Ministry of Higher Education and Scientific Research
Northern Technical University
Technical Engineering College of Mosul
Department of Building and Construction Techniques Engineering

STRENGTHENING REINFORCED CONCRETE BEAMS CONCRETE BY ECC

PROJECT BACKGROUND AND MOTIVATION

- Reinforced concrete beams are essential in construction but often face durability and cracking issues. This project investigates strengthening these beams using Engineered Cementitious Composites (ECC), aiming to enhance structural performance and extend service life with more sustainable solutions.

OBJECTIVE

The main objective of this project is to evaluate the effectiveness of using Engineered Cementitious Composites (ECC) to strengthen reinforced concrete beams. The study aims to improve the beams' structural performance, crack resistance, and overall durability under different loading conditions

MODELS

No	Strength Ecc	Steel mesh	Flexural test (Mpa)
b0 (ReF)	without	without	17.16
b1	Ecc-10 mm	without	17.7
b2	Ecc-15 mm	without	15.96
b3	Ecc-10 mm	One layer mesh 1 mm	21.96
b4	Ecc-10 mm	Two layer mesh 1 mm	18.9
b5	Ecc-15 mm	One layer mesh 1 mm	26.5
b6	Ecc-15 mm	Two layer mesh 1 mm	25.11
b7	Ecc-15 mm	One layer mesh 4 mm	22.38
b8	Ecc-10 mm	One layer mesh 4 mm	22.38
b9 carbon fiber	without	without	24.84

MIX DESIGN

contene	Mixing ratios
cement	1
Fly ash	1.2
Silica sand	0.8
Steel fiber	5%
pva	1%
Super/pinder	2%
Water	0.65

POTENTIAL MARKET

- PUBLIC & PRIVATE SECTOR
- CONSTRACTION AND CONTRACTING COMPANIES
- GOVERNMENTAL ENTITIES
- INDUSTRIAL FACILITIES
- ENGINEERING CONSULTING OFFICES

PREPARED BY:

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METHODOLOGY

This study aims to evaluate the effectiveness of using ECC concrete in strengthening reinforced concrete beams. To achieve this objective, an experimental methodology was followed, involving the preparation and laboratory testing of concrete specimens. The methodology includes the following stages:

1. Concrete Mix Design:
ECC concrete mixes were prepared according to standard specifications, with optimal proportions of materials (cement, sand, fibers, additives, etc.).

2. Preparation of Test Specimens:
Several reinforced concrete beams were cast, including control specimens (without strengthening) and others strengthened using a layer of ECC concrete.

3. Experimental Testing:
The beams were subjected to loading tests at various stages to compare the structural performance (load capacity, cracking, deflection) between the strengthened and unstrengthened beams.

4. Results Analysis:
The models were tested in the laboratory and the results are shown in the table above which shows the tolerance levels for each model.

MATERIALS USED

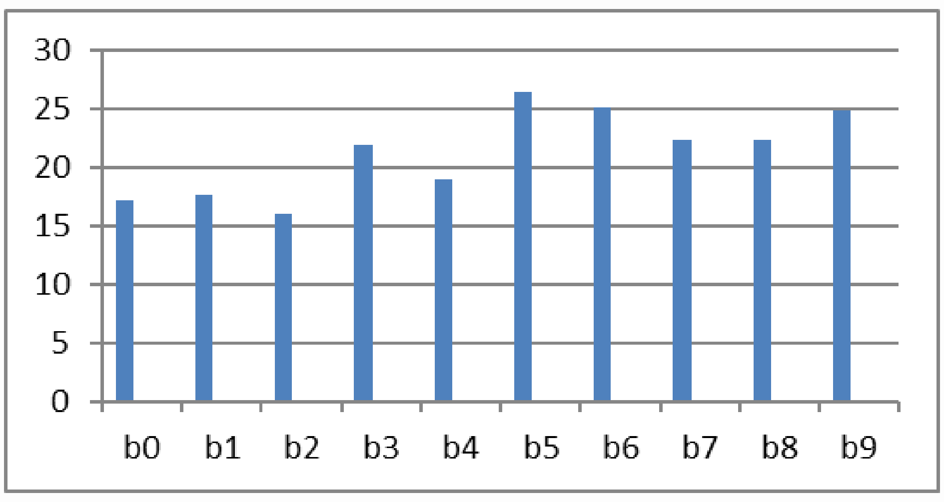
Cement ,Fly Ash : Silica sand , WATER , Superplasticizer , PVA FIibers .MICRO STEEL FIBERS. carbon fiber

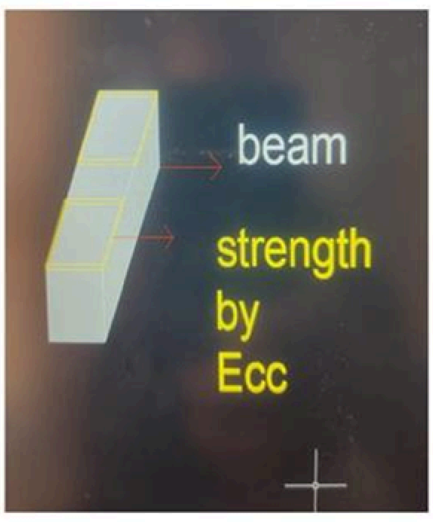
LABORATORY TESTS

1-Flexural test
2- COMPREESIVE STRENGTH

OUTCOMES

Improved Load-Carrying Capacity:
Beams strengthened with ECC showed a significant increase in load-bearing capacity compared to control beams without ECC.





SUPERVISOR:

DR. HASSAN MOHAMMED AHMED

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High Strength Cement Mortar Reinforced by Natural Fibers

PROJECT BACKGROUND AND MOTIVATION:

The construction industry seeks innovative materials to enhance strength and sustainability. High-strength cement is brittle, making natural fibers a good option.

Motivation

1. Sustainability: Reduce carbon footprint.
2. Performance: Increase strength and durability.
3. Cost: Use locally sourced fibers.
4. Durability: Improve mortar resistance.
5. Innovation: Support sustainable construction.

OBJECTIVE

1- Enhance Mechanical Properties:
Improve tensile strength, ductility, and impact resistance compared to traditional cement mortar.

2-Sustainability:
Utilize renewable natural fibers, reducing the carbon footprint and promoting eco-friendliness.

3- Durability:
Increase resistance to cracking and shrinkage over time.

4- Cost-Effectiveness:
Lower production costs by using locally available natural fibers.

METHODOLOGY

1. Materials Selection:

- Cement:
Use high-strength Portland cement.
- Aggregates: Select fine aggregates (sand) with appropriate gradation.
- Natural Fibers: Choose suitable fibers (e.g., jute, hemp, sisal) based on mechanical properties and availability.
- Water: Use clean, potable water.

2. Preparation of Fiber:

- Cleaning: Remove impurities from natural fibers.
- Cutting: Cut fibers to desired lengths (typically 10-50 mm).
- Treatment: Optionally treat fibers (e.g., soaking in a solution) to enhance bonding with the mortar.

3. Mix Design:

- Determine the optimal ratio of cement, aggregates, fibers, and water.
- Conduct preliminary trials to establish the ideal fiber content

4. Testing and Analysis:
Conduct mechanical tests and study the performance of fiber-reinforced mortar compared to conventional cement.

MATERIALS USED

cement - sand - water - superplasticizer
sika fume - sisal fibers - waste glass

POTENTIAL MARKET

1. Sustainability Trends:
- Rising demand for eco-friendly materials.

2. Infrastructure Investments:
- Major investments in durable construction projects.

3. Technological Advancements:
- Innovations enhancing high-strength cement performance.

4. Regulatory Support: Policies promoting sustainable materials.

5. Global Awareness: Rising awareness of environmental issues is driving demand for materials that reduce carbon footprints and promote sustainability.

MIX DESIGN

Cement /Sand = 1:2 - 1:2.5 - 1:3 depend on the flowabilityw/c = 0.4

Sisal fibers = 2%, 4%, 6%.

Waste glass = 15%, 30%, 60% replaced by weight of sand.

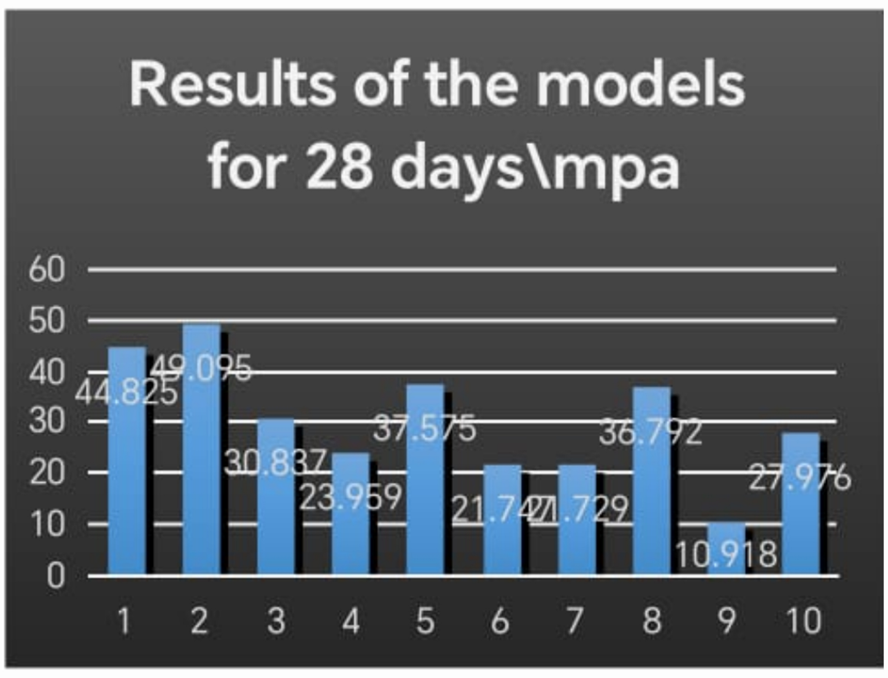
Superplastizer = 0.6% by weight of cement.

LABORATORY TESTS

1-Wet Density: according ASTM C642
2-Compressive Strength: accordingASTM C39
3-Water Absorption: according ASTM C642
4-Flexural Strength: according ASTM C78

OUTCOMES

1. **Improved Mechanical Properties:** Increased tensile and flexural strength.
2. **Durability:** Greater resistance to cracking and shrinkage.
3. **Sustainability:** Reduced reliance on synthetic materials.
4. **Cost-Effectiveness:** Lower material and maintenance costs.
5. **Lightweight Composition:** Easier handling.
6. **Aesthetic Appeal:** Unique textures and finishes.
7. **Application Versatility:** Suitable for residential, commercial, and infrastructure projects



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REHABILITATION OF LIGHTWEIGHT REINFORCED CONCRETE BEAM WITH OPENING USING CARBON FIBERS SHEET

PROJECT BACKGROUND AND MOTIVATION

Lightweight reinforced concrete beams with openings are widely used in construction due to their versatility and cost-effectiveness. However, these beams often face challenges such as reduced load-bearing capacity, susceptibility to cracking, and shear failure due to the inherent weaknesses of lightweight aggregates. The study addresses these issues by exploring the use of carbon fiber sheets and silica fume to enhance the beams' structural integrity, durability, and performance under load.

OBJECTIVE

The primary objective is to improve the mechanical properties of lightweight concrete beams by:

1. **Incorporating pumice stone as a lightweight aggregate and silica fume to enhance strength.**
2. **Reinforcing beams with carbon fiber sheets to increase resistance to shear and flexural failure.**
3. **Evaluating the performance of rehabilitated beams through laboratory tests.**

METHODOLOGY

1.Material Selection:

- ·Lightweight pumice aggregate, silica fume (partial cement replacement), and carbon fiber sheets for reinforcement.
- ·Epoxy adhesive for bonding fibers to beams.

2.Concrete Mix Design:

- ·60% coarse aggregate replaced with pumice.
- ·10% silica fume added for enhanced strength.
- ·Superplasticizer used to improve workability.

3.Experimental Process:

- ·Casting and testing concrete samples (cubes, beams).
- ·Measuring compressive, tensile, and flexural strength.
- ·Reinforcing beams with carbon fiber sheets and testing under load.

4.**Analysis**:

- ·Comparing results before and after reinforcement.
- ·Evaluating the technique’s effectiveness in improving beam durability.

MATERIALS USED

- **Cement**: Ordinary Portland Cement (OPC).
- **Aggregates**: Natural river sand, crushed gravel, and pumice stone.
- **Admixtures**: Silica fume, superplasticizer.
- **Reinforcement**: Carbon fiber sheets (Sika Wrap Hex-230C), epoxy adhesive (Sika dur 330 C).

COST ANALYSIS

- Pumice stone is cost-effective and locally available.
- Carbon fiber sheets, though expensive, offer long-term benefits in durability and strength.
- Silica fume and superplasticizer add to the cost but significantly enhance performance.

LABORATORY TESTS

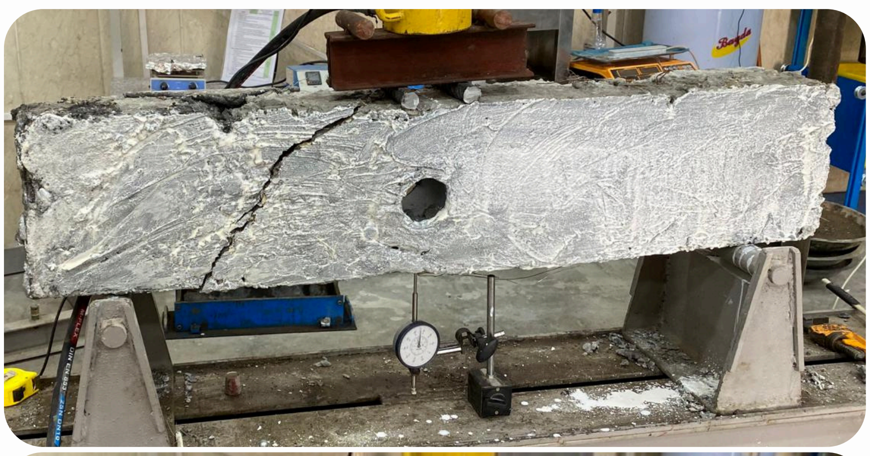
1. **Slump test (ASTM C143).**
2. **Compressive strength test (BS 1881: Part 116).**
3. **Splitting tensile strength test (ASTM C496).**
4. **Flexural strength test (ASTM C78).**

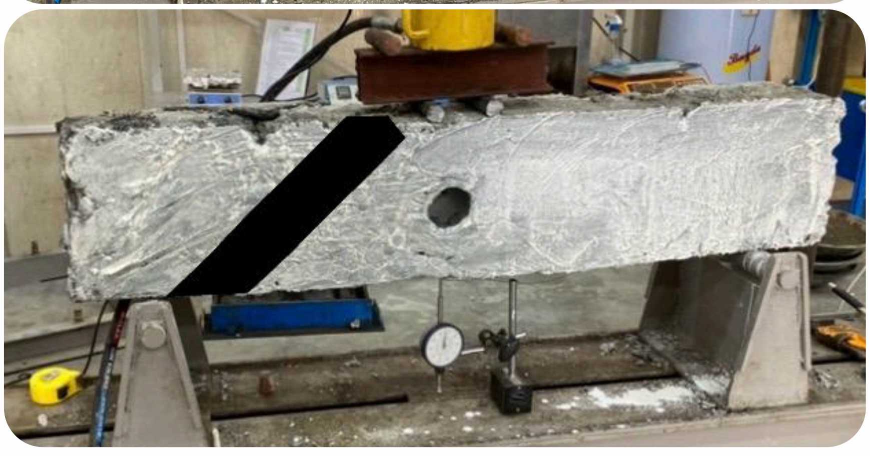
OUTCOMES

1. **Improved compressive and flexural strength of lightweight concrete.**
2. **Enhanced shear resistance and load-bearing capacity of beams with openings.**
3. **Validation of carbon fiber sheets as an effective rehabilitation method.**

SIGNIFICANCE AND IMPACT

- **Provides a cost-effective solution for rehabilitating existing lightweight concrete structures.**
- **Reduces dead load in buildings, improving seismic performance.**
- **Promotes sustainable construction by utilizing lightweight and locally available materials.**





POTENTIAL MARKET

- CONSTRUCTION COMPANIES SPECIALIZING IN LIGHTWEIGHT AND SUSTAINABLE BUILDING MATERIALS.
- INFRASTRUCTURE PROJECTS REQUIRING REHABILITATION OF EXISTING STRUCTURES.
- EARTHQUAKE-PRONE REGIONS WHERE LIGHTWEIGHT CONCRETE IS PREFERRED.

IN COLLABORATION WITH

- NORTHERN TECHNICAL UNIVERSITY, TECHNICAL ENGINEERING COLLEGE - MOSUL.
- SUPERVISED BY PROF. DR. AMMAR ABDL-JABBAR

PREPARED BY:

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SUPERVISOR:

PROF. DR. AMMAR ABDL-JABBAR

Ministry of Higher Education and Scientific Research
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PROJECT TITLE:

PREDICTING THE ULTIMATE SHEAR STRENGTH OF REINFORCED CONCRETE DEEP BEAMS USING ARTIFICIAL NEURAL NETWORKS

PROJECT BACKGROUND AND MOTIVATION

Deep beams are structural elements widely used in applications such as high-rise buildings, transfer girders, and foundation walls. These beams exhibit complex structural behavior due to nonlinear stress distribution and a lack of precise understanding of their shear failure mechanisms. Traditional methods like the ACI code or Strut-and-Tie model rely on approximate equations that may not achieve the required accuracy. This project aims to leverage artificial intelligence techniques, specifically Artificial Neural Networks (ANN), to predict ultimate shear strength with higher precision compared to conventional methods.

OBJECTIVE

1. **Develop an ANN model capable of predicting the ultimate shear strength of deep beams.**
2. **Conduct a parametric study to identify the most influential factors affecting shear strength.**
3. **Compare the proposed model's results with experimental data and standard equations (e.g., ACI).**

METHODOLOGY

1. **Data Collection:**

oUtilize data from 253 previous experiments on deep beams, including variables such as:

- Horizontal (%ρ_h) and vertical (%ρ_v) reinforcement ratios.
- Concrete compressive strength (f'_k) and steel yield strength (f_y).
- Geometric dimensions (width, height, effective depth).

2. **Data Preparation:**
- Split the data into two sets: 225 samples for training and 28 for testing.

3. **Model Development:**
- Implement a Back-Propagation Neural Network (BPNN).
- Apply transfer functions like Log-Sigmoid for optimization.

4. **Evaluation:**
- Compare results with experimental data using the correlation coefficient (R^2 = 0.96).

COST ANALYSIS

- **Theoretical Cost: Relatively low, as it relies on existing data.**
- **Operational Cost: Includes software runtime and computational resources.**

POTENTIAL MARKET

- STRUCTURAL DESIGN FIRMS.
- CONSTRUCTION AND ENGINEERING CONSULTING COMPANIES.
- RESEARCHERS IN AI AND STRUCTURAL ENGINEERING APPLICATIONS.

SUPERVISOR:

DR. MAJID ALI DHAHIR

SIGNIFICANCE AND IMPACT

- **Provides a precise tool for designing deep beams, reducing material waste and improving structural safety.**
- **Applies AI techniques in structural engineering to analyze complex phenomena.**

LABORATORY TESTS

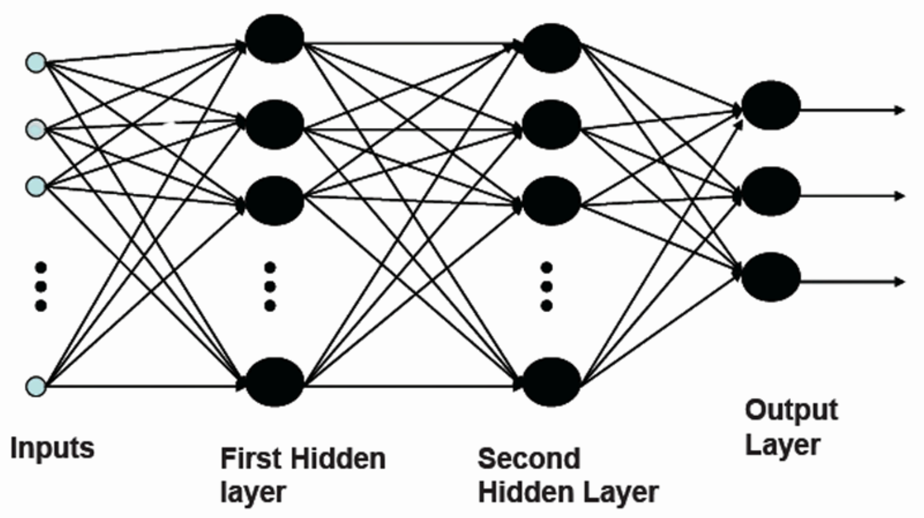
The study utilized published data, minimizing the need for new experiments.

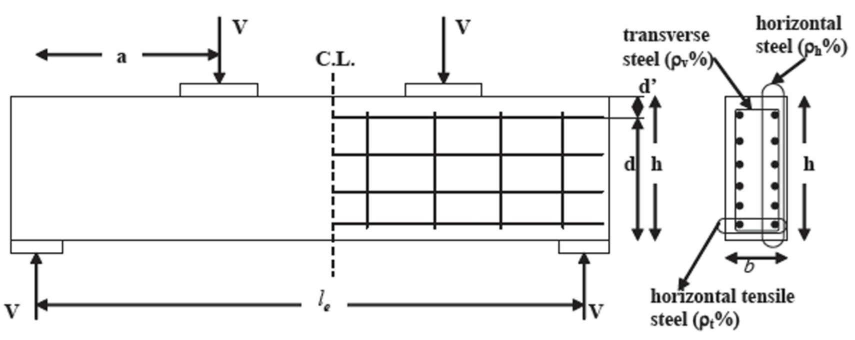
OUTCOMES

1. **The model demonstrated high accuracy in predicting shear strength, with results closely matching experimental data.**
2. **Key influential factors identified:**
   - **Horizontal reinforcement ratio (44% impact).**
   - **Vertical reinforcement ratio (24.9% impact).**
   - **Concrete and steel strength.**
3. **Observations showed that high-strength steel reinforcement reduces shear capacity due to lower elasticity.**

MATERIALS USED

- **Data: 253 samples from previous experiments.**
- **Software Tools: MATLAB for training and analysis.**
- **Mathematical Equations: Predictive equations based on ANN weights (detailed in Chapter 4).**





PREPARED BY:

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"GREEN HIGH STRENGTH CONCRETE REINFORCED BY E- WASTE FIBER"

PROJECT BACKGROUND AND MOTIVATION

The construction industry's reliance on natural resources and its environmental footprint have driven the need for sustainable alternatives. This research focuses on repurposing electronic waste (E-waste) fibers and ceramic waste (CW) into green high-strength concrete, aiming to reduce environmental impact and promote resource efficiency. E-waste, generated from discarded electronic devices, and CW, from manufacturing or demolition, are often improperly disposed of, leading to environmental pollution.

METHODOLOGY

- ·Waste Reduction: The research addresses the growing problem of electronic waste (E-waste) and ceramic waste (CW) disposal by repurposing these materials into construction applications.
- ·Resource Conservation: By replacing natural aggregates and cement with recycled materials, the study promotes sustainable resource management, conserving non-renewable resources such as sand and gravel.
- ·Cost-Effectiveness: Using recycled materials like E-waste fibers and CW can reduce the cost of concrete production, particularly in regions where raw materials are expensive or scarce

MIX DESIGN

The mix design employed a cement-to-sand-to-gravel ratio of 1:1.25:1.75, with a water-to-cement ratio (w/c) of 0.3. The control mix (M0) comprised cement, sand, gravel, silica fume (SF), a superplasticizer (SP), and water, as detailed in Table 6. E-waste fibers, derived from polyvinyl chloride (PVC) electronic waste cables, were incorporated into the concrete at 0.5% and 1%, by weight of cement. Additionally, ceramic waste (CW) was used to replace fine aggregate by weight at proportions of 10%, 20% and 30%.

PREPARED BY

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OUTCOMES

1.Percentages of E-waste fibers 0.5% and 1% were found to boost compressive and flexural strengths, attributed to improved load distribution and increased rigidity within the concrete matrix.
2.The incorporation of E-waste fibers led to a decrease in slump values, indicating reduced workability. This is linked to the fibers' physical interaction with the concrete matrix
3.Replacing fine aggregates with CW up to 30% enhanced the mixture's stiffness and load-bearing capacity.
4.Utilizing recycled materials such as E-waste fibers and CW supports sustainable construction practices by minimizing waste and resource depletion while offering economically viable solutions.

MATERIALS USED

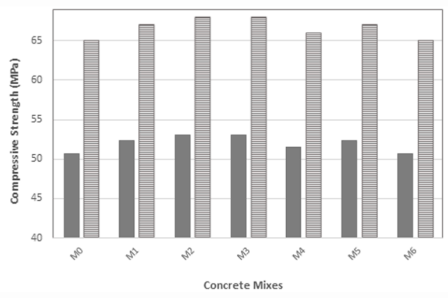
- ·Cement, Sand
- ·Aggravate, Water
- ·Siliica fume, Ceramic waste
- ·E- waste fiber, Superplastizer

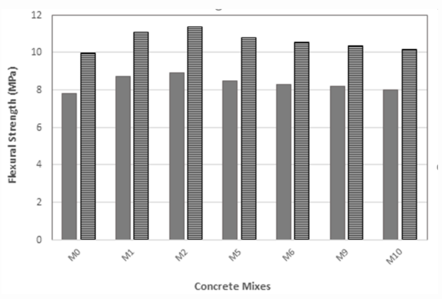
OBJECTIVE

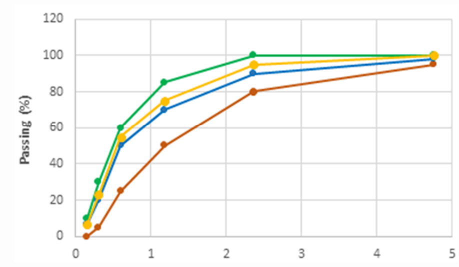
1. Explore the potential of using electronic waste (E-waste) fibers and ceramic waste (CW) as sustainable materials in high-strength concrete applications.
2. Assess how these recycled materials can contribute to reducing environmental impact and promoting resource conservation in the construction industry.
3. Study the effects of incorporating E-waste fibers at varying percentages (0.5% and 1.0% by weight of cement
4.Analyze how the physical and chemical characteristics of E-waste fibers (e.g., smooth texture, hydrophobic nature).

