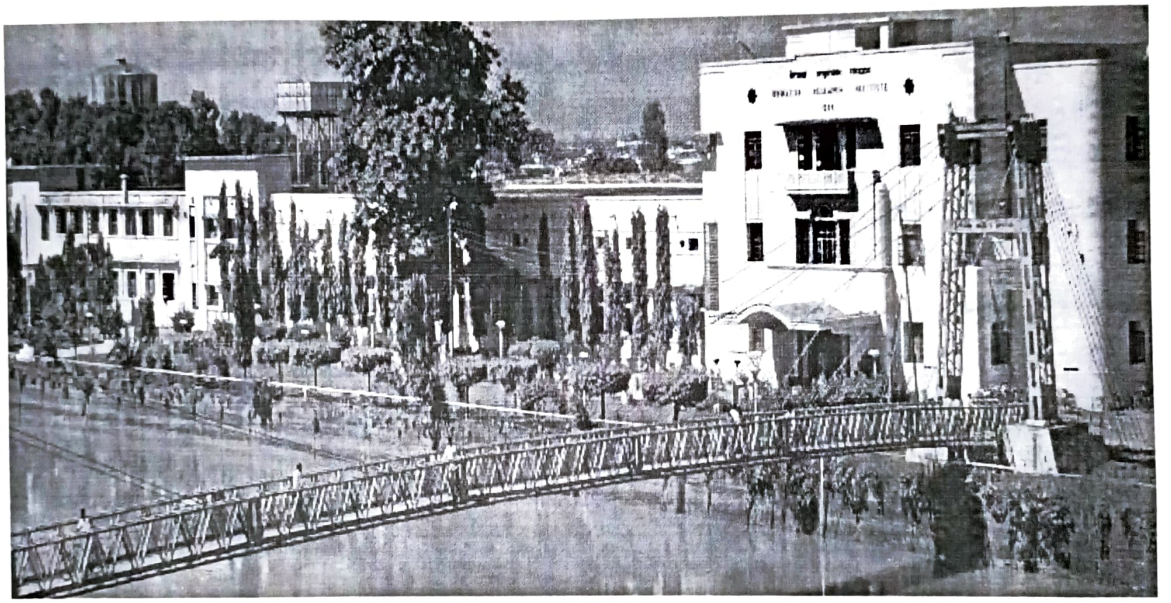
अपार शक्तेः स्त्रोतः गंगेयम्

Technical Memorandum No. 93 T.R. (MT_1 - 129)

PHYSICAL AND CHEMICAL TESTS OF AGGREGTAE (COARSE & FINE), CEMENT, FLY ASH, AND CHEMICAL ADMIXTURE FOR CONVENTIONAL CONCRETE MIX DESIGN OF JAMRANI DAM



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FEBRUARY 2023

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Test Report
T.M NO. 93 - TR {MT_1-129}

Type of Publication 'C'

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TITLE OF THE REPORT

Design of Concrete Mix for Construction of Jamrani Dam, at Gola River, Haldwani, Distt. Nainital, Uttarakhand.

Month of Issue	February 2023
No. of Pages	11
No. of Table	12
No. of Annexure	-

PROJERCT SPONSORING AUTHORITY

Executive Engineer, Jamrani Dam Construction Division-2, Damuadhunga, Haldwani, Nainital.

SPONSOR'S REFERENCE
Letter No: 10/PM -2/P.I.U.J/ Design Mix, dated 26.03.2022.

CODE OF ESTIMATE :6156

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SYNOPSIS:

Conventional concrete mix design study of Jamrani dam multipurpose drinking water project was carried out in laboratory as per IS 10262:2019 and IS 456:2000 (Reaffirmed 2021). In order to check the physical and chemical properties of all the ingredients used in concrete mix design viz. cement, fly ash, chemical admixture coarse aggregate and fine aggregate were tested in accordance with Indian Standards 4031:1999 (Reaffirmed – 2018), 4032:1985 (Reaffirmed – 2019), 6925:1973 (Reaffirmed - 2018), 9103:1999 (Reaffirmed - 2018), and 2386:1963 (Reaffirmed - 2021) respectively, prior to mix design of concrete. Test results of the ingredients are shown in this report in Table 1 – 12.

