ANALYZING THE IMPACTS OF CONSTRUCTION SCENARIO IN HOT AND ARID ZONES

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Abstract—The climatic conditions play a crucial role in the planning, designing and execution of any constructional activity. More over it also decides the procedures required to ensure the safety and health of the labors involved in the construction project. The key purpose of the project work is to find out the impacts of providing mitigation strategies for the construction activities in hot and arid climatic zones. A methodology was obtained by studying through literature review. Based on the knowledge acquired from the literature review, a questionnaire has been prepared to request for the information and the same is provided to the qualified respondents. The questionnaire is setting such a manner that it contains set of questions that deals with various issues and difficulties while carrying out the construction activity particularly in sites with hot and arid climatic conditions. From the response from the questionnaire, the obtained data are fed to the SPSS program which performs various analyses and gives the priority of the different activities based on how much they influence the risks in safety of labors. From this priority list, the necessary steps are taken to design the procedures to mitigate the risks and provide a safe environment for labors and the materials in the construction activity which will ultimately result in improved productivity.

Keywords— climatic conditions ;safety ;health of the labors; questionnaire; construction activity;

1.INTRODUCTION

1.1 GENERAL

Weather conditions affect the design, construction, and performance of buildings. The intent of this article, while presenting the cause and effect of weather, is to improve the understanding of how varying weather conditions can affect construction projects. Armed with this information, building professionals can take measures to eliminate (or at least reduce)the impact of weather. Meteorology is one of my hobbies,and I have a special interest in how weather affects building Design and construction. I have read many old weather sayings that have been repeated over the years. Some are based on scientific principles and are frequently dependable.

The various geographic regions throughout the world have prevailing weather patterns that are typical for a specific region. Climate maps that include wind speed, rainfall, and snow accumulations are published in model code books. Climatic statistics for specific cities or states are available from the National Weather Service and from various private climatic agencies such as Accu Weather. This data can be incorporated into the building during design and can influence construction materials selected and the construction means and methods used.

1.2 THE CAUSE

Weather is simply a reaction to changes in atmospheric pressure. These changes alter air movement, temperature, and humidity. Some changes are dramatic and produce violent storms. Other changes are subtle and have little effect on weather. Meteorologists can predict these changes with reasonable short-term accuracy. What is done with these predictions directly affects comfort, project design, and construction procedures.

1.3 THE EFFECTS

Weather conditions can affect many aspects of the construction project from site work to worker comfort. For the purpose of this analysis hot and dry weather conditions are analyzed. The most common effects are briefly mentioned for each condition.

1.3.1 HOT AND DRY CONDITIONS

It may be surprising to consider hot and dry weather as a problem. However, a lack of moisture can have dramatic effects on a project, especially on outside activities. The factors which are affected by such conditions are listed below

1.3.2 SITE

Dust is associated with hot and dry weather. One of the easiest ways to be tagged a bad neighbor is to allow large clouds of dust to settle on nearby property. Tanker trucks are often used to spread a water mist over designated areas to reduce dust. Dust also generates dirt that must be removed from interior surfaces on a regular basis during construction.

1.3.3 CONCRETE

Dry weather can cause the water in concrete and masonry to evaporate too fast. This rapid evaporation

produces concrete with a lower compressive strength and a finished concrete that tends to curl upward and to spall.

1.3.4 MASONRY MORTAR

Dry weather causes rapid evaporation of moisture, which causes the mortar to begin setting prematurely. When mortar begins to set prematurely, there may not be sufficient moisture to ensure the brick absorbs the mortar paste properly. This reduces the bond strength between the mortar and the brick, which is a major cause of masonry leaks.

1.3.5 BRICK

Unless properly wetted prior to laying, bricks become excessively dry and when laid, they absorb the water from the mortar so fast that the mortar paste that creates the bond between the brick units is not absorbed. When this occurs, a poor bond is formed, and can cause masonry leaks at the joints.

1.3.6 PAINT

Weather can affect both application and performance of paint .During application, when ambient temperature or surface temperature of the substrate is too high or the relative humidity is low, reducers (solvents) in paint evaporate too fast. This rapid evaporation prevents the paint from curing properly, possibly causing delimitation, wrinkles, blisters, peeling, and cracking. Most paint containers state the ambient and substrate temperature range. Some paint manufacturers include a recommended relative humidity range. Ultraviolet(UV) exposure is the worst enemy of paint performance. Eventually, all pain twill succumb to UV, ultimately prompting fading, chalking, and embrittlement. However, some paints, such as high performance polyurethane and 100percenta acrylic, are formulated to be more resistant to UV exposure.

1.3.7 SEALS AND SEALANTS

All weather, especially freeze-thaw cycles and UV exposure, will reduce the resiliency of seals and sealants, resulting in a loss of elasticity. Loss of elasticity causes embrittlement. Replacing failed sealants can be an expensive endeavor because new product installed directly over an old seal ant usually results in premature failure. To prevent premature failure, the failed material must be removed, the joint thoroughly cleaned, and new and proper sealant installed. Using high quality elastomeric sealants such as silicone and polyurethane usually prolongs the integrity of a sealed joint. Manufacturers often have details for joint design that provide for temporary protection from moisture intrusion if the sealant fails. However, these joint designs are not a substitute for a proper joint sealant.