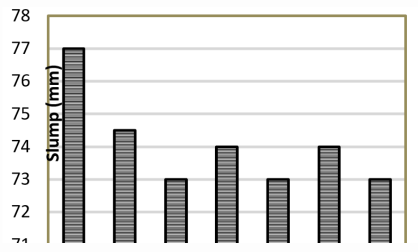
LABORATORY TESTS

1.Slump
2.Compressive strength
3.Flexural strength









SUPERVISOR:

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USE OF THE WATER QUALITY AS A SIMPLE INDICATORS OF TIGRIS RIVER POLLUTION

PROJECT BACKGROUND AND MOTIVATION

The importance of the Tigris River in Iraq, the largest river in the Middle East, and the source of Arvin, the advocate of drinking and his farming, industry and the ever continuing fascination with human activities along the course of the Tyr, I make Mulberry a big issue that affects human health and the environment. It has paved the Tigris River in the last few years. There has been an increase in pollution rates resulting from human and industrial activities, which negatively affected the ecosystem of the river and the health of the surrounding communities.

OBJECTIVE

1. **Analysis of water quality in the Tigris River and identification of sources of pollution.**
2. **The extent of the impact of industrial, agricultural and urban activities on water quality**
3. **Make recommendations to reduce pollution and improve water quality**

METHODOLOGY

- **Sampling:**

Samples are collected from various locations along the river and at predetermined points, with sampling timing determined based on seasonal changes and environmental conditions.

- **Sample analysis:**

The collected samples are analyzed to determine the levels of various contaminants, using appropriate chemical, biological and physical techniques.

- **Taking samples from the river:**

First, samples were taken from the river. We were directed to take points from the middle of the river from five areas:

- The first point is in the Al Rashidiya area according to the coordinates.
- The second point is in the forest area.
- The third point is near the third bridge.
- The fourth point is near the old bridge.
- The fifth point is near the fourth bridge.

MATERIALS USED

- **Use of the water**

POTENTIAL MARKET

- PUBLIC & PRIVATE SECTOR
- CONSTRUCTION AND CONTRACTING COMPANIES
- GOVERNMENTAL ENTITIES
- INDUSTRIAL FACILITIES
- ENGINEERING CONSULTING OFFICES

PREPARED BY:

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SUPERVISOR:

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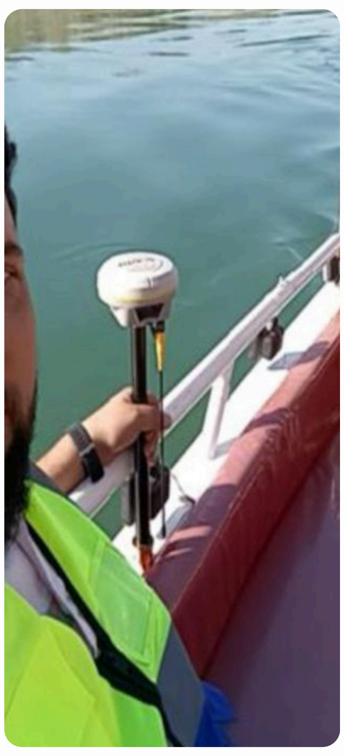
LABORATORY TESTS

Parameter	Instrument/Method
EC	HANNA HI8733 Conductivity meter
pH	Electrode pH meter
DO	BOD bottle and titration apparatus
Turbidity	HANNA LP-2000 turbid meter
TH	Titration apparatus
Ca	Titration apparatus
Mg	Titration apparatus
SO_4	Turbid meter
PO_4	PD303 UV Spectrophotometer
NO_3	PD303 UV Spectrophotometer
TDS	Filtration, weighing, and drying apparatus
ALK	Titration apparatus
Cl	Titration apparatus

OUTCOMES

1. **Improved sewage treatment:**
   - Implementing advanced sewage treatment plants to properly treat wastewater before it is discharged into the river, thereby reducing the contamination of water with organic and chemical substances.
2. **Industrial regulations:**
   - Enforcing stricter regulations on industrial waste disposal, including the implementation of proper waste management practices and the adoption of cleaner production technologies to minimize pollution from industrial sources.
3. **Agricultural best practices:**
   - Promoting the use of sustainable agricultural practices that reduce the reliance on chemical fertilizers and pesticides, thus minimizing agricultural runoff into the river.
4. **Oil spill prevention and response:**
   - Implementing measures to prevent oil spills from refineries and tankers, such as regular inspections and maintenance of infrastructure, as well as establishing effective emergency response protocols to contain and clean up spills promptly.
5. **Public awareness and education:**
   - Increasing public awareness about the importance of preserving the Tigris River and promoting responsible water usage practices among communities living along its banks.

WQI Value	Water Quality	NO. POINT	Water QUALITY
0 - 25	Excellent	p1	28.3
26 - 50	Good	p3	29.6
51 - 75	Poor	p2	29.6
76 - 100	Very Poor	p5	31.1
> 100	Unsuitable	p4	32.1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GRADUATION PROJECT

DESIGN AND ANALYSIS OF AN EARTHQUAKE-RESISTANT BUILDING ACCORDING TO THE IRAQI SEISMIC CODE

PROJECT BACKGROUND AND MOTIVATION

This study includes the conditions that must be met in buildings and structures exposed to seismic activity. When an earthquake occurs, seismic waves are generated as a result of sudden movements in the fault zone of the Earth's crust. These waves, varying in type and speed, travel through different paths before reaching the building site, subjecting the soil beneath thestructure to various types of vibrations, which are usually horizontal and vertical. This causes vibrations in the soil under the foundations, leading to movement of the foundations in different directions. As a result, the upper part of the building experiences relative vibrations accompanied by foundation movement, generating shear forces at different levels of the structure. This leads to deformations, cracks in the structure, and damage, potentially causinglocalized collapses that may resultin the building's overall collapse in some cases.

OBJECTIVE

The seismiccode primarily focuseson setting the basic engineering requirements to avoid human losses, ensure the continuity of building services, and protect buildings and structures from collapses that cause loss of life and property, as well as reducing damage to property and buildings.
Contour maps of seismiccoefficient values for Iraq have been adopted, incorporating the study of scientific advancements in the field of earthquakes to protect buildingsand structures from collapse.

METHODOLOGY

The study presents the conditions and requirements for calculating the effects of seismic activity when designing buildings and structures, including the changes that affect their structural behavior: Calculating the static horizontal forces for buildings and non-building structures. Conducting dynamic analysis for them. Calculating the lateral forces affecting the elements. Determining the technical requirements and precautions in design and execution. This study does not includeroad structures, bridges, dams, prestressed concrete, or
structures that use seismic isolationand damping systems.

MATERIALS USED

SEISMICDESIGN CRITERIA

POTENTIAL MARKET

PUBLIC & PRIVATE SECTOR ROADS AND BRIDGES DIRECTORATE NINEVEH
MUNICIPALITIES DIRECTORATE
NINEVEH GOVERNORATE

SUPERVISOR

D. MOTHANA AADIL NAJM

MIX DESIGN

The design of structures used for human occupancy is aimed at resisting seismic activity to protect them from collapse, reduce damage, and ensure the continuity of services. Additionally, the design details for structures not intended for human occupancy and extensions to existing buildings are determined in accordance with Iraqi codes.

LABORATORY TESTS

A map of a government building located in Duhok, Iraq.
The structural system of the building is a concreteframe consisting of columns and beams.

OUTCOMES

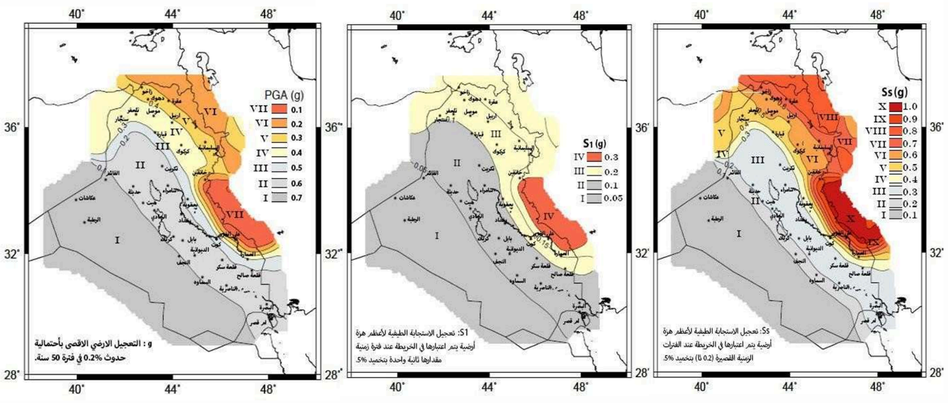
Avoiding human losses, ensuring the continuity of building services, and protecting buildingsand structures from collapses that cause loss of life and property, as well as reducing damage to property and buildings. The seismic coefficient values for Iraq have been adopted through contour maps, with the study incorporating scientific advancements in the field of earthquakes to protect buildings and structures from collapse.

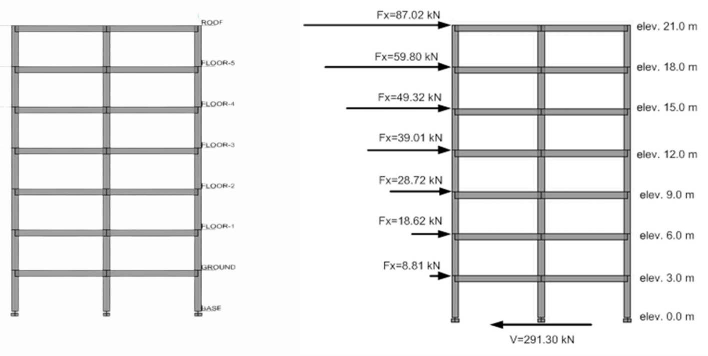
LABORATORY TESTS

A map of a government building located in Duhok, Iraq.
The structural system of the building is a concreteframe consisting of columns and beams.

COST ANALYSIS

The price will increase by 350000 Iraqi dinars per floor





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MODELLING OF SHEAR WALL UNDER SEISMIC LOAD USING ANSYS PROGRAM)

PROJECT BACKGROUND AND MOTIVATION

Shear walls are critical structural elements in civil engineering, playing a vital role in bearing lateral loads and enhancing the seismic performance of buildings. With the increasing occurrence of earthquakes and their significant impact on infrastructure, the theoretical and experimental study of shear walls under seismic load has become essential to improve engineering performance and ensure the safety of structures.

Theoretical computation programs like Ansys are used to analyze the seismic performance of shear walls. These programs allow engineers to make accurate predictions of engineering performance and qualitative analysis of shear walls under seismic load and performance of these walls under seismic load to determine potential strength and deformations.

MODAL DESIGN

Modeling name: SHEAR WALL (8) IN STAFF HOUSING BUILDING
(G + 4) Multi - Story
PART OF 400 BED EDUATIONAL HOSPITAL PROJECT.
MOSUL-IRAQ
Contractor: GERMAN MEDICAL SERVICES (GMS)
Beneficiary: MINISTRY OF HEALTH-IRAQ

OBJECTIVE

This study aims to predict the seismic behaviors of reinforced concrete shear walls using (ANSYS 22) finite element program.

This research focuses on the modeling and analysis of shear walls under seismic loads using the advanced capabilities of the ANSYS 22 program. Shear walls are integral structural elements that provide significant resistance to lateral forces, especially in earthquake-prone regions.

OUTCOMES

1.The finite element model of the shear wall (8) constructed in the program (ANSYS 22) using element (SOLD-Brick 8 node 185) in this research could capture the linear response of this system under earthquake loading.

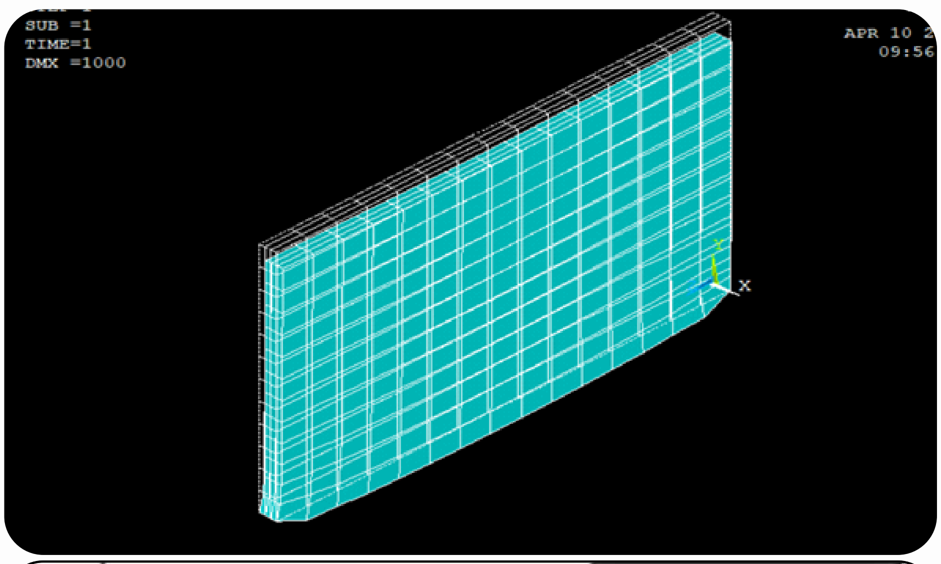
2.The maximum lateral displacement at the top story due to lateral force was in control and in limitation.

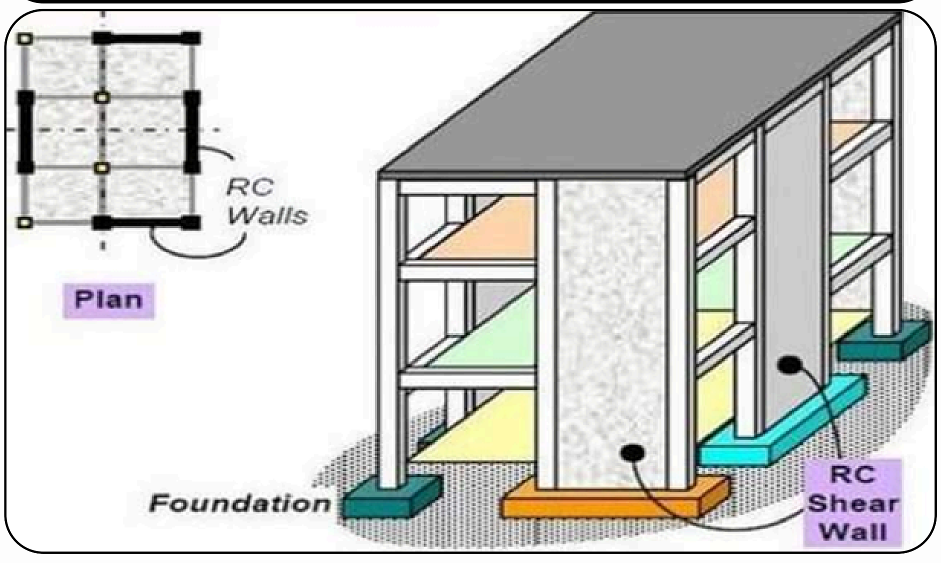
3.The check of practical calculated is safe, stable, and structurally acceptable to resist the lateral force that simulates the assumed seismic force

4.The model shear wall (8) is very effective in resisting horizontal forces coming from earthquake and wind forces and safe.

METHODOLOGY

After we entered the required information into the model (Shear wall (8) top story) using the program (ANSYS 22) to verify whether Shear Wall can withstand the lateral force applied to it, which simulates the effect of the assumed seismic force, the results appeared to us according to the required specifications and analysis according to the program. We find the result of the finite element model of the shear wall constructed in ANSYS 22 using element (SOLD-Brick 8 node 185) in this study could capture the liner-response of this system under earthquake loading.





APPLICATION USED

ANSYS 2022 / R1 PROGRAMS

LABORATORY USED

1.Computer Lab at Engineering Technical College / Mosul

PREPARED BY:

1- SUHA RASHEED IBRAHIM
2- OMAR AHMED HAMZAH
3- SAAD SALEH HASSAN
4- YASSER AHMED HASSAN

TENTIAL MARKET

- PUBLIC & PRIVATE SECTOR

SUPERVISOR

ASSIST. PROF. DR. MUTHANNA ADIL NAJM

Ministry of Higher Education and Scientific Research
Northern Technical University
Technical Engineering College of Mosul
Department of Building and Construction
Techniques Engineering

"Enhancing Al Qayara Asphalt Binder Using PGX Pand Co Polymer"

PROJECT BACKGROUND AND MOTIVATION:

Nineveh Governorate, particularly in rural areas, faces significant road infrastructure challenges due to the poor moisture resistance of Qayyarah asphalt. This asphalt material is highly susceptible to erosion, as the asphalt binder loses adhesion to the aggregate under wet conditions, leading to pavement deterioration. This study aims to enhance the mechanical properties of Qayyarah asphalt by incorporating PGX PandCo polymer, thereby improving its moisture resistance and extending the service life of rural roads.

OBJECTIVE

This project aims to enhance the performance of Qayyarah asphalt used in road pavements, particularly in the rural areas of Nineveh Governorate, by improving its moisture resistance through the incorporation of PGX PandCo polymer. The primary goal is to reduce pavement deterioration caused by the loss of adhesion between the asphalt binder and aggregate under wet conditions. This enhancement will contribute to extending the service life of roads, minimizing maintenance costs, and improving the overall quality of transportation infrastructure.

METHODOLOGY

The research methodology is structured around several key stages:

1) Data Collection and Analysis: Assessing the current properties of Qayyarah asphalt, focusing on its moisture resistance, durability, and erosion resistance.
2) LaboratoryTesting:Conducting experiments to evaluate the impact of adding PGX PandCo polymer to the asphalt's properties, including moisture resistance and stiffness.
3) Economic Analysis: Performing a cost comparison between modified and conventional asphalt, and assessing long-term economic benefits in terms of maintenance and repair cost savings.
4) Environmental Assessment: Evaluating the environmental impact of using modified asphalt, particularly in reducing the need for frequent maintenance and lowering environmental degradation.
5) Field Application: Implementing a pilot project in selected areas of Nineveh to monitor the practical performance of the modified asphalt in real-world conditions.

MATERIALS USED

Aggregate , PGX Pand Co polymer , Bitumen.

MIX DESIGN

The incorporation of PGX PandCo polymer into Qayyarah asphalt presents a cost-effective solution for enhancing the quality and durability of road pavements in Nineveh. This modification is expected to significantly improve road infrastructure, contribute to sustainable economic development, and optimize overall transportation efficiency.

LABORATORY TESTS

1) Marshall Stability (@25°C, @ 60°C)
2) Indirect tensile strength (ITS) (@25°C, @ 60°C, TSR)
3) Cantabro (@25°C, @ 60°C)

OUTCOMES

1) Enhanced Moisture Resistance: Strengthening the adhesion between the asphalt binder and aggregate, reducing the impact of moisture, and preventing pavement deterioration.
2) Increased Pavement Durability: Improving the mechanical properties of asphalt, such as resistance to deformation and wear, leading to longer-lasting roads.
3) Reduced Maintenance Costs: Minimizing road deterioration decreases the need for frequent repairs, resulting in long-term economic savings.
4) Improved Transportation Infrastructure: Providing more sustainable and efficient roads, enhancing safety and comfort for road users, particularly in rural areas.
5) Support for Economic Development: Enhancing road quality facilitates commercial activities and transportation, contributing to economic growth in the region.

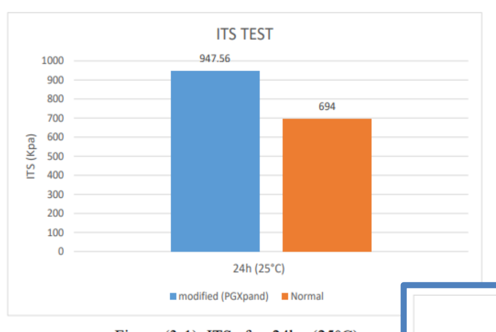


Figure (3-1) ITS after 24hr. (25°C)

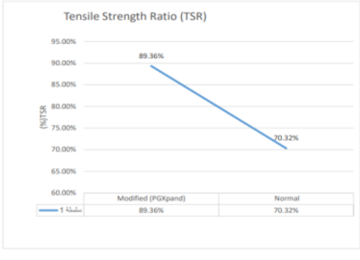


Figure (3-4) tensile strength ratio (TSR)

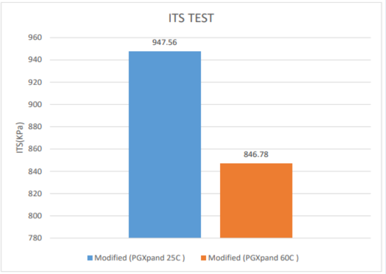


Figure (3-3) ITS after 24hr. (60°C)

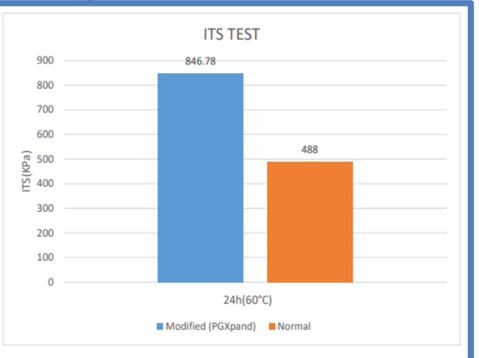


Figure (3-2) ITS after 24hr. (60°C)


Indirect Tensile Strength Instrument

Marshall's Stability Instrument


Marshall Compactor

TENTIAL MARKET

- PUBLIC & PRIVATE SECTOR
- ROADS AND BRIDGES DIRECTORATE
- NINEVEH MUNICIPALITIES DIRECTORATE
- NINEVEH GOVERNORATE

IN COLLABORATION WITH
MOSUL MUNICIPALITY

PREPARED BY:
1) Ayman Mohammed Younis
2) Bassam Waad Qasim
3) Amrou Mohammad Natiq
4) Mohammed Juma Badr
5) Abdul Rahman Ammar Younis

SUPERVISOR:
DR. ZAID HAZIM AL-SAFFAR

Ministry of Higher Education and Scientific Research
Northern Technical University
Technical Engineering College of Mosul
Department of Building and Construction Techniques Engineering

PRODUCTION OF ANTI-HUMIDITY PLASTERING MORTAR FOR HERITAGE BUILDINGS

PROJECT BACKGROUND AND MOTIVATION

The restoration of heritage buildings in Iraq, particularly in Mosul, faces significant challenges due to conflicts and environmental factors. Traditional materials like limestone, while prevalent, absorb excessive moisture, leading to structural issues such as cracking and collapse. This project addresses the need for a durable, breathable mortar that combines historical authenticity with modern durability to ensure the longevity of restored structures.

OBJECTIVE

1. **Develop an optimal blend of limestone, white cement, and sand for anti-humidity plastering mortar.**
2. **Evaluate the physical and mechanical properties of the mortar.**
3. **Ensure compatibility with heritage buildings while enhancing moisture resistance and durability.**

METHODOLOGY

1. **Material Selection**: Limestone powder, white cement, and sand were sourced locally and tested for purity and compatibility.
2. **Mix Design**: Various ratios of limestone, white cement, and sand (e.g., 1.25:3:6) were prepared and tested.
3. **Laboratory Tests**:
   - **Compressive Strength (ASTM C109)**: Measured after 28 days of curing.
   - **Flexural Strength**: Evaluated to assess flexibility.
   - **Durability**: Cyclic salt crystallization tests (sodium sulfate) were conducted.

4.**Aesthetic Evaluation**: Color and texture were matched to traditional lime plasters.

MATERIALS USED

- **Limestone Powder**: Sourced from Karbala, sieved to remove impurities.
- **White Cement**: Local market procurement.
- **Sand**: Standard construction-grade sand.
- **Water**: Adjusted for optimal workability.

MIX DESIGN

- The optimal mix ratio was determined as **1.25 parts limestone powder : 3 parts white cement : 6 parts sand,** balancing strength, workability, and moisture resistance.

LABORATORY TESTS

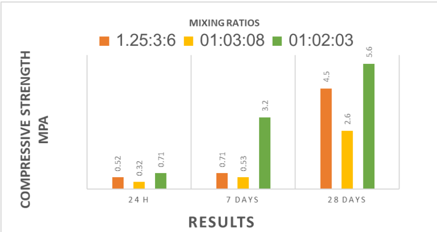
1. **Compressive Strength Test (ASTM C109).**
2. **Flexural Strength Test.**
3. **Water Absorption and Porosity Analysis.**
4. **Salt Crystallization Resistance Test**

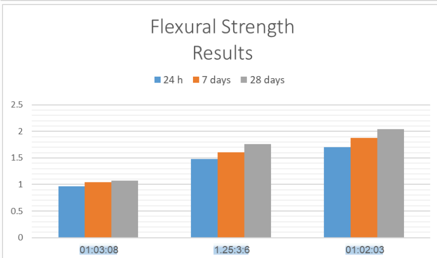
OUTCOMES

1. **Compressive Strength**: 2.5–3.2 MPa (suitable for heritage structures).
2. **Flexural Strength**: 1.2 MPa (accommodates structural movements).
3. **Durability**: Resisted salt crystallization and showed minimal degradation.
4. **Aesthetic Compatibility**: Matched traditional lime plasters in color and texture.

SIGNIFICANCE AND IMPACT

- **Cultural Preservation**: Protects Mosul's heritage buildings while maintaining historical authenticity.
- **Environmental Sustainability**: Uses locally sourced, natural materials.
- **Economic Efficiency**: Lowers long-term maintenance costs by reducing moisture-related damage.





POTENTIAL MARKET

- HERITAGE RESTORATION PROJECTS: GOVERNMENT AND UNESCO-LED INITIATIVES IN IRAQ AND SIMILAR REGIONS.
- CONSTRUCTION INDUSTRY: SUSTAINABLE BUILDING MATERIALS FOR MODERN APPLICATIONS.

