

# Modality of Concrete in Hot and Cold weather

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**Abstract**— In general, Developing and maintaining world's facilities to meet the future needs have developing to improve the total well-being. The standard and performance of concrete perform a critical role for most of the facilities including commercial, industrial, and residential and army, public works, and power plants. Concrete sets as the solid hydrates, and is an exothermic response, means it produces heat response goes quickly when the concrete is a hot condition. The primary reason for the concrete's strength and setting time is not the air temperature range but the particular heat range. Varying climate circumstances at a work site cold and hot, windy or relaxed, dry or moist may be considerably different from the best possible conditions believed at sufficient time a concrete mix is specified designed, or selected, or from lab circumstances in which concrete samples are saved and tested. This paper provides the results of a study performed to look at the condition of concrete in hot and cold weather in the construction industry under the climate of Afghanistan.

**Keywords**— Concrete, Hot and Cold Weather, Construction sector, Afghanistan.

## I. INTRODUCTION

It is reputable that when the concrete has to be combined and placed in either very hot or cold climate, it is necessary to take safety measures to make sure that the concrete is not broken or negatively suffering from the normal varying weather circumstances.

Constructional employees faced with the situation of warmth and cold weather in hot and cold areas in everyday tasks. It is times of the heat and cold weather; especially it understands for Construction engineers who were working in construction industries and students majoring Civil Engineering, during the process of building construction using and preparation of concrete considered as their immediate requirements.

Concrete, very hard, the rock-like object is determined by mixing cement, aggregates (sand and gravel), and water and in some cases additional materials, is obtained. After adding water to aggregate and cement, cement and water together enter the chemical interactions are exothermic. In effect of Interactions, the adhesive material produced that is different materials mixed and form a hard object.

Today increasing consumption of concrete in various tasks, in all Civil Engineering societies, has been accepted,

due to having excellent properties and durable enough and need to know more constituent materials with technology is making concrete.

Concrete is the perfect combination substance that hot and cold weather beyond its specified limits has negative impacts on its properties, and high temperature cause rapid hydration on the ambient fresh concrete and low-speed grip and ultimate strength, as well as low temperatures, cause freezing of the new concrete.

In all these cases, must do the appropriate steps to mixing, pouring and processing concrete is prevented of these defects during the using and pouring concrete. Most of the current situation, Industrial building, institutions to provide concrete in areas where temperatures are high and low not prepared by technological norms, then concrete has not gained enough resistance and cause resistance reduced. If in the preparation of concrete in these areas be taken into consideration and used with additional materials, it will increase the resistant.

## II. CONCRETE

**Historically**, Dating back to the Roman Empire (as beginning as between 125 and 135 A.D.), the Romans had replaced their conventional lime mortar for a new mineral found on the slopes of Mount Vesuvius.

This new agent, bearing silica and alumina, created a kind of cement that hardened underwater or in the air when burned with limestone. This cement had the same properties and essential ingredients as Portland cement, patented in 1824 by the British Joseph Aspdin.

This adhesive named for the English Portland limestone, an important part. In the 1850s, several people (such as the French J.L. Lambert and the American Thaddeus Hyatt).

**Concrete** is the building materials prepared by mixing three components aggregate (rock, sand or gravel), cement and water. Here when cement mixed with water, sand and gravel grains stick together sand supplies to fill the space between gravel, stone aggregate and gravel form in the concrete skeleton and forces acting on the bearing primarily practical and conveying.

Cement paste is usually from 25% to 40% of total volume of concrete. Moreover, which is actual volume of cement between 7% to 15%, the amount of water is from 14% to 21% depending on the amount of air in concrete pro the size of the largest real grain that is 8% of its volume.

Since sand and gravel, constitute forms 60% to 70% of Concrete, their choice of particular importance is minimal, and that sand and gravel have sufficient strength of grains. So resistant to weather conditions and must not contain harmful substances to concrete, for a sufficient cement paste, it is necessary that grains of sand and gravel aggregate be non-uniform. Concrete quality largely depends on the quality of the cement paste. In concrete, that is well-made grains of sand and gravel covered with cement paste, and all the space between the grains filled with it.

#### **The Advantages of Concrete in Construction**

- A. Long life:** Regarding utilization, Concrete member can diminish without bearing resistance, Long-term endurance.
- B. Fire Resistance:** It takes about an hour steels with a 2.5cm Concrete cover own temperature reaches 500 °C, experience has shown Concrete buildings covered with adequate protection against fire for several hours and medium-intensity, only suffered losses, but do not go down.
- C. The Abundance and Availability of Materials:** The most important constituent of concrete, sand and gravel can consider, that are readily available in most places, for this reason, can be found in most cases, for cheap prepared and used.
- D. Plasticity:** Concrete can pour in any form because after the setting and hardening come to the desired shape.
- E. High compressive strength:** in order concrete has favorable resistance, should consumer materials the desirable rate and ratio of water, cement is less than 0.5. They should also be care full of design and maintenance.

