INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X
Impact factor: 4.295
(Volume6, Issue1)
Available online at: www.ijariit.com

Comparative study on using different types of sands around Tepi Town, Southern Ethiopia

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ABSTRACT

Concrete is an intimate mixture of Coarse Aggregate, Sand (Fine Aggregate), Cement and Water. In building construction, most of the activities are executed using concrete so that concrete materials quality is important. Construction materials used in construction determine the behavior of the structure and resulted in any types of failures or defects. The objective of this study was to compare different types of sands used in building construction project around Tepi town, specifically to identify different types sands used in Tepi town, to determine engineering properties sands and to compare with a standard. The methodologies include data collection methods (field observation and laboratory test) and organized data, data-analyzed and conclusion made from the result of data analysis and forwarded recommendations. From site observation, for fine aggregate, they used four sand types namely: gambela, dimma, Tepi and Meti sand.

Based on the findings, the determined properties of materials includes silt content of sands, 4.64%, 3.85%, 9.26%,11.67%; respectively, Compacted unit weight,1407.94Kg/m3,1498.00Kg/m3,1348.92Kg/m3, 1303.08Kg/m3; and Dimma, Gambella, Tepi and Meti respectively. The compressive strength for concrete in 28th days was 30.3Mpa, 33.8Mpa, 22.91Mpa, and 24.64Mpa, Dimma, Gambella, Meti and Tepi sand respectively by using the similar course aggregate. All the above results were compared with the standard specifications.

The researcher recommended that the owner of the project must check the quality of materials, follow up and supervision during the construction period. Finally, for consultant, check and approve concrete materials according to the specification.

Keywords— *Concrete Material, sands, and properties of materials*

1. INTRODUCTION

1.1 AGGREGATES

Aggregates play an important role in civil engineering construction. The major constituents of ordinary concretes are crushed rocks or gravels used as coarse aggregates and sands used as fine aggregates. Concrete has been the most common building material for many years. Much of the developed world has infrastructures built with various forms of concrete. Mass concrete dams, reinforced concrete buildings, pre-stressed concrete bridges, and precast concrete components are some typical examples. It is anticipated that the rest of the developing world will use these forms of construction in their future development of infrastructures [1-7].

Construction materials used in construction determine the behavior of the structure and resulted in any types of failures or defects. The effects of using low-quality materials do not take place in a year or two, but in many years to come to the effects will slowly begin to spread like cancer in the concrete. The usage of materials that are not according to specification, leads defects in building construction. The fine and coarse aggregates generally occupy 60% to 75% of the concrete volume and strongly influence the concrete's freshly mixed and hardened properties, mixture proportions, and economy [8-10]. As a result, poor quality of cement, aggregates, sand having a higher amount of silt content and poor quality of water, poor form works, improper storage of raw materials, incorrectly proportion of ingredients leads to defects in building construction. Natural sand and gravel have a round, smooth particle shape. Crushed aggregate (course and fine) may have shapes that are flat and elongated, angular, cubical, disk, or rod-like. These shapes result from the crushing equipment employed and the aggregate mineralogy. Extreme angularity and elongation increase the amount of cement required to give strength, difficulty in finishing, and effort required to pump the concrete. Flat and elongated particles also increase the amount of required mixing water. The bond between angular particles is greater than that between smooth particles. Properly graded angular particles can take advantage of this property and offset the increase in water required to produce concrete with cement content and strength equal to that of a smooth-stone mix [9-14].

1.2 OBJECTIVES OF THE STUDY
The objectives of the study are: To determine and analyze the individual properties of fine aggregates in Tepi town and to compare the properties of the result with standard specification.

2. MATERIALS AND METHODS
2.1 STUDY VARIABLES
a) Independent variable: The independent variables for this research included, silt content of sands, the unit weighs of aggregates and compressive strength of concrete and the dependent variable is compared the quality of sands in Tepi town.