IN COLLABORATION WITH

- MOSUL MUNICIPALITY

PREPARED BY:

1. GHAITH HUSSEIN ALI
2. ALI AHMED SAADI
3. AMAL QASIM
4. MUHANNAD GHAZI.

SUPERVISOR:

- **DR. ZAID HAZEM AL-SAFFAR**

Ministry of Higher Education and Scientific Research
Northern Technical University
Technical Engineering College of Mosul
Department of Building and Construction
Techniques Engineering

Project Name: Strengthening of RC Beams Using Steel Wire Mesh Reinforcement

PROJECT BACKGROUND AND MOTIVATION

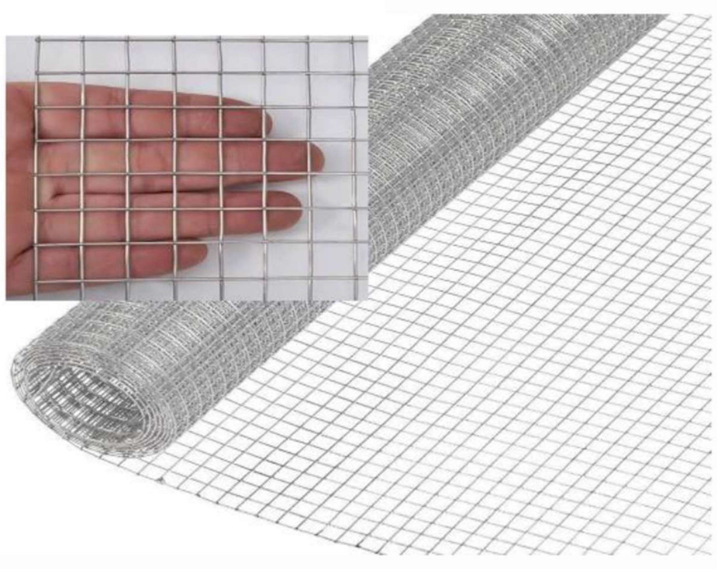
Concrete is one of the most widely used materials in construction; however, it may require upgrading or strengthening for various reasons. One method of strengthening concrete is by combining steel wire mesh with cement mortar, known as Ferro-cement. This research focuses on the effects of Ferro-cement on reinforced concrete beams, primarily its impact on flexural strength. The concept of Ferro-cement was revived by an Italian architect named Luigi Nervi who discovered that the components of Ferro-cement produced materials with approximately homogeneous mechanical properties and high resistance to impact.

MIX DESIGN

A (1:2:4) concrete mix ratio of cement to sand to gravel was used, with a water-to-cement ratio of 0.5, targeting a compressive strength of approximately 25–30 MP

LABORATORY TESTS

1-Flexural Test
2-Concrete Compressive Strength
3-Crack Pattern Observation



OBJECTIVE

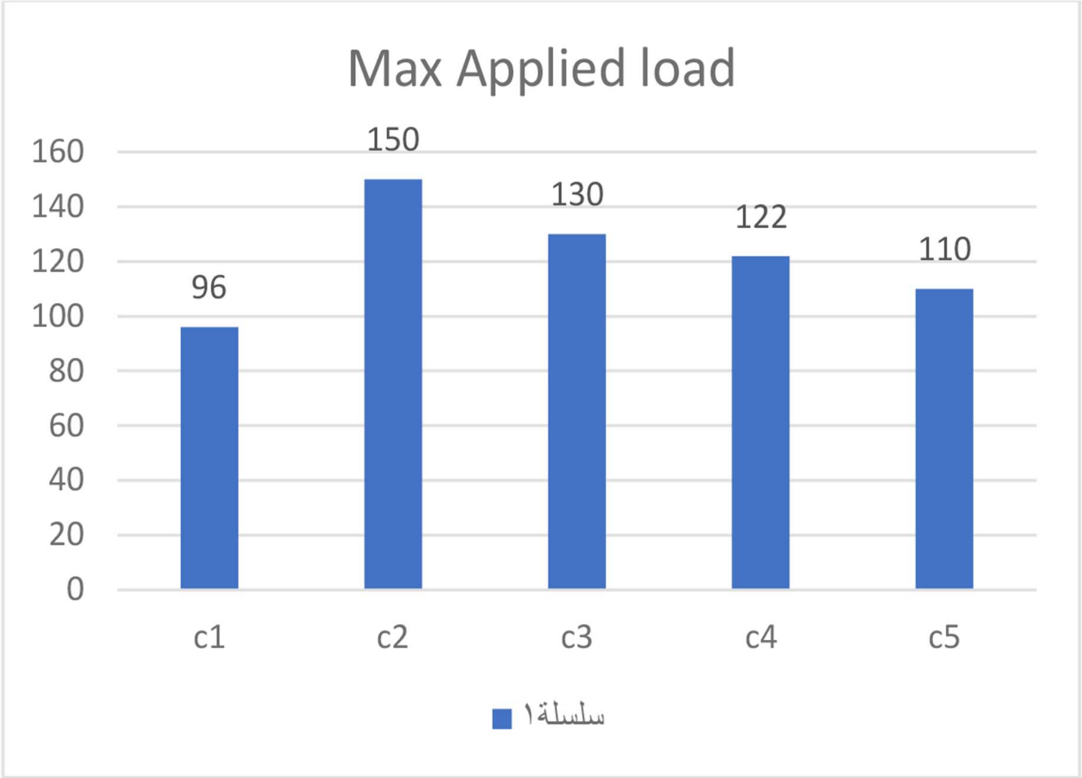
The objective of this study is to investigate and analyze the impact of using steel mesh systems in the reinforcement of reinforced concrete beams, with a focus on their contribution to enhancing structural performance and reducing common issues such as cracking and differential settlement.

METHODOLOGY

An experimental laboratory approach was adopted to study the effect of using geogrid reinforcement on the structural performance of reinforced concrete beams.
The specimens were subjected to bending and deformation tests to analyze the impact of steel wire mesh reinforcement on structural behavior. Data were recorded, analyzed, and compared between the two groups to evaluate the effectiveness of steel wire mesh in enhancing flexural resistance and reducing deflection and cracking

OUTCOMES

The results showed that the use of steel mesh reinforcement in concrete beams led to a noticeable improvement in structural performance:
-An increase in ultimate load capacity by 55.6%, 23.4%, 19.5%, and 10.2%, depending on the arrangement and positioning of the steel mesh



MATERIALS USED

Ordinary Portland cement, natural gravel as coarse aggregate, and washed sand as fine aggregate were used. High-strength steel bars (10–12 mm diameter) were applied, along with biaxial steel mesh and epoxy adhesive for steel mesh installation within the concrete specimens

After conducting a pressure test, it was found that C2 achieved the highest endurance according to the above readings.
Note :C2 tow layer 15 mm=150 Kn

PREPARED BY

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6-Mohammed Ali Mohammed

SUPERVISOR

DR. HESHAM SALIM AL RAWE

Republic of Iraq Ministry of Higher Education and

Scientific Research Northern Technical University

Effect of slag on clay soil

Project Background and Motivation:

Clay soils pose significant engineering challenges due to their high plasticity and low strength. Traditional stabilizers like lime and cement are effective but often costly and less environmentally friendly. Industrial slag, a by-product of steel production, offers a promising alternative due to its cementitious properties. It can enhance soil performance while contributing to waste reduction.
This study aims to evaluate slag as a sustainable and cost-effective solution for improving clay soil behavior.

Methodology:

This study adopts a laboratory-based experimental approach to evaluate the effect of industrial slag on the geotechnical properties of clay soil. The methodology consists of the following steps:

1. Soil Sampling:
Clay soil samples will be collected from selected sites and prepared for laboratory testing.

2. Characterization of Natural Soil:
Initial geotechnical tests will be conducted to determine the properties of untreated clay soil, including Atterberg limits, specific gravity, grain size distribution, and Proctor compaction test.

3. Preparation of Slag-Treated Samples:
Clay will be mixed with industrial slag at varying percentages (2%, 4%, 6%, and 8% by dry weight).

4. Laboratory Testing:
The following tests will be conducted on both untreated and treated samples:
- Unconfined Compressive Strength (UCS)
- Direct Shear Test
- Atterberg Limits Test
- California Bearing Ratio (CBR)
- Standard Proctor Compaction Test

Materials used

1.Clay Soil
Collected from a specific site, then classified and prepared for laboratory testing.
2.Steel Slag
A byproduct of the steel manufacturing process. It's crushed and sieved to specific sizes before being mixed with soil.
3.Water
Used in moisture, compaction, and mixing tests.

Submitted by

Mustafa Khalif Muhammad

Muhammad Amin Muhammad

Mahmoud Abdel Rahman,

Fadel Hamza Fadel

Alaa Harith Khalil

Supervised by
Enas Hashem Muhammad

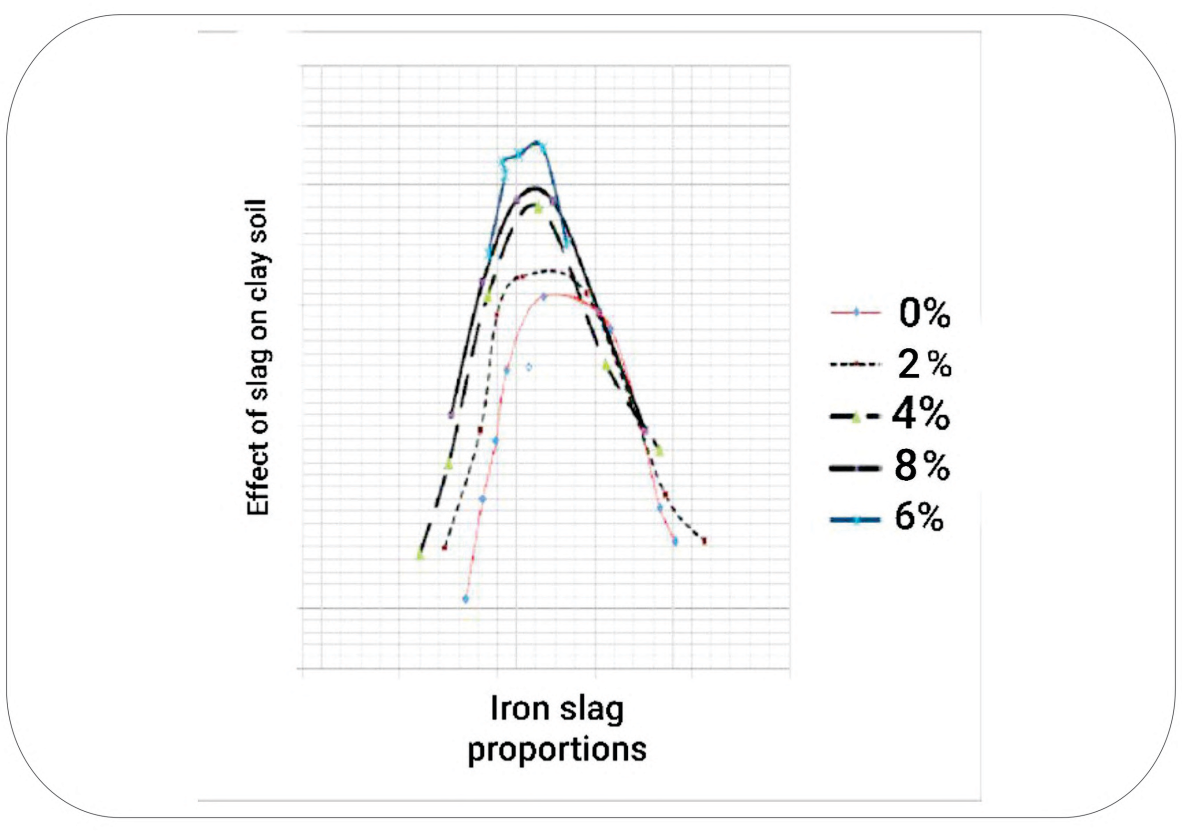
Outcomes

Improved Soil Strength:
Slag addition is expected to significantly increase the unconfined compressive strength (UCS) and shear strength of clay soil.
Enhanced Compaction Properties:
Treated soils typically show higher maximum dry density and lower optimum moisture content, improving soil workability.
Reduced Plasticity:
The Atterberg limits of the clay are expected to decrease, indicating reduced plasticity and improved stability.
Higher Bearing Capacity:
An increase in the California Bearing Ratio (CBR) is anticipated, making the soil more suitable for pavement and foundation applications.
Optimal Slag Content Identification:
The study aims to determine the most effective slag percentage (often around 4–6%) for maximum performance enhancement.
Environmental Benefit:
Utilization of slag contributes to sustainable construction by recycling industrial waste and reducing the use of conventional stabilizers.

Laboratory tests

To evaluate the effect of slag on clay soil, the following laboratory tests will be performed:

1. Atterberg Limits Test:
Determines the liquid limit, plastic limit, and plasticity index of the soil before and after slag treatment.
2. Standard Proctor Compaction Test:
Measures the maximum dry density and optimum moisture content to assess compaction characteristics.
3. Unconfined Compressive Strength (UCS) Test:
Evaluates the strength of the soil under axial loading without lateral confinement.
4. Direct Shear Test:
Determines shear strength parameters, including cohesion and angle of internal friction.



Potential market

1. Road Construction:
Slag-treated clay can improve subgrade strength, making it ideal for highways, rural roads, and temporary access roads.
2. Foundations and Embankments:
Construction companies can benefit from slag-stabilized soil in foundations, embankments, and retaining structures where soft clay is a concern.
3. Land Reclamation Projects:
Slag can be used to improve weak soils in coastal or low-lying areas undergoing reclamation.
4. Sustainable Construction Projects:
Projects focused on green building practices will find slag an eco-friendly alternative to traditional stabilizers.
5. Government Infrastructure Initiatives:
Public works and infrastructure development programs may adopt slag stabilization for cost-effective and sustainable solutions.

Ministry of Higher Education and Scientific Research
Northern Technical University
Technical Engineering College of Mosul
Department of Building and Construction Techniques Engineering

EFFECTS OF ADDITIVES ON CONCRETE'S PHYSICAL PROPERTIES UNDER DIFFERENT FIRE EXPOSURE PERIODS.

PROJECT BACKGROUND AND MOTIVATION

The importance of studying the fire resistance of concrete has increased in light of the growing number of disasters caused by fires in residential and industrial buildings. The deterioration of concrete during fire exposure can lead to the collapse of structures and loss of lives and properties. Therefore, it is essential to develop construction materials with enhanced fire resistance. Additives used in concrete may significantly improve its physical properties after being subjected to elevated temperatures.

OBJECTIVE

1. To study the effect of different additives on the fire resistance of concrete at elevated temperatures.
2. To identify the most effective additives in improving concrete resistance against weight loss and structural collapse after fire exposure.
3. To provide recommendations for applying these additives in high-risk buildings exposed to fire hazards

METHODOLOGY

1. Material Selection
   - Base Materials: Ordinary Portland Cement (OPC), fine natural sand, potable water.
   - Additives:
     - Polypropylene fibers (0.1%–0.2% by concrete volume)
     - Silica fume (5%–10% of cement weight)
     - Metakaolin (10%–15% of cement weight)
     - Fly ash (20%–30% of total cementitious materials)
     - Nano silica (1%–3% of cement weight)
2. Concrete Mix Design
   - Mix ratio: 1 (cement) : 2.4 (sand).
   - Water-cement ratio: 0.5.
   - A control mix (no additives) and multiple mixes with individual additives are prepared.
3. Specimen Casting & Curing
   - Casting 10×10×10 cm concrete cubes.
   - Curing in water for 28 days at room temperature.
4. Fire Exposure
   - Exposing specimens to high temperatures: 300°C, 600°C, 900°C.
   - Exposure durations: 30, 60, and 90 minutes at each temperature.
   - Heating is done in a controlled furnace.
5. Cooling Process
   - Letting specimens cool naturally to room temperature.
6. Post-Fire Testing
   - Absorption test (to measure water absorption).
   - Compressive strength test (to assess residual strength).
   - Shrinkage test (to evaluate dimensional changes).
7. Data Analysis & Conclusion
   - Comparing additive mixes with the control mix.
   - Evaluating each additive's performance under different fire exposures.
   - Identifying the most effective additives and providing recommendations for fire-resistant concrete applications.

SUPERVISOR

- ASSISTANT LECTURE. ISRAA MOHAMMED MUSHTAQ SAEED

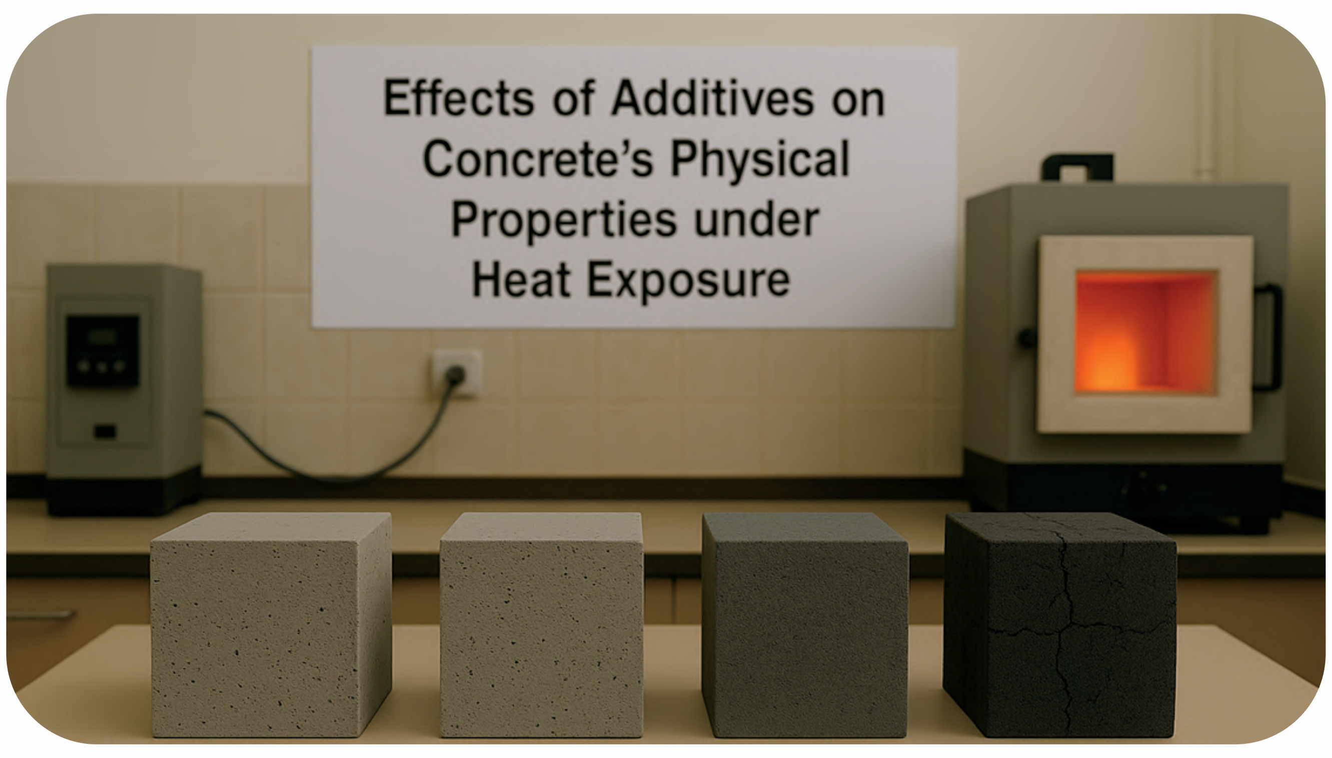
OUTCOMES

1. Effect of Additives:
• Additives may improve concrete's heat resistance, leading to less deterioration in strength and hardness compared to reference molds.
2. Effect of Fire Exposure Duration:
• 300°C: Minor changes in density and strength, with generally limited effects.
• 600°C: Concrete may lose 20-30% of its strength, with noticeable improvements when additives are used.
• 900°C: Concrete may lose 40-60% of its strength and density in reference molds, while additive-containing molds are better at maintaining properties like strength and hardness.
3. Density Change:
• At high temperatures (600-900°C), concrete may lose 15-20% of its density due to evaporation and structural changes.
4. Cracking:
• Concrete may begin to crack at temperatures between 300-500°C, with increased cracking severity as exposure duration increases.
5. Load-Bearing Capacity:
• Concrete may lose 30-50% of its strength after prolonged exposure to high heat, especially at 600°C and 900°C.
6. Environmental Impact:
• The environmental impact of additives may change after fire exposure, but some additives could offer environmental benefits such as recyclability.

LABORATORY TESTS

Temperature (°C)	Best Additive	Reason for Selection
300°C	Nano-Silica	Highest strength (24 MPa), lowest absorption (7.0%), lowest shrinkage (0.16%)
600°C	Nano-Silica	Highest strength (20 MPa), lowest absorption (8.5%), lowest shrinkage (0.22%)
1200°C	Nano-Silica	Highest strength (9 MPa), lowest absorption (10.0%), lowest shrinkage (0.46%)

TOP 5 MIXES BASED ON COMPRESSIVE STRENGTH



300°C 600°C 600°C 1200°C

POTENTIAL MARKET

- Construction and Contracting Companies
- Building Material Manufacturers
- Government Sector
- Research and Development
- Environmental Sector

PREPARED BY

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3. AHMED LAITH ISMAIL
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5. AYHAM WALID YAHYA

Ministry of Higher Education and Scientific Research Northern Technical University
Technical Engineering College of Mosul
Department of Building and Construction Techniques Engineering

USING THE INTEGRATED STATION AND GPS DEVICE TO“ CREATE ANEW ROAD IN THE TECHNICAL ENGINEERING COLLEGE/ MOSUL

PROJECT BACKGROUND AND MOTIVATION:

Road construction in Mosul faces challenges such as measurement inaccuracies and time delays using traditional methods. This project aims to integrate GPS technology with Total Stations to enhance precision and efficiency in road construction at the Technical College Engineering, Mosul. By using advanced tools for real-time data collection and positioning, we aim to reduce errors, optimize construction timelines, and improve the quality of roads, benefiting both local communities and overall infrastructure development.

OBJECTIVE

1. Cons ctruct a new access road to the knew Classrooms and Laboratories building to facilitate specimen delivery.
2. Connect the main road to the existing laboratory building to improve mobility.
3. Build a road linking the Technical Institute with the Technical Engineering College to enhance connect
4. The integration of GPS technology with Total Station systems enhanced road construction by overcoming the limitations of each tool. While the Total Station provides high accuracy in open areas, its performance is hindered by obstructions like buildings and trees. GPS, however, offers real-time data correction and reliable positioning, even in challenging environments.
Combining both technologies improved measurement accuracy, reduced discrepancies, and resulted in more precise road designs. This hybrid approach outperformed traditional methods by minimizing errors, reducing fieldwork time, and increasing overall efficiency in the surveying process, making it a superior solution for road construction projects.

METHODOLOGY

This project utilizes advanced GPS and Total Station technology to ensure high-precision road construction. The methodology involves:
1. Site Survey: Conducting a reconnaissance survey to determine control points and the project area.
2. Data Collection: Using Total Stations to measure distances, angles, and height differences along the proposed road alignment.
3. GPS Integration: Integrating GPS data to improve the accuracy of the measurements and eliminate potential errors.
4. Data Processing: Using AutoCAD Civil 3D for processing the data, generating topographical maps, and designing the road layout.

5. Verification: Cross-validating GPS and Total Station data to ensure accuracy and make necessary adjustments.

DEVICES AND TOOLS

1. **Total Station (Leica):** Measures angles and distances for road alignment and surveys; offers high accuracy and long-distance measurement.
2. **Differential GPS (DGPS):** Enhances GPS accuracy for precise land surveys and construction.
3. **Field Tools:** Includes distance measuring tapes (5m, 20m, 50m), tripods, and dye spray for marking survey points.
4. **Software:** AutoCAD Civil 3D for road design and mapping; Microsoft Excel for data analysis.

POTENTIAL MARKE

- **North Technical University**
- **Nineveh Governorate**
- **Nineveh Roads and Bridges Department**

Results

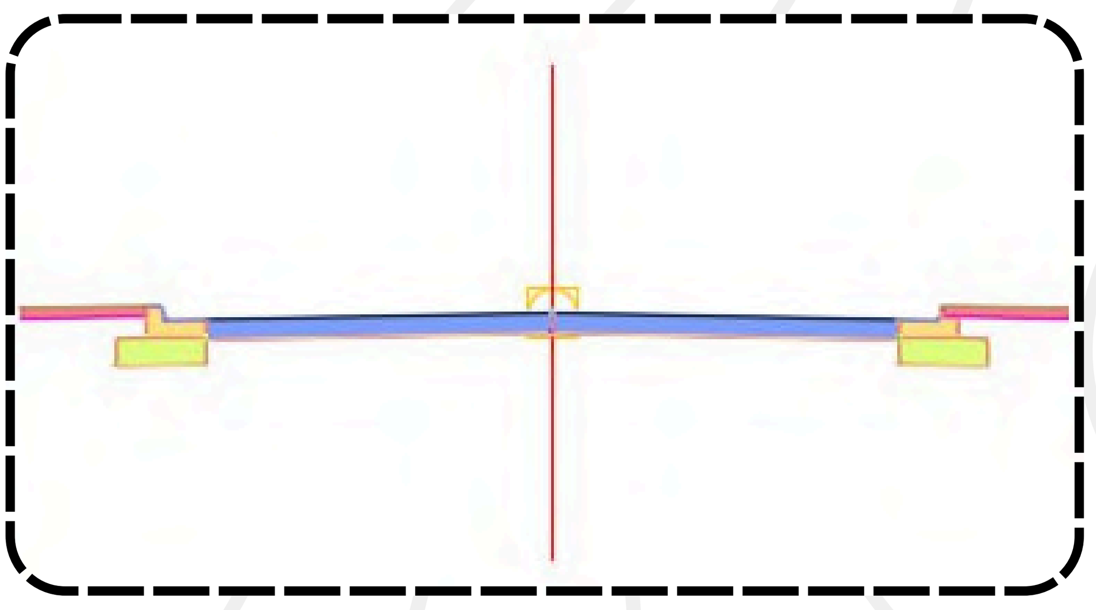
The integration of GPS and Total Station technology enhanced road alignment accuracy, optimized design using AutoCAD Civil 3D, reduced survey time, improved construction quality, and minimized costs, ensuring durable, high-precision roads with efficient construction processes.

