Comparison of Compressive Strength Among 5 Different Brands of Cement Used in Construction of Road in Nepal

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Abstract:
In Nepal, road transportation is essential but often hindered by the rapid deterioration of bituminous roads during the rainy season. To address this issue, this research focused on evaluating the strength of M20 grade concrete from five different Ordinary Portland Cement (OPC-43) brands available in Nepal: Brands A, B, C, D, and E. A series of comprehensive tests such as compressive strength tests, sieve analysis, Los Angeles Abrasion tests and Aggregate Impact Value test. The compressive strength tests revealed significant variations among the cement brands. For instance, at 7 days, the highest compressive strength observed was 28.08 N/mm² from Brand A, while the lowest was 13.10 N/mm² from Brand C. At 28 days, the highest strength recorded was 33.63 N/mm² from Brand D, and the lowest was 19.41 N/mm² from Brand C. These discrepancies highlight the need for better quality control and accurate labeling. By analyzing the performance of each cement brand, we aim to help contractors and project managers choose the best materials for building more durable reinforced concrete roads. Our findings suggest that reinforced concrete roads could be a more reliable and low-maintenance solution, especially suited for Nepal's challenging terrain and climate. We recommend further research to explore a wider range of cement brands and improve testing standards to ensure better road construction practices in Nepal.

Keywords: Nepal, road transportation, bituminous roads, reinforced concrete roads, compressive strength, M20 grade concrete, cement market, brand strength discrepancies, compressive strength analysis, sieve analysis, Los Angeles abrasion tests, Aggregate Impact Value tests, standardized labeling, quality control, Transparency in cement manufacturing, road infrastructure.

1. Introduction

Nepal, a landlocked country nestled amidst hills and mountains, predominantly relies on road transportation due to its accessibility and cost-effectiveness. Road transportation remains the preferred choice for 90% of Nepalese citizens at present hence, it plays a pivotal role in facilitating developmental activities, trade, and the movement of people and goods across various location. Typically, bituminous roads are favored in Nepal due to their quick and easy construction process. Nevertheless, bituminous roads at damp condition throughout the year which deteriorates in short life span, and also for the roads which become riddled with potholes, waterlogging, cracking, and other issues reinforced concrete roads emerge as a viable solution.

Reinforced concrete roads exhibit exceptional durability, capable of withstanding high tensile and compressive stresses with a more lifespan. They comprise concrete and reinforcing material in which concrete is composed of cement, coarse aggregate, fine aggregate, and water mixed to achieve the necessary strength. Ordinary Portland Cement (OPC) is one of the most commonly used material in road construction project. It is manufactured by crushing the clinker and mixed with 2 to 3 percent of gypsum. Chemical composition of OPC cement consists of tricalcium silicate ($3CaO \cdot SiO_2$), dicalcium silicate ($2CaO \cdot SiO_2$), tricalcium aluminate ($3CaO \cdot Al_2O_3$), and tetra-calcium aluminoferrite ($4CaO \cdot Al_2O_3.Fe_2O_3$). Generally, M20 grade of concrete is widely used for rigid pavement construction. This grade features a basic proportion of 1 part cement, 1.5 parts of fine aggregate, and 3 parts of coarse aggregate with a water-cement ratio ranging from 45-52%. The adoption of M20 concrete holds the promise of enhancing road strength and mitigating the myriad issues associated with road deterioration.

As the discourse shifts towards the utilization of M20 grade concrete, the Nepal cement market emerges as a key player in contributing to road construction efforts. However, various reports highlight discrepancies in the claimed strength of concrete by different cement brands. Therefore, understanding the actual strength of concrete offered by various brands, can aid stakeholders and contractors in selecting the appropriate cement brand for reinforced concrete roads based on project requirements.

1.1. Literature Review

As discussed in the background, Nepal heavily relies on land transportation for both people and cargo movement, given its landscape dominated by hills and mountains. However, maintaining safe and high-quality road facilities is a pressing concern due to subpar road conditions characterized by issues such as the conventional use of bitumen asphalt and inadequate material supervision during construction. The prevalence of road hazards such as potholes, waterlogging, and depressed surfaces has significantly increased road accidents in Nepal, according to Road Traffic Accidents (RTAs).

Considering the superior durability of reinforced concrete roads compared to conventional asphalt roads, there arises an opportunity for their strategic implementation in Nepal's road infrastructure. While reinforced concrete roads may entail higher costs, they prove particularly beneficial in sloping terrain, areas with weak soil bearing capacity, and regions prone to heavy rainfall or swamp lands. Understanding the behavior of concrete materials—cement, aggregate, and soil—is crucial for successful road construction projects in Nepal, especially when selecting suitable cement brands based on project requirements and budget considerations.

Present practices predominantly focus on the utilization of M20 grade concrete as a superior choice for the prevailing road conditions in Nepal. However, these studies often overlooked the diversity of cement options available in the Nepali market. In contrast, our research aims to bridge this gap by delving into the utilization of five distinct cement varieties currently available. By offering a comprehensive analysis of these options, including their associated costs, our objective is to facilitate informed decision-making for contractors and project initiators. Moreover, our study also aims to shed light on the discrepancies between the actual strength of each cement brand and their claimed strength, urging for more rigorous testing procedures by both manufacturers and regulatory bodies.

