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Optimising Marshall Stability of Coir Fiber Reinforced Dense Bituminous Macadam (DBM) Grade-II with VG-40 Bitumen

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Abstract

This study evaluates the effect of coir fiber incorporation on the Marshall properties and volumetric characteristics of Dense Bituminous Macadam (DBM) Grade II mixes at a fixed Optimum Bitumen Content (OBC) of 4.67 %. Coir fibers were chopped into five lengths (5 mm, 10 mm, 15 mm, 20 mm, and 25 mm) and added at contents ranging from 0.1 % to 0.7 % by weight of bitumen. Standard Marshall specimens were prepared and tested for stability, flow, bulk specific gravity, voids in mineral aggregate (VMA), voids filled with bitumen (VFB), and air voids (Vv). Results indicate that Marshall stability increased significantly with fiber addition, peaking at 17.51 kN for 0.4 % content and 15 mm fiber—approximately 31 % higher than the control (13.38 kN). VFB reached a maximum of 76.19 % at 0.5 % content and 15 mm length. Flow values remained near control up to 0.3 % but increased sharply beyond 0.4 %, indicating reduced compatibility. Optimal performance is achieved at 0.4 %–0.5 % fiber content with 15 mm length, balancing strength and volumetric efficiency.

Key Words: Coir fiber, Dense Bituminous Macadam, Marshall stability, Volumetric properties, Voids Filled with Bitumen (VFB), Optimum fiber content, Fiber length

CHAPTER 1: INTRODUCTION

1.1 Background

Bituminous roads form the backbone of modern transportation infrastructure, particularly in developing nations such as India. Dense Bituminous Macadam (DBM) is a commonly used bituminous base layer in road construction due to its excellent load-distribution capacity and durability. However, traditional DBM mixes face performance issues such as rutting, thermal cracking, fatigue failure, and aging under prolonged environmental and traffic stress. To overcome these limitations and improve the service life of flexible pavements, modification of bituminous mixes through the incorporation of reinforcing agents is increasingly gaining importance.

Among various modifiers, **natural fibers** are garnering attention owing to their sustainability, low cost, biodegradability, and availability. Coir fiber, extracted from coconut husk, is one such lignocellulosic waste material widely available in tropical regions. Its high tensile strength, resistance to microbial degradation, and rough surface texture enable good bonding with bituminous matrices, potentially enhancing the mechanical and volumetric properties of the mix.

This study focuses on evaluating the **Marshall Stability, flow, density, air voids (Vv), voids in mineral aggregate (VMA), and voids filled with bitumen (VFB)** of DBM mixes reinforced with coir fibers of varying lengths (5 mm–25 mm) and contents (0.1%–0.7% by weight of bitumen).

1.2 Problem Statement

Despite the advantages of DBM as a base course, it suffers from limitations such as deformation under heavy loads, low resistance to cracking, and early failure in aggressive climatic conditions. Conventional polymer or synthetic fiber additives are expensive and non-biodegradable, limiting their large-scale use. Coir fiber offers a cost-effective and eco-friendly alternative, yet its effect on DBM performance is not adequately documented, particularly regarding the optimization of **fiber content and length**. There is a pressing need to explore the mechanical response of DBM mixes reinforced with coir fiber and identify the **optimal parameters** that ensure performance enhancement without compromising workability and durability.

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Enhancing Rutting Resistance of Dense Bituminous Macadam using Coir Fiber Reinforcement

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Abstract
This study investigates the rutting resistance and mechanical performance of Dense Bituminous Macadam (DBM) Grade-II mixes reinforced with untreated coir fiber. Marshall mix design was conducted using VG-40 bitumen to determine the Optimum Binder Content (OBC) of 4.67%, followed by testing with coir fiber dosages ranging from 0% to 0.7% by bitumen weight. The mix incorporating 0.4% coir fiber exhibited the highest Marshall stability (17.51 kN), representing a 30.86% improvement over the control mix. To simulate in-service pavement behavior, rutting tests were performed using the Aimil Wheel Rut Tester at 50 °C and 10,000 load passes. The optimum mix (0.4%) demonstrated a 48.5% reduction in rut depth (5.2 mm) compared to the unreinforced mix (10.1 mm), with deformation curves exhibiting plateau behavior indicating high dynamic stability. Beyond 0.4% fiber content, performance declined due to fiber clumping and poor compaction. This research effectively bridges the gap between conventional Marshall mix design and real-world performance assessment, validating the use of natural coir fiber as a cost-effective, sustainable reinforcement in asphalt pavements.

Keywords: **Coir fiber, Dense Bituminous Macadam, rutting resistance, Marshall stability, VG-40 bitumen, dynamic stability, Aimil Wheel Rut Tester, sustainable pavements**

INTRODUCTION

1.1 Background

Flexible pavements, especially those constructed with Dense Bituminous Macadam (DBM), are extensively used in highway construction due to their cost-effectiveness and ease of maintenance. However, they are susceptible to permanent deformation (rutting) under heavy traffic loads and high temperatures. Rutting not only reduces ride quality but also poses safety hazards and accelerates pavement deterioration. In tropical and subtropical regions like India, this issue is exacerbated by extreme climatic conditions and overloaded traffic.

To enhance the performance of DBM mixes, researchers have increasingly focused on modifying the bituminous binder using various natural and synthetic fibers, which improve tensile strength, resist deformation, and extend service life. Among them, coir fiber, a natural lignocellulosic material extracted from coconut husk, has shown promising potential due to its high tensile strength, biodegradability, cost-effectiveness, and availability in India.

1.2 Importance of the Study

The integration of **coir fiber** in DBM mixes contributes toward:

- Improving resistance against rutting and permanent deformation.
- Promoting sustainable construction practices by utilizing agro-waste.
- Reducing environmental impact compared to synthetic fibers.
- Enhancing Marshall stability, volumetric properties, and rutting performance without significant cost escalation.

This study becomes crucial in the current context of sustainable pavement technologies, where environmental performance, life-cycle cost, and long-term durability are equally prioritized.

1.3 Literature Review

Several studies have explored the use of fibers in asphalt concrete and DBM mixes:

- S. B. Prasad et al. (2019) demonstrated that polypropylene and glass fibers significantly improved the fatigue and rutting resistance of bituminous mixes.
- M. Ramesh Kumar et al. (2016) investigated the effect of banana and jute fibers on Marshall properties and concluded that natural fibers could enhance pavement performance.
- Ashok Kumar et al. (2020) evaluated coconut fiber-modified bitumen mixes for fatigue and moisture susceptibility, showing improved tensile strength but limited focus on rutting.
- IS 15462:2004 supports the use of natural fibers in bitumen mixes for reinforcing effects.

Most prior research focused on Marshall properties, moisture susceptibility, and indirect tensile strength using fibers. However, limited research has evaluated the performance of DBM mixes reinforced with coir fiber under actual simulated

Performance Evaluation of Coir Fiber modified DBM Mix on Strength and Durability

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Abstract

This study evaluates the effectiveness of natural coir fiber as a reinforcement in Dense Bituminous Macadam (DBM) Grade-II mixes to enhance mechanical strength and moisture resistance. Coir fibers (15 mm) were incorporated at dosages of 0%, 0.3%, 0.4%, 0.5%, and 0.6% by weight of VG-40 bitumen. Laboratory tests—including Marshall Stability, Indirect Tensile Strength (ITS), and Tensile Strength Ratio (TSR)—were conducted per ASTM D6927, ASTM D6931, and AASHTO T283 standards. Results show that 0.4% coir fiber yields optimal performance, increasing Marshall Stability from 13.38 kN to 17.51 kN and ITS from 734.07 kPa to 1117.90 kPa, while achieving a TSR of 89.61%. maintain Air voids consistent (~7%), confirming that observed improvements are attributable to fiber reinforcement. Performance curves for stability, ITS, and TSR versus fiber content facilitate practical mix optimization. The findings demonstrate that coir fiber is a cost-effective, sustainable additive for improving DBM mix durability and crack resistance in regions prone to heavy traffic and adverse climatic conditions.

Keywords: Coir fiber, Dense Bituminous Macadam, Marshall Stability, Indirect Tensile Strength, Tensile Strength Ratio, sustainable pavement materials.

I. Introduction

Flexible pavements in tropical and semi-arid regions are often subjected to cracking, rutting, and moisture-induced damage due to repeated traffic loading and harsh environmental conditions. Conventional Dense Bituminous Macadam (DBM) mixes, though widely used, face challenges in resisting tensile failure and moisture susceptibility over time. To overcome these issues and enhance pavement performance, fiber reinforcement in bituminous mixtures has emerged as an effective solution. Among various fiber types, natural fibers such as jute, sisal, and coir have gained increasing attention due to their biodegradability, cost-effectiveness, and positive impact on mechanical performance. Notably, coir fiber, derived from coconut husk, offers a rough surface texture and high lignin content, contributing to improved bonding within the asphalt matrix and delaying crack propagation through a bridging effect.

