# HIGH STRENGTH LIGHT WEIGHT CONCRETE

Balaji B[1], Sathyakumar N[2]
[1]M.E-Structural Engineering-Final year, [2]Assistant Professor, Department of Civil Engineering
Bannari Amman institute of Technology, Erode, India

***Abstract:*** ***The aim of this study is to produce a high strength light weight concrete compared to the normal light weight concrete .Five dosages of aluminium powder (0%, 0.25%, 0.50%, 0.75%, and 1%) by weight of cement are used to produce light weight concrete. Addition of more than 1% aluminium powder reduces compressive strength and densities drastically. The ultimate strength of high strength light weight concrete ranges between 10N/mm$^2$ to 40 N/mm$^2$.The compressive strength, split tensile strength and flexural strength of light weight concrete of density 1800Kg/m$^3$ to 2000Kg/m$^3$.In this investigation, aluminium powder is increased, compressive strength is decreased. The mechanical properties such as compressive strength, split tensile strength and flexural strength of high strength light weight concrete have been researched.***

***Keywords: Silica fume; Aluminium powder; Super plasticizer.***

## I. INTRODUCTION

Light weight concrete (LWC) can be defined as a type of concrete which includes an expanding agent which increases the volume of mixture while reducing the dead weight. It is lighter than conventional concrete with a dry density below 2000 Kg/m3.The main specialties of the light weight concrete are the low density and low thermal conductivity. There are many types of light weight concrete which can be produced either by using light weight aggregate or by using an air entraining agent. In this research, aluminium powder has been used as the air entraining agent. The fine powder of aluminium reacts with the calcium hydroxide in the cementitious system produces hydrogen gas. This hydrogen gas in the mix gives the cellular structure and makes the concrete lighter than the conventional concrete. Aerated concrete is obtained by a chemical reaction generating a gas in fresh mortar, so that when it sets it contains a large number of gas bubbles. Finely divided aluminium powder in various percentages by weight of cement is used for producing aerated concrete.

## II. ALUMINIUM POWDER PROPERTIES

Aluminium powder is usually used to obtain aerated concrete by a chemical reaction generating a gas in fresh mortar, so that when its sets it contains a large number of gas bubbles. Aluminium powder with grain size less than 50µm,can easily form highly flammable aero suspensions(dust clouds)during pouring or vibration. Fine, uniform, smooth metallic powder free from aggregates available from market is used in this research and it has an atomic weight of 26.98.

## III. MIX RATIO

Table1.Mix Proportions for light weight concrete(M20 grade)

| CEMENT | F.A | C.A | WATER | Aluminium powder |
|---|---|---|---|---|
| 336 | 752 | 1024 | 168 | 0,0.84,1.68,2.52,3.36 |
| 1 | 2.23 | 3 | 0.5 | 0%,0.25%,0.50%,0.75%,1% |

Table2.Mix Proportions for High strength light weight concrete(M60 grade)

| CEMENT | F.A | C.A | WATER | SILICA FUME (10%) | SUPERPLASTICIZER (1%) | ALUMINIUM POWDER |
|---|---|---|---|---|---|---|
| 495 | 541 | 1024 | 168 | 55 | 5.5 | 0,1.38,2.75,4.12,5.2 |
| 1 | 1.09 | 2.06 | 0.30 | 0.11 | 0.01 | 0%,0.25%,0.50%,0.75%,1% |

COMPACTION:
Hand compaction (light weight concrete)
Needle vibrator (high strength light weight concrete)

## IV. RESULT AND DISCUSSION

Compressive strength test was conducted on Light weight concrete and High strength light weight concrete cubes at different curing ages of 7 and 28 days.

