A REVIEW OF EFFECT OF AGGREGATE SHAPE, SIZE ON SURFACE PROPERTIES OF FLEXIBLE PAVEMENT

[1]Ritu Mehta, [2]Avinash Gurjar, [3]Jayesh Juremalani
[1]M.tech student, [2]Junior Scientific Assistant, GERI [3]Assistant Professor
[1]Transportation Engineering, CED
[1]Parul Institute of Engineering & Technology, Parul University, Vadodara, India

***Abstract*—This paper of review the effect of aggregate shape, size on surface properties of flexible pavement by reviewing various research work carried out by various researchers, Aggregates are main and most important particle in any construction work, thus aggregates shape, size distribution influence the workability, blending, strength, stiffness, density durability & permeability of bitumen, previous studies shows that these is an obvious relationship between overall shape, surface texture, gradation of aggregate in certain volume.**

***Index Terms*—Aggregate, Shape, size, bitumen, Marshall Mix**

I. INTRODUCTION

Now a day's road transportation plays important role in development of any country. Road transport provides greater utility in transport over short and long distance. Road as one of land transportation infrastructure is very important in supporting the economic for both regional and national development due to this finding the best design of surfacing layer had been a positive competition among manufactures and designers. India has a road network of over 4.69 million kilometers, second large roadways in the world. Highway can be divided into two groups functionally and structurally. Functional classification further classified into five more categories as National Highways, State Highways, Major District Road, Other district roads, Village Road.

Based on Structural performance, pavements can be classified into two types – Rigid and Flexible. Flexible pavements are those which are surface with bituminous materials. On the other hand Rigid pavements are composed of pre-stress cement concrete (P.C.C.). Most of the Indian roads are flexible pavements. The particle size distribution, or gradation, of aggregates is most important factor that affects the whole performs of the pavement material. Gradation is one of most influence factors for Marshall Properties of DBM mix, Bituminous concrete as one of road surface material is mainly influenced by the quality of aggregates since aggregate occupies 95% by weight in total mixture.

II. LITERATURE SEARCH

Afaf A. H. M. (2014) has study the effect of Mineral aggregates make up 90 to 96% of a HMA mix by weight or approximately 75 to 85% by volume. The research has investigated the impact of aggregate gradation variations on various properties of asphalt concrete mixtures. Fine, medium and coarse gradation mixtures for different aggregate types were tested to investigate the effects of variation in the aggregate types and gradation on mix properties. The Research investigation has include testing of Properties i.e. Marshall Stability, Marshall Flow, unit weight, air voids, and voids in mineral aggregate. Analysis of the considering different aggregate type data revealed that the fine coarse and coarse-fine gradation variations had the greatest impact on mix. The research program concentrated on the Marshall Design criteria for bituminous mixes. The results indicated that optimum asphalt content (OAC) is different due to aggregate type a coarse grading with 25 mm maximum size is found to give the most satisfactory result from the stand point of stability, stiffness, and voids characteristics. Test results reveal that the bituminous concrete with WCA can give satisfactory results when they are constructed using coarse gradation [1].

Ambika Kuity and Animesh Das (2014) have carried out study of application of imaging technique to estimate the aggregate size distribution in asphalt mix. Aggregate size in asphalt mix typically varies by several orders of magnitude. Thus, it may become difficult to use a single imaging technique to assess the entire spectrum of aggregate size distribution. In the present study, different imaging equipment namely, camera, scanner and scanning electron microscope (SEM) are used to capture images of asphalt mix. Each equipment has an upper and a lower size limit within which the aggregates are distinguishable. The images are analyzed to derive information on aggregate size distribution. Performance of the individual imaging techniques on an asphalt mix sample of known aggregate gradation is studied [2].

Ramadhansyah Putra Jaya et.al. Have studied to evaluate the effects of aggregate shape on volumetric properties of asphaltic concrete mixtures. The aggregate gradation of AC14 was prepared using granite aggregates crushed via compression and impact crushers. In this study, compression crusher was used to produce aggregates with flaky and elongated shape while the impact crusher was used to produce aggregates with a cubical shape. Modified bitumen, Styrene-Butadiene-Styrene (SBS) was used in preparing the specimens. The stability, density, voids in total mix, voids filled with bitumen, and voids in mineral aggregate of asphalt mixture specimens was investigated. In addition, the resilient modulus test with temperature of 25ºC and stiffness modulus test with temperature of 40ºC was carried out using the Universal Testing Machine in accordance with ASTM D4123 standard. The test results showed that the volumetric properties improved when cubical aggregate was introduced to the asphalt mixture. Moreover, the incorporation of geometrically cubical aggregates in asphalt mixture causes an increase in resilient and stiffness modulus compared to asphalt mixture prepared with irregularly aggregates [3].

