CHARACTERSTICS OF ASPHALT PAVEMENT WITH RECLAIMED ASPHALT PAVEMENT

[1]Ujjawal Naulkha, [2]Er Mohit Bajaj

[1]M.Tech Scholar, [2]Assistant Professor
[1]GEC Panipat, [2]Chandigarh University

***Abstract*: Pavement recycling is a logical and practical way to conserve our diminishing supply of construction materials and to help reduce the cost of preserving our existing pavement network. When properly designed and constructed, recycled pavements have been found to perform as well as pavements built with all new materials. The asphalt pavement industry recycles approximately 73 million tons of material annually, which is more than twice the combined total for recycled paper, glass, plastic, and aluminum. Recycling of asphalt pavements is one of the effective and proven rehabilitation processes. It has been successfully used at many places world over and has shown satisfactory performance. Reasons to why recycling was not given importance in India during the first half of the 20th century are those of economic considerations and availability of suitable technology. The cost of new hot mix materials a few decades ago had been less than the cost of handling, transportation and reprocessing of in-situ material. Also the availability of machinery was another constraint in adopting this technology. Different percentages of reclaimed asphalt pavement material in asphalt mixtures are 0%, 12%, 24%, 36% and 48% used in this study.**

***Keywords*: Reclaimed Asphalt Pavement (RAP), Flexible Pavements, Marshall Stability, Flow value.**

1.0 INTRODUCTION

Reclaimed asphalt pavement (RAP) is the term given to removed and/or reprocessed pavement materials containing asphalt and aggregates. These materials are generated when asphalt pavements are removed for reconstruction, resurfacing, or to obtain access to buried utilities. When properly crushed and screened, RAP consists of high-quality, well-graded aggregates coated by asphalt cement.

Asphalt pavement is generally removed either by milling or full-depth removal. Milling entails removal of the pavement surface using a milling machine, which can remove up to 50 mm (2 in) thickness in a single pass. Full-depth removal involves ripping and breaking the pavement using a rhino horn on a bulldozer and/or pneumatic pavement breakers. In most instances, the broken material is picked up and loaded into haul trucks by a front-end loader and transported to a central facility for processing. At this facility, the RAP is processed using a series of operations, including crushing, screening, conveying, and stacking.

Although the majority of old asphalt pavements are recycled at central processing plants, asphalt pavements may be pulverized in place and incorporated into granular or stabilized base courses using a self-propelled pulverizing machine. Hot in-place and cold in-place recycling processes have evolved into continuous train operations that include partial depth removal of the pavement surface, mixing the reclaimed material with beneficiating additives (such as virgin aggregate, binder, and/or softening or rejuvenating agents to improve binder properties), and placing and compacting the resultant mix in a single pass.

When an asphalt parking lot or roadway is scheduled to be rehabilitated, the pavement material is removed in chunks or ground up onsite using a milling machine. The RAP chunks and millings are then taken to the asphalt plant, crushed, and mixed with virgin materials to produce new asphalt mixtures. The result is an asphalt mix containing recycled pavement material, used to build new parking lots, roads and pathways.

While several factors influence the use of RAP in asphalt pavement, the two primary factors are economic savings and environmental benefits. RAP is a useful alternative to virgin materials because it reduces the use of virgin aggregate and the amount of virgin asphalt binder required in the production of HMA. The use of RAP also conserves energy, lowers transportation costs required to obtain quality virgin aggregate, and preserves resources. Additionally, using RAP decreases the amount of construction debris placed into landfills and does not deplete nonrenewable natural resources such as virgin aggregate and asphalt binder. Ultimately, recycling asphalt creates a cycle that optimizes the use of natural resources and sustains the asphalt pavement industry.