#### **Concrete Disadvantages**

- A.** The main disadvantage of concrete is its low tensile strength that makes the concrete cannot use in parts under tension. Concrete shows excellent resistance to pressure, but its tensile strength is negligible on the contrary, the steel tensile strength and compressive strength is almost the same, to use concrete the building blocks used in places where the concrete is in tension.
- B.** Relatively heavy concrete components.
- C.** Longer runtime.

### **III. AN OVERVIEW OF THE AFGHANISTAN TEMPERATURE**

Most of Afghanistan has a subarctic mountain climate with dry and cold winters, except for the lowlands, which have arid and semiarid continental climates and temperature differences between night and day is too

much. In most regions, the climate is different from the altitude above sea level.

Most areas of northern Afghanistan is with a height of more than 2,400 meters above sea level. The winter is long and sometimes lasts for six months. However, areas where height is 1300 to 2400 meters above sea level temperate climate, such as areas that have Kabul.

In these regions, usually one year is divided into four separate seasons, and its annual humidity reaches up to 400mm. Areas that altitude is 900m to 1300m it has hot summer, and humidity reaches up to 200mm. Moisture content below a height of 900m decrease to 100mm and its climate is warm and dry.

In Afghanistan, the highest temperature of 51°C and the lowest temperature in Zaranj, Nimroz Province (52.2-) °C and mostly been in the town of Ghor. Annually in the northern Salang, the highest humidity measured approximately 1212mm and lowest has recorded about 24mm in Zaranj, Nimroz Province.

#### **The Effect of Temperature on Concrete**

Dewatering is a chemical action is accelerated by increasing the temperature and with coming down the temperature and it will slow with coming down the temperature. In the lower level from zero, the harmful effects become more important, and the result of frost the actual part or all of it ruined. At low temperatures the following measures can be continued with the construction operations:

- Can use from Aluminum cement or similar
- With the flow of electricity to steel bars concrete can be kept warm (The amount of power consumption to increase the temperature of one cubic meter of concrete from zero to 25°C is about 20 KW/h).
- All buildings can be placed inside a closed environment and kept the place warm. (At factory)

#### **The Effect of Moisture on the Concrete**

In dry weather by evaporation, the amount of water lost hydration and thus cement after a while for dewatering cannot find necessary water. Therefore dewatering becomes slow or stops since the resistance of concrete becomes less or will stop.

Protection and processing of concrete placed in hot weather have most importance than doing it in cold weather. Molds cannot be satisfactory for thermal weather protection and accepted for processing concrete.

They should loosen after placing concrete as soon as possible without reaching any harm. Moreover, then poured water on the upper part of concrete to flow down into the molds to avoid drying out the outer surfaces of the concrete and bring action process for concrete should

start immediately after the end of leveling surfaces and will continue for at least 24 hours.

### **Terms Concrete and Concrete Placement**

#### **Concrete in cold weather:**

Precautions must take when placing concrete during winter months to ensure that it will have the strength and durability to function properly. Processing of Concrete work in cold weather conditions is a call that more than three consecutive average days daily temperature should be below 5°C. If more than half of day ambient temperature is above 10°C, it is not the cold weather. When the temperature at 9 Am, is less than 5°C, There is a possibility of freezing concrete in colder areas. Two days after the concrete, cold fresh concrete creates many risks. The strength of concrete at temperatures lower than (-10) degrees Celsius will stop.

Concrete problems in cold weather with quandary cold fresh concrete are concerned. If the concrete is still not achieved it hardens to form the mixture goes into ice freezes. As a result, the total volume of concrete is increased and would not take hydration and case reduced the water mixture, setting, and hardened concrete delayed, and a small amount of cement paste is broke due to frost.

Concrete in ColdWeather is harsh and require highly precise work, because if the concrete water gets a freeze, cause crumbling cement and concrete will not be hard. It is better in cold weather as much as possible; we refrain from pouring concrete. If need to pour the concrete in winter days, a day that is not too cold must begin pouring concrete from 9 Am or 10 am and finish it till 3 Pm.

If during the pouring concrete or the time of hardening concrete face the risk of the heat sink to below zero degrees Celsius it is better to stop processing the concrete. If after pouring Concrete air temperature goes to below zero degrees it is better while the temperature is below zero when concrete must be inside the molds and concrete should remain in longer duration inside the molds.