This research is centered on the examination of Reinforced Cement Concrete (RCC) roads as a preferable solution for areas characterized by steep slopes and susceptibility to waterlogging and weak soil conditions, contrasting with the prevalent use of bitumen roads. We aim to explore the viability of integrating RCC with bitumen and other advanced road construction methods tailored to specific needs. The study is particularly attuned to the topographical and socio-economic context of Nepal. Cement brands employed were selected through randomization, disregarding cost fluctuations over time. This endeavor seeks to furnish valuable insights for road planners and users, ultimately fostering proper road infrastructure streamlined traffic management and bolstering safety protocols. To ensure the integrity and transparency of our findings, a battery of tests including compressive strength assessments in accordance with IS code on the 7th and 28th days, alongside sieve analysis, Los Angeles abrasion tests, Aggregate Impact Value tests and evaluations of cement setting time, will be conducted.

2. Methodology

2.1 Materials

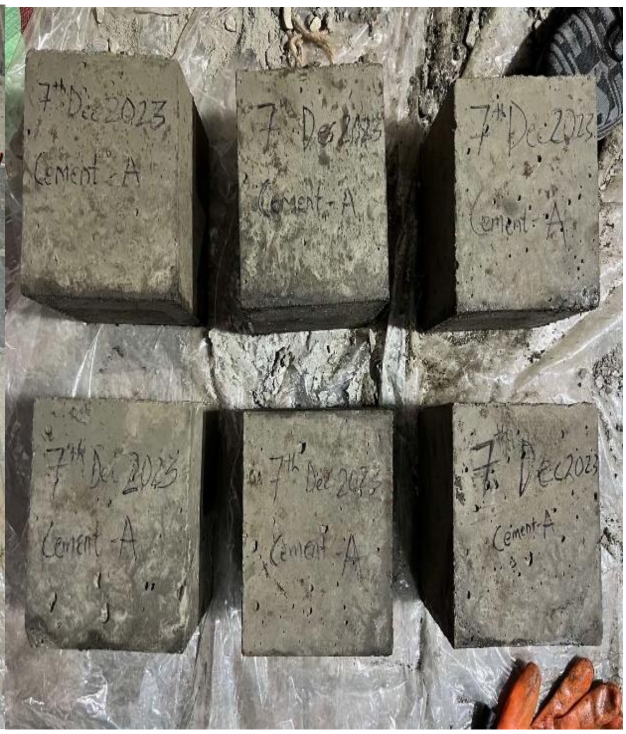
Ordinary Portland Cement (OPC)-43 from five different manufacturers were used. The grade of cement used was 43. The coarse aggregate had a maximum size of 20 mm, and the sand was double washed. No admixtures were used. The five brands of cement used were Brand A, B, C, D, and E.

In total, thirty (30) concrete cubes were made using these five popular brands of Ordinary Portland Cement commonly used in the Nepali construction industry. Various tests such as setting time of cement, sieve analysis of fine and coarse aggregates, Los Angeles Abrasion (LAA) test on coarse aggregate, and impact test on coarse aggregate were conducted.

2.2 Mix Proportion and mixing process

To measure compressive strength properties, M20 grade of concrete i.e. a mix ratio of 1:1.5:3 (cement: fine aggregates: coarse aggregates) with a water/cement ratio of 0.45 was used for the cube production. Weight batching was employed, and the materials were weighed using a weighing scale. The concrete was mixed by hand. The sand was spread evenly, and the required cement was added and mixed thoroughly with a spade until uniform in color. Coarse aggregate was then added and mixed by shoveling and turning the mass at least three times. A hollow was made in the pile, three-quarters of the water was added while turning the materials inward, and the remaining water was added gradually using a water-can until a uniform consistency was achieved. The Figure 1 below presents concrete molds being prepared, mixing of concrete, placing of concrete, the end product after opening the cube mold and curing done.

Figure 1: Pictures showing Process from Cube Mold Preparation to Curing



2.3 Tests Performed on Materials

All materials used in this research were tested as per standard requirements. For cement, the setting time was tested. Sieve analysis was conducted for both coarse and fine aggregates. For coarse aggregate, impact value and Los Angeles Abrasion tests were performed.

2.4 Designation and Preparation of Specimens

Thirty concrete cubes of 150 mm × 150 mm × 150 mm were produced in for the 7-day and 28-day compressive strength tests. Three cubes from each group were tested at 7 days, and the remaining cubes were tested at 28 days. The cube boxes were removed after twenty-four (24) hours and the cubes were kept for curing. The cubes were placed in a curing reservoir with the standard maintained temperature until they reached 28 days. The cubes were then tested at a laboratory through recently calibrated machine. The load applied was noted, and the strength of the concrete cubes was calculated using the formula:

$$\text{Compressive Strength} = {}^{\text{Maximum Load Applied}}\!/\!_{\text{Cross Sectional Area of Cube}}$$

2.5 Compressive Strength

The compressive strengths of each brand cubes were determined at 7 days and 28 days by following standard requirements. A load factor was uniformly applied until the cube was failed. The maximum load applying capacity of the machine was 2 kN.

