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The effect of high and low temperature on the engineering behavior of the reinforced concrete and its impact on resistance

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Abstract: **The objective of the current research is to identify the properties of the structural material (reinforced concrete), to identify the effect of low and high temperatures on the engineering behavior of the reinforced concrete and its impact on resistance, and to make suggestions for controlling changes in concrete due to low or high temperatures. The study found that low and high temperatures affect the behavior of reinforced concrete, as high temperatures lead to heating of concrete elements, so that the level of this heating depends on the value of the temperature, the type of heating, and the type of rebar used. The increase in the temperature of the concrete elements changes the specifications of the components of these elements and affects their behavior when exposed to different loads. This reduces their resistance to carrying loads and increases the size of their elastic deformities. The elasticity coefficient decreases gradually when exposed to high temperatures. The bonding strength of the reinforcing steel to the concrete is reduced. As for the exposure of reinforced concrete to low temperatures; there is no agreement on the behavior of concrete under low temperature, but positive, even for lack of results with these characteristics, so that the concrete in cold weather can be useful for their mechanical performance over the time. Concrete can also be negatively affected when exposed to low temperatures. Low temperatures may contribute to the tendency of the concrete to slow down or even reverse, due to the low melting rate, leading to a reduction in the quality of the concrete structure. In general, there are four main factors that affect the behavior of concrete when exposed to freezing and melting. These factors are the effect of the water content of the cement (c / w), and the effect of the ratio between water and cement (Water Cement Ratio), the concrete content of the rubble, and the temperature. The research recommended that, in order to overcome the problem of low resistance to high temperature concrete and humidity, concrete additives such as fibers can be used to improve many of its engineering properties such as strengthening its durability and resistance to tensile strength and enabling it to withstand thermal shocks. Anti-freeze additives that reduce the freezing point can also be used. In the instructions for quantities to be used from these additives,**

Keywords: **low temperatures, high temperatures, freezing, fire, reinforced concrete, concrete resistance.**

1. INTRODUCTION

The discovery of reinforced concrete as a construction material has led to significant progress in the building industry and the design of bridges, roads, etc., due to the advantages of this construction material from other materials, as it is characterized by good resistance compared to other materials, and it has high resistance against Water and fire, where the amount of this resistance increases over time due to the continuation of the reactions known as dehydration (the process of flattening) (Zarouk and Ibrahim, 2017).

As with other materials, reinforced concrete has a range of defects. The most prominent of these defects is its low resistance to tensile strength. Its resistance to tensile strength is ten times its resistance to pressure, this requires the use of large amounts of reinforcing steel at tensile positions, taking into account the compatibility between the size of stresses generated in both iron and concrete (Ferguson, 1981). Swami (1988) added that one of the deficiencies of reinforced concrete is its problems over time, especially with regard to the problems of crawling and deflation, low resistance to high temperatures, and their susceptibility to humidity.

As a result of the fact that concrete structures are among the most commonly used structures around the world, the study of their behavior and the causes and factors that increase the possibility of collapse are considered by researchers. The collapse of concrete structures occurs for many reasons, such as earthquakes, landslides, For fires to be exposed to fires, where fires are often caused by human beings and as a result of neglect and misuse, and these fires can lead to significant loss of human life, Zerouq and Ibrahim (2017) assured on the existence of three basic principles for dealing with fires in concrete installations by reducing the occurrence of fires and controlling their spread, as well as understanding the behavior and characteristics of these facilities in order to increase the ability to deal with them before and after the fire.

Studies have confirmed that precipitation has a significant impact on the behavior of concrete structures, as they may significantly reduce their resistance, and low temperatures have an impact on the behavior of concrete structures (Naus, 2008; Husain et al., 2018) Contributes to the tendency of concrete to slow down or even reverse it due to low melting rate, resulting in a decrease in the quality of the concrete structure (Demirel and Kelestemur, 2010). However, most previous studies have focused on the resistance of columns to rising or decreasing temperatures, and did not focus on studying the overall behavior of these concrete structures or on providing methods and techniques that would improve the level of resistance (Demirel and Kelestemur, 2010). To this end, the current research seeks to determine the effect of high and low temperature on the engineering behavior of the reinforced concrete and its impact on resistance.