Checked & Submitted by

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28/2/2023

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28/2/2023

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Table - 1

Physical and Chemical Properties of Admixture.

Sl. No.	Admixture	Particulars	Results	Conformity As per IS 9103-1999 (Reaffirmed 2018)
1	"BROCRETE S 888" Water reducer (FAIR MATE)	Dry material Content (%)	16.0	Within 3 % of the value stated by the manufacturer i.e., 15
2		Relative Density	1.05	Within 0.02 % of the value stated by the manufacturer i.e., 1.070
3		pH Value	7.37	Within ±1 of the value stated by Manufacturer stated value, i.e., 6 -8.5
4		Ash Content (%)	4.75	-
5		Chloride ion content (%)	0.007	Within 10 % of the value or within 0.2 % whichever is greater as stated by the manufacturer i.e., .01

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Table - 2

Physical Properties of Cement

Sl. No.	Name of Test Performed	Unit	Result	Conformity Criteria as per IS: 269 -2015 (Reaffirmed - 2020)
1	Standard Consistency	%	28.5	--
2.	Fineness (Blaine's air Permeability method)	m^2/kg	285	Not less than 225 m^2/kg
3.	Soundness (Le- Chatelier method)	mm	1.0	Not more than 10 mm
4.	Specific Gravity	-	3.05	--
5.	Initial Setting Time	minute	110	Not less than 30 minutes
6.	Final Setting Time	minute	205	Not More than 600 minutes
7.	Compressive (Strength 72±1 hour)	MPa	26.0	Min. 23 MPa
8.	Compressive Strength (168±2 hour)	MPa	35.6	Min. 33 MPa
9.	Compressive Strength (672±4 hour)	MPa	44.7	Min. 43 MPa.
10.	Heat of hydration (7 Days)	KJ/kg	195	--
11.	Heat of hydration (28 Days)	KJ/kg	453	--

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Table – 3

Chemical Analysis of Cement

Sl. No.	Name of the test	Result	Conformity Criteria as per IS: 269 -2015 (Reaffirmed - 2020)
1	Insoluble Residue (%)	4.32	< 5
2	Calcium Oxide (CaO) (%)	49.82	-
3	Silica (SiO_2) (%)	16.97	-
4	Aluminum Oxide (Al_2O_3) (%)	9.22	-
5	Ferric Oxide (Fe_2O_3) (%)	11.21	-
6	Magnesia as Oxide (%)	1.19	< 6
7	Chloride Content (%)	0.0089	< 0.1
8	Sulphuric Anhydride (SO3) (%)	2.14	< 3.5
9	Alkali Content (%)	0.36	< 1.5
10	Ratio of percentage of Lime to percentages of silica, Alumina, and Iron Oxide when calculated by the formula. (%) $\frac{CaO - 0.7\ SO_3}{2.8\ Sio_2 + 1.2\ Al_2O_3 + 0.65\ Fe_2O_3}$	0.73	0.66 to 1.02
11	Ratio of percentage of alumina (Al_2O_3) to that of iron oxide (Fe_2O_3) (%)	0.82	> 0.66
12	Loss on Ignition (%)	3.72	< 5

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TABLE - 4

Physical Properties of Fly Ash

Sl. No.	Name of Test	Unit	Test Result	Specification as per IS: 3812 (Part-1) -2013
1.	Specific Gravity	--	2.25	--
2.	Fineness			
	By Blaine's air Permeability method	m²/kg	328	>320
	Wet Sieving on 45μ	%	25.0	< 34
3.	Lime Reactivity	MPa	5.8	> 4.5
4.	Compressive Strength	MPa		
(a)	7 Days		16.2	-
(b)	28 Days		25.2	> 22.9

Table - 5

Chemical Analysis of Fly Ash

Sl. No.	Name of the test	Result (%)	Conformity as per IS Code IS:3812 (Part 1): 2013
1	Loss on Ignition	2.18	< 5
2	Silicon dioxide (SiO_2)	69.61	> 35
3	Aluminum Oxide (Al_2O_3)	18.26	-
4	Iron Oxide (Fe_2O_3)	3.99	-
5	Silicon dioxide (SiO_2) + Aluminum Oxide (Al_2O_3) + Iron Oxide (Fe_2O_3)	91.86	>70
6	Calcium Oxide (CaO)	2.07	-
7	Magnesium Oxide (MgO)	2.16	< 5
8	Sulphuric Anhydride (SO3)	0.45	< 3

