STUDY ON PERFORMANCE OF MODIFIED BITUMEN WITH ADDITION OF FLYASH ADMIXTURES IN DIFFERENT PROPORTION

Submitted in partial fulfillment of the requirements of the degree of

MASTER OF TECHNOLOGY

in

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by

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CERTIFICATE

Certified that this project report entitled "**STUDY ON PERFORMANCE OF MODIFIED BITUMEN WITH ADDITION OF FLYASH ADMIXTERS IN DIFFERENT PROPORTION**" submitted individually by student of School of Civil Engineering, Lovely Professional University, Phagwara , carried out the work under my supervision for the Award of Degree. This report has not been submitted to any other university or institution for the award of any degree.

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DECLARATION

I, Anjan Gupta (11012640), hereby declare that this thesis report entitled "**STUDY ON PERFORMANCE OF MODIFIED BITUMEN WITH ADDITION OF FLYASH ADMIXTERS IN DIFFERENT PROPORTION**" submitted in the partial fulfillment of the requirements for the award of degree of Master of Civil Engineering, in the School of Civil Engineering, Lovely Professional University, Phagwara, is my own work. This matter embodied in this report has not been submitted in part or full to any other university or institute for the award of any degree.

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Signature of Student
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ABSTRACT

The basis of the thesis was to find out the change in the physical properties of the bitumen by modifying it with fly ash. Different percentage of fly ash was used to modify the bitumen. Various physical tests were conducted on virgin and modified bitumen to evaluate its physical properties. Marshall test was conducted on bituminous mix prepared using modified and unmodified bitumen and the results were analyses and compared.

The study indicated that increase in the percentage of fly ash improves the physical properties of virgin bitumen. Further it also indicated that increase in the percentage of fly ash improves Marshall Stability and flow values in the bituminous mix.

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Chapter-1

INTRODUCTION

1.1 General

With the changing life style among different classes of the society, road network has become one of the essential backbones for the movement from place to place as it provides a good access for the commuters to travel to their desired place. Road network has been adopted long ago by the people when other modes of transport were not even invented. Over the last 50 years road transportation has expanded the most. Passengers and freight transportation.
In road network majority of the roads constructed consists of flexible pavement. Flexible pavement generally comprises of the four layers:

(i) Soil sub grade

(ii) Sub base course

(iii) Base course

(iv) Surface course

increase of traffic on the road throughout the world which has lead to heavy load implications on the pavement by the movement of the traffic. However unmodified bitumen and usually practiced lofty grade classic asphalt concrete has failed to assure the increasing demand and projected stage of act.

This insufficiency results in fatigue, excessive rutting and thermal crack and hence resultant in short service life (Isikyakar, 2009). To irradiate such problems it has led the attention of many researchers and agencies concerned to it to look for various efforts that can be made for improving the properties of the bitumen to deal with the problems related to pavement distresses. One of the methods which have recently received more attention is modification of the bitumen with other materials commonly termed as admixtures. Some admixtures have been known to

work as modifiers of bitumen if thoroughly mixed with it, resulting in an increase of binder properties. These admixtures are directly added to the bitumen mixture as a bitumen modifier or it can be added into the aggregate containing the mixture.

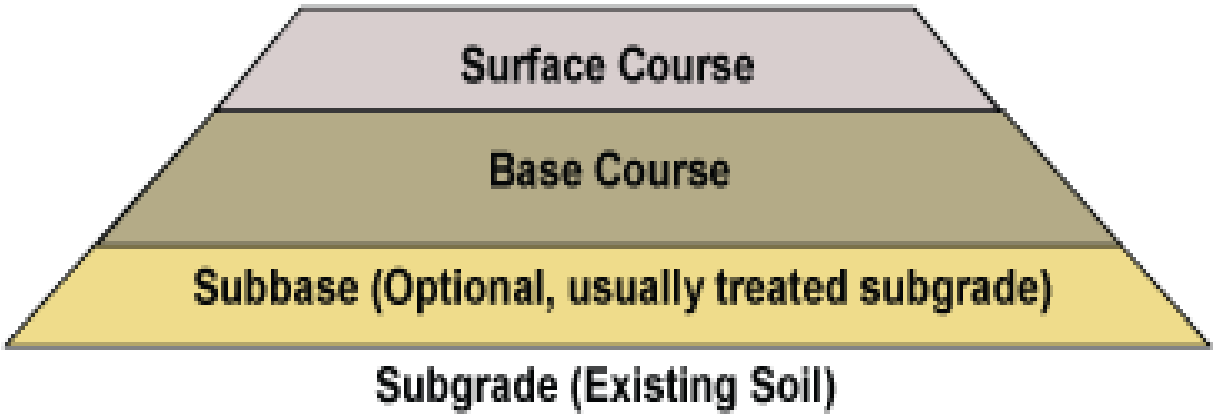

Figure 1.1 Flexible Pavement

Most of the admixtures which are being utilized for the bitumen modification are enumerated as:

(1)Polymers
  (1) Plastic polymer
  (2) Fiber polymer
  (3) Elastomers
(2)Ground Granulated Blast furnace Slag
(3)Fly ash
(4)Rubber
  (1)Crumb rubber
  (2)Natural rubber

However modified bitumen is typical produced at more expensive prices thus it can lead to the increase in the economy of the modification process. Fly ash has successfully been used as filler for Bitumen mixes for a long time, as it's easily available at a very low cost compared to other's filler's. Fly ash is the finely divided mineral residue resulting from the combination of ground

or crushed coal in electric generate plant. ‘Fly ash’ was reported to have the ability to work as a bitumen extender (Tayebali et al. 1998).

1.2 Study of the Objectives

Primary objectives of the current reading is

(1) Evaluate the properties that Bitumen have dissimilar percentage of ‘fly ash’ as admixture.

(2) To compare performance of modified bitumen with fly ash as an admixture with that of the virgin bitumen through laboratory investigation.

1.3 Scope of the study

To meet the above objectives the scope of the project will be formulated as follows:

(1) Material Characterization i.e. evaluating physical properties of virgin binder of Viscosity grading (VG 30).

(2) To find out various Marshall Characteristics (like stability, flow, air voids) of bituminous mix prepared from both virgin and modified bitumen.

1.4 Thesis overview

The thesis has been organized into five chapters enumerated as: Introduction, literature review, material characterization, performance of mixes and conclusion.

Chapter1 Of the thesis is the introduction to the thesis and it presents the problem statement for the present study, objectives and details of the possibility of work selected.

Chapter2 Discusses summary of writing analysis & concepts addressed in this work.

Chapter3 Presents the details of material characterization which includes different properties of Materials used in this current work.

Chapter4 Deals with performance of mix which focuses on various mix properties relevant to the work. The chapter includes the evaluation of Marshall Performance of different mixes.

C**hapter 5** Deals with the conclusions drawn from the present investigation**.** Scope for the future work has also been included in this chapter. This chapter is followed by a list of references which is used for the work.

Chapter-2

Literature Review

2.1 General

The roadway is provided with a suitably designed and constructed pavement structures, for a stable and even surface for the traffic. To serve as a carriage way the pavement which consists of a layer of some different type of layers of pavement is prepared as soil sub grade. To transfer the load stresses through a wider area on the soil sub grade below we have that pavement which carries the wheel load. Classification of pavement generally it is classified into two types which is specially based on structural behavior.

1. Rigid pavement
2. Flexible pavement

Rigid pavement:

Rigid pavement we all know due to high modulus of elasticity of the base course rigid pavement deflects very little. The structure of the rigid pavement is consist of Portland cement concrete and also the surface course built on the Sub grade and the other is underlying the base course. If we say in the rigid pavement the load is distributed and it will take action in slab. Resting on a viscous medium the pavement behaves like an elastic bag. Rigid pavement structure consist of cement concrete slab and also a sub base course is provided under it.

Flexible pavement:

Flexible pavements as the name suggests are the pavements in which the full totally total pavement structure bend or we can say that (flexes) to clutch traffic loads. In most of the cases flexible pavements are the most preferred type of pavement due to the fact that they provide higher stage of ease of construction and comfort compared to the rigid pavement. Flexible pavement generally comprises of different layers of materials which are confined in such a way that they allow the load being applied to them distribute in to the ground without effecting the road pavement. Flexible

pavements which is low or which is almost insignificant flexural power and which are rather stretchy in structural act below the load from vehicles being opted on it (Source: S.K Khana & C.E Justo). Flexible pavements are subjected to various stresses occurring in them with due course of Time. Most of the stresses which are being observed in such pavement include “rutting and Fatigue”.

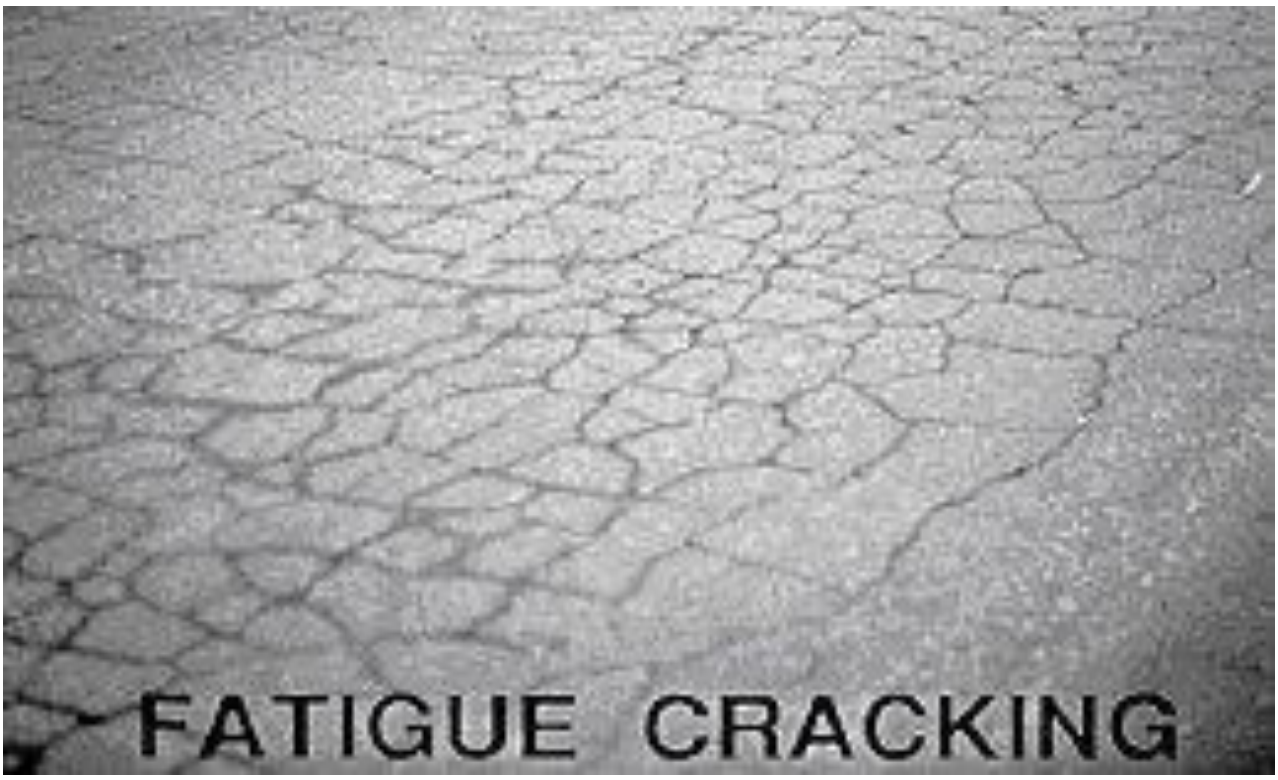

Figure 2.1 Fatigue cracking

Fatigue failure causes formation of cracks at the bottom of the HMA under repeat traffic Loading Commonly referred to as "bottom-up" or "classic" fatigue cracking. In thick walkways, aging the most likely tear start point (cracking from top to bottom) up in areas with a high local tensile tensions due to the tire-road interaction and asphalt binder. After repeated recharge, close the formation of longitudinal cracks sharp pointed elbows, which develop in a pattern similar to the back of a crocodile or crocodile

Burnt, the surface recess in the wheel track. Ruts are especially obvious after a rain when they are filled with water. There are two basic types of rut: mix rutting and underground rutting. Blend rutting occurs when the subsoil of the road surface still shows wheel track depression rut has to mix due to the compaction / design problems. Subclass Burnt occurs when the subclass exhibits expansions as a result of the task. In this case, the pavement in the subclass tracks will cause surface pits in the wheel track. Since flexible pavements are practiced according to latest design considerations (IRC: 37-2012) and huge amount of money is being utilized in its construction to meet the needs of the daily traffic, pavements are still showing failure by rutting at a premature stage. So, that creates a need to improve rutting performance of bituminous mixes. This can be done by having a clear.