2.2 STUDY POPULATION
The population of the study includes the different types of sands in Tepi town includes Dimma, Gamebella, Tepi and Meti sands.

2.3 SAMPLING TECHNIQUE AND SAMPLE SIZE
Sampling refers to the process of selecting a portion of the population to represent the entire population. The sampling techniques the researcher used non-probabilistic sampling, in this study the researcher selected the material samples which are used in ongoing or under construction building Tepi town. Based on detail observation researchers identified four types of fine aggregates those are Dimma, Tepi, Meti, Gambella sand.

3. RESULTS AND DISCUSSIONS
3.1 SILT CONTENT OF SAND RESULT
As Figure below, indicated that the y-axis represents the percentage of silt content and X-axis represents different types of sands. Based on the results of silt content, Meti and Tepi sands have high silt content than, Gamebella and Dimma sands. According to Ethiopian standards (ESC.D3.201) the allowable limit for silt/clay content is recommended not to exceed a value of 6% and in the ASTM C117 states that the allowable limit is maximum 5%, from result of silt contents, Gambella and dimma sand satisfy the standard limits but Meti and Tepi sands do not satisfy the standard limits.

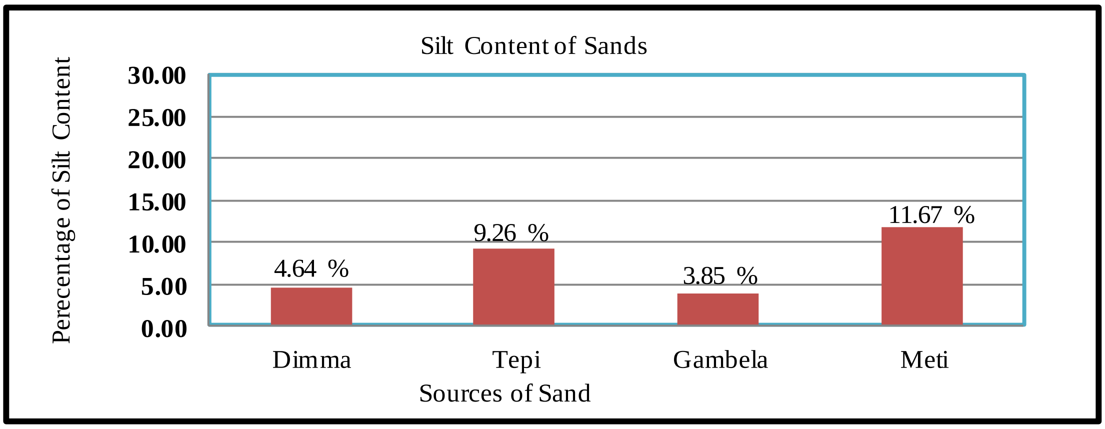

Fig. 1: Silt content of sands

3.2 UNIT WEIGHT OF SAND RESULT
As Figure below, indicated that Unit Weight of Sand results of Dimma, Gambela, Meti and Tepi respectively. The unit weight or bulk density of an aggregate is the mass or weight of the aggregate required to fill a container of a specified unit volume. The volume referred to here is that occupied by both aggregates and the voids between aggregate particles. The approximate bulk density of aggregate commonly used in normal-weight concrete ranges from about 1280 to 1920 kg/m3.

