The various elements of the structure like columns, outer walls and roof of slab were subjected to solar heat throughout the life. The rise in temperature is from sunrise to a maximum of four times the ambient temperature. In many parts of the world and in India, the peak temperature during summer goes beyond 400°C and in such conditions the structures will be subjected to 800°C and 900°C. The humidity also influences the temperature within the exposed elements due to solar heat. Hence all the elements of the structure which are exposed to solar radiation are said to be experience one thermal cycle in a day. Concrete is the extensive material used for making all the structural elements necessitates the study of behaviour of concrete subjected to temperature variations. The present experimental work was carried out on the concrete by partial replacement of cement with fly ash by 25% for all the grades of concrete subjected to thermal cycles of 28 and 56 per 8 hrs duration in a day at a temperature of 1000°C in an electric oven. The mix design of M20 to M50 grades was given less resistance to heat exposure. So they casted the cubes and kept in an electric oven for 3000°C for M30 grade concrete was observed at 30% fly ash grades was given less resistance to heat exposure. And remaining replacement of fly ash grades was given less resistance to heat exposure. So the compressive strength of concrete cubes is highest at 3000°C for M30 grade concrete was observed at 30% fly ash replacement to ordinary concrete.

II. LITERATURE REVIEW

V.Bindiganavile, K.N.Vishwanath and N.Suresh in 2014 [1]: Conducted an experimental study on the M30 grade of concrete with replacement of fly ash up to 30 percent and cubes of size 100x100x100 mm were subjected to temperature variations up to 3000°C for a period of 3 hours after 28 days curing period and the specimens were allowed to cool to room temperature then tested for compression. The results are indicated that M30 grade of concrete at 3000°C temperature and at 30% replacement of fly ash gave better resistance to heat exposure. And remaining replacement of fly ash grades was given less resistance to heat exposure. So the compressive strength of concrete cubes is highest at 3000°C for M30 grade concrete was observed at 30% fly ash replacement to ordinary concrete.

Bairagi N.K. and Dubal N.(1996) [2]: Presented the concept of thermal cycles to find out the variation of strengths in the concrete so they casted the cubes and kept in an electric oven for thermal cycles of 30 and 365 at 600°C and 900°C the compressive strength was found to decreased by 15.9% after 30 thermal cycles at 600°C and 21.2% after 30 thermal cycles at 900°C.in the same way the compressive strength was found to decreased by 20% after 365 thermal cycles at 600°C and 35% after 365 thermal cycles at 900°C.

Metin Husem (2006) [3]: investigated that the variation compressive and flexural strengths of ordinary concrete and high performance concrete was determined. In the case of ordinary concrete the specimens were casted for M30 grade...
and in the case of high performance concrete M70 grade with alternative of cement with silica fume by 10%. In both of the grades of the prisms of size 40mmx40mmx160mm were maintained. The casted the specimens were exposing them at a temperature of 2000C, 6000C, 8000C, 10000C for 1 hour duration. And finally the results indicate that the strength of high performance of concrete will give the better strength as compared to the ordinary concrete and the type of cooling will also be affects the compressive strength and flexural strengths.

Nimlyat.S and Datok.E. (2013) [4]: investigated the compressive strength and flexural strength of M40 grade concrete when the ordinary Portland cement was replaced by saw dust ash by 10% and subjected to elevated temperatures of 2000C, 4000C, 6000C and 8000C after completion of the heated specimens were cooled to room temperature and then tested for compression. The loss of compressive strength for 10% saw dust replaced was found to decrease by 23.04% for different temperatures, but in the case of ordinary Portland cement was decreased by 29.11% for different temperatures. At 8000C temperature the cubes were completely failed by flexure.

Neelam Pathak and Rafat Siddique (2012) [5]: Presented the properties of self compacting concrete such as compressive strength, splitting tensile strength. When open to the elements to prominent temperatures. And similarly the same self compacted concrete was replaced by class F fly ash varied to prominent temperatures. And similarly with the same grade of concrete with replacement of sugar cane bagasse ash. In this study they are used M25 grade of concrete with replacement of cement by sugarcane bagasse (0-40%) for cubes, cylinders and prisms are casted for curing period of 28 days and then they are tested for compression, split tension and flexure. And similarly with the same grade of concrete with replacement of sugar cane bagasse (0-40%) specimens of cubes, cylinders and prisms were casted and afterwards specimens were exposing up to 8500C in muffle furnace for about 8 hours duration up to 28 days. The results indicate that the heated specimens were give more strength than as compared to the without heating specimens.