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Table -6

Sieve Analysis of Fine Aggregate

Type of Aggregate: - Natural

❖ **Sieve Analysis**

Sl. No.	IS Sieve (mm)	Percentage Retained on IS Sieve (%)	Percentage Passing (%)	Conformity Criteria for Grading Zone II as per IS: 383-2016
1	10	0.0	100.0	100
2	4.75	0.0	100.0	90-100
3	2.36	10.2	89.8	75-100
4	1.18	21.8	78.2	55-90
5	0.60	45.6	54.4	35-59
6	0.30	71.0	29.0	08-30
7	0.15	92.0	8.2	0-10
8	**Fineness Modulus**	2.41		

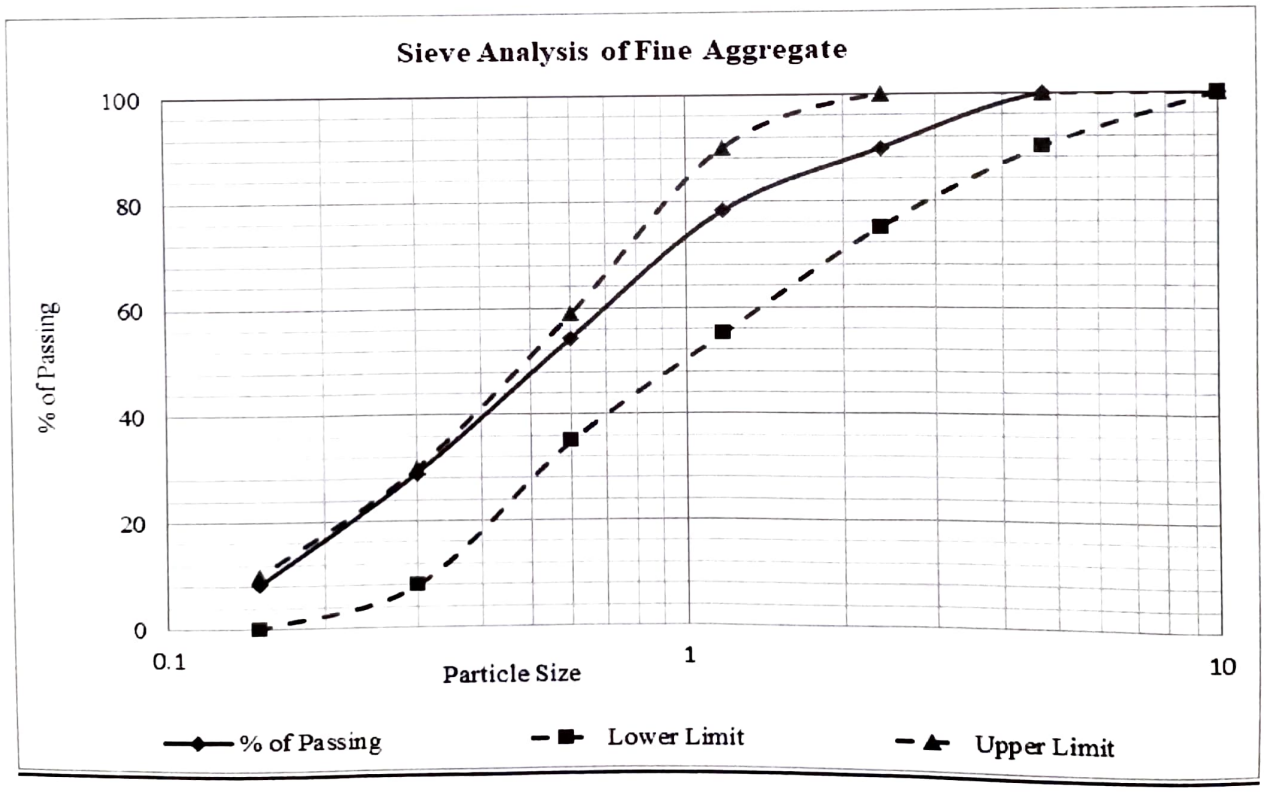

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TABLE – 7

Sieve Analysis for Coarse Aggregate of 80 mm (Single Sized)

