International Multidisciplinary Research Journal Reviews (IMRJR)

International Multidisciplinary Research Journal Reviews (IMRJR)
A Peer-reviewed journal
Volume 2, Issue 5, May 2025
DOI 10.17148/IMRJR.2025.020504

Report on the Field Assessment of MIF and LCR for Geo-synthetic Stabilized Reinforced Flexible Pavement

NIKHIL[1], PARDEEP[2]

M.Tech Scholar inSat Priya Group of Institutions, Rohtak[1]

Assistant professor in Sat Priya Group of Institutions, Rohtak[2]

Abstract: Underpinning of flexible pavements using geo- replicas — particularly geogrids has come a extensively espoused fashion to address the adding demands on road structure due to growing business loads and environmental challenges. This approach enhances the mechanical geste of pavement systems by perfecting cargo distribution, reducing stresses transferred to the subgrade, and minimizing face distortion similar as rutting and cracking. The objectification of geo-synthetic underpinning contributes to increased pavement life, bettered structural integrity, and reduced construction and conservation costs.

I. INTRODUCTION

The performance evaluation of geosynthetic-stabilized flexible pavements has become increasingly critical in modern pavement engineering, especially under variable field conditions and increasing traffic demands. Two key indicators—Modulus Improvement Factor (MIF) and Layer Coefficient Ratio (LCR)—are widely used to quantify the structural enhancement provided by geosynthetic reinforcements such as geogrids and geotextiles. These parameters help in understanding the degree of stiffness improvement and the contribution of reinforced layers to the overall pavement system.

MIF is used to assess the increase in stiffness or modulus of a pavement layer due to the inclusion of a geosynthetic, while LCR evaluates the ratio of structural contribution of a stabilized or reinforced layer relative to its unreinforced counterpart. Accurate field assessment of these factors is essential for validating design models, optimizing material usage, and ensuring long-term pavement performance.

II. LITERATURE REVIEW

The use of geosynthetics in pavement engineering has evolved significantly over the past few decades, driven by the need for cost-effective, durable, and high-performing road infrastructure. Numerous studies have focused on the evaluation of geosynthetics in flexible pavement systems, particularly in terms of their ability to enhance structural capacity, reduce deformation, and extend service life.

2.1 Modulus Improvement Factor (MIF): The Modulus Improvement Factor (MIF) is a parameter used to quantify the increase in modulus (or stiffness) of a pavement layer due to the inclusion of a geosynthetic.

2.2 Layer Coefficient Ratio (LCR): LCR is another critical indicator used in empirical pavement design to assess the relative structural contribution of geosynthetically stabilized layers. The concept is often tied to the AASHTO pavement design method, where layer coefficients represent the structural value per unit thickness of a pavement layer.

2.3 Field Performance Studies: Numerous field trials have validated the improvements predicted by MIF and LCR. For example, the Geosynthetic Materials Association (GMA) documented case studies where geogrid-reinforced pavements exhibited lower rutting and deflection values over time compared to conventional sections.

2.4 Standards and Guidelines: Documents such as IRC: SP: 89 (Part II)-2018, IRC: 37-2018, and FHWA reports provide recommendations for incorporating geosynthetics into pavement design.

III. IMPACT

- Improved Design Accuracy
- Optimized Material Use
- Enhanced Pavement Performance

International Multidisciplinary Research Journal Reviews (IMRJR)
A Peer-reviewed journal
Volume 2, Issue 5, May 2025
DOI 10.17148/IMRJR.2025.020504

- Economic and Environmental Benefits
- Validation of Design Standards
- Better Decision-Making for Road Agencies

IV. MERITS & DE-MERITS

- **Merits**

1. Improved Design Reliability
2. Optimized Material Usage
3. Enhanced Pavement Performance
4. Support for Standards Development
5. Economic and Environmental Benefits
6. Evidence-Based Decision Making

- **De-Merits**

1. High Cost and Time Requirements
2. Site-Specific Results
3. Instrumentation and Technical Complexity
4. Influence of External Variables
5. Delayed Results

V. PLATE LOAD TEST FOR MIF & LCR

A static plate load test (PLT) was used to validate MIF/LCR for geogrid reinforced flexible pavement in the field in accordance with the work's scope. Using the pavement structure's response, an approximation process is employed to determine the MIF values. It should be mentioned that such analysis may be taken into consideration to compare reinforced and un-reinforced pavement sections in the absence of a standard testing process.