As previously mentioned concrete starts to freeze at a temperature less than zero degrees and the interaction of water to cement will not take in place and resulting in hardening will stop.

Moreover, at the same time, internal force within the concrete and the internal pressure which is 9% increase in the volume of water and these forces would cause unauthorized deformation.

At the time of thaw in positive temperature, concrete gain its strength again but the concrete strength was less than average and concrete adhesive with steel bars is lees, and a compression base element is less well against external influences, If the concrete after shedding suddenly not freeze but long after that concrete get freeze takes the particular resistance, In this case, negative temperature

concrete hardening process is continuing a significant role not so easy to make the desired strength.

When concrete used in cold weather, it should protect the design from freezing until it acquires 5% of forces for 3-5 days is necessary to hardening concrete (Portland cement grade 400 and 500 and aluminum Cement) to be used.

The use of stimulants of hardening such as calcium chloride and so also reduce the period of hardening concrete. It will cover the concrete buildings through the heat insulating materials sawdust, wood and pressed boards, the thickness of thermal insulation materials determined the heat capacity based on our consideration. Alternate current electricity can prepare concrete through electrodes and to heat up in two methods:

Surface electrodes Shaped steel beam that was placed on the concrete surface and internal electrodes which are placed horizontally and vertically in the concrete mixture. The effect of an electric current passes from the concrete, the concrete heats up and therefore it is hard quickly. However, concrete should not be heated up higher than 60°C because those local parts will begin to dry.

#### **Concrete in Hot Weather:**

Hot weather introduces problems in mixing, placing and curing concrete that can adversely affect the properties and serviceability of the hardened concrete. High temperatures accelerate the hardening of concrete. Hot weather, when concrete decrease the quality of fresh concrete and its hardened, Hot air vulcanization means with or without the wind and low humidity. These factors cause rapid evaporation of water, speed up the dehydration of cement, decrease the fresh concrete work, and it is hard acceleration; this can reduce the ultimate strength of the concrete.

Also, hot weather intensifies the shrinkage of cement paste and caused cracks in the concrete. Concrete temperature while pouring concrete should not exceed 32° C for conventional concrete, and massive concrete must be 15° C.

To avoid the creation of adverse effects and access to appropriate and high strength concrete observe the following points of the concrete planters when an operation is required:

#### **Water**

Concrete water should not be warm, hot weather in additional to the high grade of concrete mix, and caused increase the water consumption which ultimately will decrease the resistance and from the water should be quite cold and if necessary be cooled by ice.

#### **Cement**

One of the important points in hot weather, the temperature cement when mixing. Raising the glue temperature will increase the Concrete grade. These will

cause accelerated dewatering, fast hardening, increase the need for water And ultimately will be adverse effects on the resistance of concrete mix. Therefore under no circumstance should the temperature of cement exceed 77° C when mixing it.

**Additives:**

The use of additives in hot weather should be base on construction norms.To reduce the risk of loss of performance concrete and increase the time of hardening should not be use additives that cause premature hardening of concrete. This material in successive concrete will avoid the creation of the cold junction in some parts.

**IV. CONCLUSION AND RECOMMENDATIONS**

The subjects discussed conclude the temperature is a major factor in securing the conviction of the concrete. Likewise, hardening of concrete requires a certain temperature and percentage humidity. As it often happens to concrete in extreme hot and cold weather to take place from outside the temperature range is set, afterward to prevent concrete strength reduction is recommended the following points:

**In Cold weather:**

- Water and cement ratio should not be higher than 0.5.
- Large grain ingredients should soak in ice and snow.
- Suppliers of fast harden or antifreeze materials used, in cases where there is a risk of frost if it is by the standards.
- To be determined the hours of pouring concrete due to regional climate.
- Aggregate heated to 50 °C temperature.
- The Concrete temperature must be recorded at least twice a day from different parts of building to make sure enough to the maintenance status of concrete.

**In Hot weather:**

- During the pouring,Concrete temperature of any parts of concrete must not be more than 30°C.
- Maximum ambient temperature, during pouring concrete, must be equal to 38°C. (Concrete actions to be performed at temperatures of 24 to 38 °C).
- Concrete materials, especially aggregates should not be under direct sunlight.
- All equipment and related equipment if possible must be in white color and be kept in dry place.

- The time interval between preparation and pouring the concrete in the mold should do in the shortest time.
- Before pouring the concrete, molds erect, and the concrete bed must spray with cold water.
- Place of pouring concrete should protect from direct sunlight during operations.
- Concrete surface must be kept moist for 24 hours.

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