AN EXPERIMENTAL STUDY ON FRESH PROPERTIES OF SCC USING ASPHALT DUST WASTE

A **MAJOR** Project Submitted in Partial Fulfillment of the requirement

For the award of

Bachelor of Technology

In Civil Engineering

By

J. VENKATA RAMARAO	**(19BQ1A0138)**
B. CHANDU	**(19BQ1A0117)**
CH. RAMESH	**(19BQ1A0118)**
A. ACHYUTH	**(19BQ1A0106)**
A. MAHESH	**(19BQ1A0105)**

Under the guidance of

Mr. K. SAI RAMYA, M-Tech

Assistant Professor

Department of Civil Engineering

VASIREDDY VENKATADRI INSTITUTE OF TECHNOLOGY
Approved by AICTE, Affiliated to JNTUK, ISO 9001:2008
Certified Accredited by NAAC with 'A' grade- B.Tech CSE, IT, ECE, EEE, ME, CE are accredited by NBA
NAMBUR (V), PEDEKAKANI (M), GUNTUR-522008

(AUTONOMOUS)

Academic Year: 2022-23

VASIREDDY VENKATADRI INSTITUTE OF TECHNOLOGY
Approved by AICTE, Affiliated to JNTUK, ISO 9001:2008
Certified Accredited by NAAC with 'A' grade- B.Tech CSE, IT, ECE, EEE, ME, CE are accredited by NBA
NAMBUR (V), PEDEKAKANI (M), GUNTUR-522008
(AUTONOMOUS)

CERTIFICATE

This is to certify that the project titled **"AN EXPERIMENTAL STUDY ON FRESH PROEPRTIES OF SCC USING ASPHALT DUST WASTE"** is a record of the bonafide work done by J. Venkata Ramarao(19BQ1A0138),B.Chandu(19BQ1A0117),Ch.Ramesh (19BQ1A0118), A. Achyuth (19BQ1A0106), A. Mahesh (19BQ1A0105) carried out in partial fulfilment of the requirements for awarding the degree of **Bachelor of Technology** in **Civil Engineering** discipline in **Vasireddy Venkatadri Institute of Technology** under **JNTUK UNIVERSITY, KAKINADA** during the academic year 2022-23.

Mrs. K. Sai Ramya
Assistant Professor,
Dept. of Civil Engineering

Dr. T. Sreedhar Babu
Professor & HOD,
Dept. of Civil Engineering

ACKNOWLEDGEMENT

I express my sincere thanks to our beloved principal **Dr. Y. Mallikarjuna Reddy**, for giving the opportunity.

Immense thanks are due to **Dr. T. Sreedhar Babu**, Head of the Department, Civil Engineering Department, for his valuable suggestions and providing the facilities in the Department.

I am extremely indebted to **Mrs. K. Sai Ramya**, Assistant Professor in Civil Engineering Department for his timely invaluable guidance and suggestions for this project work.

We are also grateful to the lab technicians, **Mr. Anil, Mr. Siva Rama Krishna** who helped us in every day to day project work from casting to curing and preserving the cubes from causing any damage.

I am much thankful to the **Management and Staff** who helped in gathering the needed information.

Last but not least we sincerely thank God, our parents and friends for their constant support, without them we would not have had the motivation to complete this thesis.

J. VENKATA RAMARAO

B. CHANDU

CH. RAMESH

A. ACHYUTH

A. MAHESH

CONTENTS

ABSTRACT

Self-compacting concrete is a fluid mixture suitable for placing in structures with congested reinforcement without vibration. Self-compacting concrete development must ensure a good balance between deformability and stability. Also, compatibility is affected by the characteristics of materials and the mix proportions. Nowadays there is a strong line of research related to global resource optimization and waste minimization in the construction field. The application of several wastes as replacement of the different materials involved in the manufacture of SCCs has been studied. Asphalt dust waste (ADW) is one of disposed materials obtained during the production of asphalt premix. These fine powder wastes contribute to environmental problems today. However, these waste materials can be utilized in the development of sustainable and economical SCC. In this project we have utilized asphalt dust waste (ADW) as a partial replacement of cement in the development of self-compacting concrete (SCC). This study is conducted to investigate the use of ADW as a partial replacement of Cement by 10%, 20% and 30% in SCC in order to maximize its benefits in improving the workability of SCC. As a result, we observed the SCC with ADW of 10% replacement has shown a reasonable result in fresh properties.

CHAPTER 1

INTRODUCTION

1.1 Concrete

Concrete is a composite materials composed of fine and coarse aggregate bonded together with a fluid cement (cement paste) that hardens (cures) over time. Concrete is the third-most-used substance in the world after water and is the most widely used building material. Its usage worldwide, ton for ton, is twice that of steel, wood, plastics, and aluminum combined. Globally, the ready-mix concrete industry, the largest segment of the concrete market, is projected to exceed $600 billion in revenue by 2025. This widespread use results in a number of environmental impacts. Most notably, the production process for cement produces large volumes of greenhouse gas emissions, leading to net 8% of global emissions.

Self Compacting Concrete was born (SCC), as an evolution of existing technology, and its use has been widespread in recent years in civil engineering, especially in the precasting industry, providing solutions to the different problems presented by ordinary concrete (OC). SCC is characterized by not requiring vibration and compaction, flowing under its own weight, completely filling the mould to be cast, achieving full compaction in the presence of high density reinforcement and homogenizing hardened concrete, all of which translates into benefits such as reduced lead times, production of complex structures, better surface finishes, reduced labour cost, improved job security, and noise and vibration reduction.

1.2 Asphalt Dust Waste

Asphalt is also referred to as bitumen whose main source is petroleum from where it is derived as the semi-solid compound and it is a thick, sticky, black, highly viscous liquid. It is classed as pitch and it is found in both natural deposits as well as in refined products. Asphaltum was the term that was used for asphalt before the 20th century. The Pitch Lake located in La Brea in southwest Trinidad which is Antilles island located on the northeastern coast of Venezuela within the Siparia Regional

Corporation consist of the largest natural asphalt deposits in the world that are accounted for almost 10 million tons.

The primary use of the asphalt goes into the construction of the road which accounts for 70% of the asphalt that is explored. Here the asphalt is used as glue and the binder is mixed with the construction aggregate materials in order to develop the asphalt concrete. Sealing flat roofs, production of roofing felts and bituminous waterproofing products are the main products that are developed from asphalt other than concrete. Naturally occurring asphalt whose viscosity is very similar to that of cold molasses is referred to as “crude bitumen”. But when the crude oil undergoes fractional distillation where it is heated at a temperature of 525 °C (977 °F), the asphalt that is generated in the process is referred to as “refined bitumen”.

1.3 Miller

As the hand mixing is impossible for the suitable slump flow, it is preferred to use Miller for faster mixing and to get the accurate results for slump flow which satisfies the classes of the concrete. A concrete mixer (often colloquially called a cement mixer) is a device that homogeneously combines cement, aggregate such as sand or gravel, and water to form concrete. A typical concrete mixer uses a revolving drum to mix the components. For smaller volume works, portable concrete mixers are often used so that the concrete can be made at the construction site, giving the workers ample time to use the concrete before it hardens. An alternative to a machine is mixing concrete by hand. This is usually done in a wheelbarrow; however, several companies have recently begun to sell modified tarps for this purpose.

1.4 Super plasticizer

Super plasticizers (SPs), also known as high range water reducers, are additives used in making high strength concrete. Plasticizers are chemical compounds that enable the production of concrete with approximately 15% less water content. Super plasticizers allow reduction in water content by 30% or more. These additives are employed at the level of a few weight percent. Plasticizers and super plasticizers retard the curing of concrete. Generally, superplasticizer can be classified into such types: purified lignosulfonates, carboxylate synthetic polymers, sulfonated synthetic polymers and synthetic polymers with mixed functionality cementitious materials.