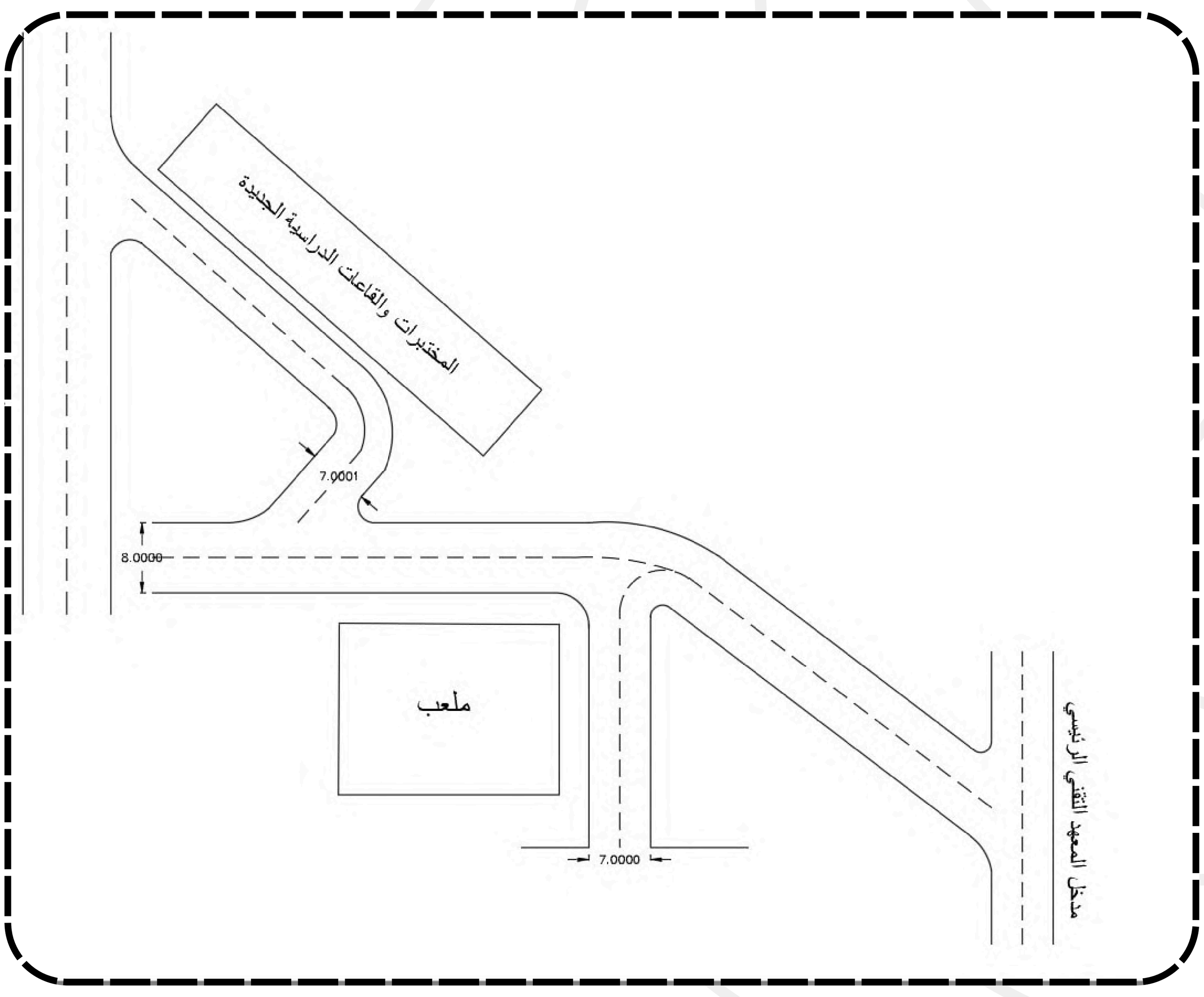
OUTCOMES

The proposed road developments are expected to significantly improve logistical efficiency and accessibility within the campus. Specifically, the new access routes will streamline the transportation of laboratory specimens, enhance movement between existing facilities, and strengthen the connection between the Technical Institute and the Engineering Technical University. Moreover, the construction of the new road has contributed to reducing traffic load on the road passing in front of the Dean’s Office of the Engineering Technical College. These improvements support academic collaboration, operational effectiveness, and overall campus integration.

Total Volume Table

Station	Fill Area	Cut Area	Fill Volume	Cut Volume	Cumulative Fill Vol	Cumulative Cut Vol
0+000.00	0.00	3.47	0.00	0.00	0.00	0.00
0+005.00	0.00	4.53	0.00	20.01	0.00	20.01
0+010.00	0.00	2.69	0.00	18.06	0.00	38.07
0+020.00	0.00	3.54	0.00	23.26	0.00	61.33
0+025.00	0.00	3.02	0.00	16.41	0.00	77.73
0+030.00	0.00	2.93	0.00	14.88	0.00	92.61
0+035.00	0.00	2.97	0.00	14.75	0.00	107.36
0+040.00	0.03	2.94	0.06	14.77	0.06	122.13
0+045.00	0.05	2.45	0.19	13.46	0.26	135.59
0+050.00	0.00	3.97	0.13	16.04	0.39	151.63
0+053.31	0.00	2.62	0.00	10.91	0.39	162.54





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Ali Abdulwahab mohammed younis
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Ministry of Higher Education and Scientific Research
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Technical Engineering College of Mosul
Department of Building and Construction Techniques Engineering

STUDY THE OPTIMAL MATURITY CURVE OF CONCRETE USING ARTIFICIAL NEURAL NETWORK

PROJECT BACKGROUND AND MOTIVATION

Concrete is the most widely used construction material globally, with its compressive strength being a critical property influenced by curing conditions. Steam curing is commonly employed in the precast concrete industry to accelerate hydration, enabling rapid demolding and faster production cycles. However, improper steam curing regimes—such as excessive temperatures or prolonged exposure—can lead to microstructural defects and reduced long-term strength. Traditional methods for optimizing curing parameters, like empirical maturity models, often oversimplify complex interactions, leading to inaccuracies. This project leverages Artificial Neural Networks (ANNs) to address these challenges by modeling the non-linear relationships between curing conditions, material composition, and concrete strength, offering a more accurate and efficient solution.

OUTCOMES

1. **Identification of optimal steam curing parameters (e.g., moderate temperatures: 50°C, durations: 5–10 hours).**
2. **Demonstration of ANN's superior accuracy in predicting compressive strength compared to traditional methods.**
3. **Practical guidelines for balancing early-age strength and long-term durability in industrial applications.**

MATERIALS USED

- **·Cement, water, aggregates (sand, gravel), and additives (fly ash, superplasticizer, slag, metakaolin, limestone).**
- **·Steam curing chambers to simulate industrial conditions.**
- **Compression testing machines for strength measurements**

METHODOLOGY

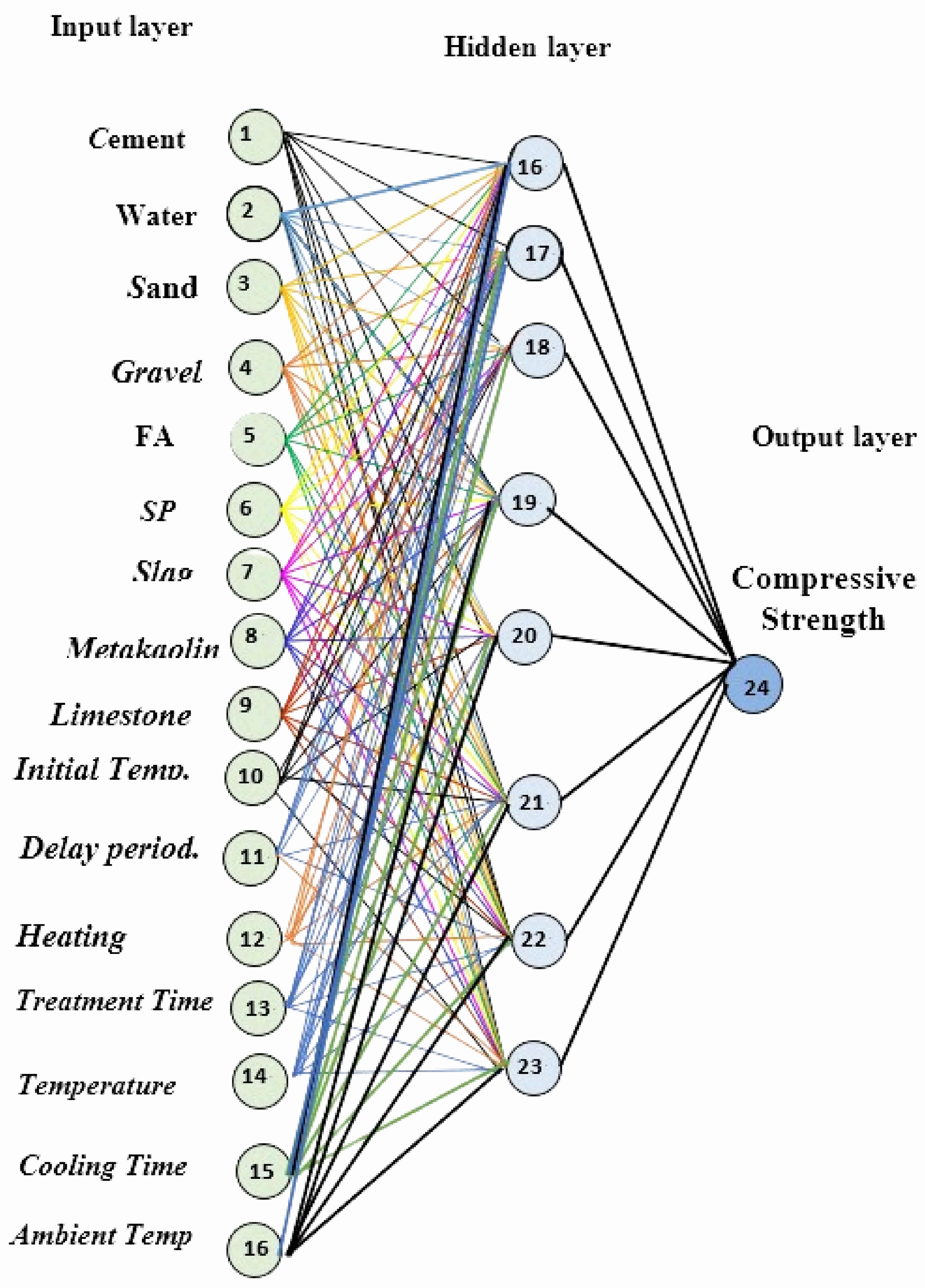
1. **Data Collection**: Gather data from 15 experimental studies, including variables like curing temperature (40–80°C), duration (4–24 hours), mix ratios (water-cement: 0.3–0.5), and compressive strength (7–28 days).
2. **Data Processing:** Normalize and scale the data to enhance ANN training efficiency.
3. **ANN Model Development**: Train the ANN to capture multi-variable relationships and predict compressive strength.
4. **Validation:** Compare the ANN's predictions with experimental results and traditional maturity models to evaluate accuracy.

OBJECTIVE

The primary aim of this project is to develop an ANN-based model to predict the optimal maturity curve of concrete under steam curing conditions. The model will analyze factors such as curing temperature, duration, mix proportions, and additives to forecast compressive strength development, thereby improving curing processes and ensuring long-term durability.

MIX DESIGN

- **Varied cement content (250–450 kg/m^3), water-cement ratio (0.3–0.5), and additive proportions to study their effects on compressive strength.**



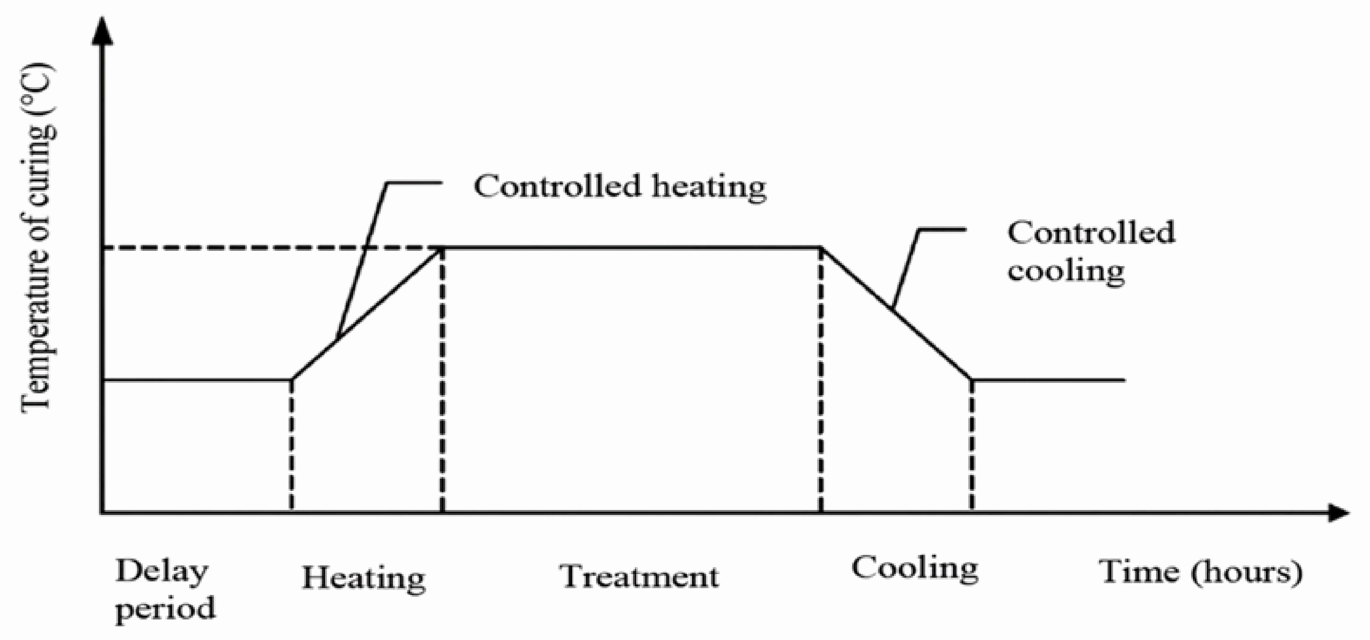


Fig. 3. Schematic representation of steam-curing procedure.

POTENTIAL MARKET

- PRECAST CONCRETE MANUFACTURERS.
- CONSTRUCTION COMPANIES SEEKING EFFICIENT CURING PROTOCOLS.
- RESEARCHERS AND DEVELOPERS IN SUSTAINABLE BUILDING MATERIALS.

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EFFECT OF EARLY MUTARATION TEMPRETURE ON CONCRETE STRENGTH

PROJECT BACKGROUND AND MOTIVATION

The significance of this study stems from the critical role that early thermal curing plays in enhancing the mechanical properties of concrete, particularly compressive strength, which is the primary indicator of concrete quality and structural efficiency. The temperature during the initial stages of concrete setting significantly affects the rate of hydration reactions and the formation of the microstructure of the cement paste, which directly influences the durability and long-term performance of concrete.
Understanding the relationship between early-age temperature and concrete strength is especially vital in regions with extreme climatic conditions, such as Iraq and other countries with hot or cold climates

METHODOLOGY

Study on the Effect of Temperature on Concrete Strength:
Determining the Effect of Temperature on Concrete’s Mechanical Properties
Analysis of the Effect of Temperature on the Chemical Reactions in Concrete
Study of the Effect of Temperature on Concrete Properties Over Time
Thermal Analysis of Concrete Structures
Practical Applications and Thermal Treatment of Concrete
The Effect of Master Glenium 51 on Compressive Strength and High Temperature Performance

OBJECTIVE

To determine the effect of early-age temperatures on the compressive strength of concrete and to evaluate the relationship between different temperature levels (both high and low) during the early curing stage and the resulting strength values at 7 and 28 days

MATERIALS USED

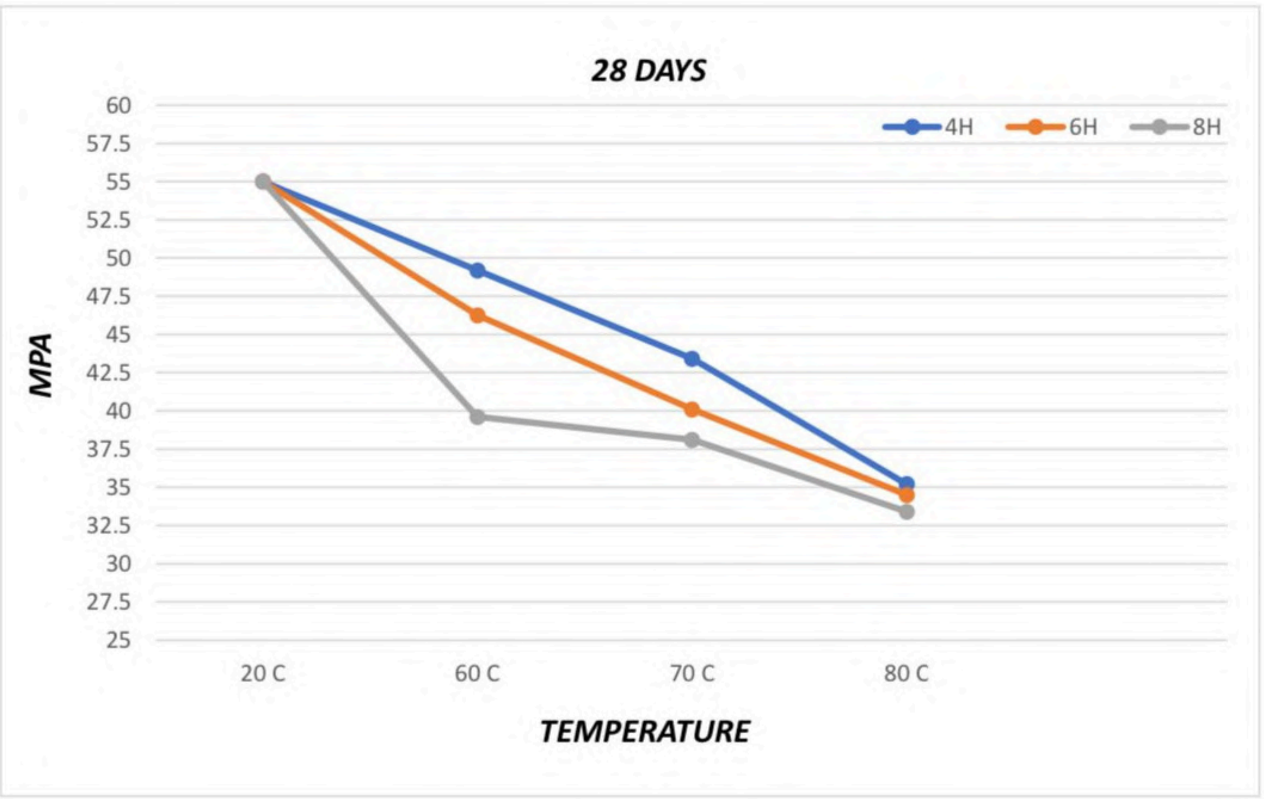
- CEMENT 25 KG
- SAND 75 KG
- GRAVEL 50 KG
- WATER
- 9L LITERS
- ADDITIVE 250 M

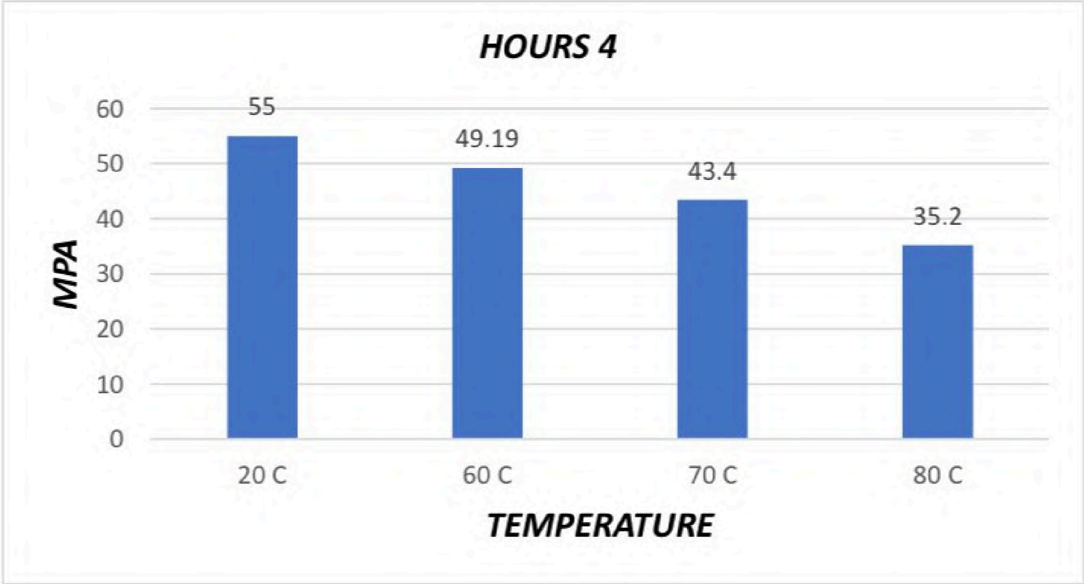
28 DAYS

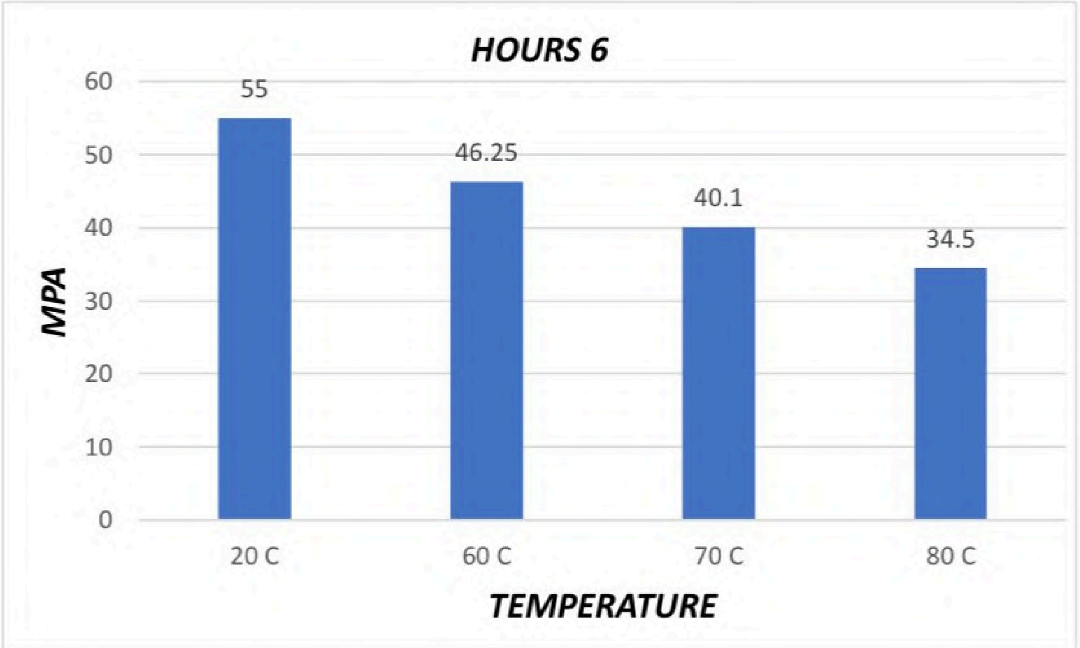
TEMPERATURE	20 °C	60 °C	70 °C	80 °C
HOURS 4	55	49.19	43.41	35.2
HOURS 6	55	46.25	40.1	34.5
HOURS 8	55	39.6	38.1	33.4

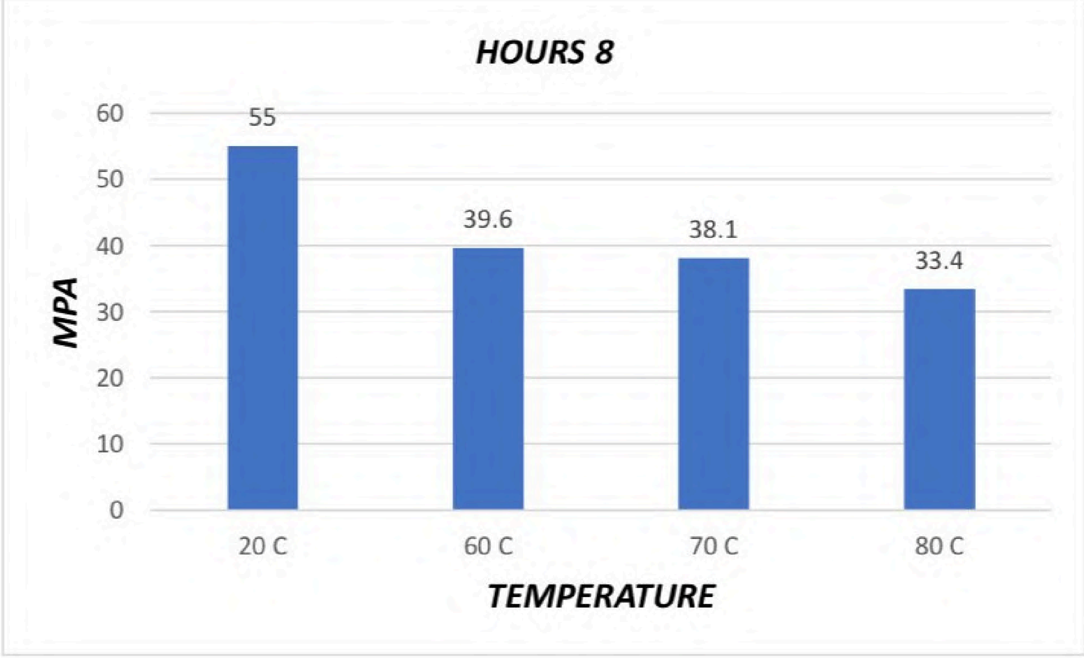
OUTCOMES

The results showed that elevated temperatures may negatively affect concrete strength if not precisely controlled, whereas moderate thermal curing enhances the hydration reaction, thereby improving strength. The results also demonstrated the effectiveness of MasterGlenium 51 in mitigating the adverse effects of high temperatures and enhancing particle dispersion within the mix.”









