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Effect of Silt Content on the Strength Property of Concrete – A Case Study

[1.] Tauseef Bashir,
Student,
Department of structural engineering,
Indo Global Group of Colleges Mohali,
Punjab 140109

[2] Manjit Kour Science
Assistant Professor,
Department of Structural Engineering,
Indo Global Group of Colleges Mohali,
Punjab 140109

***Abstract* - This project is robust with the effects of different quantities of silt content present in fine aggregates on the strength of concrete. The 3 days, 7 days, & 28 days compressive strength of concrete is checked. 36 samples were tested. For different tests such as compressive strength, split tensile strength, flexural strength on different shaped samples (cube, cylinder, & beam). Each 9 samples casted with different fine aggregates found in the river Jehlum at different locations namely, Qamarwari, Pampore, and Lasjan. Each sample is casted with design mix of M30 ratio.**

INTRODUCTION

1.1: SILT:

Silt consists of small particles or grains of soil and minerals that are easily carried and deposited by water. Each particle is smaller than a grain of sand but larger than a clay particle. When heavy rains pound the soil some of these fine granular particles are carried by the runoff water as silt. Silt carried by water runoff is deposited in lowlands, rivers or ponds as sediment. The environmental impact of silt is enormous, as once it settles into a river or lowland it provides valuable nutrients for plants and insects in the sediment it creates.

Silt carried down the Nile River, for example, created an oasis of rich, fertile soil for the ancient Egyptians. Silt is carried down the Mississippi and other rivers to the ocean where it also provides a rich habitat for plants and fish. But silt can also be a source of problems by clogging pipes and drains. When too much silt is dumped into waterways or rivers, it can become a pollutant known as siltation. This can cause a number of environmental problems, including killing fish by clogging their gills, and by reducing the water's dissolved oxygen level

1.2: Properties and characteristics of Silt:

Silt is granular material of a size between sand and clay, whose mineral origin is quartz and feldspar. Silt may occur as a soil (often mixed with sand or clay) or as sediment mixed in suspension with water (also known as a suspended load) and soil in a body of water such as a river. It may also exist as soil deposited at the bottom of a water body, like mudflows from landslides. Silt has a moderate specific_area with a typically non-sticky, plastic feel. Silt usually has a floury feel when dry, and a slippery feel when wet. Silt can be visually observed with a hand lens.

Silt particles range between 0.0039 and 0.0625 mm, larger than clay but smaller than sand particles. ISO 14688 grades silts between 0.002 mm and 0.063 mm. In actuality, silt is chemically distinct from clay, and unlike clay, grains of silt are approximately the same size in all dimensions; furthermore, their size ranges overlap. Clays are formed from thin plate-shaped particles held together by electrostatic forces, so present cohesion. According to the U.S. Department of Agriculture Soil Texture Classification system, the sand-silt distinction is made at the 0.05 mm particle size. The USDA system has been adopted by the Food and Agriculture Organization (FAO). In the Unified Soil Classification System (USCS) and the AASHTO Soil Classification system, the sand-silt distinction is made at the 0.075 mm particle size (i.e., material passing the #200 sieve). Silts and clays are distinguished mechanically by their plasticity

1.3Effects of silt on hardened concrete:

Effect of silt fines on the durability properties of concrete. Silt fines are fine aggregate particles smaller than the 75 μm (No. 200) sieve. ... The compressive strength, however, when silt fine content is small than 5%, increases only 1 MPa. But decreases from 3 MPa to 5 MPa when the silt content increases from 7% to 9%...were cast and tested in this study. Moreover, chloride transport tests were conducted to investigate the properties of concrete. Test results indicate a decrease in durability when the ratio of silt content to fine aggregate exceeds 5%. The compressive strength, however, when silt fine content is small than 5%, increases only 1 MPa. But decreases from 3 MPa to 5 MPa when the silt content increases from 7% to 9%. These results could serve as a reference in concrete production as well as quality control of fine aggregate containing a large amount of silt fines.

International Journal of Engineering Research & Technology (IJERT)
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2. SOURCE OF MATERIALS AND TEST DATA

S.No	Name of Materials	Source	Specific Gravity	Water Absorption (%)	Silt Content(%)
1	Cement OPC 43 Brand TCI		3.15	-	-
2	Coarse Aggregates (20.mm)	QAMARWARI	2.84	-	-
3	Fine Aggregates	QAMARWARI, LASJAN, PAMPORE	2.64 2.64 2.64	7.5 4.17 2.5	6.65 4.65 4.8
4	Water	1	-	-	-

3.OBSERVATION AND CALCULATION OF SILT CONTENT AS PER IS 383 FOR QAMARWARI SAMPLE

Description	Sample Numbers		
	Sample-1	Sample-2	Sample-2
Volume of sample, V_1 (ml)	75	75	75
Volume of silt after 3 hours, V_2(ml)	5	6	4
% silt by volume =(V_2/V_1)*100	6.67	8	5.3

