FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF WATER RESOURCES ENGINEERING

FINAL YEAR PROJECT REPORT

DESIGN AND CONSTRUCTION OF A VENTURI-BASED DRAINAGE CLEANING MACHINE

By

AKELLO SHARON

BU/UP/2019/1837

A final year project report submitted to the Faculty of Engineering and Technology as a partial fulfilment of the requirement for the award of a Bachelor's of Science in Water Resources Engineering at Busitema University

MAY 2023

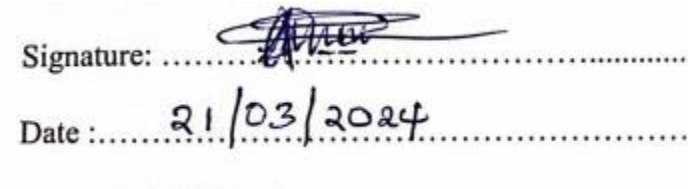
ABSTRACT

This paper proposes to design and construct a venturi-based drainage cleaning machine. Drainage systems are essential for ensuring efficient wastewater management. Over time, these systems can become clogged with debris, causing blockages that result in a range of problems, such as flooding and sewage backup.

The proposed machine utilizes the Venturi effect to create a vacuum that draws debris from the drainage system. The system comprises a series of nozzles that direct high-pressure water jets to dislodge the debris, while the vacuum created by the Venturi effect sucks it out, making it suitable for use in both residential and commercial settings. The construction of the machine involves sourcing and assembling the necessary components, such as the pump, motor, and nozzles. Once assembled, the machine was testing for its effectiveness in cleaning various types of drainage systems, but it failed to produce a suction force that sucks out the sediment and the water flushed for disintegration. This can be due to many different factors like pressure differences between the inlet and throat diameter was not created enough, there could also be inadequacies in fluid properties like temperature and viscosity of the fluid. The main objective of this machine was to create a suction force and also the disintegration of the sediment.

DECLARATION

I declare to the best of my knowledge that this research proposal report is as a result of our own effort and knowledge. I hereby affirm that it has never been submitted for any award of a degree or any academic qualification in any academic institution or university.

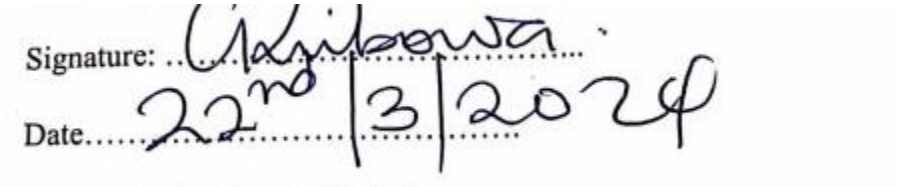


AKELLO SHARON

akellosharon398@gmail.com

APPROVAL

I hereby certify that this final year proposal report as original and individual work of **AKELLO SHARON, BU/UP/2019/1837.** It has been done under my supervision and it is ready for submission to the board of examiners of Busitema University.



MR. KIMBOWA GEORGE

Main Supervisor

ACKNOWLEDGEMENT

With great honor and appreciation, I am highly indebted to the Department of Water Resources Engineering and all my lecturers for professional guidance and mentorship they have given me.

Great thanks go to my supervisor, Mr. Kimbowa George for the tireless efforts rendered to me during the preparation of this piece of work, may the good Lord bless u so much.

Lastly, I would like to thank Water Resources (WAR) 4 of Class 2019 for all the encouragement during the preparation of this piece.

DEDICATION

I dedicate this work to my family, friends and supervisor for guiding me through this project proposal. May the Almighty God bless and reward them abundantly.

Table of Contents

LIST OF FIGURES

LIST OF TABLES

CHAPTER ONE

1.0 INTRODUCTION.

This chapter includes the background of the study, a statement of the problem, the purpose of the study, the objectives of the study, the scope of the study which includes the conceptual scope, geographical scope, time scope, and finally the justification of the study.

1.1 Background of the study

Sedimentation is a natural process that has been occurring on Earth for millions of years. The deposition of sediments has played a crucial role in shaping the Earth's landscape and creating geological formations. Sedimentation is the process by which particles settle out of a fluid due to gravity(Background, n.d.).

Provision of sufficient drainage is an important factor in the location and geometric design of transport infrastructure. Drainage facilities on any highway or street should adequately provide for the flow of water away from the surface of the pavement to properly designed channels (Gerges & Ph, n.d.).

Drainage must handle water of different origins: domestic waste water (or sullage), rainwater (or storm water, runoff), floodwater, and water from natural sources (Disease, n.d.).

