EDU AR: AUGMENTED REALITY ENHANCED E-LEARNING APPLICATION FOR KIDS WITH DOWN SYNDROME

***Project Reference No.:** 47S_BE_3414*

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KEYWORDS: Stone Mastic Asphalt mix, Reclaimed Asphalt Pavement (RAP), Steel Slag, Marshal Stability, Optimum Binder Content (OBC), Water Sensitivity, Indirect tensile strength, Tensile Strength Ratio (TSR), Fatigue characteristics.

INTRODUCTION

1.1 GENERAL

The construction and maintenance of roads play a vital role in the economic development of nations, leading to significant investments, particularly in developing countries like India. While traditional asphalt pavements have been favored for their initial cost, recent studies show concrete pavements offer better life cycle cost benefits due to their durability and lower maintenance needs.

However, challenges such as scarcity of natural aggregates and environmental concerns have led to the exploration of alternative materials like reclaimed asphalt pavement (RAP) and steel slag aggregates. RAP has gained acceptance for its environmental and economic advantages, while steel slag aggregates show promise for improving pavement stability and skid resistance, despite some challenges related to workability and chemical composition. Efforts towards sustainable development emphasize the recycling of waste materials, with various marginal materials being successfully incorporated into asphalt mixes, able it with considerations for performance and cost.

Recent studies depicted that the life cycle cost of concrete pavements is lesser than asphalt pavements. This is due to the higher service life, lower/negligible maintenance cost and higher durability of concrete pavements. Moreover, rigorous attempts have been made continuously to lower the initial construction cost by means of including several industrial as well as agricultural wastes such as fly ash, sugarcane bagasse ash, and rice husk ash in the mix design. In addition, steel slag aggregates have shown excellent results in polish resistance tests, which means that surface courses made with them keep their friction over time. This result also confirmed in field studies reporting that sections made with steel slag have equal or better skid resistance and macro texture than sections made with conventional asphalt mix. However, steel slag aggregates have irregular shape and porous texture, which slightly degrade the workability of asphalt mix and absorb high amount of binder in their porosities and hence, the consumption of binder increases

1.2 OBJECTIVES

Our attempt to use 10% RAP and 10% Steel slag in 1st combination and 20% RAP and 5% Steel slag in 2nd combination of Stone Mastic Asphalt mix has the following objectives:

- To determine the physical properties of virgin aggregate, RAP, Steel slag andBitumen.
- To determine the Optimum Binder Content (OBC) of Stone Mastic Asphalt mix blended with RAP and Steel slag.
- To determine the moisture susceptibility of Stone Mastic Asphalt mix blended with RAPand Steel slag.
- To determine the fatigue characteristics of Stone Mastic Asphalt mix blended with RAPand Steel slag.

CHAPTER 2

METHODOLOGY

The proposed methodology of our project is well executed by the flow chart below:

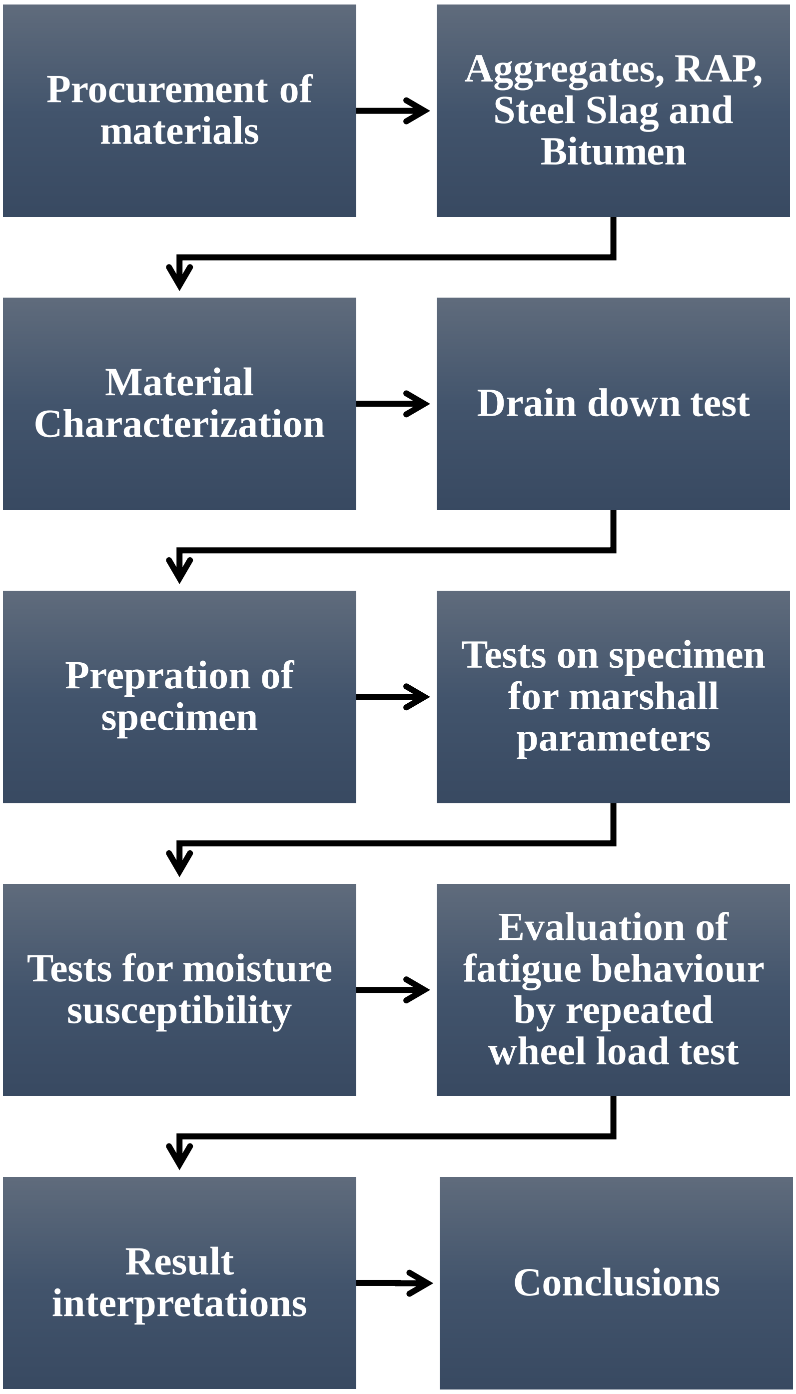

Fig 2.1 Flow chart showing the methodology of project.

2.1 MATERIALS USED

- **Aggregates**: The size and weight of aggregates taken are as tabulated:

Table 2.1 Weight of aggregates procured based on their size

IS sieve size	Weight in kg
12.5 mm	50
10mm	50
4.75mm -1.18mm	50
0.6mm-0.075mm	25
Fine sand	10

- **Bitumen**: A 60/70 grade bitumen, which weighs about 8 kgs was collected fromthe BMR hot mix plant located at, Muddianapalya, near Ramohalli.

- **Reclaimed asphalt pavement(RAP):-**This RAP can be used with stabilizer which gives the pavement better load dispersion and greater load resistance.
- **Steel slag aggregates**: Steel slag is a by-product of the steel making process, specifically the smelting and refining of iron ore to produce steel. Steel slag iscomposed mainly of calcium, iron, and silicon, along with traces of other Elements.
- **Bagasse fibers**: It is the waste product of sugarcane, which is used in SMA mix to provide adequate stability to bitumen and to prevent drainage of binder during transportation and placing.