Table3.Mixes and aluminium powder parcentage

| Mix | Aluminium powder parcentage(%) |
|---|---|
| 1 | 0 |
| 2 | 0.25 |
| 3 | 0.50 |
| 4 | 0.75 |
| 5 | 1 |

Table4.Test results of light weight concrete average compressive strength of cubes at the age of 7days and 28 days

| Mix | Average compressive strength (N/mm$^2$) | |
|---|---|---|
| | 7 days | 28 days |
| 1 | 13.68 | 20.9 |
| 2 | 9.25 | 13.66 |
| 3 | 8.13 | 11.62 |
| 4 | 5.24 | 9.01 |
| 5 | 2.32 | 4.65 |

  

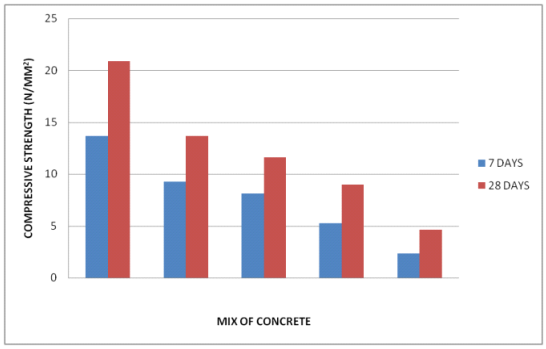


Fig1.Compressive strength of light weight concrete cubes for mixes– 1,2,3,4,5 at age of 7 days and 28 days

Table5.Test results of High strength light weight concrete average compressive strength of cubes at the age of7days and 28days

| S. No. | Mix | Average compressive strength (N/mm²) | |
|---|---|---|---|
| | | 7 days | 28 days |
| 1 | 1 | 39 | 61.57 |
| 2 | 2 | 22.33 | 38.65 |
| 3 | 3 | 18.31 | 30.22 |
| 4 | 4 | 12.18 | 22.09 |
| 5 | 5 | 6.38 | 11.33 |

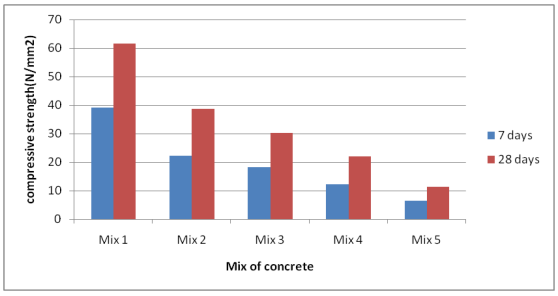


Fig2.Compressive strength of High strength light weight concrete cubes for mixes– 1,2,3,4,5 at age of 7 days and 28 days

Table6. Test results of light weight concrete Split tensile strength at the age of 7 days and 28 days

| Mix | Average split tensile strength (N/mm²) | |
|---|---|---|
| | 7 days | 28 days |
| 1 | 1.25 | 1.52 |
| 2 | 0.83 | 1.38 |
| 3 | 0.69 | 1.24 |
| 4 | 0.55 | 0.97 |
| 5 | 0.41 | 0.68 |

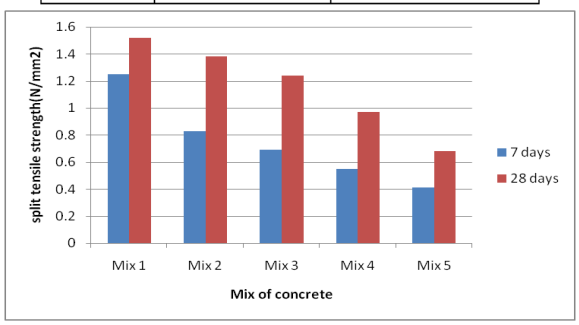


Fig3.split tensile strength of light weight concrete cubes for mixes– 1,2,3,4,5 at age of 7 days and 28 days

Table7.Test results of High strength light weight concrete average split tensile strength of cylinder at the age of 7days and 28 days

| Mix | Average split tensile strength (N/mm²) | |
|---|---|---|
| | 7 days | 28 days |
| 1 | 2.36 | 3.66 |
| 2 | 1.93 | 3.05 |
| 3 | 1.24 | 2.63 |
| 4 | 0.97 | 1.94 |
| 5 | 0.55 | 0.83 |