CHAPTER 2

LITERATURE SURVEY

Norashidah Abd Rahaman..etc.(2001) all carried out the investigation on influence of Asphalt dust waste(ADW) material in mix design for self-compacting concrete to examine the effects of water binder ratio and amount of superplasticizer (sp) on the rheological and mechanical properties of the developed SCC. The results showed that the increase of w/b ratio and amount of SP will also improve the workability of SCC. It was found that the suitable percentage of ADW as concrete filler is between 30% to 50%. They prove that the powder waste can be successfully and economically utilized in the developed of self compacted concrete (SCC). They concluded that the results showed that the optimum percentage of ADW in SCC mix design was 40% with a w/b ratio of 0.3% and 2% superplasticizer which yield a compressive strength of 40.8 MPa.

S.G. Patil.(1998):Due to environmental concerns, government agencies globally have enforced stringent laws for asphalt dust waste. This has an immense pressure on environment to dispose and recycle their waste in an ecologically safe manner. In the present project work experimental investigation is carried out to see the possibility of locally available spent catalyst and asphalt dust in the development of Self Compacting Concrete thereby reducing impact on the environment. Four mixes, such as Mix-A, Mix-B, Mix-C, and Mix-D with Water to Powder ratio of 0.8, 0.9, 1.0, 1.10 respectively, with constant Water to Cement ratio of 0.45 is used to determine the initial mix composition as per the European guidelines. Finally he concludes that the spent catalyst and asphalt dust could be successfully used in the production of SCC.

Norwati Jamaluddin, Isham ismail.etc (2000): Self-compacting concrete (SCC) was first developed in late 80's in Japan. SCC is well known for its self-consolidation and able to occupy spaces in the formwork without vibration and become new interesting topic in Construction and Building Materials Research. The aim of this review is to summaries the previous research work related to utilization of waste minimization in

SCC from 2009 to 2015 through available literature. It is important to expose new researchers on concept and fundamental theory developed by previous researchers as a reference and guidance in their research. There were a lot of opportunity to be explored in developing SCC especially in utilizing waste material as replacement materials or additives used and mix design method for rheological improvement in SCC. However, this review only focusing on waste materials that have significant to be taken care to reduce environmental impact such as waste product from construction industry and by product industry. As conclusion, this paper will provide significant idea and useful information to those new to SCC and fellow researchers for future studies in utilizing waste materials in SCC mix design.

Okamura and Ouchi (2003) addressed the two major issues faced by the international community in using SCC, namely the absence of a proper mix design method and rheology testing method. They proposed a mix design method for SCC based on super-plasticizer compatibility in mortar and concrete mixes, followed by trail mixes. However, it was emphasized that the need to test the final product for passing ability, filling ability, and flow ability and segregation resistance was more relevant to achieve the self-compact ability.

Brouwers and Radix (2005) addressed that packing and grading of sand and gravel plays a major role in developing SCC with a poly-carboxylic ether type superplasticizer (SP). The Chinese design method was adopted, in which the voids in loose aggregate are filled with paste and packing of aggregates are minimized. Basic relations were derived for powder water mixes tested with haegerman cone. The hardened concrete test reveals that using the packing theory of Andersen and its modification by Funk &Dinger and Elkem, SCC mixes can be composed. The developed SCC mix is medium strength and less cost and also met all practical and technical requirements.

Gettu etc al. (2009) concludes from their experimental study, that the robustness is assured by the parameters of slump flow and J-ring tests. The incorporation of Viscosity

Modifying Agent (VMA) increases the robustness of SCC significantly. The variation of sand content does not affect the self-compatibility adversely. The decrease in gravel increases the segregation, increases in Fly Ash content slightly decreases the segregation resistances in SCC. The effect of cement variation is expected in the strength and also segregation resistance is lowered. Reducing or increasing the amount of water influences significant on the self- compact ability expressively increases in the slump flow and decrease in V-funnel.

Corradi et al. (2009) presented the concept of low fines SCC having total fines of about 350 kg/m3 to produce 25 to 35 MPa compressive strength. The best VMA was tested with 3 types of poly-carboxyle ether SP to evaluate the compatibility. The reduction of total fines and reduction of cement leads to decrease in the unit cost of SCC. Hence need for extra filler (100 to 150 kg/m3) is eliminated by VMA which increases the robustness. The cement content in the mix was determined on the strength, class, density, and w/c and the remaining fines are provided by filler. The VMA will be a breakthrough in the RMC industry.

Trezos et al. (2010) developed three SCC mix and two normal concrete mix and cured under two different environmental conditions like air curing and underwater curing. The testing equipment was designed to study the micro cracking and porosity of the SCC surface layer (i.e.skin concrete). Water permeability was evaluated by determining the water flux upto 56 days. Flux decay as a function of time has been compared between different SCC mixtures in terms of the curve type and slope and compared to normal concrete. The flux is higher in air cured specimen then under water curing SCC mixtures.

Farzadnia et al. (2011) suggested that high performance concrete is used in mass concrete due to its technical and economic advantages. Based on the fast growing trend like sustainable development, different types of mineral admixtures in forms of binary, ternary or quaternary blended mortars were used in concrete. The literature review concludes that minerals such as silica fume, Fly Ash, Rice Husk Ash, metakaolin, blast furnace slag and palm oil, fuel ash etc., improve the performance of concrete in durability. Still more test is required for high volume supplementary cementitious material for structural behavior like brittle, crack formation, shrinkage etc.

Guru Jawahar et al. (2012) proposed the procedure for the design of SCC mixes, whose relative proportions of key components are considered by volume rather than by mass. Detailed steps for SCC mix design was presented and the constituent materials for SCC with 29% coarse aggregate content of concrete volume with a paste volume of 388 lit/cum and designed for w/p ratio 0.36 by weight. Coarse aggregate of size 16 mm and 12.5 mm with coarse aggregate blending 60:40 by percent weight of total aggregate. This tool is very simple and user friendly for the SCC mix design with or without VMA.

Pandurangan et al. (2012) focused on the effect of size and shape of coarse aggregate on the flow and strength characteristic of SCC. If two grades with 60% & 40% replacement of cement with fly ash. Normal SCC mix of M35 designed according to IS:10262-1982 and SCC mix of M35 designed according to NANSU method, namely low volume Fly Ash with 40% and high volume with Fly Ash 60% replacement of cement. The flow ability and strength of high volume Fly Ash SCC concrete mix with 10 mm to 16 mm medium size aggregate found better performance in strength flow ability than low volume Fly Ash SCC with 20 mm medium shape aggregate. There is no influence of the shape of the aggregate; however the flaky and elongated aggregates reduce the strength of SCC significantly.

Ashar et al. (2013) have studied the properties of four superplasticizers on the basis of the workability test on SCC mortar paste and selected two SP used for further studies. Two mortar mixes 1:1.5 & 1:2 were prepared with w/c ratio of 0.3, 0.35 and 0.4 varying water SP dosage from 0.6 to 2% can be reduced by increasing the dosage of SP, keeping the cement content around 225 to 450 kg/cum. From the observation the compressive strength and tensile strength of SCC concrete are higher than those of conventional concrete. The Polycarboxylete showed better results in improving the workability. However, the chemical admixtures adversely affect the setting time of mortars.