2.2 TESTS CONDUCTED

- Basic tests such as specific gravity test, aggregate crushing test, aggregate impact test, water absorption test, shape tests were conducted to determine the physical properties of virgin aggregates, Steel slag and RAP. Along with the above- mentioned tests, Centrifuge bitumen extraction test for RAP was conducted. Similarly, to assess the bitumen characteristics, specific gravity, softening point, ductility, penetration tests were carried out.
- Drain down test was conducted to check the drain down % of bitumen to the

SMA mix

- Marshal stability test was conducted to evaluate the marshal parameters such as density, stability, percentage of air voids, flow, optimum binder content for the conventional SMA mix without RAP and Steel slag and the mix blended with 10% RAP and 10% Steel slag and the SMA mix blended with 20% RAP and 5% Steel slag
- Water Sensitivity test to determine the moisture susceptibility was carried out. Also,Tensile Strength Ratio (TSR) was found out using the same.
- Fatigue characteristics of the mixes were found out using repeated wheel load test

CHAPTER 3

RESULTS AND CONCLUSIONS

3.1 RESULTS

The test results from Marshal stability tests are as tabulated below:

Mix type	OBC (%)	Gm (g/cc)	Gt (g/cc)	Vv (%)	VFB (%)	Flow (mm)	Stability (kN)
Conventional	6.45	2.21	2.30	4.8	79.41	4.21	9.1
Blended with 10% RAP and 10% Steel slag	6.2	2.26	2.28	4.65	93.84	4.76	11.65
Blended with 20%RAP and 5% Steel slag	6.02	2.21	2.27	5.8	82.97	4.15	13.55

