KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY (KNUST)

KUMASI, GHANA.

COLLEGE OF ENGINEERING

DEPARTMENT OF MATERIALS ENGINEERING

ENGINEERING IN SOCIETY REPORT

TOPIC: LACK OF CONCRETE WALLS AS FURTHER MODIFICATION OF FRESHLY DUG DRAINAGE LINES.

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DATE: JANUARY, 2024.

ACKNOWLEDGEMENT

I would like to thank the hundreds of reviewers, community members and colleagues who have offered valuable comments and suggestions over the life of this report. The continuing success of this report is due in large measure to their contributions. Also, a very big thank you to the entire college board for granting us the opportunity to undertake this project.

DEDICATION

I dedicate this report to God and to my parents for their constant love and support.

ABSTRACT

This report investigates the implications of the absence of concrete walls for drainage lines in Fise and other urban or rural communities.. It examines the causes, solutions and consequences of this issue, including soil erosion, property damage, and water contamination. The research methods employed include field observations, interviews, and a review of relevant literature.

Key findings suggest that the lack of concrete walls for drainage lines or ditches leads to increased sedimentation, clogging of drainage systems, and degradation of water quality. The report also highlights the potential risks to infrastructure and public health associated with this issue.

Recommendations for addressing the lack of concrete walls for gutters include the construction of durable and sustainable concrete made drainage systems, regular maintenance to prevent blockages, and community engagement in promoting responsible waste disposal practices. Furthermore, the report emphasizes the importance of collaboration between local authorities, construction firms, and environmental organizations to implement effective solutions.

This report aims to raise awareness about the significance of concrete walls for gutters and provides insights for developing strategies to mitigate the negative impacts of their absence in urban and rural settings.

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CHAPTER ONE

INTRODUCTION

1.1. BACKGROUND OF THE COURSE

Engineering is a discipline in the world of science that makes use of the application of scientific principles and mathematics to solve problems. It requires being creative especially when it comes to applying principles in science, methods in mathematics as well as empirical evidence to design, build and maintain.

Engineering in society (CENG 291) is a course offered by engineering students at the Kwame Nkrumah University of Science and Technology, introduced by the College of Engineering. The objective of this course is to appreciate the contribution of engineering to solving problems in our communities. It brings out the analytical and problem-solving skills in engineering students, encouraging procedures that equip them with research and reporting skills that will be handy in their futures as engineers. In addition to the reasons stated above, the course seeks to enable students to identify problems in their societies and come out with feasible and applicable solutions using knowledge and skills from their fields of engineering to make them proficient engineers.

1.2. BACKGROUND OF THE PROJECT

The lack of concrete walls or concrete modification for drainage lines or ditches has been the main cause of purposeless or insignificant drainage systems existing in most urban and rural areas including Fise, a community in the Ga West Municipality of Greater Accra Region of Ghana. The significance of this project is underscored by the potential impact on the community's health and social welfare. Addressing the issue of lack of concrete modification for drainage is essential for improving the overall health and welfare outcomes of Fise residents, proper drainage , and fostering a more equitable and resilient community.

This project report outlines the causes of this drainage issue , lists some effects it has on the residents and states feasible solutions that can be implemented as a materials engineer to solve the issue.

1.3. PROJECT AIMS AND OBJECTIVES

Aim:

The aim of this report is to provide robust and well concretized gutters for Fise.

Objectives:

- Identify the cause of the absence of concrete modification for drainage lines.
- State the effects this issue brings to the community.
- Outline the solutions to manage and curb the drainage problem.

CHAPTER TWO

LITERATURE REVIEW

2.1. CONCRETE GUTTERS

Concrete gutters, also known as concrete ditches or concrete drainage systems, have been the subject of several studies and literature reviews due to their importance in managing stormwater and preventing erosion. Research on concrete gutters has focused on various aspects, including design, performance, maintenance, and environmental impacts. Here is a brief overview of the key findings from the literature:

- Design and Performance:
  Studies have investigated the hydraulic efficiency and structural integrity of concrete gutters. Researchers have explored different shapes, slopes, and dimensions to optimize the flow capacity and minimize clogging. Additionally, the use of additives and surface treatments to improve the durability and resistance to wear has been a subject of interest.