Benaicha et al. (2013) investigated the effect of water cement ratio, cement type and Superplasticizer in rheological characterization of Self Compacting Concrete using V-funnel and Horizontal Plexiglas Channel tests. The data show that SCC must have a low flow for that flow to begin quickly and its viscosity should be moderate to limit the flow time. It is necessary to use filler to decrease yield stress and superplasticizer to increase the fluidity of Self Compacting Concrete. Compared to the rheology of SCC, the filler material silica fume Increases the demand for water and for superplasticizer than limestone.

Krishnapal et al. (2013) assessed the rheological and strength characteristics of SCC for 0.4 and 0.45 water powder ratios. The total powder content was 480 kg/m3 and 450 kg/m3 . Cement was replaced by 10%, 20% and 30% by weight to Fly Ash of fineness 2.7% and specific gravity of 2.6. FAIRPRO is used as superplasticizer. The study explores that the quantity of SP significantly reduces from 13.30 kg/m3 to 1.96 kg/m3 with increase to the percentage of Fly Ash. For all the mix design the workability properties like the slump and L-box values are close to the minimum acceptable range and the T50 cm and V-funnel exhibits the maximum acceptance range by EFNARC. The addition of Fly Ash resulted in decrease in compressive strength. But the decrease is more in early days than in later days.

Shriram and Mohitkar(2013) studied the fresh and hardened properties of Self Compacting Concrete blended with Cement Kiln Dust as supplementary cement replacement material in different percentages in addition to filler. SCC mix design for medium strength is Achieved by Modified Nan-Su method. It is observed that Cement Kiln Dust can be used in Large quantity in SCC and cement content can be reduced to as low 305.6 kg/m3 without Losing the requisite characteristic of SCC. Cement Kiln Dust is used as filler and additive to achieve the economic, environmental SCC and easy availability considerations predominate, Without much apprehension.

Lokeshwaran et al. (2017) designed SCC mixtures using GGBS by replacing ADW with 10%, 20%, 30%, 40% and 50% by Stream 2 in liquid form is used to enhance the rheological properties of SCMs. The rheology of the Self Compacting Mortar mix with RHA and Quarry dust was not significantly different from EFNARC acceptance. The decreasing trend is observed at all ages, but the rate of reduction is decreased as the age progressed. Finally the replacement level between 5% and 10%, SCMs mix can be achieved good flow properties and comparable compressive strengths. VijayaSekhar Reddy et al. (2013) the experimental study focuses on the mechanical properties of M60, high performance concrete with partial replacement of Cement by Ground Granulated Blast Furnace Slag and fine aggregate by robo-sand (crusher dust) with the addition of super plasticizer. They conclude that the robo-sand can be used as an alternative material for the fine aggregate and GGBS can be partially replaced with the cement. The maximum compressive strength achieved in M60 grade of concrete is 65.3 Mpa at 28 days curing period with 40% replacement of cement by Ground Granulated Blast Furnace Slag and 15% replacement of fine aggregate by robo-sand.

CHAPTER 3

MATERIALS AND METHODOLOGY

3.1 Objective

To conduct Experimental investigation on self compacting concrete by replacing cement with asphalt dust waste.

3.2Materials and their properties

In this project we had used materials like cement, fine aggregate, coarse aggregate, water, superplasticizer and an admixture ‘Asphalt Dust Waste’.

CEMENT:

3.2.1 Specific Gravity of Cement

1. Clean the Lechatlier flask before the use.
2. Now, take the weight of the empty flask as W1.
3. Now, take around 50 gm of cement and fill in the flask.
4. Fix stopper on flask and weight flask with cement as W2.
5. Now fill kerosene in the flask up to the neck of the bottle.
6. Thoroughly mix the cement and kerosene in the flask taking care that no air bubble is in it and take it weight as W3.
7. Take the empty flask and fill kerosene in it upto the neck of the bottleand record weight it as W4

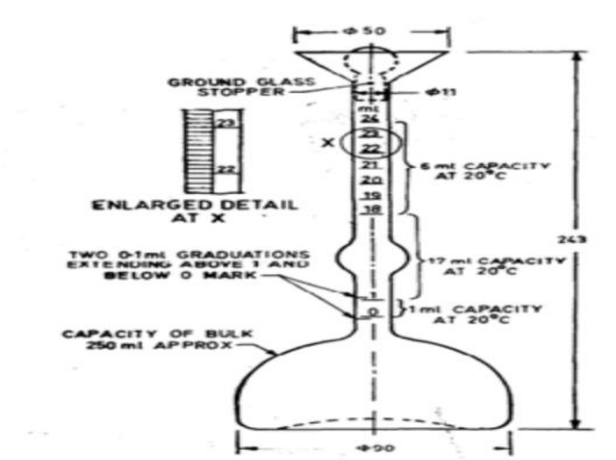


Figure 3.1 specific gravity of cement

	Sample		
	1	2	3
Weight of Empty flask (W1) kg	0.150	0.150	0.150
Weight of flask with cement (W2) kg	0.200	0.210	0.225
Weight of flask + cement + kerosene (W3) kg	0.410	0.420	0.430
Weight of flask with kerosene (W4) kg	0.375	0.375	0.375
Specific Gravity (G) $= \frac{W2-W1}{(W2-W1)-(W3-W4)\ x\ 0.82}$	2.89	3.225	3.472
Average Specific Gravity	**3.2**		

Table 3.1 specific gravity of cement

The average Specific Gravity = **3.2**

3.2.2Normal Consistency of Cement

1. Take about 300 gm of cement and prepare a paste with a weighed quantity of water (24%by weight of cement) for the first trail.
2. The paste must be prepared in standard manner and filled into the vicat's mould within 3 to 5 mimutes.
3. A standard Plunger 10mm diameter and 50 mm long is attached and brought down to touch the surface of the paste in the test block and quickly released allowing it to sink into the paste by its own weight.
4. Note the reading of the depth of penetration of the plunger.
5. Conduct several trials different water cement ratio until the plunger penetrates for a depth of 33 to 35mm from top and 5-7mm from the bottom.

S. No	Quantity of Cement	Quantity of Water in %	Depth of penetration of plunger in mm
1	350gm	24	10
2		26	16
3		28	24
4		29	30
5		**30**	34

Table 3.2 Normal consistency of cement

3.2.3 Initial Setting Time of Cement

1. Take 350 gm of cement sample and gauge it with 0.85 times the water required for standard consistency.
2. The paste is filled in the mould within 3 to 5 minutes.
3. Start the stopwatch at the moment when water is added to the cement.
4. A needle 1mm diameter and 50mm long is attached and brought down to touch the surface of the paste in the test block and quickly released allowing it to sink in to the paste by its own weight.
5. Allow it to penetrate to the test block and quickly release. In the beginning the needle will completely pierce through the test block. But after some time when the paste starts losing its plasticity the needle may penetrate only to a depth 33 to 35mm from the top.
6. The time elapsed between the times when the water is added to the cement to the time at which the needle penetrates the test block to a depth equal to 33-35mm from the top is taken as initial setting time.

Table 3.3 Initial setting time of cement

S.No	Time of penetration of needle in minutes	Depth of penetration in mm
1	5	40
2	10	40
3	15	40
4	20	40
5	25	40
6	28	40
7	29	40
8	30	39
9	31	39
10	32	39
11	33	39
12	34	38
13	35	38
14	36	38
15	37	38
16	38	37
17	39	36
18	**40**	35

The Initial setting time of cement=40minutes

3.2.4 Fineness of Cement

1. Take 100gms of cement in the standard sieve. Break down the oil set lumps with fingers.
2. Sieve the sample for a period of 15 to minutes.
3. Weight the residue left on the sieve. The percentage of the residue is calculated.