Several previous studies have reported performance improvements in fiber-reinforced bituminous mixes. However, inconsistencies remain in identifying the optimum fiber content, especially under different mix gradations and climatic conditions. Moreover, limited research is available on the use of coir fiber in DBM Grade-II mixes with VG-40 bitumen under Indian conditions. Addressing this gap, the present study focuses on the systematic evaluation of coir fiber-modified DBM mixtures using standard laboratory tests like Marshall Stability, Indirect Tensile Strength (ITS), and Tensile Strength Ratio (TSR). Coir fibers of 15 mm length were incorporated at varying dosages (0%–0.6% by weight of bitumen) to assess their impact on strength, flexibility, and moisture resistance.

The objective is to identify the optimal fiber content that maximizes mechanical and durability performance while maintaining volumetric consistency. Performance curves and graphical analyses have been used to visualize trends and assist in practical decision-making. This study not only contributes to the understanding of fiber-reinforced asphalt behavior but also promotes sustainable construction through the use of natural agro-waste, making it relevant for modern pavement engineering and green infrastructure initiatives.

II. Literature Study:

Several studies have investigated the role of fibers in improving the mechanical performance of bituminous mixtures, with natural fibers like jute, sisal, and coir showing promising results in enhancing tensile strength and mitigating crack propagation due to their bridging effect. Sundaram and Ramesh (2018) found that coir fibers significantly improved rutting resistance and reduced cracking in flexible pavements, while Khan et al. (2020) reported that coir fiber content between 0.3% and 0.4% yielded the highest Indirect Tensile Strength (ITS) and fatigue life in Dense Bituminous Macadam (DBM) mixes. However, despite adherence to standard evaluation methods such as IS 73:2013 and AASHTO T283-14, existing literature lacks consistency in determining the optimum fiber dosage under varied environmental conditions and aggregate gradations. This study aims to address these gaps by conducting a systematic investigation on DBM Grade-II mixes using locally sourced 15 mm coir fibers and VG-40 bitumen. The research employs a comprehensive testing regime including Marshall Stability, ITS, and Tensile Strength Ratio (TSR) tests in both dry and moisture-conditioned states following AASHTO T283 and MORTH guidelines. It particularly addresses the limited studies on coir fiber performance in Indian conditions, providing detailed insights on the effect of fiber dosage (0% to 0.6%) on ITS and TSR values. The paper introduces unified performance curves for ITS and TSR versus fiber content, aiding in practical implementation and optimization. By integrating key parameters such as air voids, strength, durability, and moisture susceptibility, this work offers a holistic understanding of coir fiber-reinforced bituminous mixtures and validates coir fiber as a viable, eco-friendly additive for sustainable pavement design.

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Experimental study and simulation analysis on design of stone mastic asphalt along Marshall mix methods using low-density polyethylene for eco-friendly nature

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ABSTRACT

The extended traffic volume and backing require sufficient and solid pavements, which controls the black-top difficulty. A huge amount of assessment deal with the Stone Mastic Asphalt (SMA) gives a difficult surface course. Various down to earth tries are made to adjust SMA mixes with built strands and polymers. Directly a day's plastic waste is the key issue for an eco neighbourly legitimate condition. In this assessment work, plastic waste like Low-Density Polyethylene (LDPE) fundamental food thing sacks are used as an additional substance to diminish the leakage at high temperatures during limit, transportation, circumstance, and compaction to improve the interfacial security among sums and spread. Like this, the mix plan of SMA is executed with Marshall mix structure procedures. Marshall Stability Test finishes this testing research. The all out level of the SMA mix and the folio content was 5.5%, 6%, 6.5% by weight of genuine and plastic waste used was 5%, 10%, 15% by weight of bitumen. This current paper's objective is analyzing Objectives, advancement material piece, economy achieving by using waste materials and inclinations over the mixes. For sure, even in this work, we applied simulation investigation, as you can see in this paper.

Selection and peer-review under responsibility of the scientific committee of the International Virtual Conference on Sustainable Materials (IVCSM-2k20).

1. Introduction

Street arranges assumes an essential job in the country's financial turn of events, exchange, and social combination. The voyaging and security for the two individuals and products rely on the nature of street organizes as it were. As the populace is expanding day by day, it legitimately influences the movement request. Stone lattice black-top (SMA) is a hole evaluated HMA created in Germany in the 1960s, to oppose the mileage on asphalts brought about by studded tires. Later the blend was seen as more groove safe and sturdy than traditional thick reviewed blends, and this supported other European nations to use this blend. Some transportation organizations from the USA led an investigation visit to Europe in 1990, and they were dazzled with the presentation of SMA. This prompted point by the point research center, and field examinations on SMA and its effective execution made the blend one of the essential decisions for asphalt engineers. The stone framework black-top has a higher extent of coarse totals and folio mortar contrasted with ordinary combinations. Great stone-to-stone contact exists between the counts framing rough total skeleton, which gives better quality and groove protection from the blend. The grim total framing adds to the sheer quality and compelling stacking appropriation example of vehicles to bear heavier traffic loads contrasted with the thick reviewed combinations. It comprises a blend of squashed coarse and fine totals, mineral filler, black-top concrete, and a stabilizer for the folio, for example, polymer or strands. The way of thinking of SMA is that the coarse total skeleton stone part gives a stone on stone contact to forestall rutting and give slide obstruction. It is mastic containing an entire coarse skeleton, which helps in even conveyance of the on-coming burdens. SMA builds the life of the weaving course and has

Numerous advantages. The danger of waste plastic won't settle until the commonsense advances are not started at the ground level. It is conceivable to improve the exhibition of bituminous blended utilized in the surfacing course of streets.

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EFFECTS OF ACIDS ON STRENGTH PROPERTIES OF BLACK COTTON SOIL

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ABSTRACT:

Industrial advances in agriculture and chemical industries has to lead to release of variety of pollutants into the environment contaminated the soil. Soil being contaminated by anthropogenic sources such as leakage from waste containment facilities, accidental spills and industrial operations. In this project report the effect of Sulfuric (H_2SO_4), Nitric (HNO_3) and Boric (H_3BO_3) acids on the strength characteristics of black cotton soil at varying percentage studied. Laboratory regent sulfuric, nitric and boric acids were used in concentration of 0, 2, 4, 6, 8, and 10 percents, the acid contamination of soil adversely affects the strength characteristics of soil. The strength characteristics of soil get altered when an acid compounds gets mixed with soil. Atterberg's limits, compaction characteristics, CBR test and unconfined compressive strength tests have been carried out. The results are indicative that compaction characteristics, CBR test and unconfined compressive strength are altered due to acid contamination.

Key Words: Black cotton soil, Atterberg's limits, compaction characteristics, CBR test and unconfined compressive strength

1. INTRODUCTION

Modern construction requires not only profound preliminary study of the foundation material, but also a thorough knowledge of the factors causing its changes in the life time of the structures supported by it. Behavior of any chemical or contaminant in the soil depends upon its properties and its interactivity with soil. The major sources of subsurface and surface contamination are land disposal of industrial, mining, agricultural wastes and accidental spillage of chemicals. Results of some studies indicate that the detrimental effect of seepage of acids and bases into subsoil can cause severe foundation failures.

Since constructions on black cotton soils cannot be avoided their properties are altered by many ways like mechanical, thermal, chemical and other means to make acceptable or rejected on contamination. The index and engineering properties of the ground gets modified in the vicinity of the industrial pants mainly as a result of contamination by the industrial wastes disposed. The major sources are the disposal of industrial water and accidental spillage of chemicals during the course of industrial operations. The leakage of industrial effluent in to subsoil directly affects the use and stability of the supported structure.

Industrial activity is important for economic growth of any country but simultaneously it produces large amount of waste. This waste can be in solid, liquid or gaseous form. This waste contains of acidic matter, alkalis, dyes, organic waste, toxic metals, etc., when such pollutant mixed with soil, geotechnical properties of soil gets changed due to soil-pollutant interaction. Thus, soil contamination or soil pollution is caused by the presence of xenobiotic (human made) chemicals or other alteration in the natural soil environment. It is typically caused by industrial activity, acid rain, accidental spills, agricultural chemicals, leakage in sewer liner from industries and residence, or improper disposal of waste. This adversely affects the behavior of natural soil mainly due change in anion and cation exchange capacity. Sridharan *et al.* (1981) has reported the heaving of sub grade soil due to the leakage of phosphoric acid. Masashi (1997) investigates that the increased rate of leaching of cation and absorption of H+, SO_4 2-, NO_3 -, PO_4 3- and CO_3 2- due to mixing of chemicals containing these ions alter physical, chemical and engineering properties of soil

In some cases, the sub grade soils can be treated with various materials to improve the strength and stiffness characteristics of the soil. Evolving new construction materials to suit various traffic and site conditions for economic and safe design is a challenging task in road construction. Effective utilization of local weak soils by impacting additional strength using stabilization methods enable reduction in construction cost and improved performance for roads. Hence the stabilization of sub grade pavements has been gaining popularity in the field of pavement due to its high versatility and flexible.