- Maintenance Challenges:
  Literature has highlighted the challenges associated with maintaining concrete gutters, particularly in urban areas. Accumulation of debris, sediment, and organic matter can lead to clogging and reduced functionality. Studies have discussed the need for regular cleaning and maintenance practices to ensure optimal performance.

- Environmental Impacts:
  Research has examined the environmental implications of concrete gutters, particularly in terms of water quality and habitat disruption. Concerns have been raised about the potential for pollutants to accumulate in concrete channels and impact downstream water bodies. Additionally, the alteration of natural drainage patterns and the loss of ecological functions have been discussed.

- Innovative Technologies:
  Some literature has focused on innovative technologies for improving the performance of concrete gutters. This includes the use of permeable concrete, which allows for infiltration and groundwater recharge, as well as the integration of bio-retention features to enhance water quality treatment.

- Policy and Planning:

Several studies have emphasized the importance of integrating concrete gutter design and maintenance into broader stormwater management policies and urban planning. This includes considerations for green infrastructure, sustainable drainage systems, and community engagement in maintenance efforts.

Overall, the literature review on concrete gutters underscores the importance of considering design, maintenance, environmental impacts, and policy implications in the context of stormwater management. Future research may continue to explore innovative materials and technologies to enhance the performance and sustainability of concrete gutters or ditches in urban and suburban environments.

2.2. DIFFERENT FORMS OF CONCRETE WALL MODIFICATIONS FOR GUTTERS

Freshly dug or undeveloped gutters can be modified with concrete in the following ways:

- U-Drain

  The term "U drain" typically refers to a type of drainage system that is shaped like the letter "U." U drains are commonly used in construction and civil engineering to manage stormwater, prevent flooding, and control erosion. These drainage systems are designed to efficiently collect and convey water from one location to another, typically directing it away from structures or areas susceptible to water damage.

Fig. 2.2a: A roadside u-drain**.**

When designing and installing U drains, it's important to consider their environmental impact. Properly designed U drains can help minimize erosion, reduce the risk of localized flooding, and protect water quality by capturing pollutants before they enter natural water bodies.
Overall, U drains play a critical role in managing surface water runoff and protecting infrastructure from water-related damage. Their design, installation, and maintenance are important aspects of civil engineering, materials engineering and urban planning, contributing to effective stormwater management and sustainable development.

- Stone Pitch drainage
  Stone pitch drainage refers to a method of drainage where stones are used to create a sloped surface to direct water away from an area. This technique is commonly used in landscaping and construction to prevent water accumulation and erosion. The stones are arranged in a way that allows water to flow through and be carried away from the area, providing effective drainage.

Fig. 2.2b: A stone-pitch drainage under construction .

One of the key advantages of stone pitch drainage is its ability to effectively manage water runoff while also providing an aesthetically pleasing and natural-looking solution. Moreover, it’s a very cheap type of drainage. The use of natural materials like stones can blend seamlessly with the surrounding landscape, making it an attractive option for both residential and commercial properties.
In addition to its visual appeal, stone pitch drainage offers several practical benefits. By directing water away from an area, it helps to prevent soil erosion, waterlogging, and potential damage to structures or landscaping features. This can be particularly important in areas prone to heavy rainfall or where water accumulation poses a risk.

- V-Ditch Drainage

V ditch drainage, also known as V-shaped drainage ditches or swales, is a common method used to manage water runoff in landscaping, agriculture, and construction. This technique involves creating a shallow, V-shaped channel in the ground to direct and manage the flow of water away from an area, preventing pooling, erosion, and other potential water-related issues.