Subsurface drainage systems are hydraulic structures that are used for directing the flow of water usually from one side of a road, railroad, or similar obstruction, to the other side. These types of hydraulic structures are used to form a bridge-like structure to carry traffic, manage and route runoff along, under, and away from the roadway. Occasionally, drainage systems are utilized for the management of excessive runoff (Najafzadeh, 2016).

Over time, sedimentation in drainage systems has become a challenge, which occurs through the natural process of erosion and transportation of sediment by water or wind. When water flows in a channel, it has the power to pick up and carry sediment particles. The speed and direction of water flow determine the amount of sediment to be transported. When the water flow slows down, the sediment particles lose momentum and settle out of the water. Sediment deposits are most detrimental as they often seriously reduce the culvert’s capacity to convey flows. Sediment

References

Background, G. (n.d.). *Chapter 8 Erosion and Sedimentation in Drainage*. 333–367.

Chaurette, J. (2009). *Head is the one term that most scares people about pumps*. 1–8.

Classification of Pumps. (2017). 1–8.

Council, M. S. D. (2018). *Good Practice for Watercourse Maintenance*. *February*, 1–15. http://www.midsussex.gov.uk/my-street-my-community/flooding-and-drainage/riparian-owners-faq/good-practice-for-watercourse-maintenance/

Disease, P. (n.d.). *Chapter 7 Drainage*. *15*, 90–98.

Drainage, R., & Alternatives, D. (2003). *Road Drainage, Design Alternatives and Maintenance*. *2003*(November), 3350.

Edition, Third;Yunus A.Cengel, J. M. C. (2010). *Fluid Mechanics Fundamentals and Applications*.

Gerges, N., & Ph, D. (n.d.). *Roadway Drainage Design*. *877*.

Grisso, R., Hipkins, P., Askew, S. D., Hipkins, L., & Mccall, D. (2013). Nozzles : Selection and Sizing. *Verginia Corporative Extension*, 12. https://doi.org/doi: http://pubs.ext.vt.edu/442/442-032/442-032_pdf.pdf

Guide, F. P. (2020). *Erosion and Sediment Control Measures 2 . 4 Road Drainage (Stormwater) Culverts*. *January*, 0–5.

Ha, R. R. (2019). Methodology: Cost-benefit analysis. *Encyclopedia of Animal Behavior*, 62–66. https://doi.org/10.1016/B978-0-12-809633-8.20776-0

Hern, H. O., Murphy, T., Zhang, X., Liburdy, J., & Abbasi, B. (2022). *A Design Method for Low-Pressure Venturi Nozzles*. 390–411.

Ho, H. C., Muste, M., Plenner, S., & Firoozfar, A. R. (2013). Complementary experiments for hydraulic modeling of multi-box culverts. *Canadian Journal of Civil Engineering*, *40*(4),

324–333. https://doi.org/10.1139/cjce-2012-0201

Huang, Y. H. (1983). *STABILITY ANALYSIS OF EARTH SLOPES STABILITY ANALYSIS OF*.

Krishnamurthy, A., & Li, W. (2016). *L e a n i n g*.

Najafzadeh, M. (2016). Neurofuzzy-Based GMDH-PSO to Predict Maximum Scour Depth at Equilibrium at Culvert Outlets. *Journal of Pipeline Systems Engineering and Practice*, *7*(1), 1–5. https://doi.org/10.1061/(asce)ps.1949-1204.0000204

No, I. A. (2017). *TESTING AND COMMISSIONING PROCEDURE FOR DRAINAGE INSTALLATION IN GOVERNMENT BUILDINGS OF*.

Pipe, C., Pvc, C., Pipes, C., Size, N. P., Diameter, O., Wall, M., Thickness, I. D., & Weight, P. V. C. (2018). *Shop online at www.PVCPipeSupplies.com Shop online at www.PVCPipeSupplies.com*.

Pressures, M. S. (2000). *Example Calculation*. *1*.

Report, F. (2002). *Sector H Final Report The Study on Comprehensive Water Management of Musi River Basin in the Republic of Indonesia*.

Saeed, M. (2022). *What are the types of pumps and their uses . Types of pumps . August*.

Scherer, T. F., Pfost, D., Werner, H., Wright, J. A., & Yonts, C. D. (n.d.). *Sarinkler Irriaation Systems*.

Xu, H., Demir, I., Koylu, C., & Muste, M. (2019). A web-based geovisual analytics platform for identifying potential contributors to culvert sedimentation. *Science of the Total Environment*, *692*(4), 806–817. https://doi.org/10.1016/j.scitotenv.2019.07.157