Average of above three values =6.65%

4.OBSERVATION AND CALCULATION OF SILT CONTENT FOR LASJAN SAMPLE AS PER IS 383

Description	Sample Numbers		
	Sample-1	Sample-2	Sample-2
Volume of sample, V_1 (ml)	82	82	82
Volume of silt after 3 hours, V_2(ml)	3	5	4
% silt by volume =(V_2/V_1)*100	3.4	5.8	4.8

Average of above three values =4.65%

5. OBSERVATION AND CALCULATION OF SILT CONTENT FOR PAMPORE SAMPLE AS PER IS 383

Description	Sample Numbers		
	Sample-1	Sample-2	Sample-2
Volume of sample, V_1 (ml)	82	82	82
Volume of silt after 3 hours, V_2(ml)	5	4	3
% silt by volume =(V_2/V_1)*100	6.0	4.8	3.6

Average of above three values =4.8%

6. SAMPLE DETAILS

6.1 Details of Lasjan Sample

Ingredients:	Quantity
Cement	23Kg
Coarse Aggregates	74Kg
Fine Aggregates	35Kg
Water	9Kg
Zone of Sand	IV
Silt Content	4.65%
Water Content in Sand	4.17%

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 7 Issue 09, September-2018

6.2 Details of Pampore Sample

Ingredients:	Quantity
Cement	22.97Kg
Coarse Aggregates	70Kg
Fine Aggregates	33.21Kg
Water	9.45Kg
Zone of Sand	IV
Silt Content	4.8%
Water Content in Sand	4.8%

6.3 Details of Qamarwari Sample

Ingredients:	Quantity
Cement	22.97Kg
Coarse Aggregates	70Kg
Fine Aggregates	33.21Kg
Water	7.45Kg
Zone of Sand	IV
Silt Content	6.65%
Water Content in Sand	7.5%

7.1 Tests Performed

- Compressive strength test
- Split tensile test
- Flexural strength test

SPECIMEN USED, RESULTS AND DISCUSSION

Compressive strength test

6 cubes of 15 cm size Mix. M30

Split tensile test

Concrete cylinder 15 cm diameter & 30cm long

Flexural strength test

Beam mould of size 15 x 15x 70 cm (when size of aggregate is less than 38 mm)

8. RESULTS OF LASJAN SAMPLE

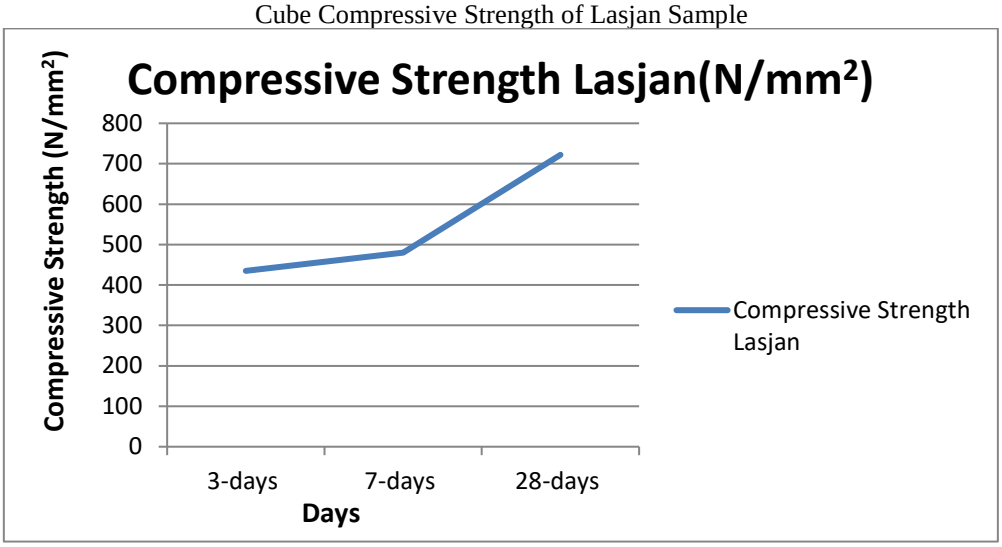
The compressive strength, split tensile strength, flexural strength test of concrete with silt content of 4.65% is shown in this table of different specimen.

Test date	CUBE(COMPRESSIVE STENGTH TEST) (N/ mm^2)	CYLINDER(SPLIT TENSILE TEST) (N/ mm^2)	BEAM(FLEXURAL STRENGTH TEST) (N/ mm^2)
3-days	435	110	8
7-days	480	160	13
28-days	722	185	15

