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A COMPARISON OF MARSHAL PROPERTIES IN HIGHWAY DESIGN FOR DIFFERENT SOILS IN INDIA

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ABSTRACT:

To develop a design guide to help highway engineers in India improve design and construction of pavement on expansive subgrades, thereby extending road life. Expansive soils as road subgrade in India have been contributing to pavement failures and subsequently causing increased annual maintenance expenditure. In India use of bitumen content since many year ago. Although these first mixture proved as a successful as a pavement material, they were not design any proper mix design method. As a knowledge regarding paving material expanded need for more economical, functional and safer design criteria should require to find out optimum bitumen content in semi dense bitumen macadam. To satisfy the mix design specification, number of methods have been developed. The present paper aims to highlight this variability involved in the asphalt mix design process and develop a procedure to find out optimum bitumen content by Marshall mix design method which attain maximum stability. This study is based on Indian specifications, where mix design, like in many other countries, is performed in accordance with Marshall Method. The main objective of the research work is to improve the properties of the soil by adding Bitumen emulsion in soil. That is used as sub-grade in the construction of the road. In the research bitumen emulsion is used in the proportion of 0%, 5%, 10% and 15% in the soil. And for the strength properties, the CBR test is done on the soil mix with emulsion. Many other tests like Liquid limit and compaction test is done on the soil at different bitumen emulsion proportion. As a result bitumen emulsion gives good strength results as used in soil. It can be useful for rural pavements. For the aim of the research to encourage the use of bitumen emulsion for the soil stabilization and explored the

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properties and stability of soil by using bitumen emulsion as a stabilizing agent.

Keywords: Pavement, Recycled concrete, aggregates, gravity.

1. INTRODUCTION

Due to increasing demand in highway construction, scientists and researchers are constantly trying to improve the performance of bitumen pavement. Asphalt concretes are widely used in pavements. Bitumen is the naturally occurring by product of crude oil. Due to increase in vehicles in recent years the road surfaces have been exposed to high traffic resulting in deformation of pavements due to excessive stress. Permanent deformation happens when pavement does not have sufficient stability, improper compaction and insufficient pavement strength. The performance of pavement is determined by the properties of bitumen. Bitumen is a viscoelastic material with suitable mechanical and rheological properties for water proofing and protective covering for roofs and roads, because of its good adhesion properties of aggregates. One of the most important properties of bitumen mixture is its ability to resist shoving and rutting under traffic. Therefore stability should be high enough to handle traffic adequately, but not higher than the traffic conditions require. Low stability causes un raveling and flow of the road surface. Some improvements in asphalt properties have been achieved by selecting the proper starting crude, to make asphalt. From practical experiences it is proved that the modification of asphalt binder with polymer additives, offers several benefits. To enhance various engineering properties of asphalt many modifiers such as styrene-based polymers, polyethylene-based polymers, polychloroprene, guillotine, various oils have been used in asphalt. Plastic usage has been increased in our daily life. Due to this increased usage of plastic the disposal of plastic has been difficult. Some studies say that 10million tones of plastic are produced in India and only 2million tones of plastic waste are recycled. Plastics have to be disposed or else it will be hazardous to nature and environment. Thus, one of the best ways of disposal of these plastics is to use in bituminous road construction by melting them. Many highway agencies are doing various studies on environmental suitability and performance of recycled products in high construction. Use of these waste plastics in bituminous road construction will help in disposal of vast quantities of plastic. Consumption of mineral water bottles which are made up of high-density polyethylene has increased abnormally.

