

Chapter One

Introduction

1.1 General

Concrete is universally used as a construction material which can be molded into any shape that man desires can be provided at a reasonable cost, and that can be designed to ensure high compressive strength. In the structural design of building, in addition to the normal earth gravity and applied loads it is also necessary in some special cases to design the structure to safely resist exposure to fire such as nuclear plants, launching platform...etc. However in normal building structures it is usually necessary to guard against structural collapse due to accidental elevated temperature for a given period of time. Steel reinforcement of concrete and masonry structures are protected from fire by the concrete cover that is present over the reinforcement, whereas steel structures are protected with externally applied fire-resistive materials [1] . In general, when concrete structures exposed to elevated temperatures the performance and the safety of the structure will be affected and a reliable evaluation of the condition of the structure by experts becomes necessary. The owners will be great interest in this evaluation, and also will be concern about the extent of repairs required to get the structure back in service with minimum delay if that possible. The complete evaluation will begin with an examination of the general condition of structural elements that were exposed to the fire, many methods and various tests are available for assessing the damage, and a proper assessment of the structure after a fire event involves both field and laboratory work to determine the nature and extent of fire damage, in order to design appropriate and cost effective repairs. The preliminary investigation is to inspect the structural elements in affected areas for physical appearance, observations of cracking, spalling, deflections,

distortions, misalignment, and exposed steel reinforcement should be noted. Various measurements of geometry deflections, deformations...etc. defected members can be taken for comparison against undamaged members of the same structure. During the investigation, it is useful to document and categorize the type of damage and its severity of the different building elements such as beams, slabs, columns and walls. Having a summarized schedule of damage allows for a broader picture of damaged members in need of a more detailed investigation, and is helpful in evaluating the extent and nature of the repair process [2] . To estimate the severity of fire a detailed investigation must be done, there are several methods available for this purpose: a) nondestructive testing: Non-destructive testing (NDT) systems employ measurement techniques that utilize pulse-velocity, impact-echo (hummer), and impulse radar technologies. The pulse velocity measures the speed of sound through concrete and relates this to estimated compressive strength, modulus of elasticity, and quality of hardened concrete, it is also used for detecting cracks, although it does not distinguish between crack size and the amount that are present. 3 Impact-echo (NDT) involves the use of an (impact hammer) to send a low frequency stress wave into the Concrete. The wave energy is reflected back and measured with a receiving transducer on the same side of the member and the signals are recorded on an oscilloscope. The collected data can be used to detect, locate, and classify discontinuities such as voids, cracks, and bond loss between cement paste and aggregates within hardened concrete. b) Destructive testing: Destructive testing methods typically involve the extraction of concrete core samples or steel reinforcement from existing construction for laboratory examination and testing. Destructive test methods are likely to provide the most comprehensive and detailed information about damaged areas. Their drawbacks include being destructive by nature and more time consuming due to testing and analytical work that is typically conducted at off-site

laboratories. When using destructive methods, extreme caution must be exercised during the removal of concrete cores or steel reinforcement and the removal of cores and steel samples should only be done under the supervision of a structural engineer. Estimates of concrete compressive strength, modulus of elasticity, and Poisson's ratio, can be determined from testing a limited number of extracted core samples [3].

1.3 Research Questions:-

1. The effect of high temperature on the hardened concrete quality exposed to different degree of fire heat at constant time.
2. The influence of concrete Cover on protecting Structures from failure by heating.
3. The effect of Concrete Compressive strength on resisting Structures to withstand against fire .

1.4 Research Objectives:

- 1- To study the specifications of concrete components and the stages of concrete growth.
- 2- To study the effect of laboratory testing on concrete components.
- 3- To investigate the effect of high Temperatures on the compressive strength of concrete.
- 4- To study the effect of Fire resistance on concrete with the passage of time.
- 5- To investigate the effect of high Temperatures on the modulus of elasticity of concrete.
- 6- To Study how to withstand the Elements of Concrete after Firing.
- 7- To Study The validity of the concrete Elements After exposure to firing.

1.5 Research methodology:-

- 1- Gather preliminary information on the properties of concrete components and tests extension types and stages of development of concrete and also take advantage of available scientific literature, previous studies, published papers, magazines and scientific papers, and experiences.
- 2- Conduct laboratory tests on concrete cubes with dimensions of $(15*15*15)$ cm of concrete mix designed and experimentally using chemical additives (super plasticizers) and then burned to higher temperatures.
- 3- Analyzing the results of laboratory tests and comparison between the compressive strength results in deference degrees of temperatures, and take advantage of the efficiency of automated computer to show the results and discussion.

1.6 Research Organization:

This research is composed of the following Topics:

- Chapter one: presents general introduction, research problem, objectives and methodology.
- Chapter two: contains literature review for effect of fire on building material , fire resistance rating , fire endurance of structure , ASTM standard fire test , advanced analytical models ,ACI method ,the code Approach , thickness requirements, cover requirement , the influence of fire on concrete as structural material , disadvantages of using concrete , advantage of concrete as construction material , concrete components , the chemical composition of Portland cement , types of cement , aggregate , properties of aggregate , mixing water , previous studies.

- Chapter three: contains experiments and laboratory testing for the problem statement and the case studied.
- Chapter four: presents presentation and discussion of results for slump test results, compressive strength, concrete compressive strength vs Amp.
- Chapter five: presents conclusion and recommendation, for this investigation moreover, suggestion for future researches.