

**Natural Vegetation influence over pipe jacking force: A
case study in Metro Colombo Torrington Storm Water
Project**

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Master in Science in Geotechnical Engineering

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Thesis/Dissertation submitted in partial fulfillment of the requirements for the degree
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DECLARATION

I declare that this is my own work and this thesis/dissertation does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other University or Institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text. I retain the right to use this content in whole or part in future works (such as articles or books).

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The above candidate has carried out research for the Master thesis/dissertation under my supervision. I confirm that the declaration made above by the student is true and correct.

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Signature of the Supervisor: ***UOM Verified Signature***

Date: 10-04-2024

DEDICATION

My heartfelt dedications to

My mother, farther,
Loving wife and my son
Sister and brother

ACKNOWLEDGEMENT

My sincere and heartfelt thanks goes to

- **My research supervisor; Prof (Eng) U.G.A Puswewala** – he guided and directed me, and tolerated all my delays and failures without any excuses.
- **Prof (Eng) S.A.S Kulathilaka Prof (Eng) Nalin De Silva, Prof (Eng) Udeni Nawagamuwa, and all academic and supportive members** in the Department of Civil Engineering, University of Moratuwa.
- **Senior management and officials in the Training Division of Central Engineering Consultancy Bureau (CECB)** - who offered me that Master opportunity, financial sponsorship and granting leaves.
- **Team Leader and senior officials who were in Sri Lanka for Yooshin Engineering (Korea) Corporation** – granted me opportunities to work as the Chief Construction Supervising Engineer for the Torrington Tunnel project.
- **Project Director – Metro Colombo Development Project, officials from SLRDC, CMC, China Petroleum Pipeline (PvT) Ltd,** - granted me opportunity for worked as the Chief Construction Supervising Engineer, collect site construction and technical details for my master research works.
- **all project teams and colleagues who worked with me during 2019-2023 (Umaoya multipurpose development project, Torrington tunnel project, Katunayaka Airport development project, Thalpitigala reservoir development project, Mahaweli Water Security Investment Program)** – who assisted, shared my duties, tolerated me.
- **All my master class follow colleagues, my special thanking goes to Eng. Chamila Jayawardhana, one of my colleague in the Geotechnical Msc – UoM class who encouraged me, shared knowledge and opinions, connected with peoples who expert in the field. Without his support, I could not complete this research / study in this manner.**
- **All my close friends and relatives** – who cared me and my family within the very hard-felt time period (2021-2023)

ABSTRACT

Pipe jacking is a popular trenchless tunneling technique in urban areas with advantageous in its different aspects. Torrington storm water tunnel is a project by the Sri Lankan government to tackle the storm water flooding issues related with metro Colombo. Torrington storm water tunnel is constructed by Slurry Pressure Balance TBM method (pipe jacking). The entire tunnel system is constructed through an uniformly graded granular sand medium. Soil Suction (sum of Matric and Osmosis) improve the shear strength of soil medium. Evapotranspiration and water uptake is seen to highly influence the development of capillary action throughout the soil and subsequently the matric suction in the soil. With increase of matric suction, the shear strength is improved. In pipe jacking, the imposed hydraulic force should be in equilibrium / stabilized with the sum of soil-concrete interface resistance force and face resistance force. In this case study, the matric suction induced shear strength improvement in soil in Torrington-Colombo area is considered. This improvement impacted the pipe jacking process by increasing the required hydraulic force. This force increment is proportional to the improvement of the shear strength in the particular soil medium. Three tunnel segments in the Torrington tunnel project are considered for this study. Soil shear strength parameters and GWT were estimated using borehole log data. At the Vadose zone of the respective sections, the imposed hydraulic pipe jacking force increased comparatively to the rest. Accordingly, the Vadose zone of the vegetation effect could be determined. Prior to pipe jacking, the pipe jacking models are considered in order to predict the maximum pipe jacking force and other fluctuations. There are several standard pipe jacking models proposed for different soil and geotechnical conditions. After analyzing by using three available models for sand, Alan Atalah method is found to be the most suitable and complying method for pipe jacking process in the Torrington tunnel project.

Keywords: Pipe jacking, matric suction, Shear strength, Vadoze zone, unsaturated sand,

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LIST OF ABBREVIATIONS

Abbreviation	Description
AEV	Air Entry Value
BOQ	Bill Of Quantities
CECB	Central Engineering Consultancy Bureau
CIRIA	Construction Industry Research Information Association
CMC	Colombo Municipal Council
CPP	China Petroleum Pipeline Ltd.
EPB	Earth Pressure Balance
GWT	Ground Water Table
MCUDP	Metro Colombo Urban Development Project
M - C	Mohr - Coulomb
MHS	Man Hole Spine
MHT	Man Hole Tunnel
MSL	Mean Sea Level
SLRDC	Sri Lanka Land Reclamation Corporation
SPB	Slurry Pressure Balance
SWCC	Soil Water Characteristic Curve
TBH	Tunnel Bore Hole
TBM	Tunnel Boring Machine
UDA	Urban Development Authority
USCS	Unified Soil Classification System