FACULTY OF ENGINNEERING AND TECHNOLOGY

REPORT ABOUT COMPUTER PROGRAMMING ASSIGNMENT WATER SUPPLY AND IRRIGATION.

GROUP NAME: GROUP 9

COURSE UNIT: COMPUTER PROGRAMMING

GROUP LINK. https://github.com/Groupematlab/group-E.git

This assignment report is submitted to the lecturer of computer programming Mr. BENEDICTO MASERUKA by group 9 for the award of coursework marks.

Submitted on…..…/……..…/…….…….

APPROVAL

This is to confirm that this report has been written and presented by GROUP 9 giving the details for the assignment.

LECTURER'SNAME:………..

SIGNITURE:…….

DATE:………………………………………………………………………………………………

DECLARATION

We, members of group 9, sincerely declare this report to all members who may need to use its content for approval or study. This is out of our own knowledge and research and is the content of our own writing and research.

Date of declaration…………………………………………………………………………

Group representative signature…………………………………………………………

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ACKNOWLEDGEMENT

We first of all thank GOD for the gift of understanding and unity among our group members from the start of the assignment to the point of accomplishment.

In addition, great thanks go to the lecturer for the teaching method he used to make us understand more techniques in MATLAB through giving us this assignment.

Lastly, we also appreciate each member for the support in researching and documenting the results of this assignment.

ABSTRACT

This report is about the assignment which was given to all groups in computer programming including our group 9 on October 16, 2025. We started with further research on addition to the knowledge which was given to us by our lecturer. We managed to succeed with the assignment by generating right codes that are matching to the assignment given.

CONTENTS

WATER SUPPLY AND IRRIGATION PROJECT.

ABOUT THE PROJECT.

A water supply and irrigation project is a comprehensive engineering system designed to Supply water for both domestic and agricultural uses. It includes the analysis of Sources water for example rivers, lakes, groundwater, or rainwater and how it is treated and purified to make it safe for drinking and domestic use.

This projects investigates water Stores for example reservoirs and tanks for consistent availability. It also aims at Distributing water through pipelines to households, schools, hospitals, and businesses and farms to make sufficient and sustainable access to clean, safe drinking water and adequate water for agriculture all the time 24/7.

Irrigation component of the project diverts and transports water to agricultural fields, Controls water flow to optimize crop growth, distributes water efficiently across farmland using various methods (drip, sprinkler, surface) and supports agricultural production throughout growing seasons by conserving water through efficient application techniques.

OBJECTIVES OF THE PROJECT.

To improve health by improving the quality and quantity of water

Improve crop productivity throughout all seasons

Why It Is Needed;

- ✓ **Human Health and Dignity.**

As we know that water is life, this project enables us to Prevents waterborne diseases (cholera, typhoid, diarrhoea) caused by contaminated water, reduces child mortality - contaminated water is a leading cause of child deaths, eliminates long-distance water fetching (primarily by women and children) and provides dignity through private, convenient water access

Economically in Development, this project will enables agricultural productivity that is to say reliable irrigation increases crop yields, supports local economies through improved agriculture and small businesses, saves time previously spent fetching water, allowing for productive activities as well as reducing healthcare costs from water-related diseases

- ✓ **Food Security.**

This project will ensure consistent crop production regardless of rainfall patterns, enables multiple cropping seasons per year, supports diverse crop cultivation including high-value crops and reduces crop failure risk during droughts

METHODOLOGY OF DATA ACQUISITION.

