 20, and 20) minutes. Depending on the field results, Horton's equation in the four locations were determined. The results of field measurements showed that the values of constant infiltration rate have similarity in four assigned locations. Based on the ratio of the field values of initial infiltration rate to steady state infiltration rate; the permeability of the soil in the four locations were classified.

To view the projects' posters and get more information please visit:

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