EXPERIMENTAL ANALYSIS OF FIRE RESISTANT CONCRETE USING FLY ASH

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Abstract- *Waste disposal is on the list of main issues being experienced by all of the nations across the world. Fly ash is a manufacturing by-product, generated of combustion of coal within the thermal power plants. The growing scarcity of raw materials and also an immediate need to preserve the surroundings against contamination has accentuated the significance of building brand new building materials dependent on industrial-manufacturing waste produced from coal fired thermal electric power station and also is producing unmanageable disposal issues because of its possible to pollute the environment.*

Pozzolanic concretes are used carefully throughout the world where oil, gas, nuclear and power industries are among the main users. The uses of such concretes are rising every day resulting from the superior structural performance of theirs, environmental friendliness, and effort conserving implications. Aside from the typical danger of fire flame, these concretes are exposed to temperatures that are high for extensive periods in the above mentioned industries. Although concrete is usually thought to be a great fireproofing material, but there's substantial damage or maybe also catastrophic failure at temperatures that are high. At temperatures that are high, synthetic transformation of the gel weakened the matrix bonding that brought about a loss in resistance and strength of fly ash concrete.

Fly ash is utilized for a mineral add-on in concrete to enhance its strength and durability characteristics. Fly ash are used also as an admixture or maybe like a partial replacing of cement or perhaps like a partial replacement of total replacement or fine aggregates of fine aggregate and as additional addition to attain various qualities of concrete.
In the existing study, split tensile strength, the compressive strength and also modulus of suppleness of fly ash concrete at temperature that is elevated up to 120˚C with blend proportions of 1:1.45:2.2:1.103 with a water cement ratio of 0.5 by excess weight was determined. Cement was replaced with three proportions of fly ash. The proportions of replacements were 30, 40 as well as 50 % by weight of cement. Tests had been carried out for compressive strength, split tensile strength and also modulus of elasticity. Compressive strength, split tensile strength and modulus of elasticity had been carried out for room environment, 80˚C, 100˚C, plus 120˚C for most kinds of fly ash concrete during several curing periods (28 and 56 days). Reference concrete with no fly ash has in addition been used.

Test results demonstrated that the compressive strength, split tensile strength and also modulus of suppleness of concrete experiencing cement replacement up to 30 % was much like the reference concrete with no fly ash. Compressive strength, split tensile strength and also modulus of elasticity of concrete mixtures with 30 %, 40 % along with 50 % of fly ash as cement replacing was lower compared to the control combination at any age which the strength of all mixtures went on to improve together with the age. With the increased heat, compressive sturdiness of concrete mixes with 30 %, 40 % along with 50 % of fly ash as cement replacing decreases by 11.4 %, 28.9 %, 30.1 %, along with 27.5 % from 120˚C when as opposed to room temperature.

Keywords- Fly ash Construction Materials, Component Pozzolanic concrete

I. INTRODUCTION

Pozzolanic concretes are used carefully throughout the world where oil, gasoline, nuclear and power industries are among the main users. The uses of such concretes are rising every day resulting from the superior structural performance of theirs, environmental friendliness, and effort conserving implications. Aside from the typical danger of fire-flame, these concretes are exposed to temperatures that are high for extensive periods in the above mentioned industries. Although concrete is usually thought to be a great fireproofing material, but there's substantial damage or maybe also catastrophic failure at temperatures that are high. At temperatures that are high, synthetic transformation of the gel weakened the matrix bonding, that brought about a loss in strength of fly ash concrete.

The hunt for alternate binders, or maybe cement replacement materials, is performed for decades. Study was conducted about the usage of fly ash, pulverized-fuel ash, volcanic pumice, volcanic ash, blast slag and silica fume as cement replacing materials. Fly ash and some are pozzolanic materials due to the reaction of theirs with lime liberated throughout the hydration of cement. These supplies also can enhance the durability of concrete and also the speed of gain in strength and can also decrease the rate of liberation of high heat, which is advantageous for mass concrete.