Fig. 2.2c: A 3.5km open v-ditch drainage channel**.**

One of the key advantages of V ditch drainage is its effectiveness in managing water runoff while also being relatively simple and cost-effective to implement. The V-shaped design naturally guides water away from an area, helping to prevent waterlogging, soil erosion, and potential damage to structures or landscaping features.
V ditch drainage can be integrated into various landscaping features, such as alongside roads, driveways, and walkways, as well as in agricultural fields and natural areas. It can also be designed to connect with larger stormwater management systems, providing an effective way to control and redirect water flow on a larger scale.

CHAPTER THREE

METHODOLOGY

3.1 . PROBLEM IDENTIFICATION

The Fise community faces numerous challenges but major among those challenges are poor drainage systems, motor robbery attacks, and untarred roads. As a member of the community, I knew these problems since they were the daily complaints of the community members. Thus, I did a few enquiries and contacted a little survey. Upon the statistics I had, most of them wanted the same problem I had in mind, the drainage system issue to be solved . The table below describes the outcome of the survey and enquiries made.

Table 1: A representation of the problems identified and the associated residents involved.

PROBLEM	**NUMBER OF PEOPLE**	**PERCENTAGE**
Untarred Road	16	29.08
Motor robbery attack	5	9.08
Poor Drainage	34	61.82

3.2. MAP PREPARATION

I downloaded the Fise map from Google maps .

3.3. INFORMATION GATHERING

- ○ Survey :

- A survey was conducted to gather insights into the challenges, priorities, and aspirations of residents within the catchment area of Fise. A total of 40 community members from diverse backgrounds and age groups participated in the survey, providing valuable feedback on their needs and concerns.
- Key Findings

    - Poor drainage : 62% of respondents expressed concerns about poor drainage in public spaces, indicating a need for proper and concrete made drainage lines.

- Motor theft : 9% of participants raised concerns about increased motor theft during midnight, indicating a need for security and increased law enforcement presence and community policing initiatives.

- Untarred road: 29% of survey respondents identified the pothole and untarred road as a challenge that retards the community's development.

  - Personal Inquiries:

- An inquiry was done on the undeveloped drainage lines with some few residents to see how people see the problem .