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 7 Issue 09, September-2018

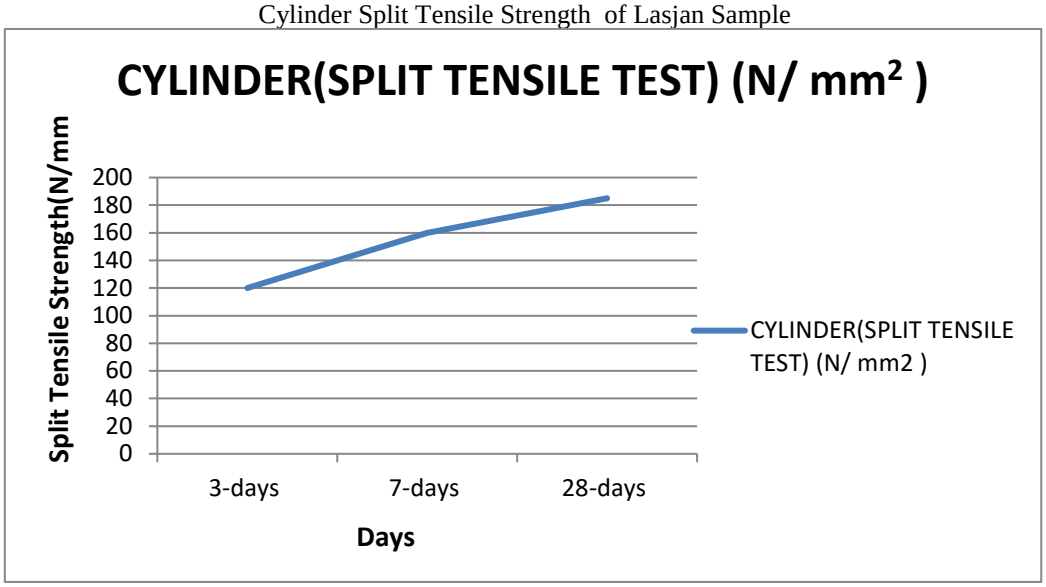
The 3-days, 7days and 28 days compressive strength of lasjan sample is shown in the graph below:-

Cube Compressive Strength of Lasjan Sample



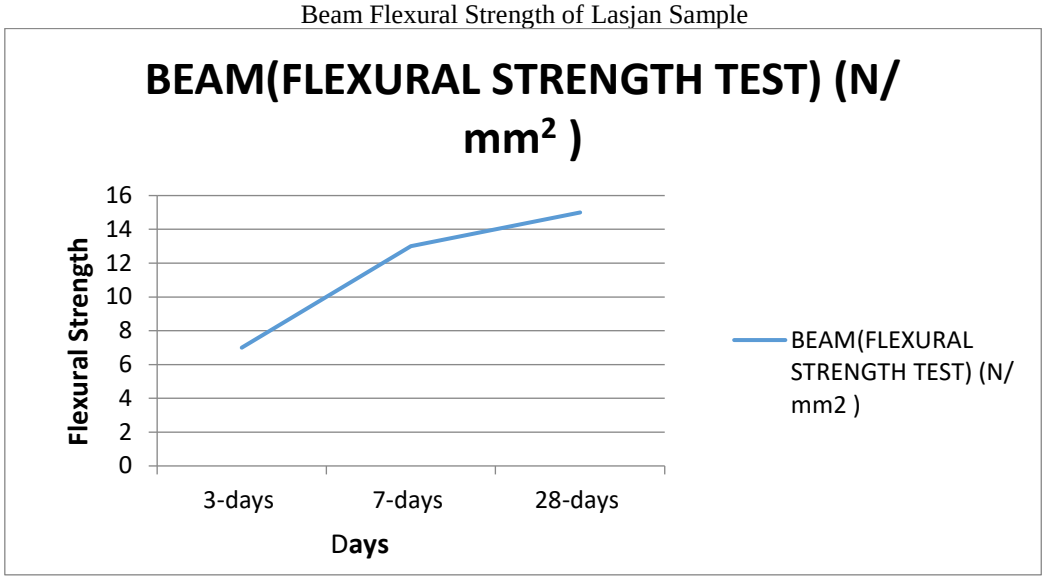
The 3-days, 7days and 28 days Split Tensile Strength of lasjan sample is shown in the graph below:-

Cylinder Split Tensile Strength of Lasjan Sample



The 3-days, 7days and 28 days Flexural strength of lasjan sample is shown in the graph below:-

Beam Flexural Strength of Lasjan Sample



International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 7 Issue 09, September-2018