Figure 2.2 Severe mix rutting

Understanding of the characteristics of binders and mixes used in construction phase of experiment.

2.2 Effect of fly ash in asphalt concrete:

United States environmental protection agency:- Suggested that Fly ash can also be used as an additive in asphalt surfaces. Addition of such additives increases the improve the rutting resistance, stiffness of the tarmac mortar, of the road surface, improve the toughness of the mixture.

Some of the other benefits of use of fly ash in asphalt pavement consist of:

(1) Reduced potential for asphalt stripping

(2) Reduced cost compared to other mineral fillers

John Francis McLaughlin &William Harmer Goetz:- Did investigation on utilize of a mechanically precipitate Fly-Ash as Filler for Bituminous Concrete. They divided their study into three parts, In the first stage a comparison of fly ash and limestone dust fillers in bituminous concrete was made through the use of the Marshall test , The second and third parts involved the use of the ASTM direct compression test and the follow conclusion be made based upon result:

(1) The mixtures containing fly ash had adequate stability as was measured by the Marshall test.

(2) Stripping resistance of the fly ash mixtures as measured by ASTM D-1075 compared favorably to the results for mixtures containing limestone dust.

J.Alam and M.N Akhtar:- during their practical analysis of fly ash in road construction found flight bag, which has good potential for use in road applications. The low density, casual nature, light compression, insensitivity to changes in moisture content, good friction properties etc. are used profitably in the streets.

From the report by **Konstantin Sobolev, Ismael Flores, Justin David Bohler :-** It was found that feasibility of using fly ash in asphalt concrete. In the study two binders with different grades namely PG 70-22 and the other one is PG 58-28 were used. These types of the binder were blended with the filler i.e. Fly ash at two concentrations (5% and 60% by weight). AASHTO T-315 these are used to evaluate characteristics of modified asphalt binder there using the Dynamic Shear Rheometer (DSR). The research result demonstrated that

(1) The adding of fly ash improve rheological properties of asphalt mastics and mixtures.

(2) Fly ash appears to improve the aging resistance of the mastics.

(3) It was further observed that addition of fly as does not affect the compatibility of the asphalt mixtures. Thus the conventional pavement construction technologies and conventional mix design procedures can be adopted for asphalt with fly ash.

2.3 Use of fly ash in different scenario's to enhance the property of the pavement:

M. Jovanovich, A. Mujkanovic, and A. Seper:- In their research prepared samples of bituminous aggregate mixtures with fly ash as filler with: 3.5, 4.0, 4.5, 5.0 and 5.5% bitumen. Laboratory investigation of bituminous aggregate mixtures was done and following conclusions were made:

(1) as the filler fly ash can be used in asphalt.

(2) Optimum bitumen content was found to be lower. It is used for mixture as fly ash as filler. Lower contented of optimum moisture content is considered good for the flexible pavement as lower OMC leads to lower voids in the sub grade. Thus there is less settlement in case of loading on the pavement during its usage.

American coal ash association:- In their report mentioned that in hot mix asphalt paving applications fly ash can be used as cost effective mineral filler. It was further concluded that generally meet mineral filler as flyash requirement it is of gradation it is also for organic impurities and also for the plasticity. Fly ash is hydrophobic. It is also used for reducing the potential for asphalt stripping.

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Lakshmi keshav & Mangairkarasi :- Through their research came to the conclusion that the strength and it can also be improved as highly expensive soil characterstics by fly ash stabilization. These are the result follow conclusion were necessary:

(1) By the addition of different quantities of fly ash, the ratio of liquor perimeter and plasticity index of the soil are decreased as calculated using CBR test.

Table 2.1 Change in Liquid limit and Plastic index using Fly ash in soil

Properties	**5% Flyash**	**10% Flyash**	**15% Flyash**	**20% Flyash**	**25% Flyash**
Liquids limit's (LL)	56.81	56.01	55.01	52.01	50.51
Plastics Index's (PI)	35.10	25.21	17.64	31.00	30.50

1 Swelling in the soil is common and it is reduced with the help of addition of fly ash.

2 California bearing ratio approximately using fly ash as filler can be increased 1.64 times to the initial strength of the soil without being modified by filler.

2.4 Characteristics of Fly ash

Ferguson et al:- Power plant fly ash (ASTM C 618) burning pulverized coal or the ground minutes, divided mineral residue. Coal fly ash is made of inorganic material, which is melted in the combustion of carbon present. When the exhaust gases from the exhaust gas collected by electrostatic precipitation of the suspended material is suspended. The

exposure time is more rigid particles in the exhaust gas, the generally spherical particles of fly ash. Fly ash particles are collected, generally electrostatic precipitators (0074-0,005 mm) is

2.4.1 Fly ash classification (ASTM C 618):

There are the two different type of fly ash. It is based on the properties of chemical composition, According to ASTM C 618,

(a) Fly ash (F)

Solid, old anthracite and hard coal firing to produce Class F flight bag. This is the nature of the pozzolanic flight, and less than 20% of lime (CaO by). pozzolanic properties of Class F fly ash is a glass of silica and alumina in the presence of water to produce compounds react with and zementring Portland cement, hydrated lime or cement agent, such as the requirement

(b) Fly ash (c)

Fly ash produced by the combustion of lignite or subbituminous coal self-cement pozzolanic properties, including the addition of a set characteristic. Class C fly ash and starch in the presence of water should be evaporated. Category C flight bag is usually more than 20% of lime (CaO) than said. Alkali and sulphate content of the class C (SO4) fly ash is usually higher.

2.5 Influence of Aggregate characteristics on Adhesion

Little et al. :- In their research on stripping, discuss total surface rich in metallic elements, such as calcium, which seem to be resistance resistance stripping. This resistance to stripping is due to the fact that such metals strongly associate with bitumen acids and hydrophobic forms salts which are not soluble in water.

Roberts et al. :- State that aggregates typically provide a heterogeneous surface on which specific chemical functionalities preferentially adsorb bitumen by interaction with the entire adsorption sites. The forces of interfacial interaction depends on the nature and activity surface of the aggregate, which depends on the nature of the minerals and metal ions.

Yoon et al.;- also pointed out that some of the aggregate physical properties that Influence of moisture damage is surface roughness, porosity, shape, brittleness, and the presence and type of adsorbed coatings. Good adhesion is promoted by a coarse aggregate surface.

2.6 Mechanisms of the Fly ash-Bitumen interaction:-

Lime contained in flyash improves rheological properties of tarmac binder as inert filler. As inert filler, Fly ash imparts a stiffening of the asphalt mixture and an improvement in resistance to permanent deformation. Fly ash also has an active filler effect, which is the unique ability to reduce age hardening characteristics of bituminous mixtures by interacting with reactive polar compounds in the binder.

Fly ash is also well known and widely used in asphalt for its ability to substantially reduce the deleterious effects of moisture. Moisture in asphalt promotes loss of strength and loss of aggregate.

Sharma et al. :-did laboratory investigation on fly ash as it is packing used in bituminous Concrete mix. The flyash it is collected from the main source that is the thermal station we have 14 thermal station. It is the main source for collecting the flyash.

It is divided into four different groups (group 1, 2, 3 and 4) based on properties like physical and chemical. After that it is the type of filler at the bituminous concrete mixes. The conventional filler like the dust stone is also used in India, its was also used as the method of comparing the types of results.

Various test F / B ratio of softening point, viscosity testing and dynamic shear rheo meter test has been plagued since. As Marshall stability, strength, tensile strength, static and creep tests of strength and durability tests were conducted with five types of fillers on Asphaltic Concrete Mixing different filler percentage with (4.0%, 5.5%, 7%, and 8.5%) And 60/70 binders. After the results were analyzed and compared. Flight bags normally used in all four groups were higher than the filling gravel showed good resistance to moisture sensitivity. This study shows that a mixture of filler mixture ratio according to the OBC. This does not depend on the fineness of the filling. RS with increasing tensile strength ratio TSR, and the filler content. Group 4 is greater because of the presence of the oxide of calcium fly ash TSR and RS showed a high value. B.C. an optimum combination of performance, based on the fill level of 7% found.

Asi and Assad:- did laboratory investigation on Fly ash obtained after burning of oil Received physical and chemical analysis of the fly ash. Flight ash asphalt concrete (0%, 0%, 50%, 100%) as a substitute for inorganic filler blends prepared with the participation of several. Sample Marshall stability, indirect tensile strength, strength, modulus tapes, dynamic creep, fatigue, and had the distinction by examining Planum. Replacing 10% of the fly ash produced mineral filler to improve the mechanical properties of the samples proved to be the most effective percent.

Chapter 3

MATERIAL CHARACTERIZATION

3.1 General:

It is defined as a viscoelastic liquid or solid hydrocarbons and also derivatives consisting essentially sufficient to trichlorethylene soluble and non-volatile, and are soft to heat slowly. It is black or brown, and waterproofing and adhesive properties. Obtained by refining petroleum origin and can be found as a natural deposit or a constitution natural asphalt, where it is combined with the mineral.

3.2 Different types of asphalt

3.2.1 Based upon 'Penetration Grade':

`Bitumen 80/100: the properties of this class attaching the 90 degree S 73-1992 IS. It is also used for low down volume. `

`Bitumen 60/70: This quality is harder than 80/100 and able to carry more traffic loads. Confirm the characteristics of this class, the 65 degree S 73-1992 IS. It is currently mainly use at the manufacture of roads and highways.

`Bitumen 30/40: it can withstand very heavy traffic loads and it can bear a lot of it. To conform the Properties of this class S is 35 degrees of IS-73-1992. In special applications bitumen 30 and 40 is used such as the runway at the airport in the coastal cities and the heavy traffic on the road

3.2.2 Bitumen grade industrial

Blow bitumen is also known as grade bitumen. High temperature hot air is blown for bitumen (usually beyond $180^{o}C$). When the hot air is blown into the bitumen the outcome occurs in structural change in the bitumen. Within the method the asphalting contented is enlarged which outcome in high soften peak and extremely low incursion amount. Industrialized mark bitumen is use industrialized appliance and in water proofing etc.

3.2.3 Cutback

It is a fluid that flows freely at ordinary temperature after that the result obtain by flux bitumen with appropriate solvents. Addition of kerosene and other solvent is significantly compacted in bitumen viscosity. It is also has been used it other applications like tack coat.

3.2.3.1 Emulsion bitumen

Bituminous emulsion is a free flow fluid at different temperature. The fine water tar balls endlessly bitumen emulsion is a stable dispersion. Along with a colloidal dispersion of additives selected and controlled through similar conditions of asphalt hand and water is achieved. The quality and stability of acidity emulsion use and adjust to the breaking of agglomerates / applied to the road surface is important to ensure that.