Type of aggregate: - Crushed

Sl. No	Sieve Size (mm)	Percentage Passing (%)	Conformity Criteria as per IS 383:2016 Percentage Passing for single – sized Aggregate of Nominal Size
1	80	100	90 - 100
2	40	**50.3***	0 - 10

***Value is not as per Indian Standard.**

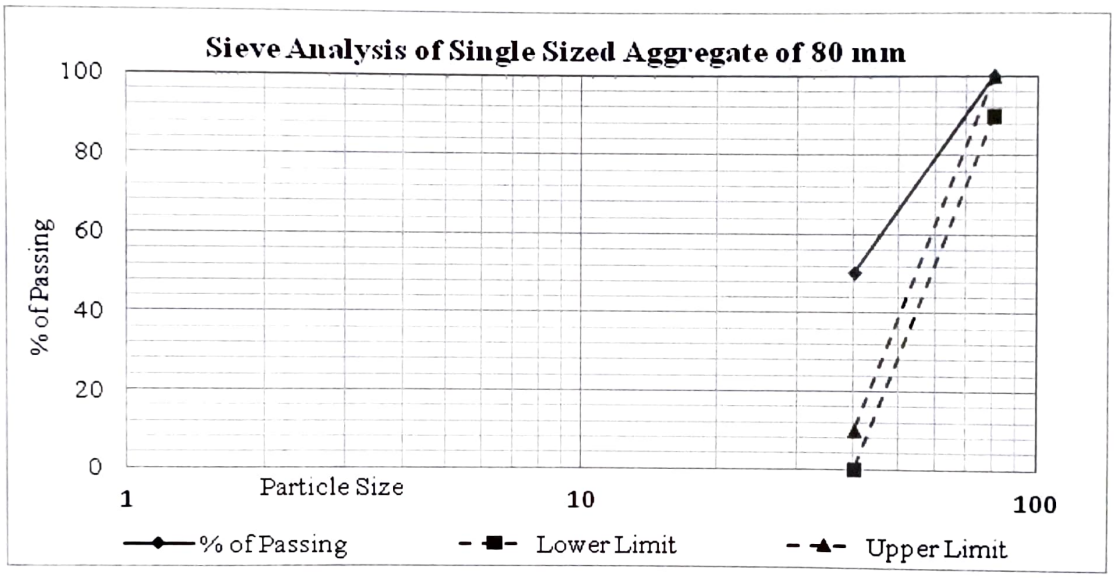

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Table - 8

Sieve Analysis for Coarse Aggregate of 40 mm (Single Sized)

Type of aggregate: - Crushed

Sl. No	Sieve Size (mm)	Percentage Passing (%)	Conformity Criteria as per IS 383:2016 Percentage Passing for single – sized Aggregate of Nominal Size
1	63	100.0	100
2	40	95.6	85 - 100
3	20	2.2	0 - 20
4	10	0.0	0 - 5