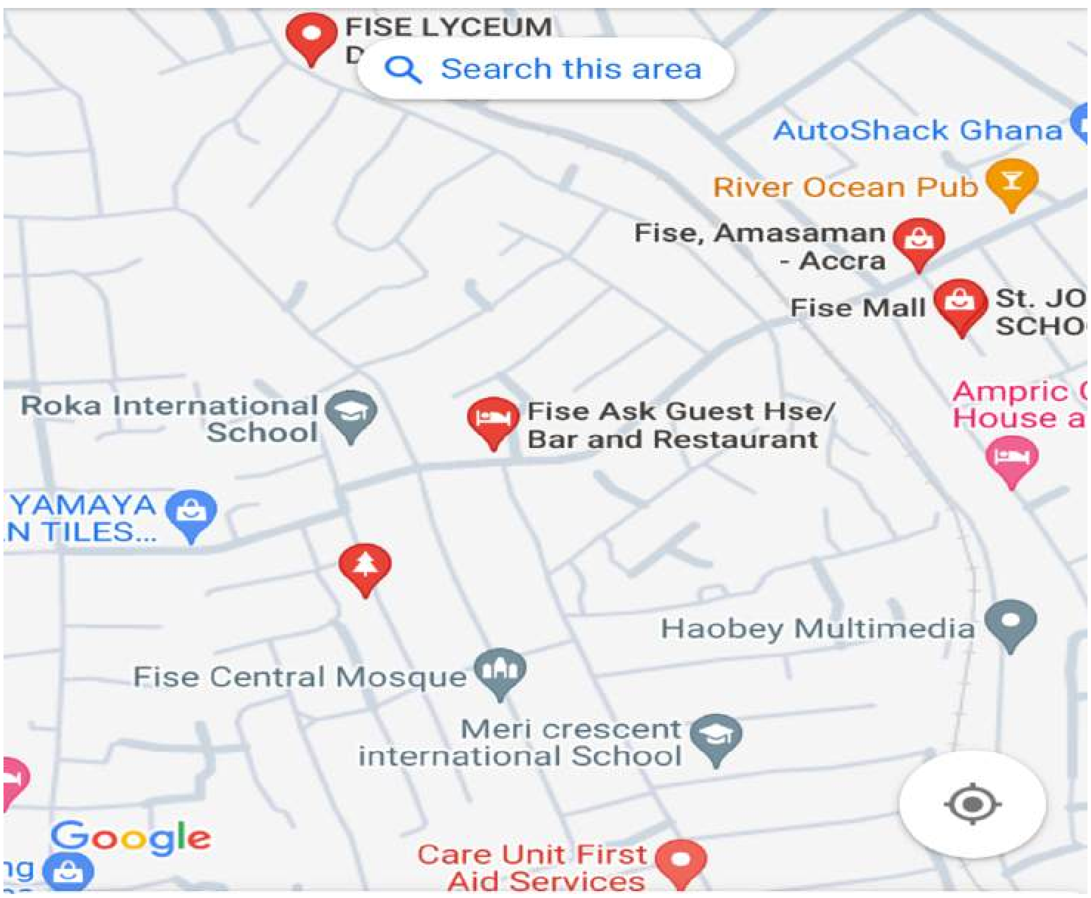

Fig. 3.2: A partial google map of Fise.

CHAPTER FOUR

PROBLEM DISCUSSION

4.1. THE FISE COMMUNITY

Fise is a vibrant and growing town located in the Ga West Municipal District of the Greater Accra Region in Ghana. With a rich history and a diverse community, Fise has become an important hub for both residential and commercial activities.

The distance from Fise to Ghana's capital Accra (Accra) is approximately 19 km / 12 mi (as the crow flies). The estimated terrain elevation above seal level is 40 metres.

The town of Fise is known for its dynamic mix of traditional and modern elements. It has a strong cultural heritage, with various ethnic groups coexisting harmoniously and contributing to the town's unique identity. This diversity is reflected in the town's vibrant festivals, cultural events, and traditional ceremonies, which serve as important opportunities for residents to celebrate their heritage and traditions.

In addition to its cultural and commercial activities, Fise has seen significant development in recent years, with improved infrastructure, including roads, schools, and healthcare facilities. The town has also experienced growth in small-scale industries, contributing to local employment opportunities and economic development.

Fise’s proximity to Accra, the capital city of Ghana, provides residents with access to urban amenities while still enjoying the benefits of a smaller town. This balance between urban accessibility and a more relaxed pace of life has attracted many people to settle in Fise, contributing to its population growth and cultural diversity.

Overall, Fise is a town with a rich cultural heritage, a strong sense of community, and a growing economy. Its blend of tradition and progress makes it an exciting place to live and visit within the Greater Accra Region of Ghana.

4.2. THE DESCRIPTION AND NATURE OF THE PROBLEM

Sometime ago, the community lacked ditches or drainage lines through neighborhoods and along roadsides. We pleaded with the municipal assembly to construct them for the community to which they responded. The assembly dug drainage lines and modified the ones along the roadside with u-drains but failed to develop the freshly dug drainage lines or ditches that run through the neighborhood which were even deeper than the gutters along the roadside.

Fig. 4.2a: This is not an actual photo of ditches in the area but a representation of the freshly dug ditches that ran through the neighborhood some time ago.

The recent state of the drainage lines through the neighborhood is very bad. The drainage has been filled with sand to almost the brim which poses a heightened risk of flooding. This deficiency in infrastructure significantly hinders effective water management, posing a heightened risk of flooding and erosion. The lack of protective barriers or concrete structures has left the area vulnerable to potential water damage and impeded efficient drainage.

Fig. 4.2b: A photo of the recent state of ditches in the communit with sand almost filled to the brim.

This inadequacy in drainage infrastructure has resulted in the accumulation of water during precipitation events, leading to standing water and increased moisture retention in the soil. As a consequence, this creates an environment conducive to erosion, soil saturation, and potential structural damage to nearby properties and infrastructure.