Research Problem

Fire damage can be observed on a concrete structure from minor blotches or smoke distortion to the complete destruction of the structural structure as a result of the loss of mechanical strength. The effects of the fire, as well as its intensity and expansion, are directly related to the ability that the building can resist or not develop into a fire. Galleto and Meneguini (2000) assured on that there is no absolute fire safety, and therefore many preventive measures are used to reduce risks. At present, little is known about the behavior of armed concrete structures under fire or even when exposed to low temperatures (Souza and Moreno, 2010). This lack of information is a result of the current difficulties of testing in the real life. Most of the data is the result of laboratory tests, which are carried out on isolated elements of a building. This confirms the need for theoretical literature to modern studies that support this aspect and reinforce it with a modern scientific reference that may contribute In the presentation of the statement for future studies, and thus the problem of the current research to identify the impact of high and low temperatures on the engineering behavior of the concrete and the extent of resistance to the resistance.

Research Importance

The importance of the research is highlighted by the importance of the research topic which aims at highlighting the effect of high and low temperatures on the engineering behavior of reinforced concrete. Concrete is one of the most important materials that meet the needs of construction personnel. , As well as the use of concrete not only confined to buildings and buildings; but also to the construction of dams, bridges, roads and airports, in addition to irrigation and drainage projects and ports, and this indicates the widespread use of concrete in daily life. Ezziane et al. (2015) added that the concrete industry in all its forms is the main factor that contributed to the urban expansion witnessed by the different countries of the world and helped the human to adapt to different weather conditions, whether cold or hot.

The identification of the characteristics of this structural material, the identification of the factors affecting it and the clarification of the nature of this effect will help engineers and various workers in the engineering field to take the necessary measures to reduce this negative impact, it also guides them to the solutions and tools that can be used to deal with the different thermal conditions (low and high), since the presence of buildings and facilities in different areas necessarily means exposure to different temperatures, whether due to natural environmental conditions or accidents that may occur. Thus, knowing the impact of high temperature or low concrete behavior instructs engineers on how to deal with these climatic conditions that may be natural or abnormal due to accidents.

The importance of the study is highlighted in its attempt to make proposals through which changes in concrete can be controlled by exposure to low or high temperature, this will increase the level of awareness of engineers in this field and guide them towards the adoption of these proposals and work and employ them effectively in the process of construction and design of concrete. This study could contribute to a better understanding of the impact of high temperatures on the characteristics of reinforced concrete and thus contribute to the development of standards for the design of restoration of structures exposed to fire.

Research Objectives

The present research seeks to achieve the following objectives:

1. Identification of the properties of the structural material (reinforced concrete).

2. Identifying the effect of high temperature on the engineering behavior of the reinforced concrete and its impact on resistance.

3. Identification of the effect of low temperatures on the engineering behavior of the reinforced concrete and its impact on resistance.

4. Provide suggestions on which changes in concrete can be controlled by exposure to low or high temperature.

2. RESEARCH METHODOLOGY

In order to achieve the objectives of the study, the descriptive approach will be based on data collection from books, studies and previous articles related to the current research topic. The descriptive approach is one of the forms based on the description of a particular phenomenon or subject, and its qualitative portrayal through the collection, analysis and interpretation of data and information related to the phenomenon within the correct scientific foundations (Adas, 1999).