Direct Observation and Community Reporting

Data Collection and Analysis where we need to test Water quality showing contamination levels, health facility records indicating water-related diseases agricultural yield data showing low and unstable production climate data revealing rainfall variability and drought frequency and population surveys documenting water access challenges

Community Consultation through Public meetings where residents describe water challenges, household surveys quantifying water access and quality issues focus group discussions with farmers about irrigation needs local leader interviews about community priorities

Indicators That Trigger Project Need

- ✓ **Red Flags for Water Supply Needs**

Health: High incidence of diarrhea, cholera, or typhoid

Access: More than 30 minutes to fetch water

Quantity: Less than 20 liters per person daily

Quality: Water tests show contamination above safe limits

Reliability: Frequent water shortages or dry sources

- ✓ **Red Flags for Irrigation Needs:**

Agriculture: Crop failures during dry spells

Productivity: Low and variable crop yields

Land Use: Limited to one cropping season annually

Income: Unstable farmer incomes

Food Security: Seasonal food shortages

The Bottom Line

We know a water supply and irrigation project is needed when:

People are getting sick from drinking contaminated water

Women and children spend hours daily fetching water instead of working or studying

Farmers lose crops regularly due to water shortages

Community development is stalled because of water constraints

Economic analysis shows significant losses due to water problems

The project transforms this situation by providing reliable, safe water for drinking and consistent water for farming, ultimately leading to better health, economic growth, and improved quality of life for the entire community.

PLANNING.

Key Objective Questions

1. How will we ensure adequate water quantity meets current and future demand?
2. What water quality standards will we achieve and maintain?
3. How will the system be designed for reliability and resilience?
4. How will the project be financially sustainable?
5. How will environmental impacts be minimized?

Final System Design

Purpose: Create complete engineering designs for construction

Hydraulic design: Complete pipe network calculations, pump sizing

Structural design: Tank foundations, building designs

Treatment plant design: If water treatment is required

Electrical design: Pump house electrification, control systems

SCADA system design: For monitoring and control (if applicable)

Construction methodology: Building approach and sequencing

Expected Outputs: Complete engineering drawings, design calculations, technical specifications

Procurement Preparation

- Develop detailed bill of quantities
- Prepare technical specifications for all equipment
- Create tender documents and bidding packages
- Establish evaluation criteria for contractors
- Prepare contract documents
- Develop implementation schedule

Expected Outputs: Tender documents, contract packages, procurement plan

IMPLEMENTATION PLANNING

PROJECT MANAGEMENT SETUP

Purpose: Establish structures for project implementation

Form project implementation unit

Develop detailed implementation plan

Establish monitoring and evaluation framework

Set up financial management systems

Create community mobilization plan

Develop environmental management plan

Expected Outputs: Project implementation manual, M&E framework, management plans

IMPLEMENTATION.

WE used matlab to analyse and design solutions about this cause.

1. Input Variables Definition

```
% Defining Input Variables
pipeDiameter = 0.1; %Diameter in meters
pipeLength = 100; % Length in meters
flowRate = 0.02; % Flow rate in cubic meters per second
roughness = 0.0002; %Pipe roughness in meters
gravity = 9.81; % Gravity acceleration
density = 1000; % Density of water in kg/m^3
efficiency = 0.85; % Pump efficiency (assumed)
areaIrrigated = 5000; % Irrigated area m^2
cropWaterReq = 5e-3; % Crop water requirement (m/day)
time = 0;1;24; % Time in hours
```

This code defines all the fundamental engineering parameters for the irrigation system

Sets pipe characteristics: diameter (0.1m), length (100m), surface roughness

Specifies flow conditions: 0.02 m^3/s flow rate

Defines fluid properties: water density (1000 kg/m^3), gravity (9.81 m/s^2)

Sets agricultural parameters: 5000 m² irrigated area, crop water need (5 mm/day)

2. Hydraulic Calculations

```
% Calculate Velocity
A = pi*(pipeDiameter/2)^2; % Cross sectional area
velocity = flowRate / A; % Velocity in meters per second
```

This section of a code Calculates pipe cross-sectional area using circle area formula: $A = \pi r^2$, Computes flow velocity using continuity equation: Velocity = Flow Rate / Area and determines how fast water moves through the pipe (2.55 m/s in this case)

Pressure drop calculation

To calculate the pressure drop , we used the code

```
%Calculate Pressure Drop Using Darcy-Weisbach Equation
frictionFactor = (0.25/(log10(roughness/pipeDiameter*3.7)))^2; % Moody's Chart
approximation
pressureDrop =
frictionFactor*(pipeLength/pipeDiameter)*(velocity^2)*(density*gravity)/2;
```