Table 3.4 fineness of cement

Particulars	Sample 1	Sample2	Sample 3
Mass of cement in gm	100	100	100
Mass of residue	2	3	1
Fineness $=\frac{Mass\ of\ residue}{Initial\ weight\ of\ cement} X\ 100$	2%	3%	1%

ASPHALT DUST WASTE (ADW):

3.2.5 Specific Gravity of ADW:

1. Clean the Lechatlier flask before use. It should be free from moisture.
2. Now take the weight of the empty flask as W1
3. Take around 150 gm of asphalt dust waste and fill in the flask
4. Take 100gms of cement in the standard sieve. Break down the oil set lumps with fingers.
5. Sieve the sample for a period of 15 to minutes.
6. Weight the residue left on the sieve. The percentage of the residue is calculated.
7. Fix stopper on flask and weight flask with ADW as W2.
8. Now fill kerosene in the flask up to the neck of the bottle.
9. Thoroughly mix ADW and kerosene in flask taking care; no air bubble is left it. Record the weight as W3.
10. Take empty bottle and fill kerosene and weight it as W4.

Table3.5 Specific Gravity of ADW

	Sample		
	1	**2**	**3**
Weight of empty flask (W1) kg	0.15	0.150	0.150
Weight of flask with ADW (W2) kg	0.200	0.210	0.205
Weight of flask + ADW + kerosene (W3) kg	0.410	0.415	0.415
Weight of flask with kerosene (W4) kg	0.375	0.375	0.375
Specific Gravity (G)= $\frac{w2-w1}{(w2-w1)-(w3-w4)X0.82}$	2.89	2.60	3.182
Average Specific Gravity	2.89		

FINE AGGREGATE and COARSE AGGREGATE:

The fine aggregate used must be properly classified to have a minimal void fraction and free from materials such as clay and slit. The grain size of the fine aggregate should be such that it does not increase the water requirement of the concrete and create voids. A sticky consistency that makes compacting difficult and grinding with a fineness of about 3 offers the best workability and compressive strength. Properties such as pore ratio, gradation and density must be taken into account in order to design the mixture with the optimal cement content and to reduce the mixing water.

Figure 3.2 Fine Aggregate

3.2.6 Specific Gravity of Fine Aggregate:

As per IS: 383 – 2016 and IS 2386 (1963) part 3

1. Take the weight of empty Pycnometer (Jar), note as W1 kg.
2. Fill the jar with sand up to 1/3 of its volume and weight it, note as W2 kg.
3. Fill the jar with sand, with water and stir with a glass rod to expel air Bubbles, if any place with lid and fill the remaining gap with water and level with top of hole. Now weight the jar, W3.
4. Empty the Pycnometer, properly clean it and then fill with water up to top of hole. Again weight the jar, W4.

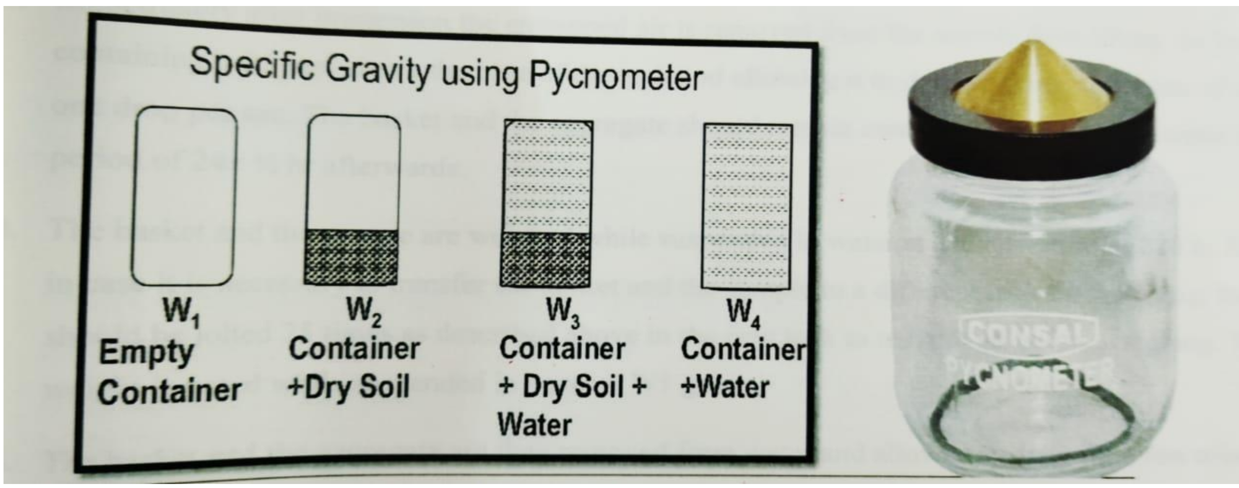


Figure 3.3Specific Gravity of Fine Aggregate

Particulars	sample		
	1	2	3
Weight of the Pycnometer (W1) kg	0.545	0.545	0.545
Weight of the Pycnometer with aggregate (W2) kg	1.135	1.60	1.170
Weight of the Pycnometer with water + fine aggregate (W3) kg	1.940	1.960	1.965
Weight of the Pycnometer with water (W4) kg	1.580	1.580	1.580
Specific Gravity(G) $\frac{(W2-W1)}{(W2-W1)-(W3-W4)}$	2.56	2.61	2.60
Average Specific Gravity	**2.60**		

Table 3.6 Specific Gravity of fine aggregate

The Specific Gravity of fine aggregate = 2.60

3.2.7 Specific Gravity of Coarse Aggregate:

1. Take min 2 kg of the aggregate sample is washed thoroughly to remove fine, drained and then placed in the wire basket and immersed in distilled water at a temperature between 230 and 320 C and with a cover of at least 5cm of water above the top of the basket.
2. Immediately after immersion the entrapped air is removed from the sample from lifting the basket containing it 25 mm above the base of the tank and allowing it to drop 25 times at the rate of above one drop per sec.
3. The basket and the sample are weight while suspended in water at a temperature of 220 to 320 C. This weight is noted while suspended in water = W1 gm.
4. The basket and the aggregates are the removed from water and allowed to drain for a few minutes, after basket which the aggregates are transfer to one of the dry absorbent cloths.
5. The empty basket is then returned to the tank of water, jolted 25 times and weighed in water =W2 gm.
6. The aggregates placed on the absorbent clothes are surface dried till these clothes remove no further moisture. 10 to 60 min drying may be needed.
7. A gentle current of unheated air may be used during the first 10 min to accelerate the drying of aggregate surface. The surface dried aggregate is then weighed= W3 gm.

Figure3.4 specific gravity of coarse Aggregate

Table 3.7 Specific Gravity of coarse Aggregate

Particulars	sample		
	1	2	3
Weight of saturated Aggregate suspended in water with the basket (W1)	2.730	2.735	2.740
Weight of basket suspended in water (W2)	1.470	1.470	1.470
Weight of the dry Aggregates (W3)	2.000	2.000	2.000
Weight of saturated Aggregate in Water (Ws) = W1 – W2	1.26	1.265	1.27
Specific Gravity (G) $\frac{Dry\ weight\ of\ Aggregate}{Weight\ of\ Equal\ volume\ of\ Water} = \frac{W3}{(W3-WS)}$	2.68	2.72	2.73
Average Specific Gravity	2.71		

The Specific Gravity of Coarse Aggregate = 2.71

3.3 Mix Design:

Mix Design can be defined as the process of selecting suitable concrete ingredients and determining their relative proportions in order to produce concrete with a certain minimum strength and durability in the most economical way possible. Concrete mix design requires a thorough understanding of the various properties of these Components. Materials, these make the mixed design task more complex and difficult.