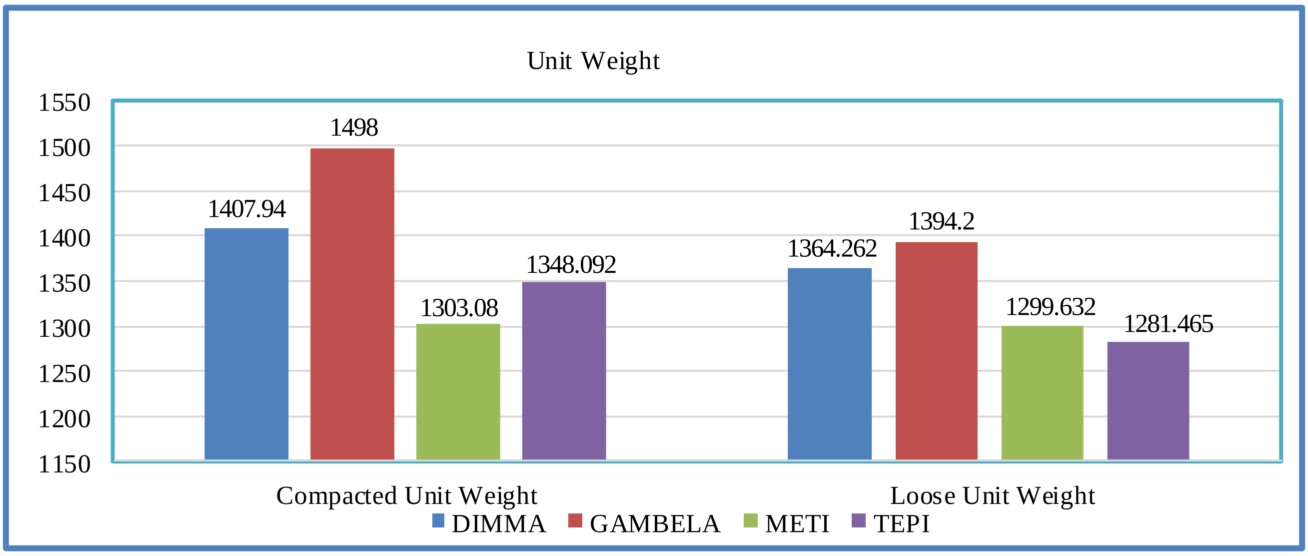

Fig. 2: Unit Weight of Sands

3.3 COMPRESSIVE STRENGTH RESULTS

The compressive strength results of the experiments are described in the table and figure below:

Table 1: Compressive strength of concrete by using Dimma sand

No.	Test Age (Days)	Dimensions of cubical mold (cm)			Sample Weight (gm)	Volume of cubical mold (cm^3)	Failure Load (KN)	Compressive Strength (MPa)=Failure load per area of cubical mold	Unit Weight (gm/cm3) = sample Weight per volume of mold
		L	W	H					
1	28	15	15	15	8565	3375	690.75	30.70	2.54
2		15	15	15	8330	3375	695.25	30.90	2.47
3		15	15	15	8265	3375	659.25	29.30	2.45
Mean							681.75	30.3	2.49

As a table, 1 results, describe that the compressive strength results by using dimma sands and the mean three trail mix at 28 days showed that 30.3 Mpa.

Table 2: Compressive strength of concrete by using Gambella sand

No	Test Age (Days)	Dimensions of cubical mold (cm)			Sample Weight (gm)	Volume of cubical mold (cm^3)	Failure Load (KN)	Compressive Strength(MPa) = Failure load per area of cubical mold	Unit Weight (gm/cm3)= sample Weight per volume of mold
		L	W	H					
1	**28**	15	15	15	8600	3375	776.25	34.5	2.55
2		15	15	15	8350	3375	724.5	32.2	2.47
3		15	15	15	8255	3375	780.75	34.7	2.45
Mean							760.5	33.80	2.49

As table 2, results describe that the compressive strength results by using gamebella sands and the mean three trail mix at 28 days showed that 33.80Mpa.

Table 3: Compressive strength of concrete by using Tepi sand

No.	Test Age (Days)	Dimensions of cubical mold (cm)			Sample Weight (gm)	Volume of cubical mold (cm3)	Failure Load (KN)	Compressive Strength(MPa =Failure load per area of cubical mold	Unit Weight (gm/cm3)=sample Weight per volume of mold
		L	W	H					
1	28	15	15	15	8150	3375	564.75	25.1	2.41
2		15	15	15	8100	3375	559.8	24.88	2.4
3		15	15	15	8115	3375	538.43	23.93	2.404
Mean							554.33	24.64	2.4

As table 3, results describe that the compressive strength results by using Tepi sands and the mean three trail mix at 28 days showed that 24.64Mpa.