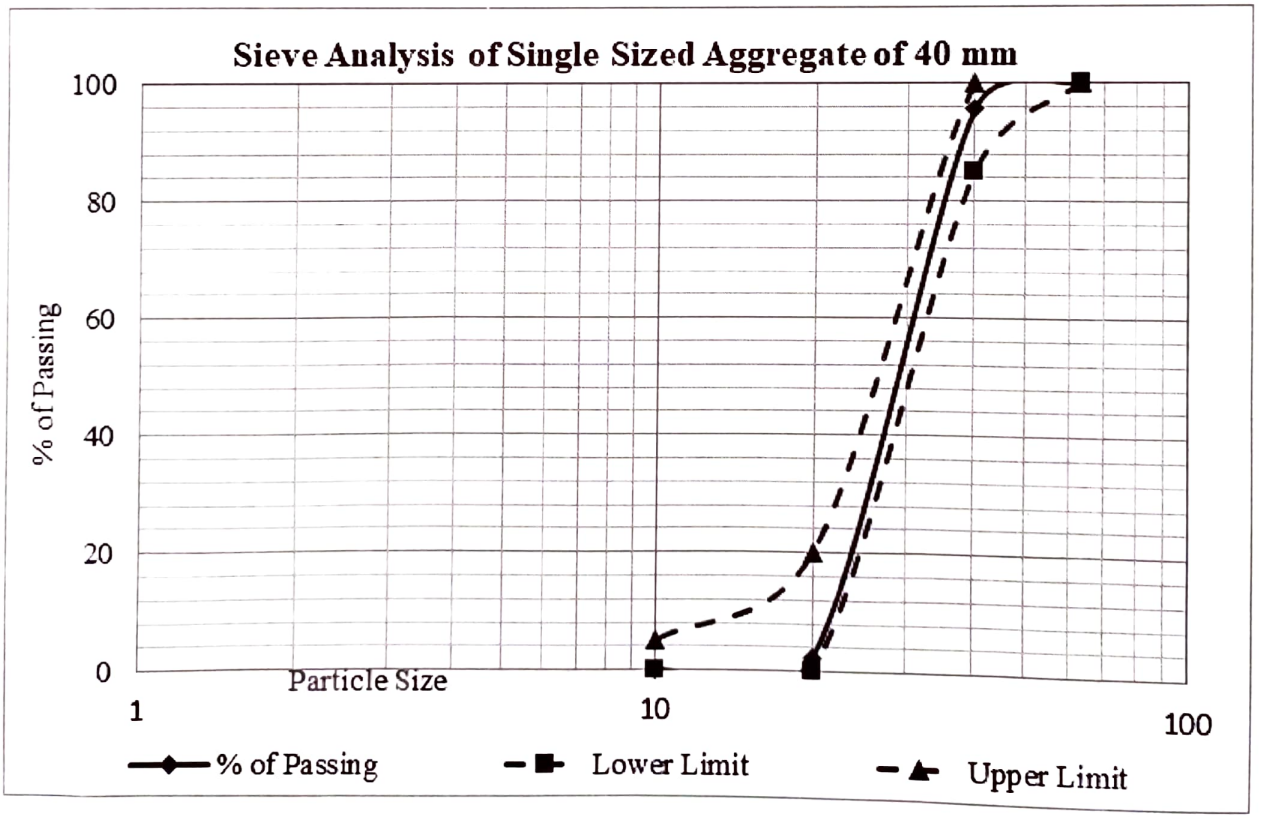

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Table - 9

Sieve Analysis for Coarse Aggregate of 20 mm (Single Sized)

Type of aggregate: - Crushed

Sl. No	Sieve Size (mm)	Percentage Passing (%)	Conformity Criteria as per IS 383:2016 Percentage Passing for single – sized Aggregate of Nominal Size
1	40	100.0	100
2	20	87.9	85 - 100
3	10	22.8	0 - 20
4	4.75	0.0	0 - 5