2. LITERATURE REVIEW

K. Madhavi, Dr. M. Kameswar Rao (2017) Soil which is a major and primary element for the construction is gradually leading to the degradation of its properties. This proposed study mainly aims to determine the depth of contamination with pollutants in the soil. To determine this the soil sample is tested by adding various contaminants and the study is carried by testing it for the various tests such as particle size analysis, swelling index, plasticity index, unconfined compression strength and the compaction are examined. Further the effects of soil properties with the contaminants are studied.

M AMULYA, CH R V PRASAD, P H P REDDY AND G K KUMAR (2015) Sub surface soil pollution by various processes with high concentration of contaminants can significantly alter geotechnical properties of soils causing unexpected failures of structures. Unexpected behavior of soil upon contamination with acid solution is one of the major challenges faced by the geotechnical

RESEARCH ARTICLE

MECHANICAL CHARACTERIZATION OF GEOPOLYME... STABILIZED BASES AND SUBBASES INCORPORATED WI... COPPER-SLAG FOR LOW-VOLUME ROADS

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ABSTRACT

A majority of Indian road-network is covered by rural roads or low-volume roads. India has a second-largest road network after United States of America (USA), out of which 80% (approximately) of total road network is occupied by the rural roads. The present study is focused on base and subbase mixes stabilized with geopolymer binders for low volume roads. The present article presented the mechanical characterization (in terms of moisture-density relations, unconfined compressive strength, indirect tensile strength and resilient modulus)for geopolymer stabilized mixes in which natural aggregates are replaced by copper-slag (< 4.75mm in size) at a replacement dosage of 0, 5, 10, 15, 20 and 25% (by weight of total dry aggregates). The preliminary tests are conducted to evaluate physical properties of aggregates and copper-slag. Later, a series of stabilized mixes are prepared with flyash-based, slag-based geopolymers and subjected to various tests to determine compaction characteristics, unconfined compressive strength and resilient modulus. The results showed an increase in maximum dry density with increase in copper-slag from 0 to 25%. The compression and tensile tests produced a decreasing trend in strength with increase in copper-slag, but, the decreased strength values were not declined below the acceptable strength (1.7MPa for subbase layers) for most of the combinations. Finally, the study suggested geopolymer stabilization and copper-slag (up to 25%) as a replacement material for natural aggregates for constructing base and subbase layers of low-volume roads.

Keywords: sustainable; geopolymer; flyash; natural aggregates; copper-slag; bases and subbases; low volume roads:

INTRODUCTION

The unbounded bases/subbases are composed of natural aggregates without any binding agents. But, the preparation of unbound bases/subbases require huge quantity of high-quality natural aggregates to meet the strength and durability characteristics. In order to avoid heavy usage of high-quality natural aggregates, the researchers have started stabilizing the natural aggregates for reducing the utilization of natural aggregates and encouraging the non-conventional aggregates such as marginal materials and recycled aggregates. Firstly, the researchers have started using cement as a stabilizer for constructing the bounded bases/subbases. In the ancient-era, Egyptians, Romans and Greeks used different types of cementitious materials such as lime and calcinated gypsum. As the time elapsed, the utilization of cement was extended to wide range of pavement-applications. In 1935, first time, the cement treated base (CTB) was introduced [1] for pavement applications. Generally, the cement treated aggregate bases are stabilized with cement at a dosage of 3-6% of cement. Later, the concept of cement and other stabilized bases was enabled the utilization of recycled aggregates and industrial waste.

In the recent years, the researchers focused on reducing the adverse environmental effects caused by cement-production and utilization and the concept of zero-cement or geopolymer binders were evolved [2-5]. Generally, a geopolymer binder composed of an alkali activating solution, alumino-silicate resource materials such as flyash, ground granulated blast furnace slag (GGBS), metakaolin, pulverized fuel ash, palm oil fuel ash and rice husk ash etc [6-17]. Geopolymer binders can be formed by activating alumino-silicate resources materials with alkali activating solution. The strength of geopolymer mixes is a highly dependent of mix components such as concentration of alkali solution [18-23], ratio of silicate solution to

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PAVEMENT DESIGN OF CEMENT TREATED RECYCLED CONCRETE AGGREGATE BASES FOR LOW VOLUME ROADS

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Abstract

Generally, cement-treated bases are the non-conventional pavement layers used for improving the mechanical characteristics of base and sub-base courses. The present study focused on the design and analysis of the pavement with cement-treated bases made of Recycled Concrete Aggregates (RCA). The mechanical characteristics of the cement-treated recycled concrete aggregate mixes with 75% and 100% RCA are explored in the current study. The mixes with 2% and 4% cement are used as either a base or a sub-base for pavement design and analysis. To investigate the stresses and strains analysis and subgrade California Bearing Ratio (CBR) of 5% and 1 to 2 million standard axles (msa) of design traffic are considered. The reference pavement sections are considered corresponding to subgrade class-III and a total of 3 traffic categories ranging from T-7 to T-9 are considered as per the IRC: SP-72-2015. Initially, the Resilient Moduli (M_R) of the pavement layers for corresponding reference sections are calculated. Using the above-calculated M_R values, thicknesses and Poisson's ratio of 0.35 is considered corresponding to the granular layers. The allowable stresses and strains are estimated by using the KENPAVE software. By taking these stresses and strains as the benchmark, the pavement design and analysis was carried out. From the obtained results, it is concluded that the Cement Treated Mixes with 75% RCA and 100% RCA can be recommended for the base/sub-base layer materials especially for Low Volume Roads (LVRs)

Keywords: Cement Treated Bases (CTB); Recycled Concrete Aggregates (RCA); Strains; KENPAVE;

1. Background

There are several essential points to be considered while evolving suitable and economical designs for the LVRs roads in India. First and foremost is the aspect of practical implement ability of the recommended designs within the available resources and level of expertise in rural areas, availability of equipment/plant for construction and maintenance as well as the level of quality control that can be effectively exercised. To the extent possible, the use of locally available innovative or marginal materials as such or after suitable processing has to be maximized in the immense interest of the economy. The design life to be taken for purposes of pavement design should neither be too short of requiring expensive up-gradation at close intervals nor should it be so long as to require prohibitively high cost of initial construction. Pavement design forms an integral part of the detailed engineering study. The economic benefit accrued to society directly depends on the performance of the pavement. The design of pavement by following the guidelines and specifications given IRC: SP: 72-2015. In practice, CTBs was first brought back in 1935 in order to improve the roadbed for State Highway 41 at Johnsonville. Even though the idea of stabilizing the soils and pavement materials is present over a century, at present, thousands of kilometers of treated bases with cement are put in to practice in developing and developed countries. Presently, in India, a considerable amount of research work is being done on CTBs to enhance its utilization in all the high and low volume roads. Generally, CTB is composed of 2 layers, in which the upper layer has less thermal expansion as compared to the lower layer (Scullion et al. (1998). The CTB can also be reinforced with fibers in order to improve tensile and toughness properties (Mohammed et al. (2000)). Lim et al. (2003) performed an experimental study to calculate the modulus of elasticity and compressive strength of CTAB materials.

2. Experimental Program

In the current research paper, the pavement design is based on specifications given in IRC: SP-72-2015 for the flexible pavement design of LVRs. The pavement composition of LVRs for sugared CBR 5% and traffic volume in the range of1-2 msa is considered. The pavement design followed a different step by step procedure. Firstly, the resilient moduli of the pavement layers are calculated for the composition given in IRC: SP-72-2015. Secondly, the approximate thickness of different layers is determined based on Odemark's method of equivalent thickness for both cement stabilized and emulsion stabilized low volume flexible pavements. Thirdly, the stress-strain analysis was carried out using KENPAVE software for optimizing the thickness of

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FLEXURAL BEHAVIOR AND MICROSTRUCTURAL CHANGES IN GEOPOLYMER STABILIZED AGGREGATES BASES WITH COPPER-SLAG AS FINE AGGREGATES

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Abstract:

Scarcity of natural materials and sustainable solutions have become major concerns of civil-engineers. As a part of it, the pavement engineers started using low-carbon emission binder materials such as geopolymer binders and recycled materials in different layers of flexible and rigid pavements. The present article focused on flexural behavior of geopolymer stabilized aggregate bases by replacing natural fine aggregates with copper-slag at a replacement dosage of 0, 5, 10, 15, 20 and 25% by total weight of dry aggregates and different dosages of geopolymer binder (3, 4 and 5% by weight of total dry aggregates). A set of prismatic specimens were prepared and subjected to both static and repeated four-point bending for the determination of flexural strength and indirect tensile fatigue test was conducted to determine the fatigue life of geopolymer stabilized mixes at different stress ratios (0.6, 0.7 and 0.9). Further, the changes in microstructure with respect to type of geopolymer binder are investigated through scanning electron microscopy (SEM) at constant dosage of 5%. The study revealed an insignificant reduction in flexural strength with a maximum replacement dosage (20%) of natural aggregates with copper-slag. Further the results revealed a significant influence of dosage of geopolymer binder on flexural strength and fatigue behavior of geopolymer stabilized aggregate mixes.