3.2.4 Bitumen Modified

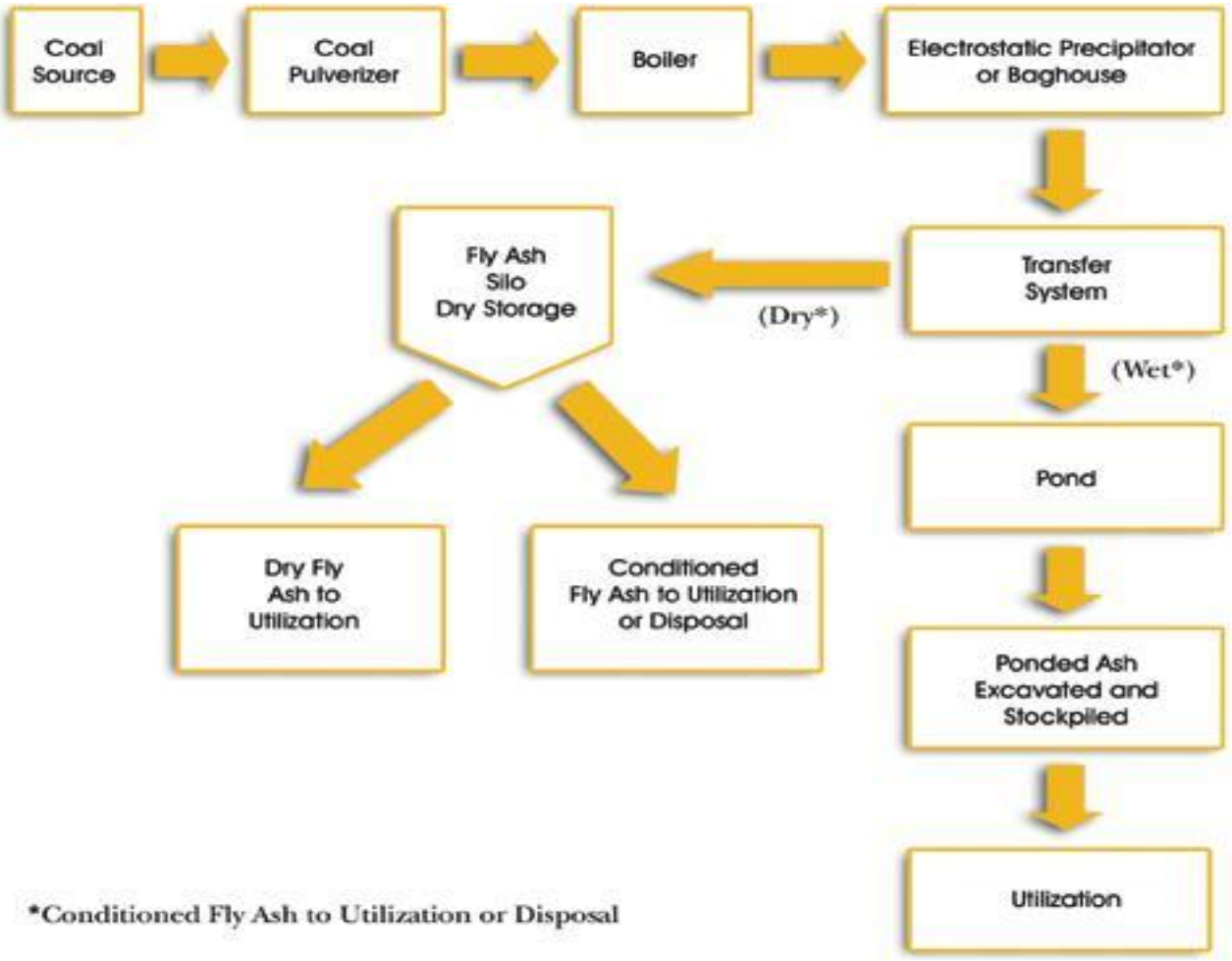
It asphalt with additives. Additives that help to promote the growth properties of the asphalt road. Modified asphalt road, which in the past, and with the creation of translation is often reduced duplication. Modified asphalt road to the construction of paved roads can be cost-effective is the total life-cycle costs are considered.

3.3 Fly ash

Divided finely pulverized coal combustion residues resulting from the production process, the use of the product is one of the most interesting Conservation of natural resources. It is a combustion exhaust gas is transferred from the chamber. Fly ash over 61 million metric tons (68 million tons) was in 2001.

3.3.1 Fly ash Production

Fly ash and produce steam for electricity generated from coal. Usually pulverized coal boiler combustion chamber, which immediately ignited with air will burn, the heat generated, and the remains of a melted mineral. boiler tubes, boiler, cooling the flue gas, ash and molten rock sensation residue.



Coarse ash particles, mentioned under slag or ash, fall into the depth in ignition compartment while particles of flyash is lighter, the so-called fly ash, flue gas remain suspended. Prior to the existing flue gas, it is distant by particulate emissions control devices, there as electrostatic filters or we can say it is tissue filter bag houses.

Currently, more than 20 million tons of fly ash per year in a variety of technical application. Typical road construction applications are: the cement which is (PCC), it is described as Portland cement concrete, soil and road foundation stabilization, flow into the filling, asphalt filling, structure filling and meal.

3.3.2 Fly ash Chemical composition

The particle of flyash are in form of spherical in shape and ranges it starts from the range which is considered as 0.5 micron to 100 micron .

Table below gives the chemical composition of the Fly ash.

Table 3.1 composition of the chemical.

Chemical composition	Percentage (%)	Percentage (%)
	Class f	**Class c**
Silica (Sio2)	55	40
Magnesium oxide	2	5
Alumina	26	17
Calcium oxide	9	24
Iron oxide	7	6
Sulphur	1	3

Source: - American coal association

3.4 Physical properties of the Fly ash

3.4.1 Specific Gravity Test

ASTM D854-10 was approved to obtain density ash. Description Density means that An equal volume of distilled water at a given temperature in air, its weight in a weight ratio of the air volume of the material at a particular temperature.

3.5 Bituminous Binder Evaluation

Regarding the scale and the bituminous binder characterization approach previously found, the binders were tested on a variety of empirical. On the properties of the bituminous material there

are a number of tests to evaluate. Number of test are generally performed to estimate different property of bituminous material in accordance with the standard reference to IS and super pave, ASTM specification

3.5.1 Physical properties of bitumen

3.5.1.1 Penetration Test:

ASTM D5, these experiments were performed. This test provides a measure of the strength or hardness of the bitumen. The most common test for monitoring input asphalt penetration test. In this test, a certain level of a needle, a tar sample under a known load (100 kg) for a given (5 seconds) to a constant temperature (25 ° C), can penetrate it.

Also penetration, which is (tar) and is said to be as the space of the needle is measured in a tenth of the millimeter. Solid bitumen Soft bituminous penetration is low and vice versa, the value of the distribution of the highest quality.

Figure 3.2 Penetration test setup

3.5.1.2 Ductility test:

Referring to 1208-1978. Cohesive strength test for measuring the hardness of the asphalt to an empirical test. In this test, a standard tar sample is a solid sample temperature. A constant temperature of the sample was obtained at a uniform rate. The height at which the sample is toughness.

Hardness test has a unique feature, and note the difference in temperature varies in different countries varies from stage to stage. cohesion strength of asphalt test ductility an index, the index is very close to the fatigue strength of the material. The figure shown below:-

FIGURE3.3 (Ductility test)

3.5.1.3 Specific gravity test

1202-1978 is the densest concentration of tar weight ratios relate to the same volume of water to 27oC is determined by the volume fraction is defined as the mass of bitumen is carried out. A solid or semi-solid state pycnometer density or soft copy of a cube can be measured. Concentration of bitumen from its chemical composition is very positive. It occurs when there is a sudden increase in the specific gravity of the sudden increase in type fragrance impurities.

3.6 Bituminous Mixes Strength Test

3.6.1 Marshall Test:

This test is done to perform the Marshall stability of bituminous mixture as per ASTM D 1559. This Method ,the resistance to plastic deformation of cylindrical specimen when same is loaded at periphery at 5cm per min. These type of test procedure is extensively used in routine Test program for fruit business Mixing Two of the main features of this system is Marshall

A) Density – Voids analysis

B) Stability - flow test

Marshall stability is defined as a compact mixer is powered by a maximum load Standard test temperature is 60 ° C Marshall wave distortion test The maximum load is up to 0.255 mm during the loading one sample take place.

Marshall Samples prepared by using Gradation:-

IS SIEVE	Cummulative Weight (Gm)	Individual Weight (Gm)
26.5	12501	0
19	1118.75	131.24
13.2	862.5	256.34
9.5	775	87.4
4.75	562.5	212.5
2.36	450	112.5
1.18	337.5	112.5
0.6	262.5	75
0.3	187.5	75
0.15	112.5	75
0.075	62.5	50
<0.075		62.5

Source :-BCI as per north Specification(2001)

Marshall method of mixing design according to ASTM D15599 have been set correctly Contents Resistance (OBC) and overall mild heated separately if necessary temperature. The virgin and the total amount were added to the revised bitumen Mineral aggregate and mix thoroughly until well and uniformly summarize left with soft.

Then rinse mat with its inner surface to avoid sticking to the oily mixture. The mixture is then poured into the mold and the interior is punctured with spatula around the edges Mold. Marshall hammer This blend applies when hit by 75 Mixing face and then allowed to cool. The room was cold sample temperature They have been extracted from the moulds.

Three samples are prepared and tested for determining mix parameters. The determination of analysis of mix such as density and air voids of the prepared sample. After getting the values then they are projected on the graph to get the relationship between modified and virgin bitumen characteristics.

CHAPTER 4

LABORATORY INVESTIGATION

4.1 INTRODUCTION

In this chapter it presents the details of materials used and test procedures adopted for the evaluation of materials and mixes in the present study ,Various uses of the mixture are prepared Analysis ratio of fly ash as a bituminious converter. The main concern of current research work is to study pitch changes Damage pitches leads to change characteristics. To evaluate various experimental exams The general characteristics of the pitch changed pitch compare to the order changes Rigid / virgin bitumen relationship is his property.

4.2 PROPERTIES- PHYSICAL PROPERTIES OF BITUMEN (VG30)

4.2.1 PENETRATION TEST ANALYSIS:-

The use of fly ash as a convergence of tested pitches is the result of penetration test 25 ° C table shows virgin and change penetration rate of pitch. Penetration The revised bitumen price was not available in 25 ° C significantly reduced flame ash Increase.


figure.4.1 Penetration test.

4.2.2 DUCTILITY TEST ANALYSIS:-

Figure 4.2 Ductility test

This is the test which is carried out at modified bitumen as well as virgin at room temperature at the ratio of (25°c). The values evaluated it decreased the ductility values leading to allow the bitumen to get stiffer

4.2.3 SPECIFIC GRAVITY TEST:-

Weight of Bitumen = 40 gms

For three samples for Modified and Virgin Bitumen

Test is performed at constant room temperature. The evaluation is given below in table.

Table 4.1: Properties of modified and unmodified bitumen

TEST	MODIFIED BITUMEN			UNMODIFIED
	4% FlyAsh	6% Flyash	8% Flyash	
Penetration	45.1mm	38.4mm	31.4mm	63.5mm
Ductility	48.1cm	40.04cm	37.6mm	100+
Specific Gravity	1.08mm	1.10	1.10mm	1.04

4.3 PROPERTIES OF FLYASH

4.3.1 SPECIFIC GRAVITY OF FLYASH:-

This test is performed by using the equipment Pycnometer.