28 DAYS

POTENTIAL MARKET

PUBLIC AND PRIVATE SECTOR

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PRODUCTION OF SUSTAINABLE CONCRETE USING SLUDGE

PROJECT BACKGROUND AND MOTIVATION

The production of solid waste from industries and cities is increasing, including sewage sludge from wastewater treatment, which causes pollution when disposed of through landfilling or incineration. This sludge can be converted into ash (SSA) and used in concrete, improving its properties while reducing reliance on polluting cement.

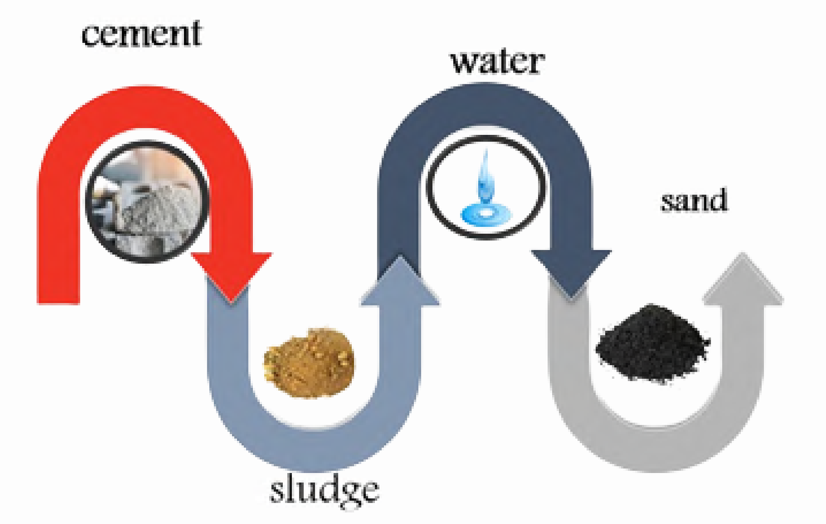
OBJECTIVE

TO UTILIZE SLUDGE AS SUSTAINABLE CONSTRUCTION MATERIAL, ASSESSING ITS IMPACT ON PHYSICAL PROPERTIES AND COMPRESSIVE STRENGTH, AND DETERMINING THE OPTIMAL REPLACEMENT PERCENTAGE.

METHODOLOGY

1. **Material Preparation:**
   - Use Ordinary Portland Cement (OPC), standard fine sand, and water.
   - Treat three types of wastewater sludge (dried uncalcined, calcined at 600°C, and calcined at 700°C) to enhance pozzolanic properties.
2. **Mix Design:**
   - Replace part of cement with sludge (5%, 10%, 15%).
   - Prepare a reference mix (1:2.75 cement-to-sand ratio, 0.5 water-cement ratio) for comparison.
3. **Mixing & Curing:**
   - Mix using standard procedures and cast specimens.
   - Cure under controlled conditions (20°C ± 2°C, 95% RH) for proper hydration.
4. **Mechanical Testing:**
   - Test compressive strength, flexural strength, and water absorption at 7 and 28 days.
   - Compare sludge-modified concrete with the control mix.
5. **Performance Monitoring:**
   - Track strength development and durability over time.

MATERIALS USED



MIX DESIGN

- **·A reference mix ratio of (1:2.75) (cement: sand)**
- **·A water-to-cement ratio of 0.5**
- **·Partial replacement of cement with sludge was carried out at 5%, 10%, and 15% for each type of sludge.**

LABORATORY TESTS

Flow Test results
Compressive Strength Test
Flexural Strength Test

OUTCOMES

- **Fresh properties: flow test.**

0% (Reference)	180 mm

Replacement Ratio (%)	Unburned Sludge (mm)	Sludge Burned at 600°C (mm)	Sludge Burned at 700°C (mm)
5%	175	178	180
10%	170	175	178
15%	165	170	175

- **Compressive Strength Results:-**

(Reference)	7 Days (MPa)	28 Days (MPa)
0%	25	32

Replacement Ratio (%)	Unburned Sludge - 7 Days (MPa)	Unburned Sludge - 28 Days (MPa)	Sludge Burned at 600°C - 7 Days (MPa)	Sludge Burned at 600°C - 28 Days (MPa)	Sludge Burned at 700°C - 7 Days (MPa)	Sludge Burned at 700°C - 28 Days (MPa)
5%	23	30	26	34	27	35
10%	21	28	27	36	28	37
15%	18	25	24	33	26	34

- **Flexural Strength Results**

(Reference)	7 Days (MPa)	28 Days (MPa)
0%	4.2	5.5

Replacement Ratio (%)	**Unburned Sludge - 7 Days (MPa)**	**Unburned Sludge - 28 Days (MPa)**	**Sludge Burned at 600°C - 7 Days (MPa)**	**Sludge Burned at 600°C - 28 Days (MPa)**	**Sludge Burned at 700°C - 7 Days (MPa)**	**Sludge Burned at 700°C - 28 Days (MPa)**
5%	4.0	5.2	4.4	5.8	4.5	5.9
10%	3.8	5.0	4.5	6.0	4.7	6.2
15%	3.5	4.8	4.2	5.7	4.6	6.0

POTENTIAL MARKET

- MINISTRIES OF ENVIRONMENT
- MINISTRIES OF INDUSTRY
- MUNICIPALITIES OF WATER
- RESEARCH CENTERS AND UNIVERSITIES

IN COLLABORATION WITH

- NINEVEH WATER DIRECTORATE

PREPARED BY

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SUPERVISOR

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PROJECT NAME INVESTIGATION PERFORMANCE OF REINFORCED CONCRETE BEAMS STRENGTHENED BY GEO-GRID MESH LAYERS.

PROJECT BACKGROUND AND MOTIVATION

This study explores the effectiveness of geo-grid systems in enhancing the structural performance of reinforced concrete beams , particularly under challenging soil conditions and uneven load distributions. Geo-grids have proven to be a modern geotechnical solution that improves soil stability, minimizes cracking, and promotes more uniform load transfer. The research highlights the geo-grid's role as a cost-effective and sustainable alternative to traditional reinforcement methods. Emphasis is placed on its potential to increase structural safety, extend service life, and reduce construction and maintenance costs, making it a valuable addition to contemporary beam engineering practices.

OBJECTIVE

The objective of this study is to investigate and analyze the impact of using geo-grid systems in the reinforcement of reinforced concrete beams , with a focus on their contribution to enhancing structural performance and reducing common issues such as cracking and differential settlement.

METHODOLOGY

An experimental laboratory approach was adopted to study the effect of using geogrid reinforcement on the structural performance of reinforced concrete beams. The study involved preparing a number of concrete beam specimens with uniform dimensions, which were divided into two main groups:

- Group 1: Concrete beams without geo-grid reinforcement (reference specimens).
- Group 2: Concrete beams reinforced with geo-grid layers placed at different positions within the cross-section.

The specimens were subjected to bending and deformation tests to analyze the impact of geo-grid reinforcement on structural behavior. Data were recorded, analyzed, and compared between the two groups to evaluate the effectiveness of geo-grid in enhancing flexural resistance and reducing deflection and cracking.

MATERIALS USED

Ordinary Portland cement, natural gravel as coarse aggregate, and washed sand as fine aggregate were used. High-strength steel bars (10–12 mm diameter) were applied, along with biaxial geo-grid mesh and epoxy adhesive for geo-grid installation within the concrete specimens.

POTENTIAL MARKET

The project targets construction companies, infrastructure projects, and rehabilitation works. Geo-grid reinforcement offers enhanced structural performance for concrete beams, making it a cost-effective and reliable solution.

SUPERVISOR

DR. HESHAM SALIM AL RAWE

MIX DESIGN

A (1:2:4) concrete mix ratio of cement to sand to gravel was used, with a water-to-cement ratio of 0.5, targeting a compressive strength of approximately 25–30 MPa .

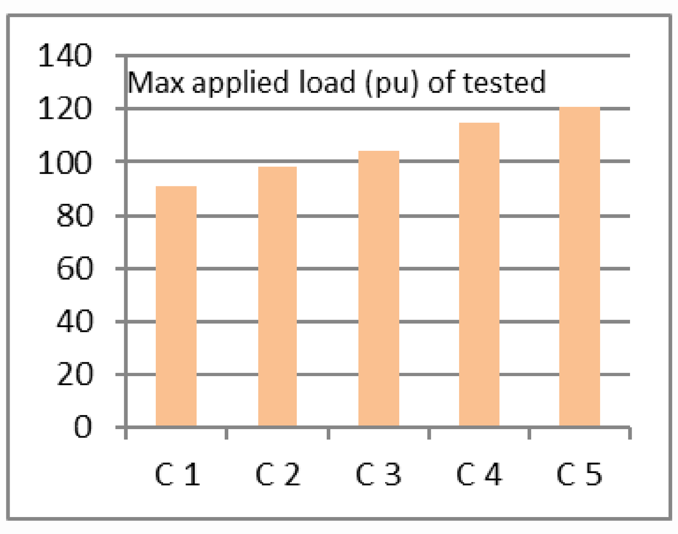
LABORATORY TESTS

- -Flexural Test
- -Concrete Compressive Strength
- -Crack Pattern Observation

OUTCOMES

The results showed that the use of geo-grid reinforcement in concrete beams led to a noticeable improvement in structural performance:

- -An increase in ultimate load capacity by 7.7%, 14.2%, 26.37%, and 32.96%, depending on the arrangement and positioning of the geogrid.
- -Improved ductility, as the geogrid-reinforced beams demonstrated greater deformation capacity without sudden failure.
- -More uniform crack distribution with reduced crack widths, indicating enhanced crack control.



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"IMPROVING THE STABILIZER LAYER IN RURAL STREETS OF NINEVEH GOVERNORATE USING ANTI-STRIPPING AGENT"

PROJECT BACKGROUND AND MOTIVATION:

The Nineveh Governorate, especially in rural areas, has road infrastructure challenges due to the poor moisture resistance of the local Qayyarah asphalt. This asphalt material is prone to stripping, where the asphalt binder loses adhesion to the aggregate under moist conditions, leading to pavement deterioration. This project aims to enhance the durability of Qayyarah asphalt by incorporating anti-stripping agents, improving its resilience to moisture and extending the lifespan of rural roads.

OBJECTIVE

To improve the moisture resistance and durability of the stabilizer layer in Nineveh's rural streets by adding anti-stripping agents to Qayyarah asphalt, enhancing its performance under wet conditions and reducing maintenance needs.

METHODOLOGY

The methodology consists of collection of aggregates, bitumen and anti-stripping agents, and conducting the respective tests on their properties and finally preparation of normal and modified marshal specimen and their testing.

1) **Material Analysis:** Assess the chemical and physical properties of Qayyarah asphalt to identify its moisture sensitivity.
2) **Anti-Stripping Agent Selection:** Choose suitable anti-stripping agents that can bond effectively with Qayyarah asphalt.
3) **Mix Design:** Develop asphalt mixtures with varying concentrations of the selected anti-stripping agent.
4) **Moisture Resistance Testing:** Perform tests like the Tensile Strength Ratio (TSR) and Boiling Test to measure improvements in adhesion and resistance to stripping.
5) **Field Testing:** Apply the improved asphalt mix to selected rural roads and monitor its performance over time.

MATERIALS USED

Aggregate,Anti-Stripping Agent,Bitumen.

MIX DESIGN

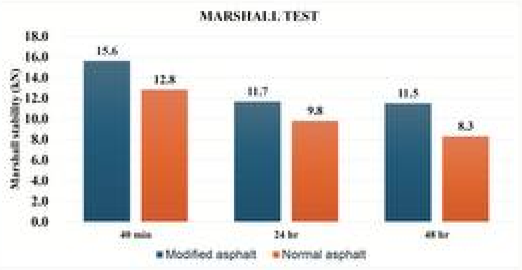
Among the various methods available for mix design, Marshall method of mix design is the most popular one and is used here in our research, we relied on a previously prepared asphalt mixture, and the design proportions of the mixture were as follows.

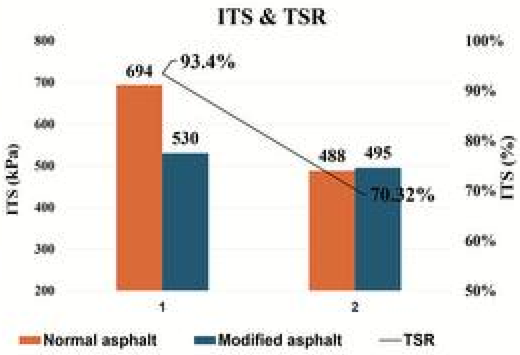
LABORATORY TESTS

1) Marshall Stability (@25c̊ , @60c̊)
2) Indirect tensile strength (ITS) (@25c̊, @60c̊, TSR)
3) Cantabro (@60c̊ ,@25c̊)

OUTCOMES

1) Enhanced adhesion of asphalt to aggregates, resulting in improved moisture resistance.
2) Reduced pavement deterioration and lower maintenance costs due to minimized stripping.
3) Increased longevity and serviceability of rural roads in Nineveh, benefiting local communities.





POTENTIAL MARKET

- PUBLIC & PRIVATE SECTOR
- ROADS AND BRIDGES DIRECTORATE
- NINEVEH MUNICIPALITIES DIRECTORATE
- NINEVEH GOVERNORATE

IN COLLABORATION WITH

MOSUL MUNICIPALITY

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SUPERVISOR:

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USING THE TOTAL STATION DEVICE TO RAISER LEVELS AND DRAW COUNTER LINES FOR A PLOT OF LAND AT THE TECHNICAL COLLEGE OF ENGINEERING / MOSUL

PROJECT BACKGROUND AND MOTIVATION:

- The project focuses on using a Total Station to survey and draw contour lines for a sloping plot at the Technical Engineering College in Mosul.
- It aims to enhance surveying accuracy and reduce human errors compared to traditional methods, especially in challenging terr

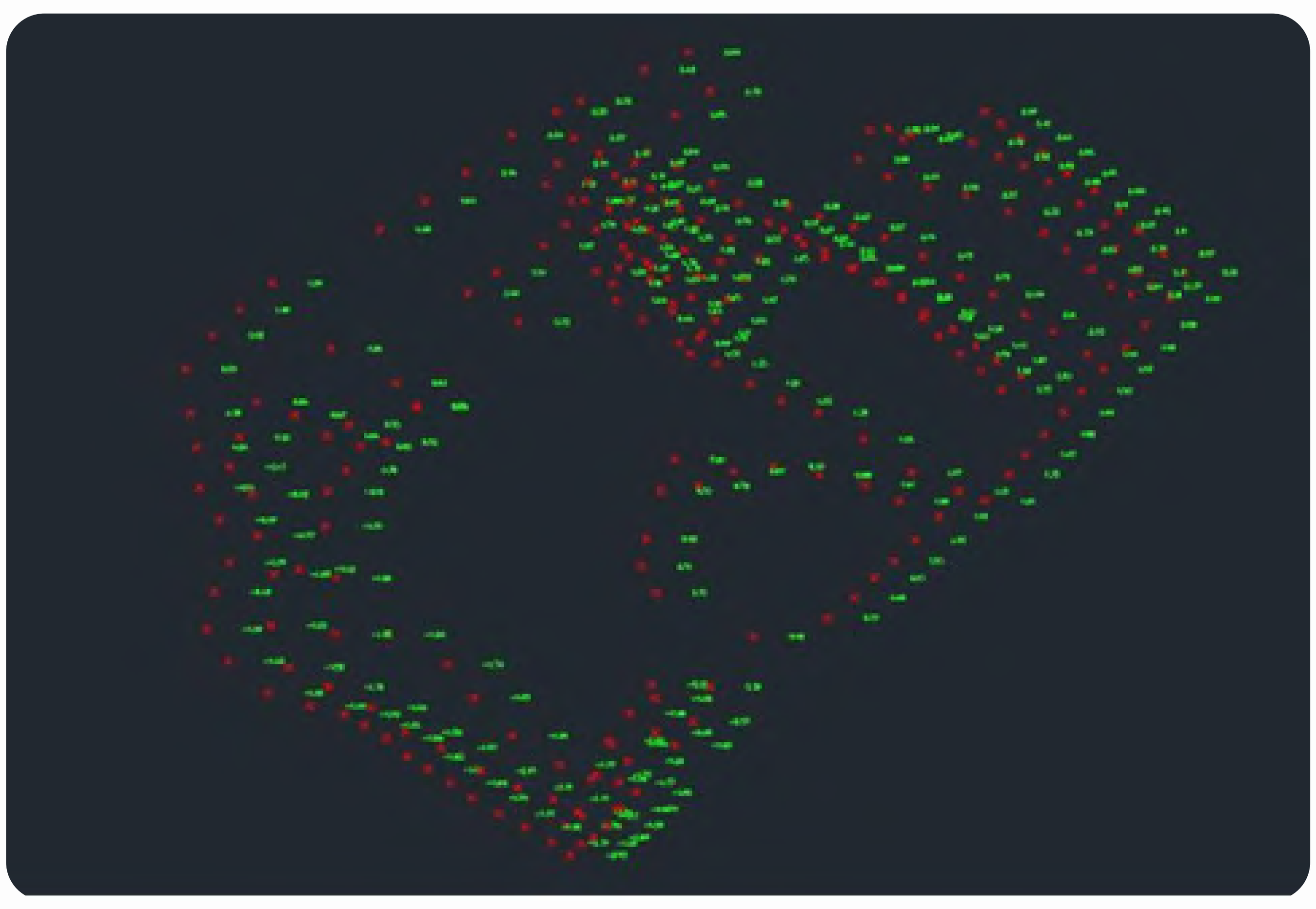
ADDED VALUE:

- Balances cost, safety, and precision in construction projects.
- Applicable to hilly and sloping regions in Iraq and the Middle East.

OBJECTIVE

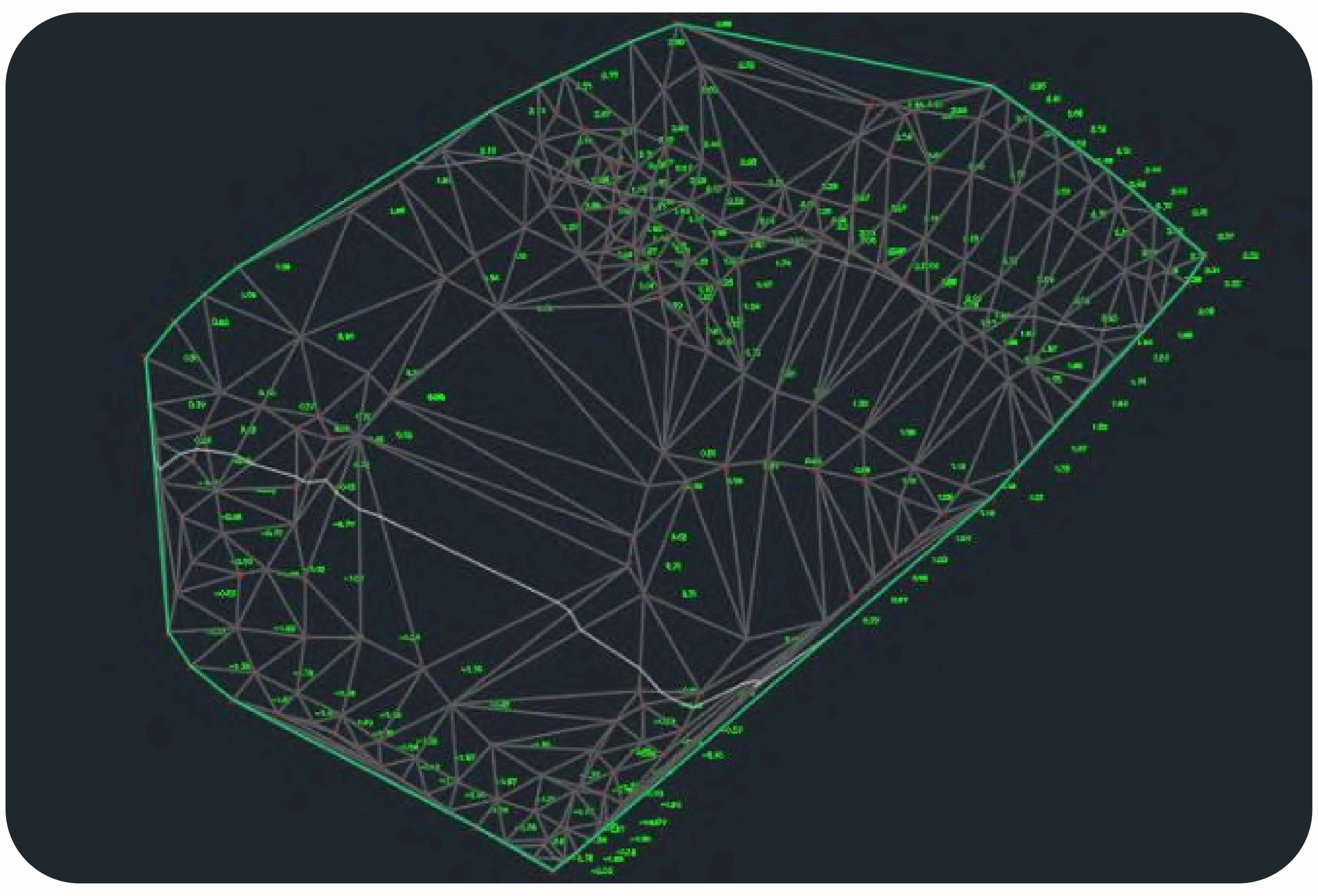
1. Create contour maps and 3D models to analyze terrain.
2. Identify safe zones for construction and infrastructure design (roads, drainage systems).
3. Develop engineers' skills in modern surveying technologies.

OUTCOMES



METHODOLOGY

- Device setup (tripod calibration, leveling).
- Collect 250+ survey points (X, Y, Z coordinates).
- Process data using software (e.g., AutoCAD Civil 3D) to generate maps and models.
- Analyze slopes and identify safe construction zones (<15% gradient) .



DEVICE USED

Total Station Device

POTENTIAL MARKET

- CONSTRUCTION FIRMS (SITE PLANNING, FOUNDATION DESIGN).
- GOVERNMENT AGENCIES (URBAN PLANNING, LAND MANAGEMENT).
- ENVIRONMENTAL PROJECTS (EROSION CONTROL, SOIL STABILIZATION).
- ACADEMIC INSTITUTIONS (TRAINING STUDENTS ON MODERN TOOLS).

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RHEOLOGICAL AND MECHANICAL PERFORMANCE OF STEEL FIBER REINFORCED ECC CONCRETE

PROJECT BACKGROUND AND MOTIVATION

Engineered Cementitious Composites (ECC), a class of high-performance fiber-reinforced concrete, are renowned for their exceptional ductility and strain-hardening behavior under tensile loads. Unlike conventional concrete, which exhibits brittle failure, ECC achieves tensile strain capacities of 3–5% through micro-mechanical design principles, enabling controlled microcar formation (Li, 2003).

OBJECTIVE

- Enhanced ductility: PVA fibers enable strain-hardening behavior
- (3–5% tensile strain), minimizing brittle failure.
- Superior crack resistance: Steel fibers bridge macro-cracks (>0.3
- mm), improving post-yield strength by 25–40% .
- Energy dissipation: Synergistic fiber interaction increases
- fracture energy by 50%, critical for seismic energy absorption

METHODOLOGY

1. **Weighing**:
   - Materials were measured using the sensitive balance
   and glass graduates.
2. **Dry Mixing**:
   - Cement, sand, and fly ash blended manually for 2 minutes.
3. **Wet Mixing**:
   Water and superplasticizer added gradually, followed by 5 minutes of mixing.
4. **Fiber Addition**:
   - Steel fibers incorporated first to minimize segregation.
   - PVA fibers added subsequently.

MATERIALS USED

1. **Ordinary Portland Cement (OPC)**
2. **Superplasticizer**
3. **Water**
4. **Fly Ash (Type F)**
5. **Silica Sand**
6. **Fibers**

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SUPERVISOR:

ASST. LECH.DR. HASSAN MOHAMMED AHMED

MIX DESIGN

- hybrid Fiber reinforced ECC mix proportions:
(Cement:Fly ash:Silica sand); (w/c)
(1:1.2:0.8); (0.45, 0.5, 0.55)
Fibers: (0.2,0.4,0.6 % of steel)(1 % PVA)

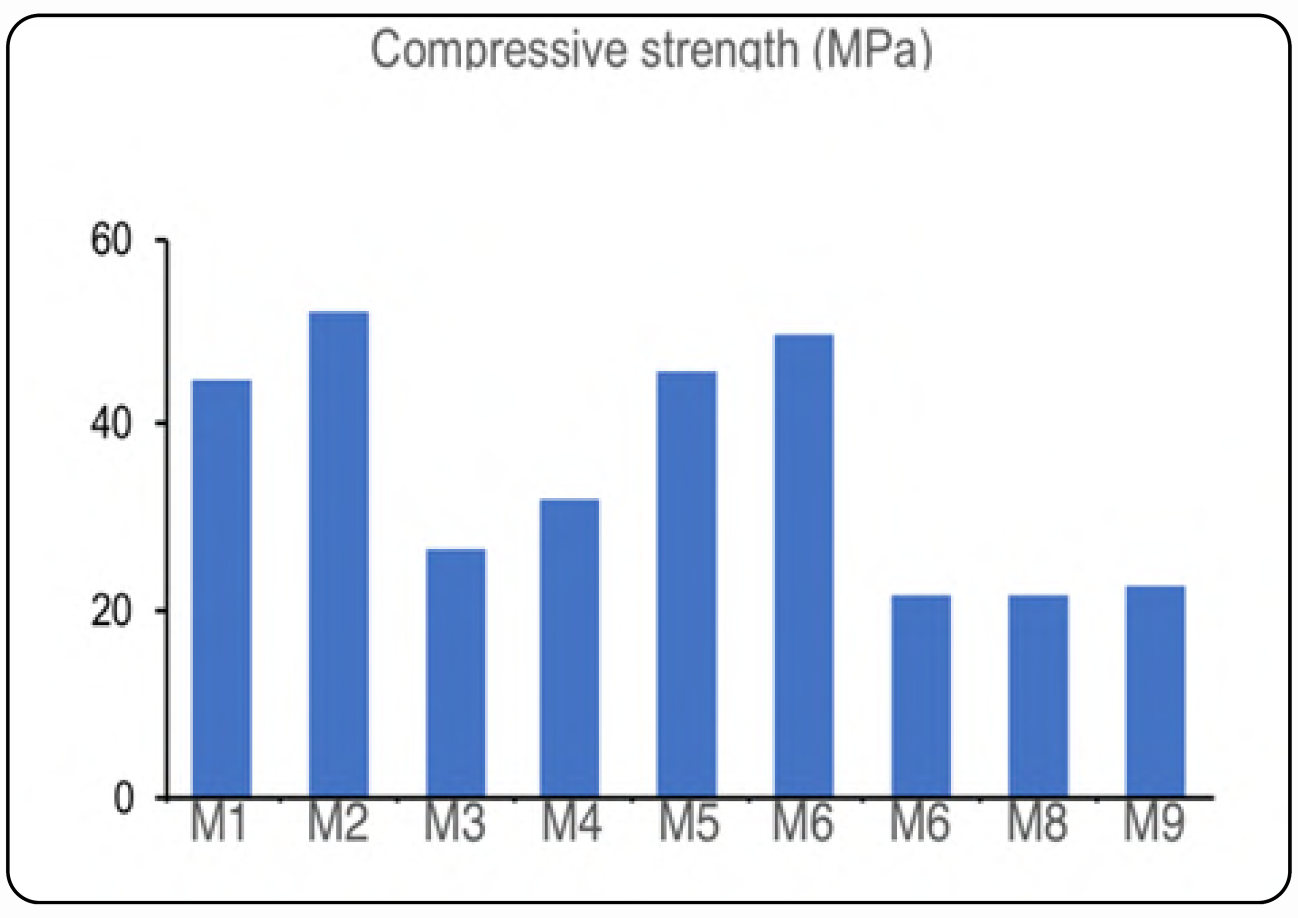
LABORATORY TESTS

- Mini slump flow
- Compressive Strength
- Tensile Strength

MARKET POTENTIAL

This high-performance ECC concrete targets infrastructure, seismic buildings, and marine projects. Its durability and crack resistance are key advantages. Its cost and standardization need addressing for broader use in construction markets.