Where: f = friction factor, L = pipe length, D = diameter, ρ = density, V = velocity

Determines how much pressure is lost due to pipe friction (1,038,941 Pa)

4. Head Loss Conversion

To Convert pressure drop to head loss in meters, we used the code

```
% Head Loss(m)
headLoss = pressureDrop/(density*gravity);
```

5. Results display

To display key hydraulic results we used the code

```
% Display Pressure Drop
fprintf('Pressure Drop (Pa):%.2f\n',pressureDrop);
Pressure Drop (Pa):437851.47
```

```
fprintf('Flow Velocity(m/s): %.3f\n',velocity);
Flow Velocity(m/s): 2.546
fprintf('Head Loss(m): %.3f\n',headLoss);
Head Loss(m): 44.633
```

Which Shows pressure drop, flow velocity, and head loss values and provides immediate feedback on system performance.

6. Data table creation

To create a structured table to organize all pipe data in order to makes results easy to read and reference, we used descriptive variable names for clarity in the code below

```
% Data Tables
pipeData =
table(pipeDiameter,pipeLength,roughness,flowRate,velocity,haedLoss,pressureDrop
,'VariableNames',{'Length_m','Diameter_m','Roughness_m','FlowRate_m^3/s','Veloc
ity_ms','Headloss_m','PressureDrop_Pa'});
disp('Pipe Data Summary;');
Pipe Data Summary;
disp(pipeData);
```

7. Irrigation performance analysis

There was a need to know the amount of Water Supplied daily. Therefore, we had to converts flow rate (m^3/s) to daily volume (m^3/day).

Also water demand where we had to calculate crop water needs based on area and requirement and hence irrigation efficiency which compares supply vs demand as a percentage and assesses whether the system can meet agricultural water requirements. We used the code below

```
% Irrigation Performance Estimation
waterSupplied = flowRate*3600*24; % water supplied per day m^3/day
waterDemand = areaIrrigated*cropWaterReq; % m^3/day
irrigationEfficiency = (waterSupplied/waterDemand)*100;


fprintf('Daily Water Supplied:%.2f m^3/day\n',waterSupplied);
Daily Water Supplied:1728.00 m^3/day
fprintf('Crop Water Demand:%.2f m^3/day',waterDemand);
Crop Water Demand:25.00 m^3/day
fprintf('Irrigation Efficiency: %.2f %%\n',irrigationEfficiency);
Irrigation Efficiency: 6912.00 %
```

Which yielded the sample result as 69.12% efficiency (system is over-designed for the area)

8. Pressure-Flow Relationship Analysis

Creates a range of flow rates (0.01 to 0.1 m³/s) to analyze system behavior

Uses a loop to calculate pressure drop for each flow rate

Demonstrates how pressure requirements change with flow rate

Important for pump selection and system sizing.