Keywords: geopolymer stabilization, copper-slag, base and subbase layers, flexure, microstructure.

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The Effective Study of Black Cotton Soil Using Flyash and Geopolymer

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Abstract: ***Nearly 51.8 million hectares of land area in India are covered with Expansive soil (mainly Black Cotton soil). The property of these expansive soils, in general, is that they are very hard when in dry state, but they lose all of their strength when in wet state. In light of this property of expansive soils, these soils pose problems worldwide that serve as challenge to overcome for the Geotechnical engineers. One of the most important aspects for construction purposes is soil stabilization, which is used widely in foundation and road pavement constructions; this is because such a stabilization regime improves engineering properties of the soil. In the present study soil is considered namely Black cotton soil have been stabilized using geopolymers (Alkaline activators, sodium silicate:sodium hydroxide in 2:1ratio). The alkaline solution , sodium silicate: sodium hydroxide in 2:1 ratio was used in different concentrations.In this study deal with the obtaining the unconfined compressive strength values and California bearing ratio by fixing 25% Flyash and % varying of Alkaline material (2%, 4%, 6%, 8% and 10%).***

Keywords: Expansive soil, Flyash, Geopolymer, Unconfined Compressive strength (UCS) and California Bearing Ratio(CBR)

1. Introduction

Geotechnical engineering, especially the treatment and usage of soil (or earth) in construction, is a venerable technical field, dating to the beginning of human civilization. Soil stabilization in a wide-ranging sense includes various methods used for modify the properties of soil to improve its engineering performance. By stabilization the major properties of soil, i.e., volume stability, strength, compressibility, permeability, durability and dust control is improved, which makes the soil suitable for use.

There are different methods of stabilization, which include physical, chemical and polymer methods of stabilization. Physical methods involve physical processes to improve soil properties. This includes compaction methods and drainage. Compaction processes lead to increase in water resistance capacity of soil. Drainage is less common due to generally poor connection between method effectiveness and cost. But, compaction is very common method. Although, it makes soil more resistant to water, this resistance will be reducing over time. Chemical soil stabilization uses chemicals and emulsions as compaction aids, water repellents and binders. The most effective chemical soil stabilization is one which results in non-water-soluble and hard soil matrix. Polymer methods of stabilization have a number of significant advantages over physical and chemical methods. These polymers are cheaper and are more effective and drastically less dangerous for the environment as compared to many chemical solutions.

In the present study, expansive soils are considered for effectiveness of Geopolymer stabilization. As an alternative to such traditional soil treatment and improvement techniques, biological approaches are now being actively investigated in the field of geotechnical engineering, including microbe injection and by product precipitation.

2. Objective

The objective of this research is to evaluate the strength behavior of soil with Geopolymers, (Alkaline material, sodium silicate: sodium hydroxide in 2:1ratio) and to determine the effect of the Geopolymer stabilizers on engineering properties of expansive soils.

In this study dealt with the obtaining the unconfined compressive strength values and California bearing ratio by fixing 25% Flyash and % varying of Alkaline material (2%, 4%, 6%, 8% and 10%).

3. Literature Review

Satyanarayana*et al.* (2004) studied the combined effect of addition of fly ash and lime on engineering properties of expansive soil and found that the optimum proportions of soil: fly ash: lime should be70:30:4 for construction of roads and embankments.

Phani Kumar and Sharma (2004) observed that plasticity, hydraulic conductivity andswelling properties of the expansive soil fly ash blends decreased and the dry unit weight and strength increased with increase in fly ash content. The resistance to penetration of the blends increased significantly with an increase in fly ash content fora given water content. They presented a statistical model to predict the undrained shear strength of the treated soil.

Buhler and Cerato (2007) studied the stabilization of expansive soils using lime and Class C flyash. The reduction in linear shrinkage was better with lime stabilization as compared to same percentage of Class C fly ash.

Wagh (2006) used fly ash, rock flour and lime separately and also in combination, indifferent proportion to stabilize black cotton soil from Nagpur Plateau, India. Addition of either

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Strength Characteristics of Expansive Soils Using Eco-Friendly Xanthan Gum

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Abstract: ***Soil treatment as well as improvement is commonly performed in the field of geotechnical engineering. Methods and resources to achieve this such as soil stabilization in addition to mixing with cementations binders have been utilized in engineered soil applications since the beginning of human civilization. Demand for environment-friendly and sustainable alternatives is currently rising. Suitable eco-friendly replacement for conventional materials is required. Xanthan gum is a polysaccharide commonly used as a food additive and rheology modifier. It has been used as a soil improvement material in the present study and experimental tests were performed with expansive soils. Xanthan were identified for the study over a range of concentration (0.2%, 0.4%, 0.6%, 0.8%, 1.0%, 1.2%, & 1.4%). The results show that the Xanthan gum fibers interact directly with the charged surfaces of clayey particles while forming Xanthan matrices that resemble a hard plastic between uncharged particles. Through experiments with varying concentrations of Xanthan gum, it was found that the strengthening effect leveled off at higher concentrations. The strengthening effect was also shown to be greatly dependent on the hydration level of the soils. Overall, the strengthening effect of Xanthan gum is shown to be dependent on four factors: type of soil, hydration level (e.g., moisture content), Xanthan gum content, and mixing method. Moreover, continuing research is suggested to ensure performance in terms of practical implementation, reliability, and durability of in situ biopolymer applications for geotechnical engineering purposes.***

Keywords: Expansive soil, Xanthan Gum, Shear Strength, Environmentally-friendly

1. Introduction

Geotechnical engineering, especially the treatment and usage of soil (or earth) in construction, is a venerable technical field, dating to the beginning of human civilization. Soil stabilization in a wide-ranging sense includes various methods used for modify the properties of soil to improve its engineering performance. By stabilization the major properties of soil, i.e., volume stability, strength, compressibility, permeability, durability and dust control is improved, which makes the soil suitable for use.

There are different methods of stabilization, which include physical, chemical and polymer methods of stabilization. Physical methods involve physical processes to improve soil properties. This includes compaction methods and drainage. Compaction processes lead to increase in water resistance capacity of soil. Drainage is less common due to generally poor connection between method effectiveness and cost. But, compaction is very common method. Although, it makes soil more resistant to water, this resistance will be reducing over time. Chemical soil stabilization uses chemicals and emulsions as compaction aids, water repellents and binders. The most effective chemical soil stabilization is one which results in non-water-soluble and hard soil matrix. Polymer methods of stabilization have a number of significant advantages over physical and chemical methods. These polymers are cheaper and are more effective and drastically less dangerous for the environment as compared to many chemical solutions.

In the present study, expansive soils are considered for effectiveness of biopolymer stabilization. As an alternative to such traditional soil treatment and improvement techniques, biological approaches are now being actively investigated in the field of geotechnical engineering, including microbe injection and by product precipitation. In particular, microbial induced polymers—or biopolymers—have been introduced as a new kind of construction binder, especially for soil treatment and improvement. To date, most studies on these applications of biopolymers have been experimental efforts that have produced preliminary findings and analyses, and the number of theoretical explanations and case studies of practical implementation in the literature are still limited. In response, this paper provides a detailed review of biopolymer applications in geotechnical engineering including the most recent studies. In this review, strengthening mechanisms between typical biopolymers and soils based on microscopic inter-particle interactions are summarized. The advantages and disadvantages of biopolymer applications are compared with those of existing soil engineering methods. Finally, the potential for practical implementation is evaluated via an economic feasibility analysis, including environment-friendly considerations.

2. Objective of the Work

The objective of this research is to evaluate the strength behaviour of soil with natural biopolymers, and to determine the effect of the biopolymer stabilizers on engineering properties of expansive soils. Unconfined compressive strength and California Bearing Ratio (CBR) of biopolymer-soil specimen is measured. The biopolymers used are Xanthan Gum with concentration of (0.2%, 0.4%, 0.6%, 0.8%, 1.0%, 1.2%, 1.4%, & 1.6%) by weight of dry soil.

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INFLUENCE OF FLYASH ON THE STRENGTH AND SWELLING CHARACTERISTICS OF BENTONITE

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Abstract: Swelling soil like Bentonite causes many problems more for lightly loaded structures than moderately loaded structures. Through consolidation under load and changing volumetrically along with seasonal moisture variation, these problems are proved through swelling, shrinkage and unequal settlement. It leads to damage of foundations, structural elements and architectural aspects which defeats the purpose for which the structures are erected. So, to avoid these types of failures research is done and some methods have been proposed. Pre-stabilization is very effective method in tackling expansive soil. Therefore, a many laboratory experiments are conducted to ascertain host of soil engineering properties of a naturally available expansive soil before and after stabilization. Pre stabilized and post stabilized results are compared to arrive at conclusion that can thwart expansive soil problems. Such structures are requiring renovation of foundation by under pinning. New structural shall need special techniques for control of swelling and shrinkage. Index properties of expansive soil like Atterberg limits and shrinkage limit with and without fly-ash have been compared. Grain size distribution has also been determined by experiments. The swelling potential of this soil has been determined for various percentage of fly-ash. Maximum dry density (MDD) and optimum moisture contents (OPC) have been found out by the proctor compaction test and the graphs are drawn. The strength of swelling soil is determined for soil specimens with different fly-ash concentrations through Unconfined Compression Test and the results are compared through the graphs.
The above results of experiments are compared among them to obtain a percentage concentration of fly-ash with swelling soil which gives best results for lower value of swelling potential and higher strength.