3.3.1Factors to be considered for mix design:

1. The grade designation giving the characteristic strength requirement of concrete.

2. The type of cement influences the rate of development of compressive strength of concrete.

3. Maximum nominal size of aggregates to be used in concrete may be as large as possible within the limits prescribed by IS 456:2000.

4. The cement content is to be limited from shrinkage, cracking and creep.

5. Workability of concrete for satisfactory placing and compaction is related to size and shape of section, quantity and spacing of reinforcement and technique transportation, placing and compaction.

3.3.2 Procedure

1. Determine the mean target strength ft from the specified characteristic compressive strength at 28-day fck and the level of quality control.

ft=fck +1.65 S

Where S is the standard deviation obtained from the Table of approximate contents given after the design mix.

2. Obtain the water cement ratio for the desired mean target using the empirical relationship between compressive strength and water cement ratio so chosen is checked against the limiting water cement ratio. The water cement ratio so chosen is checked against the limiting water cement ratio for the requirements of durability given in table and adopts the lower of the two values.

3. Estimate the amount of entrapped air for maximum nominal size of the aggregate from the table.

4. Select the water content, for the required workability and maximum size of aggregates (for aggregates in saturated surface dry condition) from table.

5. Determine the percentage of fine aggregate in total aggregate by absolute volume from table for the concrete using crushed coarse aggregate.

6. Adjust the values of water content and percentage of sand as provided in the table for any difference in workability, water cement ratio, grading of fine aggregate and for rounded aggregate the values are given in table.

7. Calculate the cement content from the water-cement ratio and the final water content as arrived after adjustment. Check the cement against the minimum cement content from the requirements of the durability, and greater of the two values is adopted.

8. From the quantities of water and cement per unit volume of concrete and the percentage of sand already determined in steps 6 and 7 above, calculate the content of coarse and fine aggregates per unit volume of concrete from the following relations:

$$v = [w + \frac{C}{Sc} + \frac{1}{p}\frac{fa}{Sfa}] x \frac{1}{1000}$$

$$V = [W + \frac{C}{Sc} + \frac{1}{1-p}\frac{Ca}{Sca}] x \frac{1}{1000}$$

where V =absolute volume of concrete

=gross volume (1m3) minus the volume of entrapped air

Sc=Specific gravity of cement

W=Mass of water per cubic meter of concrete, kg

C=mass of cement per cubic meter of concrete, kg

P= Ratio of fine aggregate to total aggregate by absolute volume

$F_a.c_a$=Total masses of fine and coarse aggregates, per m' of concrete respectively, kg.

$S_{fa}.S_{ca}$=specific gravities of saturated surface dry fine and coarse aggregate

9. Determine the concrete mix proportions for the first trial mix.

10. Prepare the concrete using the calculated proportions and cast three cubes and test them wet after 28-days moist curing and check for the strength.

3.3.3 Concrete Mix Design

A Preliminary Design Data:

Grade designation: M30

Type of cement: RAMCO OPC 53 grade

Coarse Aggregate size: 12.5-10mm passing

Water Cement Ratio: 0.45

B Target Strength for Mix Proportion:

F_{ck}= F_{ck}+1.65s

From Table 1 standard deviation=5N/mm^2

Target Strength= 30+1.65 x 5

= 38.25 N/mm^2

$F^{|}_{ck}$= F_{ck} + X

= 30 + 6.5

= 36.5 N/mm^2

C Selection of Water Cement Ratio:

Selection of water content from the table 2 for agrregatesize of 10mm is 208

D Calculation of Cement content

Cement content = 208/0.45

= 465 kg/m^3

E Selection of Admixture Content

Assuming 2% by the cementitious materials

$\frac{2}{100}$x 465 = 9.3 kg/m^3

F Selection of Powder Content and fine Aggregate:

Fine Aggregate = Total Powder Content – (Asphalt content + Cement content)

(Assuming powder content as 540)

= 540-465

= 75 KG/m^3

Fine Aggregate = $\frac{75}{0.08}$

= 937.5 KG/M^3

G Selection of Coarse Aggregate Content:

Vca = (1-air content) – (volume of water + volume of cement + volume of asphalt + volume of admixture + volume of fine aggregate)

= (1-0.001) – ($\frac{230}{1000} + \frac{465}{3.15} * \frac{1}{1000} + \frac{9.3}{1.08} * \frac{1}{1000} + \frac{937.5}{2.65} * \frac{1}{1000}$)

= 0.2589

Vca= 2.74 * 0.2589 * 10

= 709.64 KG/M^3

MIX PROPORTIONS:

Cement = 416 Kg/m^3

Water = 208 litre

Fine aggregate = 937.5 Kg/m^3

Coarse aggregate = 709.64 Kg/m^3

Table 3.8 Materials required for the replacement percentage of ADW

Cement Replacement %	**Cement (kg/m^3)**	**ADW (kg/m^3)**	**Fine Aggregate (kg/m^3)**	**Coarse Aggregate (kg/m^3)**	**Water content (kg/m^3)**	**Chemical admixture (kg/m^3)**
0%	465	0	937.5	819.29	208	9.30
10%	418.5	46.5	937.5	795.97	208	9.30
20%	372	93	937.5	778.5	208	9.30
30%	325	140	937.5	760.5	208	9.30

CHAPTER 4

EXPERIMENTAL INVESTIGATION

4.1 Introduction

In this chapter we were going to study about fresh properties like slump flow, L-BOX, V-FUNNEL and U-BOX with different replacement percentages of Asphalt dust waste.

4.2 Tests on Fresh Concrete

4.2.1 Slump Flow Test:

1. Wipe the internal and external surfaces of the slump cone and plate with wet cloth Place the slump cone on the plate, which is laid horizontally.

2. Fill the sample in the cone either by Method A or Method B. The case where the actual construction does not involve consolidation is referred to as Method A, and the case with vibratory consolidation is referred to as Method B. In Method A, concrete is filled in one continuous layer without rodding or vibrating. In Method B, concrete is filled in three layers of equal quantities. Level each layer with a tamping rod and then rod five strokes uniformly over the area.

3. The time from the beginning to the end of filling concrete in the slump cone shall be within 2 minutes.

4. Level the top surface of concrete with the top rim of the slump cone, and immediately raise the cone vertically by a steady upward lift without interruption. When the movement of the concrete has stopped, measure the apparently maximum diameter and the diameter at right angles to it, and take the average of both diameters as the slump flow. The measurement shall be performed once.

Note: The time to raise the slump cone to 300mm in height shall be 2 to 3 seconds.

5. When measuring the time to 500mm flow, measure the time from the beginning of the raising of the slump cone to the moment when the apparently maximum diameter reaches 500 mm with a stopwatch to the nearest 0.1sec.

6. Then measuring the time to the end of the flow, measure the time from the beginning of the raising of the slump cone to the moment when the flow visually stops with a stopwatch to the nearest 0.1sec.

Remark: When measuring the slump, measure the vertical subsidence at the center of

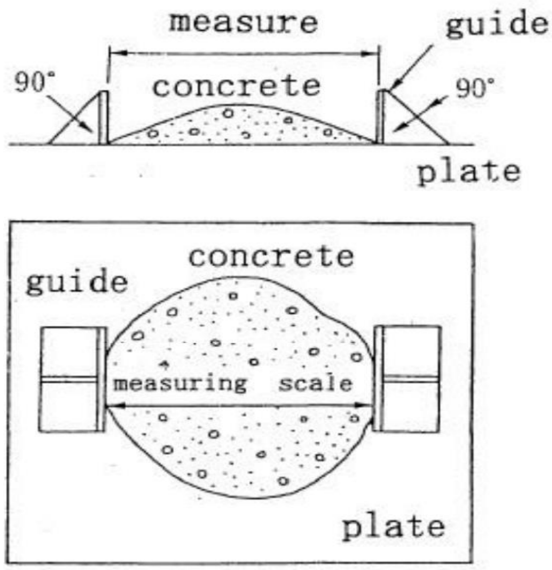


Fig. 1 slump flow measurement

concrete and take it as the slump. Measure the slump to the nearest 5mm.