Table 4: Compressive strength of concrete by using Meti sand

No	Test Age (Days)	Dimensions of cubical mold (cm)			Sample Weight (gm)	Volume of cubical mold (cm3)	Failure Load (KN)	Compressive Strength (MPa)=Failure load per area of cubical mold	Unit Weight (gm/cm3)=sample Weight per volume of mold.
		L	W	H					
1	28	15	15	15	8365	3375	520.43	23.13	2.48
2		15	15	15	8381	3375	517.05	22.98	2.48
3		15	15	15	8400	3375	508.73	22.61	2.49
Mean							515.4	22.91	2.485

As table 4, results describe that the compressive strength results by using Meti sand and the mean three trail mix at 28 days showed that 22.91Mpa. From the above four tables, the average compressive strength of different sand samples results presented and summarized in graph forms below.

As figure 3 below, indicated that, the compressive strength of gambela sand scored the highest compressive strength with 33.8 MPa and the next three positions were taken by dimma, Meti and Tepi sand manufactured concretes respectively. Numerically, Dimma, Tepi and Meti sand manufactured concrete scored 30.3, 24.64 and 22.91 MPa compressive strength. From the standard point of view, according to Ethiopian Standards (EBCS-2) gambela and dimma sand manufactured concrete strength satisfied. On the contrary, meti and tepi sand manufactured concrete strength was failed by scoring below 30MPa.

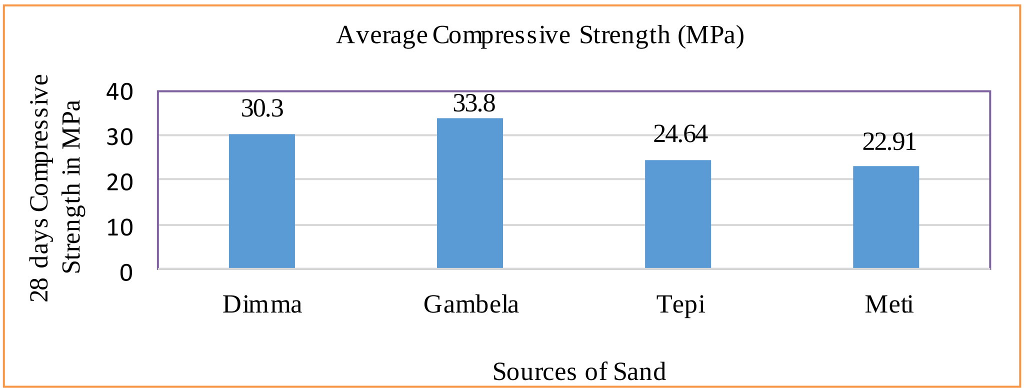

Fig. 3: Compressive strength in 28 days

4. CONCLUSION

For fine aggregates based on, ES standards for evaluation of their suitability as building concrete material. From experimental tests, the results show that the gradations of Gambella sand satisfy the standard limits. Dimma, Tepi and Meti sands were not satisfied the standard limits based on Ethiopian standards. ASTM specification limits the amount of material passing the 75 µm (No. 200) sieves to 5% in fine aggregate. Laboratory test evaluation showed that both Gambela and Dimma sand samples satisfied ASTM and ES limitation however Tepi and Meti sand samples did not satisfied so that in original sample Tepi and Meti sand is not suggested for building construction unless if it is washed.

According to Ethiopian Standards (EBCS-2) gambela and dimma compressive strength satisfied concrete satisfied results 33.8 and 30.3 Mpa respectively, and. On the contrary, Meti and Tepi sand results 22.91 and 24.64 respectively, concrete strength was failed by scoring below 30MPa, therefore, the results showed that if the silt content high, the strength of the concrete minimum.

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