SCRAP CONCRETE

DISSERTATION - II REPORT

Submitted by

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(11304610)

In partial fulfilment for the award of the degree of

MASTERS OF TECHNOLOGY

IN

STRUCTURAL ENGINEERING

(Civil Engineering)

Transforming Education Transforming India

Under the Guidance of

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DECLARATION

I, Kamepalli Sai Gopi, Student of Lovely professional University (School of civil Engineering) Hereby declare that the report on "**SCRAP CONCRETE**" is a pure work done by me. It hereby Declare that it is not submitted by any other as final report of Dissertation-II.

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CERTIFICATE

*Certified that this project report entitled **"SCRAP CONCRETE",** submitted by **Kamepalli Sai Gopi** Registration Number **11304610** student of School of Civil Engineering, Lovely Professional University, Phagwara, Punjab who carried out the project work under my supervision.*

To the best of my knowledge, the matter embodied in the project report has not been submitted to any other University / Institute for the award of any Degree or Diploma.

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ABSTRACT

A lot of researches are happening around the world for the treatment of waste. Many waste materials will be used as the raw materials in many industries, such that the energy and natural resources consumption will become low. And this will decrease the negative effect on the environment and helpful for the establishment of secondary and tertiary industries.

Scrap and waste are the older terms and are waste products in the older ages. But after the advancement in technology this scrap and the waste can be used as a raw material for many other industries. The current study considers the utilization of recycled aluminium waste in producing concrete and gives out the information of utilizing a scrap of aluminium in the concrete as a replacement of Coarse aggregate and, which is the third most available raw material subsequently Oxygen and Silicon, and which can reduce the Corrosion effect in the Concrete. This paper also seeks to reduce the natural aggregates which we get from blasting and crumbling down of natural mountains. The research has been performed to develop an environment friendly solution to utilise hazardous waste from the aluminium industry using Aluminium caps of size nearly about 2.5 cm which are partially replacing coarse aggregates by 10, 15 and 20 % in the Concrete. The Compressive and Flexural strength of the Concrete is determined and computed with the Nominal Concrete.

In contempt of disposing of, burning and lending money for landfills, this Scrap can be utilised as one of the composites of Concrete.

Keywords: Recycled Concrete, Aluminium Scarp, Environmental Impact, Natural aggregate.

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List of Abbreviations

Cao	Calcium Oxide
OPC	Ordinary Portland Cement
F A	Fine Aggregates
C A	Coarse Aggregates
A S	Aluminium Scrap
M^2/Kg	Meter square/Kilogram
Min	minutes
Hr	Hour
N/mm^2	Newton/Millimetre square
%	Percentage
Mm	millimetre
Is	Indian standard
M	meter
ASTM	American Society for Testing and Material
CTM	Compressive Testing Machine
P	Standard consistency
KN	Kilo Newton
N	Newton
Mpa	Mega Pascals
Sr.No	Serial Number
W/C	Water per Cement

1 CHAPTER

INTRODUCTION

1.1 General

Concrete is the mostly consumed material around the world. In addition, concrete is the 2nd most consumed substance in the world-behind water. It is one of the world's most adaptable and extensively used construction materials, ready mixed concrete provides for durable, buoyant and sustainable end products The worth of this Industry over $37 billion,. On the other hand, tremendous quantity of by-product materials is engender from industries, domestic, and agricultural activities. These by-products or so-called waste materials acquire lots of environmental problems. Because of the rapid increase of aluminium in automobile industry around the world and in the same way the scrap deposits are increasing, and the recycling industry is very poor in India whereas in developed countries the rate of recyclibilty is very high. . There were many studies to use aluminium as a building material as a replacement of cement, Fine Aggregate and Coarse aggregate. The final results gave a conclusion that the aluminium products shows much variance at the different percentage of replacement. Puertas et al. stated that Dross from Aluminium having high amount of alumina can be utilized as raw material in cement manufacturing industry [1]. Pereira et al. studied the hardened properties of Aluminium waste (AW) on the PPC and said that it can be used as a partial replacement of binder up to certain percent and it will be useful in both economic and environmental purposes [2]. As the replacement of Dross of Aluminium increases stated that the compressive and Permeability value of the concrete decreases and similarly the amount of entrapped air is extensively increases and it causes the adverse effect on the concrete mix and on its permeability properties and Dross of aluminium used as an expanding agent, it can be used in the manufacturing of building floors, blocks and pre-moulded panels [3]. And this alloy is likewise used broadly for aerospace, automotive, railroad, and different business programs, gives lightweight, good corrosion resistance, and awesome formability [4]. The concrete produced with 30% Al dross alternative reviews a higher fee of flexural strength devaluation because of inhomogeneity inside the distribution of hydration products in concrete at hot climate situations. By substitute of these materials within the concrete this kind of concrete will be low-cost and ecological beneficial inside the area of construction [5].

1.2 Problem Background

Aluminium is the maximum considerable metal located in the earth's crust, Aluminium is extremely good for the metals low density and for capability to face up to corrosion due to the phenomenon of passivation.

Given the reality that India's in per capita consumption of aluminium remains one of the lowest at 2.2 kg against a world average of 8kg, with 22-25 kg in advanced countries, it will likely be too early to name it an afternoon, however the location of challenge right here is the complete lack of shape for aluminium scrap managing and secondary metal recovery.

The manufacturing and consumption of Aluminium have multiplied notably worldwide in recent years and has created a huge deposit in the domestic wastes and landfills. However, the rate of recycling plastic bottle was only 25% and the remaining was sent to landfill or incinerate. Despite the fact of increasing cost for landfill, Aluminium cap required a significant amount of time, approximately up to hundreds of year to be fully decomposed. On the other hand, high demands for raw materials such as natural aggregate due to the rapid increase of population and construction development has caused a heavy exploitation of the natural resources. Continuous of natural aggregate quarrying produced issues like damaging the environment and depleting fast, causing a shortage in natural aggregate. Thus, comprising the Negative environmental effect of aluminum cap and the depletion of natural aggregate, make use of waste aluminum cap as a partial mixture replacement in concrete has foreseen to end up the appreciably powerful solution for the issues. The development of aluminium cap aggregate as construction materials are important to both the construction and aluminium recycling industry as it is essential to preserves our depleting natural resources.