4.2.2 L-BOX

1. Place the L-type flow tester on a horizontal p1ane and wipe the internal surfaces of the tester with a wet cloth.

2. Attach the sliding gate to the L-type flow tester and pour the sample using the charging container in one layer without applying rodding or vibration.

3. Level the top surface of the concrete filled in the tester with the top edge using a straightedge.

4. When the top surface has been leveled, immediately raise the sliding gate. An L-flow refers to the distance between the inside of the sliding gate and the tip of concrete.

5. Measure the time to reach an arbitrary L-flow with a stopwatch.

6. The L-flow when the motion of concrete stops is referred to as the maximum L-flow.

7. Measure the subsidence of concrete from the initial level by reading the length from the top edge of the tester to the highest point of the concrete with a measuring scale.

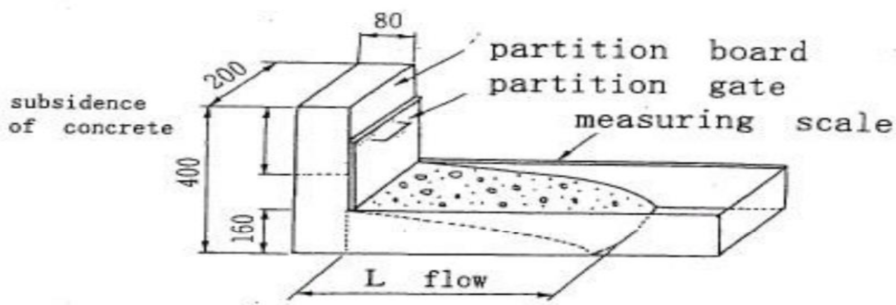


Fig. 1 Shapes and Dimension of L-type flow

4.2.3 V-FUNNEL

1. Wash a funnel with water and set it vertically (with the top edge/rim being horizontal). Wipe with a tightly squeezed wet cloth to maintain the internal surfaces in a wet condition.

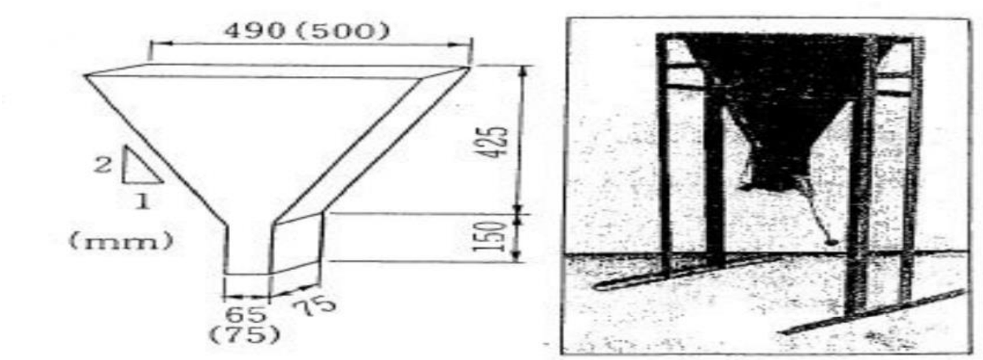
2. Place a receiving container under the orifice and close the trap.

3. Gently pour a concrete sample from the charging container to the top edge/rim of the funnel.

4. Level the top surface of the concrete with the top edge/rim of the funnel using a straightedge.

5. After having leveled the top surface, open the trap within 10 seconds and measure the time to the moment when all the concrete comes out of the funnel with a stopwatch. Take this as t_0

6. When determining the flow-through index, place a sample in the funnel, leave to stand for 5 minutes and then measure the flow-through time. Take this as t5.



( ) :dimensions in case of V75-funnnel
(b) V-funnel

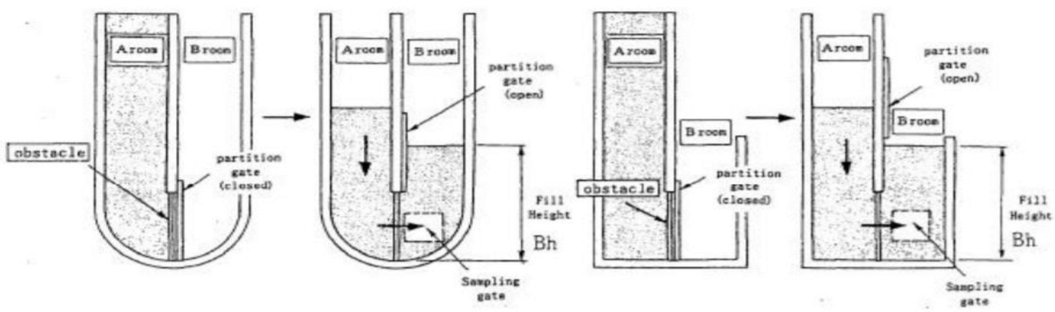
4.2.4 U- BOX

1. Place the U-shaped or Box-shaped container vertically, with the top edge being horizontal.

2. Insert the sliding gate and partition plate with an obstacle into the U-shaped or Box-shaped container.

3. Wipe the internal surfaces of the tester, sliding gate, partition plate and obstacle with a wet cloth.

4. Place concrete in Room A from, e.g., a jug with the sliding gate closed. Concrete should be placed continuously to the top edge of Room A without rodding with a tamping rod or tapping.
5. Remove excess sample with a metal straightedge or trowel, level the sample with the top edge of the tester using, e.g., a straightedge, and leave to stand for 1 minute.
6. Open the sliding gate in a quick motion. Allow the concrete to flow through the obstacle into Room B, and leave to stand until the concrete stops.
7. Measure the height from the bottom to the top of the concrete in Room B to 1 mm with a measuring scale. Take this as the fill height, Bh (mm). Here the height is measured at three points, i.e., at the center of the tester width and both comers.
8. Measure the time from immediately after opening the sliding gate to the end of filling into Room B to 1/10 sec with a stopwatch. Take this as the filling time, Btime (sec).