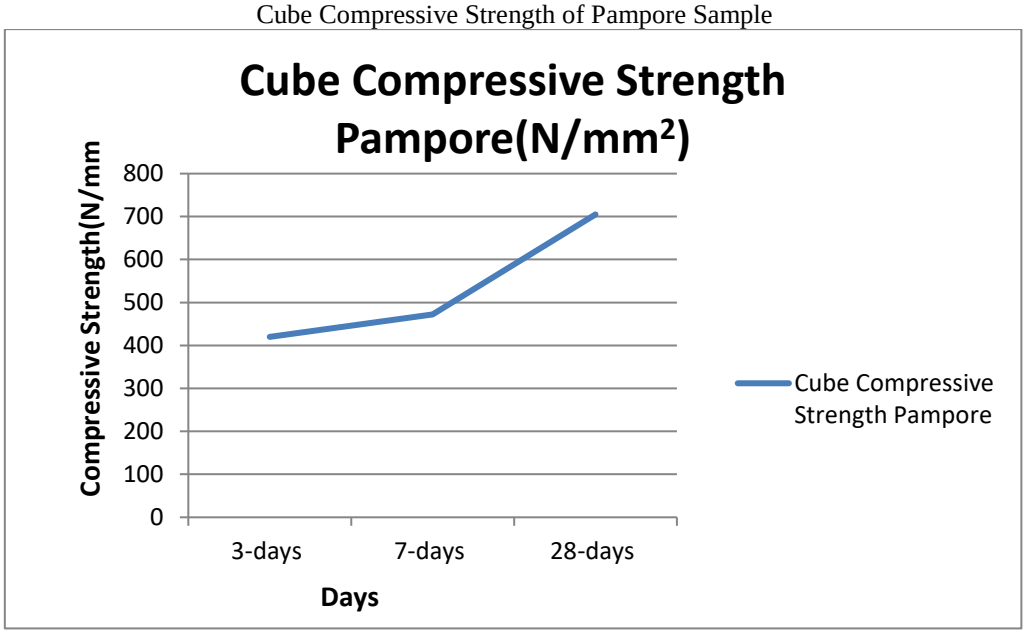
9. DETAILS OF PAMPORE SAMPLE

The compressive strength, split tensile strength, flexural strength test of concrete with silt content of 4.80% is shown in this table of different specimen.

Test date	CUBE(COMPRESSIVE STENGTH TEST) (N/ mm^2)	CYLINDER(SPLIT TENSILE TEST) (N/ mm^2)	BEAM(FLEXURAL STRENGTH TEST) (N/ mm^2)
3-days	420	80	7
7-days	472	120	12
28-days	705	150	14

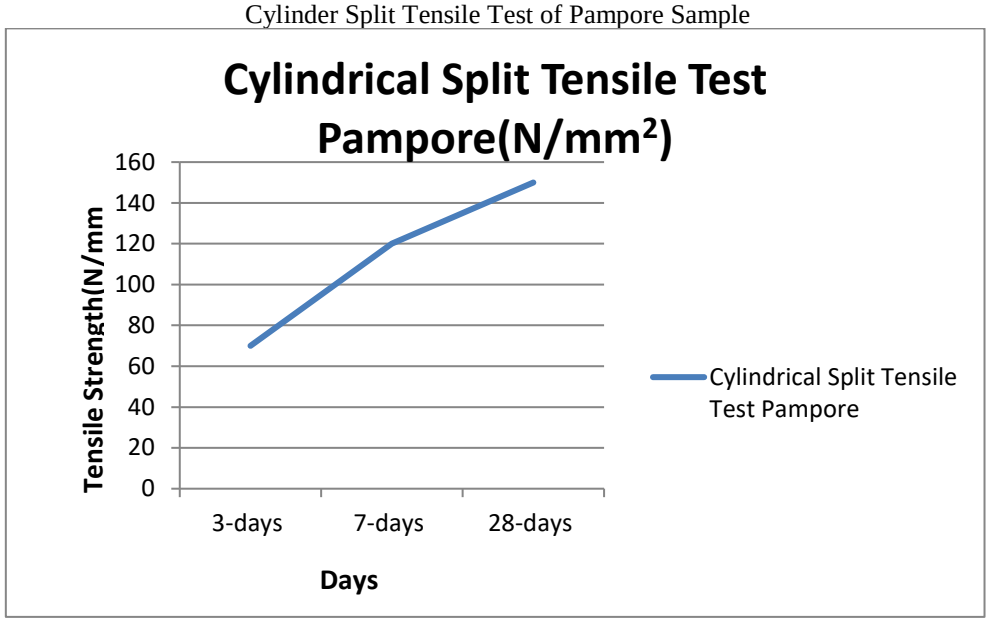
The 3-days, 7days and 28 days compressive strength of pampore sample is shown in the graph below:-

Cube Compressive Strength of Pampore Sample



The 3-days, 7days and 28 days Split Tensile Strength of pampore sample is shown in the graph below:-

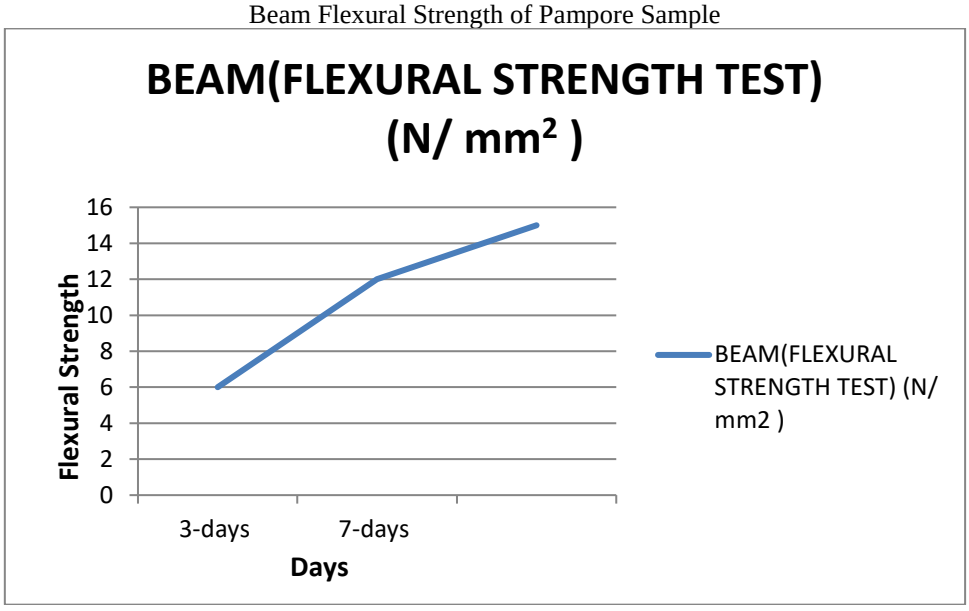
Cylinder Split Tensile Test of Pampore Sample



