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## Investigating the effect of poor handling of concrete ingredient in the properties of fresh and harden concrete

Mikiyas Alemeshet Abera

[mikectmeng@gmail.com](mailto:mikectmeng@gmail.com)

Wolaita Sodo University, Wolaita Sodo, Ethiopia

### ABSTRACT

*Construction materials management is an important element in the management of construction projects. One of the construction materials widely used in construction projects is concrete. Concrete is one of the important constituents of many of the construction projects, in addition to its subjectivity to variability, requires a close and thorough care and handling in construction projects. The constituents of concrete, in which majority of them occur naturally, are subjected to a wide range of variability and quality problems. Therefore, with this respect, a research was carried out and the objective of this experimental study was to investigate the effect of poorly handled concrete ingredients in the properties of fresh and harden concrete to assess the effect. The ingredients were collected from Five (5) active construction sites around the study area and they wear ready for use when the sample was taken for the research purpose. A laboratory test was conducted for each ingredient before the preparation of concrete. After that mix design was prepared specifically for C-25 concrete then by using weight batching the ingredients are introduced to electrical mixer, after the mix prepared, workability, setting time, and compaction factor test was conducted to identify the properties of the fresh concrete and then a total of 45 concrete cube sample was cast or three (3) sample for each source of the ingredients and for each testing day, the compressive strength test was conducted on the 7th, 14th and 28th day. For the workability test, both slump test and flow table tests were conducted and the result shows that the concrete mix has high workability and the slump is collapse slump and this result is due to the high-water content on both coarse and fine aggregate. The initial setting time of the concrete mix was greater than the ASTM standard specification due to the impurities present in the mixing water also the mix has a high compaction factor test result due to the high workability of the mix or due to self-consolidating property of the concrete mix. The average compressive strength of the concrete after 28th day was not satisfied with the desired strength also the 7th day and the 14th-day compressive strength was less than 60% and 90% respectively of the desired 28th day compressive strength. The result is occurred due to low aggregate crushing value, high silt content of fine aggregate, water impurities and high-water content in the mix. The result shows that the effect of poor handling of concrete ingredients in the properties of fresh and hardened concrete.*

**Keywords**— Concrete, Ingredient, Handling

### 1. INTRODUCTION

Concrete is one of the oldest construction materials in the construction industry and it is widely used throughout the world. It is suitable for almost all types of constructions starting from foundations, road pavements, dams, buildings of various types, etc. However, the process involved in the production of concrete requires due care and attention. The care starts with the selection and estimation of the amounts of constituents of the concrete. The materials used for concrete production should satisfy certain requirements in order to get the concrete of the desired strength and durability with a reasonable economy.

Concrete is a composite product of different ingredient materials. Ensuring the availability and supply of suitable and acceptable ingredients is one of the important tasks towards the production of concrete which satisfies standard requirements. However, since most of the ingredients of concrete are naturally available and are used directly for concrete production it is so important to give due consideration for their handling, production process and be aware that poor handling of the ingredients has influence on the properties of fresh and hardened concrete. Concrete is produced from different construction raw materials that can be both manufactured and naturally available. Cement is one of the constituents of concrete and is a result of a factory manufacturing process. The rest constituents that are aggregates and water are naturally available and are usually used directly for construction purposes. Hence, due consideration should be given in selecting and using these materials for concrete production. The purpose of careful handling and control, in proper sequence, of these concrete making materials is to produce satisfactorily a selected batch assembly for the continuous production of homogeneous concrete.

**2. OBJECTIVE**

The primary objective of this experimental study was to investigate the effect of poorly handled concrete ingredients in the properties of fresh and harden concrete.

**3. STUDY DESIGN**

The study was an experimental study on the properties of fresh and harden concrete due to the use of poorly handled concrete ingredients. The amount of the ingredient, water-cement ratio, mixing procedure is constant through all samples and the study was conducted in different steps. These include material preparation, determining engineering property of materials and production of concrete cube samples then compressive strength test was conducted.

**3.1 Material Preparation**

Sample material was prepared or taken from five (5) different active construction sites that have identified previously for the research purpose for their poor ingredient handling practice around the study area.

**3.2 Determination of Engineering Properties**

After the preparation of the ingredient, the engineering properties of the ingredients were tested in the material laboratory according to ASTM standard and the result was recorded for the analyses purpose

**3.3 Mix design**

By using EBCS (Ethiopian Building Code of Standard) the mix design was prepared and by following all necessary procedure the concrete was prepared and concrete cube sample specimen was cast.

**3.4 Laboratory test**

Then after there were laboratory tests within 7th, 14th and 28th days for the compressive strength of concrete cube sample specimen has been carryout then a comparison is made between the mixes and with different standards specification

**3.5 Sampling procedure and sample size**

The sampling procedure was purposive sampling; therefore, the sample size was determined accordingly to the test specimen number required to conduct the compressive strength of concrete. Therefore, there were (3) samples for compressive strength for each sampling site and testing age.

