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Performance Evaluation and Behaviour Analysis of Modified Bituminous Concrete with Processed Waste

Bharathi B¹, Deekshitha H V², Shreyas M³, Subashchandra B R⁴, Chandu N⁵

¹Assistant Professor, Department of Civil Engineering, ATME Engineering College, Mellahalli, Mysuru, India

^{2,3,4,5}U.G. Student, Department of Civil Engineering, ATME Engineering College, Mellahalli, Mysuru, India

ABSTRACT: The analysis of the behavioral change of temperature on rigid pavement is a critical aspect of understanding the performance and durability of Bituminous concrete roadways. Temperature fluctuations significantly impact the rigid pavement, leading to distresses such as cracking, deformation, and reduced service life. This experimental study aims to investigate the effects of temperature variations on the behavior of Bituminous Concrete pavement and develop strategies to mitigate potential issues.

The objective of this research is to analyze the behavioral response of rigid pavement under controlled temperature changes. To achieve this objective, a representative section of rigid pavement was selected for testing. The pavement sample was constructed according to standard specifications, ensuring it accurately represents real-world conditions. The sample consisted of typical layers found in a rigid pavement structure, including the concrete slab, base, and sub base layers.

The collected data was analyzed to understand the effects of temperature changes on the rigid pavement. Statistical analysis and visualization techniques were employed to identify patterns, trends, and correlations between temperature variations and the observed behavioral changes. The analysis provided insights into the susceptibility of rigid pavements to temperature-induced distress, such as thermal cracking and differential expansion.

KEYWORDS: LM 35sensor, Arduino, Temperature variation.

I. INTRODUCTION

The surface course, also known as the wearing course or pavement surface, is the topmost layer of a flexible pavement system. It is the layer that comes in direct contact with vehicular traffic and provides a smooth and durable driving surface. The surface course is designed to withstand the traffic loads, resist wear and tear, and provide skid resistance for safe driving. In flexible pavement systems, the surface course is typically composed of asphalt concrete (commonly referred to as asphalt) or occasionally Portland cement concrete (PCC). These materials are chosen for their excellent load-carrying capacity, flexibility, and ability to withstand the dynamic forces exerted by vehicles. Total is gotten from normal rocks. Mining of the total, prompts the decrease of normal assets. The nations having restricted assets of normal total are remembering to save their regular assets for their group of people yet to come. An enormous area of land is used for the removal of steel slag strong squanders, creating by the steel and iron making ventures. Factors like ecological, financial, specialized and lack of legitimate development material definitely stand out enough to be noticed of scientists towards the steel slag the best option of regular aggregate. The result creates from the dissolving of scratch to deliver steel by an electric circular segment heater (EAF), and through the change of iron to steel by a fundamental oxygen heater (BOF). The steel slag acquired from these heater appears as though comparable however the properties might vary in view of the grade of steel delivered and the heater, while the compound organization stays inside the reach. The high unambiguous gravity and the legitimate interlocking because of rakishness of steel slag result better soundness and opposition against rutting also.

II. METHODOLOGY

In this experimental study, M20 grade concrete is designed as per the IS code. The materials are collected i.e. cement, fine aggregate, coarse aggregate, and steel slag with the control concrete with 5%, 10%, and 15% replacement in coarse aggregate. The mould is casted for both conventional concrete and replaced concrete with steel slag. Casted specimen are cured in water for 7, 14, 28 days respectively. After curing, the compression strength test is conducted at 7, 14 and



28days. These cubes are tested for each designation and average of three results will be taken. Mould is cleaned properly and greased with Mould oil. Concrete is placed in the Mould of dimension 150mmX150mmX150mm in 3 layer each layer of height approximately 50mm. After the placement of first layer of concrete it is compacted by a tamping rod of 16mm diameter, 0.6m long and bullet pointed at the lower end. The stroke of the bar is uniformly distributed over the cross section of the mould. Each layer is compacted with 35 strokes and next scoop of concrete is placed followed by same manner of compaction and top layer is finished.