International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 7 Issue 09, September-2018

The 3-days, 7days and 28 days Flexural strength of Pampore sample is shown in the graph below:-

Beam Flexural Strength of Pampore Sample



From above results it is observed that sand from pampore with silt content 4.80 %, compressive strength, split tensile strength, and flexural strength is increased as days of curing increased. If results are compared with sand from Lasjan with silt content (4.65%), it is observed that all strength is decreasing as slit content is increased.

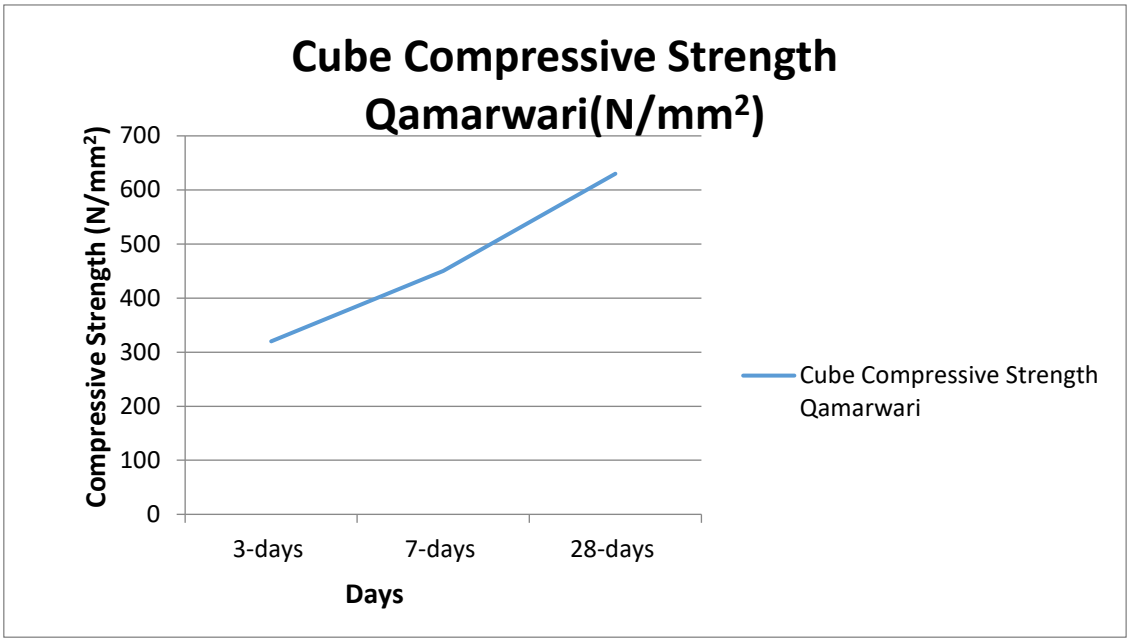
10. RESULTS OF QAMARWARI SAMPLE

The compressive strength, split tensile strength, flexural strength test of concrete with silt content of 6.65% is shown in this table of different specimen.

Test date	CUBE(COMPRESSIVE STENGTH TEST) (N/ mm^2)	CYLINDER(SPLIT TENSILE TEST)(N/ mm^2)	BEAM(FLEXURAL STRENGTH TEST)(N/ mm^2)
3-days	320	70	6
7-days	450	110	10
28-days	630	130	13

The 3-days, 7days and 28 days compressive strength of Qamarwari sample is shown in the graph below:-