Burak Sengoz, Amir Onsori and Ali Topal (2014) have study one of the most important properties of flexible pavements in terms of tire-pavement interface is surface texture. The texture of a pavement surface and its ability to resist polishing effect of traffic is of prime importance in providing skidding resistance. Pavement surface texture greatly contributes to tire-pavement skid resistance which has a direct

effect on traffic operation and safety particularly at high speeds. Doubtless, there exists a close relationship between pavement surface texture and aggregate angularity within the wearing course. This paper is aimed to determine the effect of aggregate shape on the surface properties of Hot Mix Asphalt (HMA). Two different mineralogical types of aggregate (basalt and limestone) have been crushed with impact, jaw and roll type of crushers. Various types of aggregate with different shapes have been mixed with 50/70 penetration grade bitumen to form dense graded mixtures. Test methods related with the evaluation of shape and texture characteristics have been utilized to characterize the geometrical properties of aggregates. The texture and friction properties of asphalt slabs have been evaluated by means of sand patch test, 3D laser scanner and dynamic friction tester respectively. The results indicated that a relationship exists between the shape characteristics of aggregate and the surface properties of HMA[4].

Meor Othman Hamzah, Marliana Azura Ahmad Puzi and Khairun Azizi Mohd Azizl have carried out recherché of findings of a laboratory study aimed at investigating the effects of asphalt mixtures incorporating geometrically cubical aggregate to optimize the design of HMA mix. A total of 75 specimens with a high degree of cubicity were tested for stability and flow. The Marshall Test results of five different coarse cubical aggregate percentages show the substantial effect of aggregate shape on mix mechanical properties. The partial substitution of normal aggregate in hot-mix asphalt (HMA) with geometrically cubical aggregate was investigated. The process and mechanism of aggregate cubisizing within the rock on rock impact crusher is unique as the crusher was effectively tuned to reshape and treat the much finer fractions. In this research, the crushing technology effectively crushed, trimmed and churned up normal aggregate to produce coarse and fine aggregates. This study also quantified the properties of geometrically cubical and normal shape surface texture of both fine and coarse aggregates. The morphological properties of fine and coarse aggregates were analyzed and observed under the Light Microscope and Scanning Electron Microscope (SEM). The results indicate that, in general, incorporation of geometrically cubical aggregate was beneficial in improving physical and mechanical characteristics of coarse aggregate in HMA[5].

Deepesh Kumar Singh Lodhi and R. K. Yadav have study Semi Dense Bituminous concrete (SDBC) is the upper bituminous layer of the road subjected to moderate traffic loads. The grading of aggregates used to make the SDBC mix should fall inside the limits specified in MoRTH. For each aggregate fraction there is a definite gradation range with lower and higher limits of aggregates passing through a particular sieve size. The study is done, so they evaluate the Marshall property of SDBC mix makes using the aggregate having different grading within the grading limits specified by the MoRTH. In order to study this aspect five mixes having different gradation were prepared. The test result shown that there is important variation in Marshall Properties of the mixes having different gradation of the aggregates. The Stability values obtained is maximum for the Lower Middle Grade (L.M.G.) range of MoRTH specification. The Flow values obtained is maximum for the Middle Grade (M.G.).The Optimum Bitumen Content (O.B.C.) is also minimum in Lower Middle Grade (L.M.G.)

Suren muhammad salih and Dr p.sravana has investigate shape criteria that govern behavior and performance of aggregate in the bituminous mixes. This research has been done in Hyderabad airport in India, which a lot of pavement area cracked and failed due to existence of flaky aggregate particles. The strength and serviceability needs of bituminous mixture such as Stability, Flow, and Voids in Total mix (VTM) and Voids Filled with Bitumen and (VFB) highly depend on the physical properties of aggregates. The particle shape determined how aggregate was packed into a dense configuration and also determined the internal resistance of a mix. The results they found from the study showed that the strength and stability of the bituminous mixes decreases gradually by increasing flakiness index.

Abu Zakir Morshed and Quazi Sazzad Hossain has done study in Bangladesh. Bangladesh is a developing country and its road network demands an ever-increasing expansion. Roads in Bangladesh are usually constructed of flexible pavement. The type and quality of aggregates are of prime importance on the design strength of the pavement. A laboratory investigation was made to evaluate the effect of the shape of aggregates as manifested by flakiness and elongation indices on the design strength of the bituminous mixes for flexible pavement construction. Test results revealed that both stability and flow values increased with the decrement of flaky and elongated particles for the aggregate matrix. At a temperature of 3000F and when no elongated or flaky particles were used in the mix, the stability value was 340 kN and the flow value was 4.8. When temperature was increased to 3200F, stability also increased by 18.5% but the flow reduced to 4.4. Stability value reached as high as 598 kN when flakiness index was 34% with no elongated particles in the mix.

Ganapati naidu .P and S. Adiseshu has developes that the shape of aggregate particle has significant influence on performance of the Bitumen pavement. Particle shape can be defined as cubical, blade, disk and rod .The strength serviceability requirements of Bitumen mixes such as stability, flow, voids in mineral aggregate (VMA), voids filled with bitumen (VFB) and air voids are highly depend on the physical properties of aggregate. They also studied that dense bituminous macadam (DBM) mixes were considered with different proportions (10%, 20%, 30%, 40%, 50%) of different shape of aggregates . Mixes with cubical and rod shape aggregates has been exposed good results on stability. The parameters such as air voids and voids in mineral aggregate increases with increase in proportion of blade type of aggregates in DBM mixes. The particle index value of coarse aggregate significantly affected the engineering properties of Hot mix asphalt (HMA) mix. The particle shape determined how aggregate packed into a dense configuration and also determined the internal resistance of a mix.

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