Figure 2: Determining compressive strength using a compression machine

2.6 Validity of Test Results

All aggregates used for the tests were air-dried at normal room temperature, ensuring that the particle distribution of the aggregates used for mixing represented the supply accurately. Aggregates were free from organic impurities. Mixing, filling of molds, and compaction times were kept uniform for all cubes.

3. Results & Discussion

Sieve Analysis

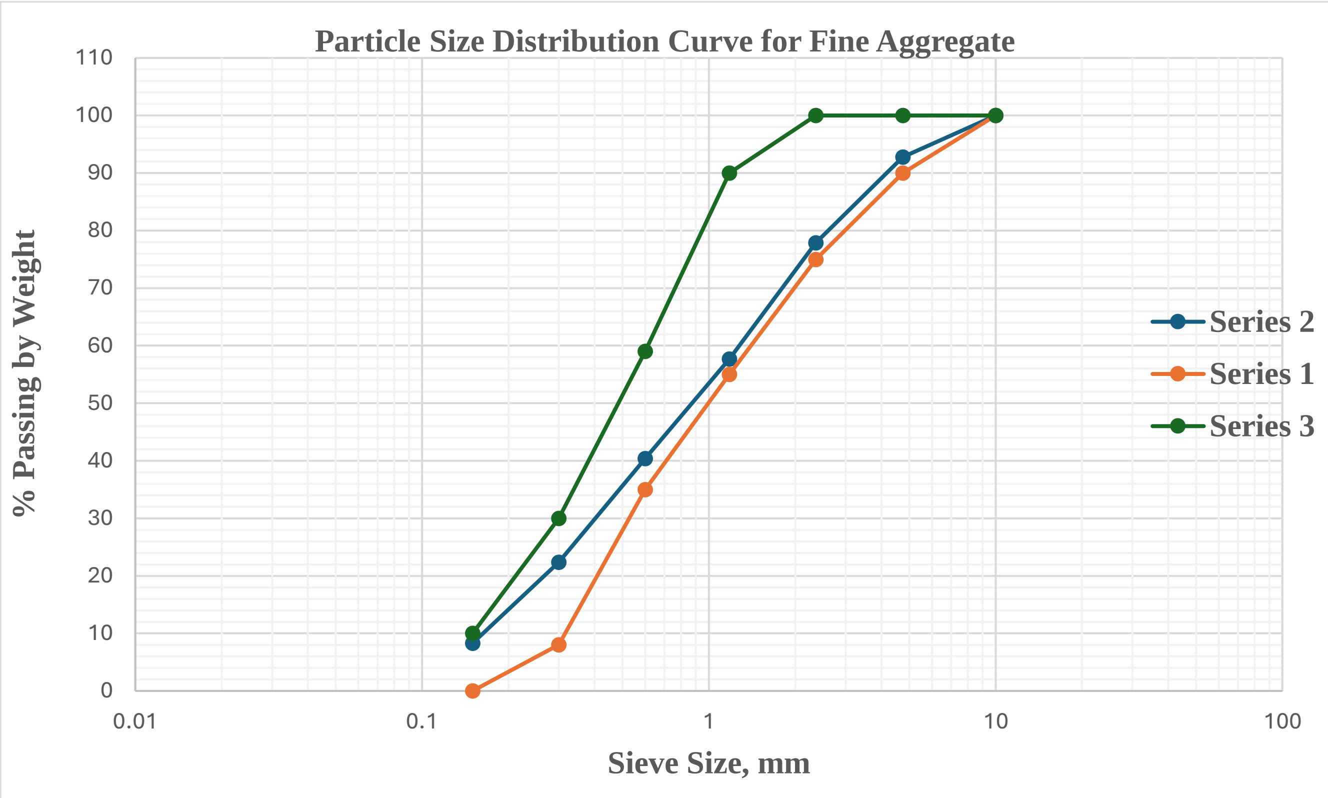
The test results conducted for the sieve analysis of Fine and Coarse Aggregate used for this research purpose are presented in Table 1 and 2 with their particle size distribution curve shown in Figures 3 and 4.

Table 1: Sieve Analysis of Fine Aggregate

		SIEVE ANALYSIS OF FINE AGG			Specified Requirement For Grading Zone II (As per Table 4 Cl 4.3 IS: 383-1970)	
IS SIEVE SIZE(mm)	MASS RETAINED (gm)	CUMULATIVE MASS RETAINED (gm)	CUMULATIVE % MASS.RETAINED	CUMULATIVE % MASS. PASSING	Min	Max
10	0	0	0	100	100	100
4.75	72	72	7.2	92.8	90	100
2.36	149	221	22.1	77.9	75	100
1.18	202	423	42.3	57.7	55	90
0.6	173	596	59.6	40.4	35	59
0.3	180	776	77.6	22.4	8	30
0.15	141	917	91.7	8.3	0	10
Pan	83	1000				
TOTAL	1000		300.5	Series 2 Curve	Series 1 Curve	Series 3 Curve

Hence Fineness Modulus (F.M) is 3.005 < 3.2 which indicates the sand as coarse sand. As per Table 9 Cl 6.3 of IS 383-2016 the above data resembles with Grading Zone II of Fine Aggregate which is presented in the Particle Size Distribution Curve as shown in Figure 3.

