A Review Paper on Bituminous Concrete Mixed Design For Road Construction

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Abstract – 98% highways constructed in flexible pavement road. Bituminous Concrete mix design emphasizes to determine the proportion of bitumen, filler, fine aggregates, and coarse aggregates to produce a mix which is workable, strong, durable and economical. Bituminous concrete mix is the most common material used for flexible pavement road construction. It primarily consists of bitumen binder and aggregates. Bitumen binder acts as an adhesive agent that binds aggregate particles into a cohesive mass. One thing is of major considerations in this regard –pavement design. Our project emphasizes on the mix design consideration to find out the optimum binder content. In this design we have studied Marshall Stability test method.

Keywords – Bitumen, Aggregate, Bituminous Concrete, Optimum Binder Content, Marshall Stability

I-INTRODUCTION - Most of the roadways in India constructed with flexible pavement having surfacing course with bituminous concrete. Bituminous concrete should be constructed to satisfy the recommendation and requirements of Ministry of road transport and highways Section 509. This clause specifies the construction of Bituminous Concrete, for use in surfacing and profile corrective courses. During 1900's, the bituminous paving technique was first used on rural roads – so as to handle rapid removal of fine particles in the form of dust, from Water Bound Macadam, which was caused due to rapid growth of automobiles [Roberts et al. 2002]. At initial stage, heavy oils were used as dust palliative. An eye estimation process, called pat test, was used to estimate the requisite quantity of the heavy oil in the mix. By this process, the mixture was patted like a pancake shape, and pressed against a brown paper. The first formal mix design method was Hubbard field method, which was originally developed on sand bitumen mixture. Mixes with large aggregates could not be handled in Hubbard field method. India being the second largest growing economy in the world, in par with other developmental activities, road infrastructure is developing at a very fast rate. Large scale road infrastructure developmental projects like National Highway Development Project (NHDP) and Pradhan Manthri Gram Sadak Yojna (PMGSY) are in progress. The spurt in the growth of traffic and overloading of vehicles decreases the life span of roads laid with conventional bituminous mixes. This also leads to the reduction in the riding quality resulting in exorbitant vehicle operating costs and frequent maintenance interventions due to premature failure of pavements. Providing durable roads has always been a problem for a country like India with varied climate, terrain condition, rainfall intensities and soil characteristics. A good amount of research is going on all over the country in this field to solve the problems associated with pavements. It is observed that Stone Matrix Asphalt mixture is an ideal mixture for long lasting Indian Highways. The literature pertaining to the bituminous mixtures is reviewed in this chapter with a detailed discussion of SMA mixtures. Several research studies investigated the role that aggregate gradation plays in the performance of asphalt mixtures-

Elliot et al. (1991) conducted an investigation to evaluate the effect of different aggregate gradations on the properties of asphalt mixtures. The aggregate blends included: coarse, fine, and medium gradations and two poorly graded. From this investigation, they concluded that:- Variations in gradation have the greatest effect when the general shape of the gradation curve is changed (i.e., coarse-to-fine & fine-to-coarse gradations). Fine gradation produced the highest Marshall stability, while the fine-to-coarse poorly graded gradation produced the lowest Marshall stability.

Kandhal et al. (1993) studied the effect of aggregate gradation on measured asphalt content. A total of 547 binder coarse mix samples and 147 wearing coarse mix samples were obtained from field projects and the asphalt cement was extracted using ASTM D2172 "Standard Test Methods for Quantitative Extraction of Bitumen From Bituminous Paving Mixtures" procedure. Correlation analysis was performed to determine if the pavement layer density or the percentage passing various sieve sizes correlate with asphalt cement content. It was concluded that for binder course mixtures, the percent passing the 4.75 mm and 2.36 mm sieves correlated with measured asphalt cement content. Prediction equations were developed to adjust the measured asphalt cement content to account for the change in gradation from the job mix formula on the 12.5 mm sieve and either 4.75 mm or 2.36 mm sieves.

Krutz et al. (1993) evaluated the effects of aggregate gradation on permanent deformation of HMA mixtures for the Nevada Department of Transportation. They utilized four different gradations, two aggregate sources, and two sources of asphalt cement AC20 asphalt cement. Two of the gradations were labeled as extreme fine and extreme coarse with 60 % and 43 % passing sieve, respectively. The middle gradations had 52 % and 54 % passing sieve. The Hveem mixture design method was followed to design the asphalt mixtures. Repeated load tri axial test was used to evaluate all the mixtures. The key findings of this research were that the best aggregate gradations is dependent on the type and source of aggregate and that coarse aggregate gradations performed the worst and fine aggregate.

Roque et al. evaluated the effects of aggregate gradation on shear resistance and volumetric properties of asphalt mixtures. Eighteen 12.5 mm mixtures were studied. Limestone aggregates were blended to produce coarse aggregate gradations ranging from gap graded gradations to very close to the maximum density line resulting in gradation curves that pass through and below the initial Superpave requirement of restricted zone. A gyratory testing machine (GTM) was used to compact and evaluate all mixtures. Gyratory shear index (Gs), determined from the GTM test was used as the basis for evaluating the shear resistance of the mixtures. It was found that several aggregate structures ranging from those passing through the restricted zone to gap graded structures provided good shear resistance when suitable gradations were used.

1.1Objectives of mix design-: To study laboratory performance of bituminous mix design & to study volumetric properties of bituminous concrete.

1.2. Methodology: First, we Study Laboratory testing to find the physical properties of aggregate tests like Aggregate Impact value, Abrasion Test, Crushing value test, Flakiness and elongation Index (combined), Water absorption, Specific Gravity etc.

Also, by sieve analysis the Gradation of Aggregate has been decided which satisfied the requirement of Gradation of nominal size of aggregate for Bituminous Concrete design as per MORTH section 509. Similarly, Then we study to find physical properties of bitumen test like Penetration test at 25 °C, Softening Point test, Ductility test at 27 °C ,Viscosity at 150 °C, Specific Gravity etc which satisfied the requirement of IS:73-2006. Then, we study Marshall Stability test.

2. CONCLUSIONS: The overall objective of this study is to determine the optimum ratio of bitumen aggregate mix for the design of flexible pavement, because if the percentage of bitumen is less than the required proportion then proper binding will not occur. On the other hand if its percentage increases than overall cost of construction is increased.

REFERENCES:

[1].Airey, G. D., Collop, A. C., Zoorob, S. E., & Elliott, R. C. (2008). The influence of aggregate, filler and bitumen on asphalt mixture moisture damage. Construction and Building Materials, 22(9), 2015-2024.

[2].Kandhal, P. S., & Cross, S. A. (1993). Effect of aggregate gradation on measured asphalt content. Auburn: National Center for Asphalt Technology.

[3].Kandhal, P. S. (1993). Waste materials in hot mix asphalt—An overview. In Use of waste materials in hot-mix asphalt. ASTM International.

[4].Krutz, N. C., & Sebaaly, P. E. (1993). The Effects of Aggregate Gradation on Permanent Deformation of Asphalt Concrete. Journal of the Association of Asphalt Paving Technologists, 62.

[5].Birgisson, B., Roque, R., Kim, J., & Pham, L. V. (2004). The use of complex modulus to characterize the performance of asphalt mixtures and pavements in Florida. Final Report, 4910-4501.