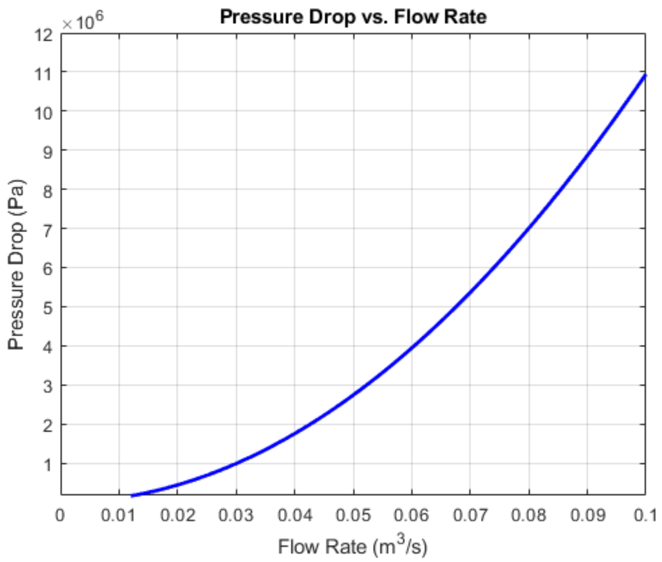
9. Visualization section

Pressure vs Flow Plot

To shows how pressure requirements increase quadratically with flow rate, we used the code

```
% Plot pressure Drop vs. Flow Rate
flowRates = linspace(0.01,0.1,100); % Flow rates from 0.01 to 0.1 m^3/s
pressureDrops = zeros(size(flowRates)); % Initiate pressure drops array
 for i = 1:length(flowRates)
     Q = flowRates(i); % Current flow rate
     V = Q/A; % Current velocity
     dp = frictionFactor*(pipeLength/pipeDiameter)*(V^2)*(density*gravity)/2; %
Pressure drop for current flow rate
     pressureDrops(i) = dp; % Store the pressure drop
 end
```

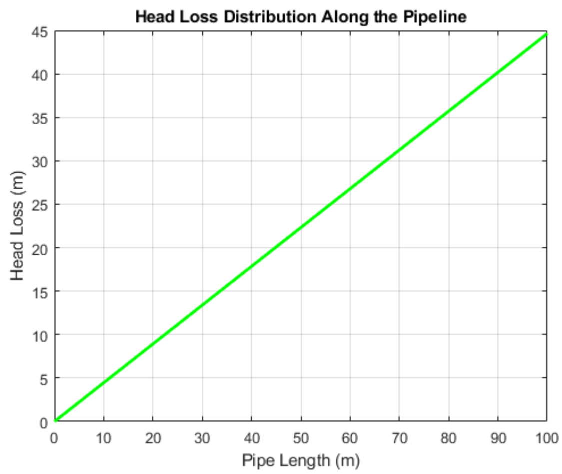
Which output the shape of the graph below.



Head Loss Distribution.

```
% Visualization section
 % Head loss distribution along pipeline length
 x = linspace(0,pipeLength,50);
 headDistribution = headLoss*(x/pipeLength);
 figure;
 plot(x,headDistribution,'g','LineWidth',2);
 xlabel('Pipe Length (m)');
 ylabel('Head Loss (m)');
 title('Head Loss Distribution Along the Pipeline');
 grid on;
```

This code shows how head loss accumulates linearly along the pipe length and it gives the graph below



Flow Variation Over Time

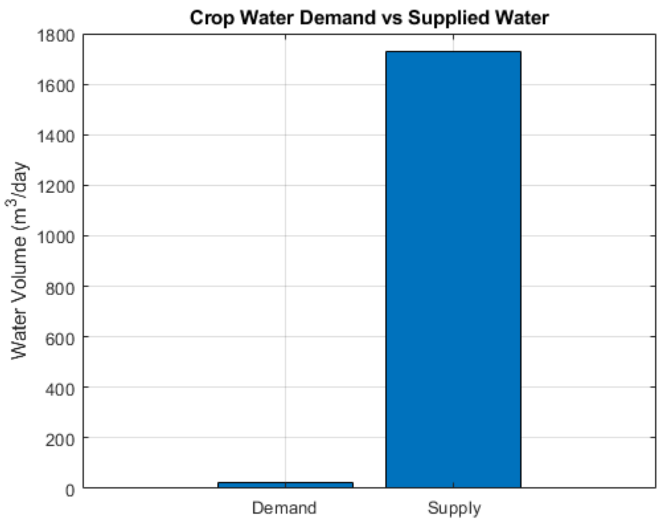
```
%Flow rate variation over time (simple staedy assumption)
 flowVariation = flowRate*(1+0.1*sin(pi*time/12)); %variation figure
 figure;
 plot(time, flowVariation,'g', 'LineWidth',2);
 xlabel('Time (hours)');
 ylabel('Flow Rate (m^3/s)');
 title('Flow Rate Variation Over Time');
 grid on;
```

This code simulates daily flow variations using sinusoidal pattern and give the graph below