1.3 Research Objectives:

Due to high consumption of aluminium in all the manufacturing industries, and the recycling process is very weak in our country so these can be used to partially replace the coarse aggregate

Objectives of the Study are:

- To determine the Strength of the concrete when it is maximum percent replaced with the aluminium scrap.

- To compare the hardened properties of the aluminium scrap concrete with control concrete.
- To reduce the use of natural Coarse aggregates with Aluminium waste.
- To determine various tests on the concrete made up of aluminium waste.

2 CHAPTER

RESEARCH METHODOLOGY

The availability of the coarse aggregates is turning into less in recent times and the scrap deposits of aluminium is increasing, such that scrap manufactures from aluminium which can be used as a lid of cold liquids and every other beverage are accumulated, the cause for choice of this scrap due to the fact the dimensions of the aggregates used in the mixed layout must not be more than 30mm.

Description of work done:

- Plastic liners present inside these scrap are removed manually such that to prevent the degrading of concrete when mixed with plastic liners.
- Tampering is done such that there will be no hallow space present inside the scrap and has a rough texture.
- Physical test on these scrap are done like shape, size, and all other tests were performed.
- Concrete of three types are prepared, one is without replacement of these aluminium scrap and one with 15% and 25% replacement of these scrap by weight.
- The grade of concrete used for this test is M25 using IS: 10262-1982
- Coarse aggregate that is used is crushed granite and the fine aggregate used is river sand.
- Cement that is used of type Ordinary Portland Cement.
- Tap water is used for the mix.
- The consistency test was carried out to ensure that the mix design was adequate to produce a grade 25 mm concrete.
- The 150 x 150 x 150 mm sized cube has been chosen as the dimension of cube for Compression test.
- To determine the Flexural Strength Beams were casted.
- The specimens were being tested at the age of 7, 14 and 28 days with according to the standard recommendation (BS 1881).

2.1 Material

2.1.1 Concrete

Concrete is the most versatile, available and economic material when compared with all the other structural materials. Concrete is the absolute necessary material around the world, almost all the structures like Buildings, Bridges, Dams and other major structures are constructed using concrete.

Concrete is the material which is the composition of many materials like Cement, Fine aggregates, Coarse aggregate, water and many types of super plasticizers.

The grade of concrete used for this project is M25 where M is the mix and 25 is the characteristic strength of the concrete. This mix is prepared using IS 10262-1982.

Figure 1 : Concrete

2.2 Material Properties

This section gives the information about the physical and chemical properties of the materials used in this study and for the preparation of this M25 grade Concrete

2.2.1 Cement

An Ordinary Portland cement which is the most commonly used cement in all construction projects is used which is manufactured by ACC to comply BIS Specifications (IS 8112-1989 for 43 grade OPC). More than 75% of the mixture is the other form of Calcium silicate which is the main responsible material for the bonding Process of the Concrete. When this calcium silicate gets contact with the water and undergoes a chemical process which leads to the solidification of the cement with the other materials and this Particular process is called “Hydration of Cement”.

There are two different ways in which compounds of cement can react with water:
1) A method in which direct addition of some water molecules the reaction will takes place and this is called real reaction of hydration.
2) The **2nd** method in this the reaction takes place with water is known as Hydrolysis, and the reaction is explained by using the equation:

3CaO.SiO2 + H2O → Ca (OH) 2 + xCaO.ySiO2.aq. (Calcium silicate hydrate)

The reaction of C3S with water continue even after the solution is cause to combine with lime and their after the remaining proportions of lime
Resulted amounts of lime deposited in solid form from a solution to crystals form Ca (OH) 2.

2.2.1.1 Chemical Analysis of Cement

Table 1 : Chemical Composition of Cement

Parameters	**Results Obtained**	**Requirement as per IS 269:2015 (Variety : OPC 43)**
Lime Saturation Factor Cao – 0.7 SO_3/ (2.8 Sio_2 + 1.2 Al_2O_3 + 0.65 Fe_2O_3	0.62	Not greater than 1.02 and not less than 0.66
Ratio of % Alumina to that of Iron Oxide Al_2O_3 / Fe_2O_3	1.69	Not less than 0.66
Insoluble Residue (% by mass)	0.92	Not more than 5.0%
Magnesia (% by mass)	1.78	Not more than 6.0%
Sulphuric Anhydrite (% by mass)	2.38	Not more than 3.5%
Total loss of Ignition (%)	1.56	Not more than 5.0%
Chloride Content (%)	0.007	Not more than 0.1% for general purpose & Not more than 0.05% for pre-stressed Structures

Source: This chemical composition is provided by the Manufacturer of ACC cement Industries.

2.2.1.2 Physical Analysis of Cement

Consistency of Cement

The consistency of cement is determined by using Vicat Apparatus, with the 10mm plunger is fixed to the apparatus. And the water required for the formation of Cement Paste of normal Consistency is **34%**

Figure 2 : Standard Consistency

2.2.2 Aggregates

Aggregates are the composite materials which resist compressive stresses, these are the construction materials which were made by crushed stone, slag, or many recycled materials, and sand also comes under this category.

Aggregates are classified into two types:

- Coarse Aggregates
- Fine Aggregates

Aggregates whose size is greater than 4.75mm are called coarse aggregates and smaller than 4.75 mm are called as Fine aggregates.