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2. LITERATURE SURVEY

Flexible pavements with bituminous surfacing are widely used in India. The high traffic intensity in terms of commercial vehicles, overloading of trucks and significant variations in daily and seasonal temperature of the pavement have been responsible for early development of distress symptoms like raveling, undulations, rutting, cracking, bleeding, shoving, potholing of bituminous surfacing. Increased incidence of premature rutting of heavy-duty asphalt pavements has been experienced in recent years. There is a general agreement among most asphalt paving technologists that the use of large size stone in the binder and base courses will minimize or eliminate the rutting of heavy-duty pavements. However, the wide acceptance of the Marshall and Hveem mix design procedures inhibits the use of large stone mixes because these methods use standard 4-inch (100 mm) diameter specimens and limit the maximum aggregate size to one inch (25.4 mm). Modified Marshall Equipment is now available for compacting and testing 6-inch (150 mm) diameter specimens to accommodate aggregate up to 2-inch (50.8 mm) maximum size. This study compares the mix properties such as Marshall Stability, flow and indirect tensile strength obtained on 100 mm and 150 mm diameter specimens.

explored the possibility of the use of Crumb Rubber Modified Binders as an alternative to the conventional high-priced grade binders in mixtures consisting of high percentages of RAP. the effects of inclusion of thermoplastic modifiers like High density Poly Ethylene and Polypropylene to conventional bitumen. An improvement in the dynamic behavior was noted and modification in the rheological properties. The penetration test result exhibited increase in viscosity. The Polymer modified bitumen with an increment in softening point showed better pavement performance for rutting, fatigue and temperature vulnerability. probed into the efficacy of using agricultural as well as wastes from industry in subgrade. To improve the bearing capacity of soil, different industrial wastes like fly ash as well as ash of rice husk and bagasse were used while rice straw ash was used as an agricultural waste. Various tests were conducted namely shrinkage limit test, CBR test, Unconfined compressive strength test, triaxial test. Based on the above tests, the authors recommend the use of all the materials identified to be used as soil stabilizer.

Bing Liua, , Linli Yan b , Zhiwei Wang (2017) This paper aims to find a reclassification approach which could balance the different requirements of mobility, street activity and green transport priority, and provide a better

basis for urban road planning and design. This paper firstly reviews the provisions of road classification in the current and points out the defects of the single classification standard based on car-oriented mobility, which resulted in many problems such as inadequate bus priority, squeezed space for non-motorized transport and street life decay. Then, it compares the international practices of road classification updates and adjustments; and further clarifies the relationship from three aspects of mobility and place, multi-modes and differentiated priorities, as well as standardization and flexibility of road classification system, thereby establishing a theoretical framework for urban road reclassification. In the background of green transport and street revival, this paper argues the necessity of urban road reclassification, and proposes a three-dimensional road classification system integrating "hierarchy of mobility, types of street activity and travel mode priority". The new HAM system is expected to provide a more balanced, comprehensive and flexible approach for urban road design accommodating multi-modes of green transport and a variety of street activities, to meet the policy shift from the "car-oriented" to the "people-oriented.

Yazan Issa (2014),"Driven by the increasing travel demands of cars, lots of urban roads were built or upgraded to adapt to the large scale motorization process of Chinese cities. For them, car-oriented road network was formed rapidly during the last two decades, whereas "multi-modal transport network with complementary advantages" was far from the requirements of Code TPUR. The outcomes arising from this road classification are not aligned with the green transport principles, and it has caused more concerns in the fields of urban planning and transport planning. Urban road system is considered to be an essential part of this transformation, for it determines the rights of way of all kinds of surface modes and the space quality for numerous road users. Since the lock-in effects of road classification system for the overall layout of transport network and urban areas, it is of great significance to reclassify urban roads to coordinate multi-modal traffic as well as to facilitate street activities, which will help to improve road conditions for green modes and accordingly, enhance street vitality.

Arasan, T.V (2012). Necessity of urban road reclassification system from the above, car-oriented road classification system which separated the functions of "traffic and place" as well as "movement and access", had led to the fragmentation of non-motorized network and degradation of place function. Today, the integrated development of road multiple functions is being recognized, and the ideology

of urban road classification has begun to change. Based on vehicular access and mobility needs on one hand, the "place" dimension could correct the rigid tendency of road planning and design. Only with a comprehensive consideration of cross-scale mobility, environmental capacity and community values, can it fully respond to the aspirations of the neighboring areas. One the other hand, the function of movement and access presents a greater/ wide range of compatibility within multi-modal transport system.