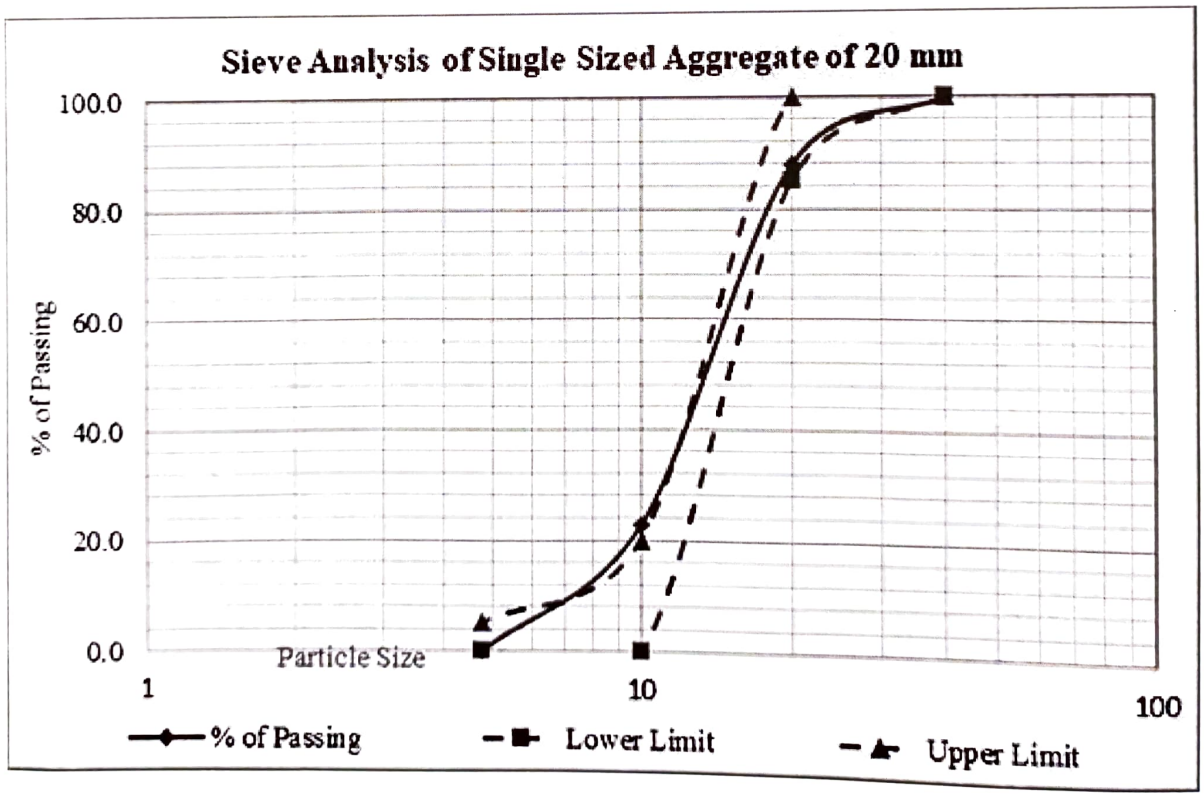

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Table – 10

Sieve Analysis for Coarse Aggregate of 10 mm (Single Sized)

Type of aggregate: - Crushed

Sl. No	Sieve Size (mm)	Percentage Passing (%)	Conformity Criteria as per IS 383:2016 Percentage Passing for single – sized Aggregate of Nominal Size
1	12.5	**77.9***	100
2	10	**48.9***	85 - 100
3	4.75	3.2	0 - 20
4	2.36	0.0	0 - 5