Natural sand which is collected nearby is used as fine aggregates and aggregates which are collected nearby quarry is used as coarse aggregates. Crushed stone maximum size of 20mm with shapes like circular, angular, cubical shape were collected.

2.2.2.1 Aggregate Appearance and Aggregate Shape

The appearance of aggregates is the thing that belongs that which changes the workability and strength of Concrete Mix. Surface appearance indicates the degree of irregularity or roughness property of the aggregate. The term roughness define that the aggregate has a large number of irregularity on its surface. And aggregates with smoothie refers that the aggregate has less amount of irregularity. Many research studies have shown that the benefits of using the irregular and regular shape of aggregates requires less water while these are used in concrete. And using aggregates with irregular shape shows higher strength when compared to the aggregates with smooth surface. This is due to these rough surface aggregates has a larger bonding between the Cementous paste and the aggregates.

2.2.2.2 Aggregate Size

The important aspect that is attributed to the version in power of bond between coarser aggregate and cement paste with unique aggregate sizes (Xie et al. 2012

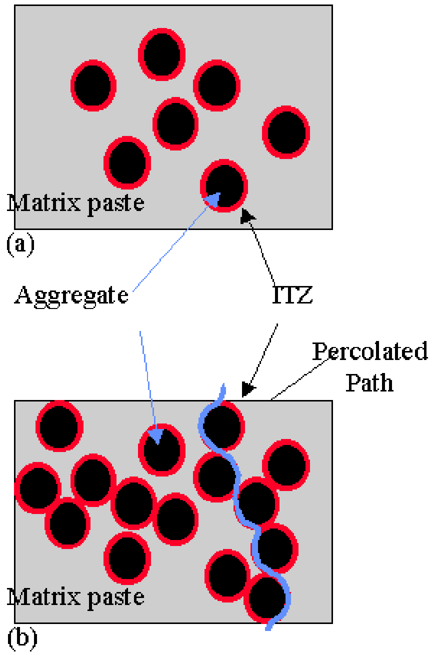


Figure 3 : Schematic of Weak Interfacial Transition Zone Forming Pathway (Shane et al. 2000)

2.3 Tests on Aggregates

2.3.1 Gradation of Coarse aggregate

Gradation of coarse combination is the manner which is used to determine the particle length distribution of granular material. The length distribution is common analysis of the importance to the way the fabric plays in use. Continuously the graded aggregates and gradations with particularly packed densities are selected because to develop the excessive strength of the concrete. (Koehler and Fowler 2006; Young et al. 1998). The Gap between the aggregates will also shows the effect on the Concrete Consistency This gradation of aggregates tests were conformed to IS 383-1970