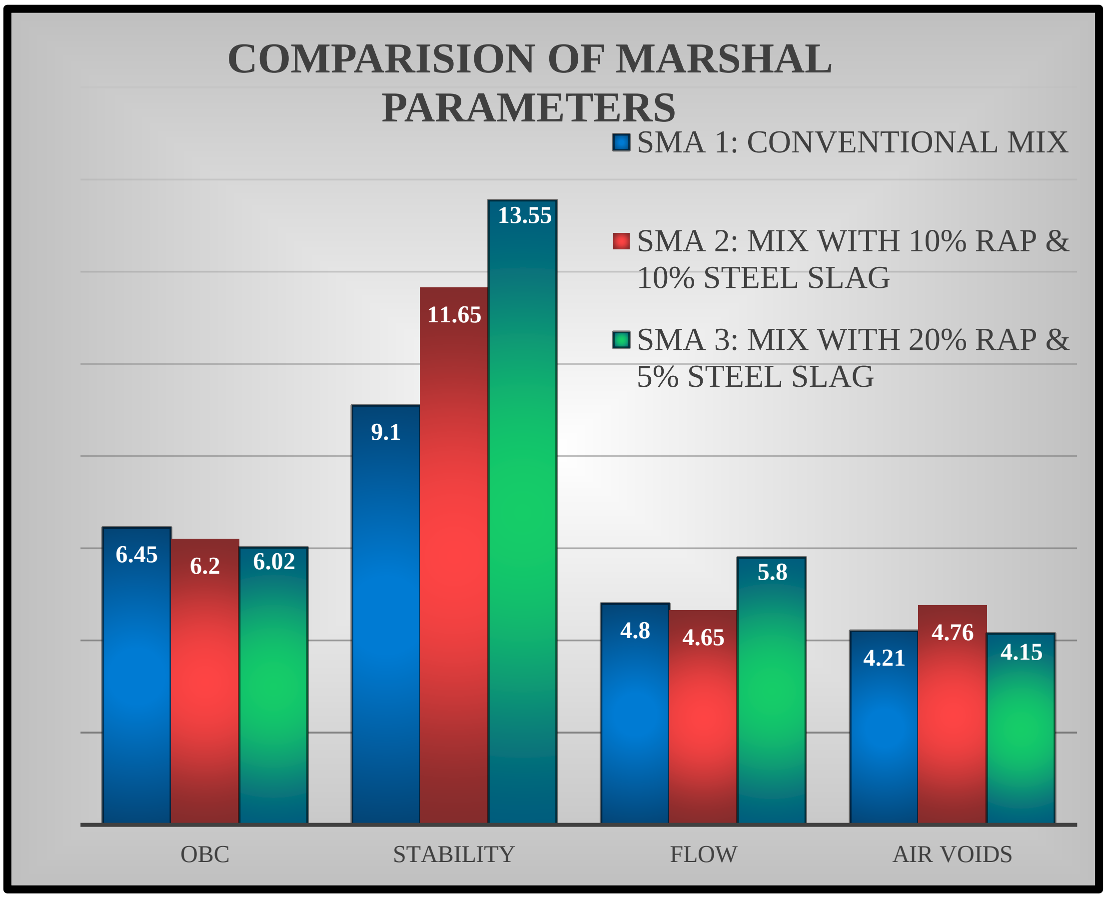

Fig 3.1 Comparison of the Marshal stability test results

The results obtained from Water sensitivity test are tabulated:

Mix type	TSR	TSR (%)
Conventional Mix	0.92	92
Mix blended with 10% RAP and 10% Steel slag	0.87	87
Mix blended with 20% RAP and 5% Steel slag	0.98	98

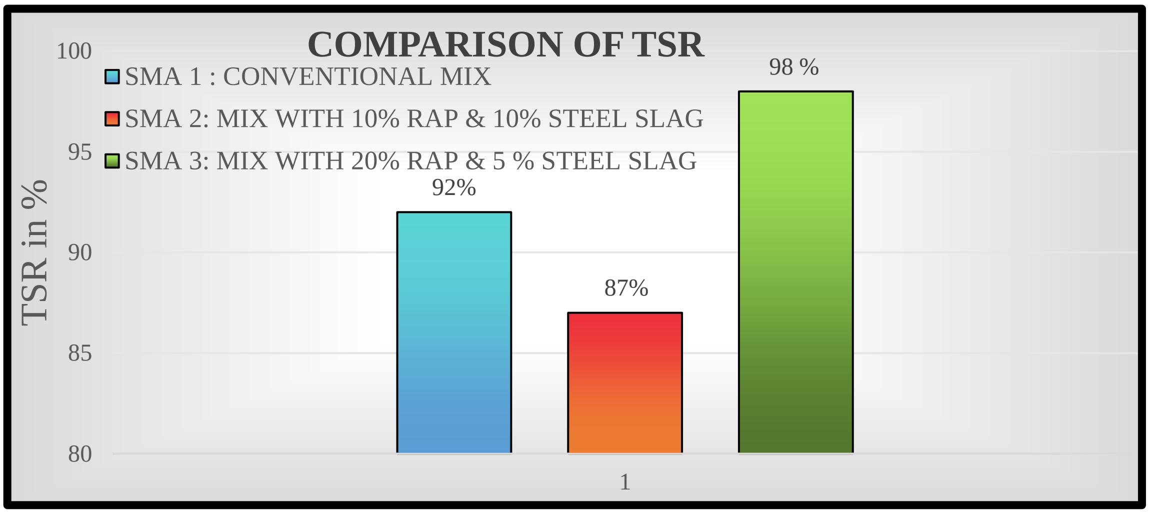

Fig 3.2 Comparison of TSR

Fatigue test results: The number of cycles taken by the Stone mastic asphalt mix blended with RAP and Steel slag is 1512 and 1020 for SMA 1 & SMA 2 respectively when 10% of the maximum tensile load is applied and 761 and 511 for SMA 1 & SMA 2 respectively when 20% of the maximum tensile load is applied and that taken by conventional SMA 1 mix without RAP and Steel slag is 354 when 10% of the maximum tensile load is applied and 198 when 20% of the maximum load is applied. The greater difference is attributed to the fact that the mix blended with steel slag and RAP can resist repeated varying wheel load.