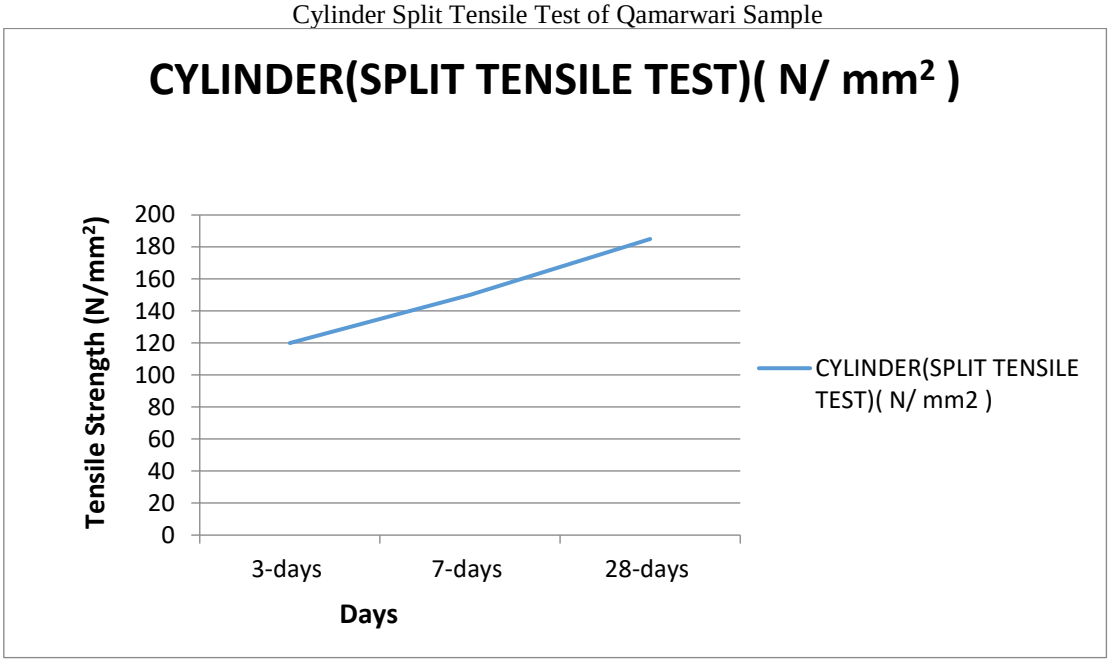
Cube compressive Strength of Qamarwari Sample



International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 7 Issue 09, September-2018

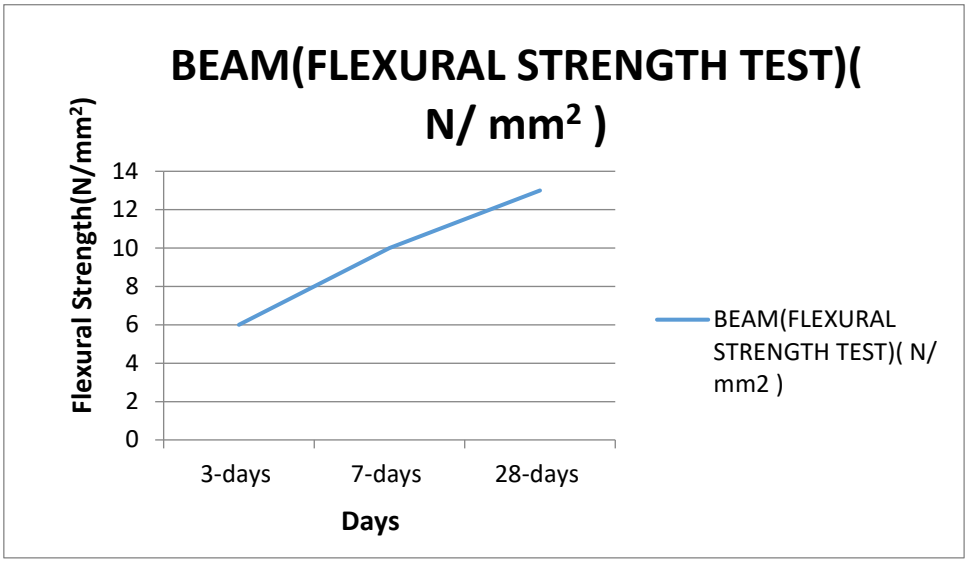
The 3-days, 7days and 28 days Split Tensile Strength of qamarwari sample is shown in the graph below:-

Cylinder Split Tensile Test of Qamarwari Sample



The 3-days, 7days and 28 days Flexural strength of Qamarwari sample is shown in the graph below:-