Figure 3: Particle Size Distribution Curve for Fine Aggregate



The Sieve analysis result for Coarse Aggregate with the gradation curve is presented below.

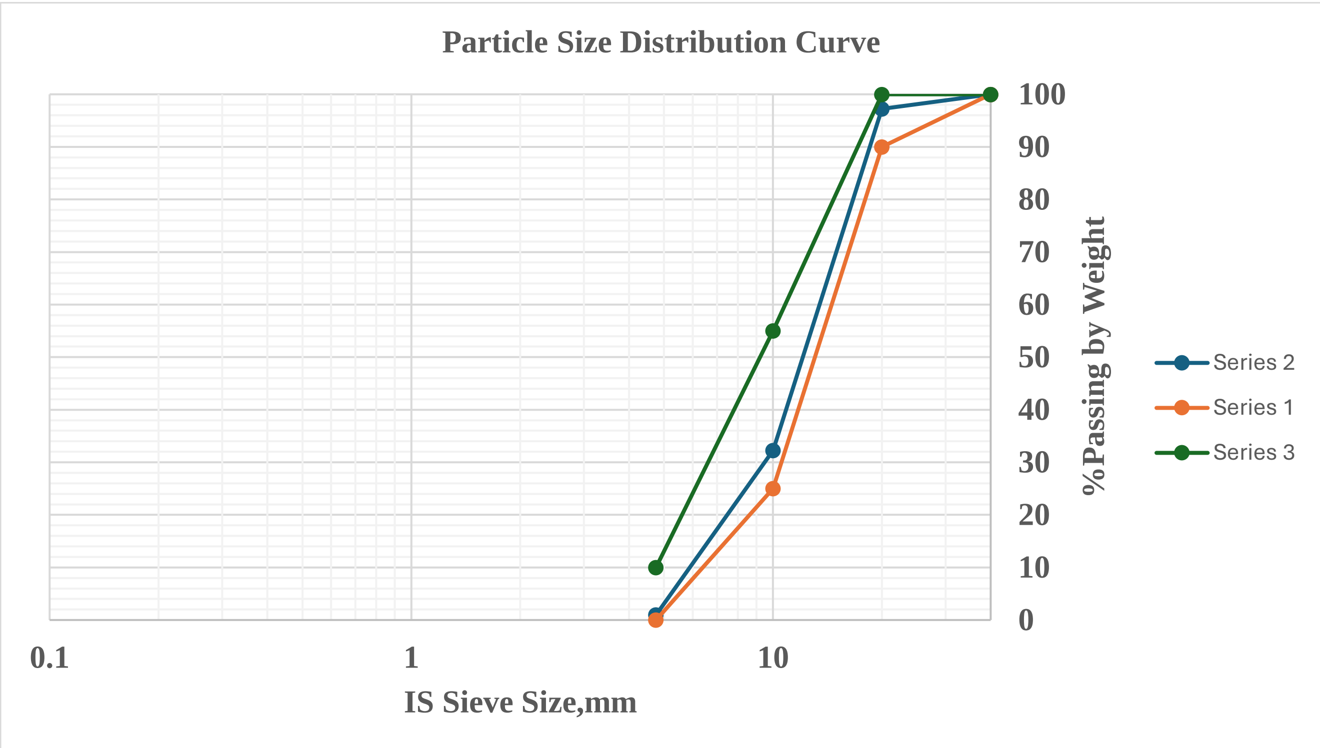
Table 2: Sieve Analysis of Coarse Aggregate

SIEVE ANALYSIS OF COARSE AGGREGATE						
IS SIEVE SIZE (mm)	MASS RETAINED (Kg)	CUMULATIVE MASS RETAINED (Kg)	CUMULATIVE % MASS.RETAINED	% Passing by Mass	Specification Limit	
					Min	Max
40	0	0	0	100	100	100
20	0.278	0.278	2.78	97.22	90	100
10	6.496	6.774	67.74	32.26	25	55
4.75	3.13	9.904	99.04	0.96	0	10
2.36	0	9.904	99.04	0.96	Limit as presented in Table 7 Cl 6.1 and 6.2 of IS 383:2016	
1.18	0	9.904	99.04	0.96		
0.6	0	9.904	99.04	0.96		
0.15	0	9.904	99.04	0.96		
Pan	0.096	10	100	0		
Total Weight	10		665.72			
Hence, Fineness Modulus (F.M.) is			6.6572	Series 2 Curve	Series 1 Curve	Series 3 Curve

The Fineness Modulus is within the range for maximum 20mm nominal size of aggregate.

As per Table 7 Cl. 6.1 and 6.2 of IS 383:2016 the standard limit for percentage passing by weight is presented for different sieve size. Also, the gradation curve for the Coarse Aggregate used is presented below in Figure 4.

Figure 4: Particle Size Distribution Curve for Coarse Aggregate



Aggregate Impact Value

The aggregate impact value is determined with the process as mentioned in accordance with IS 2386: Part 4 – 1963. The results of the test carried out is presented below in Table 3.