The plate load test (PLT) is used to verify the in-field MIF and LCR values for both reinforced and un-reinforced sections. We call this part part 1. In Section 1, the PLT was completed at the top of the subgrade, reinforced WMM (granular base), GSB (granular sub-base), and un-reinforced WMM. Figure 1 provides an example. As we all know the thickness of subgrade is generally taken as 500 mm deep.

The field PLT was carried out using a 60-ton tandem axle truck. At the intended location, a cylindrical plate with a 300 mm diameter and a cylindrical hydraulic load system was positioned on the test section's wheel path. Two tests were conducted on each bed, and the average strength was calculated. The load was applied at a rate of about 2.0 tonnes per minute using the loaded vehicle as a reaction frame. Two dial gauges were used to record the deflection reading at roughly 2.0-tonne intervals. For computational purposes, the parameters under analysis were averaged.

$$\sigma = \frac{Load\ (N)}{Area\ of\ Plate\ (mm^2)}$$

...Equation 1- Stress Determination

$$\varepsilon = \frac{\Delta d\ (mm)}{Total\ Crust\ Thickness\ (mm)} \times 100$$

...Equation 2- Strain Determination

VI. MIF & LCR CALCULATION

After performing plate load test on the above sections, the MIF value is determined by using the equation: Given that the reinforced and unreinforced sections have moduli of 6900 MPa and 616 MPa, respectively, the MIF for the geo-synthetically stabilized reinforced flexible pavement is 11.2, which is significantly greater than what is usually employed in design. When exercising such results, the data's variability should be properly taken into account. Furthermore, it is anticipated that the geogrid location and the compaction properties of the various layers will affect the outcomes.

Additionally, using equation 6, the layer coefficient ratio (LCR) value was determined, taking into account the 60% CBR of granular layers. According to the PLT data, the relevant LCR value is 3.180.

It is clear that, in contrast to sections 1a and 1b, the compaction properties of the underlying layers in sections 1c and 1d varied. As a result, the modulus values for sections 1c and 1d showed greater variations. Comparing the apparent

International Multidisciplinary Research Journal Reviews (IMRJR)
A Peer-reviewed journal
Volume 2, Issue 5, May 2025
DOI 10.17148/IMRJR.2025.020504

modulus of sections 1c and 1d in order to assess MIF and LCR would be conservative. The average Ea for Sections 1c and 1d is 745 and 343 correspondingly, as indicated in Table 1. As a result, the MIF is determined to be 2.17, a value that is characteristic of geogrid reinforced pavement. It is determined the LCR is 1.70.

VII. CONCLUSION

The field evaluation of **Modulus Improvement Factor (MIF)** and **Layer Coefficient Ratio (LCR)** provides critical insights into the actual performance benefits of geosynthetic reinforcement in flexible pavement systems. By quantifying the enhancement in stiffness and structural contribution due to geosynthetics, these parameters enable engineers to design more reliable, cost-effective, and sustainable pavements.

REFERENCES

[1]. IRC: 37-2018 (4th Revision) – Offers comprehensive guidelines for designing flexible pavement structures in accordance with modern engineering practices.
[2]. IRC: 72-2015 (1st revision), which provides standards for adaptable pavement design parameters for country roads with low traffic volumes
[3]. IRC: 109-2015 (1st Revision) – WMM layers.
[4]. Guidelines on the design parameters of stabilized base pavements, IRC: SP: 89 (Part-II) -2018 (1st revision)
[5]. National Rural Infrastructure Development Agency (NRIDA) – A government body responsible for policy and technical oversight of rural infrastructure development, including road construction.
[6]. Philadelphia University Website – An online portal offering academic and research-based resources in various disciplines, including civil engineering.
[7]. McGraw-Hill Education’s "Handbook of Transportation Engineering" – A comprehensive reference manual covering a wide spectrum of transportation engineering topics and standards.
[8]. Koerner, R. M. (2012). "Designing with Geosynthetics" (6th Edition) – A key academic text offering in-depth insight into the principles and applications of geosynthetics in engineering projects.
[9]. Geosynthetic Materials Association (GMA, 2008) – Published a specialized design guide focused on the integration of geosynthetic reinforcements in roadway construction.