Jordan Journal of Civil Engineering, Volume **17**, No. **2**, **2023**
DOI: https://doi.org/10.14525/JJCE.v17i2.08

Structural Performance of Cement-treated Base Layer by Incorporating Reclaimed Asphalt Material and Plastic Waste

Arijit Kumar Banerji [1)*], ***Pijush Topdar*** [2)] ***and Aloke K Datta*** [3)]

[1)] Research Scholar, NIT Durgapur and Assistant Professor, Dr. B.C. Roy Engineering College, Durgapur, India. * Corresponding Author. E-Mail: arijit.banerji@bcrec.ac.in
[2)] Associate Professor, NIT Durgapur, India. E-Mail: pijush.topdar@ce.nitdgp.ac.in
[3)] Associate Professor, NIT Durgapur, India. E-Mail: alokekumar.datta@ce.nitdgp.ac.in

ABSTRACT

The reuse of reclaimed asphalt material (RAM) and polyethylene terephthalate (PET) plastic waste is a reliable approach to limit the use of virgin aggregates for road construction and mitigate environmental challenges. This study highlights the structural performance of the cementitious base or cement-treated base (CTB) layer by incorporating reclaimed asphalt and plastic waste material. Structural compatibility of CTB layer with different proportions of RAM (20%, 45%, 70% and 95%), virgin aggregates and plastic waste (5%) is recognized by the moisture-density relationship, unconfined compressive, indirect tensile strength, flexural strength and California bearing ratio tests. In the current study, a ranking methodology is used to analyze the overall suitability of the cementitious base mix proportions using different laboratory test parameters. Furthermore, a finite element analysis using the ANSYS software is performed to investigate the effect of CTB layer on the pavement structural responses. Also, using the central public works department guidelines, a cost comparative study is provided. Experimental results showed that all the cementitious base mixes met the requirements for the unconfined compressive strength, except for the 95% and 70% RAM mixes. Therefore, 20%-45% of RAM can partially be used in the CTB layer to replace virgin aggregates partially. The finite element analysis results showed that CTB reduced fatigue strain by 57% and surface deformation by 47%. Moreover, it has been concluded that by utilizing a cementitious base with RAM, there is a 30% cost reduction.

KEYWORDS: Reclaimed asphalt material, Cement-treated base, Polyethylene terephthalate, Finite element analysis, Unconfined compressive strength.

INTRODUCTION

The construction of a cement-treated base (CTB) layer is now becoming extensively popular in India due to its improved performance. The CTB layer provides a stiffer foundation than conventional base material and minimizes the deformations induced by heavy wheel loads (Bagui, 2012). It can result in a longer pavement service life by preventing the ingress of fatigue cracking distress. A CTB layer also enhances the pavement's susceptibility to rutting and freezing-thawing cycles, providing a durable and long-lasting foundation for a flexible pavement (Halsted et al., 2006). In flexible pavement, the CTB layer is made of aggregate particles, reclaimed asphalt materials (RAMs), pulverized slag, concrete aggregates or a soil-aggregate mix and these are mostly stabilized with cement (IRC, 2018). Accordingly, due to the lack of virgin aggregates (VAs) in today's construction industry, several government organizations are increasingly emphasizing the reuse of RAMs, which is feasible because of its economic and environmental advantages (Chhabra et al., 2021).

The concept of utilizing RAMs for new pavement construction emerged around 1915 (Kasu et al., 2020). In 1935, the concept of using CTB was first employed to strengthen the foundation of a state highway in South Carolina (Arulrajah et al., 2021) and in 1950, the practical applications of inverted pavement or CTB pavement has been recognized as a cost-effective and

Received on 12/9/2022.
Accepted for Publication on 27/12/2022.