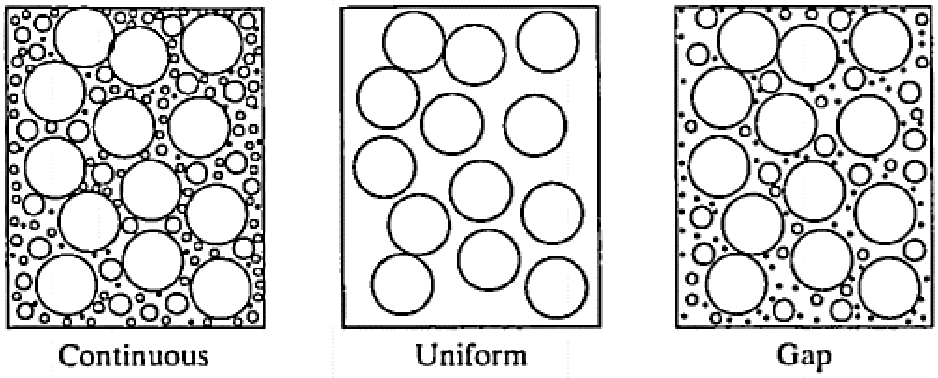


Figure 4 : Package of aggregates

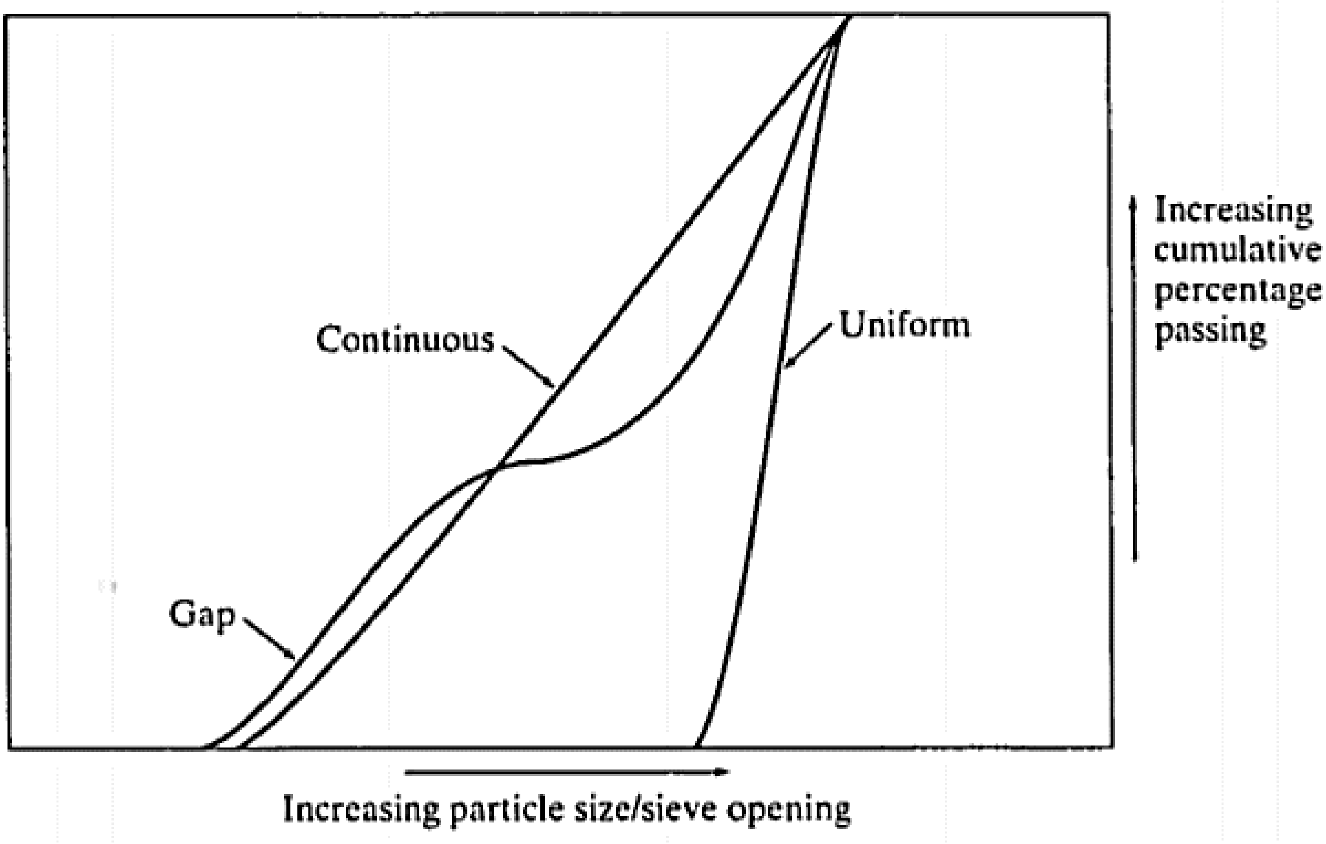


Figure 5 : Representations of Different Aggregate Gradations and Corresponding Gradation Curves (Young et al. 1998)

Figure 6 : Different types of Sieve's

Table 2 : Gradation of Coarse aggregates

IS Sieve	Weight of Aggregate retained(gm)	Weight retained % of total	Weight of % of total Cumulative	% Passing	IS limit
20mm	0	0	0	100	100
16mm	0.190	19	19	81	85-100
12.5mm	0.360	36	55	45	45-60
10mm	0.120	12	67	33	25-33
4.75mm	0.200	20	87	13	0-10
Pan	0.130	13	100	0	0

2.3.2 Specific gravity and Water absorption of Coarse aggregate

Specific gravity of a mixture is described as the ratio of the mass of a given extent of mixture sample to the mass of an identical quantity of water at a positive temperature.

And water absorption influence the aggregates in their behaviour when used for concrete in several important aspects.

The Specific gravity of Coarse aggregate is 2.90, 2.67 for fine aggregate, and water absorption is determined as 0.3%.

Figure 7 : Specific Gravity test

2.4 Aluminium Scrap

Aluminium is a chemical material which is silvery white in colour, soft in texture non-magnetic and belongs to boron group. Aluminium is very resistant to Corrosion and by a special process called anodizing the top surface of the aluminium can be protected by oxides and it can even strengthen and can make more resistant to corrosion.

Aluminium is basically prepared by the Ore bauxite, which is the third most available raw material after Oxygen and Silicon. The raw materials of Aluminium is found combined with other 270 different materials.

Figure 8 : Aluminium Scrap Deposits

3 CHAPTER
LITERATURE REVIEW

3.1 Literature review

Sai Gopi et al. (2017) determined the strength of the Concrete when the coarse aggregates were replaced with certain percentage of Aluminium caps, these are the caps made of aluminium and used mainly in beverage industry as lids of the storage bottles, these caps were collected and the plastic liners which are presented inside the aluminium caps, basically these plastic liners were used to prevent the liquid present inside the container from decaying. After removal of these liners the caps were tampered manually and made into a particular size such that they possess the features of the coarse aggregate. By replacing 10% by weight with coarse aggregate Cubes were casted for determining the Compressive strength for 3, 14, 28 days. It was noted that the increase of Strength was observed after 28 days, and that strength was increased by 12% when compared to nominal Concrete.

U. Elinwa et al. (2004) Determined the placing instances improved as percent of AW improved. It desires greater water for consistency and while added to cement triggers off a pozzolanic response with the extra Ca (OH) 2 produced at some point of the cement hydration .An increasing trend inside the power of AW/OPC concrete as the period of curing increases is indicated. Aluminium waste (AW) have been used as a replacement for cement. Aluminium can be used as a retarding agent and it is a good material for hot weathering conditions. Optimum results were obtained at the replacement of 10%. Aluminium dross is the mixture of free metal and non-metal substances. The possibility for non-waste utilization of aluminium dross and converting it into commercially useful products was investigated by Lucheve *et al.* (2005). Lack of comprehensive information on the characteristics of by-products is a major barrier to increased use of these materials. Valuable aluminium metals and oxides are getting wasted and are not degrading due to less availability of recycling techniques.(Ramesh 1999) This process of strength attainment is expected to continue with curing period until integration of hydration of cement-AW mixture (Elinwa and Mahmood 2002). Ramesh, J. (1999)" Processing and Recreating of Aluminium – Project Fact Sheet" http//www.oit.doe.gov/OF/aluminum. Therefore this research will be helpful for the usage of aluminium waste (AW).

Table 3 : Mix design

Source	DF	SS	MS	F	P	Significant
AW (%)	5	1775.27	355.05	102.95	0.000	Yes
Age	4	5068.81	1267.20	367.44	0.000	Yes
Repl.	2	14.09	7.65	2.12	0.129	No
AW*Age	20	194.49	9.72	2.82	0.001	Yes
Error	60	206.93	3.45			
Total	89	7245.50				

Wernick et al. (1998) Concluded that the shortage of complete records on the characteristics of by using-products is a chief barrier to elevated use of these materials. Manufacturing of concrete products together with light-weight masonry, foamed concrete, and mine and grouts. The aluminium enterprise might be capable of growth its healing of aluminium steel at the same time as lowering strength intake and pollution.

