Performance Evaluation of Reclaimed Asphalt Pavement (RAP) in Rural Roads

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Abstract — This paper seeks to evaluate the performance of Reclaimed Asphalt Pavement (RAP) in the construction of rural roads. It aims to assess the engineering properties, environmental sustainability, cost-effectiveness, and overall performance of RAP under rural road conditions. The study makes use of both field studies and laboratory tests to comprehensively understand the properties and performance of RAP. The present study will be helpful for the objective identification and characterization of RAP material, the optimum portion of RAP binder will be used in virgin binder and RAP aggregates can be reused in asphalt and sub-base as well. Marshall Flow value increased with increasing the RAP content. Marshall Stability= 916.33 kg. Bitumen content corresponding to maximum Stability = 5.5 %. Bitumen content (5.5%) and RAP content (20%) corresponding to. Air voids = 1.40%. VFB at 20 % = 95.38%.

Keywords: Reclaimed Asphalt Pavement (RAP), Rural Roads

I. INTRODUCTION

Despite asphalt being an integral part of human society for over 6,000 years and modern society for over a century, many complexities of asphalt pavement still elude researchers. In particular, this research focuses on the ability to recycle spent asphalt pavement and aggregate into new pavements. When old asphalt pavement is in need of maintenance or replacing the old material can be mechanically ground and then reused as a substitute for raw materials in new roads. This old, recyclable material is known as reclaimed asphalt pavement (RAP). Nowadays the use of RAP as secondary material in the production of asphalt mixes has become a norm and a cost effective method of pavement construction and rehabilitation. Utilizing reclaimed asphalt pavement is found to be very beneficial from the technical, economic, and environmental perspectives. Some of the advantages include reduced waste, preservation of the existing pavement geometric, conservation of energy, and reduction in life-cycle cost. Many laboratory and field studies have shown that asphalt mixtures containing RAP performed similarly if not better than conventional asphalt materials in terms of indirect tensile strength, moisture susceptibility, permanent deformation, and fatigue. However, research has also shown that RAP inclusion can have a negative effect on the fatigue resistance of the mixture.

II. OBJECTIVES

The experimental work is carried out to find the effect of varying proportions of RAP materials on the Strength and Durability of Pavement, following objectives are proposed:

- To use RAP as a recycled material and to solve the problem of waste disposal.
- To evaluate the strength characteristics of Bitumen and Recycled Aggregates for different proportions of RAP in replacement of 10%, 20%, 30%,40%, and 50%.
- To study the results of replacement and concentration on future use, & Study the aging effect on RAP hot mix asphalt.
- To determine the Marshall stability at an optimum bitumen content.

III. RESULTS AND DISCUSSION

i. Finding Optimum Bitumen Content:- The ideal bitumen content for the blend outline is found by taking the normal estimation of the accompanying three bitumen substance found from the charts of the test outcomes.

- Bitumen content relating to most extreme security.
- Bitumen content relating to most extreme unit weight.
- Bitumen content relating to the middle of composed breaking points of percent air voids in absolute blend (4%).

The Marshall Stability esteem, Flow esteem and percent Voids Filled with Bitumen at the normal estimation of bitumen substance are checked with the Marshall blend outline criteria/determinations as given in Table 3 underneath.

$$Bo = \frac{B1+B2+B3}{3} \quad \text{..... (1)}$$

Where:-

B_o = optimum content.

B_1 = % of asphalt content at maximum specific gravity.

B_2 = % of asphalt content at maximum stability.

B_3 =% of asphalt content at 4 % of air voids in total mix.

$$Bo = \frac{B1 + B2 + B3}{3}$$

$$Bo = \frac{5 + 5.5 + 5}{3}$$

$$Bo = 5.1\%$$

Marshall Stability= 902 kg

Bitumen content corresponding to maximum Stability = 5.1 %

Bitumen content corresponding to air voids = 4.805%

And VFB at 5.1 % = 67.89%

After using RAP Plotting Curves

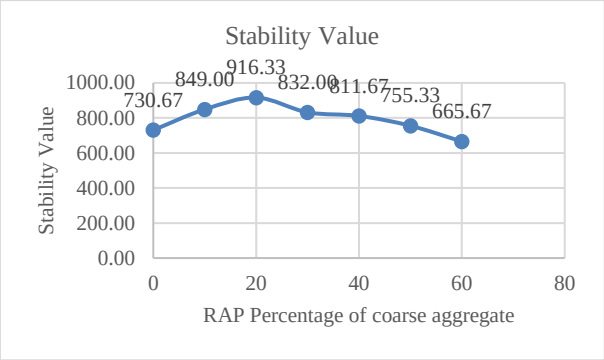

Fig. 1: Plotting Curves Marshall Stability Value vs Bitumen + RAP Content

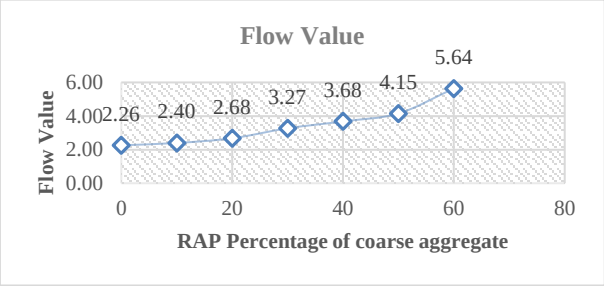

Fig. 2: Plotting Curves Marshall Flow Value VS Bitumen + RAP Content

IV. Results and Discussion

- RAP materials can be successfully used in granular sub-base layers of flexible pavements after blending to match the required grading as per MORTH specifications for sub-base material.
- Asphalt recycling will be sustainable, Asphalt recycling will be economical & Asphalt recycling works will start.
- Optimum bitumen contain got utilizing the marshal solidness test is 5.1%.
- It is watched that the expansion Marshall Stability esteem with bitumen contains up to 5% and from there on reductions.
- Marshall Flow esteem increments with the expansion of the rate of bitumen contain.
- Maximum Marshall Stability value is 916.33 at 20% of RAP content and 5.5 % constant bitumen content.
- It is watched that the Marshall Stability value is increased at the percentage of 20% and than decreased
- Marshall Flow value increased with increasing the RAP content
    - Marshall Stability= 916.33 kg
    - Bitumen content corresponding to maximum Stability = 5.5 %
    - Bitumen content (5.5%) and RAP content (20%) corresponding to
    - Air voids = 1.40%
    - VFB at 20 % = 95.38%

For a country like India, where hot temperature prevails in summer in several parts, permanent deformation of bituminous layer is a major concern.

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