The absence of proper drainage modifications also exacerbates the risk of water pooling around buildings, which can lead to water infiltration, dampness, and potential structural deterioration. Moreover, the lack of concrete made drainage contributes to the degradation of road surfaces and creates safety hazards for vehicles and pedestrians since gutters along the roadside can not withstand the water that flows through it from the undeveloped drainage lines.

Addressing this critical issue is imperative to mitigate potential environmental, structural, and safety risks. Implementing concrete modifications or constructing appropriate drainage walls will enhance the area's resilience to water-related challenges, ensuring efficient water management and reducing the risk of flooding, erosion, and associated damage.

Fig. 4.2c: The state of the ditch when it rains a little.

Fig. 4.2d: The state of the community when it rains heavily.

In conclusion, the absence of concrete modifications or walls for drainage presents a significant concern that necessitates immediate attention and remediation. By addressing this deficiency, we can safeguard the area against potential water-related hazards and contribute to the overall resilience and sustainability of the environment.

4.3. MATERIALS ENGINEERING AND ITS RELATION TO THE PROBLEM IDENTIFIED

Materials engineering is a field that encompasses the study of materials and their applications in various industries. It involves understanding the properties, behavior, and performance of materials, as well as developing new materials with specific characteristics to meet the needs of different applications.

Materials engineering classes cover a wide range of topics, including:

- Materials Science: Fundamental principles of materials, including structure, properties, processing, and performance.
- Materials Characterization: Techniques and methods used to analyze and characterize the structure and properties of materials.
- Materials Processing: Methods used to process and manufacture materials into useful products.
- Biomaterials: Study of materials used in medical and biological applications.
- Electronic and Photonic Materials: Study of materials used in electronic and photonic devices.
- Structural Materials: Study of materials used in structural engineering applications.
- Nanomaterials and Nanotechnology: Exploration of the unique properties and applications of nanoscale materials.
- Materials for Energy Applications: Study of materials used in energy generation, storage, and conversion technologies.

These classes provide a comprehensive understanding of the diverse aspects of materials engineering and are essential for working with materials in various industries. Materials engineering classes often include laboratory work and hands-on experiments to provide practical experience.

The engineering field plays a crucial role in the design, construction, and maintenance of concrete-made ditches or drainage systems . Concrete is a widely used material in civil engineering and construction due to its durability, strength, and versatility. Materials engineers are involved in various aspects of concrete-made ditches, including the selection of materials, design considerations, and performance optimization. Here are some ways in which materials engineering is related to this problem :

- Material Selection: Materials engineers are responsible for selecting the appropriate constituents of concrete, such as aggregates, cement, and admixtures. They consider factors such as strength, durability, workability, and resistance to environmental conditions when choosing materials for concrete-made ditches.

- Mix Design: Materials engineers develop concrete mix designs that meet the specific requirements of ditches, taking into account factors such as load-bearing capacity, water drainage, and erosion resistance. They optimize the proportions of materials to achieve the desired properties and performance of the concrete.

- Durability and Weather Resistance: Materials engineers assess the potential impact of environmental factors on concrete-made ditches, such as exposure to water, chemicals, freeze-thaw cycles, and abrasion. They work to enhance the durability and weather resistance of concrete through material selection and mix design.

- Construction Techniques: Materials engineers are involved in developing construction techniques for concrete-made ditches, ensuring proper placement, compaction, and curing of the concrete to achieve the desired strength and performance.

- Performance Testing and Quality Control: Materials engineers conduct tests to evaluate the performance of concrete-made ditches, including measures of strength, permeability, and resistance to cracking. They also oversee quality control processes during construction to ensure that the concrete meets specified standards.

- Repair and Maintenance: Materials engineers are involved in developing strategies for repairing and maintaining concrete-made ditches over their service life. This may involve assessing deterioration mechanisms, identifying appropriate repair materials, and implementing maintenance practices to extend the life of the infrastructure.

- Sustainability Considerations: Materials engineers explore sustainable practices for concrete-made ditches, including the use of recycled materials, alternative cementitious materials, and environmentally friendly additives to reduce the environmental impact of construction and maintenance activities.