***Value is not as per Indian Standard.**

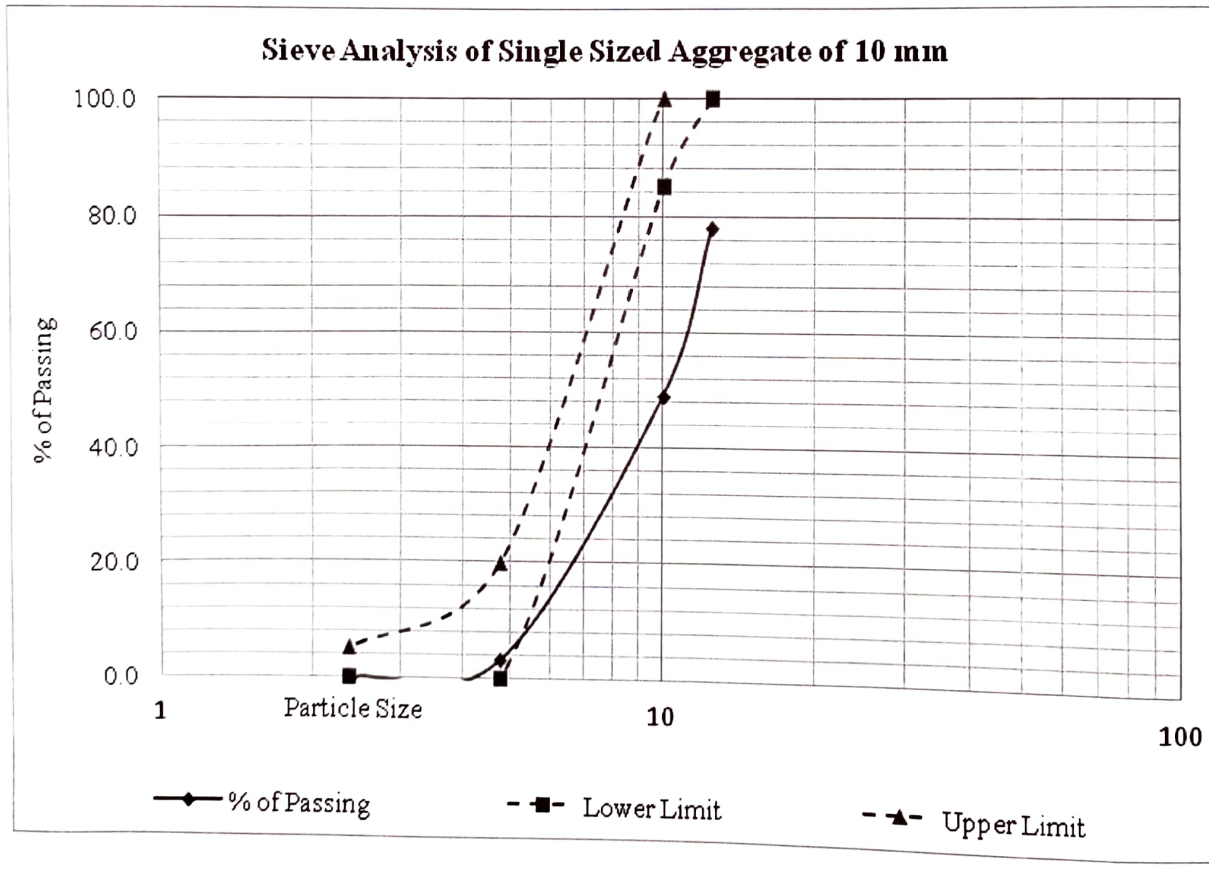

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Table - 11
Physical Properties of Coarse Aggregate

Sl. No	Name of Test	Aggregate Type	Result	Conformity Criteria as per IS 383: 2016
1	Material Finer than 75 micron	Fine Aggregate	1.80	Max 3.0%
2	Water Absorption	Fine Aggregate	1.25	-
3	Combined Flakiness & Elongation (%)	40 mm	**46.7***	< 40% for uncrushed or crushed aggregate. However, the Engineer-in-Charge at his discretion may relax the limit keeping in view the requirement, and availability of aggregates and performance based on tests on concrete.
4		20 mm	25.6	
5		10 mm	**45.9***	
6	Clay Lumps (%)	40 mm	0.2	< 1.00 %
7		20 mm	0.7	
8		10 mm	0.9	
9	Specific Gravity	40 mm	2.93	2.1-3.2
10		20 mm	2.45	
11		10 mm	2.45	
12		Fine aggregate	2.64	
13	Bulk Density (Loose) (Kg/m³)	40 mm	1.410	-
14		20 mm	1.430	
15		10 mm	1.350	
16		Fine aggregate	1.680	
17	Bulk Density (Compacted) (Kg/m³)	40 mm	1.540	-
18		20 mm	1.540	
19		10 mm	1.440	
20		Fine aggregate	1.770	

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21	Void (%)	40 mm	52.0	-
22		20 mm	42.0	-
23		10 mm	45.0	-
24		Fine aggregate	47.0	
25	Impact Value (%)	12.5-10mm	16.0	<30%
26	Crushing Value (%)	12.5-10 mm	18.2	< 30%
27	Abrasion value (%)	40 mm	21.9	< 30%
		20 mm	20.6	
		10 mm	22.6	

Table - 12

Alkali Aggregate Reactivity of Aggregate

Sl. No.	Type of Sample	Unit	Results		Conformity as per IS 2386:1963 (Part -7) Reaffirmed 2021
			Soluble Silica	Reduction in Alkalinity	
1	Coarse Aggregate	Millimoles/ Litre	15	8	Innocuous Aggregate
2	Fine Aggregate	Millimoles/ Litre	2	36	Innocuous Aggregate

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