# MAXIMUM PERMISSIBLE SLOPE FOR INTERLOCKING CONCRETE BLOCK PAVING FOR RESIDENTIAL ROADS

C.J. Atapattu

219565T

Master of Engineering in Highway and Traffic Engineering

Department of Civil Engineering
Faculty of Engineering

University of Moratuwa
Sri Lanka

July 2025

# MAXIMUM PERMISSIBLE SLOPE FOR INTERLOCKING CONCRETE BLOCK PAVING FOR RESIDENTIAL ROADS

C.J. Atapattu

219565T

Dissertation submitted in partial fulfillment of the requirements for the degree

Master of Engineering in Highway and Traffic Engineering

Department of Civil Engineering

Faculty of Engineering

University of Moratuwa

Sri Lanka

July 2025

# DECLARATION

I affirm that this dissertation is my original work and does not incorporate, without proper acknowledgment, any material previously submitted for a degree or diploma at any other university or institution. To the best of my knowledge, it does not contain any material previously published or written by another person, except where such references are clearly cited in the text.

Furthermore, I authorize the University of Moratuwa to reproduce and distribute this thesis/dissertation, in whole or in part, in both print and electronic formats. I retain the right to use all or part of this material in future publications, such as journal articles or books.

Signature: Date: 24/07/2025

I hereby certify that the candidate has carried out the research presented in this Master's thesis/dissertation under my supervision. I confirm that, to the best of my knowledge, the declaration made by the candidate above is accurate and correct.

Name of Supervisor: Prof. W. K. Mamperachchi

Signature of the Supervisor: Date: 28/07/2025

# ABSTRACT

Concrete Block Paving (CBP) is a popular surfacing method currently used for rural roads in Sri Lanka, primarily due to its cost-effectiveness, ease of construction, and suitability for medium- to low-traffic conditions. Nowadays, CBP is applied not only on flat terrains but also on steep slopes. Determining the maximum permissible slope for block paving is critical to ensuring the durability, stability, and functionality of the pavement system. Empirical studies and field observations show that gradients exceeding permissible limits can lead to problems such as erosion, block displacement, and reduced skid resistance, especially over unsealed subgrades.

While several studies have examined the influence of block shape, laying pattern, laying angle, joint width, and block thickness on CBP performance in flat terrain, these factors may behave differently on sloped surfaces due to additional forces acting on the blocks. Therefore, the aim of this research is to investigate the maximum permissible slope for CBP under medium- to low-traffic conditions.

As part of the study, a 90-meter road segment with slopes ranging from 0° to 10° was constructed. Paving was done at 10-meter intervals using Uni-style blocks, while varying the block patterns, laying angles, and cross beam intervals. Field data were used to calculate relative vertical deflections. A Finite Element Model (FEM) was also developed in ANSYS software to simulate the behavior of the pavement system by varying slope, laying pattern, laying angle, and cross beam spacing.

The results indicate that as slope increases, horizontal deflection tends to increase while vertical deflection decreases. However, when cross beams are placed at optimal intervals, both horizontal and vertical deflections become negligible. Under such conditions, the effects of slope, laying pattern, and laying angle on pavement performance are significantly reduced, making CBP a viable option for rural roads even on sloped terrains.



**Keywords**: Concrete Block Paving (CBP), Finite-element model (FEM), uni style block pattern, Herring bond pattern.

# ACKNOWLEDGEMENT

I would like to gratefully acknowledge the valuable guidance and support of everyone who contributed to the success of this M.Eng. research project. I sincerely appreciate their assistance and take this opportunity to extend my heartfelt thanks.

First and foremost, I express my deepest gratitude to my research supervisor, Prof. W.K. Mampearachchi, for his invaluable guidance, unwavering support, and continuous encouragement throughout the course of this study. His direction, from the beginning to the successful completion of the project, was truly instrumental.

I also extend my sincere appreciation to Mr. R.P. Tharanga, Executive Engineer, and his team at the Road Development Authority, Matara, for their generous support in facilitating the trial section and assisting with data collection—an essential component of this research.

My thanks also go to the Department of Civil Engineering, University of Moratuwa, for providing me with the opportunity and the necessary resources to undertake this study.

I take this opportunity as well to thank all the lecturers who imparted their knowledge throughout my Master of Engineering degree and those who offered valuable insights that helped shape this project.

Lastly, I express my heartfelt thanks to my family, whose constant support, encouragement, and timely assistance provided the foundation that allowed me to focus and complete this work successfully.

# TABLE OF CONTENTS

# LIST OF FIGURES

# LIST OF TABLES

**Table** **Description** **Page**

# LIST OF ABBREVIATIONS

| Abbreviation | Description |
|---|---|
| CBP | Concrete Block Paving |
| FEM | Finite Element Method |
| CB | Cross beam |