Srinivasa Rao, Potha Raju, and Raju (2007) [8]: Conducted tests on compressive strength for M60 grade high strength concrete made by both ordinary Portland cement and Portland pozzolona cement. After cubes were removed from curing tank they were subjected to different temperatures like from 500C to 2500C, there is at an interval of 500C temperature for all the specimens, and the concrete specimens were exposed to heating periods of 1 hour, 2 hours and 3 hours. The heating period rate of specimens was followed from the code of ISO-834. Finally they concluded that concrete made by the Portland pozzolona cement was gave more strength than the concrete made from the ordinary Portland cement.

Sireesha.G, Kanta Rao.M and Kanta Rao.P (2013) [9]: studied those strength properties of concrete when cement is partially replaced with sugar cane bagasse ash. In this study they prepared M25 grade of concrete with replacement of cement by sugarcane bagasse (0-40%) for cubes, cylinders and prisms are casted for curing period of 28 days and then they are tested for compression, split tension and flexure. And similarly with the same grade of concrete with replacement of sugar cane bagasse (0-40%) specimens of cubes, cylinders and prisms were casted and afterwards specimens were exposing up to 8500C in muffle furnace for about 8 hours duration up to 28 days. The results indicate that the heated specimens were gave more strength than as compared to the without heating specimens.

Srinivasa Rao.P, Sravana.P, and M.V. Seshagiri Rao (2006) [10]: Conducted tests on concrete for compression, tension and dynamic modulus. In this they are used M20 and M30 grades of concrete replaced with 25% fly ash replacement, after completion of the curing period of 28 days the specimens were from oven and kept in electric oven for thermal cycles of 7, 14, 21 and 28 at 500C and 1000C temperature. The compressive strength of fly ash blended concrete was found to increase by 11 and 12% after 28 thermal cycles at 500C and 1000C in similar way split tensile strength, dynamic modulus of elasticity of fly ash blended concrete was found to increase by 5 to 10% after 28 thermal cycles at 500C and 1000C.

Srinivasa Rao .P and Mouli Chandra (2011) [11]: Conducted tests on M40 and M50 grades of both ordinary concrete and glass fibre concrete for compression. In this they used the concept of thermal cycles. The concrete specimens of size 100mmx100mmx100mm cubes were kept for thermal cycles of 28, 56, 90 and 180 at 1000C temperature in an electric oven. From the test results we observed that compressive strength of glass fibre concrete was found to decrease by 17 to 28% in glass fibre concrete mixes when compared to the zero thermal cycles of ordinary concrete.
Sravana.P, Srinivasa Rao.P (2006) [12]: Conducted tests on concrete cubes for compression M20 to M50 grades of concrete. Here they replaced cement with high volume fly ash in all grades of concrete. After the curing period of specimens were exposed to thermal cycles of 7, 28, 45 and 90 at temperatures of 500°C and 1000°C. From the test results they observed the compressive strength of ordinary concrete was found to decrease by 4 to 19% for thermal cycles of 7, 28, 45, 90 at 500°C & 7 to 24% for thermal cycles of 7, 28, 45, 90 at 1000°C. The compressive strength of high volume fly ash blended concrete (both addition of fly ash + replacement) was found to increase by 3 to 5% for thermal cycles of 7, 28, 45, 90 at 500°C & 1000°C temperature.

III. SCOPE OF INVESTIGATION

3.1 GENERAL
The scope of present research is to study and evaluate “the effect of thermal cycles on compressive strength of M20 to M50 grades of ordinary concrete and fly ash concretes”. Cubes of standard size 100mm x 100mm x 100mm (length x width x depth) were cast tested for 28 days and 56 days compressive strength. After completion of the normal curing period of 28 days and 56 days the specimens were tested for compression and then the specimens were kept in the electric oven for thermal cycles of 28 days and 56 days at a temperature of 100°C for about 8 hours daily and also specimens were tested for compression. In this chapter the methods that are adopted and tests that are conducted are explained briefly. The method adopted to obtain the design mixes for M20 to M50 grades of concrete are done according to IS: 10262-2009. For fresh concrete the slump cone test, compaction factor test and vee-bee time has been conducted and for hardened concrete the tests like compressive strength for cubes of size 100mm x 100mm x 100mm has been conducted.

3.2 OBJECTIVES
The work reported in this study, Fly ash obtained from the Fly ash used was brought from NTPC, Visakhapatnam is used as a cement replacement material in concrete mix. The final focus of this work is to ascertain the performance of concrete mix containing fly ash and compare with plain concrete mix. This is expected to provide:-
To partially replace cement content with fly ash in concrete as it directly influences economy in construction.
To evaluate the workability characteristics in terms of slump, compaction factor and vee-bee time on addition of fly ash only (25%).
To design and proportion the concrete mix for M20 to M50 grades concrete, as per the recommendation of IS: 10262-2009.
To find the Volume proportions of the concrete mixes by partially replacing Cement by fly ash.
To evaluate the M20 to M50 grades of ordinary concrete and fly ash concretes for the compressive strengths at 28 days and 56 days of normal curing by replacing cement with fly ash in proportion of 0% and 25%.
To evaluate the M20 to M50 grades of ordinary concrete and fly ash concretes for the compressive strengths at 28 days and 56 days thermal cycles at a temperature of 100°C by replacing cement with fly ash in proportion of 0% and 25%.