**Table 1: Number of samples**

Sample Site	Number of Samples			Total
	7th day	14th day	28th day	
Site 1	3	3	3	9
Site 2	3	3	3	9
Site 3	3	3	3	9
Site 4	3	3	3	9
Site 5	3	3	3	9
				45

**3.6 Compressive strength test result**

Compressive strength of the 7th, 14th and 28th days of concrete cube sample spacemen were tested in the laboratory in different age of the sample. A total of six (3) samples for each age and sample site are taken and the results are shown below.

**Table 2: 7<sup>th</sup>-day compressive strength**

Sample Site	7 <sup>th</sup> -day Compressive strength (N/mm <sup>2</sup> )			Average compressive strength
	Sample 1	Sample 2	Sample 3	
Site 1	12.47	13.21	11.79	12.49
Site 2	14.57	13.82	15.77	14.72
Site 3	12.34	11.65	13.33	12.44
Site 4	15.21	14.37	16.0	15.19
Site 5	14.07	14.16	12.08	13.43

From the 7<sup>th</sup>-day compressive strength result we can see that the 7<sup>th</sup>-day strength doesn't satisfy ASTM standard. It didn't reach a minimum of 60% of the desired 28<sup>th</sup> day compressive strength.

**Table 3: 14<sup>th</sup>-day compressive strength**

Sample Site	14 <sup>th</sup> -day Compressive strength (N/mm <sup>2</sup> )			Average compressive strength
	Sample 1	Sample 2	Sample 3	
Site 1	19.06	20.27	22.43	20.58
Site 2	22.17	20.5	21.35	21.34
Site 3	19.97	20.38	21.11	20.48
Site 4	21.03	22.22	20.74	21.23
Site 5	20.14	22.23	21.61	21.32

From the 14<sup>th</sup>-day compressive strength result we can see that the 14<sup>th</sup>-day strength doesn't satisfy ASTM standard. It didn't reach a minimum of 90% of the desired 28<sup>th</sup> day compressive strength.

**Table 4: 28<sup>th</sup>-day compressive strength**

Sample Site	28th-day Compressive strength (N/mm <sup>2</sup> )			Average compressive strength
	Sample 1	Sample 2	Sample 3	
Site 1	22.3	24.27	25.34	23.97
Site 2	25.47	23.53	24.75	21.34
Site 3	22.37	22.98	25.24	24.58
Site 4	25.03	25.32	23.17	24.5
Site 5	22.14	24.23	23.61	23.32

From the 28<sup>th</sup>-day compressive strength result we can see that the 128<sup>th</sup>-day strength doesn't satisfy ASTM standard. It didn't reach a minimum number of the desired 28<sup>th</sup> day compressive strength. From the result we also clearly identify that poor handling of concrete ingredient have a meager effect on the compressive strength of concrete and the factors that affect the properties of the concrete strength have discussed below.

### 3.7 Aggregate crushing value result

Due to the poor handling of coarse aggregate, the aggregate was exposed to direct sunlight and rainwater for a long time so due to the freezing and thawing of the environment, the durability and the crushing strength of the aggregate decreased.

### 3.8 Water content on both fine and coarse aggregate

Due to the poor handling of coarse and fine aggregate, the aggregate was exposed to direct rainwater for a long time and this cause a high amount of water in the concrete mix and this condition directly affect the compressive strength of the concrete because water-cement ratio and compressive strength have an inversely proportional.

### 3.9 Silt and dust content on both coarse and fine aggregate

Due to the poor handling of coarse and fine aggregate, the aggregate was exposed to direct sunlight, rainwater and wind for a long time different specks of dust and impurities were found in the fine and coarse aggregate, and this condition also decreases the compressive strength of the concrete.

### 3.10 Mixing water impurities

The mixing water for the concrete was exposed for different impurities like oil, algae, and different impurities so this condition also has a meager effect on the setting time and compressive strength properties of the concrete.

## 4. CONCLUSION

Materials management is an important element in project planning and control. Further, one important aspect of materials management is the handling of construction materials. Concrete is one of the construction materials used in almost all construction works. Concrete is one of the important constituents of many of the construction projects, in addition to its subjectivity to variability, requires a close and thorough care and management in construction projects. The constituents of concrete which most of them are naturally occurring materials are subjected to a wide range of variability. The first constituent, water, is a relatively non variable and usually available in a condition to be used for concrete readily. The second constituent, cement, is also a factory product that is relatively easy to control its production process and it is quality. However, the third constituents of concrete, which are coarse and fine aggregates, are usually naturally occurring that they are subjected to a wide range of variability. Therefore, poor handling of concrete ingredients has many effects on the properties of freshly mixed and already harden concrete. Some of the properties affected by poor handling of concrete ingredient is workability, initial setting time, final setting time, compressive strength and durability are some of them, so, different stake holders should have control the handling method of concrete ingredients and if the problem occurs they should take a measure like testing the ingredients, changing the ingredients and making an agistments in the concrete mix design stage.

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