Compressive Strength Mpa	Mix ID
44.574	M1
51.776	M2
26.684	M3
31.754	M4
45.733	M5
49.590	M6
21.765	M7
21.782	M8
22.650	M9



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PERFORMANCE OF BASALT FIBER REINFORCED MORTAR EXPOSED TO HIGH TEMPERATURES

PROJECT BACKGROUND AND MOTIVATION

Basalt fibers are emerging as a sustainable alternative in construction due to their high thermal and mechanical resistance. When used in mortar, they enhance fire resistance and structural integrity at elevated temperatures.

OBJECTIVE

The main objective of this research is to investigate the thermal performance, mechanical properties, and structural integrity of basalt fiber reinforced mortar (BFRM) when exposed to high temperatures. The study aims to:

1. Evaluate the residual strength (compressive, tensile, and flexural strength) of BFRM after exposure to elevated temperatures.
2. Analyze microstructural changes using SEM and XRD to understand degradation mechanisms.
3. Compare performance with conventional mortar under similar thermal conditions.
4. Assess crack resistance and spalling behavior to determine fire resistance capabilities.
5. Establish optimal basalt fiber content for improved high-temperature durability.

METHODOLOGY

The study follows a structured methodology:

- **Preparation of mortar samples with varying basalt fiber contents (0.5%, 1%, and 1.5%).**
- **Controlled exposure to high temperatures (200°C, 400°C, 600°C, 800°C).**
- **Mechanical and microstructural testing after heating.**
- **Comparative analysis between fiber-reinforced and plain mortars.**

MATERIALS USED

- **Portland cement**
- **Fine aggregate (sand)**
- **Basalt fibers (0.5%, 1%, 1.5% by weight)**
- **Water (water/cement ratio = 0.5)**

POTENTIAL MARKET

- FIREPROOF CONSTRUCTION (TUNNELS, HIGH-RISES)
- INDUSTRIAL FLOORS AND CHIMNEYS
- OIL & GAS INSULATION
- POWER PLANTS AND TRANSPORT INFRASTRUCTURE

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SUPERVISOR:

ASST. LECH. DR. HASSAN MOHAMMED AHMED

LABORATORY TESTS

1. **Compressive Strength Test (ASTM C109)**
2. **Flexural Strength Test (ASTM C348)**
3. **Tensile Strength Test (Brazilian Splitting)**
4. **Scanning Electron Microscopy (SEM)**
5. **X-ray Diffraction (XRD)**
6. **Mass Loss Measurement after heat exposure**

OUTCOMES

1. **1% fiber content improved strength by 10–15%**
2. **Optimal performance up to 400°C**
3. **Significant degradation begins at 600°C**
4. **Enhanced resistance to cracks and spalling**

Temperature (°C)	Compressive Strength (%)	Flexural Strength (%)	Tensile Strength (%)
25 (Control)	100%	100%	100%
200	85-90%	80-85%	75-80%
400	70-75%	65-70%	60-65%
600	50-55%	45-50%	40-45%
800	30-35%	25-30%	20-25%

MECHANICAL PROPERTIES AFTER HEAT EXPOSURE

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IMPACT OF VARIOUS FIBER TYPES ON THE PROPERTIES OF ROLLER COMPACTED CONCRETE

PROJECT BACKGROUND AND MOTIVATION:

- Roller Compacted Concrete (RCC) is a type of concrete that is poured and compacted using machinery commonly employed in the construction of asphalt road layers.
- It consists of the same basic components as conventional concrete: aggregates, cement, and water.
- Roller Compacted Concrete (RCC) is gaining recognition as a viable alternative to traditional paving materials, particularly for heavyweight roadways that experience high loads.
- The use of recycled materials in Roller Compacted Concrete (RCC) has gained attention as a sustainable solution in construction.
- This research aims to evaluate the properties of Roller Compacted Concrete when incorporating different percentages of waste materials.

OBJECTIVE

·To determine the effect of different percentages of waste materials on Roller Compacted Concrete.
·To study the properties of Green Roller Compacted Concrete (GRCC) using different waste construction materials such as PET and MPP.
·To understand the impact of incorporating recycled materials on the properties, durability, and environmental sustainability of Roller Compacted Concrete.

METHODOLOGY

- The research involved two main phases:
- Phase 1: Designation of the reference mixture (M0) according to ACI 211.3R.
- Phase 2: Preparation of green mixtures by adding different percentages and types of fibers, and testing the effectiveness of these materials.
- Use of materials such as Ordinary Portland Cement Type 1, coarse and fine aggregate, polypropylene fibers, and recycled PET.
- Conducting various tests on fresh and hardened mixtures.

MATERIALS USED

- Ordinary Portland Cement Type 1
- Coarse aggregate (gravel)
- Fine aggregate (sand)
- Polypropylene fibers
- Recycled PET

MIX DESIGN

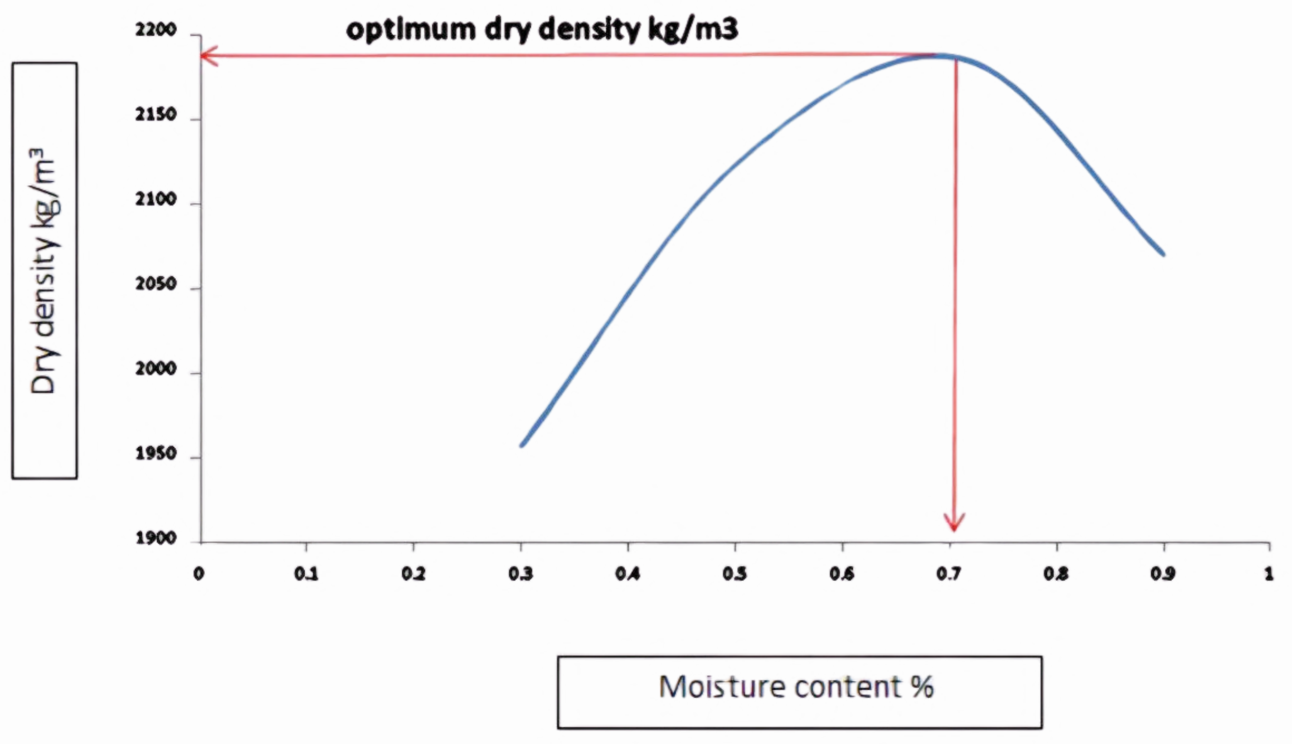
- Fine aggregate: 1100 kg/m³
- Coarse aggregate: 915 kg/m³
- Cement: 280 kg/m³
- Water: 140 kg/m³

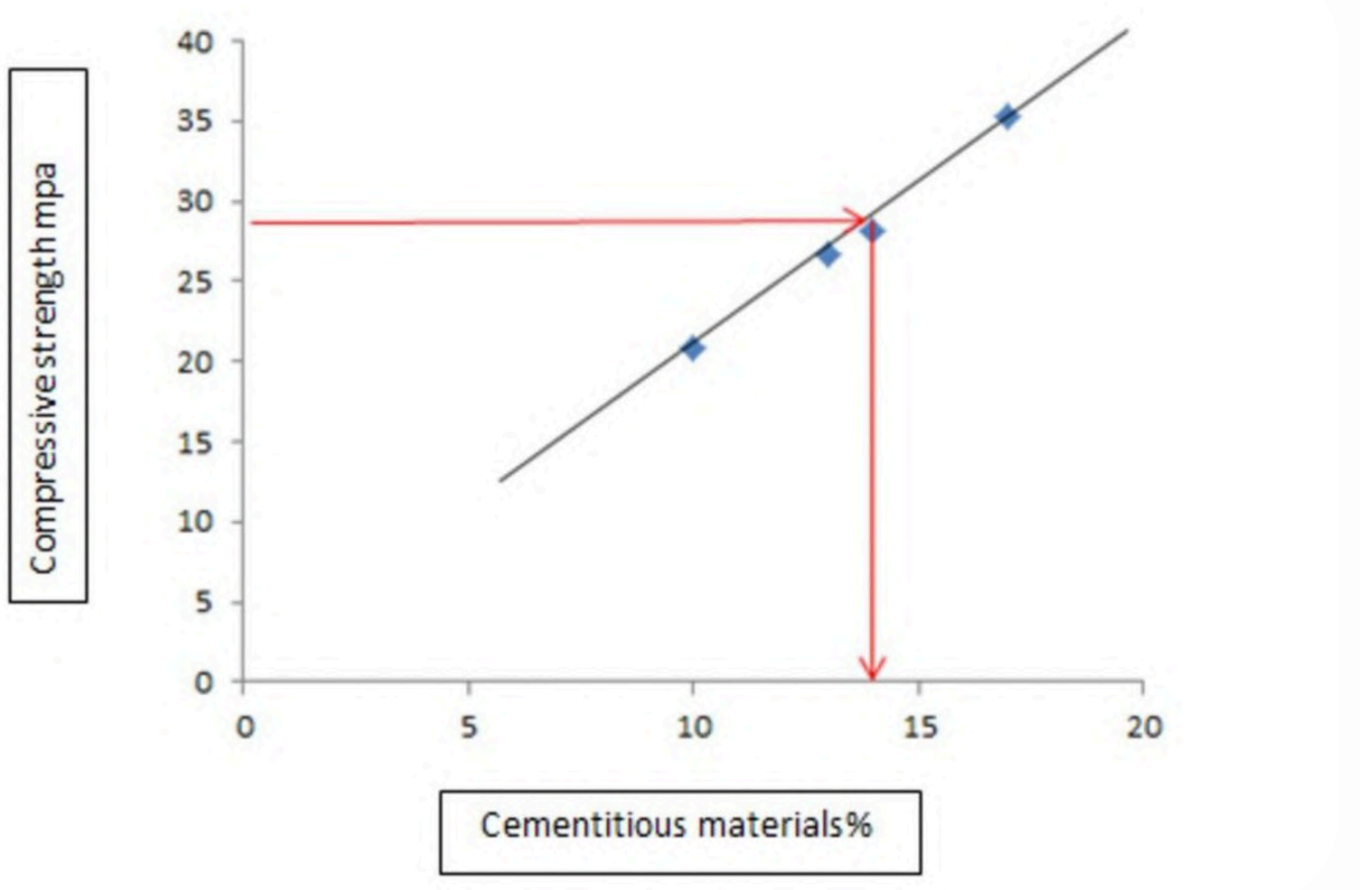
LABORATORY TESTS

- Consistency test
- Density test
- Compressive strength test
- Flexural strength test
- Splitting tensile strength test

OUTCOMES

- Effect of additives on consistency and density of Green Roller Compacted Concrete.
- For example, the addition of fibers increases the consistency, while superplasticizers reduce it.





POTENTIAL MARKET

- PUBLIC & PRIVATE SECTOR
- ROADS AND BRIDGES DIRECTORATE
- NINEVEH MUNICIPALITIES DIRECTORATE
- NINEVEH GOVERNORATE

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ENGINEERING MISTAKES CONSTRUCTION MATERIALS USED IN IRAQ

PROJECT BACKGROUND AND MOTIVATION

Construction is a vital sector of society, but it can encounter defects and problems whether it is a new construction or a renovation. Therefore, these problems should be recognized as soon as possible, as they can range from minor cosmetic issues to major structural damage that may require costly repairs. Therefore, construction defects should be managed effectively rather than ignored.

OBJECTIVE

To identify possible types of defects and take appropriate action in a timely manner to maintain the integrity of your property, avoid costly repairs, and preserve the value of your investment.

MATERIALS USED

- **1- ABSORPTION TEST**
- **2- COMPRESSIVE TEST**
- **3- MOISTURE TEST FOR PARQUET**

METHODOLOGY

Methodology This research relies on a descriptive and analytical approach, which aims to study and analyze engineering errors related to building materials, identify their causes and effects, and then propose appropriate solutions to reduce them

1-Material Analysis: Assess the chemical and physical properties for tiles and parquet

2- Absorption test: to find the total amount of absorption for tiles

3-Compressive test : Testing the resistance of tiles to compression

4- Parquet tests: Parquet inspections are important to ensure its quality and safety before and after installation

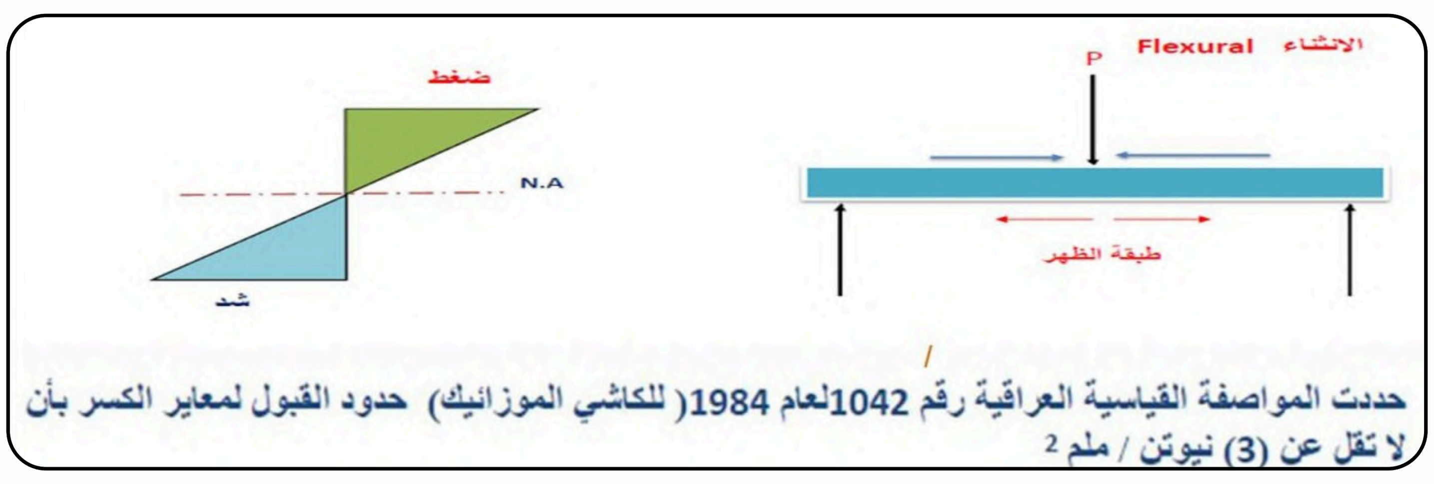
5- Cost: In some projects, they use lower quality materials at a lower cost.

OUTCOMES

1- Auditing the selection of materials
2- Reducing problems that occur after construction
3-Elimigh maintenance cost

MIX DESIGN

Understanding construction defects and performing all necessary checks on materials, such as tiles or other materials, will reduce problems or prevent cracks in the building materials used.



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POTENTIAL MARKET

- **ENGINEERING PROJECTS IN MOSUL THAT ARE UNDER CONSTRUCTION**
- **ENGINEERING OFFICES IN MOSUL AND ERBIL**
- **RESIDENTIAL COMPLEXES IN ERBIL**

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PRODUCTION OF LIGHTWEIGHT ROLLER COMPACTED CONCRETE (LWRCC) USING PUMICE AGGREGATE

PROJECT BACKGROUND AND MOTIVATION

Roller Compacted Concrete (RCC) is a durable and cost-effective material widely used in heavy-duty pavements, industrial zones, and infrastructure projects. However, its high density limits its application in structures requiring reduced dead loads. Lightweight RCC (LWRCC) addresses this by incorporating lightweight aggregates like pumice, which lowers density while maintaining structural integrity. This project explores the feasibility of using pumice as a partial or full replacement for coarse aggregates in RCC, aiming to combine sustainability, cost efficiency, and performance.

OBJECTIVE

1. **To design and produce LWRCC by replacing coarse aggregates with pumice at varying percentages (20% to 100%).**
2. **To evaluate the mechanical properties (compressive strength, flexural strength, density) and durability of LWRCC.**
3. **To compare LWRCC performance with conventional RCC and identify optimal pumice replacement ratios.**

METHODOLOGY

1. **Materials Preparation:**
   - Cement: Ordinary Portland Cement (OPC) meeting ASTM C150 standards.
   - Aggregates: Natural sand (fine aggregate) and gravel (coarse aggregate), partially replaced with pumice (volcanic lightweight aggregate).
   - Water: Clean tap water.
2. **Mix Design:**
   - Stage 1: Designed a reference RCC mix following ACI 211.3R guidelines (14% cement content, w/c = 0.47).
   - Stage 2: Prepared five LWRCC mixes with pumice replacing coarse aggregate at 20%, 40%, 60%, 80%, and 100% by volume.
3. **Testing:**
   - Fresh Properties: Consistency (VeBe test, ASTM C1170).
   - Hardened Properties:
     - Compressive strength (BS 1881).
     - Flexural strength (ASTM C78).
     - Density and workability.

MATERIALS USED

- **Cement**: OPC Type I (ASTM C150).
- **Fine Aggregate**: Natural sand (Kanhash region).
- **Coarse Aggregate**: Gravel (max size 19mm) and pumice (density: 810 kg/m³).
- **Chemical Admixtures**: None (focus on natural pumice).

MIX DESIGN

- **Reference RCC**: 1:3.23:2.63 (cement:sand:gravel), w/c = 0.47.
- **LWRCC Mixes**: Varied pumice content (e.g., **LWRCC35**: 20% pumice; LWRCC39: 100% pumice).

LABORATORY TESTS

1. **Consistency**: VeBe test (ASTM C1170).
2. **Compressive Strength**: Cube test (100mm³, BS 1881).
3. **Flexural Strength**: Prism test (ASTM C78).
4. **Density**: Measured for fresh and hardened concrete.

OUTCOMES

1. **Density**: Reduced from 2385 kg/m³ (0% pumice) to 1735 kg/m³ (100% pumice).
2. **Strength**:
   - **Compressive Strength**: Decreased by 15% (20% pumice) to 40% (100% pumice) compared to RCC.
   - **Flexural Strength**: Declined by 18.6% (20% pumice) to 48.3% (100% pumice).
3. **Workability**: Improved (lower VeBe time) with higher pumice content.

SIGNIFICANCE AND IMPACT

- **Sustainability**: Utilizes natural pumice, reducing environmental impact.
- **Economic Benefits**: Lower material costs due to reduced cement and aggregate use.
- **Applications**: Ideal for lightweight structures, non-load-bearing walls, and thermal insulation.

POTENTIAL MARKET

- LIGHTWEIGHT CONSTRUCTION (RESIDENTIAL, COMMERCIAL).
- PAVEMENTS AND INFRASTRUCTURE PROJECTS REQUIRING REDUCED DEAD LOADS.

IN COLLABORATION WITH

- NORTHERN TECHNICAL UNIVERSITY / TECHNICAL ENGINEERING COLLEGE – MOSUL.

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EVALUATION ABUNDANCE OF MICROPLASTICS IN BOTTLED WATER

PROJECT BACKGROUND AND MOTIVATION:

In this study, the levels of microplastic contamination in bottled water from various commercial brands in Mosul City were assessed. The study was conducted over a period of 45 days, during which samples were collected from local markets. A total of 125 samples were obtained: 25 samples of 0.75 L, 50 samples of 0.5 L, and 50 samples of 0.25 L. The objective was to quantify the abundance, morphology, and color characteristics of microplastic particles using a stereomicroscope (dissecting light microscope)

OBJECTIVE

1- Assessment of the abundance of microplastic particles based on microscopic examination.
2- Evaluation of microplastic contamination levels in several bottled water brands available in Mosul City.
3- Investigation of certain characteristics of microplastic particles, such as color and shape, using a stereoscopic (dissecting) microscope.

METHODOLOGY

We studied and researched plastic affect drinking water, their impact on human health, and their disadvantages.

MATERIALS USED

- **Steromicroscope** : Motic2300S-V37-45X Zoom, Italy.
- **Buchner Funnel** : Diameter 60 µm.
- **Glass plate** : To keep the nomination papers in it .
- **Filter papers** :Diameter 47mm ,pore size 0.45 µm.

OUTCOMES

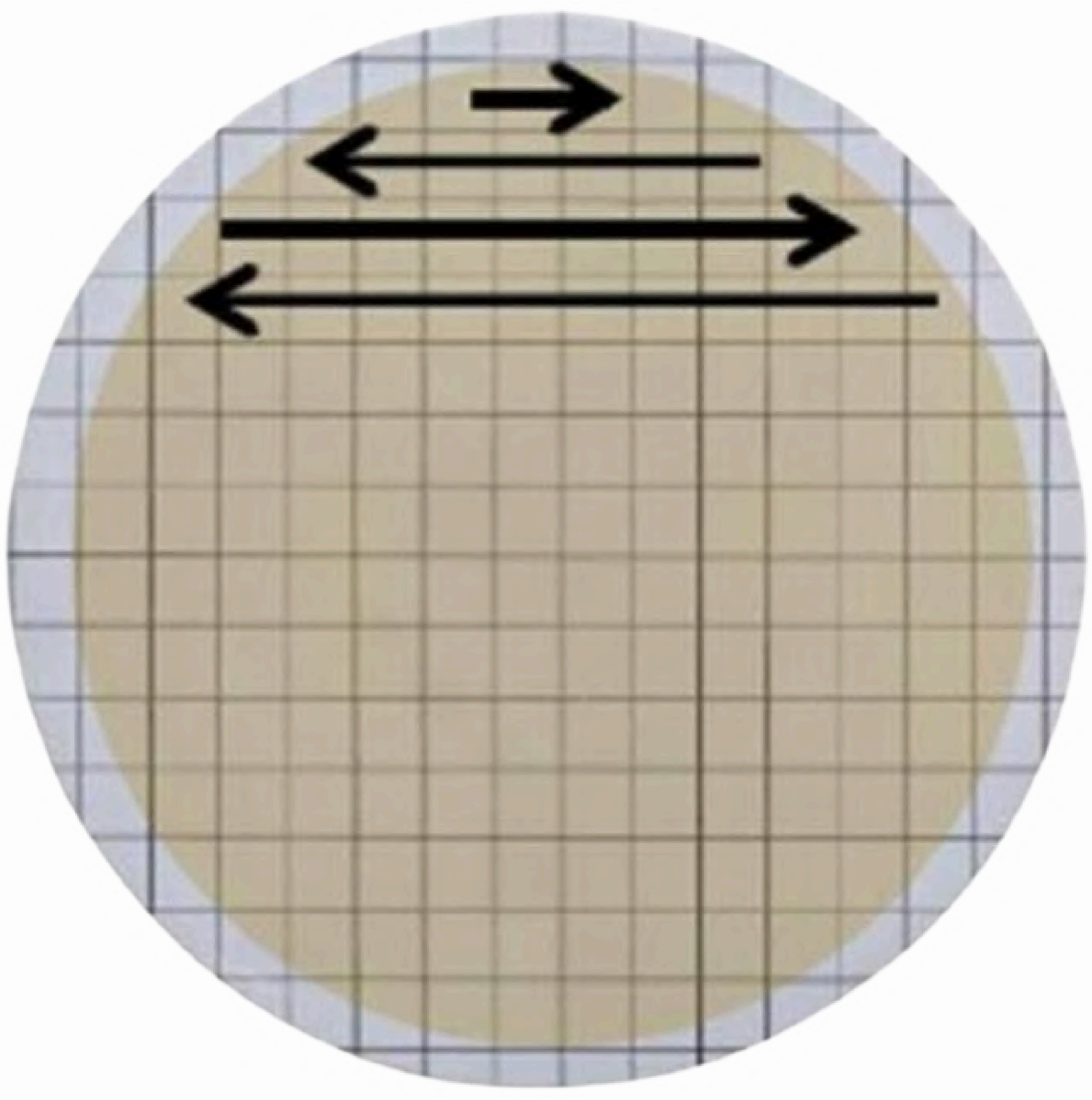
Microscopic examination results showed that the abundance of microplastic particles in 0.75-liter bottled water was as follows: fibers ranged from 26 to 29 particles/L, fragments ranged from 17 to 20 particles/L, and filaments were 5 particles/L, with a total of 50 particles/L. In the 0.5-liter bottles, fibers ranged from 18 to 22 particles/L, fragments ranged from 10 to 13 particles/L, and filaments were 2 particles/L, with a total of 34 particles/L. For the 0.25-liter bottles, fibers ranged from 11 to 13 particles/L, fragments ranged from 7 to 10 particles/L, and filaments were not observed, with a total of 18 particles/L.