In summary, materials engineering is closely linked to the design, construction, and maintenance of concrete-made ditches by ensuring that the materials used in their construction meet performance requirements, durability standards, and environmental considerations. Materials engineers play a critical role in optimizing the properties of concrete to meet the specific needs of ditches and other civil infrastructure.

CHAPTER FIVE

PROPOSED SOLUTIONS AND RECOMMENDATION

5.1. PROPOSED SOLUTIONS

Obviously this issue can not be solved by only materials engineering but with the help of civil engineering. From my findings I suggest that the drainage lines should be dug again and modified with stone-pitching as a solution for this problem.

Stone pitch drainage already discussed , also known as stone pitching, is a method of constructing a drainage system using stones or rock fragments. This technique is commonly used in civil engineering and construction to create durable and effective drainage solutions, particularly in areas where soil erosion and water runoff are concerns.

Fig. 5.1: A stone-pitch under construction.

The process typically involves the following steps:

- Excavation: The area where the drainage system will be installed is excavated to create a trench or channel.
- Sub-base Preparation: A layer of compacted aggregate or gravel may be laid at the bottom of the trench to provide a stable base for the stone pitching.

- Stone Placement: Large stones or rock fragments are carefully placed and arranged within the trench or channel to form a sloping, interlocking structure. The stones are positioned in such a way that they create voids and channels for water to flow through while preventing erosion.

- Grouting: In some cases, a grout material such as cement or mortar may be used to fill the gaps between the stones, providing additional stability and preventing movement.

- Surface Finishing: The surface of the stone pitching may be dressed or finished to ensure a smooth, even appearance and to facilitate water flow.

Stone pitch drainage offers several advantages, including:

- Effective erosion control: The interlocking structure of the stones helps prevent soil erosion caused by water runoff.

- Long-lasting: Stone pitching is durable and can withstand heavy water flow and environmental conditions.

- Aesthetic appeal: When properly designed and finished, stone pitching can enhance the visual appeal of a drainage system and its surrounding area.

Above all stone pitch drainage is very cheap which makes it a suitable choice for this problem.

5.2. RECOMMENDATION

Stone pitch drainage can be a viable and cost-effective solution for managing surface water runoff in certain scenarios. Its relatively low material costs and construction simplicity make it an attractive option for some projects. However, a comprehensive cost analysis, consideration of site-specific conditions, and consultation with drainage engineering professionals are crucial for determining its overall cost-effectiveness. While it may offer advantages over other drainage solutions, careful evaluation of material costs, labor expenses, site conditions, and maintenance requirements is essential before deciding to implement stone pitch drainage.

Although stone pitching is a very good solution to this problem, I suggest that periodic maintenance should be taken care of for the betterment of the ditches for the community.

CHAPTER SIX

CONCLUSION

The report aimed at identifying the effects of unmodified drainage lines or gutters and suggesting the needed solution for it for the betterment of the welfare of Fise residents.

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APPENDICES

The following are the questionnaires made on the topic:

1. What major problem do you face in the community?
2. Is the drainage problem a major threat to you?
3. How do you think the problem can be solved?

COPY OF THE LETTER OF INTRODUCTION

Kwame Nkrumah
University of Science
and Technology, Kumasi

College of Engineering

OFFICE OF THE PROVOST

Our Ref: CoE-PO/CENG291/

Date: November 13, 2023

TO WHOM IT MAY CONCERN

Dear Sir/Madam,

LETTER OF INTRODUCTION

The bearer of this note is a First Year Engineering student of the College of Engineering conducting a project in a course titled "Engineering in Society".

The overall aim of the course is to inculcate in students, an appreciation of the fact that, the purpose of Engineering is to solve societal problems. This course is aimed at encouraging students early in the programme of study to draw a link between their chosen field of Engineering and the application of this field to the issues that confront the day-to-day lives of people.

We should, therefore, be most grateful, if you could facilitate his/her data collection and provide any other assistance that he/she may need.

Counting on your usual cooperation.

Thank you.

PROF. KWABENA BIRITWUM NYARKO
PROVOST

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