3.3 TEST PROGRAMME
To evaluate the strength characteristics in terms of compressive strength a total of 4 mixes were tried with different percentages of fly ash (0% & 25%). In all mixes the same type of aggregate i.e. crushed granite aggregate, fine aggregate, fly ash are used. The relative proportions of cement, coarse aggregate, sand and water are obtained by IS - Code method. M20 to M50 are considered as the reference mixes. (Appendix-I)

The parameters are
- For M20 design mix, the percentage of cement replaced with fly ash is in proportion of 0% and 25%.
- For M30 design mix, the percentage of cement replaced with fly ash is in proportion of 0% and 25%.
- For M40 design mix, the percentage of cement replaced with fly ash is in proportion of 0% and 25%.
- For M50 design mix, the percentage of cement replaced with fly ash is in proportion of 0% and 25%.

A total no. of 96 cubes of size 100mm x 100mm x 100 mm were casted and tested for each percentage of partial replacement of cement. A sample calculation for determination of weight and volumes is presented in Appendix- II. The test programme consisted of conducting compressive strength test on cubes at 28 days and 56 days of normal curing and 28 days and 56 days thermal cycles at a temperature of 100°C.

IV. IV.THEORY
In the present experimental work fly ash has been used as partial replacement of cement as an additional ingredient in concrete mixes. The details of the materials used are given below.

MATERIALS:
CEMENT: The cement used was Ordinary Portland Cement (KCP 53 grade). The cement procured was tested for physical requirements in accordance with IS: 12269-1987. The details are given in Table 3.1.

<table>
<thead>
<tr>
<th>TABLE 4.1 Physical properties of Cement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Properties</td>
</tr>
<tr>
<td>---------------------------</td>
</tr>
<tr>
<td>Fineness</td>
</tr>
<tr>
<td>Normal consistency</td>
</tr>
<tr>
<td>Specific gravity</td>
</tr>
</tbody>
</table>

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4.2. FLY ASH:

“Fly ash used was brought from NTPC, Visakhapatnam. Fly ash is one of the residues generated in the combustion of coal. Fly ash, a by-product of the thermal power generation industries, is widely used as a cementious and pozzolanic ingredient in OPC concrete. Fly ash chemically reacts with the by-product calcium hydroxide released by the chemical reaction between cement and water to form additional cementitious products that improve many desirable properties of concrete. All fly ashes exhibit cementitious properties to varying degrees depending on the chemical and physical properties of both the fly ash and cement. Compared to cement and water, the chemical reaction between fly ash and calcium hydroxide typically is slower resulting in delayed hardening of the concrete. Delayed concrete hardening coupled with the variability of fly ash properties can create significant challenges for the concrete producer and finisher when placing steel-troweled floors.”

<table>
<thead>
<tr>
<th>Sl. NO.</th>
<th>Properties</th>
<th>Test results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Particle shape</td>
<td>Small &amp; spherical</td>
</tr>
<tr>
<td>2</td>
<td>Appearance</td>
<td>Dark grey</td>
</tr>
<tr>
<td>3</td>
<td>Specific gravity</td>
<td>2.28</td>
</tr>
<tr>
<td>4</td>
<td>Bulk density</td>
<td>0.99 g/cc</td>
</tr>
<tr>
<td>5</td>
<td>Particle size</td>
<td>6.90 microns</td>
</tr>
<tr>
<td>6</td>
<td>Moisture content</td>
<td>3.14</td>
</tr>
<tr>
<td>7</td>
<td>Fineness</td>
<td>320 m²/kg</td>
</tr>
<tr>
<td>8</td>
<td>Lime reactivity</td>
<td>4.0 N/mm²</td>
</tr>
<tr>
<td>9</td>
<td>Compressive strength @28 days</td>
<td>80 % of strength of corresponding plain cement mortar Cubes</td>
</tr>
<tr>
<td>10</td>
<td>Soundness by autoclave</td>
<td>0.8%</td>
</tr>
</tbody>
</table>

TABLE 4.2 Physical properties of Fly ash (as per supplier)

<table>
<thead>
<tr>
<th>Sl. NO.</th>
<th>Chemical composition</th>
<th>Wt</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sulphur dioxide</td>
<td>60</td>
</tr>
<tr>
<td>2</td>
<td>Aluminium trioxide</td>
<td>17</td>
</tr>
<tr>
<td>3</td>
<td>Iron trioxide</td>
<td>6.5</td>
</tr>
<tr>
<td>4</td>
<td>Calcium oxide</td>
<td>5.50</td>
</tr>
<tr>
<td>5</td>
<td>Magnesium oxide</td>
<td>2.3</td>
</tr>
<tr>
<td>6</td>
<td>Sulphur trioxide</td>
<td>1.00</td>
</tr>
<tr>
<td>7</td>
<td>Loss of ignition</td>
<td>4.2</td>
</tr>
<tr>
<td>8</td>
<td>Alkalies</td>
<td>0.80</td>
</tr>
</tbody>
</table>

4.3. AGGREGATES:

Aggregates can be classified on the basis of the size as coarse aggregate and fine aggregate.