(a) U-shaped (b) Box-shaped

Fig.2 Measurement of Fill Height, Bh

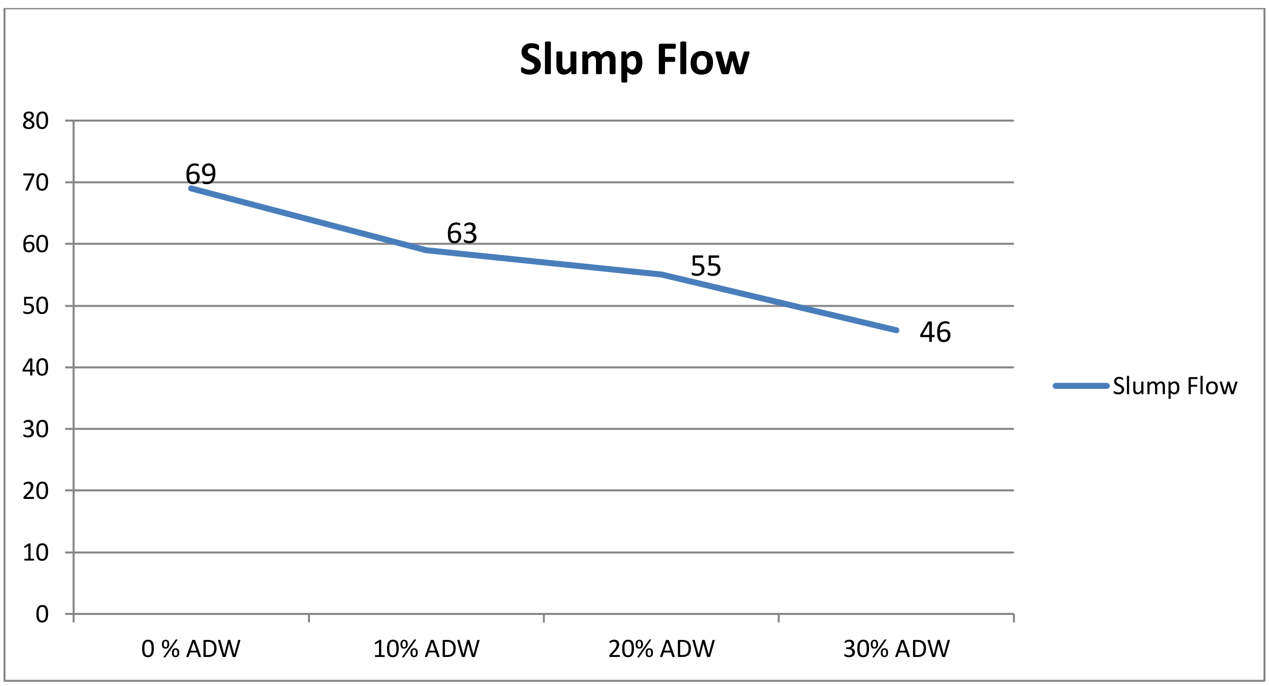
CHAPTER 5

RESULTS

5.1.1 Slump flow Test

The following results were obtained while conducting slump flow test:

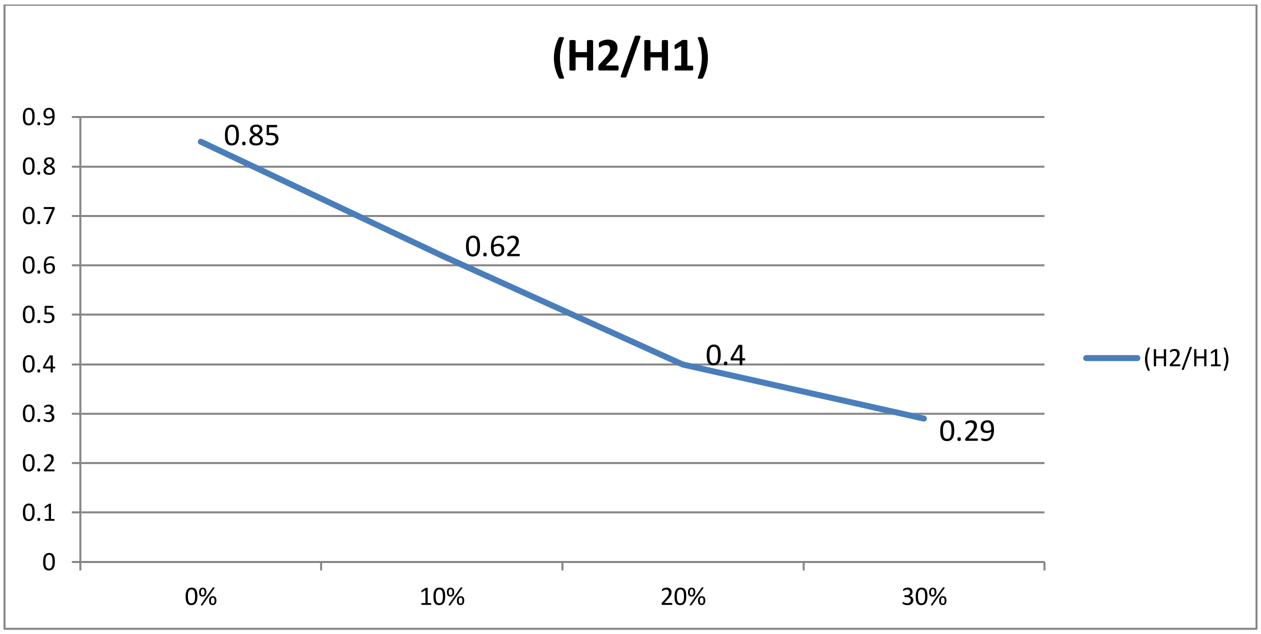
S. No	% of Replacement of ADW	Slump Flow (cm)
1	0%	69
2	10%	63
3	20%	55
4	30%	46



5.1.2 L-Box

The following results were obtained while conducting L-Box test:

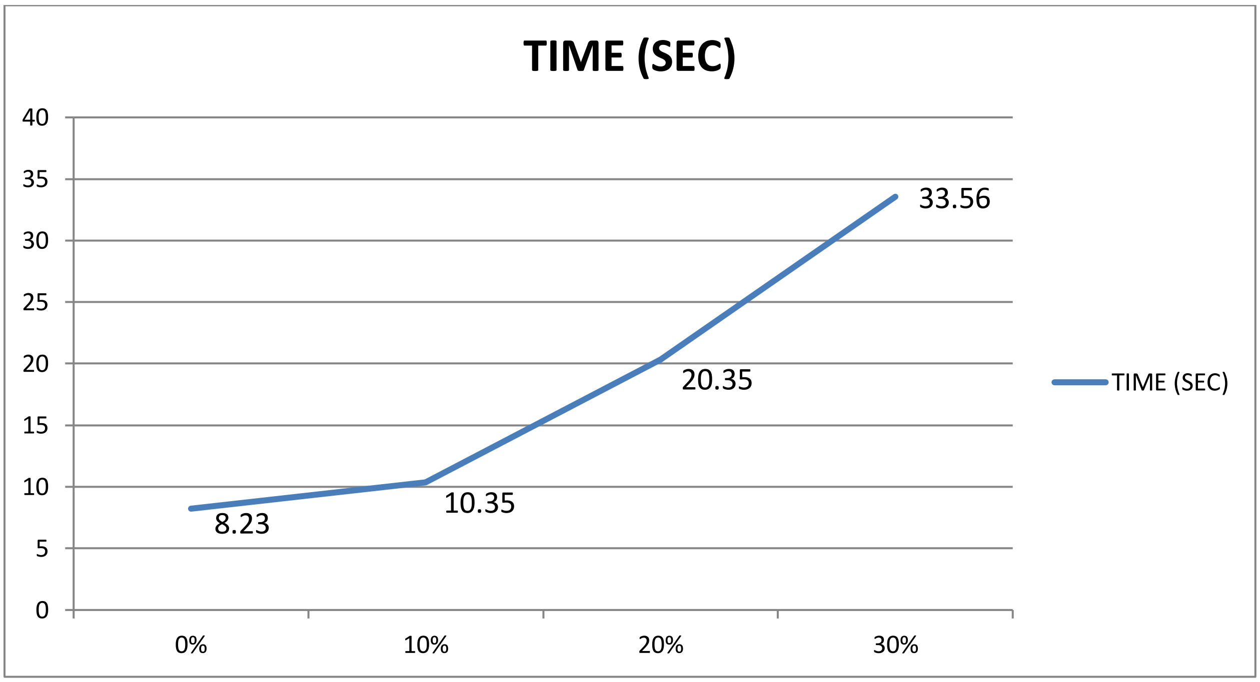
S. No	% of Replacement of ADW	TIME (sec)	H_2/H_1
1	0%	38	0.85
2	10%	56	0.62
3	20%	70	0.40
4	30%	85	0.29