SUPERVISOR:

DR . FADIA A. SULAIMAN

LABORATORY TESTS

- 1. Filtration The samples were filtered using cellulose nitrate membrane filter papers with a pore size of 0.45 mm (CHMLAB GROUP, Spain). The filters were placed on a filtration flask, and after filtration, the membranes containing the deposited particles were transferred into glass dishes and left at room temperature for 24 hours to dry, in preparation for subsequent analyses.
- 2. Microscopic Observation To observe the plastic particles deposited on the filter papers, a stereomicroscope (Motic 2300S-V37-45X Zoom, Italy) was used, as shown in Figure (4). During the observation, the particles were counted and their colors and shapes were identified. The particles were categorized by shape into different groups: fibers, irregular fragments, filaments, foam, and others. They were also classified by color into transparent, black, blue, red, white, green, yellow, and others.



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MISTAKE IN BUILDING DESIGN PROCEDURE IN IRAQ

PROJECT BACKGROUND AND MOTIVATION:

Despite Iraq's rich architectural heritage, contemporary construction practices often diverge from international engineering standards (IBC, ACI). Field surveys of 40 projects in Mosul and surrounding regions revealed:

- 1) Overuse of raft foundations in low-rise buildings (66% of cases) where strip or pad foundations would suffice.
- 2) Excavation depths under 4 m in 80% of sites or exceeding 4 m without technical justification in 20%, leading to unnecessary cost increases.
- 3)Misapplication of concrete block masonry in structures over two stories without adequate reinforcement, compromising lateral and vertical load resistance.

These issues stem from outdated national codes (Iraq Code No. 52/1987), limited geotechnical assessment, and low awareness of alternative solutions.

OBJECTIVE

1) Identify and classify prevalent structural design errors in Iraqi construction.
2) Develop an evaluation framework that integrates geotechnical, economic, and sustainability criteria.
3) Formulate actionable recommendations for code updates and best-practice guidelines.
4) Prototype digital tools for preliminary foundation selection and excavation-depth estimation.

METHODOLOGY

1. **Data Collection:**
   - Site visits to 40 construction projects at various stages (excavation, foundation, superstructure).
   - Structured questionnaires and semi-structured interviews with 50 engineers and contractors..
2. **Statistical Analysis:**
   - Error categorization (foundations, excavation, materials).
   - Frequency distributions and correlation analysis between soil type, foundation choice, and excavation depth.
3. **Benchmarking**:
   - Comparison with IBC 2021, ACI 318-19, Saudi SBC 304, and Egyptian codes.
4. **Recommendation Development:**
   - Mapping gaps to specific code amendments, training modules, and digital-tool requirements.

IN COLLABORATION WITH

LOCAL DESIGN COMPANIES, ENGINEERING OFFICES, AND CONTRACTORS WHO PROVIDED FIELD DATA AND TECHNICAL INSIGHTS.

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PROF. DR. MOHAMMAD ADNAN BASHIR

OUTCOMES

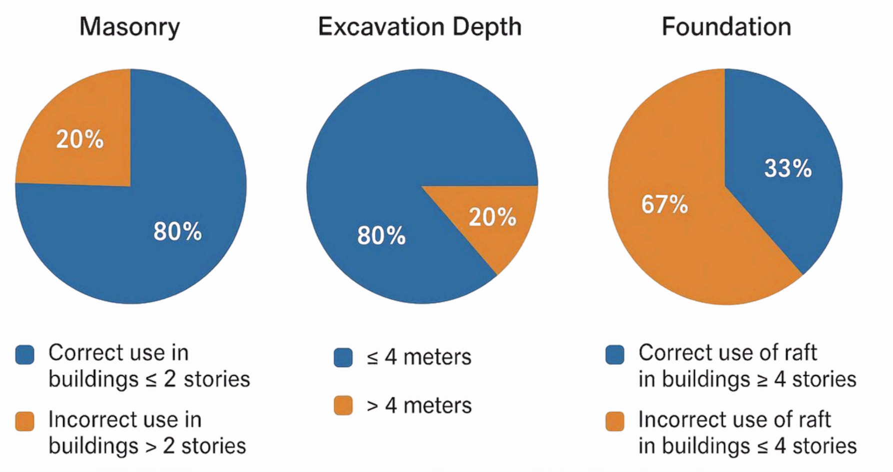
1) concise guide for selecting foundation types and excavation depths based on soil conditions.
2) Recommendations for alternative techniques (soil stabilization, strip foundations).
3) A framework for regulatory oversight and professional training.

EXPECTED DELIVERABLES

1) Comprehensive Report with tables and charts showing error rates, cost impacts, and structural risks.
2) Design Efficiency Framework that practitioners can apply to future projects.
3) Best-Practice Handbook summarizing when to use different foundation types, calculate excavation depth, and select masonry materials.
4) Draft Amendments to Iraq Code No. 52/1987 for foundations, excavation, and masonry provisions.
5) Training Materials and workshop agendas for local engineers and contractors.

POTENTIAL MARKET

1. **Government & Regulators:** Ministries and municipal authorities for updating and enforcing building codes.
2. **Engineering & Construction Firms:** Design offices and contractors aiming to reduce costs and enhance safety.
3. **Material Manufacturers:** Brick and concrete producers interested in training and product guides.
4. **Academic & Training Institutions**: Universities and vocational centers providing professional development.
5. **Technology Providers:** BIM software and excavation planning app developers.



CURRENT BENEFITS OF THE RESEARCH

Enhanced Structural Efficiency

- Addresssing overuse of raft foundations in low-ise builings 166% by promoting cost-effective alternatives (e.g strip foundations can reduce construction costs by 20-30% for smail-scale projects
- Correcting excavation deoth practices reduce iniderental efficiency entrimimizing unnecessary experises and environmental disruption

Resource Rationalization

- Reducing material wasta (e.g opttimized founndtion quage) through optimized:foundation and material selection
- Minimizing over-excavation lowers energy consumption and carbon emissions during construction

Professional Capacity Building

- Providing actionable guidelines for engineers and contractors bridges knowledge gaps, reducing designerrors

FUTURE BENEFITS OF THE RESEARCH

Modernized National Building Codes

- Serving as a catalyst to update Iraq's outdated codes to align with global standards

Sustainable Construction Practices

- Promoting soil stabilization techniques and material efficiency could reduce construction sector's carbon footprint by 30-15% by 2080

Digital Transformation

- Developing AI-driven tools for foundation selection and excavation planning could cut design time by 30

NATIONAL IMPACT

Economic

- Annual savings of $20-50 million by avoiding redundant costs from design flaws and resource mismanagemennt

Social

- Increased public trust in building safety, reducing disaster-related casualities by 25-3-36% over the next decade

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FEASIBILITY STUDY – CONSTRUCTION OF PEDESTRIAN BRIDGES IN MOSUL CITY

PROJECT BACKGROUND AND MOTIVATION

The design of an iconic infantry bridge is a tourist attraction and a teacher for the city of Mosul

OBJECTIVE

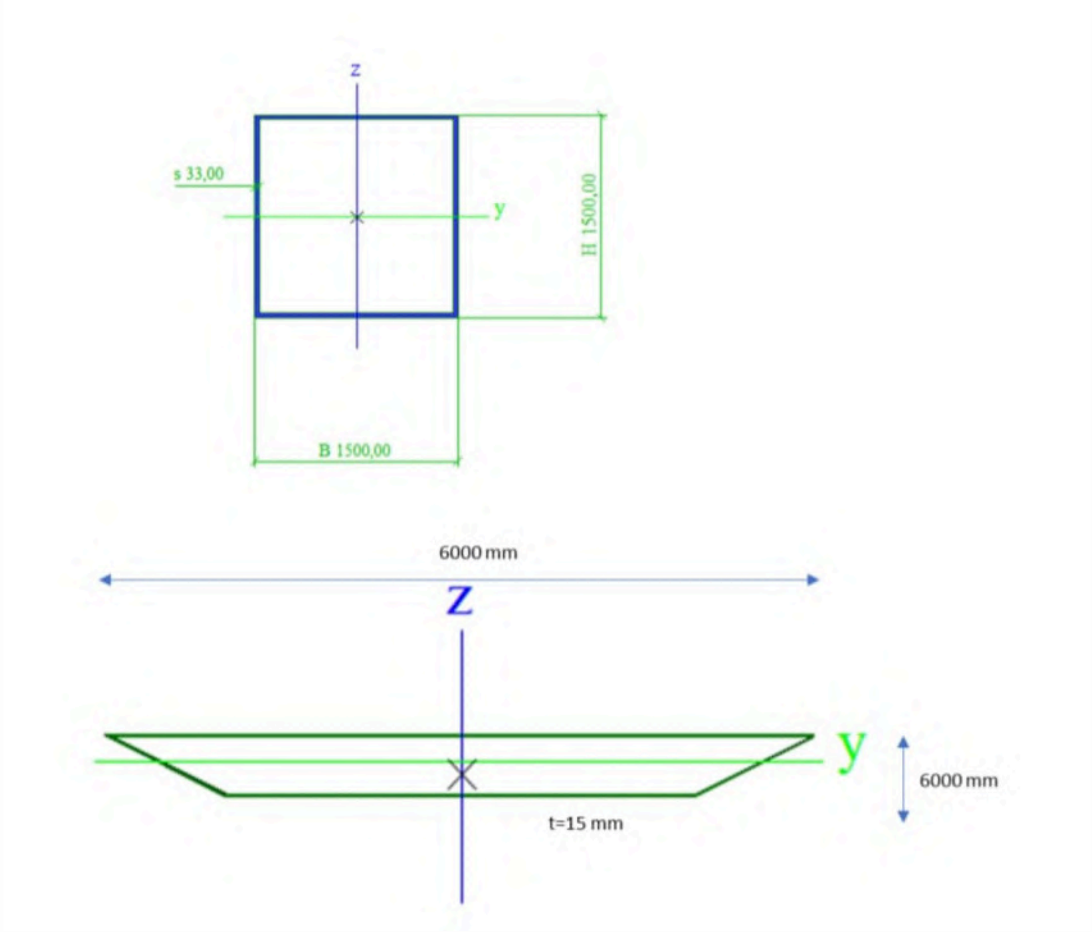
1.Preliminary analysis and design of tied arch bridge using SCIA Engineer software
2. Suggesting suitable locations where foot bridges are required
3. Show briefly the social and the economical effects of footbridges on the community

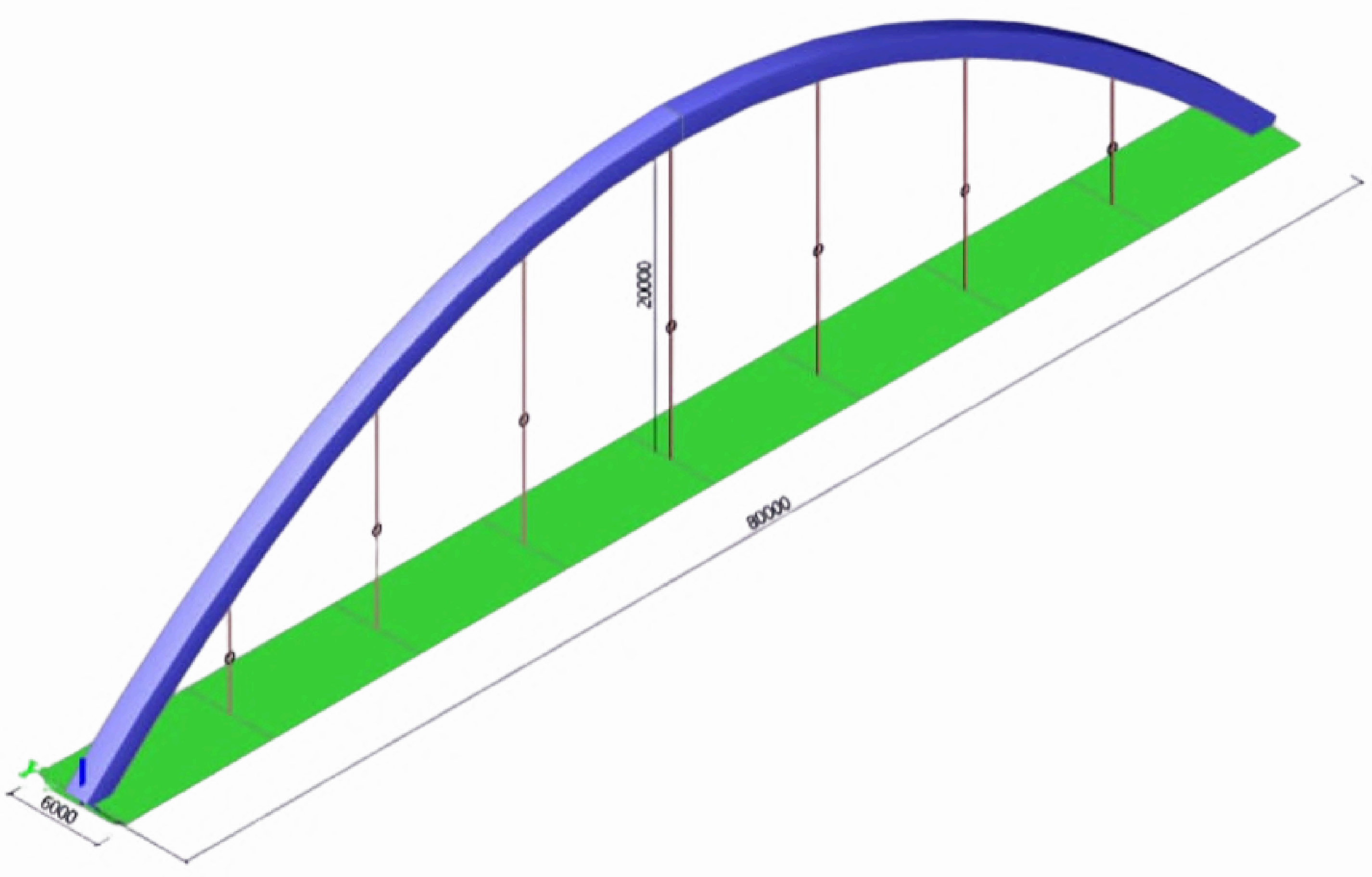
METHODOLOGY

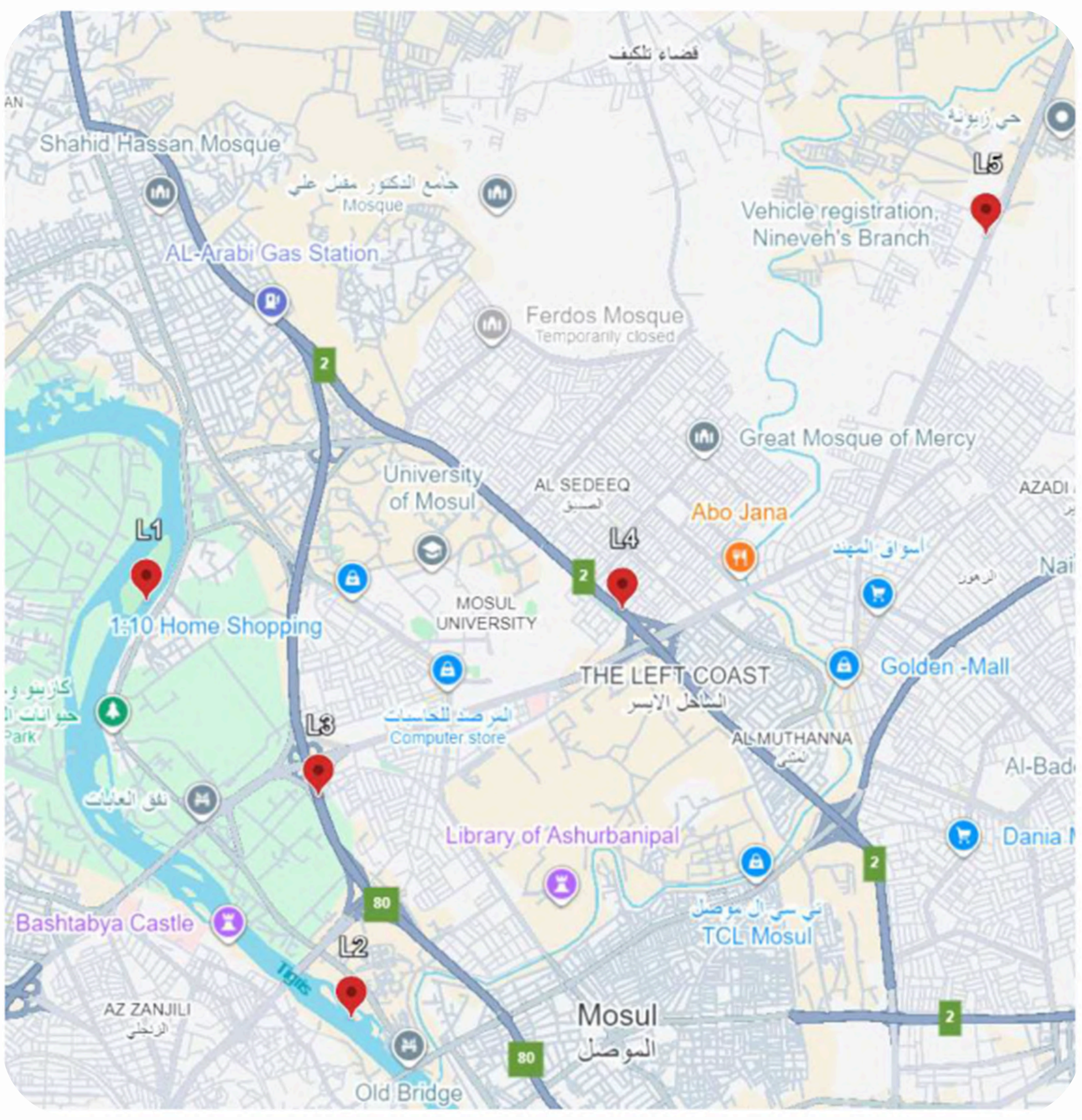
1.Site selection
2.Bridge type selection
3.Structural system of the bridge
4.Load hypothesis
5.Manual structural analysis
6.Bridge design

OUTCOMES

- Analysis of internal forces (axial forces, bending moments, shear forces, torsion force)
- Analysis of deflections (horizontal and vertical)
- Unity check of structural elements
- Cost estimation







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PRODUCTION OF COLOURED PLASTERING MORTAR FOR HERITAGE BUILDINGS

PROJECT BACKGROUND AND MOTIVATION:

The city of Mosul, with its rich heritage and historic architecture, faces unique challenges in preserving its traditional buildings. Many heritage buildings have white-painted walls, which frequently suffer from peeling due to high moisture levels. This issue arises because the paint layer separates from the plaster underneath, especially in humid conditions. This project seeks to address these challenges by developing a colored plastering mortar for heritage buildings, eliminating the need for external paint and enhancing durability.

OBJECTIVE

To create a durable, moisture-resistant, and aesthetically appealing plastering mortar that integrates color directly into the mixture, preserving the visual authenticity and heritage value of historic buildings in Mosul without relying on paint that may peel away.

METHODOLOGY

1. **Material Selection: Identify natural and synthetic pigments compatible with traditional mortar materials.**
2. **Mix Design: Develop a mortar mix that incorporates these pigments while maintaining structural integrity and durability.**
3. **Moisture Resistance Testing: Conduct tests to ensure the mortar resists moisture effectively, reducing the risk of detachment.**
4. **Color Testing: Evaluate color consistency and stability over time, especially under exposure to Mosul's climate conditions.**

MATERIALS USED

1. Gypsum
- a. White
- b. Red

2. Lime
3.Chromium oxide
4. Liquid oxide
5. Powder oxide
6.Water

POTENTIAL MARKET

- NINEVEH GOVERNORATE
- PRIVATE SECTOR

IN COLLABORATION WITH

MOSUL MUNICIPALITY

MIX DESIGN

Mix1:1 W/b=0.6

Materials	Percentage (%)	Weight (gm)
White gypsum	10	17.3
Red gypsum	90	151
Lime	100	94

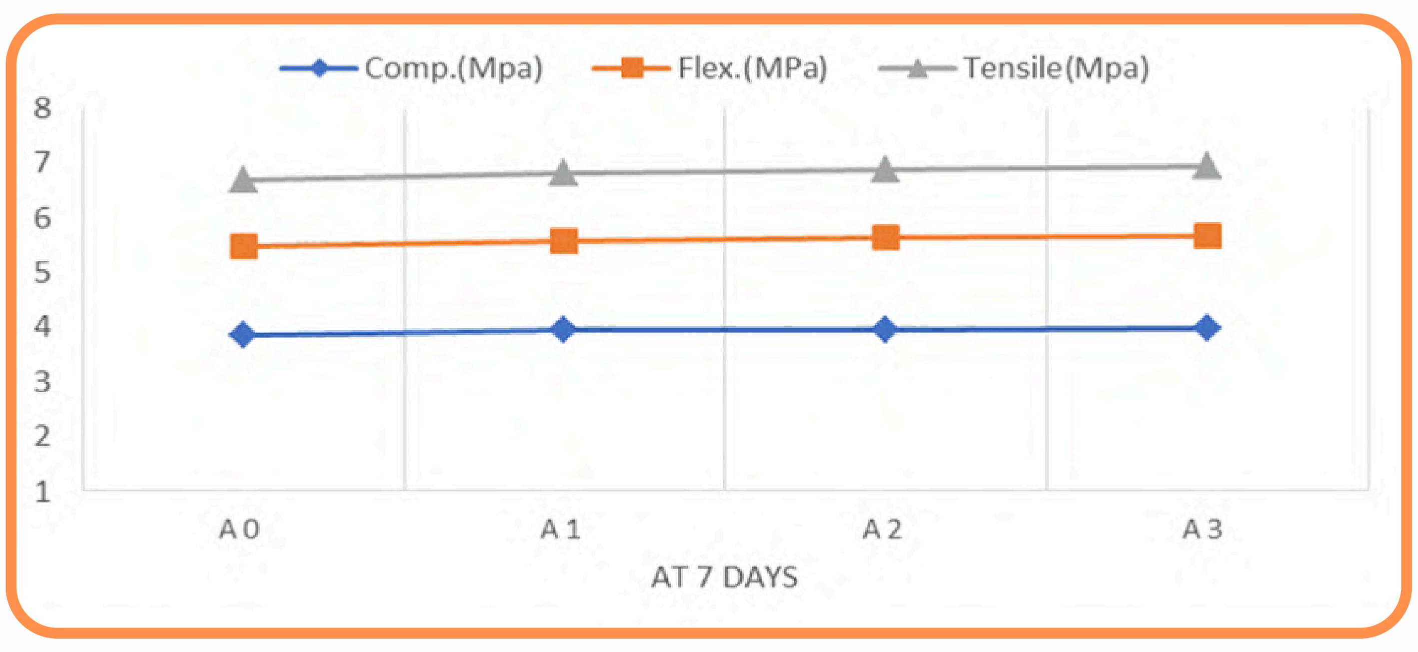
Group code	colors	Quantity percentage
A_0	-	-
A_1	Chromium oxide	0.5(g)
	Powder oxide	6(g)
A_2	Powder oxide	4(g)
	Liquid oxide	0.2(ml)
A_3	Chromium oxide	0.5(g)
	Powder oxide	4(g)
	Liquid oxide	0.2(ml)

LABORATORY TESTS

1.Flexural Strength
2.Compressive Strength
3.Tensile strength
4-.Shrinkage cracking

OUTCOMES

Mix.N0	Compressive strength (MPa)	Flexural strength (MPa)	Tensile (MPa)
A0	3.84	1.647	1.23
A1	3.93	1.65	1.26
A2	3.93	1.66	1.27
A3	3.96	1.69	1.29



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MECHANICAL AND MICRO-STRUCTURAL PROPERTIES OF ECO- FRIENDLY CONCRETE INCORPORATING LOW CARBON MATERIALS

PROJECT BACKGROUND AND MOTIVATION

The use of brickpowder and steel slag as partial substitutes for cement is an interesting topic with significant environmental and economic benefits. It can help reduce the consumption of natural raw materials and lower carbon emissions resulting from the production of traditional cement. Additionally, it can enhance the properties of concrete, such as strength and durability.

OBJECTIVE

1-Improving Environmental Sustainability.
2- Enhancing Resource Efficiency.
3- Improving Durability and Service Life.

METHODOLOGY

The methodology consists of preparing the materials (brickspowuder and steel slag) and mixing them in specific proportions with cement, sand, and gravel, followed by conducting relevant tests on their properties. The preparation is carried out as follows:

1. Material analysis : The activity index test was employed to assess the activity of the materials employed, with a 20% replacement ratio utilizing various waste materials like brick powder , steel slag "It must exceed 75% after 7 days in accordance with ASTM C 318 specification."
2. Replacement materials : A partial replacement of cement was carried out using alternative materials: brick powder and steel slag.
3. mix design : Mixing ratio relative to the reference: (1 : 1.68 : 3.3) and water 60%
4. Replacement material Casting: The partial replacement ratios of cement with brick powder and steel slag were: 10%, 20%, 30%, and 40%.
5. lab testing: Tests were conducted on the reference cement as well as on the mixtures containing brick powder and steel slag."