López-Delgado et al. (2012) Said that Aluminium is one of the most recycled metals and has many packages in modern-day society because of its precise mixture of traits: softness, lightness and energy; brilliant electrical and heat conductivity; corrosion resistance; low density and coffee melting factor; and its whole recyclability. It is likewise the 0.33 maximum abundant metallic inside the Earth's crust after silicon and the lightest after magnesium. Close to 50 million tonnes of aluminium steel (from primary and secondary manufacturing) have been consumed in 2006 in packaging, automobiles, aircraft, homes, machinery and hundreds of other products. Transportation makes use of are one of the quickest developing regions for aluminium use.

Table 4 : Aluminium refiners Production

Table 1. Aluminium refiners production, 1997–2007 (× 1000 tonnes). Data from OEA (OEA, 2010).

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
USA[a]	1308.0	1385.0	1505.00	1352.6	1143.4	952.0	884.0	824.0	702.0	634.4	772.3
Japan	958.0	857.4	858.1	909.8	913.1	957.8	986.6	1014.7	1038.4	1067.4	1117.7
Germany	432.5	459.2	515.1	572.3	622.9[b]	666.1	680.4	703.8	718.3	795.7	857.6
Italy	442.9	502.6	501.8	596.9	578.3	591.3	594.0	619.0	654.1	666.0	703.3
France	241.7	246.3	253.3	270.0	263.9	261.9	249.7	239.0	243.0	243.6[c]	
United Kingdom	244.5	274.8	285.3	237.7	248.6	207.2	206.5	186.7	134.0	204.0	
Spain	173.2	210.0	224.0	240.5	221.7	242.6	261.0	290.0	310.2	335.2	345.2
Austria	118.8	128.4	143.0	158.1	149.9	151.1	100.8	110.1	112.3	111.8	116.8
Finland	38.2	40.5	43.2	43.4	34.0	28.0	23.6	24.7	20.2	21.7	22.9
Sweden	25.0	27.0	28.0	30.0	30.0	32.0	30.5	39.0	41.7	47.1	46.1

[a]Since 2002 new calculation basis – source US Geological Survey.
[b]Revised.
[c]Estimated.

Ozerkan et al. (2014) examined that Dross of Aluminium having high alumina can be used as raw material in cement manufacturing industry. The dross of Aluminium can be used in concrete such that the corrosion resistance property of the concrete increases and it also seen that the concrete containing Dross of aluminium shows acceleration of Setting of the concrete.

When this Dross of Aluminium been processed in Clinkers to a define size less than 700µm these tiny particles can be used as fillers in the Concrete. And the by-products of these dross can be used as aluminates of Cement.

The study states that the dross which is manufactured by refractory method and when these materials used in concrete up to 15% replacement of Cement shows the increase of mechanical strength of the concrete. With the increasing of Dross percentage in the Concrete the Compressive and Permeable properties of the Concrete gets decreases because a much amount of air gets entrapped and it cause this impact on the concrete.

Table 5 : Compressive Strength results

Mix ID	W/CM	Compressive Strength (MPa)					
		3 Days		7 Days		28 Days	
		Mean	COV (%)	Mean	COV (%)	Mean	COV (%)
1	0.46	23.15	39.95	24.43	20.55	39.84	2.36
2	0.45	7.42	8.60	10.15	19.89	11.73	7.34
3	0.46	5.55	13.22	8.86	3.00	11.17	23.69
4	0.50	1.94	2.24	2.74	16.85	6.74	15.90
5	0.53	-	-	-	-	-	-

Mailar et al. (2016) Concluded that Aluminium waste shows the effect on the setting time of the concrete. It slows down the setting time of the concrete. Water Cement ratio between 0.40 gives optimum results when compared to water cement ratio of 0.45. Mortar produced by 20 % replacement of the aluminium waste shows retarding of concrete for 30 minutes in initial setting time. The flexural strength has increased when the material was replaced by 20% due to distribution of hydration process. The durability of concrete is increased. The water absorption of concrete is less when compared to nominal concrete. By replacement of these materials in the concrete this type of concrete will be economical and ecological beneficial in the field of construction.

Table 6 : Compression test Results

Mix designation	7th day compressive strength (MPa)	Std. dev (σ)	14th day compressive strength (MPa)	Std. dev (σ)	28th day compressive strength (MPa)	Std. dev (σ)
M1	18.2	0.23	24.85	0.36	33.3	0.57
M2	14.45	0.41	23.4	0.48	34.8	0.45
M3	13.15	0.35	26.5	0.52	37.25	0.48
M4	12.2	0.52	23.9	0.44	32.2	0.51
M5	19.35	0.39	27.75	0.38	35.35	0.53
M6	15.3	0.47	25.8	0.49	36.65	0.49
M7	14.85	0.49	27.2	0.47	38.95	0.56
M8	13.25	0.28	24.15	0.51	33.85	0.55

Table 7 : Tensile test results

Split tensile strength results of aluminium dross concrete at the age of 28 days.

Mix designation	M1	M2	M3	M4	M5	M6	M7	M8
28th day tensile strength (MPa)	4.2	4.3	4.75	3.8	4.4	4.6	4.95	4.05
Std. dev (σ)	0.28	0.32	0.27	0.35	0.33	0.29	0.39	0.37

B. Lucheva et. Al analysed the secondary aluminium dross which is obtained from primary aluminium dross which is salt free processed in a rotary DC electrical arc Furnace, for this they had collected 50g of this sample and it was melted in mould which is full of graphite at an temperature of 800 degrees, and this temperature is maintained in an induction furnace.