Three samples were taken of 30gm weight of flyash taken for the test.specific gravity tables is given below

Table 4.2:- Specific gravity of the flyash

SAMPLE	1	2	3
W1	123.24	107.5	123.4
W2	163.24	147.69	163.2
W3	392.75	376.72	392.5
W4	371.42	355.75	372.3

From above table

W1= weight of empty flask

W2= weight of empty flask + fly ash

W3= weight of empty flask + fly Ash + Full water

W4= weight of empty flask + full water

This specific gravity = $\frac{(w2-w1)}{(w4-w1) - (w3-w2)}$

The average specific gravity of fly ash is 2.07

4.4 Preparation of Modified bitumen specimen

In this bitumen was used to modified using the ratio of flyash with a quantity of 4% ,6% ,8% to the equal weight of bitumen used. In this we used to pre heat flyash by oven storage at 170°c for 24 hrs to remove any water present.

The bitumen of grade VG(30) was heated to the temperature of 150°c before the flyash is added and after that the flyash is kept for 15mintues at constant or same temperature for 150°c

4.5 Marshall Mix characteristics of bituminous mixes:-

With virgin prepared by combining the sum of the cylindrical sample of 100 mm diameter And gentle appropriate amount has been set. And a combination of temperature for mixing Binder of

each type was chosen. Sample 75 was blown by compact application Marshall hammer in front of the sample.

The values for various Marshall parameters were evaluated and the relationship between virgin and modified bitumen using these figures:

4.5.1 Observations from Marshall test:

4.5.1.1 Data obtained from Marshall test using the virgin Bitumen are:-

Table 4.3 Characteristics of a Marshall mix using virgin Bitumen

Bitumen Content (%)	Unit density (Gm)	Air void (%) (Vv)	VFB (%)	STABILITY (kg)	Flow (mm)
4.5	2.291	4.7	79.65	27.86	6
5	2.296	4.1	82.36	44.1	8.5
5.5	2.87	3.6	83.39	39.43	10.7