3. THE GENERAL FRAMEWORK

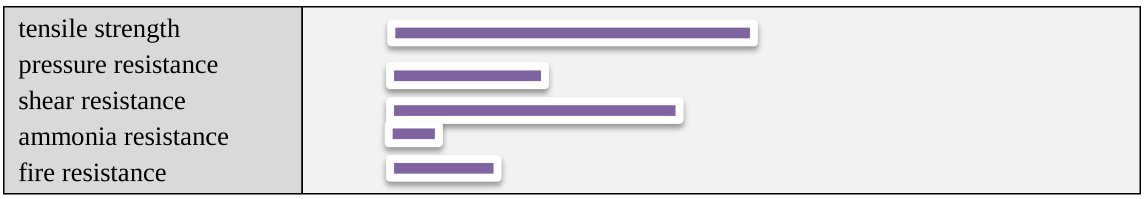
- **Concrete as structural material**

Concrete is an Arabic term that means artificial stone, it is caused by the chemical process that occurs between the various natural substances added or between natural materials and synthetic materials. This term is called "concrete" in English. The concrete is composed of a homogeneous mixture of Portland cement, aggregates, gravel, sand and water, which is added in limited proportions to ensure the maintenance of the concrete. Cement in the concrete mixture represents the chemical bond that interacts with the water to give in the end a homogeneous and interrelated mixture. Between (Ezziane et al., 2015), the efficiency and durability of concrete depends on the additives in the concrete mixture and on the proportion of these materials, where it is necessary to add materials (whether natural or artificial) in specific and precise proportions.

The concrete in its hardened state looks like a rock material with high pressure resistance, and the plasticity is taken when it is in the fresh state through which it can be formed in any form. This material is one of the most commonly used materials due to its availability at reasonable prices and its possible use with other materials such as sectors composite for manufacture of composite materials. Both concrete and reinforcing steel are integral components in terms of properties. Each material contributes to the completion of the deficiencies that may be present in the corresponding material. The following table shows this integration in terms of tensile strength, pressure resistance, shear resistance, fire resistance and ammonia.

Table 1: Integration between concrete and reinforcing steel

Characteristic	Concrete	Reinforced steel
tensile strength	very weak	very good
pressure resistance	good	good, but there is a dent for the slender sectors
shear resistance	medium	good
ammonia resistance	very good	weak, and eroded if unprotected
fire resistance	good	weak, and lose resistance quickly at high temperatures



Concrete has many disadvantages, notably (Ezziane et al., 2015):

1. The concrete resistance of the tensile is weak, so it is used with steel skewers when used in construction to compensate for its low tensile strength.

2. Concrete is subject to shrinkage when exposed to dehydration or moisture. This leads to cracks and breakdowns. Reinforcement steel is placed in the concrete or concrete joints are used at spaced distances to reinforce the concrete.

3. Concrete allows for the passage of liquids and gases in different proportions. These ratios depend on the quality, durability and proportion of the concrete. Concrete exposure to such access increases the likelihood of the reinforcement steel being exposed to rust and damage.

Concrete has many species, such as (Guo, 2014):

1. Ordinary Concrete: The concrete used to fill the voids and install the soil under or around the installations, but not exposed to loads.

2. Reinforced concrete: Concrete this is poured with iron bars, where different forms are taken by the planning engineers to identify these forms in a way that allows for the appropriate strength and durability and enable the concrete to carry multiple weights and loads. Such as concrete used in bridges, roofs, and large buildings.

3. White Concrete: This concrete consists of white cement, sand and gravel mortar.

- **The concept and characteristics of reinforced concrete**

Over the years, reinforced concrete has been one of the most widely used building systems. According to Helene and Levys (2003), concrete will have a more promising future in the coming decades through diversity in architecture as well as increased durability, as it ensures that any project will be implemented and developed.

The use of concrete in 1900 began in the floors of buildings and walls. Reinforced concrete is a concrete used in reinforcing steel. This concrete is weak in steel but has great compressive strength, so the steel is added to increase its ability to withstand tensile strength.