Table 8 : The chemical Composition of Aluminium Dross

Mg	Al	Si	Mn	Fe	Cu	Zn
0,00	90,28	5,93	0,34	1,10	1,82	0,53

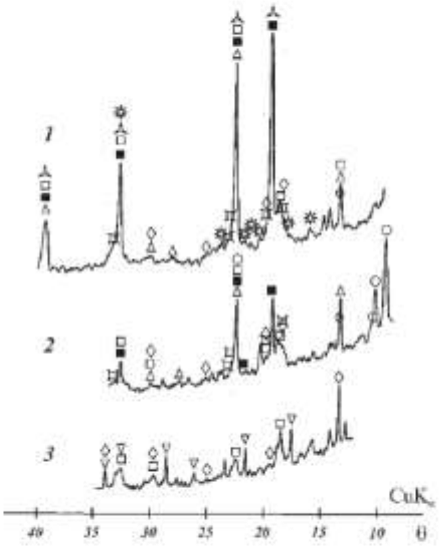


Figure 9 : X-ray analysis of: 1 – secondary aluminium dross; 2 – NMP, obtained from alkaline leaching; 3 – NMP, calcined at 1000 o

4 CHAPTER
DEVELOPMENT OF CONCRETE MIXTURE DESIGN

To develop the concrete mix designs for this research project M25 grade of concrete is selected and following the specifications specified in IS 10262-1982.

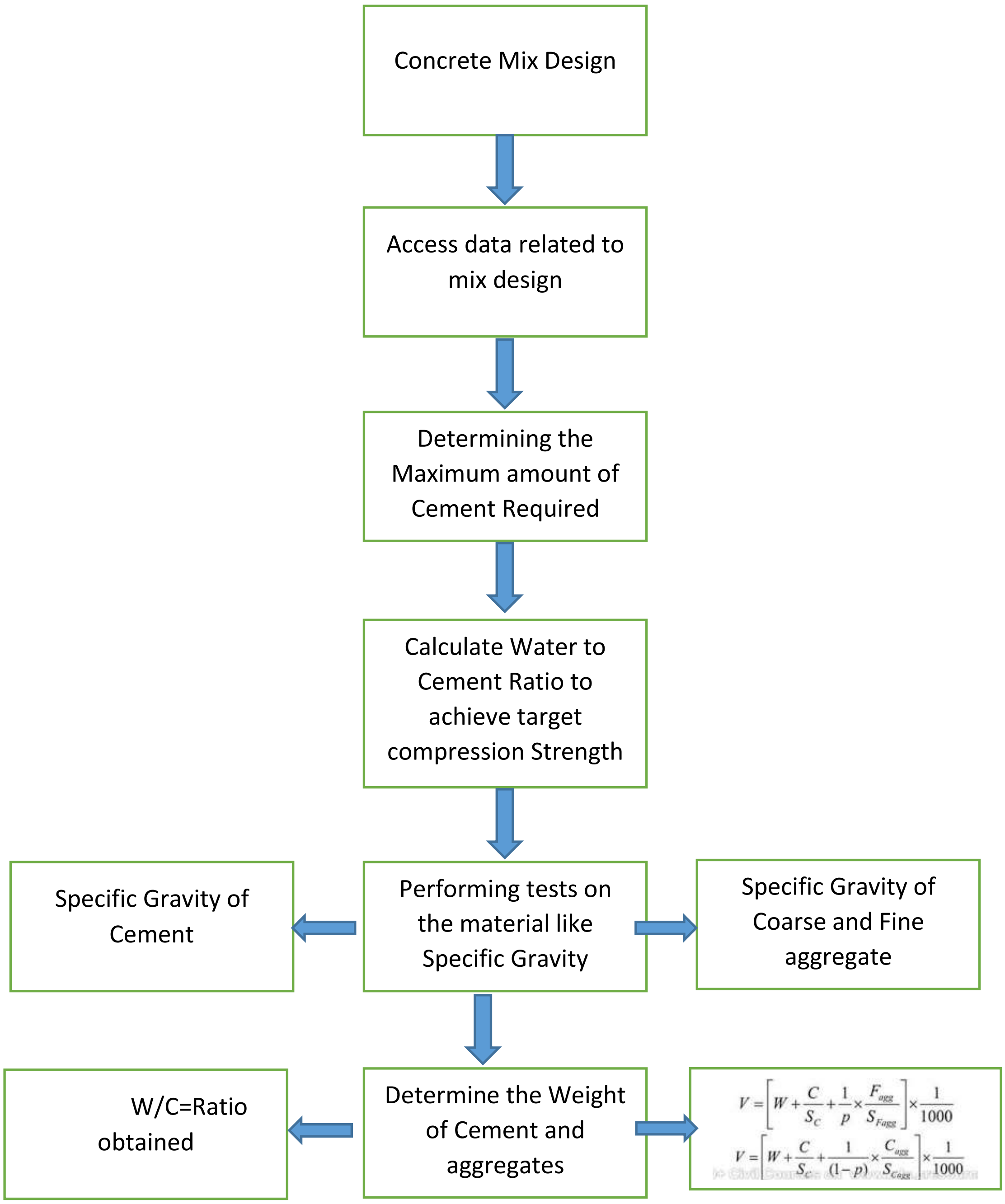


Figure 10 : Flow Chart for Mix Design of Concrete

4.1 Materials

Materials used for this study are Ordinary Portland Cement, River Sand, Granite Aggregate, Aluminium Caps, Tap water. Aluminium Caps are used for partial replacement of coarse aggregate.

4.1.1 Aggregates

Aggregates from Hoshiarpur were used for this project, for both the fine and coarse aggregates, mix batch of aggregates were selected and tests were performed.