Table 3: Results of Aggregate Impact Value

Determination of Aggregate Impact Value			
S.N.	Details	Units	Values
1	Total Weight of Sample, m	gm	354
2	Weight of 2.36 passing sample, m1	gm	54
3	Weight of 2.36retained sample, m2	gm	300
4	Aggregate Impact Value=(m1/m) *100%	%	15.26

According to IS 383-2016 Cl.5.4.2, the maximum value of Aggregate Impact Value for the aggregates to be used in concrete for wearing surfaces (such as railways, roads) is 30%. We have Aggregate Impact Value for the Coarse aggregate that we have used in this research as 15.26%, which is within the range. The value obtained in the test showed that the aggregate that we have used is suitable for the concrete to be used as wearing surface.

Coarse Aggregate Abrasion Test

The abrasion test of coarse aggregate used for this research purpose was done by the use of Los Angeles Machine. The test is also said as LAA test. The gradings of test sample from Cl. 5.3.3 of IS: 2386 (Part IV)-1963 and the test results of LAA test are presented below in Table 4 and Table 5, respectively.

Table 4: Gradings of Test Sample

As per Table II Cl. 5.3.3 of IS: 2386 (Part IV) -1963 Gradings of Test Sample								
Sieve(mm)		**Mass of Sample (gm)**						
Passing	**Retained**	**A**	**B**	**C**	**D**	**E**	**F**	**G**
80	63	-	-	-	-	2500	-	-
63	50	-	-	-	-	2500	-	-
50	40	-	-	-	-	5000	5000	-
40	25	1250	-	-	-	-	5000	5000
25	20	1250	-	-	-	-	-	5000
20	12.5	1250	**2500**	-	-	-	-	-
12.5	10	1250	**2500**	-	-	-	-	-
10	6.3	-	-	2500	-	-	-	-
6.3	4.75	-	-	2500	-	-	-	-
4.75	2.36	-	-	-	5000	-	-	-
Total		5000	**5000**	5000	5000	10000	10000	10000
No. of Spheres		12	**11**	8	6	12	12	12

Table 5: Results of Los Angeles Abrasion Test

Test No.	Grade	No. of Charge	No. of Revolution	Wt. of Sample (gm)	Wt. in gm after test		% Wear
					Retained 1.7 mm	Passing 1.7 mm	
1	B	11	500	5000	3837	1158	23.16

According to IS 383-2016 Cl. 5.4.3 the maximum value of abrasion for the coarse aggregate to be used in construction of wearing surface (railways, roads, etc.) is 30%. The results of the LAA test conducted for the coarse aggregate used for this research purpose showed the percentage wear i.e. abrasion value as

23.16%. The value obtained in the test showed that the aggregate that we have used is suitable for the concrete to be used as wearing surface.

Cement Test

According to Nepal Standard Specifications, for OPC-43 Grade Cement, the minimum initial setting time is 45 minutes and the maximum value for the final setting time is 600 minutes. The initial and final setting time for five different cement brands used in this research is determined. The results are summarized and presented in the Table 6 below.

Table 6: Setting time for Five different OPC-43 Grade Cement

S.N.	Cement	Type	Initial Setting Time (min)	Final Setting Time (min)	Nepal Standard Specifications (NS 572:2076)	
					Initial Setting Time (min)	Final Setting Time (min)
1	A	OPC-43	105	240	45 minimum	600 maximum
2	B	OPC-43	85	225	45 minimum	600 maximum
3	C	OPC-43	80	235	45 minimum	600 maximum
4	D	OPC-43	90	215	45 minimum	600 maximum
5	E	OPC-43	85	240	45 minimum	600 maximum

Grade of Concrete and Ingredients for preparing Cubes

The grade of concrete, ingredients used for preparing 6 cubes of each cement brand for compressive strength test is summarized and presented in Table 7 below.

Table 7: Quantities of different Ingredients of Concrete – Standard weight and taken weight

				Standards Weight to be taken					Weight Taken					
S.N.	Grade of Concrete	Cement	Cement Type	Mass of Cement (Kg)	W/C Ratio	Quantity of Water (l)	Mass of Fine Agg. (Kg)	Mass of Coarse Agg. (Kg)	Mass of Cement (Kg)	W/C Ratio	Quantity of Water (l)	Mass of Fine Agg. (Kg)	Mass of Coarse Agg. (Kg)	No. of Cubes
1	M20	A	OPC-43 Grade	8.165	0.45	3.67	14.305	27.216	8.175	0.45	3.68	14.32	27.26	6
2		B		8.165	0.45	3.67	14.305	27.216	8.21	0.45	3.69	14.35	27.21	
3		C		8.165	0.45	3.67	14.305	27.216	8.192	0.45	3.69	14.343	27.25	
4		D		8.165	0.45	3.67	14.305	27.216	8.37	0.45	3.77	14.44	27.22	
5		E		8.165	0.45	3.67	14.305	27.216	8.265	0.45	3.72	14.38	27.29	

Compressive Strength

The compressive strength for M20 i.e. mix ratio of 1:1.5:3 (Cement: Fine Aggregate: Coarse Aggregate) for different brands of cements used for this research purpose are presented in Table 8-17 with results of cube crushing at 7 and 28 days respectively. In total 6 cubes for each cement brand were prepared and crushed. 3 cubes for 7 days and 3 cubes for 28 days were crushed. The cube mold with inner dimension of 150 mm (l)* 150mm (b) * 150mm (h) was used with an area of 22500 mm^2.