The reinforced concrete has many properties, including (Narayanan, 2013):

1. High resistance to compression.

2. Its inability to withstand high tensile strength.

3. Is properly bonded with iron skewers, so that the concrete can transfer the excess tensile stresses that it cannot afford to the high-strength, high-strength steels.

4. The internal stresses in the reinforced concrete do not appear when the temperature changes. This is necessarily due to the ratio of the longitudinal expansion coefficient of the concrete with the longitudinal coefficient of iron.

5. Cement does not react with iron but protects it from exposure to rust.

6. Reinforced concrete can live for long periods of time.

7. Reinforced concrete has the ability to resist insects, worms and lichens.

8. Characterized as easy to configure.

9. Low maintenance cost in the long term.

- **High temperature effect on reinforced concrete**

The components of the concrete mix are one of the factors that can determine the level of impact of concrete exposed to high temperatures, as the nature of reactions that occur during higher temperatures which depends mainly on the intensity of the fire and its duration represent the main factors through which to infer the level of calving behavior exposed to concrete elements, the results of the studies and research have shown that the extent of the influence of the concrete elements on the diffusion of heat inside them depends mainly on the changes that occur in the properties of the material such as low resistance (Kafri et al., 2016).

Under normal conditions, most concrete structures are subject to many temperatures, whether by nature, climatic conditions, or environmental conditions. However, there are important situations in which these structures can be exposed to much higher temperatures (eg, jet engine explosions, building fires, chemical and metallurgical industrial applications where the concrete is close to the furnaces, and some hypothetical events associated with nuclear energy conditions).

Bastami et al. (2010) emphasized that the thermal properties of concrete are more complex than most materials because concrete is not only a composite material with different components, but its properties also depend on moisture and porosity. Exposure to high temperature concrete affects their mechanical and physical properties. Souza and Moreno (2010) found that when concrete was exposed to temperatures close to 900 ° C, its mechanical properties - either tensile or compressive - could reach values close to Zero. The effect of elevated concrete temperature on a range of concrete properties is illustrated below.

- The effect of high temperature on concrete strength

It was found that early temperature rise had a negative effect on concrete strength later. Some researchers have verified the harmful effect on the strength of concrete over the long term due to the high initial temperature. The higher initial rate of water due to temperature increase Irregular distribution of hydration products. This is because when the initial water rate rises from the start, there is not enough time to spread the water away from the cement particles, all of which lead to the concentration of water molecules close to each other that have a negative impact on strength (Naus, 2008; Husain et al., 2018).

- The effect of high temperature on concrete resistance to pressure and tensile

When concrete structures are exposed to high temperatures, a change in the durability of high humidity concrete occurs. Prismatic resistance is reduced in heavy concrete which has a high humidity level when exposed to temperatures between 60-90 ° C and constant temperature rise to 200- 400 ° C The value of the resistance increases When the temperature exceeds 400 ° C, the resistance of the concrete is reduced. Concrete elements begin to break down fragilely when exposed to temperatures higher than 200 ° C. As concrete continues to rise in temperature, thermal gradients begin to appear between the interior and exterior concrete layers (Husain et al., 2016).

When exposed to high resistance to a temperature of 800 degrees Celsius, it was noted that these concrete becomes easy to break for the following reasons (Capable, 2000):

1. Difference in thermal deformation of both cement granules and aggregates.

2. Exposure of quartz in the aggregate to the transformation.

3. When the concrete is heated to a temperature higher than 200 ° C, the calcium oxides are dehydrated in the cement grains.

The load level of the concrete elements at high temperature affects the resistance of the concrete to this increase. When the stress level is low, the pressure resistance of the samples is heated and is subject to loading by 12-15% of the resistance of the samples that are heated first and then Exposed to download. If the load level increases, thus increasing the level of stress and exposing the sample to heating, the resistance will be less than if the sample was initially heated and then subjected to high loads.