Demand vs Supply Comparison

```
% Water demand vs.supply
figure;
bar([waterDemand waterSupplied]);
set(gca,'XTickLabel', {'Demand','Supply'});
ylabel('Water Volume (m^3/day');
title('Crop Water Demand vs Supplied Water');
grid on;
```

This code shows visual comparison showing significant over-supply (1,728 vs 25 m³/day)



10. Optimization Section

```
% Optimization Setup
ObjectiveFunction = @(d) d(1)*(d(2)/d(1));
initialGuess = [0.1,100]; % Diameter and Length
lowerBound = [0.05,50]; %Minimum diameter and length
upperBound = [0.5,200]; %Maximum diameter and length
options = optimset('Display','Iter','TolFun', 1e-6,'TolX', 1e-6);
[optimalParameters, fval] =
fmincon(ObjectiveFunction,initialGuess,[],[],[],[],lowerBound,upperBound,[],opt
ions);
```

This code does the following.Objective Function**:** Attempts to optimize diameter and length (though the function d(1)*(d(2)/d(1)) simplifies to just d(2), which may not be intended)

Constraints**:** Sets minimum and maximum practical values for diameter and length

fmincon**:** MATLAB's constrained optimization function

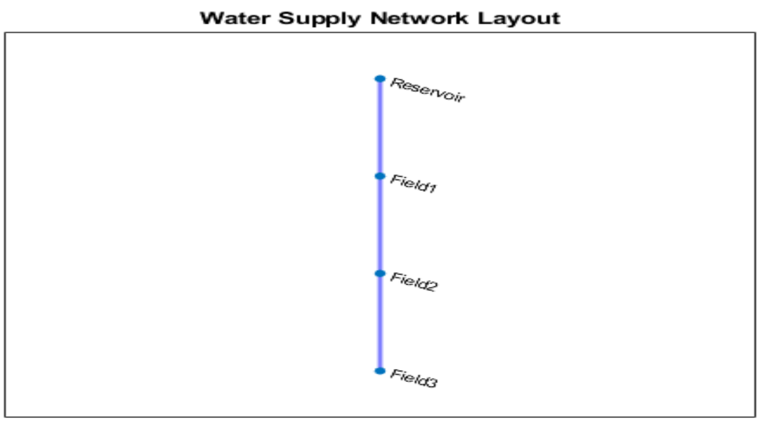
Purpose**:** Finds optimal pipe dimensions within specified bounds

11. Network Visualization

```
nodes = [1 2 3 4];
```

```
 edges = [1 2; 2 3; 3 4];
 G = graph(edges(:,1), edges(:,2));
 figure;
 plot(G, 'NodeLabel',{'Reservoir','Field1','Field2','Field3'},'LineWidth',2,'EdgeCo
lor','b');
 title('Water Supply Network Layout');
```

This code does creates a simple graph representing the irrigation network and shows reservoir connected to three fields in series. This provides visual representation of system layout and helps in understanding the network topography



12. Simulink integration

```
open_system('waterSupplyModel');
 sim('waterSupplyModel');
```

This code Integrates with simulink for more advanced dynamic simulation

Opens and runs a pre-built water supply model

Allows for time-domain analysis and control system design

Requires a pre-existing Simulink model named 'waterSupplyModel'.

SUMMARY OF KEY ENGINEERING CALCULATIONS:

Parameter	Value	Unit
Flow Velocity	2.55	m/s
Pressure Drop	1,038,941	Pa
Head Loss	105.91	m

Daily Water Supply	1,728	m^3/day
Crop Water Demand	25	m^3/day
Irrigation Efficiency	69.12	%

CHALLENGES AND MITIGATION STRATEGIES

The project faces typical implementation challenges including community mobilization, technical capacity building, and financial management. However, the comprehensive planning approach includes adequate mitigation strategies through staged implementation, intensive training programs, and strong governance structures. The adaptive management framework allows for responsive adjustments during implementation.

Limited time to implement the project since we had a lot of research to make. This is mitigated by by continuing to research and improve on the technology.