Beam Flexural Strength of Qamarwari Sample

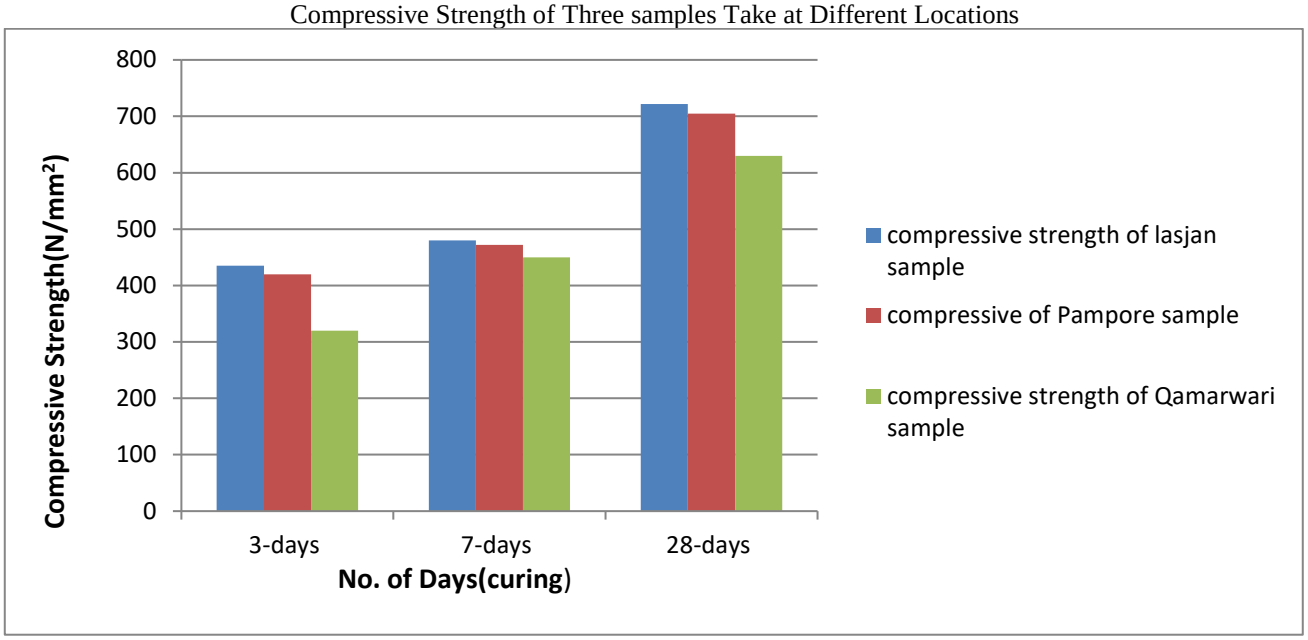


From above results it is observed that sand from pampore, Lasjan and qamarwari with silt content 4.80 %, 4.65% and 6.65% compressive strength, split tensile strength, and flexural strength is increased as days of curing increased. If results are compared with sand from Lasjan with silt content (4.65%), it is observed that all strength is decreasing as slit content is increased.

- At the end, all the strengths are compared with each other .
  In below graph comparison of compressive strength of sand from different location having different percentage of silt content are shown.

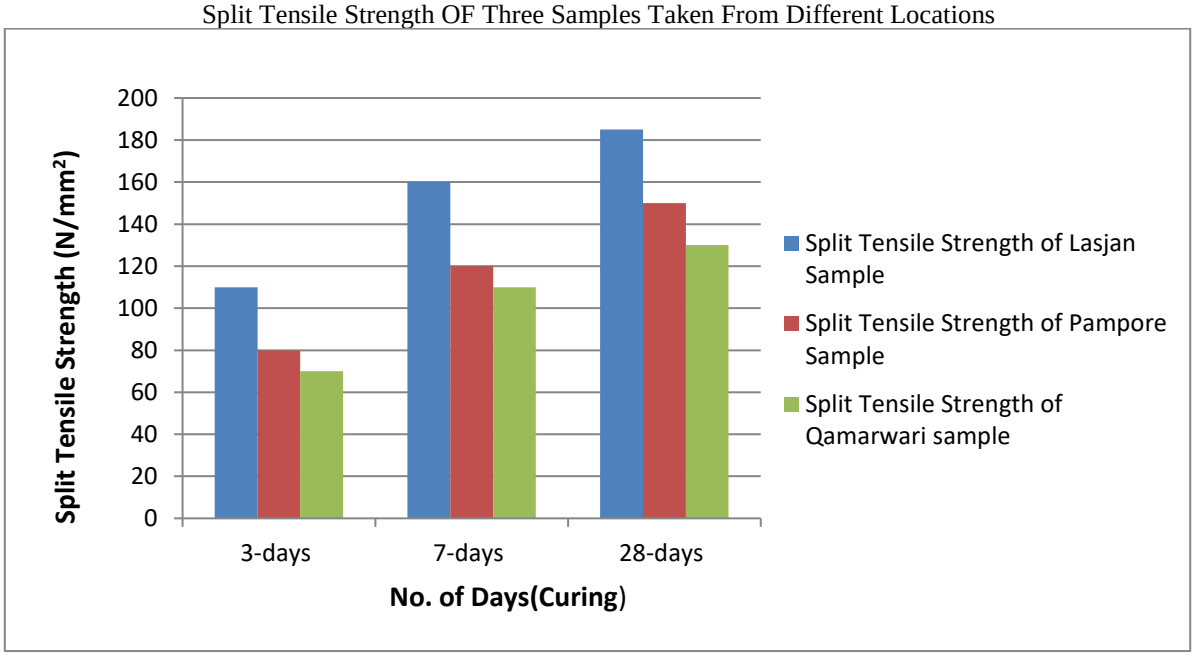
International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 7 Issue 09, September-2018

Compressive Strength of Three samples Take at Different Locations



In Below split tensile strength of all the samples taken from three different locations are compared with each other having different percentage of silt content.