Figure 11 : Fine and Coarse aggregates

Table 9 : Properties of Coarse aggregates

Sr. No	Properties	Values obtained Experimentally
1	Maximum size(mm)	20
2	Specific Gravity	2.66
3	Total water absorption (%)	1.76
4	Fineness modulus	7.68

Table 10 : Properties of Fine aggregates

Sr. No	Properties	Values obtained Experimentally
1	Maximum size(mm)	4.75
2	Specific Gravity	2.53
3	Total water absorption (%)	1.76
4	Fineness modulus	7.68

4.1.2 Cement

Cement of OPC 43 of ACC manufacturer is selected.

Figure 12 : ACC Cement bag

The physical Property tests were conducted on this cement and the properties were discussed below table

Table 11 : Physical properties of Cement

S.No	Characterises	Equipment used	Values obtained Experimentally
1	Specific Gravity	Le Chatelier Flask	3.12
2	Standard Consistency	Picard’s	31
3	Initial setting time (minutes)	Picard’s	48
4	Final Setting time	Picard’s	240

4.1.3 Water Cement Ratio

The water ratio is obtained from the shown graphs

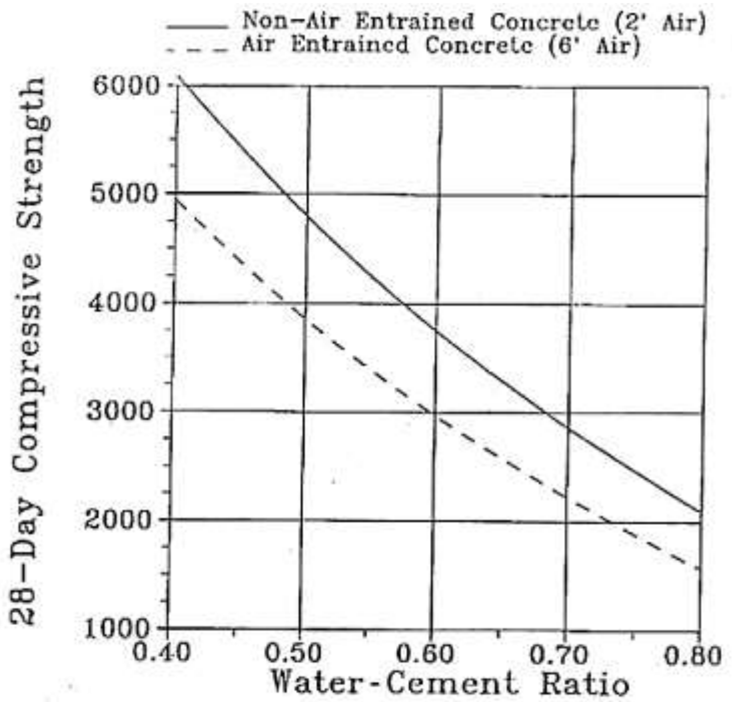


Figure 13 : Graph showing Water Cement Ratio

The particular water Cement ratio is been using this graphs which has Water- Cement ratio along X axis and 28 days Compressive Strength along Y axis. First we will calculate the required strength and will see the particular value which lie along Y axis and the same the water cement ratio will be seen along X axis for that particular Compression Strength.

And for this Research the water cement ration is taken as 0.43.

4.1.4 Aluminium Scrap

The main motive of this research is to calculate the strength of the concrete when the coarse aggregates in the concrete is replaced by aluminium scrap, as a replacement for coarse aggregate that to with aluminium scrap, aluminium caps which were used in the beverage industry were collected from nearby collection centre and there were used as replacement of 15% and 20% for Coarse aggregate. All the caps were tampered and made into size which has a compatibility of coarse aggregates.

4.2 Preparation of Mix design

1. Parameters of Mix Design M-25

i	Grade Designation	=	M-25
ii	Type of cement	=	O.P.C- 43 grade
iii	Brand of cement	=	A.C.C
iv	Fine Aggregate	=	Zone IV

2. Specific Gravity

i.	Cement	=	3.15
ii.	Fine aggregate	=	2.61
iii.	Coarse aggregate (20mm)	=	2.66

Minimum cement used (As per IS code) = 400kg/m^3

Maximum Water Cement ratio (As per Graph) =0.43

Now increasing the Cement, Water by 2.5% for trail mix

Cement =400*1.025= 410 kg/m^3

Water = 410*0.43= 177kg/m^3

Fine aggregate and coarse aggregate quantity is calculated by using this formula

$$V = \left[W + \frac{C}{S_C} + \frac{1}{p} \times \frac{F_{agg}}{S_{Fagg}} \right] \times \frac{1}{1000}$$

$$V = \left[W + \frac{C}{S_C} + \frac{1}{(1-p)} \times \frac{C_{agg}}{S_{Cagg}} \right] \times \frac{1}{1000}$$

Weight of Fine aggregates = 419 kg/m^3

Weight of Coarse Aggregate = 1344 kg/m^3

Coarse aggregate 20mm = 807 kg/m^3

Coarse aggregate 10mm = 537 kg/m^3

Mix Proportion

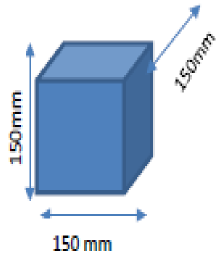
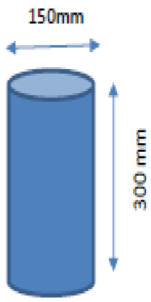
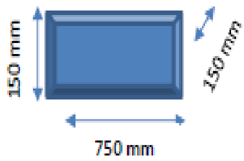
Table 12 : Mix Proportions

Unit of Batch	Cement(Kg)	Fine Aggregate (Kg)	Coarse Aggregate (Kg)		Water
			10mm	20mm	
Cubic Meter Content	410	419	807	537	177
Ratio of Mix	1	1.02	1.96	1.30	0.43