The effectiveness of extracting heat from the surface of the Bituminous concrete pavement. Compare the surface temperature of the Bituminous concrete pavement with that of the conventional pavement. Assess the thermal performance and heat dissipation capabilities. Collect temperature data from the sensors at predetermined time intervals. Record the temperature readings along with corresponding date and time stamps. Ensure consistent and reliable data collection throughout the experiment. Obtain high-quality material with suitable characteristics for thermal conductivity enhance. Prepare the concrete mixture by incorporating the cementations matrix. Ensure proper dispersion and uniform distribution within the concrete to maximize its thermal properties.

Procedure For Checking Temperature using Arduino Uno

Connect the temperature sensor to the Arduino Uno as follows:

- └ Connect the VCC pin of the temperature sensor to the 5V pin of the Arduino.
- └ Connect the GND pin of the temperature sensor to the GND pin of the Arduino.
- └ Connect the signal pin of the temperature sensor to a digital input pin of the Arduino (e.g., pin 2).
- └ Write the Arduino code to read temperature data from the sensor.

II. EXPERIMENTAL RESULTS

The properties and the quantity of proportions remain same for all the mixes but the percentage of admixtures changes for every mixes. The strengths of self-curing concrete is compared to the strengths of normal concrete.

COMPRESSIVE STRENGTH RESULTS FOR DIFFERENT PERCENTAGE OF STEEL SLAG FORM 20 GRADE

SL. NO	Percentage replacement of Steel slag	Compressive strength in MPa		
		7 days N/mm ²	14 days N/mm ²	28 days N/mm ²
1	0%	22.02	27.81	30.6
		25.81	30.3	33.33
2	5%	29.8	33.24	36.56
		31.3	35.81	39.39



Mould Observation

Sample 1 (Concrete Mould)

SLNo	Actual Temperature	Block Temperature
Day1 10.00AM 2.00PM 4.00PM	30°C 37°C 37°C	45.92°C 68.36°C 70.52°C
DAY2 10.00AM 2.00AM 4.00PM	31°C 37°C 37°C	48.92°C 75.69°C 70.52°C
DAY3 10.00AM 2.00AM 4.00PM	30°C 37°C 38°C	50.81°C 70.92°C 71.55°C
DAY4 10.00AM 2.00AM 4.00PM	30°C 36°C 37°C	58.91°C 69.08°C 71.81°C

Sample 2 (Bituminous Concrete Mould)

SLNo	Actual Temperature	Block Temperature
Day1 10.00AM 2.00PM 4.00PM	30°C 37°C 37°C	65.16°C 75.45°C 78.23°C
DAY2 10.00AM 2.00AM 4.00PM	31°C 37°C 38°C	68.15°C 75.82°C 78.89°C
DAY3 10.00AM 2.00AM 4.00PM	30°C 37°C 37°C	65.81°C 72.3°C 75.4°C
DAY4 10.00AM 2.00AM 4.00PM	30°C 37°C 37°C	68.58°C 74.3°C 79.4°C

Sample 3 (Concrete Mould)

SLNo	Actual Temperature	Block Temperature
Day1		
10.00AM	30°C	55.58°C
2.00PM	37°C	67.5°C
4.00PM	38°C	68.6°C
DAY2		
10.00AM	30°C	58.035°C
2.00AM	37°C	70.3°C
4.00PM	37°C	75.4°C
DAY3		
10.00AM	31°C	61.25°C
2.00AM	37°C	73.3°C
4.00PM	37°C	78.4°C
DAY4		
10.00AM	30°C	54.2°C
2.00AM	38°C	75.3°C
4.00PM	37°C	73.4°C

III. CONCLUSION

The Compressive strength of concrete M20 grade mix is obtained by increase with increase in steel slag with constant percentage of coarse aggregate as compared to conventional/normal concrete. Crushing strength less than 40% non-wearing course. Abrasion value for the selected aggregates is 35% which can be used for surface course of bituminous concrete pavement. The Impact value of selected aggregate of 29% which can be used for construction of bituminous concrete pavement. Flakiness and Elongation index of the selected sample of aggregate is 12.4% and 11.6% respectively hence can be used for construction of bituminous concrete pavement. Penetration value of the selected Bitumen of grade VG-30 is 54mm and hence it can be used for surface course. Ductility value of the selected Bitumen of grade VG-30 is 82mm and hence it can be used for surface course. Softening point of the selected Bitumen of grade VG-30 is 57°C and therefore it can be used for surface course. Temperature checking for bituminous mould .

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