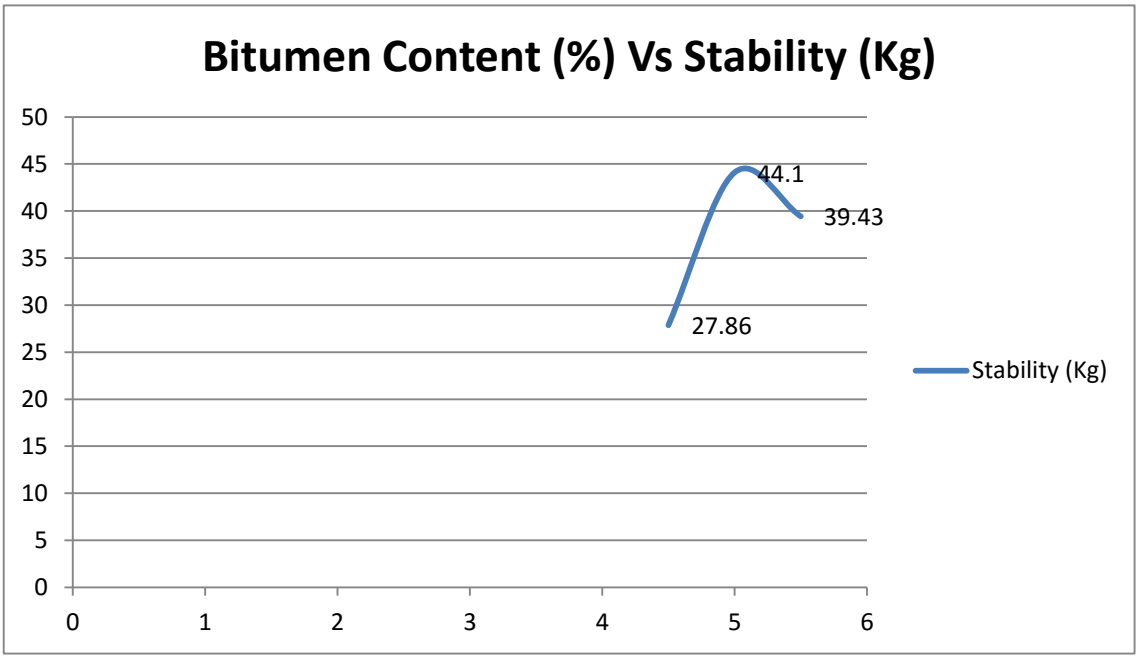


Figure.4.3 Marshall stability value

FLOW BITUMEN CONTENT

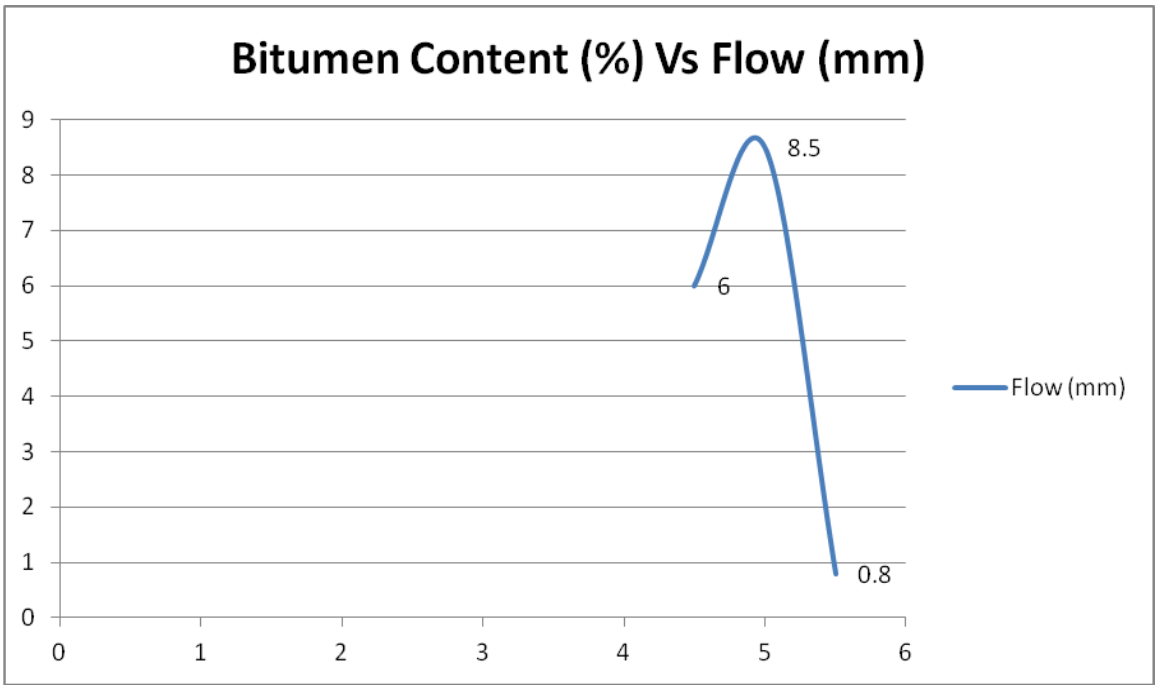


FIGURE 4.4 Marshall flow value

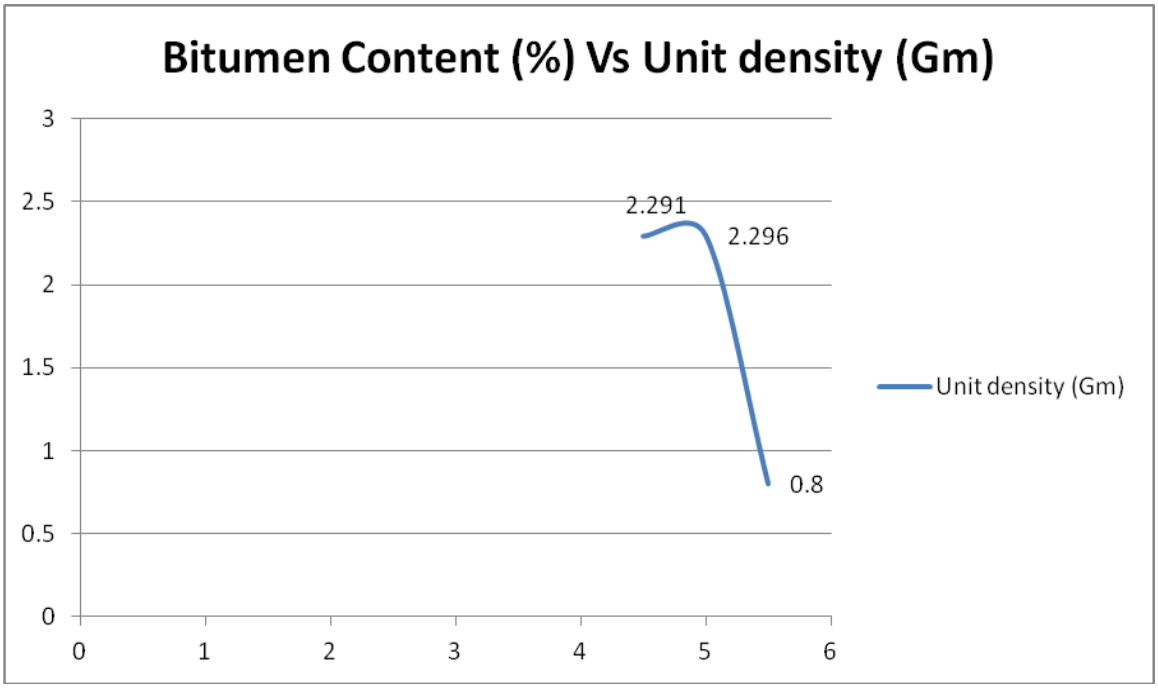


FIGURE 4.5 Unit density of Bituminous Mix

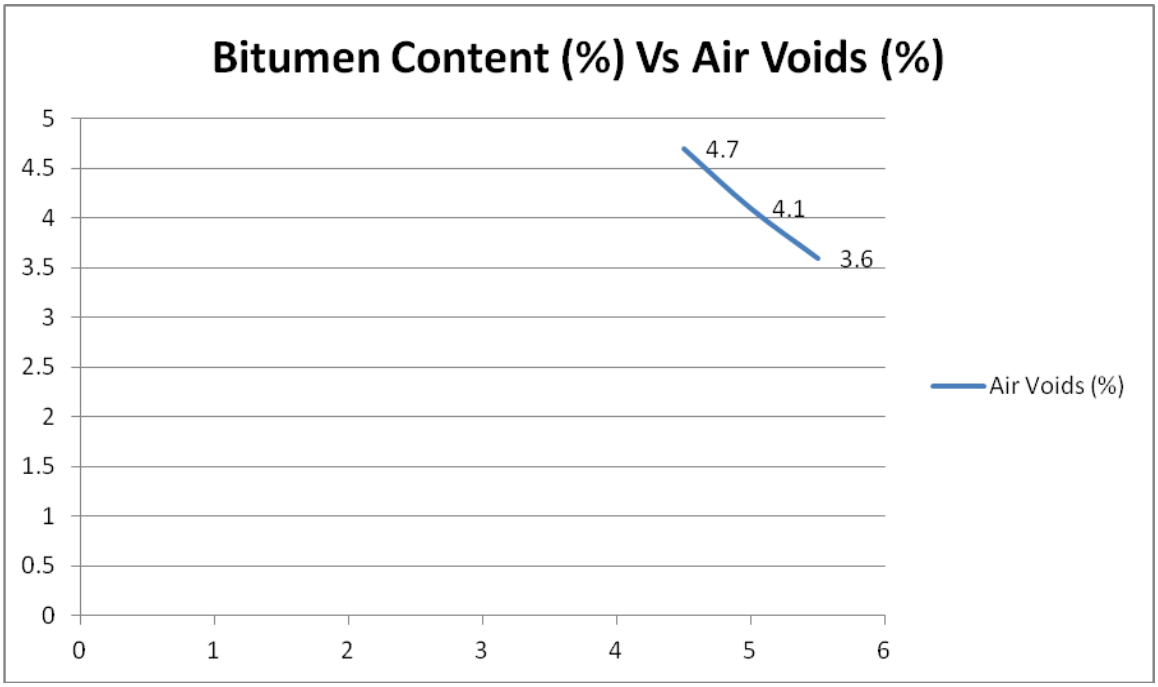


FIGURE 4.6 Percentage Air voids in Bituminous Mix

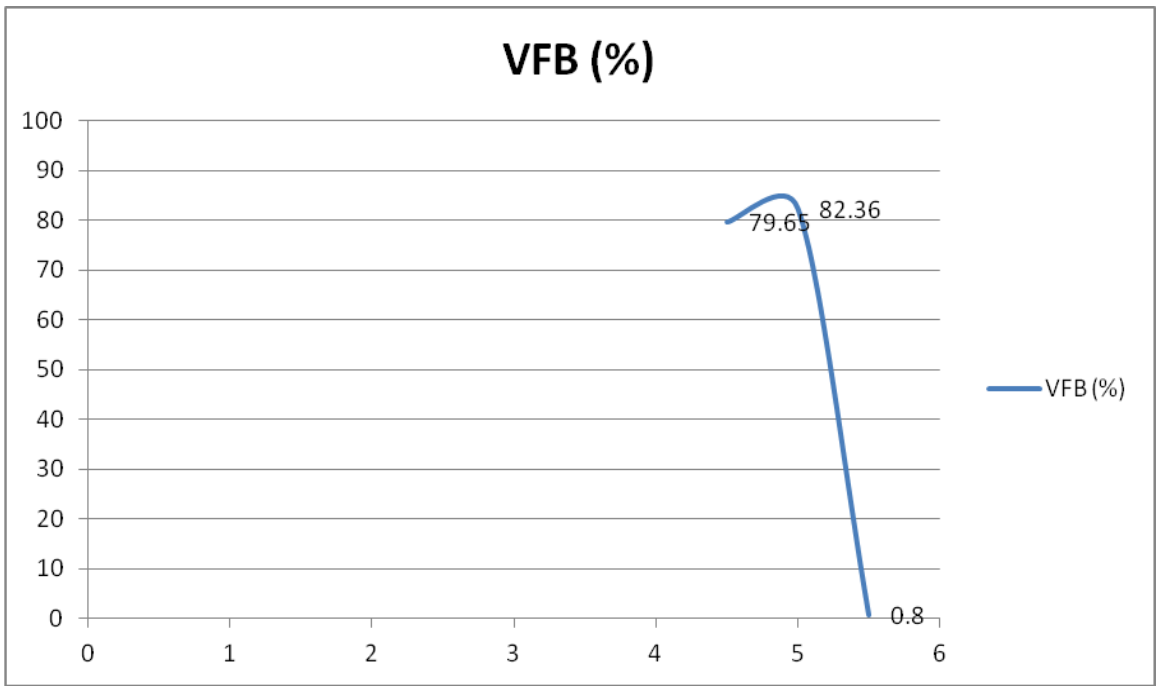


FIGURE 4.7 Percent voids filled with bitumen in mix.

The value for stability calculated came out to at 5.1% bitumen

4.5.1.2 Determination of data Obtained with the help of Marshall test using Modified Bitumen:-

Table 4.4 Characteristics of a Marshall test using Modified Bitumen

Bitumen Content (%)	FlyAsh Content(%)	Unit density (Gm)	Air void (%) (Vv)	VFB (%)	Stability (KG)	Flow (mm)
4.5	4	2.30	11.9	58.73	55.8	6
4.5	6	2.285	12.7	55.973	69.2	6.5
4.5	8	2.264	13.4	55	76.1	7.9
5	4	2.40	7.6	68.94	60.53	4.3
5	6	2.35	8.1	68.24	70.72	5.4
5	8	2.35	9.1	64.48	74.8	6.2
5.5	4	2.35	9.2	65.05	70.73	3.24
5.5	6	2.32	9.6	63.27	75.83	4.2
5.5	8	2.295	11.3	58.90	78.1	6.1

Marshall Stability:-

As the amount of fly ash content increases it is seen that the Marshall stability becomes higher. If the amount of flyash is increased in binder that will change the properties and it will cause the mix become stiffer and this will increase the shear resistance. It (Fly ash) can be used as a filler

to fill more voids in aggregate grains. The mix will grain strength when it comes in contact between aggregate due to existence of filler in the void between aggregate.

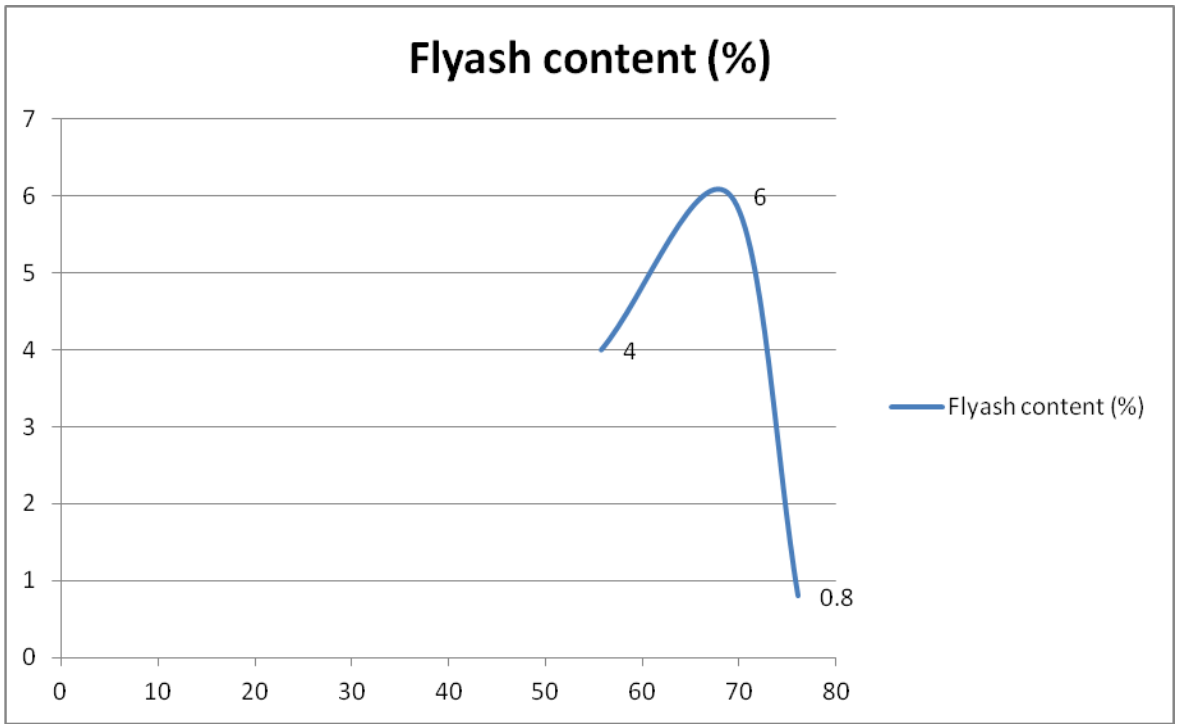


Figure : 4.8 Stability of Bituminous Mix with 4.5% bitumen

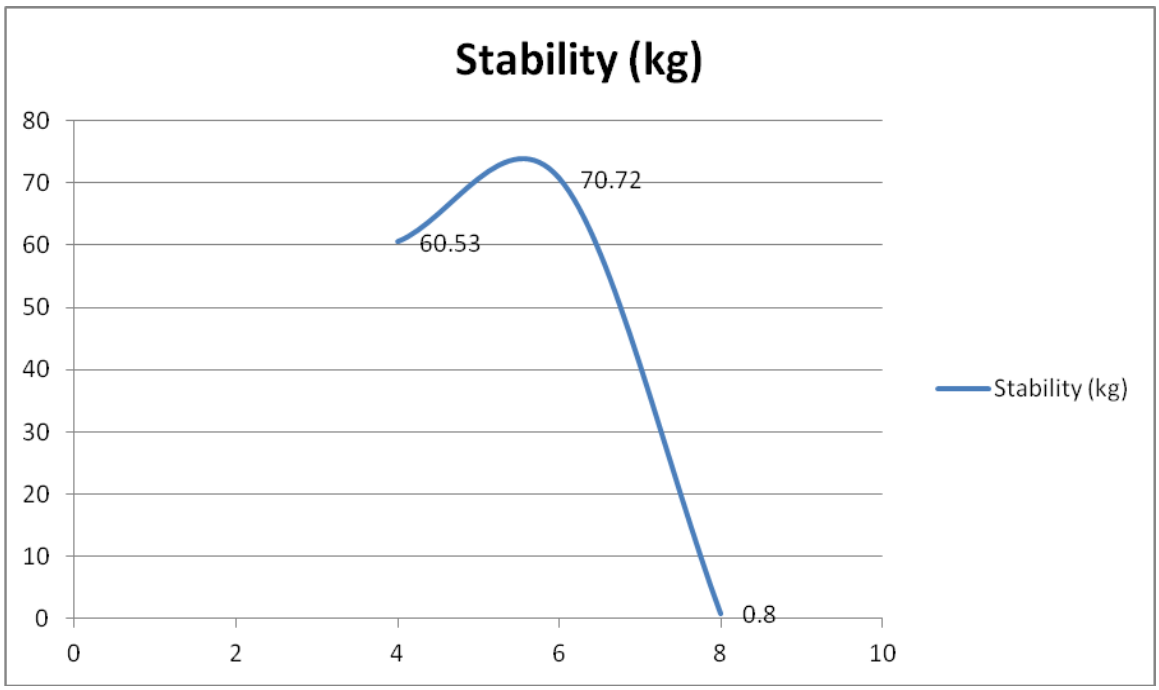


Figure :- 4.9 stability of bituminous mix with 5% bitumen

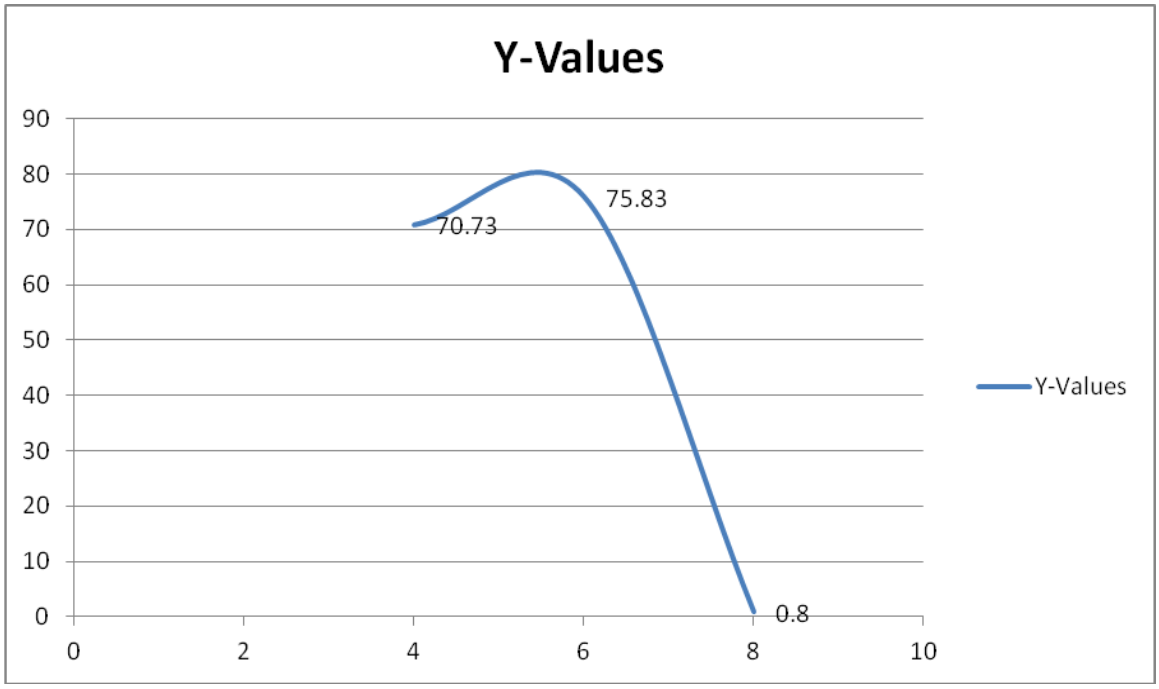


Figure:- 4.10 Stability of bituminous mix with 5.5% bitumen

Workbook above the optimal value, increasing the amount of contact between the fee will decrease Stability and further reduction of workbook agglomerates resulting in the burden, reduce Lubricants its ability and adhesion to the overall mix.