For Cement Brand A

7-Day Compressive Strength

Table 8: Results of 7 Days Compressive Strength Test of Cubes for Cement Brand A

S.N.	Cement	Cube No.	Age (Days)	Mass of Cube (Kg)	Avg. Mass of Cube (Kg)	Load Reading (KN)	Compresive Strength (N/mm^2)	Avg.Compresive Strength (N/mm^2)	Variations as per Cl. 15.4 of IS 456:2000	
									Min (N/mm^2)	Max (N/mm^2)
1	A	1	7	8.36	8.39	688	30.58	28.08	23.868	32.292
2		2		8.34		634	28.18			
3		3		8.47		573	25.47			
				Avg.Compresive Strength is within the range of variation. Hence, Test results are valid.						

28- Days Compressive Strength

Table 9: Results of 28 Days Compressive Strength Test of Cubes for Cement Brand A

S.N.	Cement	Cube No.	Age (Days)	Mass of Cube (Kg)	Avg. Mass of Cube (Kg)	Load Reading (KN)	Compresive Strength (N/mm^2)	Avg.Compresive Strength (N/mm^2)	Variations as per Cl. 15.4 of IS 456:2000	
									Min (N/mm^2)	Max (N/mm^2)
1	A	4	28	8.57	8.39	774	34.4	32.34	27.489	37.191
2		5		8.35		739	32.84			
3		6		8.24		670	29.78			
				Avg.Compresive Strength is within the range of variation. Hence, Test results are valid.						

For Cement Brand B

7- Days Compressive Strength

Table 10: Results of 7 Days Compressive Strength Test of Cubes for Cement Brand B

S.N.	Cement	Cube No.	Age (Days)	Mass of Cube (Kg)	Avg. Mass of Cube (Kg)	Load Reading (KN)	Compresive Strength (N/mm^2)	Avg.Compresive Strength (N/mm^2)	Variations as per Cl. 15.4 of IS 456:2000	
									Min (N/mm^2)	Max (N/mm^2)
1	B	1	7	8.54	8.38	453	20.13	22	18.7	25.3
2		2		8.25		496	22.04			
3		3		8.36		536	23.82			
				Avg.Compresive Strength is within the range of variation. Hence, Test results are valid.						

28- Days Compressive Strength

Table 11: Results of 28 Days Compressive Strength Test of Cubes for Cement Brand B

S.N.	Cement	Cube No.	Age (Days)	Mass of Cube (Kg)	Avg. Mass of Cube (Kg)	Load Reading (KN)	Compresive Strength (N/mm^2)	Avg.Compresive Strength (N/mm^2)	Variations as per Cl. 15.4 of IS 456:2000	
									Min (N/mm^2)	Max (N/mm^2)
1	B	4	28	8.42	8.37	583	25.91	28.01	23.8085	32.2115
2		5		8.35		696	30.93			
3		6		8.33		612	27.2			
				Avg.Compresive Strength is within the range of variation. Hence, Test results are valid.						

For Cement Brand C

7-Days Compressive Strength

Table 12: Results of 7 Days Compressive Strength Test of Cubes for Cement Brand C

S.N.	Cement	Cube No.	Age (Days)	Mass of Cube (Kg)	Avg. Mass of Cube (Kg)	Load Reading (KN)	Compresive Strength (N/mm^2)	Avg.Compresive Strength (N/mm^2)	Variations as per Cl. 15.4 of IS 456:2000	
									Min (N/mm^2)	Max (N/mm^2)
1	C	1	7	8.37	8.36	254	11.29	13.1	11.135	15.065
2		2		8.33		313	13.91			
3		3		8.38		317	14.09			
				Avg.Compresive Strength is within the range of variation. Hence, Test results are valid.						

28-Days Compressive Strength

Table 13: Results of 28 Days Compressive Strength Test of Cubes for Cement Brand C

S.N.	Cement	Cube No.	Age (Days)	Mass of Cube (Kg)	Avg. Mass of Cube (Kg)	Load Reading (KN)	Compresive Strength (N/mm^2)	Avg.Compresive Strength (N/mm^2)	Variations as per Cl. 15.4 of IS 456:2000	
									Min (N/mm^2)	Max (N/mm^2)
1	C	4	28	8.33	8.29	403	17.91	19.41	16.4985	22.3215
2		5		8.32		475	21.11			
3		6		8.21		432	19.2			
				Avg.Compresive Strength is within the range of variation. Hence, Test results are valid.						

For Cement Brand D

7-Days Compressive Strength

Table 14: Results of 7 Days Compressive Strength Test of Cubes for Cement Brand D

S.N.	Cement	Cube No.	Age (Days)	Mass of Cube (Kg)	Avg. Mass of Cube (Kg)	Load Reading (KN)	Compresive Strength (N/mm^2)	Avg.Compresive Strength (N/mm^2)	Variations as per Cl. 15.4 of IS 456:2000	
									Min (N/mm^2)	Max (N/mm^2)
1	D	1	7	8.45	8.4	546	24.27	22.49	19.1165	25.8635
2		2		8.33		482	21.42			
3		3		8.43		490	21.78			
				Avg.Compresive Strength is within the range of variation. Hence, Test results are valid.						