2. BENEFITS OF ASPHALT RECYCLING

1. The recycled version is just as good as the original. This is one instance where recycling doesn't lose any quality. Some even argue that the recycled asphalt pavement or RAP is of a higher quality than the original pavement, being more durable and sturdy. RAP is also renewable - something traditional asphalt can't claim.
2. Asphalt increases the use of other recyclables. Materials from other industries are recycled into asphalt materials instead of winding up in landfills. Everything from glass, and asphalt roofing shingles finds a home in new asphalt. You get benefits from these additions too - each added material brings a new property to the mixture.
3. Still thinking about the environment? Increased use of RAP as a percentage of the total asphalt mix can significantly reduce greenhouse gas emissions by eliminating the significant fuel consumption required to acquire and process raw materials for virgin mix.
4. Stone, sand and gravel, the aggregates of asphalt are actually a limited resource. Preserving these resources through recycling is essential to keeping roads safe and comfortable into the future
5. Sustainable development of project

6. Optimisationing the use of natural recourses
7. Diminution in material cost, energy cost and total job cost
8. Increase in restrictions on the dumping of reclaimable materials
9. Reducing environmental impact ratio
10. Lower cost.

3. PROCESS OF USING RAP

Removal and reuse of asphalt layer of existing pavement is termed as RAP. However full depth reclamation (FDR) is defined as removal and reuse of hot mix asphalt layer and entire base course. RAP can be reused immediately at sites. The required gradation of RAP is achieved by pulverizing the material in a crusher. The use of Reclaimed Asphalt Pavement is gradually receiving popularity with the latest development in technology. Earlier we used pavements were scarified by excavators work which gave huge blocks of Reclaimed Asphalt Pavement materials. Therefore it was tough to use Reclaimed Asphalt Pavement materials in the construction of new pavements construction work. Now with the modern development in science technology, combatant have been made available in the market easily which cut the pavement to desired thickness thereby making the use of Reclaimed Asphalt Pavement materials much easier.