I. INTRODUCTION

For a long time, we are facing problems like failures of small and big structures. The biggest problem behind this is swelling soil. This is very unstable soil. Its property varies from hard to soft and dry to wet. It exhibits swelling and shrinkage with different water content. As a result, the many structures usually face excessive settlement and differential movements, which results in damage to foundation systems and structural elements. We are aware about this situation for a long time, but unable to make improvements due to absence of technologies till now. So now our main aim is to improve the properties of swelling soil like Bentonite. The purpose was to check the scope of improving bearing capacity value and reduce expansiveness by adding additives like fly ash, lime fly ash, ordinary Portland cement etc.

Expansive soils are found in many parts of the world like Burma, south Africa, Western USA, Cuba, Spain, Russia and Indonesia etc... In India it found in Madhya Pradesh, Maharashtra, Gujarat and Orissa. In many countries, coal is the primary fuel in thermal power plant and other industry. The fine residue collected from field is known as fly ash and considered as a waste material. The fly ash is tossed out of either in the dry form or mixed with water and discharged in slurry into locations known as ash ponds. Production of flyash worldwide is huge and increasing day by day. Four countries, namely, China, India, United State and Poland are producing more than 270 million tons of fly ash every year. It is causing hazards to our environment. Therefore, it is used as admixture for expansive soil like Bentonite, to stabilize it which is easy, ideal and cheap technique.

Bentonite is naturally occurring industrial rock, characterized by the property of absorbing water and by capacity for base exchange; both properties are significantly greater than that of plastic clays and kaolin; in certain bentonites water absorption is accompanied by a considerable increase in volume and formation of gelatinous mass (Johnstone and Johnstone, 1961). Bentonite is processed to give sodium and calcium montmorillonite, activated clays and organo-clays all of which have different properties that can be

Pavement Analysis and Design of Low-Volume Roads with Recycled Concrete Aggregate Bases treated with Bitumen-Emulsion

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Abstract:

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Low-Volume Roads recorded highest share in the Indian road network. The annual length of rural roads constructed in India is approximately 7.2 lakh kilometers for the year of 2019-20 (As per Pradhan Mantri Gram Sadak Yojana). As the rate of road construction is increasing day-by-day, it is necessary to acquire the sufficient quantity of aggregates. To address this and avoid the use of Natural Aggregates, the Recycled Aggregates like Recycled Concrete Aggregates (RCA), Reclaimed Asphalt Pavement (RAP) material and Reclaimed Asphalt Shingles (RAS) are become familiar in pavement construction. The present study focused on the design and analysis of low-volume roads with aggregate bases treated Bitumen-Emulsion and sub-bases treated with cement. In prior to carry out the pavement analysis and design, the mechanical characteristics of bitumen-emulsion mixes with different proportions of RCA (25, 50 and 75%) are analyzed. The samples are prepared with various amounts (6 to 9%) of Bitumen-Emulsion Contents (BEC) and 1.5% cement. The prepared samples are evaluated for mechanical characteristics like Marshall Stability, Indirect Tensile Strength (ITS), Resilient Modulus (M_R), density and Tensile Strength Ratio (TSR). From the Marshall Stability-Test, the optimum BEC is determined and noted as 8% for the mixes with 25, 50 and 75% RCA contents. Later, the fatigue behavior is analyzed using Repeated Load Test. In addition to it, the sub-bases with 75% RCA and 2% cement are used in pavement analysis and design and corresponding characteristics are listed in this article. Finally, the pavement design and analysis are conducted for the pavements with bitumen-emulsion stabilized bases (BESB) having 75% RCA at optimum BEC for subgrade CBR of 5%. In overall, it is concluded that the Recycled Concrete Aggregates can be successfully utilized instead of Natural Aggregates in the bitumen-emulsion treated bases for construction of low-volume roads.

1 Background

The bitumen-stabilized materials (BSM) generally prepared with either bitumen-emulsion or foamed-bitumen. The behavior of BSMs is different from the cement treated mixes and conventional mixes. For BSMs, the ratio of residual bitumen and cement is restricted to 1 as per Asphalt Academy Technical Guidelines-2009 [1]. In this study the amount

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Studies on Stone Mastic Asphalt mixes with Partially Replacement in Addition with Waste Plastic

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ABSTRACT--*The present assessment inquires about the benefits of offsetting the stone mastic dark top (SMA) mix in versatile black-top with decimated squander plastic. Standard (without plastic) and the reasonable out SMA mixes were presented to execution of compressive quality tests and split pliable quality tests with moving rate bitumen by weight of mineral aggregate (5% to 6.5%)) and by varying rate plastic by weight of mix(5%,10% and 15%). Plastic substance of 10% by weight of bitumen is endorsed for the improvement of the display of Stone Mastic Asphalt mixes. 10% plastic substance empowers an extension in the compressive stood out strain stretch from the customary SMA Mix*

Keywords-- *SMA, Waste Plastic, Void Ratio, Compressive Strength, Split Tensile*

I. INTRODUCTION

1.1. General

Stone mastic dark top (SMA) is a stone-on-stone like skeletal structure of gap surveyed all out, sustained together by mastic, which truly is higher spread substance, filler and fiber to diminish the latch channel. This structure improves the quality and the presentation of SMA a lot higher than the thick assessed and open looked into dark top mixes. Significant level of clasp content is basic to ensure the robustness and laying characteristics of SMA.

1.2. Air Voids

Air voids are little airspaces or pockets of air that happen between the covered total particles in the last compacted blend. A specific level of air voids is important in all thick reviewed expressway blends to take into consideration some extra asphalt compaction under traffic and to give spaces into which limited quantities of black-top can stream during this ensuing compaction. The suitable level of air voids (in research facility examples) is between 2.0 percent and 4.0 percent for most surface course blends or as required by the proprietor. The sturdiness of a black-top asphalt is a component of the air-void substance. This is on the grounds that the lower the air-voids, the less porous the blend becomes. Too high an air-void substance gives ways through the blend to the passage of harming air and water. A low air-void substance, then again, can prompt flushing, a condition where abundance black-top presses out of the blend to the surface. Thickness and void substance are legitimately related. The higher the thickness, the lower the level of voids in the blend, and the other way around. Employment particulars require asphalt that permits as low an air void substance as is viable, around 8.0 percent.

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Effect of P^H on Shear Strength Behaviour of Expansive Soil

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Abstract: The spatial extent of black cotton soil in India is more with low bearing capacity and high settlements. These soils have to be stabilized to improve bearing capacity and to reduce settlements of the structures to be constructed on them. Huge amount of research is carried in stabilizing black cotton soils with various stabilizers (lime, cement, phosphogypsum, rice husk ash, groundnut shell ash, waste saw dust ash and other materials) showed improvement in the properties of the soil. Recently Bio-Enzymes also used as stabilizers. This paper is an attempt to study the effect of Sulphuric acid and Sodium Hydroxide on black cotton soils when mixed at pH levels of H2SO4: 1, 3, 5 and NaOH: 9, 11, and 13 with the help of EDAX and SEM tests.

I. INTRODUCTION

In India, expensive soils are called as black cotton soil. The name black cotton soil as an agriculture origin. The greater part of this dirt are dark in shading and are useful for agribusiness developing cotton and happening in Maharashtra, Karnataka, Gujarat parts of Andhra Pradesh and tamilnadu. These are costly in nature .by virtue of high swelling in shrinkage potential these are distinctive soils to manage in an establishment plan. All these black soil are not expensive soils and all expensive soils are not in black in colored. These soil passed high strength in summer and decrease rapidly in winter. The soil has a swelling property due to presence of montmoranlite mineral. Black soil which are high expensive characteristics. These soils are low shrinkage limit and with high optimum moisture content. It is high sensitive to a moisture charges. Black cotton soils are generally found in sedimentary plain as a result thousands of eroding the clay content from the surroundings and also on level land on plateaus as well as in depressions. Smaller areas of expensive soils are found on hill slopes and piedmont plains. These dirts gangs low quality and experience costs volume changes making the utilization in the development in an unexpected way. The properties pf dark cotton soil might be modified in any ways i.e., mechanical, warm, substance and so forth. Alterations of dark cotton soil by admixtures is a typical adjustment strategy for such soils. The swelling soils of India have been origin in subaqueous solution of basally rock r weathering or insult . Form this information infrastructures may be prevented from damages causing expensive soils, Black soils are highly argillaceous and are relatively rich in caco3. soil differ from one part of the world to another, even one part of a background to another. They differ because of a how they are formed. Five major factors interact to create different types of soils

Parentmaterial:

This alludes to the mineral material, or natural material from which the dirt is shaped. Soils will convey the qualities of its parent material, for example, shading, surface, structure, mineral arrangement, etc. For instance, if soils are shaped from a zone with substantial rocks (parent rocks) of red sandstone, the dirts will likewise be red in shading and have a similar vibe as its parent material.