28-Days Compressive Strength

Table 15: Results of 28 Days Compressive Strength Test of Cubes for Cement Brand D

S.N.	Cement	Cube No.	Age (Days)	Mass of Cube (Kg)	Avg. Mass of Cube (Kg)	Load Reading (KN)	Compresive Strength (N/mm^2)	Avg.Compresive Strength (N/mm^2)	Variations as per Cl. 15.4 of IS 456:2000	
									Min (N/mm^2)	Max (N/mm^2)
1	D	4	28	8.37	8.38	782	34.76	33.63	28.5855	38.6745
2		5		8.44		766	34.04			
3		6		8.34		722	32.09			
				Avg.Compresive Strength is within the range of variation. Hence, Test results are valid.						

For Cement Brand E

7-Days Compressive Strength

Table 16: Results of 7 Days Compressive Strength Test of Cubes for Cement Brand E

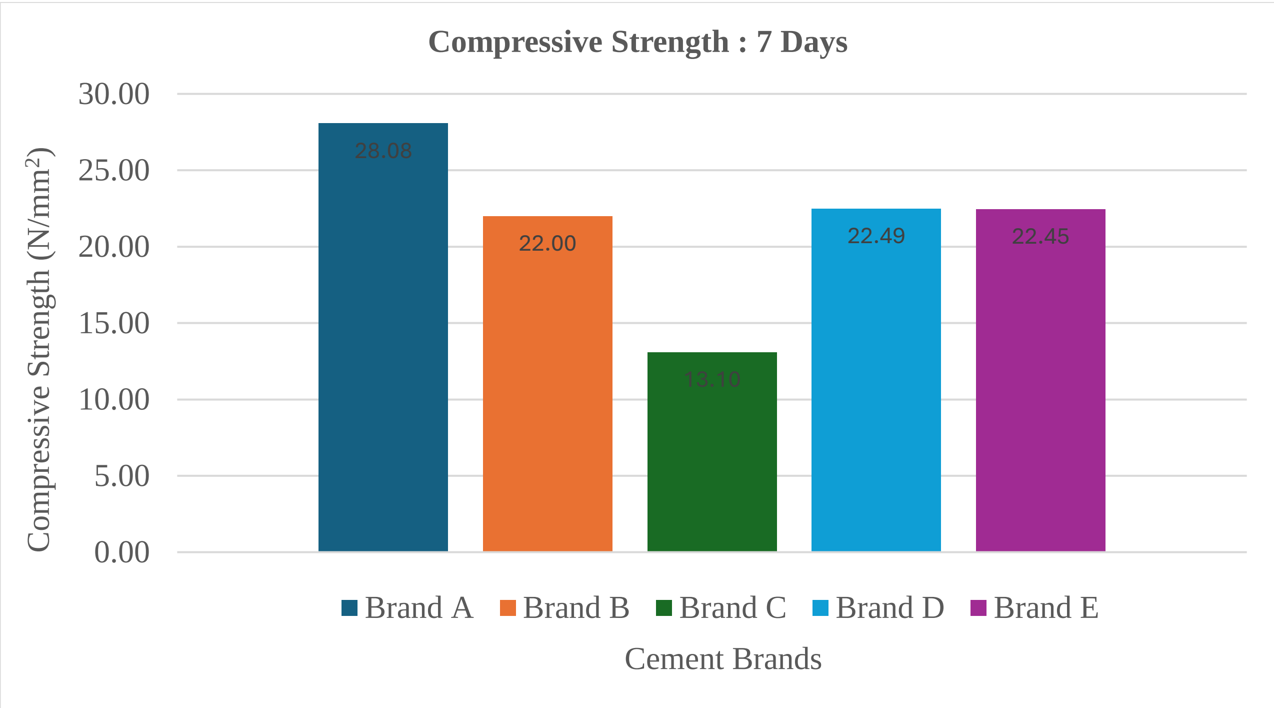
S.N.	Cement	Cube No.	Age (Days)	Mass of Cube (Kg)	Avg. Mass of Cube (Kg)	Load Reading (KN)	Compresive Strength (N/mm^2)	Avg.Compresive Strength (N/mm^2)	Variations as per Cl. 15.4 of IS 456:2000	
									Min (N/mm^2)	Max (N/mm^2)
1	E	1	7	8.47	8.44	508	22.58	22.45	19.0825	25.8175
2		2		8.46		512	22.76			
3		3		8.39		495	22			
				Avg.Compresive Strength is within the range of variation. Hence, Test results are valid.						