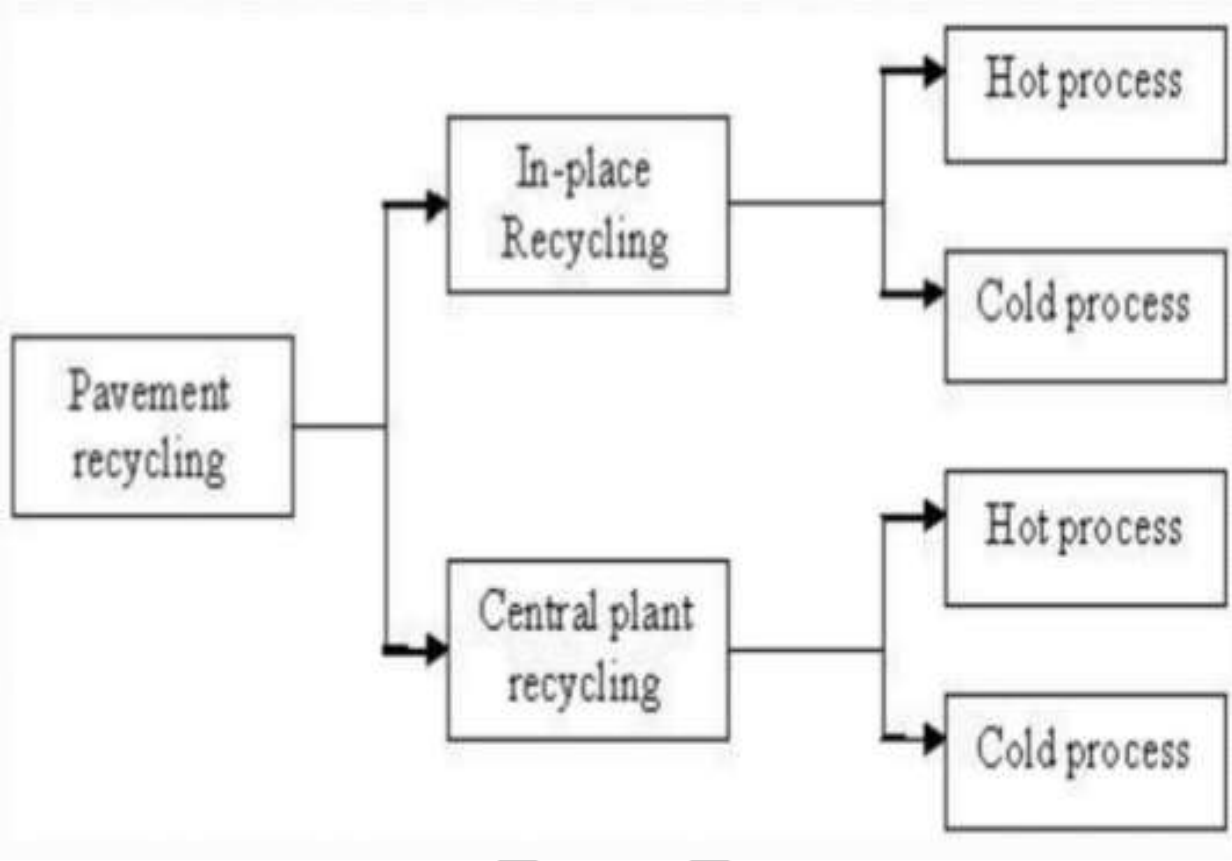

Figure 1: Process of Recycling

4. LITERATURE REVIEW

Burak Sengoz et al stated the Performance Evaluation of Warm Mix Asphalt Mixtures with Recycled Asphalt Pavement. This paper shows the feasibility of utilizing four different WMA additives (organic, chemical, synthetic zeolite and natural zeolite) with different rates of RAP. Following the determination of optimum RAP content corresponding to each WMA additive, Marshall Analysis, indirect tensile stiffness modulus and fatigue behavior of HMA and WMA involving RAP were analyzed and compared with control specimens. Hamburg wheel tracking device was also utilized to evaluate the permanent deformation characteristics of mixtures containing optimum RAP content. In this research, RAP has been used (at contents of 10–50%) within both HMA and WMA mixtures. Each type of WMA mixture has been prepared with an optimum rate of WMA additive that is based on the recommendation of manufacturers (organic additive at a rate of 3%, chemical additive at a rate of 2% and two types of water containing additives at a rate of 5% by weight of the bitumen). The mechanical performances of the samples were evaluated by Marshall Stability test. Following the determination of optimum RAP content regarding each mixture involving four different types of WMA additive, indirect tensile stiffness modulus (ITSM) and fatigue behavior of WMA and HMA containing optimum RAP content were analyzed and compared with control specimens. Hamburg wheel tracking device was also used to determine the rutting properties of mixtures involving optimum RAP content.

Maulik Rao et al studied the utilization of recycled asphalt pavement in the Urban Area at Surat, Gujarat, India. The main / primary objective was to justify the cost of milling and to make it viable option so that the same can be used effectively. Some practical options to use the RAP material in urban areas are discussed in this study and thereby achieving economy in the construction besides solving the raised level of roads, effective disposal of RAP and above all using the principles of environment friendly Green

technology that is: Reduce, Reuse and Recycle. The practical study shows the definite impact on replacement of virgin material for various road constructions. The CBR values increasing to 2, 3.8 and 6.8 % respectively by 20, 40 and 60 % RAP mixing in black cotton soil surely work for improved sub-grade.

Ahmed Ebrahim et al characterized the use of Recycled Asphalt Pavement (RAP) for Use in Flexible Pavement. The main objective of this paper is to investigate the use of a homogeneity reclaimed asphalt pavement in the pavement industry evaluating the effects of partial and total replacements of aggregates by RAP on the mechanical and durability performance of dense-graded HMA mixtures. The performance of RAP mixtures was evaluated through a series of laboratory tests including Marshall test, indirect tensile strength test, granule adhesion test and material test systems. A series of binder mixes containing varying percentages of RAP were designed and subjected to different moisture conditioning periods (1, 3 and 7 days) to investigate the moisture damage effect on RAP mixtures. The laboratory results indicated that when properly designed, the asphalt mixes with RAP especially at 50 to 100% replacement ratio provided better performance compared to those of new conventional HMA mixtures where they minimized the environmental impacts through the reduction of energy consumption, improved the mechanical properties, durability performance and also stripping resistance.