Climate:

This is likely the most imperative factor that can shape the development of soils. Two vital climatic parts, temperature and precipitation are vital. They decide how rapidly enduring will be, and what sort of natural materials might be accessible on and within the dirts. Dampness decides the substance and organic responses that will happen as the dirts are framed. Hotter atmosphere with more precipitation implies progressively vegetative spread and increasingly creature activity. It additionally implies more spillover, more permeation and more water disintegration. They all assistance to decide the sort of soils in a area.

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Performance of Recycled Aggregate as Constituents of Base and Sub-Base Layers for Rural Roads

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Abstract

This investigation is an endeavour to evaluate the performance of recycled aggregate as constituents of base and sub-base layers of rural roads in India. The physical and strength properties of the materials are tested and utilised to evaluate their performance. It is found that the physical properties of the Recycled Aggregate (RA) are unsatisfactory to those of crushed natural granite. The water absorption of 3.76% observed in RA is higher than the recommended 2%. The Recycled Aggregate (RA) is blended with the natural aggregates at 25%, 50%, 75%, and 100% replacement levels. The mixture with 100% crushed granite is utilised as control. The MDD of the aggregates is reduced with an increase in RA content and as a result, the OMC is increased. The CBR values of the aggregates reduced as the RA increased. The 0%, 25%, 50%, 75%, and 100% of RA had CBRs of 92%, 91%, 46%, 44%, and 28% respectively. Based on the CBR values and other tests conducted, exploitation of mixed RA for sub-base layers of rural roads is recommended. However, where mixed RA are utilised for base layers it should be limited to 25% inclusion.

Keywords:*CBR, compaction, base, recycled aggregates, sub-base*

I. INTRODUCTION

Human deeds remain the foremost cause of the global climate change due to heavy loads of greenhouse gasses released into the environment from these activities. As a result, critical environmental and health challenges are being experienced by humans and other creatures in recent times (Jimenez et al., 2012a). Various developmental strategies of different countries in the world require a continuous construction and re-enactment of accommodation and transportation infrastructures. This has made the construction activities an inevitable and endless human demand. Road construction is most important infrastructural provision because it links several economic activities within a country and across countries.

Provision of quality, drivable and measurable road networks both in cities and suburbs remains a very good indicator for sustainable development. It remains a necessity for human subsistence and development of global regions (Gilpin et al., 2004). Instead of reducing road construction activities, efforts are made towards making road construction more sustainable. The material flow for road pavement construction is a key area where sustainability strategies can be applied.

Below every pavement surface lies different materials, mostly unbound aggregates are utilised as the road base and sub-base materials. These materials are placed on the subgrade soil to ensure efficient transfer of traffic loads to the subgrade soil (Thomas et al., 2000). In order to withstand traffic

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PERFORMANCE EVALUATION AND SIMULATION ANALYSIS ON SMA MIX DESIGN TECHNIQUE BY USING LDPE

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Abstract

The current examination explores the advantages of settling the stone mastic black-top (SMA) blend in adaptable asphalt with destroyed waste plastic. Customary (without plastic) and the settled SMA blends were exposed to execution tests including Marshall Stability test. SMA, which is stone lattice black-top, is a hole reviewed HMA which is utilized to augment rutting obstruction and solidness in overwhelming rush hour gridlock conditions. The paper audits about the different issues identified with the development of asphalts utilizing SMA. This examination is to check the practicality of waste plastic as balancing out added substances in which the stream esteems and solidness esteems were broke down by performing Marshall Stability test. Different rates, for example, 5%, 5.5%, 6% of bitumen are chosen for this investigation. Plastic substance of 5%,10%,15% by weight of bitumen is suggested for the improvement of the presentation of Stone Mastic Asphalt blends. Natural and monetary contemplations have urged structural architects to discover ways the accommodation of plastic waste as productive material in adaptable asphalts. The ebb and flow paper presents a test research on the chance of using waste plastic in stone mastic asphalt(SMA) blends. Blended in with squander plastic in bitumen to deliver SMA examples. The got outcomes showed the utilization of plastic waste to in part supplanted by bitumen expanded the required folio content in the black-top blends. 10% plastic substance gives an expansion in the solidness of about 64%, 18% and 75% individually contrasted with the customary SMA blend. The channel down worth declines with an expansion in plastic substance and the worth is just 0.09 % at 10% plastic substance and ends up being a successful balancing out added substance in SMA blends. Even in this work we applied stimulation analysis and we created equation for better getting understanding and for advanced usages.

Keywords: Stone mastic asphalt (SMA),Bitumen, Marshall stability, Plastic waste, simulation analysis

1. Introduction

Stone Matrix Asphalt (SMA) is a hot blend black-top that was created in Germany in the late sixties. SMA has been used in other European nations for over two decades to give higher rutting obstruction just as studded tire wear. Due to its achievement in Europe, the United States of America (USA) likewise propelled the development of SMA asphalts in certain states, in a joint effort with the Federal Highway Administration. Ongoing examinations have demonstrated that in excess of 28 states in the USA use SMA due to its expanded strength, up to 20%–30%, contrasted with ordinary blends.

SMA has low air voids with significant levels of full scale surface when laid, bringing about a waterproof layer with great surface waste.

A roadway venture requires gigantic measure of speculation. In current circumstance a Stone Matrix Asphalt (SMA) of solid, protection from weariness load, strong and practical is basically required. SMA is blend of various evaluations of total, black-top as folio and non-regular materials(LDPE squander plastic). Researchers and architects are continually looking on changed techniques to improve the presentation of black-top asphalts. Extensive exploration has been done to decide the reasonableness of plastic waste modifier in development of bituminous mixes.loe thickness polyethelene(LDPE) basic food item sacks might be valuable in bituminous asphalts bringing about diminished perpetual misshapening through rutting and decreased low temperature splitting of asphalt surfacing.

Different added substances like polymers and strands have been used to improve the high and low temperature qualities of bitumen organizations, just as to improve their strength and toughness. Added

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LABORATORY EVALUATION OF BITUMEN EMULSION STABILIZED BASES WITH RECYCLED CONCRETE AGGREGATES AND STONE DUST

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ABSTRACT: The bitumen-emulsion stabilized materials (BESM) have become familiar due to their better performance as compared to the conventional granular layers. These materials enabled the enhancement of the usage of recycled materials. The present paper evaluated the bitumen-emulsion stabilized mixes with stone dust, different proportions (25, 50 and 75%) of Recycled Concrete Aggregates (RCA) and two stacks of natural aggregates (NA). The mechanical characterization is studied for the BESMs with 1.5% cement and 3% water. The specimens are prepared with Bitumen Emulsion Contents (BEC) of 6, 7, 8 and 9% by weight of the dry aggregates. The compacted specimens are cured with the mould for 24hours (at 25±2°C) and without the mould for 72hours (at 40°C). Firstly, the cured specimens are tested for Indirect Tensile Strength, and Optimum Bitumen Emulsion Content (OBEC) is determined. Later, the mechanical characteristics like Marshall Stability, Resilient Modulus (MR) and durability in terms of Tensile Strength Ratio (TSR) are studied. Finally, the repeated load test (RLT) is conducted for investigating the fatigue resistance according to the guidelines given in ASTM-D4123. Multiple Linear Regression analysis is carried and a model for the number of load applications causing the fatigue failure (N_f) is developed. The results showed a decrease in M_R with an increase in RCA content at OBEC. From this research study, it is concluded that the BESMs with RCA can be adopted for the construction of the bases stabilized bitumen-emulsion for design traffic less than 1 million equivalent standard axles (mesa).

KEYWORDS: Bitumen Emulsion Stabilized Mix (BESM), Bitumen Emulsion Content (BEC), Marshall Stability, Indirect Tensile Strength (ITS), Moisture loss, Fatigue, Modelling.

I. BACKGROUND

Bitumen Stabilized Material (BSM), it is first time coined in Asphalt Academy Technical Guidelines in the year of 2002. Generally, BSMs can be prepared by either bitumen emulsion or foamed bitumen. But in this study, the BSMs with bitumen emulsion with recycled concrete aggregate (RCA) are discussed. The bitumen emulsion mixes composed of bitumen emulsion, recycled aggregates, natural aggregates, water and active filler like cement or lime. Generally, cement is preferred over lime due to better strength properties and abundant availability in the market. Any study related to bitumen emulsion stabilized mixes (BESM) mainly composed of two stages. Out of them, the mixture design is the primary stage while mechanical characterization is the secondary stage.