The level of concrete humidity affects the resistance of the concrete to pressure. There is an inverse relationship between the moisture of the concrete and its resistance to pressure. In addition, if the concrete is subjected to water cooling after heating, its resistance level is less than the pressure, where the amount of this reduction may be about 20-30% (Husain et al., 2016).

- The effect of high temperature on flexible and concrete specifications of concrete

The exposure of heavy concrete to high temperatures necessarily affects the level of resistance and coefficient of flexibility, as heating the concrete to 100 degrees Celsius lead to a decrease in flexibility by about 30%, and when the temperature to 500 degrees Celsius, the elasticity factor is about 20% of its original value. This decline in elasticity can be explained by the increasing level of deformities and the decline in concrete resistance, due to the increased erosion due to changes in concrete components (Kader, 2000).

Studies have found that concrete with a moisture content of more than 4% and high humidity concrete (more than 5%) is more likely to collapse if exposed to high temperatures. Concrete begins to collapse after about 5-20 minutes of heating when concrete surfaces are separated Located at a depth of 5-10 cm, where this type of collapse is called an explosion. Studies have shown that this collapse does not depend on the longevity of the concrete. It depends mainly on the moisture content of the concrete. In the case of low humidity, the level of concrete exposure decreases. The level of the concrete is also affected by the collapse of the concrete. The probability of concrete being reduced is reduced (Husain et al., 2016).

- The effect of high temperature on steel specifications

The exposure of reinforcing steel in reinforced concrete to high temperatures necessarily affects the properties of the steel used, its resistance is affected. Mechanical and deformation characteristics are the most variable specifications of steel when subjected to high temperatures (Husain et al., 2016).

Steel is affected when exposed to high temperatures by a variety of factors, including the amount of stresses and distortions and plasticity and the stability of the installation of steel, when the steel has a clear elongation, the high temperature lead to decrease the level of elongation until it can disappear completely if the temperature reached 300 degrees Celsius. In general, high temperatures lead to (Kader, 2000):

1. Increase in the size of thermal deformation due to expansion of reinforcing steel.

2. The increase in elastic deformities due to the low elasticity coefficient of steel.

3. Increased plastic deformation due to excess deformation caused by steel elongation.

4. Steel deformation is increased at a constant speed while the temperature continues to rise. These distortions are related to the level of stress that the reinforcing steel is subjected to prior to heating.

- The effect of high temperature on the flexible specifications and plasticity of reinforcing steel

In general, it is possible to say that the coefficient of elasticity in reinforcing steel decreases when the reinforcing steel is exposed to temperatures of up to 200 ° C, and the amount of iron deformation depends on the value of the temperature, the iron brand and the amount of stress exposed to it.

In addition, the concrete used during the hot months of the year is subject to conditions that may adversely affect the properties and serviceability of the hardened concrete. Some of the problems you may face include:

- Increased demand for water
- Increase the rate of slump loss
- Increase the tendency to crack the plastic shrinkage and shrink drying
- Lower strength eventually
- Low durability
- Unwanted surface appearance

- The low temperature effect on reinforced concrete

In order for concrete to achieve its expected resistances in order to achieve good performance, it is essential that the water reactions be complete between the cement and the water. Therefore, the external temperature acts as a catalyst for these reactions, the more hot the water, the faster these reactions occur. According to Shoukry et al. (2010), temperature combined with relative air humidity play a significant role in cement hydration reactions by influencing the properties of fresh and solid concrete.

Pinto Barbosa and others (Pinto Barbosa et al., 2006) note that the entire cement wetting process can be traced back to an evolutionary rate that depends on the concentration and temperature of all the reaction materials in the solution. The process of dilution is accelerated at high temperatures and reduced at low temperatures. Kim and others (Kim et al., 2002) further confirm that high temperature concrete at early stages reaches higher early resistance, but reduces the growth rate of resistance over the time.