Table 13 : Quantity of Materials used for 1m3

S.No	Items	0%	15%	20%
1	**Cement**	410kg	410kg	410kg
2	**Water**	177kg	177kg	177kg
3	**Fine Aggregates**	419kg	419kg	419kg
4	**Coarse Aggregate**	1344kg	1142.4kg	1075.2kg
5	**Aluminium Scrap**	0kg	201.6kg	268.8kg

Table 14 : Mix design for this research

Name of Test	Measurements(m)				No's		Mix Design for(M25) 1 m3				
Compression Test	b	d	h	Volume(m3)	7 Days		Cement	F.A	C.A	A.C	Water
	0.15	0.15	0.15	0.003375	Parent	3	412	419	1344	0	177
	3% Wastage			0.00347625	15%	3	412	419	1142.4	201.6	177
					20%	3	412	419	1075.2	268.8	177
					14 Days						
					Parent	3	412	419	1344	0	177
					15%	3	412	419	1142.4	201.6	177
					20%	3	412	419	1075.2	268.8	177
					28 Days						
					Parent	3	412	419	1344	0	177
					15%	3	412	419	1142.4	201.6	177
					20%	3	412	419	1075.2	268.8	177
					Total	27					
	Total volume of Concrete					0.093859	38.66981	39.32682	111.4291	14.71705	16.613
Split tensile Test					7 Days		Cement	F.A	C.A	A.C	Water
	0.15	0	0.3	0.00529875	Parent	3	412	419	1344	0	177
	3% Wastage			0.005457713	15%	3	412	419	1142.4	201.6	177
					20%	3	412	419	1075.2	268.8	177
					14 Days						
					Parent	3					
					15%	3					
					20%	3					
					28 Days						
					Parent	3					
					15%	3					
					20%	3					
					Total	27					
	Total volume of Concrete					0.147358	60.71159	61.7431	174.9437	23.10577	26.08241
Flexural Test					7 Days		Cement	F.A	C.A	A.C	Water
	0.5	0.1	0.1	0.005	Parent	3	412	419	1344	0	177
	3% Wastage			0.00515	15%	3	412	419	1142.4	201.6	177
					20%	3	412	419	1075.2	268.8	177
					14 Days						
					Parent	3	412	419	1344	0	177
					15%	3	412	419	1142.4	201.6	177
					20%	3	412	419	1075.2	268.8	177
					28 Days						
					Parent	3	412	419	1344	0	177
					15%	3	412	419	1142.4	201.6	177
					20%	3	412	419	1075.2	268.8	177
					Total	27					
	Total volume of Concrete					0.13905	57.2886	58.26195	165.0802	21.80304	24.61185
	Total Quantities Required in (kg)					0.380267	156.67	159.3319	451.453	59.62586	67.30726
All the quantities are in Kg											
A.C represents Aluminium Caps				F.A represents Fine Aggergate				C.A represents Coarse Aggregate			

4.3 Casting, Moulding and Demoulding of the Specimens

This process generally occurs in dealing with the 4-step process:

4.3.1 Preparation of Cubes

After the sample, has been mixed, the moulds are previously cleaned thoroughly with the lubricating agent. Immediately the cube moulds are filled with the sample material and the compaction is done with the help of tamping rod. So, that any trapped air voids left in the mould comes out otherwise these might reduce the strength of the concrete cube. Care must be taken while the compaction of the cubes of concrete. Because over compaction might cause the segregation of the aggregates and the replaced caps along with the cement mix. The former condition can reduce the final compressive strength of the concrete. The size of the mould (cubes) taken is about "150*150*150 mm.

Figure 14 : Preparation of Moulds

4.3.2 Compacting with compacting Bar and Vibration

Three layers of the concrete mix is provided for the filling of cube of equal depth. Compacting is done with the help of tamping rod after each layer of 380mm long and weighing about 1.5 kg.

During the compaction of each layer, the strokes of the tamping rod should be distributed evenly over the surface of concrete and each layer is compacted to its full required depth. For the better compaction of the mix in the mould 25 strokes are provided. After the 3 layers are completed, the end (top) layer is levelled to the surface of the cube and placed on the mechanical vibrator form the uniform distribution of the concrete mix. To attain a good texture over the top layer, proper finishing is done. Vibration process should be ceased as soon as the surface of the concrete mix in the cube appears smooth and all the entrapped air appears on the surface of the cube. Once the specimen has been compacted, it should not be left standing on the same bench as another specimen that is being compacted. If this is done, some vibration will be must be passed on to the first specimen and it will be more compacted than the other.

Figure 15 : Compacting of Concrete using Vibratory Table and Tamping Rod

4.3.3 Demoulding the Test Cubes.

Figure 16 : De Moulding of Cubes

The demoulding of the cubes moulded has done after 24-30 hrs. so as to attain a required compressive strength. If in any of the mould has not attained the sufficient strength for the process of demoulding, furtherly more 12hrs are delayed for this former process. Care must be taken while removing the concrete from the mould apart otherwise cracks might occur during this process which might lead to the strength reducing of the concrete cube. After demoulding every cube, each cube is marked with a legible identification on the top or bottom using a waterproof crayon or some phosphorus paint. The mould must be cleaned thoroughly ensuring that grease or dirt should not be collected between the faces of the flanges otherwise gapes between the cube plates might occur resulting in an irregular shape of the concrete cubes.

4.3.4 Curing

Cubes must be cured properly before they are tested. Only the cubes are to be used for their respective testing or else they are must be placed in the water curing tank or in a moist room. The curing temperature of the water in the curing tank should be maintained (27-30) C. If the curing is done in a, moist room the relative humidity should be maintained at no less than 95%. Curing must be continued as long as possible till the time of testing.

Figure 17 : Curing for 24 hours

Figure 18 : Curing in Curing Tank

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