The mixture design composed of determination of total fluid contents (TFC) or Pre-wetting water content (PWWC) and BEC [1-3]. As far of now, there is no universally accepting procedure for determining TFC/PWWC and BEC. As per Indian Standards, 50:50 bitumen-emulsion diluted with water is considered for optimizing the TFC [4], while American standards like Asphalt Academy TG-2 adopted the optimization of TFC with trail BEC and assumed PWWC staring from 1%. Some studies preferred ITS [5-6] as an indicative measure while other prefer Marshall Stability for optimizing the BEC [7]. Several studies are recommended to use the cement instead of using the lime [8].The addition of cement as secondary binder or active filler is helpful in improving the early strength properties [9] and accelerating the breaking process [10]. Based on the previous studies, it is recommended to use a range of 1 to 2.5 % cement [10-14]. In this study 1.5% of cement is selected in order to

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Lime Pile Technique for the Improvement of Properties of Clay Soil

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Abstract: *Soil improvement is one of the basic requirements for the preparing in situ soils for the appropriate strengthening, stiffness, and stability in civil engineering designs and applications. The modification technique, which involves mechanical, thermal and chemical components, requires monitoring techniques to determine its efficiency and suitability. This study examines the geotechnical improvement of properties of clay soils using the lime pile technique on a laboratory scale model. The clay-lime physicochemical reactions resulting from cat ion exchange were examined through basic experimental analyses. Remolded compacted clay soil blocks were carefully prepared in rectangular test tank with lime piles installed in them. The treated soil block properties were then investigated as a function of lime pile at different curing periods. The curing periods are 28, 60, 90 and 120days etc…It was observed that there are significant changes in the atterberg limits, shrinkage, compaction characteristics, and strength of the treated soils due to the clay-lime reactions. The results indicate that these reactions have remarkable effects on the lime pile treated soil and produced strong interpartical bonds and unconfined compressive strength of the soil. This is attributed to the migration of Ca^{2+} and $Mg2^{+}$ ions from the lime piles into the soil, flocculation of particles, and pozzolanic reactions. The significant shear strength values suggest that their correlative changes can be used as monitoring technique to determine the improvement in geotechnical properties of chemically treated soil.*

Keywords: soil, lime piles, physicochemical reactions, Atterberg limits, Omc and Mdd, shear strength

1. Introduction

Lime column technique has been applied successfully in recent years to improve the physical and mechanical properties of the soils. Both the dry and wet lime mixing are carried out by injecting a preferable pressure into soil and form a lime-column in-situ. This technique increases soil bearing capacity and reduces soil settlement owing to improving of soil strength and stiffness. A study carried by on full-scale model showed that the stiffness of the improved soil using lime column increased more significantly than that of lime-cement column. Researchers such as Shen et al(2003),Tonoz et al (2003),and Budi et al (2003)studied separately the strength of the soil surrounding the lime column. They reported that the soil strength increased near the column to a distance up to 2 to 3 times of the column diameter in radial direction. But, the effect of strength change beneath the bottom of lime column was not studied. It is reasonable to assume that the lime will flow easily downward into soil in vertical direction and the soil strength may also increases with the availability of lime. After lime column installed, the lime or calcium ions migrate into soil surround the lime column. The soil properties around lime column will change due to consolidation, densification and hardening resulted by the chemical reaction between lime and soil. For an efficient stabilization, calcium and hydroxyl ions should migrate through the clay, because hydroxyl ions cause highly alkanic conditions give rise to the slow solution of alumino-silicates which are then precipitated as hydrated cementitious reaction products. These reaction products contribute to flocculation by bonding adjacent soil particles together and curing is allowed the clay soil is strengthened. This mechanism will control the strength of the soil surround the lime column. The soil the center of the lime column both in radial and vertical direction.

2. Review of Literature

Kennedy et.al (1987) observed an increase in the unconfined compressive strength with the addition of lime to some clay soils.

Allen, et.al., (1977) reported that higher than normal temperature activate the strength producing pozzolanic reactions of lime –soil mixtures.

Lashed and Mizrahi (2008) concluded that hydrated lime treatments ' are very effective in reducing the swelling pressure and consequently the swelling potential of the treated expansive clay soils.

Tonoz et al. 2003; Arnsberg 2006; A typical expansive soil is characterized with high plasticity, excessive heave, high swell,and shrinkage potential that may result in damages to civil engineering structures.

Mitchell and Hooper (1961) conventionally, geotechnical properties of lime pile–treated soils are dependent on their ionic content, type of lime used, curing time, curing temperature and water content.

Timo 1998; Friedman 2005 The movement of ions in clay soils is attributed to the degree of saturation, magnitude of electric field, temperature difference, amount of fines, organic content, pore ionic concentration, and particle structures.

Allele. Al., (1977); Saber and Parches, (1979); Kennedy et. Al.,(1987) Extensive research has been conducted on the effects of lime stabilization on the engineering properties of natural clayey soils.

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Statistical Analysis and Treatment of Accident Black Spots: A Case Study of Nandyal Mandal

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Abstract:

Background:

Increased, economic activity raised the consumption levels of the people across the country. This created scope for increase in travel and transportation. The increase in the vehicles since last 10 years has put lot of pressure on the existing roads and ultimately resulting in road accidents.

Nandyal Mandal is located in the Kurnool district of Andhra Pradesh and well developed in both agricultural and industrial sectors after Kurnool. 567 accidents occurred in the last seven years at 143 locations shows the severity of the accidents in the Nandyal Mandal. There is a need to carry out some work in the Nandyal Mandal to improve the accidents black spots for reducing the accidents.

Methods:

Last seven years (2010-2016) of accident data collected from Police Stations. Weighted Severity Index (WSI), a scientific method is used for identifying the accident black spots. Statistical analysis has carried out for the collected data using Chi-Square Test to determine the independence of accidents with other attributes. Chi-Square Goodness of fit test conducted for test whether the accidents are occurring by chance or following any pattern.

Results:

WSI values are determined for the 143 locations. The Locations with high WSI are treated as accident black spots. Five black spots are taken for field study. After field observations and interaction with the public, some improvements are suggested for improving the accident black spots.

There is no relationship between the severity of accidents and the other attributes like month, season, day, hours in day and the age group except type of vehicle. Road accidents are distributed throughout the Year, Month and Season. Road accidents are not distributed throughout the day.

Keywords: Severity Index, Accident black spot, Chi-Square Test.

MANTECH Publications

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A Study on Stabilization of Black Cotton Soil Using Terrazyme- A Bio-Enzyme

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Abstract

In India vast area was occupied by Black Cotton Soil which contains clay as chief constituent. These soils show minimal bearing capacity and low strength. They swell when come in contact with water and shrink as they dry out. Engineers face problems with such type of soils, which do not possess sufficient strength to carry the imposed loads during construction and the life of the structure. Properties of the soil must be increased to achieve economy and to improve the performance of structures.

Soil stabilization is the process of reducing undesirable behaviour of expansive soils. Conventional stabilization methods are time consuming and are proved to be not economical; it became necessary to look for alternative eco-friendly stabilizers like bio-enzymes. Recently there are many bio-enzymes available for soil stabilization such as Renolith, Permazyme, Terrazyme and Fujibeton, proved to be effective and economical.

The present study deals the effect of Terrazyme a bio-enzyme on shear strength and CBR value of expansive soil. Laboratory tests were conducted on various dosages, stabilizer was added by replacing 1%,2%,3%,4% of the optimum water content of the black cotton soil..

Keywords: *Expansive soil, Terrazyme, Shear strength, CBR*

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Performance Evaluation of Flexible Pavement on National Highway-18 Kurnool District of Andhra Pradesh

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Transportation system,

Arterial road system,

Premature distress.

ABSTRACT

An efficient and adequate transportation system is one of the key indicators of a nati prosperity, its developmental status and overall economic growth. The roads pass through a with extreme climatic conditions from heavy rainfall to desert conditions; diverse terrains f plains to extremely high mountains, plateaus and varying soil grades, rocky and gravell marshy land. Over the past four decades, the share of total rail and road traffic carr passengers and goods is gradually increasing because of fast and ever-increasing indus commercial, and other socioeconomic development activities, the road transport vel population, especially the vehicles carrying goods, has also increased phenomenally during period. Because of economies in road transportation, overloading by truck operator common. The majority of the arterial road system experiences overloading, as much as 1 20-tonne axle loads versus the permissible legal limit of 10.2 tonnes. The existing road netv has shown signs of premature distress because of the unexpected demands of growing tr volume and heavier axle loads. The network has fallen short of its structural capacity and h it is greatly overstrained. The majority of allocated funds are utilized for providing mainten and rehabilitation measures to the existing network rather than for new construction. With background, in the present study, a road section is identified in Kurnool district of An Pradesh to carry out the pavement performance study on distresses. For the selected str data was collected on rutting, raveling, potholes, edge failures, traffic, etc. The detailed ana was performed using NCSS statistical tool and to develop a pavement performance mode the selected stretch.