4.4.1. COARSE AGGREGATE:

Coarse aggregates are used for making concrete. The aggregate fractions from 80mm to 4.75mm are termed as coarse aggregate. Machine crushed angular granite metal of 20mm passed and 10mm retained has been used. It is free from impurities such as dust, clay particles and organic matter. The coarse aggregate is tested for various properties according to IS 2386-1963. The physical properties and sieve analysis are given in table 4.4 and table 4.5.

<table>
<thead>
<tr>
<th>S.NO</th>
<th>Properties</th>
<th>Test results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Specific Gravity</td>
<td>2.81</td>
</tr>
<tr>
<td>2</td>
<td>Water Absorption</td>
<td>0.96 %</td>
</tr>
<tr>
<td>3</td>
<td>Flakiness Index</td>
<td>14.15 %</td>
</tr>
<tr>
<td>4</td>
<td>Elongation Index</td>
<td>21.30 %</td>
</tr>
<tr>
<td>5</td>
<td>Crushing value</td>
<td>21.4 %</td>
</tr>
<tr>
<td>6</td>
<td>Impact Value</td>
<td>15.8 %</td>
</tr>
<tr>
<td>7</td>
<td>Fineness Modulus</td>
<td>7.25</td>
</tr>
</tbody>
</table>
V. EXPERIMENTAL PROGRAMME
In this chapter the methods that are adopted and tests that are conducted are explained briefly. The method adopted to obtain the design mixes for M20 to M50 grades of concrete are done according to IS: 10262-2009. Similarly for all the grades of concrete we replaced the cement with fly ash is 25%. For fresh concrete the slump cone test, compacting factor and vee-bee time tests have been conducted and for hardened concrete the tests like compressive strength for cubes of size 100mm x 100mm x 100mm has been conducted.

5.1. PREPARATION OF TESTING SPECIMEN:
5.1.1. MIXING:
The required proportions of materials of concrete are taken in dry condition, mixed thoroughly before they were put in the concrete mixer. The wet concrete from the concrete mixer were tested for its workability.

5.1.2. CASTING OF THE SPECIMENS:
The concrete trial specimens of size 100 mm x 100 mm x 100mm cubes were casted and compacted using table vibrator and made the level surface smooth using trowel as per IS 516-1959.

5.1.3. COMPACTION OF CONCRETE:
“Compaction of concrete is the process adopted for expelling the entrapped air from the concrete. In the process of placing and mixing of concrete, air is likely to get entrapped in the concrete. If air is not removed fully, the concrete loses strength considerably”.
In order to achieve full compaction and maximum density Table vibrator is used in this experiment.

5.1.4. CURING OF TEST SPECIMENS:
After casting, the moulded specimens are stored in laboratory in room temperature for 24 hours. After these periods the specimens were removed from the moulds and immediately submerged in clean, fresh water curing tank for required period as per IS 516-1959. The specimens are cured for 28 days and 56 days in present experimental work.

VI. SUMMARY AND CONCLUSIONS
6.1 SUMMARY
Results were analysed to derive useful conclusions regarding the workability, strength characteristics of concrete with 25% replacement of cement by Fly ash 25% for M20 to M50 grades of Concrete.
6.2 CONCLUSIONS
1. The concrete trial specimens, irrespective of the grade of without fly ash content a decreasing trend ranging from 10 % to 18 % of compressive strength was observed for 28 thermal cycles.
2. The concrete trial specimens, irrespective of the grade of with fly ash content an increasing trend ranging from 8.63 % to 15 % of compressive strength was observed for 28 thermal cycles.
3. The concrete trial specimens, irrespective of the grade of without fly ash content a decreasing trend ranging from 14 % to 20 % of compressive strength was observed for 56 thermal cycles.
4. The concrete trial specimens, irrespective of the grade of with fly ash content an increasing trend ranging from 5.64 % to 8.5 % of compressive strength was observed for 56 thermal cycles.
5. From the test results an increasing of compressive strength was observed from 28 days to 56 days in case of fly ash blended cement concrete.
6. Based on the experimental investigations fly ash blended cement concretes resists better than ordinary concrete in case of high temperatures.

REFERENCES
[15]. Metin Husem, ”The effects of high temperature on