Marshall flow :-

When The Marshall stability is measured at the same time the Marshall flow of bituminous mix is measured. The stray is admit of comparison with to the vertical deformation of the sip in mm There are some figures below demonstrates Marshall flow.with the result varing flyash content.

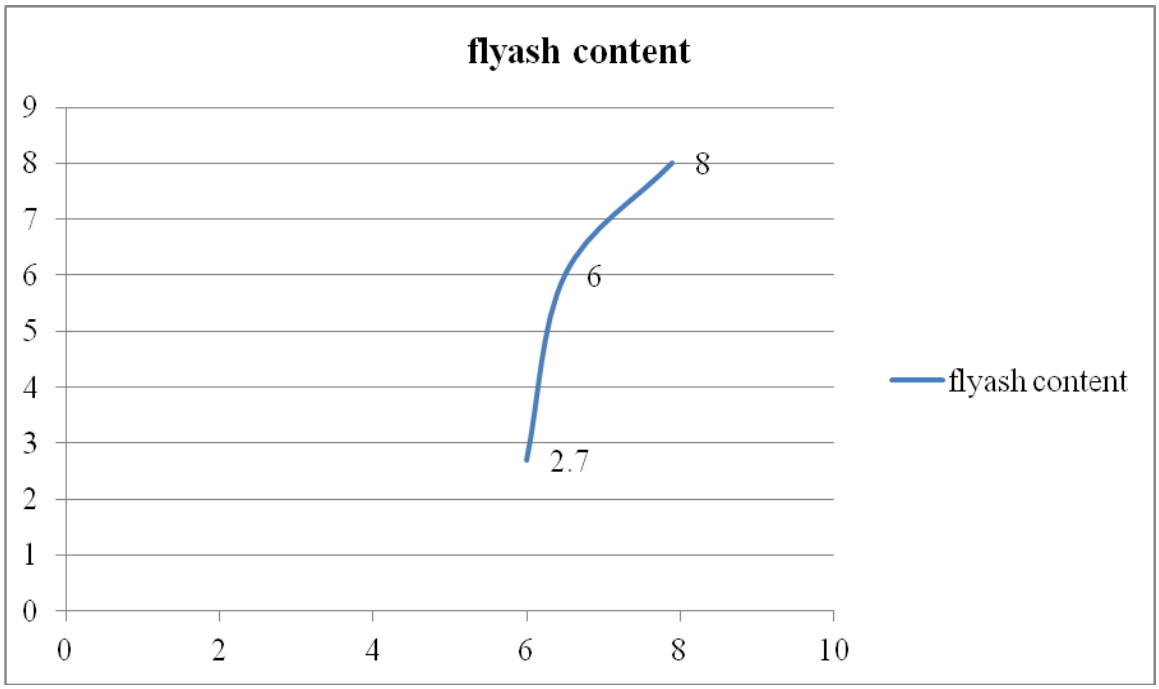


Figure 4.11 flow bituminous mix with 4.5% bitumen

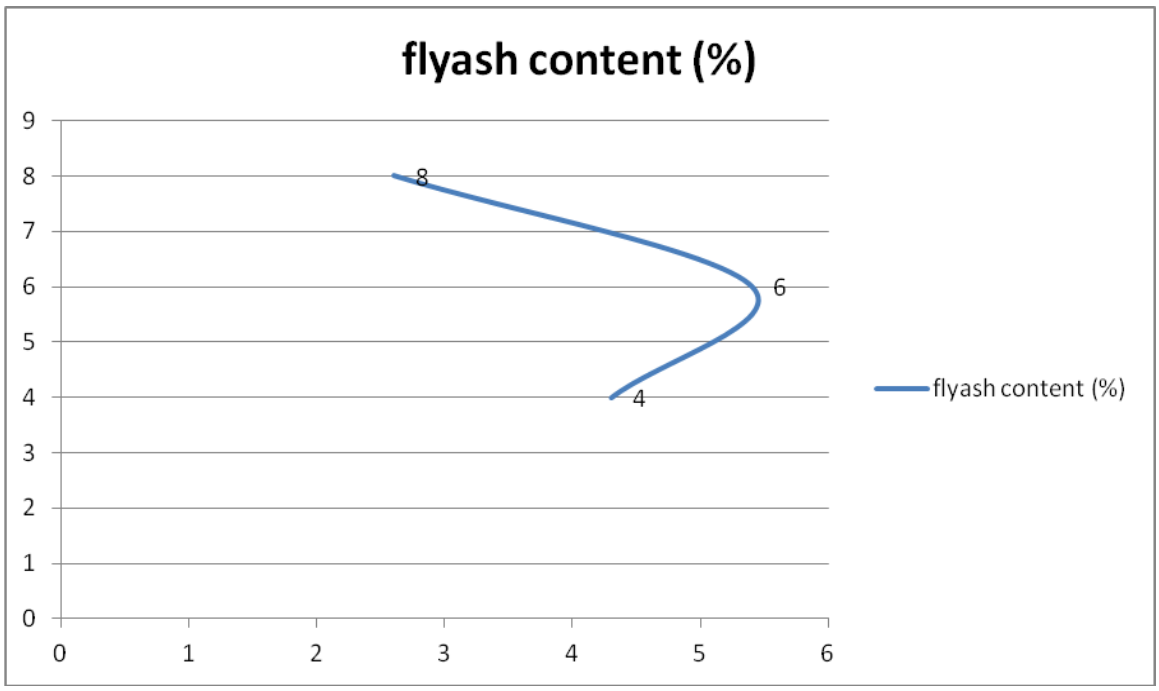


Figure 4.12 flow bituminous mix with 5% bitumen

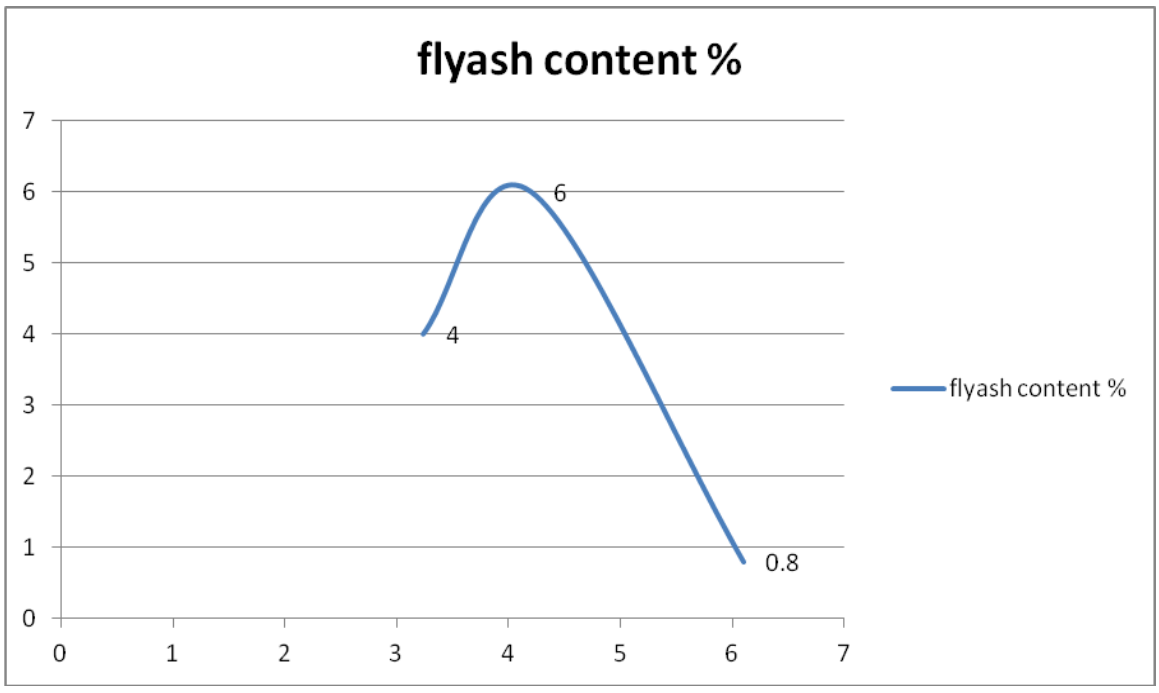


Figure 4.13 :- flow bituminous mix in 5.5% bitumen

From the observation it came to the conclusion that as the increased fly ash content of binder, it will fulfill the inefficiency of the collective, which will become the total step of the density and increase the shear resistance and hence the Marshal flow will decrease

Density:-

Useful modified bitumen binder reduces the increase in the content of the fly ash in the use of concentrations of bitumen. Increased amounts of fly ash in bitumen increase the lubrication of the compounds because it allows bitumen to be rigid, which reduces compact degree in the same composition.