28-Days Compressive Strength

Table 17: Results of 7 Days Compressive Strength Test of Cubes for Cement Brand E

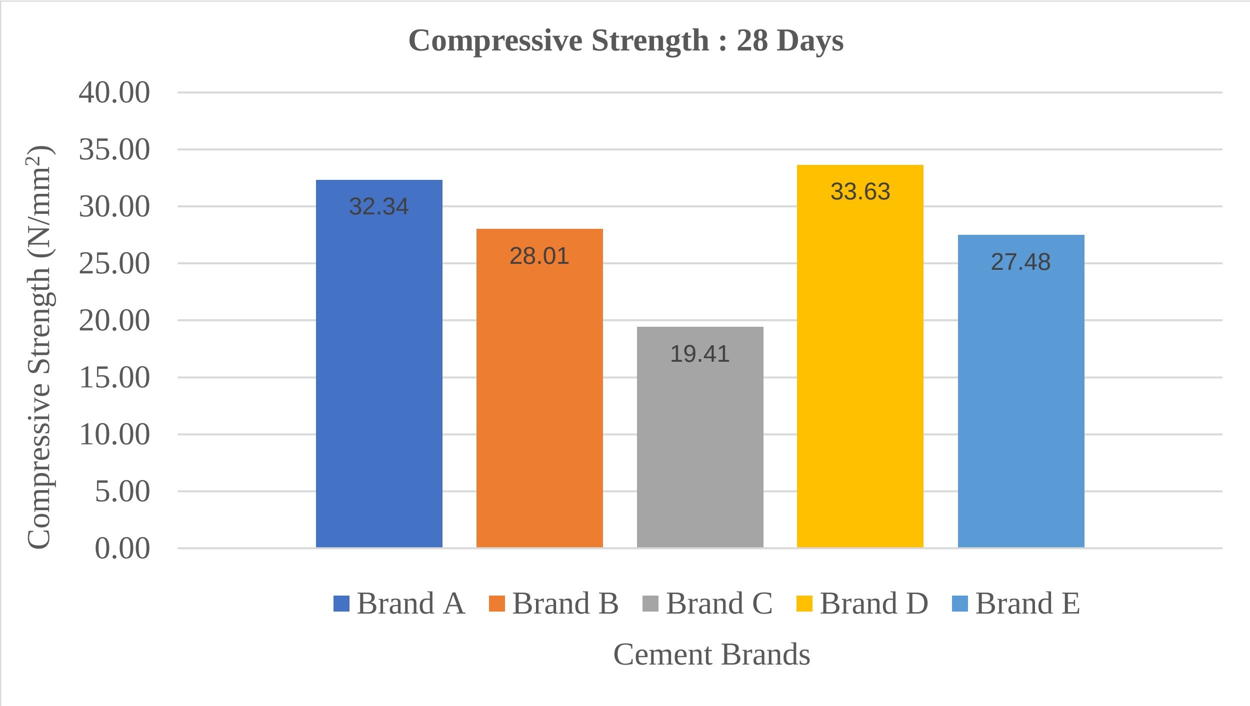
S.N.	Cement	Cube No.	Age (Days)	Mass of Cube (Kg)	Avg. Mass of Cube (Kg)	Load Reading (KN)	Compresive Strength (N/mm^2)	Avg.Compresive Strength (N/mm^2)	Variations as per Cl. 15.4 of IS 456:2000	
									Min (N/mm^2)	Max (N/mm^2)
1	E	4	28	8.35	8.42	641	28.49	27.48	23.358	31.602
2		5		8.44		662	29.42			
3		6		8.46		552	24.53			
				Avg.Compresive Strength is within the range of variation. Hence, Test results are valid.						

Figure 5: Graph showing the Compressive Strength gained by different brands of Cement in 7 Days.



In 7 Days, the average compressive strength (N/mm^2) gained is highest for Cement Brand A with the value of 28.08 N/mm^2, the least gain is of Cement Brand C with the value of 13.10 N/mm^2.

Figure 6: Graph showing the Compressive Strength gained by different brands of Cement in 28 Days.



In 28 Days, the average compressive strength (N/mm^2) gained is highest for Cement Brand D with the value of 33.63 N/mm^2 whereas, the least gain is of Cement Brand C with the value of 19.41 N/mm^2. This variation of increased compressive strength at the earliest age can be attributed to the addition of a high gaining strength additive in the cement brand.

CONCLUSION

In this study, our objective was to assess the compressive strength of concrete using five different cement brands available in Nepal. Through comprehensive testing including crushing strength analysis of M20 grade concrete, sieve analysis, and Los Angeles abrasion test, Aggregate Impact Value test, we observed variations in compressive strength among the cement brands. These findings underscore the necessity for improved labeling standards and rigorous testing protocols for materials and admixtures used in each cement brand. Furthermore, our research offers valuable insights for road planners, providing them with informed choices based on their specific requirements. Given the diverse topography and challenging road conditions in Nepal, our focus on reinforced cement concrete (RCC) roads holds significant implications for infrastructure development, road safety, and traffic management.

RECOMMENDATION

Moving forward, there are several avenues for further exploration. Future studies could delve deeper into identifying the most efficient cement brands for road construction in Nepal. Rapid hardening or quick setting cement can be used for quick completion and open highway for traffic flow in case of road construction on a busy highway. Additionally, researchers can expand upon our methodology by including a broader range of cement brands to cater to diverse client needs and project specifications. Also, by addressing these recommendations, stakeholders in the cement industry should collaborate to establish standardized labeling practices, ensuring clarity on cement composition. Cement manufacturers must prioritize stringent quality control measures to enhance product consistency. Continued research investment is vital for optimizing cement selection and fostering knowledge exchange for improved road construction practices.

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