5.1.3 V-FUNNEL

The following results were obtained while conducting V-Funnel test:

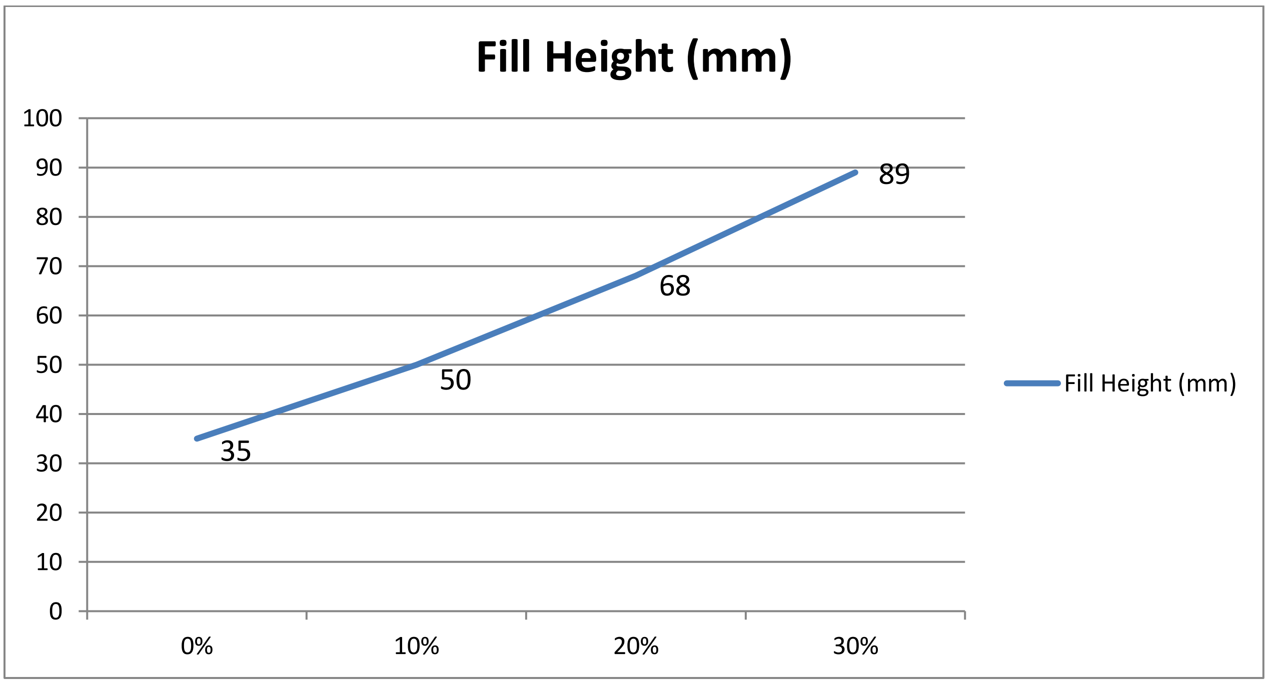
S. No	% of Replacement of ADW	TIME (sec)
1	0%	8.23
2	10%	10.35
3	20%	20.35
4	30%	33.56



5.1.4 U-BOX

The following results were obtained while conducting L-Box test:

S. No	% of Replacement of ADW	Fill Height (mm)
1	0%	35
2	10%	50
3	20%	68
4	30%	89



CHAPTER 6

CONCLUSIONS

After thorough study on the above results, the following conclusions were drawn:

- The **slump flow** for the mixes is reduced by increasing the percentage of replacement of Asphalt Dust waste beyond 10%.
- The **L-Box value** was not satisfied with the requirements of SCC (0.85-1.0) at all the replacement percentages (10%, 20%, and 30%) of Asphalt Dust waste.
- The **V-Funnel time** is satisfied at 10% replacement of Asphalt Dust waste.
- The **U-Box value** was also not satisfied with the requirements of SCC (30mm Max.) at all the replacement percentages (10%, 20%, and 30%) of Asphalt Dust waste.

At an Outset, we have observed the following:

- The increase in the percentage of the super plasticizer will result in the delay of the setting time of cement which results in the delay of unmolding of formwork.
- The super plasticizer percentage should not exceed the 1% of the cementitious materials.
- A fresh mix has to be used for any particular type of Test.
- A Proper and keen care has to be taken while designing the Mix for SCC.
- We may try at still lesser percentages of ADW to make it a suitable replaceable admixture.

CHAPTER 7

REFERENCES

1. H. Okamura and M. Ouchi, Self-compacting concrete, Adv. Concrete. Technology., 1(1), 5– 15, (2003)
2. Y. Sheen, L.-J. Huang, T.H. Sun and D.H. Le, Engineering properties of selfcompacting concrete containing stainless steel slags, Procedia Eng., 142, 79–86, (2016)
3. M. Benaicha, X. Roguiez, O. Jalbaud, Y. Burtschell and A. H. Alaoui, Influence of silica fume and viscosity modifying agent on the mechanical and rheological behavior of self compacting concrete, Constr. Build. Mater., 84, 103–110, (2015)
4. D. Carro López, B. González Fonteboa, J. de Brito, F. Martínez-Abella, I. GonzálezTaboada and P. Silva, Study of the rheology of self-compacting concrete with fine recycled concrete aggregates, Constr. Build. Mater., 96, 491–501, (2015)
5. E. Guneyisi, M. Gesoglu, A. Al-Goody and S. İpek, Fresh and rheological behavior of nano-silica and fly ash blended self-compacting concrete, Constr. Build. Mater., 95, 29–44, (2015)
6. H. Okamura and M. Ouchi, Adv. Concr. Technol.1, 5–15 (2003).
7. N. Su, K.-C. Hsu, and H.-W. Chai, Cem. Concr. Res. 31 1799–1807 (2001).
8. EFNARC, "Specification and Guidelines for Self-Compacting Concrete," United Kingdom, 2002.
9. Ismail, N. Jamaluddin, and S. Shahidan, J. Teknol.5, 29–35 (2016).
10. N.F.I. M. Abdul Rahim, N. M. Ibrahim, Z. Idris, Z. M. Ghazaly, S. Shahidan, N. L. Rahim, L. A. Sofri, Mater. Sci. Forum 803, 288–293 (2014).
11. S. Shahidan, I. Isham, and N. Jamaluddin, MATEC Web Conf. 47, 1–7 (2016).
12. P.L. Domone, Cem. Concr. Compos. 28, 197–208 (2006).
13. P.L. Domone, Cem. Concr. Compos. 29, 1–12 (2007).
14. C. Shi, Z. Wu, K. Lv, and L. Wu, Constr. Build. Mater. 84, 387–398 (2015).
15. J. Martin, J. Rodriguez Montero, F. Moreno, J. L. Piqueras Sala, M. C. Rubio, Feasibility analysis of the reuse of waste filler of bituminous mixtures for the production of self-compacting concrete, Mater. Des. 46 (2013) 372–380.
16. N. Su, K. C. Hsu, H. W. Chai, A simple mix design method for self-compacting concrete, Cem. Concr. Res. 31(12) (2001) 1799–1807.
17. S. Shahidan, I. Isham, N. Jamaluddin, A Review on Waste Minimization by Adopting in Self Compacting Concrete MATEC Web of Conferences This review based on information gathered from available literature journal papers since 2009 till, MATEC Web Conf., 47 (2016) 1–7.