Farzaneh Tahmoorian et al evaluated the Mechanical Properties of Recycled Material for Utilization in Asphalt Mixtures. In this research, the properties of RCA have been evaluated through laboratory investigations. Based on the test results, it is required that combination of RCA with some other targeted waste materials be considered in asphalt mixture. This paper presents the results of an experimental study to evaluate the RCA properties as an alternative for virgin aggregate in asphalt mixture under different percentages and combination with other aggregates, such as reclaimed asphalt pavement (RAP) and basalt.

5. PREPARATION OF MARSHALL SAMPLES

To achieve the objectives of this study the basic properties tests were performed on the studied materials and then Marshall Test was conducted on asphalt mixtures with different percentages of reclaimed asphalt pavement materials with optimum bitumen content determined for 100% fresh aggregate. The different percentages of reclaimed asphalt pavement material in asphalt mixtures are 0%, 12%, 24%, 36% and 48%. Following is the procedure for the preparation of specimen mix.

1. 1200 grams of aggregate blended in the desired proportions is measured and heated in the oven to the mixing temperature.
2. Bitumen is added at the mixing temperature to produce viscosity of 170 ± centi-stokes at various percentages.
3. The materials are mixed in a heated pan with heated mixing tools.
4. The mixture is returned to the oven and reheated to the compacting temperature (to produce viscosity of 280±30 centi-stokes).
5. The mixture is then placed in a heated Marshall mould with a collar and base and the mixture is spaded around the sides of the mould. A filter paper is placed under the sample and on top of the sample.
6. The mould is placed in the Marshall Compaction pedestal.
7. The material is compacted with 50 blows of the hammer (or as specified), and the sample is inverted and compacted in the other face with same number of blows.
8. After compaction, the mold is inverted. With collar on the bottom, the base is removed and the sample is extracted by pushing it out the extractor.
9. The sample is allowed to stand for the few hours to cool.

The mass of the sample in air and when submerged is used to measure the density of specimen, so as to allow, calculation of the void properties.