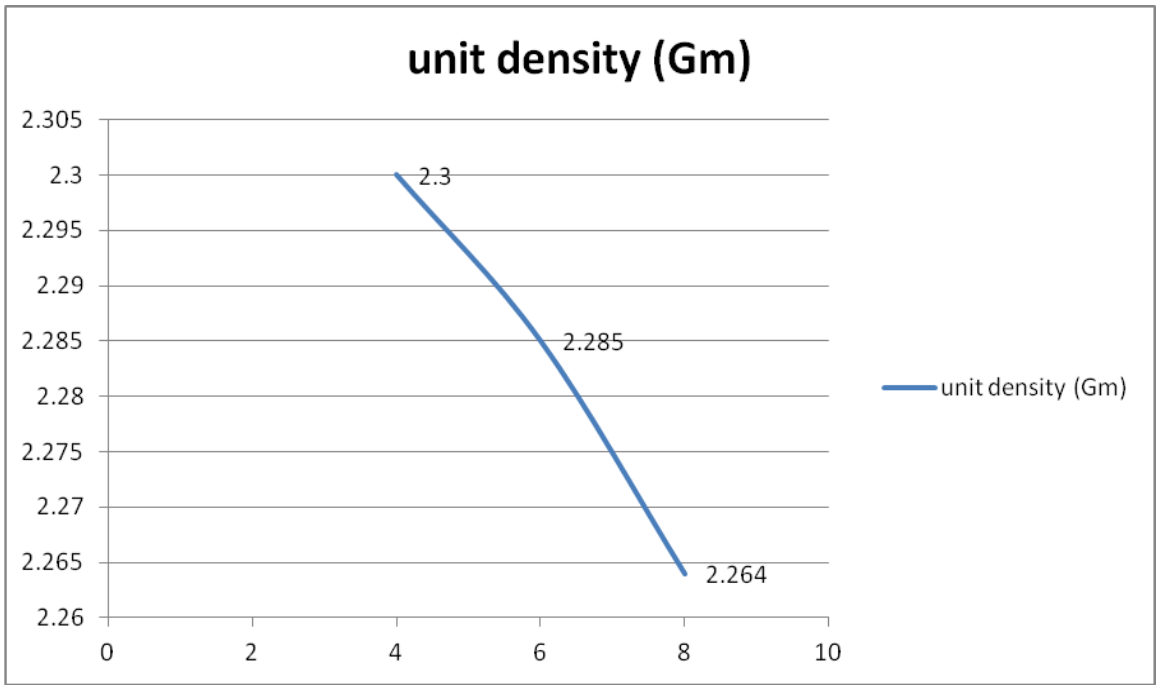


Figure 4.14 Unit density of Bituminous Mix with 4.5% bitumen

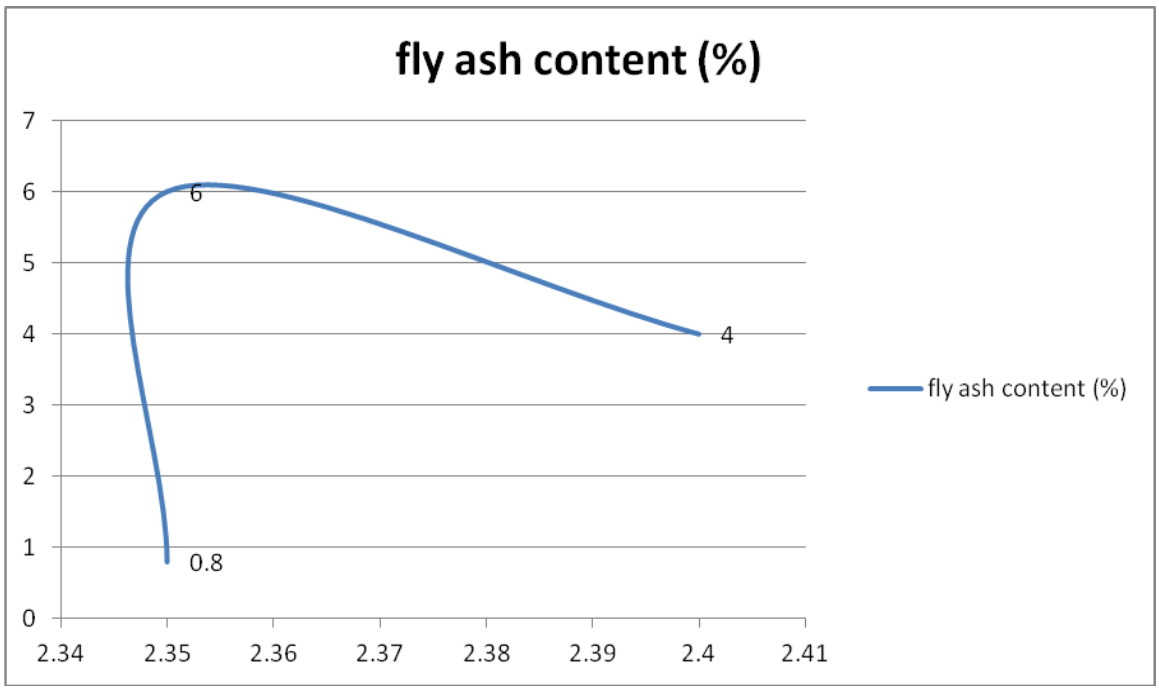


Figure 4.15 Unit density of Bituminous Mix with 5% bitumen

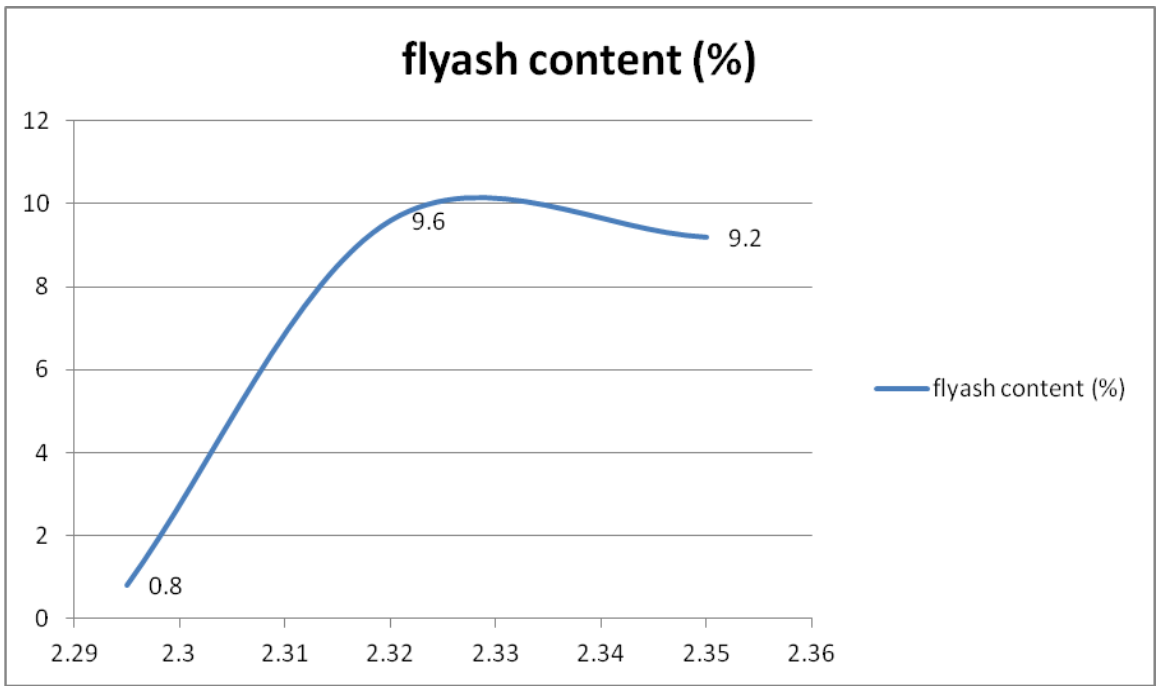


Figure 4.16 Unit density of bituminous mix with 5.5% bitumen

Percentage air voids:-

The results we get after the increasement of Bitumen's are mixed using the fly ash in the mix of non-viable results in the mixture. when we increase the flyash in bitumen it will increase the void in mix.