Concretes that contain mineral admixtures are used carefully during the entire world for the good performance of theirs and for economic and ecological reason. The effect of temperature that is high on concrete containing fly ash or maybe natural pozzolans hasn't been examined in information unlike fly ash concrete which is under searching since the 1960s. There are transformations in the attributes of concretes, especially in the assortment of 100-300 °C. Above 300°C, there's decrease in mechanical characteristics. Nevertheless, there's a decrease in strength because of the number of high temperature quality analyzed, so the assortment of constituent components of concrete used. The behaviour of concrete put through temperatures that are high is an outcome of numerous factors; including heating rate, peak temperature ranges, dehydration of C-S-H gel, stage changes, along with thermal incompatibility between aggregates plus cement paste. On another hands, quality control over concrete, by way of non-destructive techniques, in constructions put through fire or perhaps not high temperature exposure circumstances, is not especially easy to always be carried out. The correlation probably exists generally describes the hydration age of 28 days.

High temperatures that are high cause severe micro structural changes which alter physical qualities of Portland cement concrete. The pore construction and then thought its actual physical qualities change with time after hydration and aging procedures and they're clearly affected not just by the mechanical load but in addition through the thermal hygrometric status of concrete as well as their precious time history..

The chemical and physical modifications in concrete under temperatures that are high rely not simply along the matrix make up but in addition on the kind of aggregate (mineralogical qualities, dilatation etc.). Other things with impact are definitely the water/cement ratio, the porosity, age and humidity of concrete. As the cement paste is subjected to increasing temperatures the next consequences may be distinguished: the expulsion of evaporable water (100°C), the start of the dehydration on the hydrate calcium silicate (180°C), the decomposition of calcium hydroxide (500°C) as well as of the hydrate calcium silicate (that starts around 700°C). The alterations created by temperatures that are high are usually more apparent once the temperature surpasses 500°C. At this particular temperature level, many changes that is happening to concrete may be seen as irreversible.

At the structural fitness level, the actions of concrete elements exposed to temperatures that are high is characterized spalling, that's a brittle failure with almost all cracks parallel to the warmed surface. The physical properties of concrete on the whole are negatively impacted by thermal exposure. Nevertheless, the consequences of thermal exposure on the physical properties of high end concrete (HPC) have discovered to be pronounced compared to the consequences on typical concrete. When HPC subjected to fairly quick heating (above l°C/min), it's been proven to be much more susceptible to dramatic spalling failure. The spalling failures in lab conditions are recognized from becoming progressive (continuous spalling of minimal scales within the specimen's surface area when put through radiant heating) to intense (sudden disintegration on the specimen accompanied by the introduction of a huge amount of energy that projects the broken concrete fragments in all of directions with good velocity). It's been theorized that the higher susceptibility of HPC to intense spalling at temperature that is high is thanks, for part, to its lesser permeability, which restricts the capability of water vapour to escape from the pores. This ends in a build-up of pore pressure inside the concrete. As heating improves, the pore pressure in addition increases. This increased vapour pressure remains until the internal stresses start to be very huge as to cause unexpected, explosive spalling.. Often, intense spalling has happened to just a couple of HPC specimens from a bigger group of examples that have been put through the same testing conditions. This erratic behaviour causes it to be hard to predict with certainty under what disorders HPC will fail by intense spalling.

OBJECTIVE :-

The aim of this study is usually to determine the outcome of fire on concrete. The concrete structure was impacted in term of its qualities like loss of pre stress, recurring deformations, cracking and damage of content by spalling, detailing and connection failure especially between metal and reinforced concrete member The amount of harm is based on the degree of temperature. Next, the damage of concrete is able to connect straight to the character of temperature.

SCOPE :-

The field of structural forensic is these kinds of a wide study. However for this research, it's just cover for scopes which is going to fulfill the objectives. The very first one is concentrate on the harmful effects on concrete to create a procedure of temperature identifying become simple. There are numerous consequences which will happen when concrete subjected to fire. The analysis will covers about the solution technique which may be identify appropriately to the category of the damage. The resulting answer method is just for the common method. This does due to the method will briefly describe within the chapter of literature evaluation.