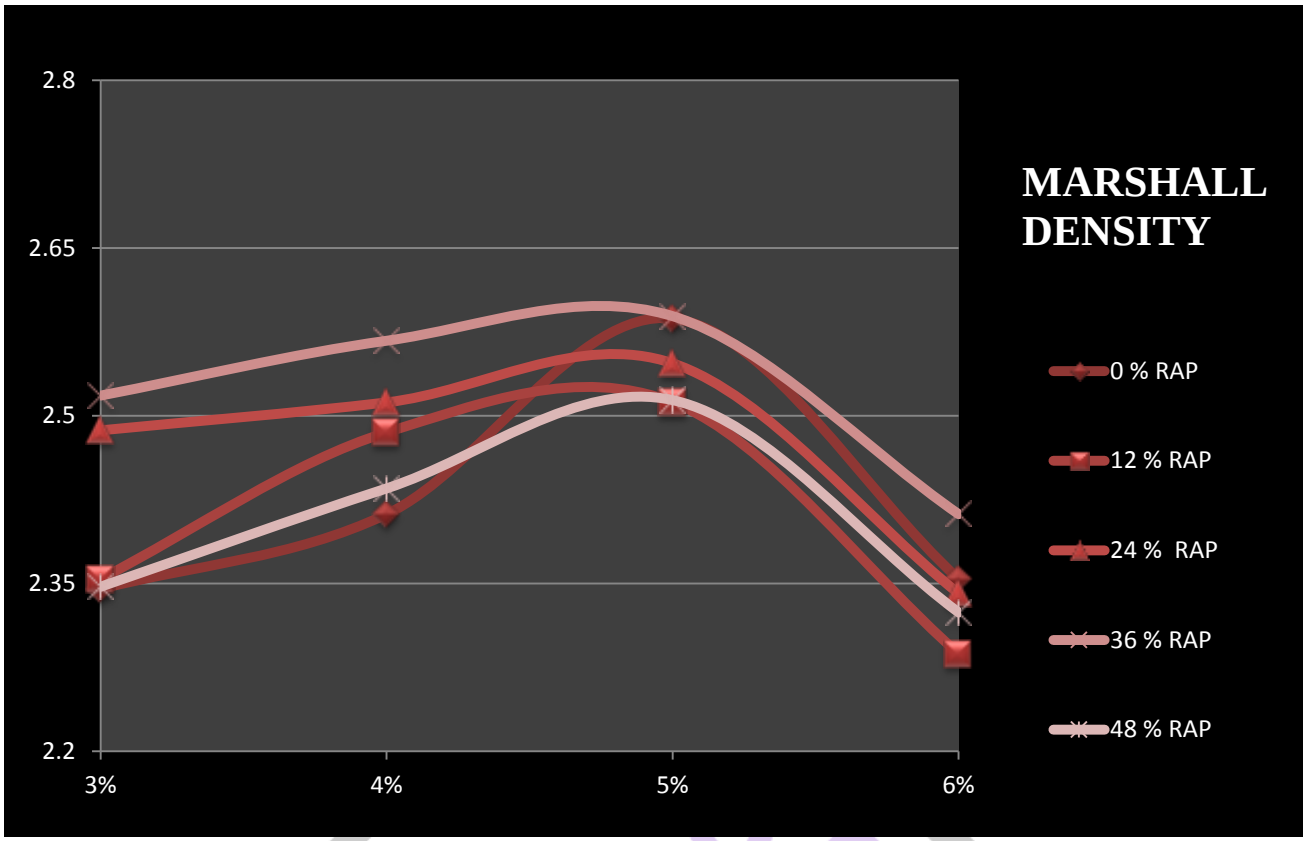

Figure 2: Variation of Marshall Density With %age of RAP

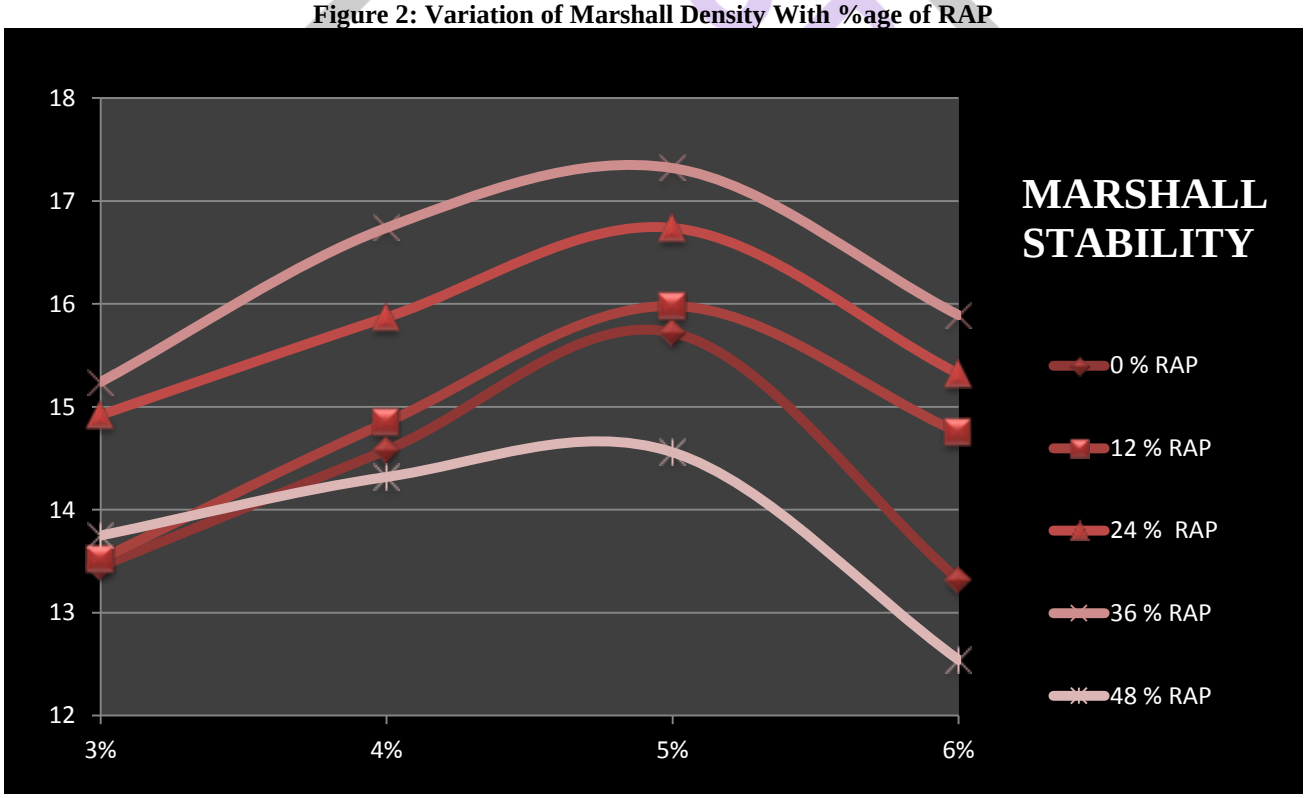

Figure 3: Variation of Stability With %age of RAP

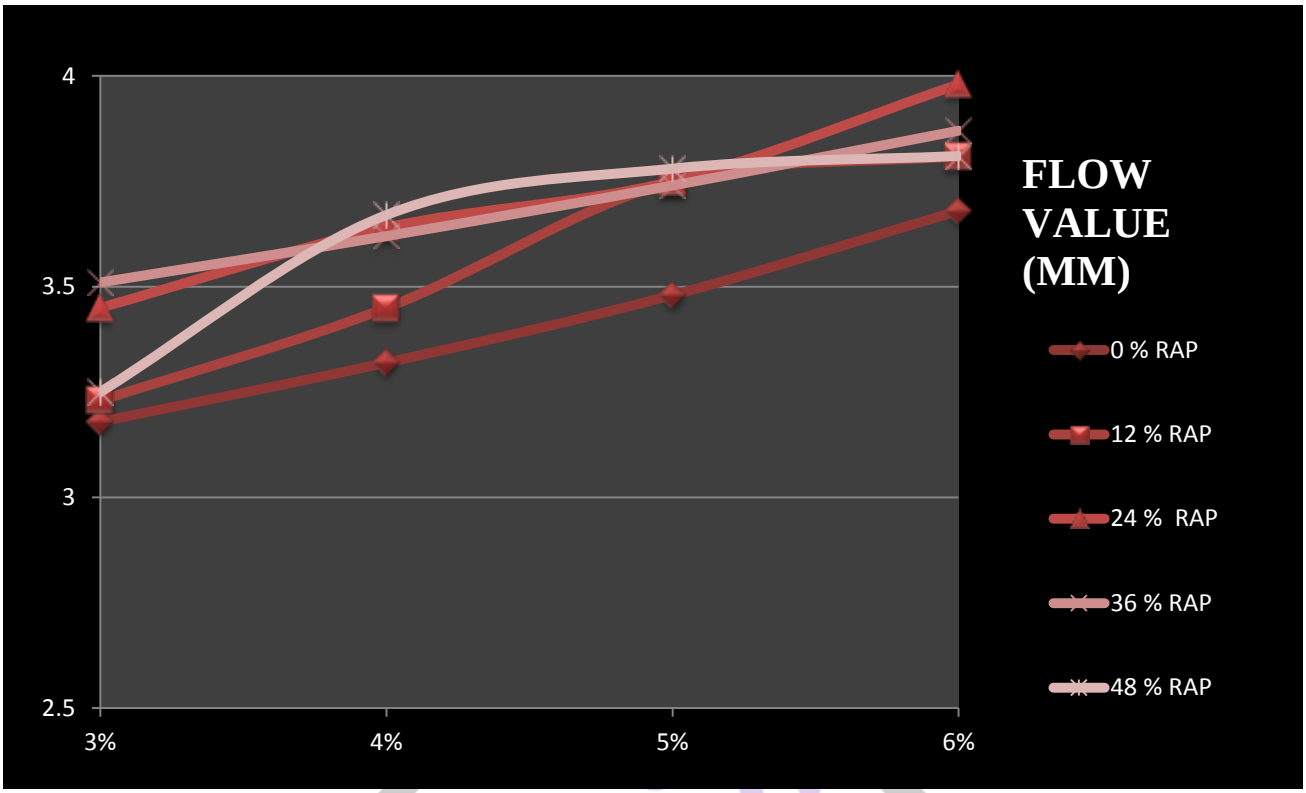

Figure 4: Variation of Flow Value With %age of RAP

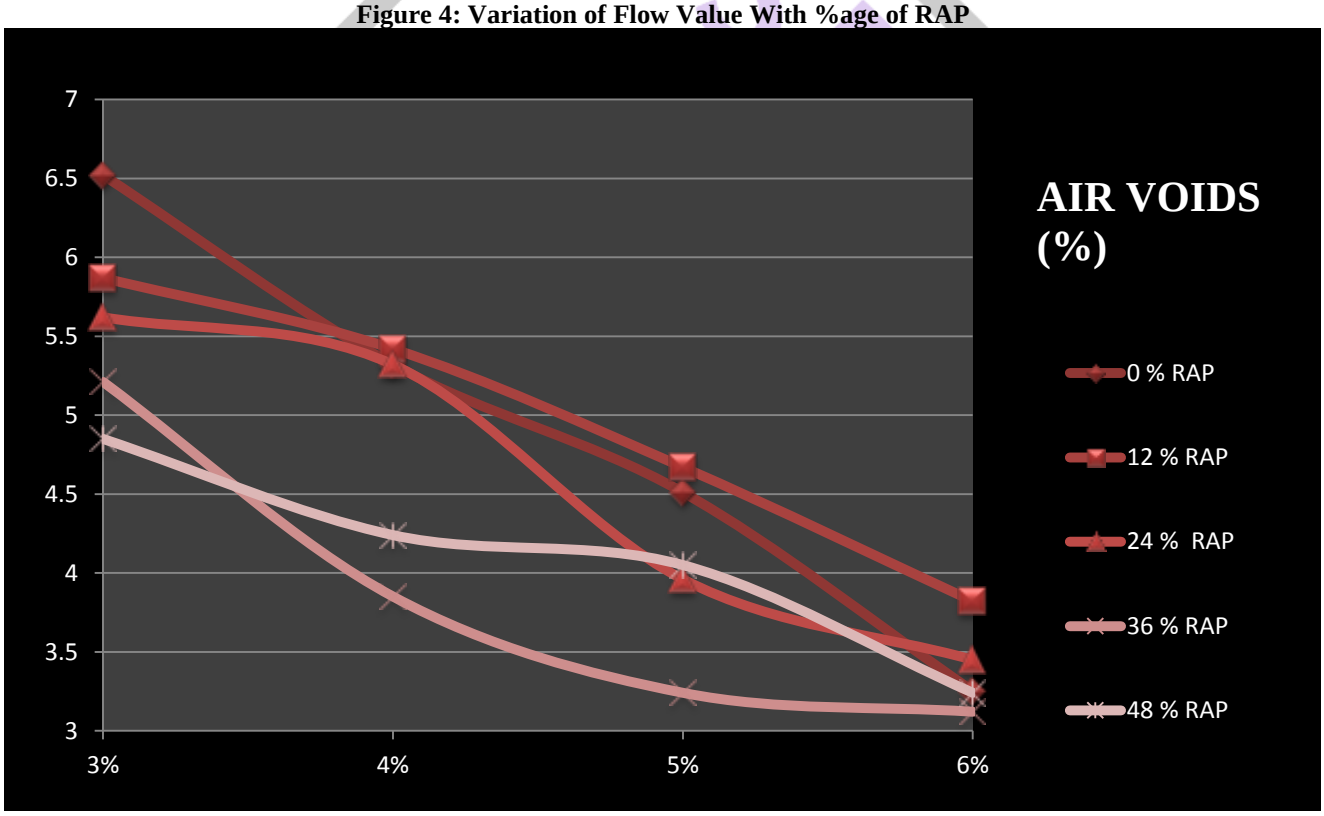

Figure 5: Variation of Air Voids With %age of RAP

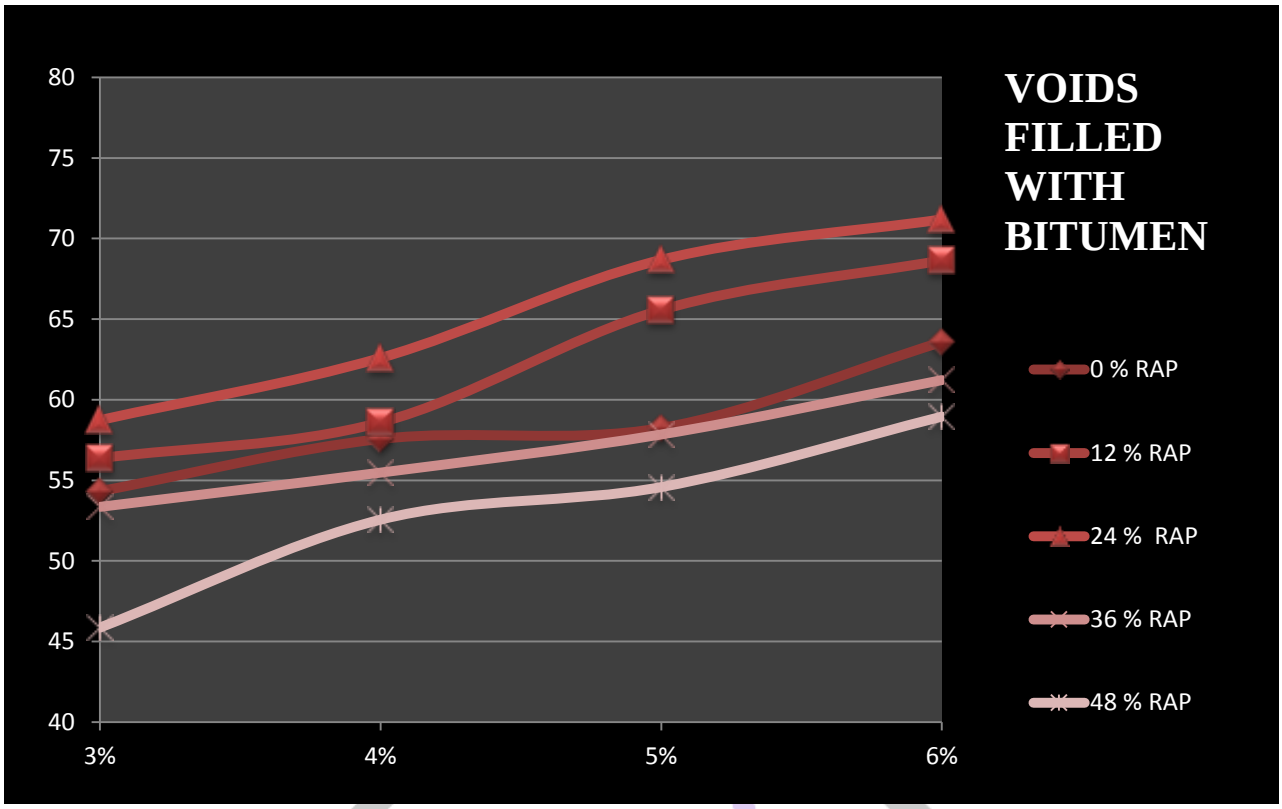

Figure 6: Variation of Voids filled with bitumen with %age of RAP

CONCLUSION

Based on the results and discussion of experimental investigation carried out on mixes, Following conclusions are drawn:

1. In laboratory, bituminous mixture blended with RAP is designed using Marshall Method and it is observed that bituminous mixes containing RAP material perform same or even better than the conventional mix.
2. The optimum binder content is 5 % for fresh aggregate.
3. The maximum Marshall stability of bituminous mix is achieved at 36 %.
4. Reclaimed Asphalt Pavement is a new technology of construction work with the help of which bituminous pavements can be constructed at a decreased cost as it involves the utilize of old bituminous pavement materials.
5. The resistant to rutting and high skid resistance will increase with the use of reclaimed asphalt content.
6. The fact that Optimum Binder Content remained unchanged even after adding RAP materials indicates that the old binder perfectly blended with fresh binder.
7. The proportioning of the aggregates with reclaimed aggregates at all specified percentages of 12,24,36 and 48 % have given correct blending of the aggregates meeting the specification requirements.

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