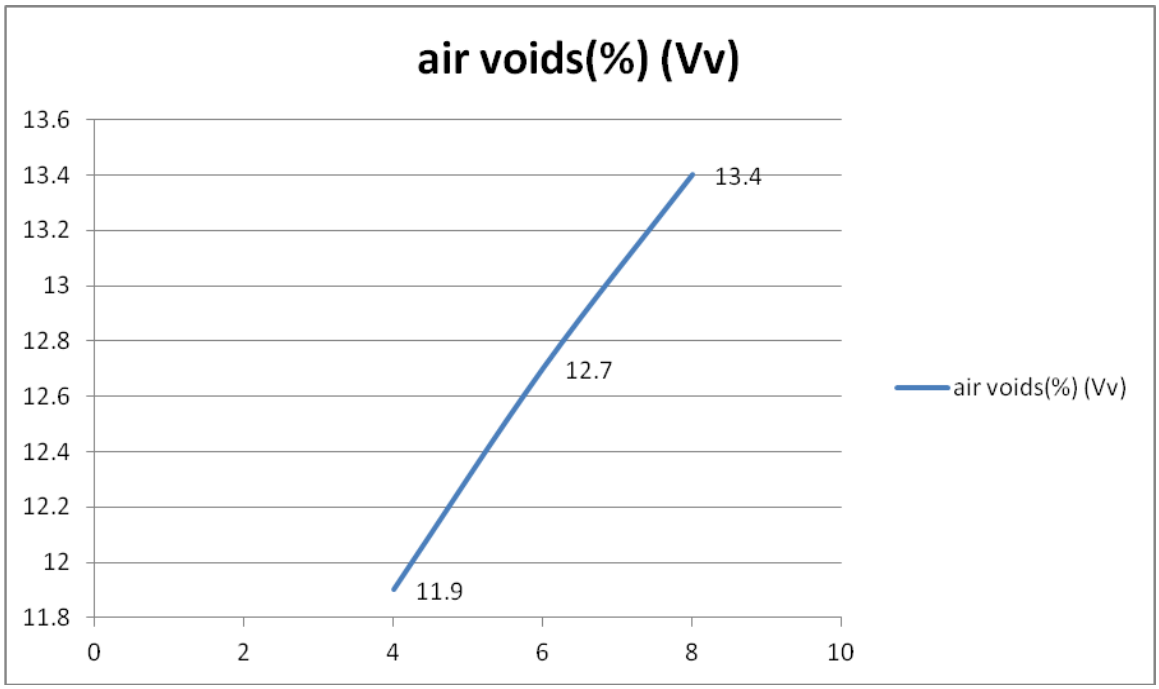


Figure 4.17 Percent air voids of bitumen mix with 4.5% Bitumen

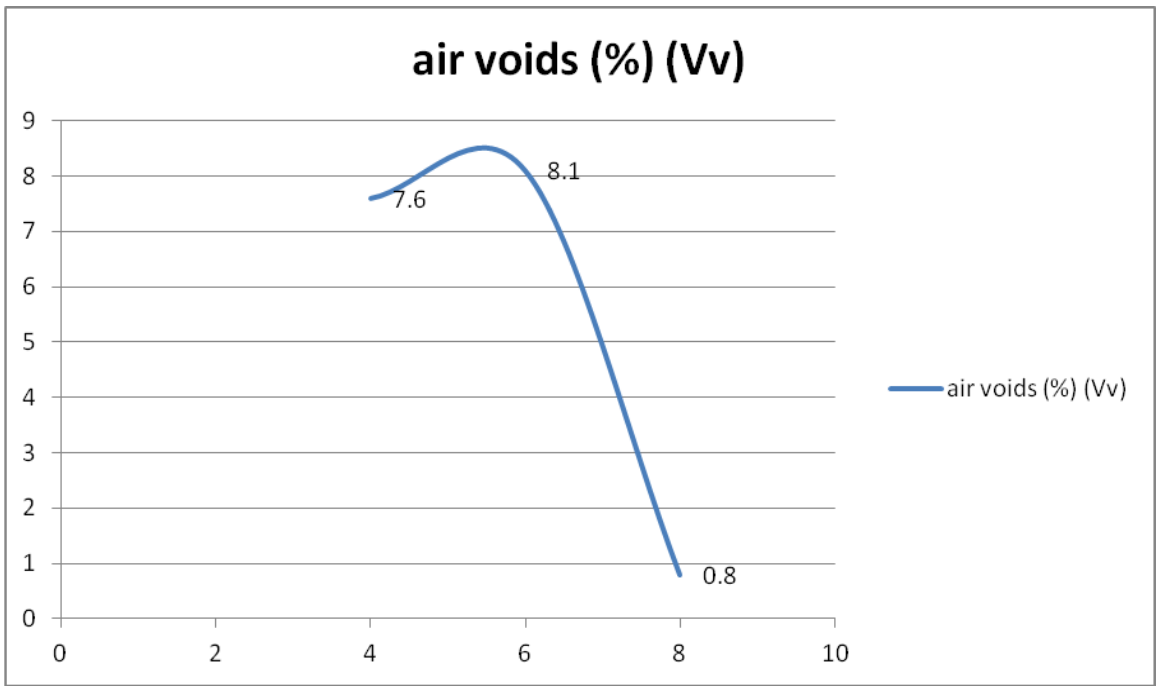


Figure 4.18 Percent Air voids of Bituinous Mix with 5%

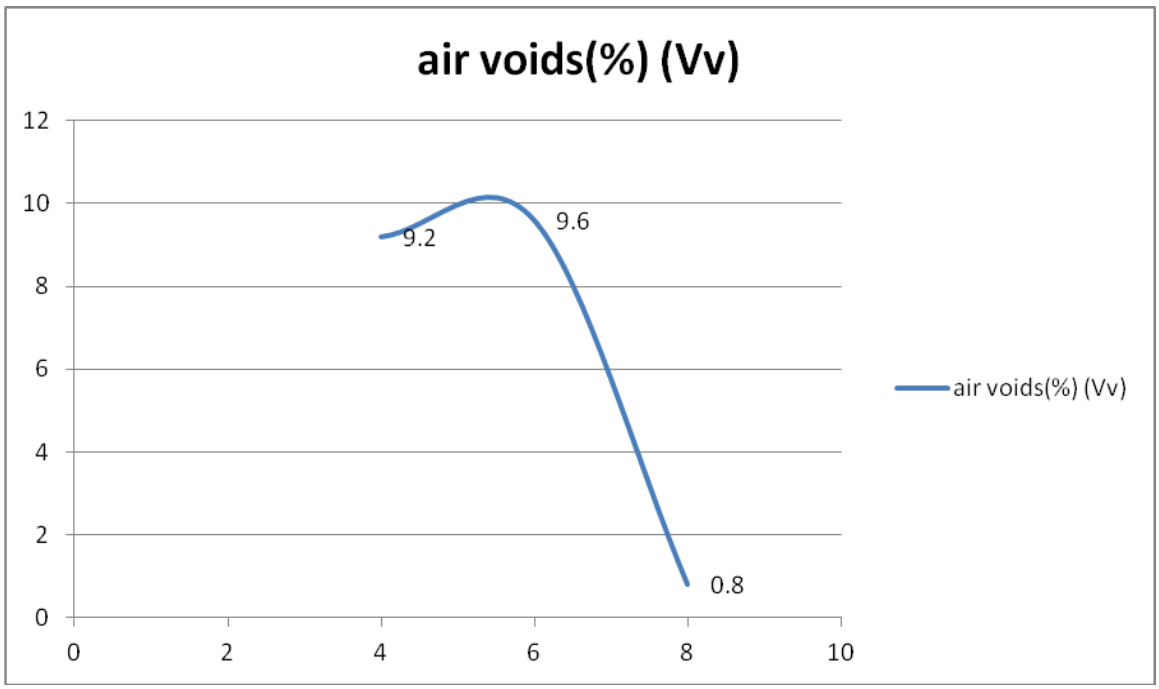


Figure 4.19 Percent Air void of bituminous Mix with 5.5%

The Voids are filled with the help of Bitumen (VFB) :-

As the amount of fly Ash in binder increases the amount of VFB decreases. This all thing was happen because the amount of flyash in binder will let the bitumen stiffer and this will happen to lead more compaction effort.

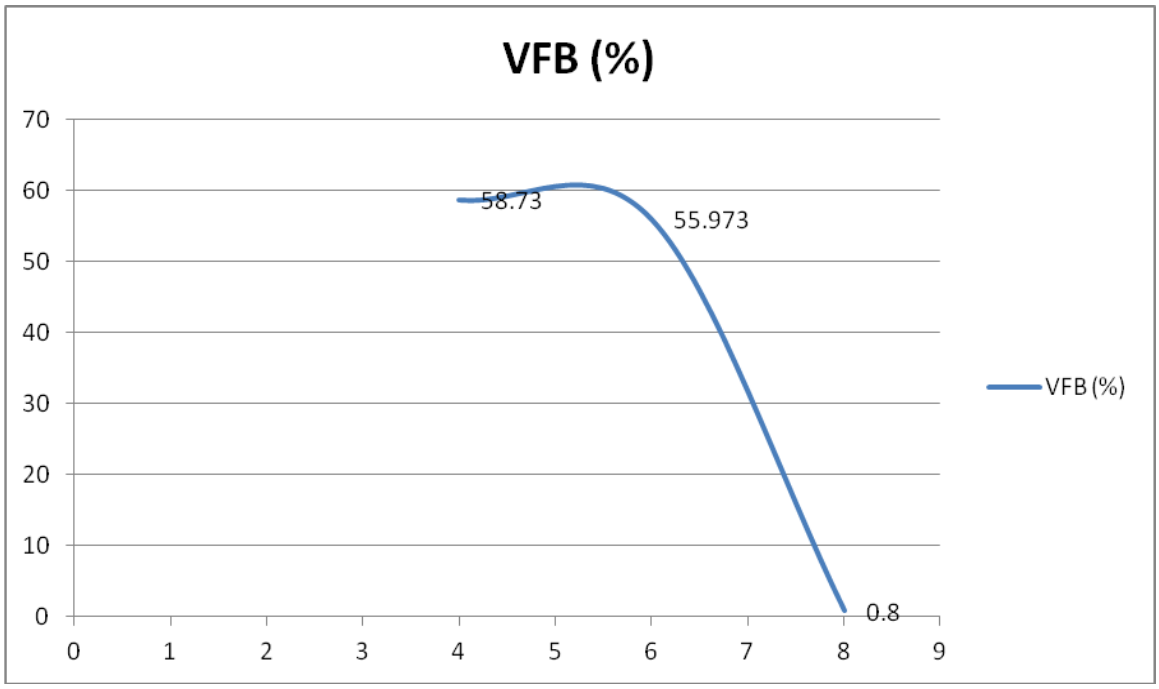


Figure 4.20 VFB of bituminous Mix with 4.5% bitumen

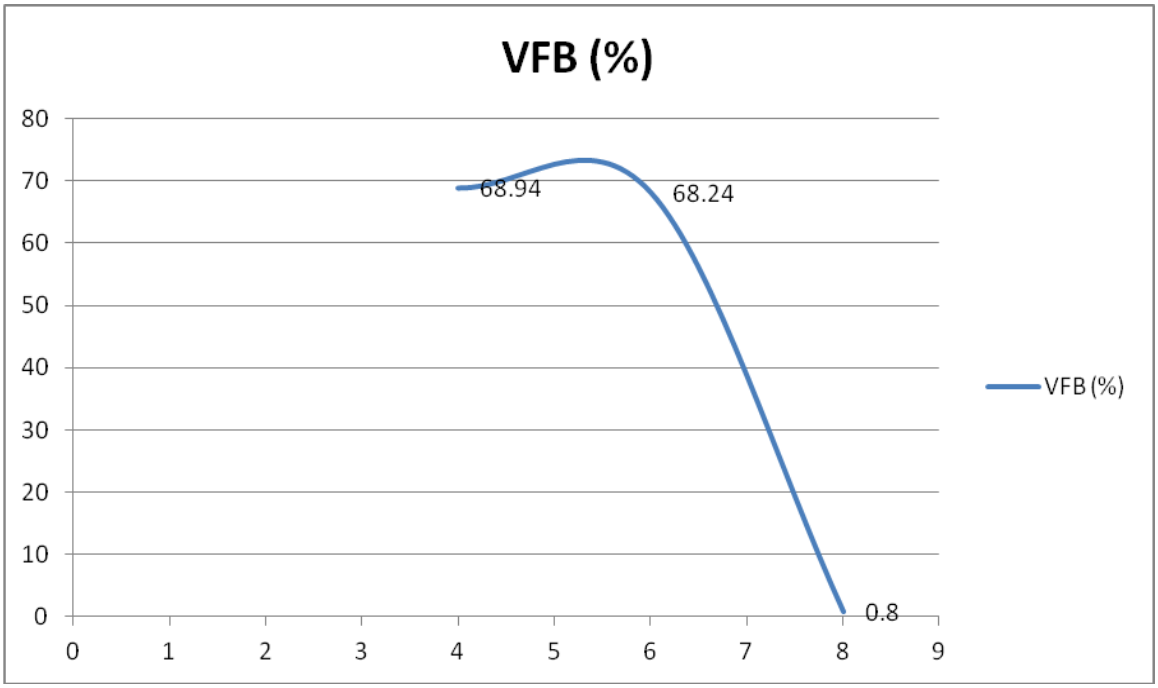


Figure: 4.21 VFB of Bituminous Mix with 5% bitumen

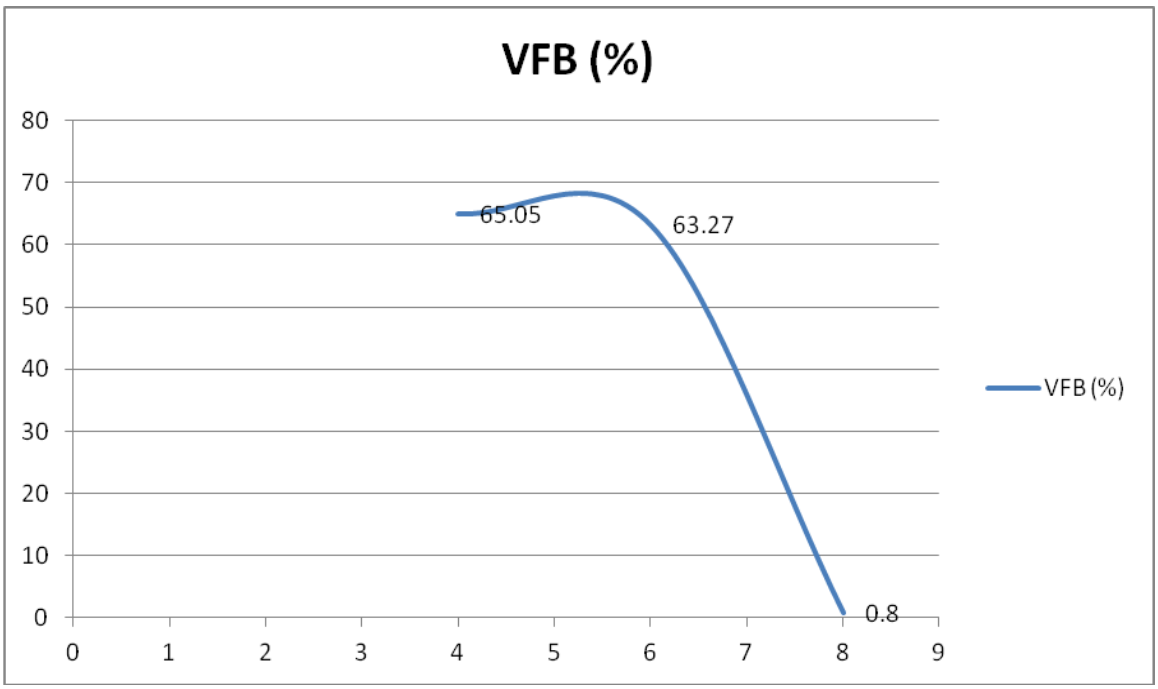


Figure :4.22 VFB of bituminous Mix with 5.5% of bitumen

CHAPTER-5

CONCLUSIONS AND FUTURE SCOPE

5.1 CONCLUSIONS:-

It is shown now by the results of the experimental investigation which we performed on the normal and the Modified bitumen using Fly ash in different quantities, to which modify virgin bitumen, the following conclusion are these.

1. With the increase in percentage of fly ash the ductility value decreased and this will cause the bitumen to become stiffer.
2. By the use of different types of percentage of fly ash. It gives the less penetration value, so that lower grade Bitumen can be modified to with stand the higher loads.
3. In case of Marshall stability test, we find the stability values were increased as the fly ash content increased. Fly ash is used to fill more voids between the aggregates grains. So in this case the mix will continue to grain strength and this will leads to increase in stability of the Bituminous Mix.
4. By using the modified binder the density of bituminous mixes prepared and it decreases as the fly ash content in bitumen increases.
5. The Marshall flow value increases in the percentage of fly ash in binder. This will also shows, that the improvement in the resistance to permanent deformation of bituminous mixes with addition of fly ash.

5.2 Future Scope:-

1. Tensile strength evaluation intended for mixing Modified binder directly using flyash
2. Bitumen mixes with alteration by changing bitumen by using different sub systems to evaluate pet fatigue performance.
3. It is to find out the relative rutting characteristics of different types of bituminous mixes by static indication test at the temperature of 60°c.

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