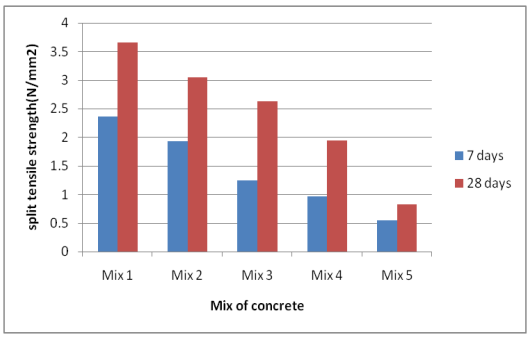


Fig4.split tensile strength of High strength light weight concrete cylinder for mixes– 1,2,3,4,5 at age of 7 days and 28 days

Table8.Test results of light weight concrete flexural strength at the age of 28 days

| Mix | Average flexural strength (N/mm²) |
|---|---|
| Mix-1 | 3.33 |
| Mix-2 | 2.16 |
| Mix-3 | 1.67 |
| Mix-4 | 1.25 |
| Mix-5 | 1.05 |

Table9.Test results of High strength light weight concrete flexural strength at the age of 28 days

| Mix | Average flexural strength (N/mm²) |
|---|---|
| Mix-1 | 6.75 |
| Mix-2 | 5.31 |
| Mix-3 | 4.79 |
| Mix-4 | 4.36 |
| Mix-5 | 3.8 |

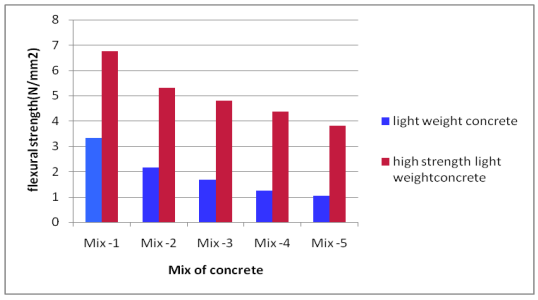


Fig5.flexural strength of light weight concrete and high strength light weight concrete for Mixes–1, 2, 3,4,5 at 28 days strength

  

DENSITY RESULTS

Table10.Density of Cubes

| Mix | Light weight concrete Average Density(kg/m$^3$) | High strength light weight concrete average Density(kg/m$^3$) |
|---|---|---|
| Mix-1 | 2478 | 2485 |
| Mix-2 | 2244 | 2226 |
| Mix-3 | 2134 | 2140 |
| Mix-4 | 1996 | 1931 |
| Mix-5 | 1813 | 1872 |

Table11.Density of cylinders

| Mix | Light weight concrete Average Density(kg/m$^3$) | High strength light weight concrete average Density(kg/m$^3$) |
|---|---|---|
| Mix-1 | 2422 | 2458 |
| Mix-2 | 2199 | 2165 |
| Mix-3 | 2132 | 2136 |
| Mix-4 | 2029 | 2043 |
| Mix-5 | 1886 | 1876 |

Table12.Density of prisms

| Mix | Light weight concrete Average Density(kg/m$^3$) | High strength light weight concrete average Density(kg/m$^3$) |
|---|---|---|
| Mix-1 | 2450 | 2485 |
| Mix-2 | 2208 | 2226 |
| Mix-3 | 2134 | 2140 |
| Mix-4 | 2032 | 1931 |
| Mix-5 | 1863 | 1872 |

Fig6.Aluminium powder reaction on concrete

## V. CONCLUSION

Based on the experimental investigation, the following conclusions could be drawn:

[1] Five different concrete mixes have been identified to get High strength light concrete based on cube (150mm size) compressive strength in the range 11.38 MPa to 38.65 MPa. Light weight concrete based on cube (150mm size) compressive strength in the range 4.65MPa to 13.66 MPa. successfully achieved high strength light weight concrete compared to normal light weight concrete.

[2] High strength Light weight concrete of density 1900-2000 Kg/m3 can be produced by using aluminium powder.

[3] Aluminium powder is increased, Compressive strength, split tensile strength, flexural strength is decreased. Aluminium powder is decreased, Compressive strength,split tensile strength, flexural strength is increased.

[4] The flexural strength of the concrete is about 10% of cube compressive strength of concrete.

[5] 0.2% of aluminium powder gives a higher strength (38.65MPa) compared to other parcentage of aluminium powder mixes.

[6]1% of aluminium powder causes more voids inside the concrete thereby reduced in strength.

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