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**DEVELOPMENT OF STANDARDIZED TESTING  
PROTOCOLS FOR NNDG USE IN QUALITY CONTROL**

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Degree of Master of Engineering

Department of Civil Engineering

University of Moratuwa

Sri Lanka

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The thesis was submitted in partial fulfilment of the requirements for the Master of  
Engineering in Civil Engineering degree.

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## DECLARATION

I solemnly declare that the contents of this thesis represent my original work, and where other sources of information have been used, these have been duly acknowledged. This thesis has not been submitted as a whole or in part for any other academic degree or qualification. To the best of my knowledge and belief, this thesis does not contain any material previously published or written by another person except where due reference has been made in the text. I affirm that I have retained the right to use this work in future scholarly endeavours, including publications or further academic pursuits.

Signature:

Date:

The aforementioned candidate has conducted research for the Master's thesis under my supervision. I now affirm that the declaration made by the student above is accurate and truthful.

Name of Supervisor: Prof. W.K.Mampearachchi

Signature of the Supervisor:

Date: Oct. 21, 2025

## ABSTRACT

Ensuring proper compaction in asphalt pavements is critical for their structural integrity and longevity. Traditional methods of measuring pavement density, such as core sampling and Nuclear Density Gauges (NDGs), present limitations including safety risks, regulatory burdens, and operational complexity. This thesis investigates the viability of Non-Nuclear Density Gauges (NNDGs) as a safer, efficient, and environmentally friendly alternative for in-situ density measurements. Through a combination of laboratory calibration and extensive field testing across varied mix types, compaction stages, and environmental conditions, the study evaluates the accuracy, repeatability, and operational reliability of NNDGs compared to NDGs and core samples. Key findings demonstrate that with appropriate calibration and temperature correction factors, NNDGs can produce results with a high correlation to traditional methods. The research develops statistical models to account for temperature and material variability and proposes a comprehensive Standard Operating Procedure (SOP) for consistent NNDG deployment in pavement quality control. Finally, the thesis recommends best practices for industry adoption and regulatory integration, positioning NNDGs as a practical tool for enhancing construction quality and safety standards in asphalt paving.

**Key Words:** Non-Nuclear Density Gauge (NNDG), Asphalt Pavement, Quality Control, Density Measurement, Standard Operating Procedure (SOP), Temperature Correction Factors, Calibration, Compaction, Pavement Testing Protocols, Non-Destructive Testing

## DEDICATION

To the cherished memory of my beloved father, **Erambu**. Though no longer with us in person, his spirit, wisdom, and unwavering belief in me continue to guide and inspire every step of my journey. His boundless love and quiet strength have been the foundation upon which I've built my values, my resilience, and my pursuit of knowledge. I am forever grateful for the lessons he imparted—spoken and unspoken—and for the enduring light he brought into my life. This work stands as a tribute to his lasting legacy and the profound influence he will always hold in my heart and mind.

Forever missed, always remembered.

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