Thus, when the concrete is in solidification or at the beginning of sclerosis and has low temperature interference, these actions lead to the tendency of the concrete to slow down or even reverse it due to the low decomposition of the active ingredients (Canovas, 1988) Reduction in the quality of the concrete structure (Demirel, B. and Kelestemur, 2010).

In general, it is possible to say that low temperature affects the behavior of reinforced concrete. In cold areas and in a marine environment where temperatures are relatively low, concrete is affected by low temperatures. The freezing process, then the solubility of concrete, contributes to cracks in reinforced concrete, which adversely affects them and in some cases discourages them from collapsing. On the other hand, the process of freezing and melting affects the resistance of the concrete, so that the repeated occurrence of freezing and melting affects the durability of the concrete, Certain stresses are created that lead to internal stresses that contribute to the creation of internal forces. The stresses and internal forces are caused by the expansion of water inside the concrete after freezing. After a short period of time, these internal stresses contribute to the pressure inside the concrete. If the value of these stresses exceeds the value of the tensile strength of the concrete, this leads to cracks in the concrete that facilitate the water entering. When the water enters the concrete, And if the iron is exposed to rust, this leads to an increase in the size of reinforcing steel, thus increasing the pressure on the concrete, which leads to the exposure of concrete to deteriorate, especially over the time.

Hussain et al. (2016) states that in cases where engineers use chemical solvents to prevent concrete from freezing, these solvents will contribute to increasing the volume of internal forces and thus expose the concrete to deterioration. The excessive use of these solvents the chemical increases the chance of steel exposure to rust. Hussain et al. (2016) assured on the existence of four main factors that affect the behavior of concrete when exposed to freezing and melting. These factors are:

1. Effect of water content of cement (c / w): Where Increasing the ratio between water and cement increases the effect of freezing and melting on concrete.

2. The effect of the ratio between water and cement: The increase in the percentage of spaces in the concrete lead to increase the volume of water in the concrete, and when the volume of water, this leads to internal pressure on the concrete, but if there are gaps between granules Cement, these spaces absorb more air, thus reducing the pressure on the concrete.

In general, when the concrete freezes, the porous water in the concrete begins to freeze when the temperature reaches about -1 ° C, and with the freezing of some water, the concentration of the ion increases in the non-freezing water, increasing the freezing point pressure. At a temperature of 3 ° C to 4 ° C (25 ° F to 27 ° F), enough porous water is frozen until the water stops completely, and depending on how moisturizing, Thus, the strength of the concrete and the forces resulting from ice expansion (ice occupies 9% more water) may be harmful to the long-term safety of the concrete (Husain et al., 2016).

Hussain et al. (2016) states that at a temperature ranging from the freezing point of water to about 2000 ° C, the strength of concrete is significantly higher than when it is present at room temperature. The compressive strength may be as high as 2 to 3 times the strength at room temperature when the concrete is wet during cooling, but the pressure strength of the dry air concrete increases less.

Shoukry et al. (2010) argue that the engineer must consider the structural design of the change in the development of concrete properties because of the temperature because this may affect its structural behavior, Where the researchers showed a temperature difference of 80 ° C (-25 to 55 ° C) at 28 days of treatment, There is a 38% and 26% reduction in pressure and stress resistance respectively.

Cecconello and Tutikian (2010) conducted a study aimed at analyzing the effect of low temperatures on the development of concrete strength by casting test samples at different temperatures. The results of the tentative program at low-temperature temperatures showed that the strength of the concrete mix develops more slowly, the results also found that the processed concrete at higher temperatures is less powerful than the treatment at a lower temperature. Thus, it was concluded that concrete in cold weather can be useful for its mechanical performance over the time.

4. RESULTS AND PROPOSALS

The use of reinforced concrete is useful in cases where temperature insulation is required, where reinforced concrete has a direct and direct role in maintaining the strength and strength of buildings in the event of low or high temperatures. Several studies have been conducted to investigate the changes taking place on the physical and mechanical characteristics of concrete if exposed to high temperatures. High temperatures lead to heating of concrete elements, where the level of this heating depends on the value of the temperature, the type of heating and the type of rebar used. The high temperature of the concrete elements changes the specifications of the components of these elements and affects their behavior when exposed to different amounts of loads, reducing their resistance to carrying loads and increase the size of their flexible deformities.