MATERIALS USED

- Cement
- Brick powder
- Steel slag
- Sand
- Gravel

POTENTIAL MARKET

1-Privet engineering offices
2-Engineering offices"
3-Department of Reconstruction and Buildings"
4-Mosul Municipality
5-State commission for buildings

SUPERVISOR

ASST. LECH. MOHAMMED Y. HAMID

MIX DESIGN

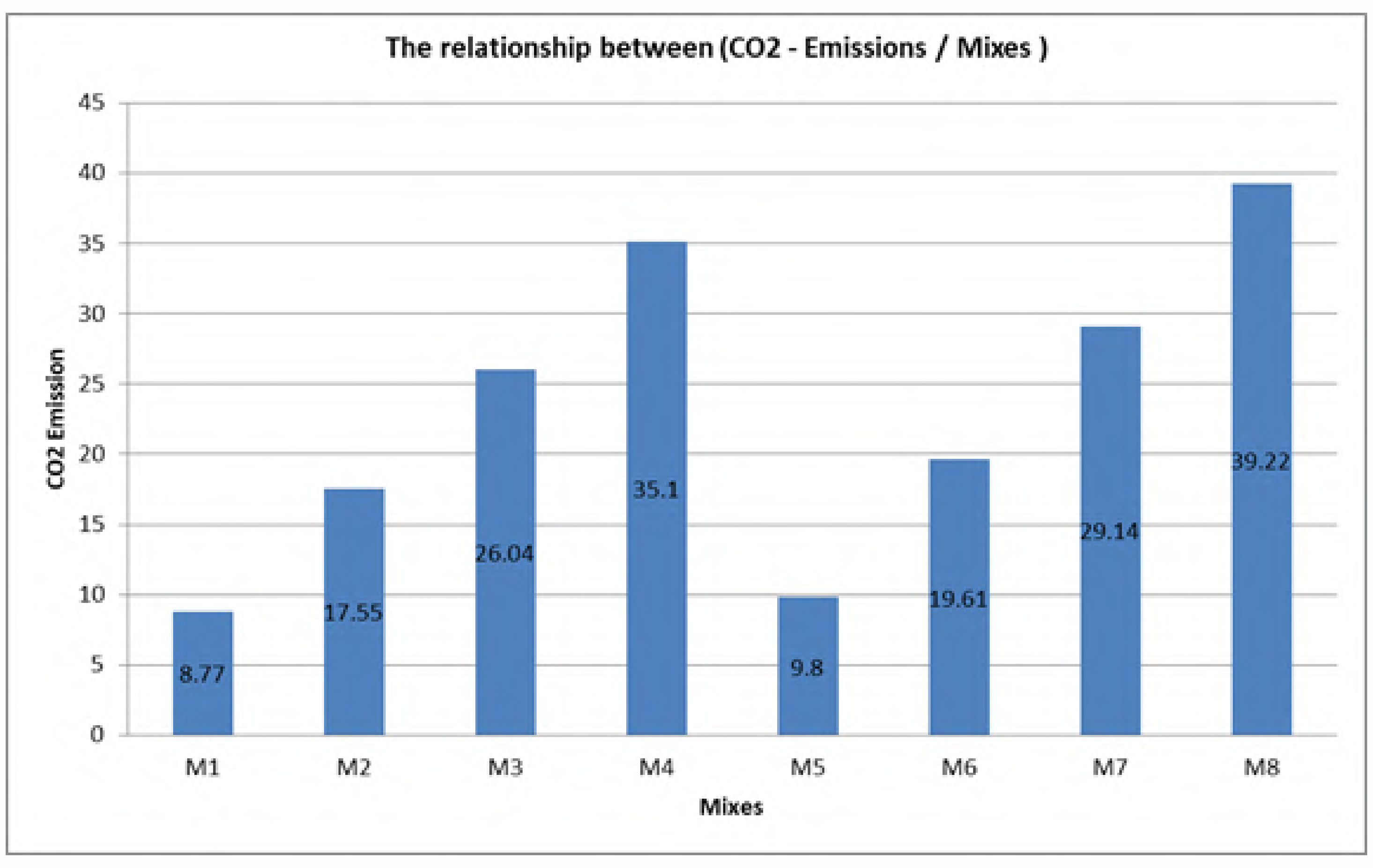
Mixing ratio relative to the reference: (1 : 1.68 : 3.3) and water 60% and The partial replacement ratios of cement with brick powder and steel slag were: 10%, 20%, 30%, and 40%.

OUTCOMES

1. "Reduction of carbon emissions from different types of concrete."
2. "Minimization of excess materials and construction waste."
3- "We have managed to reduce carbon emissions by up to 39.22%, as shown in the chart."

LABORATORY TESTS

1Flexural strength
2-Spliting strength
3-Compressive strength
4-Slump test
5-concret Density



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IMPROVING THERMAL COMFORT IN EDUCATIONAL INDOOR ENVIRONMENTS USING BREATHING CONCRETE UNITS

PROJECT BACKGROUND AND MOTIVATION

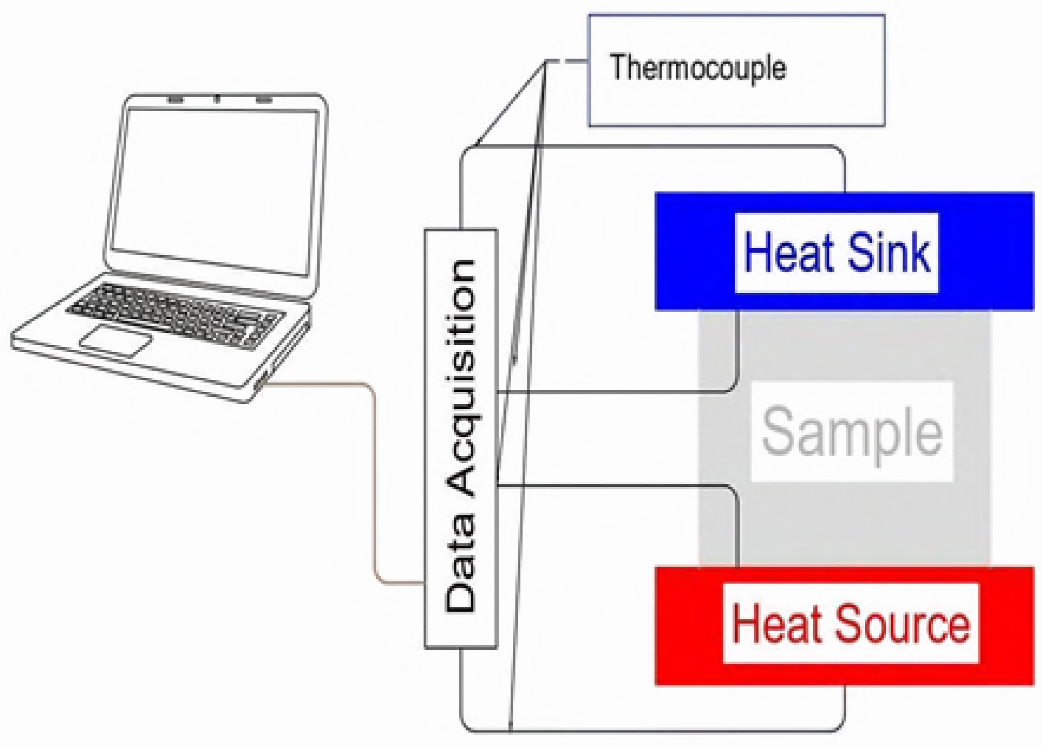
The main contribution of this study can be summarized in three points:

- 1.The study adds scientific value by deepening the understanding of the impact of innovative architectural materials on energy consumption efficiency.
- 2.Providing scientific data that supports the shift of educational buildings towards the use of more sustainable materials, thereby enhancing the importance of breathing concrete in achieving greater sustainability.
- 3-Providing insights into the economic and environmental feasibility of using these materials in educational buildings, thereby reinforcing the idea that investing in these materials is beneficial in the long term

OBJECTIVE

1. The main objective of the study is to produce breathable concrete units and evaluate their impact on improving thermal comfort in educational buildings, as they are among the buildings with high energy consumption.
2. Study of the chemical and physical properties of the materials used in the production of these materials through:

- -investigate the effect of using slag and fly ash in proportions of 20%, 30%, and 40% as partial replacements for cement in concrete mixes.
- study the impact of adding a high-performance polymer (5% and 10%) on the thermal insulation, mechanical properties, and breathability of the concrete blocks.
- Assess the performance of the resulting concrete blocks in terms of compressive strength, breathability, permeability, and thermal insulation.



POTENTIAL MARKET

1_EDUCATIONAL BUILDINGS .
2_RESIDENTIAL AND COMMERCIAL COMPLEXES .
3_GOVERNMENT DEPARTMENTS .
4_INDUSTRIAL FACILITIES .
5_COLD ROOMS AND WAREHOUSES .
6_AGRICULTURAL FACILITIES .
7_SCHOOLS AND HOSPITALS .
8_HOTELS AND RESIDENTIAL COMPLEXES

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METHODOLOGY

- This study employs a mixed-methods approach, combining experimental analysis with a review of existing literature. Fifteen mix designs were developed, incorporating varying proportions of SCMs and polymers. The experimental program involves mechanical, thermal, and permeability tests, following ASTM standards [25]. Sawdust was treated with a bituminous binder to enhance its durability and compatibility with concrete, following protocols outlined in recent studies [26] [27].
- The methodology emphasizes the synergistic effects of SCMs and polymers, aiming to optimize thermal insulation and breathability without compromising strength. Statistical analysis was performed to identify significant trends and correlations, ensuring the reliability of results [28].
- Thermal insulation testing of the produced units using a device to measure the amount of thermal heat flow and calculating the insulation percentage of the produced units.

MATERIALS USED

- PORTLAND,FINE AGGREGATE,COARSE
- AGGREGATE,FLY ASH,LIMESTON,
- SAWDUST,POLYMER,SUPERPLA STICIZER

MIX DESIGN

We mixed a quantity of cement, sand, crushed gravel passing through sieve No. 8, polymer, super-stosizer sawdust and a percentage of water using four cylindrical molds of size 10*20, three molds of size 10*15 and four molds of size 10*40 with a slampe test and making models for thermal insulation test. The thickness of the mold or model is 11 mm.

OUTCOMES

Mix	28 Days	56 Days
Control Mix	38.2	41.5
Mix 1	36.0	39.8
Mix 2	34.5	37.9
Mix 3	32.7	36.1
Mix 4	35.8	39.2
Mix 5	34.1	37.5
Mix 6	32.5	35.8
Mix 7	36.5	40.0
Mix 8	34.9	38.3
Mix 9	33.0	36.4
Mix 10	35.6	39.1
Mix 11	34.4	37.7
Mix 12	32.8	36.0
Mix 13	34.7	38.1
Mix 14	33.2	36.7
Mix 15	32.4	35.5

Mix	28 Days
Control Mix	1.42
Mix 1	1.26
Mix 2	1.18
Mix 3	1.10
Mix 4	1.25
Mix 5	1.17
Mix 6	1.09
Mix 7	1.20
Mix 8	1.14
Mix 9	1.08
Mix 10	1.22
Mix 11	1.15
Mix 12	1.07
Mix 13	1.16
Mix 14	1.11
Mix 15	1.06

LABORATORY TESTS

Test	Standard/Method	Purpose	Frequency
Compressive Strength	ASTM C39	Assess mechanical strength	28, 56 days

SUPERVISOR

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The physical properties of concrete under different fire exposure periods: an experimental

PROJECT BACKGROUND AND MOTIVATION

Concrete is the most commonly used construction material due to its strength and load-bearing capacity. However, high temperatures—caused by fire or environmental factors—can significantly weaken its physical and mechanical properties, such as strength loss, increased porosity, and cracking. This has created a need for heat-resistant concrete mixes, especially in modern residential and industrial buildings.

OBJECTIVE

Project Content Summary:
The project presents an experimental study on the effect of heat on concrete, divided into key sections:
1. Introduction:
Highlights the importance of studying how high temperatures affect concrete's strength, durability, color, and porosity.
2. Objective:
To identify the most heat-resistant concrete mixes and analyze the physical and mechanical changes after thermal exposure.
3. Materials & Methods:
• Tested various mix ratios (e.g., 1:1.5:2.5, 1:2:4, 4:2:1).
• Adjusted water-to-cement ratios.
• Cast concrete cubes and exposed them to heat before testing.
4. Results & Analysis:
• Compared performance of each mix after heating.
• Determined which mixes retained the most strength.
• Documented visual and physical changes like cracks, color change, and weight loss.

MODELS

Practical Summary:
1. Concrete Mix Preparation:
Multiple mix ratios were used (e.g., 1-1.5- 2.5, 1-2-4, 4-2-1, 6-3-1, 1-1-1).
Concrete cubes (15×15×15 cm) were cast for testing.
2. Curing:
After 24 hours, the cubes were demolded and cured in water for at least 7 days to enhance strength through hydration.
3. Heat Exposure:
Samples were exposed to temperatures of 200°C, 250°C, 300°C, 600°C, and 900°C using an electric furnace for 2–4 hours

MIX DESIGN

Before heating:	***After heating:***
Slump test to measure workability. **Compressive strength test at 7 and** **28 days.** **Density and permeability tests**	**Compressive strength test again to measure residual strength.** **Visual inspection for color change and crack formation.** **Water absorption test.** **Ultrasonic Pulse Velocity (UPV)** **test to assess internal damage.** **Scanning Electron Microscope (SEM) analysis to examine microstructural changes (in some mixes**

POTENTIAL MARKET

▪ Effect of Cement and Water Ratios: Mixes with higher cement content and lower water ratio exhibited greater thermal resistance. Mixes with higher water content or low cement deteriorated rapidly after heat exposure.
#Post-Heating Test Observations: Color change (to light gray or pink). Appearance of fine to moderate cracks. Increased water absorption due to higher porosity. Reduced Ultrasonic Pulse Velocity (UPV) indicating internal damage
Main Conclusion:
To produce heat-resistant concrete, it is recommended to use mixes with a high cement content and moderate water ratio. Exposure to temperatures above 300°C should be avoided unless the concrete is specifically designed to withstand such conditions

OUTCOMES

1-Best Performing Concrete Mix in Terms of Heat Resistance:

Mix: (1 : 1.5 : 2.5) Cement : Sand : Gravel

Water-to-Cement Ratio: 0.45

Temperature: 200°C for 2 hours

Result: Retained 98.04% of its original strength

Analysis: The mix remained cohesive, had low porosity, and exhibited very minimal cracking

2-Worst Performing Mix in Terms of Heat Resistance:

Mix: (1 : 2 : 4)

Water-to-Cement Ratio: 0.65

Temperature: 400°C for 2 hours

Result: Lost more than 50% of its strength

Analysis: Due to the high water content, the concrete became more porous and developed significant cracks

	Mixture number G-S-Cem	Extend the immersion in water for days	Burning degree (°C)	Burning time	Uses Concrete	The most important tests after a burn	After burning model
1	2.5-1.5-1	14	300	60	lightweight reinforced concrete	Density and friability test	It will cause a significant loss of its resistance and although it will not collapse immediately, it will become unfit for structural use after being exposed to this heat.
2	4-2-1	7	300	60	Concrete for foundations and walls	Visual inspection and fragmentation	Concrete will not collapse at 250°C, but it will lose some of its strength and become more brittle and porous, especially with a low cement content in the mix (4:2:1

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IMPROVING THE STABILIZER LAYER IN RURAL STREETS OF NINEVEH GOVERNORATE USING ANTI-STRIPPING AGENT

PROJECT BACKGROUND AND MOTIVATION:

The repair and restoration of old concrete buildings need novel materials and processes that meet contemporary technical standards while maintaining structural integrity. Engineered Cementitious Composites (ECC), noted for their ductility and self-healing properties, have surfaced as a viable option for the restoration of old concrete .

OBJECTIVE:

TThis work seeks to formulate ECC mixtures that integrate hybrid fibers (PPF and date palm fibers) with supplementary cementitious materials (MK, SF, and GGBS) at different Replacement ratios. Assess the mechanical characteristics, including compressive strength, tensile strength, and flexural behavior, of the formulated ECC mixtures. Evaluate the durability performance of ECC mixtures under harsh environmental conditions. Examine the microstructural properties of ECC mixtures to comprehend the synergistic impacts of hybrid fibers and supplementary cementitious materials (SCMs). Offer pragmatic suggestions for using ECC in the restoration of old concrete edifices.

METHODOLOGY:

The methodology A comprehensive experimental program was conducted to systematically assess the performance of ECC mixes. Formulations of engineered cementitious composites (ECC) incorporating different ratios of supplementary cementitious materials (SCMs) and hybrid fibers were created and evaluated.
The subsequent steps outline the methodology:
ECC mixtures were formulated utilizing Portland cement (PC), Metakaolin (MK), Silica Fume (SF), and Ground Granulated Blast Furnace Slag (GGBS). The binder composition comprised %20 ,%10, and %30 MK, %5 , %10, and %15 SF, along with %20, %30, and %40 GGBS.
Polypropylene fibers and date palm fibers (PPF) and date palm fibers were utilized as hybrid fibers at specified proportions of %0.2 and %1.5 by volume, respectively.
Styrene Butadiene Rubber (SBR) was incorporated at concentrations of %5 and %10 relative to the binder weight.
A water-to-binder ratio (W/B) of 0.45 was consistently upheld across all mixtures

MATERIALS USED:

1. Materials and Mix proportions
2. Metakaolin
3. The Silica fume
4. Ground Granulated Blast Furnace Slag (GGBS)
5. Polypropylene Fiber
6. Date Palm Fiber: The Date Palm Fibers
7. Superplasticizer

MIX DESIGN:

Ten ECC mixes were developed using various replacement ratios of Metakaolin (MK), Silica Fume (SF), and Ground Granulated Blast Furnace Slag (GGBS) as partial substitutes for cement. Each mix included hybrid fibers: %0.2 polypropylene and %1.5 treated date palm fibers by volume. A constant water-to-binder ratio (0.45) and superplasticizer dosage (%1.5) were maintained across all mixes to evaluate mechanical and durability performance.

OUTCOMES:

Outcomes:
- Improved strength (compressive, tensile, flexural) of ECC mixes.
- Enhanced durability with lower water absorption and better sulfate/chloride resistance.
- Optimized mix (M6) ideal for historic concrete restoration.
- Greater sustainability via natural fibers and SCMs, reducing cement use.
- Better crack resistance and longer service life for repairs.

SIGNIFICANCE AND IMPACT:

This project contributes to sustainable construction by utilizing eco-friendly materials like natural fibers and SCMs. The optimized ECC mix enhances the structural integrity and longevity of historic buildings, offering a cost-effective, durable solution for restoration. It aligns with global goals for environmental conservation and resource efficiency.

COST ANALYSIS

Although the use of hybrid fibers and supplementary cementitious materials slightly increases material costs, the improved durability, reduced maintenance, and extended service life of restored structures result in significant long-term savings. The selected materials are locally available, supporting cost-efficiency and sustainability

LABORATORY TESTS:

1. Compressive Strength Test – to evaluate load-bearing capacity at 28 and 90 days.
2. Tensile Strength Test – to assess crack resistance and ductility.
3. Flexural Strength Test – to measure bending resistance.
4. Water Absorption Test (ASTM C642) – to determine permeability.
5. Chloride Penetration Test (ASTM C1202) – to evaluate durability against chloride attack.
6. Sulfate Resistance Test (ASTM C1012 & C452) – to monitor expansion due to sulfate exposure.
7. Microstructural Analysis (SEM) – to study fiber-matrix bonding and porosity.

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"Investigation of Bio-Based Repair Mortar Using Metakaolin and Natural Fibers for Historic Masonry Structures"

PROJECT BACKGROUND AND MOTIVATION:

Iraq is a country of heritage and civilizations,which possesses a huge number of historical buildings that need to be restored and maintenance properly decent with its great past That should not be fixed with regular cement mortar This issue has driven research toward the development of bio-based repair mortars

OBJECTIVE:

The goal of this technology is to play an important role by increasing the mechanical characteristics of historical structure in terms of flexibility,strength and sustainability as well and the most important point is Reducing carbon emissions that harmful to the environment,and the general appearance that matchs historical buildings without the sharp shape of original cement morta.

METHODOLOGY :

The methodology consists of bio-based cementitious mortar by partially replacing cement with Metakaolin and incorporating Date Palm fibers to enhance the repair properties of the mortar used for historicmasonry structures.

Materials used :

Portland cement, sand, polymer, palm fibers that treated by sodium hydroxide, Metakaolin

POTENTIAL MARKET :

- International Organizations such as UNESCO
- Municipalities and Governorates
- Restoration and Construction Companies Specializing in Historic Buildings
- Universities and Architectural Research Center Heritage and Antiquities Authorities

Mix design:

1- The implementation of this mixture environmentally friendly and does not havenegative treatment stages.
2- It reduces the use of industrial fibers and it also reduces the cost of the project for being available in many countries, and finally palm fibers are mainly used in sustainable construction projects that aim to reduce carbon emissions.

Laboratory tests:

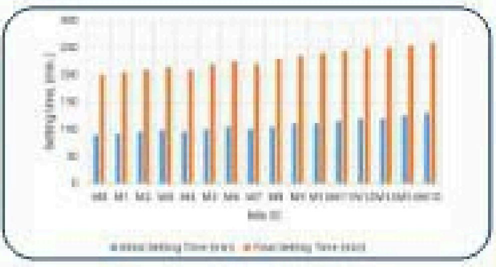
1- Mechanical Tests :
- Compressive Strength Tested at 28 and 56 days
- Flexural and Tensile Strength Tested at 28 days

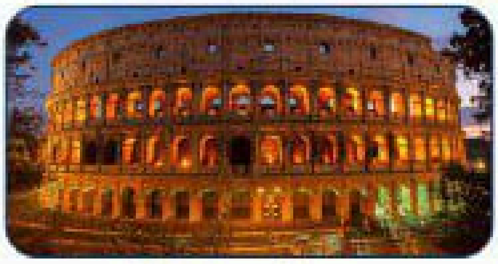
2-Durability Tests :
- Water Absorption Assessed to evaluate porosity and permeability
- Salt Crystallization Evaluated for resistance to salt-induced damage

3- Workability Tests:
- Slump Test Measured to ensure proper workability
- Setting Time Determined to assess the working period of the mortar

Outcomes:

1- The results indicate that the addition of 20% Metakaolin in the M7 enhanced the compressive strength compared to the reference MO specimen.
2- palm fibers were used to enhance the strength of the caly walls while preserving the heritage character. also added to the mortar to enhance crack resistance and improve adhesion.





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Determine the quantities and characteristics of domestic and medical solid waste disposed of in the city of Mosul

PROJECT BACKGROUND AND MOTIVATION

Like many developing countries, Iraq faces significant challenges in managing solid waste due to the reliance on traditional and inefficient methods, along with the absence of accurate databases and scientific decision-making tools. These challenges have been exacerbated by rapid population growth and urban expansion, leading to an increase in waste volume and difficulty in its management. This has created an urgent need for scientific and practical solutions for solid waste management, particularly in the city of Mosul.

OBJECTIVE

The study highlights the following:
- Protecting public health through a very small number of infected individuals.
- Reducing the environmental impacts of waste generated during treatment and disposal.
- Encouraging recycling and resource recovery.
- Reducing the volume of waste produced.
- Supporting a sustainable economy by creating job opportunities for the Cardiology Department.
- Enables waste collection and expansion.
- Raising public awareness and encouraging community participation in proper waste management.

LABORATORY TESTS:

Laboratory tests were conducted, including:

- Analysis of the components of household waste.
- Density measurement using a metal cylinder.
- Moisture content measurement by drying samples in an electric oven.
- Classification of medical waste according to World Health Organization standards.
- Density measurement of hazardous and regular medical waste (233.75 kg/m³ for hazardous waste and 175.83 kg/m³ for regular waste).

MIX DESIGN

The study followed a combined field, laboratory, and office-based approach:

Fieldwork: Collection and

analysis of samples fromselected neighborhoods over three seasons.

Laboratory work: Analysis of waste components, moisture content, and density.

Office work: Estimation of waste quantities, application of criteria for landfill site selection, and the design of an integrated waste management system.

Data sources included Mosul Municipality and the Urban Planning Directorate.

POTENTIAL MARKET

Though not presented under a dedicated section, the potential market can be inferred from the recommendations:

Primary beneficiaries: Mosul Municipality and local hospitals.

Recycling and biological treatment companies.

The private sector, particularly in organic waste composting projects.

International organizations that could fund or support improved waste management initiatives

OUTCOMES

Average household waste generation in Mosul: 0.516 kg/person/day.

Organic waste, such as food, comprises approximately 76.69% of total waste.

The highest waste generation was recorded on Fridays during autumn.

Daily generation of general medical waste: 3,393.566 kg.

Hazardous medical waste generation: 1.607 kg/bed/day.

A comprehensive waste management framework was proposed, including segregation, transportation, recycling, biological treatment, and sanitary landfilling.

Though not presented under a dedicated section, the potential market can be inferred from the recommendations:

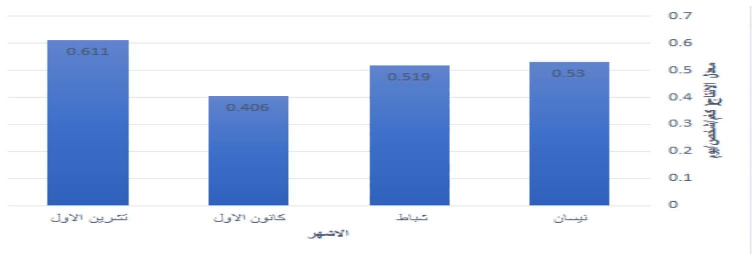
Primary beneficiaries: Mosul Municipality and local hospitals.

Recycling and biological treatment companies.

The private sector, particularly in organic waste composting projects. International organizations that could fund or support improved waste management initiatives.

Household Solid Waste Mix (According to the Study in Mosul)

Percentage (%)	Component
76.886%	Food Waste (Organic)
6.86%	Paper
5.852%	Metals
4.148%	Plastics & Textiles
2.426%	Garden Waste & Soil
1.833%	Glass



حاوية نفايات خطرة

حاوية نفايات اعتيادية

العلامة الدولية للنفايات الخطرة

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