Background

Performance prediction models represent a key element of road infrastructure asset management systems or pavement management systems. Thus successful implementation of these systems depends heavily on the performance prediction model used as the accuracy of the predictions determines the reasonableness of the decisions. Several pavement performance prediction models have been proposed over the years. Many of these models are developed for application in a particular region or country under specific traffic and climatic conditions. Therefore they cannot be directly applied in other countries or conditions. Although much research has been devoted to performance modelling of pavements, a comprehensive model that can predict pavement performance accurately has yet to be developed. The available models can be broadly classified into three groups; empirical, mechanistic-empirical and subjective models. Various empirical models are proposed for application at network and project levels. The mechanistic-empirical models are often developed in connection to design systems and therefore have not been widely applied in pavement management systems (PMS), but have the potential to be applied at a network level. The subjective models are mostly developed for strategic (investment) planning at the network level. Thus, the review showed that there is a need to develop improved models for use both at the network level and the project level. Assessing the level of compaction of sub-surface soils can be essential to designing and building structures, particularly those subject to transient or cycling loads. A perfect example is roadways. If the soil beneath a roadway is not compacted sufficiently, then over time the cycling loads of passing traffic will compact the soil further, leading to surface failure such as large cracks, potholes and displaced pavement. For the evaluation purpose he Dynamic Cone Penetrometer Test (DCPT) was in the study.

Methodology

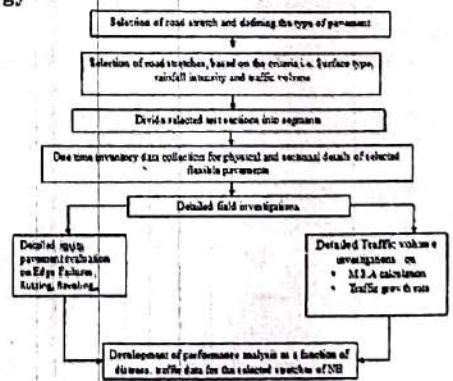

Figure 1. Proposed Methodology

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Quantification of Accidents and Suggested Improvements A Case Study of Nandyal Town in Andhra Pradesh

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Vehicular defects,
Environmental factors
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management systems.

ABSTRACT

The problem of accident is very acute in highway transportation, leading to loss of life and property. The various causes of road accidents are road users, vehicular defects, road condition, road design, environmental factors and other causes such as improper location of advertisement boards, improper location of level crossings not closed when required etc. Road accidents cannot be totally prevented, but by adopting suitable traffic engineering and management systems the accident rate can be reduced to a certain extent. Proper investigation of the cause of accident will help to propose preventive measures in terms of design and control. With this back ground in the present the detailed investigation on the quantification of accidents in Nandyal town, Andhra Pradesh has been carried out and suitable remedial measures has been suggested by conducting through filed investigations.

Introduction

Road accidents have been a source of major concern to every one as it causes loss of life, injuries and sufferings to the human being, besides involving huge economic loss to the country. The accidents and the fatalities on the roads are the results of inter play of a number of factors, such as fault of drivers; in adequate and improper traffic control devices; inadequate care in design, construction and maintenance of roads; inadequate knowledge about road safety; non observance of traffic rules; etc. Over one million fatalities are caused by the accidents every year across the globe .The road accidents cause economic loss equal to 1 to 2 percent of the Gross Domestic Product (GDP) of the nations. Considering the enormity and seriousness of the cause, most of the countries have drawn up plans and policies to reduce the fatalities. "Road accidents do not just happen but are caused" is a common cliché in the area of traffic safety. Thus, if accidents are caused by some agents, surely they could be identified and appropriate remedial measures could be developed and implemented for their prevention to the extent feasible for the reduction of the ill effects and trauma of the accidents. Analysis of the data on accidents in the country showed that drivers of the motor vehicle are the single major factor responsible for the accidents as they fail to perceive the situation ahead because of poor reflexes, fatigue, inexperience or being under the influence of toxicants. There are however, other factors, which contribute directly or indirectly to the road accidents are, road, vehicle, road user and environmental factors. In our country, an accident occurs at every 1.2 minute and a person is killed in every six minutes, this is to say that 235 persons die every day and 1243 persons get injured in road accidents. Nearly 60 percent of total accidents take place during nights though the night traffic is hardly 15 percent of 24 hours volume which means that the accidents in India during night times greater than the day traffic.

Study Area Description

The present study involves the data collection and analysis of eight busy stretches in the zone of Nandyal, Kurnool district of Andhra Pradesh. The first collector street is from Bommalasathram to Nunenepally which is of 2.47 km length consisting of no speed breakers and no horizontal curves. The, second stretch is from chamakalva to railway station road which is of 1.29 km length comprising of 3 horizontal curves and 6 speed breakers. The third collector street is from railway station to saibaba nagar which is of 1.59 km length and comprising of 3 horizontal curves and 5 speed breakers the fourth stretch is from Bommalasathram to bus stand which is of 2.79 km length involving two horizontal curves and four speed breakers. The fifth one is from sreenivas centre to government hospital which is of 1.95 km length and comprising of 14 horizontal curves and 11 speed breakers. The sixth stretch is from Byrmal Street to bus stand which is of 0.62 km length with 6 horizontal curves and no speed breakers. The seventh stretch is from sreenivas centre to sanjeev nagar which is of 1.53 km length and it consists of 2 horizontal curves and 3 speed breakers. The Last collector street is from sreenivas centre to Gandhi chowk which is of 0.48 km length involving zero horizontal curves and 4 speed breakers.

Study Methodology

The methodology involves the collection of accident data, calculation of speed data, collection of population data, and collection of traffic data as presented below.

Step1 Collection of Accidental Data

Accident data of the selected roads is collected from the secondary sources for the past 7 years i.e., from 2008 to 2014. These data are collected from different police stations all around the Nandyal zone. The data includes number of

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Design of four Phase Traffic Signal using Webster Method -A Case Study

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Webster Method,
Signal Design,
Passenger Car Unit,
Signal Phase.

ABSTRACT

The main aim of this investigations is to avoid conflicts at intersections and cross sections by proposing a safe and efficient design of four phase traffic signal at intersections where there are large number of crossings and right turns. The earlier practice of controlling the traffic by a traffic police using stop signs alternately at the cross roads so that one stream of traffic is allowed while the traffic flow from the other stream is stopped was quite effective. But now a days, due to the increase of traffic as well as pollution, a lot of difficulties are being faced by the traffic control authorities. In this aspect, the same problem is been faced at sreenivas centre in Nandyal which is a four legged intersection. The heavy traffic flowing from bus-stand towards Atmakur and Srisailam causes a lot of conflicts in the traffic flow from Nunepally towards Gandhi Chowk and Byrmal Street. So in this direction to have a pleasant and safe travel, there should be an orderly movement of traffic which is possible through signal control. So there is a strong requirement of signal regulated traffic flow for the four legged intersection at Sreenivas Centre. This study proposed and designed the cycle length for the four phases traffic signal using Webster method.

Introduction

A traffic light is a device that is designed to control the flow of traffic by using three colored lights. These lights are mainly green, yellow, and red. In 1860"s London, the first traffic control device had arms that extended out to command drivers on how to react at an intersection. The first four way three color traffic light did not come until December 1920 in Detroit. A traffic light, traffic signal, or stop light is a signaling device positioned at a road intersection Pedestrian crossing, or other location in order To indicate when it is safe to drive, ride, or walk using a universal color code. In Malaysia, the Traffic light for vehicles commonly has three main lights, a red light that means stop, a green Light that mean go and yellow that means ready to stop. However for the pedestrians, there have only two lights, a red light and a green light that mean go and stop respectively. The traffic lights have given many benefits to all road users. Besides reducing the number of accidents, it made the traffic flow smoothly and possibly could save people time.

Site Selected For Design of Signal

Sreenivas centre is one of the busiest circles in the town of Nandyal. Roads from Srisailam and Atmakur cross the busiest street of Nandyal which is stretched from Nunepally towards Gandhi Chowkand Byrmal Street. The screen shot from Google map is shown in Fig1. As this cross section, there are merges and diverges in the crossing of these two roads and there will be no orderly movement of traffic. In this connection, there is possibility for the traffic jams as well as accidents to occur. So there is a very heavy requirement for regulation of traffic, as well as orderly movement. To achieve this, there is a need of signalized cross-section. As it is a cross-section of two roads, there is a need of a four phase traffic signal.

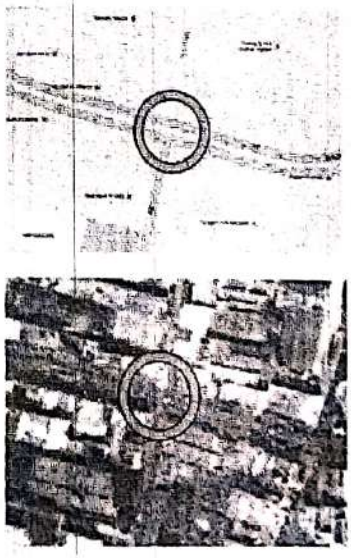

Fig 1 Screen shot for Google map of selected site for design of signal

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