1. Early high temperature has a negative effect on concrete strength later.

2. The level of the humidity of the concrete affects the resistance of the concrete to the pressure, where there is an inverse relationship between the moisture of the concrete and the level of resistance to pressure.

3. When concrete structures are exposed to high temperatures, a change in the durability of high humidity concrete occurs. Prismatic resistance is reduced in heavy concrete which has a high humidity level when exposed to temperatures between 60-90 ° C, 200-400 ° C The resistance value increases, and when the temperature exceeds 400 ° C, the concrete resistance decreases.

4. Heating the concrete to 100 ° C results in a 30% reduction in elasticity. When the temperature reaches 500 ° C, the elasticity factor is about 20% of its original value.

5. Crushed concrete with a moisture content of more than 4% and high-moisture concrete (exceeding 5%) is more likely to collapse if exposed to high temperatures.

6. Reinforcement steel is affected when exposed to high temperatures by a variety of factors, including the amount of stresses and distortions and plasticity and the stability of the installation of steel, when the steel has a long elongation, the high temperature leads to a decrease in the level of elongation.

7. The increase in the temperature of reinforcing steel leads to an increase in the size of thermal deformation, increased elastic deformities and increased iron deformities, which are affected by the level of stress that the reinforcing steel is subjected to before heating.

8. When concrete is exposed to low temperatures, the strength of the concrete and the forces resulting from the expansion of the ice (ice containing 9% more water) may be detrimental to the long-term safety of the concrete

9. There is no agreement on concrete behavior under low temperature, but positive, even for lack of results with these properties, so that concrete in cold weather can be useful for its mechanical performance over the time.

10. The treated concrete at higher temperatures is less powerful than the treated at a lower temperature.

11. There are four main factors that affect the behavior of the concrete when exposed to freezing and melting. These factors are the effect of the water content of the cement (c / w), the effect of water cement ratio, the content of the concrete from the aggregate, and the temperature.

In order to overcome the problem of the low resistance of reinforced concrete to high temperatures in addition to their susceptibility to moisture levels, Matar (2018) indicated that there are many ways in which buildings can be treated before and after cracks and breakdowns. Concrete additives such as fibers contribute to the improvement of many of its engineering characteristics such as strengthening its durability and resistance to tensile, and enable them to withstand thermal shocks.

It is also possible to use anti-freeze additives that reduce the freezing point, where it must adhere to the educational requirements of the quantities to be used from these additives, and these additives can contribute in:

1. Preventing reinforced concrete structures from corrosion due to corrosion inhibitors used in additives.

2. The concrete mixture to become durable in less time.

It is also necessary to assess the ability of elements exposed to high temperature tolerance, as well as to determine the level of tolerance of the age after exposure to thermal effect through the studies of this, and this will contribute to determine the ability of elements to invest in Later times in order to avoid other disasters if exposed to high temperature again. Design aspects of section shapes and concrete thickness should also be taken into consideration, so that the minimum capacity of elements to withstand low and high temperatures can be ensured.

In general, the following tips can be used when designing reinforced concrete to deal with hot weather:

1. The use of a concrete mixture that is appropriately suited to the expected conditions in the field can help reduce the rate of slump loss and demand for water.

2. Fly ash can also be used to decrease the effects of instant concrete.

3. Provide sufficient manpower and equipment available to deal with concrete at the desired rate of activation and unloading concrete trucks immediately.

4. The deflation crack is significantly affected by the amount of water in the mixture. As the increasing of temperature, the amount of water needed to maintain the specified drop increases. Add water only once and adjust the gradient when the truck first arrives and then track it with immediate mode.

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