II. WHAT IS MEANT BY SPLIT TENSILE STRENGTH OF CONCRETE ?

A method of determining the tensile strength of concrete using a cylinder which splits across the vertical diameter. It is an indirect method of testing tensile strength of concrete

what is the is code split tensile strength of concrete

- IS-516
- IS 5816 : 1999

2. Classification of Fly Ash

ASTM – C 618-93 categorizes natural pozzolans and fly ashes into the following three categories: -

1. Class N Fly ash: Raw or calcined natural pozzolans such as some diatomaceous earths, opalinechert and shale, stuffs, volcanic ashes and pumice come in this category. Calcined kaolin clay and laterite shale also fall in this category of pozzolans.
2. Class F Fly ash: Fly ash normally produced from burning anthracite or bituminous coal falls in this category. This class of fly ash exhibits pozzolanic property but rarely if any, self-hardening property
3. Class C Fly ash: Fly ash normally produced from lignite or sub- bituminous coal is the only material included in this category. This class of fly ash has both pozzolanic and varying degree of self-cementations properties. (Most class C fly ashes contain more than 15 % CaO. But some class C fly ashes may contain as little as 10 % CaO.

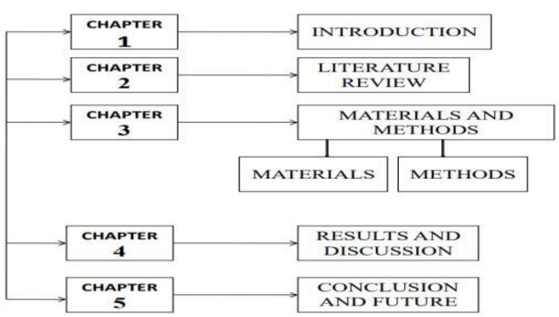

Fig.4.2: 3D View of Model I

(B)MODEL II: Structure With Steel Staggered Truss (STS)
In this type of structure, the structure is created using steel staggered truss system (STS). The G +7 storey building is created. In this model steel staggered truss are placed alternatively on the floor.

III. OBJECT OF TESTING

The primary goal of testing knew the actions of concrete with replacing of cement with higher amount fly ash at temperature that is elevated up to 120˚C. The primary parameters studied were compressive strength, split tensile toughness, modulus of elasticity. The materials employed for casting concrete samples together with tested results are discussed.

Test Results of Materials Used In Present Work

3.2.1 Cement

IS mark 43 grade cement (Brand-ACC cement) was used for all concrete mixes. The cement used was fresh and without any lumps. Testing of cement was done as per IS: 8112-1989 [26]. The cement used was similar to Type I cement (ASTM C 150). The various tests results conducted on the cement are reported.

3.2.2 Coarse aggregates

Locally available coarse aggregates getting optimum dimensions of 10 mm and 20mm were worn within the present work. The 10mm aggregates employed had been first sieved through 10mm sieve and then through 4.75 mm sieve as well as 20mm aggregates were firstly sieved via 20mm sieve. They were then cleaned to clean out dirt and dust and have been dried out to surface dry situation. The aggregates had been evaluated a Indian Standard Specifications IS: 383-1970. The outcomes of different assessments done on coarse aggregate are provided.

3.2.3 Fine Aggregate

Sand was for starters sieved via 4.75 mm sieve to eliminate some particles in excess of 4.75 mm after which were washed to eliminate the dust. The good aggregates have been evaluated a Indian Standard The sand for the experimental program was locally procured as well as conformed to grading zone III.

The Specifications IS: 383-1970 [27]. Properties of the fine aggregate used in the experimental work

3.2.4 Fly ash

Investigations have been produced on fly ash procured, It was examined for physical properties and chemical a ASTM C 311.The chemical substance and physical qualities of the fly ash applied to this investigation are mentioned
3.2.5 Water
Potable tap water was used for the concrete preparation and for the curing of specimens.

IV. CONCLUSION

The following conclusions are drawn from this particular study:
1. Compressive strength of concrete reduced with the increased cement replacement with Class-F fly ash. Nevertheless, at each replacement degree of cement with fly ash, an increased strength was found with the increased age.
2. With the deviation of temperature compressive strength changed. With the increase in temperature from room temperature to 120˚C, compressive strength decreased.
3. Splitting tensile strength and also modulus of elasticity amplified with increased age range at every replacement degree of cement with fly ash as much as 50 % though they had been reduced with increased amount of fly ash.
4. Increased temperature up to 120˚C reduced the splitting tensile strength and also modulus of elasticity, this's because of the substance transformation on the gel weakened the matrix bonding, that brought about a loss in strength of fly ash concrete during temperatures that are high.
5. The examples failed after the development of a selection of longitudinal (vertical) splits in the loading guidance, along with no shear type problems occurred.

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