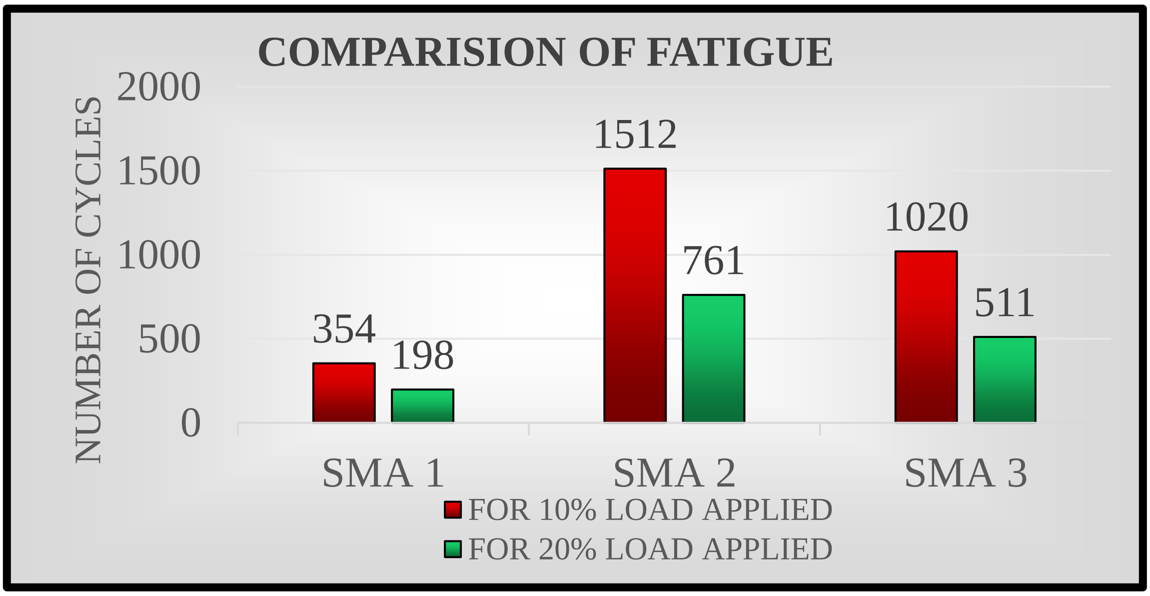

Fig 3.3 Chart showing no.of cycles taken by the test specimens to attain fatigue failure

3.2 CONCLUSIONS

- The incorporation of steel slag and RAP in Bituminous Concrete mix showed significant impacts on Marshal parameters and fatigue behaviour.
- The incorporation of steel slag and RAP in SMA mix resulted in a decrease in the Optimum Bitumen Content (OBC) from 6.45% to 6.2% in SMA 2 MIX and 6.45% to 6.02% in SMA 3 MIX. This reduction signifies improved binder-aggregate interactions, enhanced mixture performance, and the potential for better stability, durability, and resistance to rutting and fatigue cracking, while also offering economic and environmental benefits through reduced bitumen usage. These findings highlight the effectiveness and sustainability of steel slag and RAP as additives in SMA mixes.
- The incorporation of steel slag in the SMA mix improved the stability by 24.73% in SMA 2 MIX and 48.9% in SMA 3 MIX , enhancing its resistance to deformation under traffic loads. Additionally, the utilization of RAP contributed to improved strength and stiffness of the mixture. These enhancements in Marshal parameters have the potential to enhance the overall performance and longevity of the pavement structure.
- In the water sensitivity test, the SMA 1 mix got 92 % TSR value where as SMA 2 and SMA 3 got 87% and 98% respectively. This improvement exceeds the minimum specified value of 80% and suggests enhanced moisture resistance, indicating the potential for better performance in terms of resisting damage caused by water infiltration.
- The use of steel slag and reclaimed asphalt pavement (RAP) in SMA mix positively influenced its fatigue behavior, as evidenced by a higher number of cycles compared to the conventional mix without RAP and steel slag.
    1. It was found that increase in 1158 number of cycles in SMA 2 MIX and 666 number of cycles in SMA 3 MIX than the SMA 1 MIX when 10% load is applied.
    2. It was found that increase in 563 number of cycles in SMA 2 MIX and 313 number of cycles in SMA 3 MIX than the SMA 1 mix when 20% load is applied.This improvement can be attributed to the enhanced resistance against fatigue cracking, resulting from the improved stiffness and strength characteristics of the mix achieved through the inclusion of steel slag and RAP.
- Overall, steel slag and RAP can be effective, eco-friendly and sustainable materials in Bituminous pavement construction. This innovation enhances road durability, stability, load-bearing capacity, and reduces environmental impact, providing a cost-effective approach to paving.