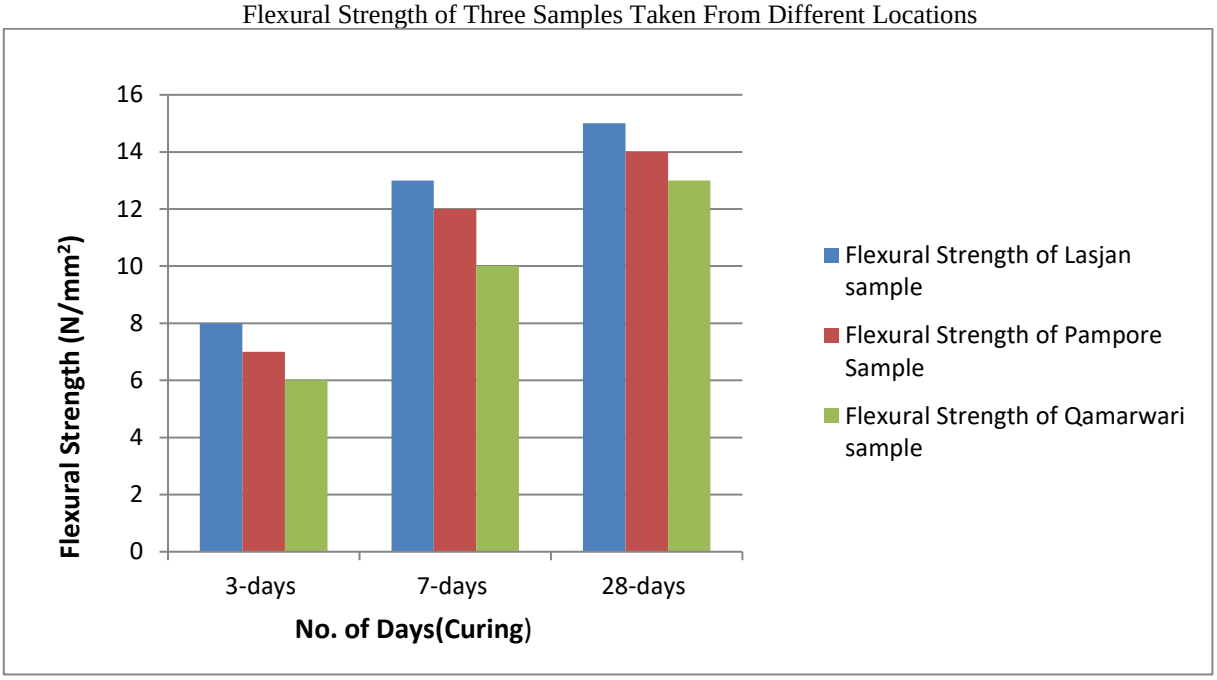
Split Tensile Strength OF Three Samples Taken From Different Locations



In below Bar Chart flexural strength of all the samples taken from three different locations are compared with each other having different percentage of silt content .

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 7 Issue 09, September-2018

Flexural Strength of Three Samples Taken From Different Locations



From above graphs, it is observed that all types of strengths are decreases as the silt content is increases.

CONCLUSION:

Based on the experimental investigations, the following conclusions were drawn.

1) The control mix for M30 grade with the varying quantity of silt content by 6.65%, 4.65%, & 4.80% were designed.

2) It is concluded that with the increase in 0.15% of silt content in fine aggregates, the compressive strength of concrete mixes decreases by 0.15%,0.08%,and 0.17% after 3,7 and 28 days respectively comparing Lasjan and Pampore samples.

3) It is concluded that with the increase in 1.85% of silt content in fine aggregates, the compressive strength of concrete mixes decreases by 1%, 0.22%, and 0.75% after 3, 7 and 28 days respectively comparing pampore and qamarwari samples.

4)) It is concluded that with the increase in 2% of silt content in fine aggregates, the compressive strength of concrete mixes decreases by 1.15%,0.30%,and 0.92% after 3,7 and 28 days respectively comparing Lasjan and Qamarwari samples.

5)) It is concluded that with the increase in 0.15% of silt content in fine aggregates, the Split Tensile strength of concrete mixes decreases by 0.3%,0.40%,and 0.35% after 3,7 and 28 days respectively comparing Lasjan and Pampore samples.

6) It is concluded that with the increase in 1.85% of silt content in fine aggregates, the Split Tensile strength of concrete mixes decreases by 0.1%, 0.1%, and 0.2% after 3, 7 and 28 days respectively comparing qamarwari and Pampore samples.

7)) It is concluded that with the increase in 2% of silt content in fine aggregates, the compressive strength of concrete mixes decreases by 1.4%,0.5%,and 0.55% after 3,7 and 28 days respectively comparing Lasjan and Qamarwari samples.

8)) It is concluded that with the increase in 0.15% of silt content in fine aggregates, the flexural strength of concrete mixes decreases by 0.01%,0.01%,and 0.01% after 3,7 and 28 days respectively comparing Lasjan and pampore samples.

9)) It is concluded that with the increase in 1,85% of silt content in fine aggregates, the compressive strength of concrete mixes decreases by 0.01%,0.02%,and 0.01% after 3,7 and 28 days respectively comparing pampore and Qamarwari samples.

10)) It is concluded that with the increase in 2% of silt content in fine aggregates, the flexural strength of concrete mixes decreases by 1.02%,0.03%,and 0.02% after 3,7 and 28 days respectively comparing Lasjan and Qamarwari samples.

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