Kuo, Y. and Wang, C (2011) Many cases combining the functions of Commercial Street and traffic thoroughfare (taking Champs-Elysees Avenue for a typical example) show that the features of efficiency of car traffic, accessibility of transit and high priority for walking may be contained in one road simultaneously. It is more urgent to provide guidance for individualized road space with a variety of purposes, but current technical framework of road classification system as well as related planning policies and regulations could not adapt to the changing tendency. If the car-oriented road classification continued to be used in the future, it would hinder the construction of multimodal network even the development of green transport system. With pro-green planning policies under the national strategy of New-type Urbanization, it is a good chance to promote the restructure of road classification system with equal emphasis on both traffic and space function, together with balanced jurisdictions of multi-modal mobility, to create well-tailored road system containing diverse street activities and more inclusive/pluralistic hierarchical order.

3. RELATED STUDY

Recycling of Concrete from C&D Wastes:

Recycling of concrete is a relatively simple process. It involves breaking, removing, and crushing existing concrete into a material with a specified size and quality. The quality of concrete with RCA is very much dependent on the quality of the recycled material used. Reinforcing steel and other embedded items, if any must be removed and care must be taken to prevent contamination by other materials that can be troublesome such as asphalt, soil and clay balls, chlorides, glass, gypsum board, sealants, paper, plaster, wood, and roofing materials. Recycling of C&D wastes can take place either at the site where the material is sourced, or the material may be transported to a central recycling facility, where large stockpiles may be accumulated

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Fig.3.1. Recycling of Concrete from C&D Wastes.

4. METHODOLOGY

Methodology Adopted For Present Study

- To conduct the Standard tests for the properties of plain bitumen.
- To determine the optimum binder content for plain mixes 80/100, 60/70, by Marshall Stability method.
- To use waste plastic as additive with aggregate and blended with bitumen and test all the basic test parameters.

Integrated Land Use Transport Planning:

Urban transport is a derived demand closely linked to urban growth policies. Therefore, integrated land-use transport planning to minimize transport demand is essential. Some types of land use patterns increase the use of car, while others reduce the amount of vehicle travel needed to access goods, services and activities. Some transport policies such as increase in road capacity and speed, Generous parking supply, Low road user charges and fuel taxes, Poor walking and cycling conditions, Inferior public transit service, High public transit fares, tend to encourage city sprawl and hence travel demand, while others such as Transit service improvements, more affordable public transit fares, Pedestrian and cycling improvements, Reduced parking supply with parking management, Road and parking pricing, Traffic calming and traffic speed reductions tend to encourage Smart Growth and reduce travel demand. Thus rather than an urban sprawl, smart city growth should be the objective. The present trend is unbridled expansion of the city as an urban sprawl. This increases trip length and discourages the use of the desirable green modes NMT and MRT. NMT being manually driven suits short distance trips. MRT does not get concentration of demand. As a result the financial viability of MRT further falls.

Transport Demand Management:

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It is not enough to improve traffic flow and augment urban transport facilities. There is a limit to augmentation of services and infrastructure in a city. There is thus, in addition, a need to control the growth in transport demand. Otherwise supply of urban transport may never be able to catch up with demand. Hence a 'Transport demand management' program should be an essential part of planning. TDM is a wide range of policies, programs, services and products that influence why, when, where and how people travel to make travel behaviors more sustainable. There is a need to proactively shape travel demands so they can be served - efficiently, effectively, equitably and sustainably. TDM has four main components that provide an integrated approach to transport demand management

Recommendations to improve development connectivity:

For the purposes of this report, we define "connectivity" as the degree of interconnection between roadways. The recommendations in this report are geared towards improving the efficiency of movement using the roadway system. "Mobility" (i.e. ease of movement) is one attribute of such efficiency but so is "accessibility" (i.e. the ability to go from an origin to a desired destination). The benefits of better connectivity go beyond improved mobility and accessibility and can include enhanced potential for transit (through better pedestrian connections and shorter, more direct walk trips) as well as more constant speeds and less congestion, which in turn results in lower greenhouse gas emissions. Reducing emergency response times; increasing effectiveness of municipal service delivery; and freeing up arterial capacity to better serve regional long distance travel needs are further benefits of enhanced connectivity. There are subtle tradeoffs between increased connectivity and increased speed - pedestrian safety, vehicle miles traveled and so forth, but this report will not go into these nuances. For the purposes of this work, we assume that enhanced connectivity is a clear net benefit. Based on our review and understanding of Texas Local Government Code, Under Texas law subdivision review is an administrative function of local government – at the municipal, within the extraterritorial jurisdiction (ETJ), or unincorporated county level. To improve connectivity local governments will need to adopt standards and evaluation tools that mandate planned roadways and interconnected subdivision before the subdivision applications are submitted. Extemporaneous requirements to provide connectivity, even though supported by sound planning judgment, may encounter opposition by an applicant and may not withstand legal scrutiny. To avoid these potential challenges, the tools

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recommended under the Major Thoroughfare and Subdivision sections of this report will require upfront planning by the municipality or the county and necessitate amending the subdivision regulations to establish specific rules and procedures. The suggested strategies under the Comprehensive Planning and Zoning subsections provide an opportunity to fine tune the connectivity policies of the municipalities and to implement site-specific improvements. Capital Improvement Programming (CIP) planning to fund projects connecting corridors and neighborhoods can be done at the municipal or the county level; however, the financing options available to local governments vary.

RESULTS:

SALIENT FEATURES OF HIGHWAY ROADS:

In India more than 4.25 million Km of road is available. If only some of them are constructed or repaired using this technique, there will be less waste plastic littered on the road. The process is eco-friendly. Segregating plastic from the MSW at municipal yard involves application of resources, the cost of which runs into crores of rupees. A substantial amount of this can be saved. Lab tests and real time tests have revealed that the life expectancy of a plastic road, compared to a normal road is at least 100% more. This technique adds a cumulative benefit to National Economy also gives contribution to environmental benefits, employment generation and agricultural efficiency some of the roads in Delhi region made with plastic waste.

- Stronger road with increased Marshall Stability value
- Better resistance towards rain water and water stagnation so no stripping and no potholes.
- Increase binding and better bonding of the mix thus reduction in pores in aggregate and hence less rutting a raveling
- No leaching of plastics. No effect of radiation like UV.
- The load withstanding property increases.
- It helps to satisfy today's need of increased road transport.
- Value addition to the waste plastics
- The cost of road construction is also decreased and the maintenance cost is almost nil.

As road pavement life is doubled when we use this novel technique for road construction, we have to pay only Rs. 25000/- more, instead of spending Rs. 10, 80,000/- for its up gradation in just 2-3 years, thus saving Rs.10, 50,000/- per Km.

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Widening Geotechnical Issues of NH 563:

· Excavation to accommodate a 3% or 4% grade along Highway 1 appears to be feasible with a uniform side slope of 3:1 Alternately, a retaining wall structure could be considered if space restrictions for excavation are apparent.

- The surficial soils along Highway 1 generally consist of silty clay, silt to sandy clay tills However, there may be some areas of weak silt, clay and/or organics that would require mitigation measures and stabilization Bedrock may be encountered at shallow depths along Highway 1, particularly near the crest of vertical curves. Blasting may be required.
- Approach embankments constructed with engineering (structural) fill (provided acceptable compaction methods are applied) can be constructed to a height of 23m (if necessary) at a slope of 2.5:1 without benching.
- Excessive long-term settling should not be experienced. It is anticipated that most of the settlement of native ground and compacted earth embankments would occur within the first few years post-construction of the approach embankments.