4 INNOVATION OF THE WORK:

By incorporating steel slag and reclaimed asphalt pavement (RAP) in bituminous road construction offers a sustainable solution by utilizing waste materials. This innovation enhances road durability, stability, load-bearing capacity, and reduces environmental impact, providing a cost-effective and eco-friendly approach to paving.

Embracing steel slag roads contributes to achieving Sustainable Development Goals: like SDG's 9,11,12 & 15.

9. INDUSTRY, INNOVATION AND INFRASTRUCTURE : Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.(quality, reliable, sustainable infrastructure, promote sustainable industrialization).

11. SUSTAINABLE CITIES AND COMMUNITIES : Make cities and human settlements inclusive, safe, resilient and sustainable.(Reduce environment impact through waste management, supporting least developed countries).

12. SUSTAINABLE CONSUMPTION AND PRODUCTION : Ensure sustainable consumption and production patterns.(reduce waste generation through prevention, reduction, recycling, reuse).

15. LIFE ON LAND : Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.(prevention of land degradation by reducing the landfills).

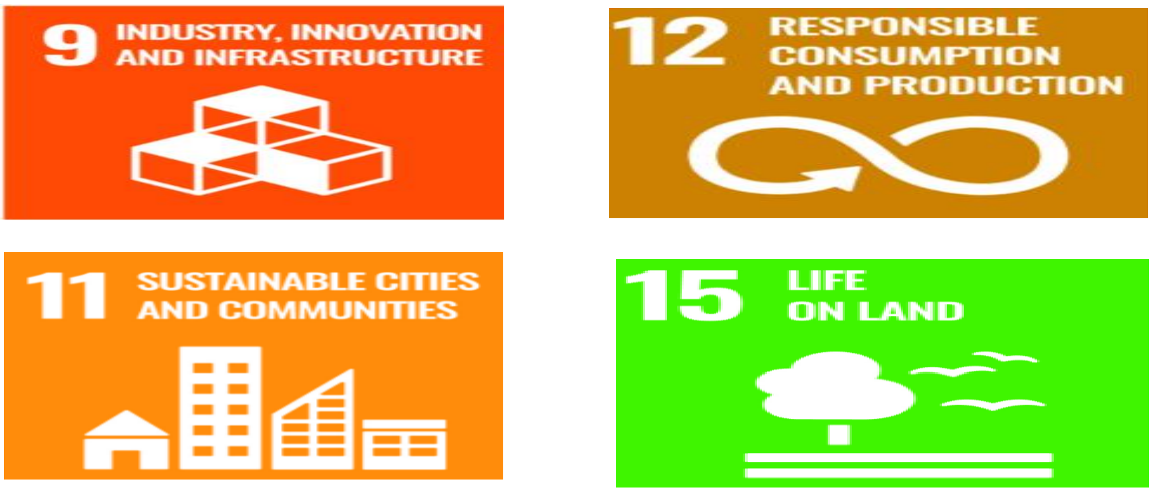

Fig 4.1 Sustainable Development Goals

5. SCOPE FOR FUTURE WORK:

- To determine the optimal percentages of RAP and steel slag for different road conditions and mix designs.
- Future studies should focus on evaluating the long-term performance of bituminous pavements using RAP and steel slag, including monitoring factors such as rutting, cracking, and durability.
- Development of standardized guidelines and specifications for incorporating RAP and steel slag in bituminous pavements would facilitate wider adoption and ensureconsistent quality across road construction projects.
- It includes conducting comprehensive environmental impact assessments to quantify the sustainability benefits of using RAP and steel slag, including reductionsin carbon emissions, energy consumption, and natural resource depletion, promoting their wider implementation in road infrastructure projects.