Cumulative Traffic (msa)	Total pavement Thicknes s (mm)	Pavement Composition			
		BC (mm)	DBM (mm)	Base	Sub Base
10	760	30	80	250	390
20	790	30	100	250	390
30	810	40	120	250	390
50	830	40	140	250	390
100	860	50	180	250	390

CBR Ratio Test

The C.B.R test was developed by California division of highways as a method of Classifying and evaluating soil sub-grade and base course materials for flexible Pavements. The C.B.R is a measure of shearing resistance of the material under controlled Density and moisture conditions. The C.B.R is defined as the ratio of the standard Load, expressed as percentage for a given penetration of the plunger. C.B.R = (Total load/ Standard load) x 100.

Where standard load is penetration resistance of the plunger into a standard sample of crushed stone for the corresponding penetration

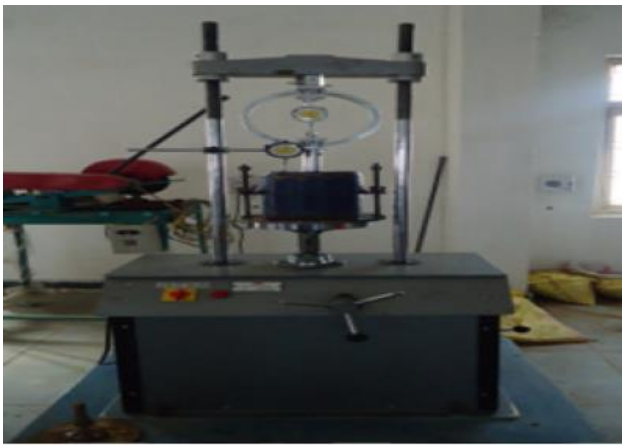

Fig.4.1. CBR test results.

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	2013	2014	2015	2016	2017	2018
Passenger car	770	811	889	955	1,043	1,148
Bus	214	224	225	225	227	229
Truck	457	461	469	496	529	562
Motor cycles	4,768	5,243	6,108	6,884	7,638	8,473
Total	6,209	6,739	7,691	8,560	9,437	10,412

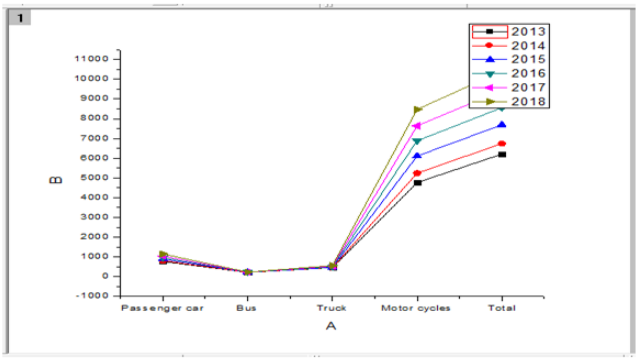

Fig.4.2. Output results.

5. CONCLUSION

The conclusions of this Nowadays it's a great need to use an alternate material in construction which is having a good engineering property. The material used must be cheap and easily available. It can be used in different construction projects to enhance the engineering property of soil. As we know, the continuous use of natural resources will give rise to the risk of depletion of natural resources. Every civil engineering structure whether it is a building, a bridge or a dam is founded on or below the surface of the earth. Foundations are required to transmit the load of the structure to soil safely and efficiently. So it is very necessary to enhance the load-bearing capacity of sub-grade by stabilization of sub grade soil by adding some additive. The benefit of proposed widening of NH- 563 Development lead to changes in the level of well- being and human development, through their benefit of consumption level, educational attainments The road construction will provide better transportation facility for tourists visiting regions the pavement and we found that rigid pavement is more economic than flexible pavement after adding the 20 year life cycle cost. For reduction in accident installation of proper road safety system through signage, barricades, crash barriers, will add to be safety of the vehicular traffic on the stretch of the road. This includes health and education services for which current access is insufficient and inadequate. It also includes services that are presently not available such as access to government services and infrastructure like electricity/water supply and veterinary extension services.

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