1.3.8 EQUIPMENT

Filters on vehicles, machinery, and equipment, both inside an outside, are exposed to dusty conditions. These filters should be checked and changed regularly to prevent premature breakdowns. Dust can also find its way into working parts and cause accelerated wear. Equipment should be cleaned and lubricated regularly

1.3.9 THERMAL MOVEMENT

Based on their respective thermal coefficients of expansion, some materials will move significantly more than others when exposed to temperature variations. For example, aluminum has a higher thermal coefficient of expansion than stainless steel and will experience more movement. However, contrary to common assumption, thickness does not affect the amount of movement. Thus, 0.032-inch thick aluminum sheet will not move any more than 0.125-inch thick extruded aluminum. However, when thick and thin pieces of aluminum are fastened to a substrate, the thick piece of aluminum, because of its mass, will exert more pressure on the fasteners than the thin piece of aluminum. When a design does not allow for thermal movement, joints or seams can open, fasteners can fail, and components can distort or break. Both expansion from heat and contraction from cooling should be considered during design and construction.

1.3.10 WORKERS

Physical activity associated with construction work will cause a considerable loss of body fluid. Since it is imperative that this body fluid loss be replenished, fresh water should be readily available to workers to prevent dehydration, especially to those outside. Drowsiness, disorientation, dizziness, and fatigue are common symptoms of dehydration and can resulting lost-time accidents or sickness.

1.4 NEED FOR THE PROJECT

Around 40-60% of the total construction worker time has been spent on either the supporting tasks or due to heat stress affects. High demand for labor and increase in labor rates.

Decrease in labor health affects the efficiency and growth of an organization and also reduces the profit. A deeper understanding is still needed to improve the labor productivity.

Managing the risks associated with heat stress.

Maximizing organizational health, safety and welfare while delivering high quality service and learning outcomes for students and children.

1.5 OBJECTIVES

The following are the objectives of the present project work

To develop and facilitate best practice heat stress procedures.

To reduce the incidence of workplace injury and illness.

To assist site managers to identify, implement and review heat stress control measures.

1.6 SCOPE

The scope of this thesis is focused for heat stress management and effective use of resources in construction industry.

Improvement of productivity.

To stand better in the market.

To make the working conditions better.

Assurance for security and satisfaction in job

2. METHODOLOGY

2.1 PROCEDURE

Collection of data from journals and gathering information from field studies.

Preparation of questionnaire based on literature review.

Data collection through questionnaire survey

Identification, categorization and classification of productivity factors

Prioritization of factors using analysis of SPSS 20.

Proposing mitigation strategies for top ranked factors based on data analysis.

2.2 DELPHI METHOD

The name "Delphi" derives from the Oracle of Delphi. The Delphi method is based on the assumption that group judgments are more valid than individual judgments. A forecasting method based on the results of questionnaires sent to a panel of experts. Several rounds of questionnaires are sent out, and the anonymous responses are aggregated and shared with the group after each round. The experts are allowed to adjust their answering subsequent rounds. Because multiple rounds of questions are asked and because each member of the panel is told what the group thinks as a whole, the Delphi Method seeks to reach the "correct" response through consensus The Delphi method is a structured communication technique, originally developed as a systematic, interactive forecasting method which relies on a panel of experts.

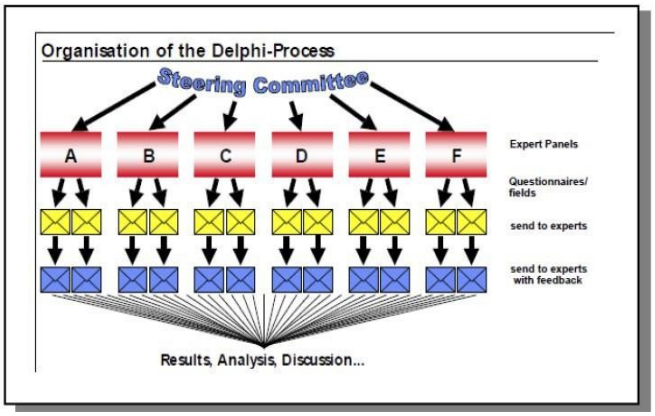

Fig: 2.2 Delphi Method Process

The Delphi Technique was originally conceived as a way to obtain the opinion of experts without necessarily bringing them together face to face.

2.3 SPSS SOFTWARE

SPSS is used for data analysis. The approaches used under SPSS are as follows Descriptive Analysis, Frequency Analysis and several other statistical analysis. The main purpose in choosing the SPSS analysis techniques is to provide clear and non-technical formats for common statistical procedures .It is also, because it is widely available and covers a broad spectrum of statistical procedures.

2.3.1 DESCRIPTIVE ANALYSIS

This is the SPSS procedure that computes descriptive statistics. These statistics are used to summarize a set of scores in a convenient form and typically are the first calculations performed on a distribution of scores. With the descriptive procedure, any or all of the following statistics can be calculated such as mean, variance, standard deviation, and sum of scores, minimum and maximum scores, range, standard error.

2.3.2 FREQUENCY ANALYSIS

Frequency distribution is a mathematical distribution which the objective is to obtain a count of the number of responses associated with different values of one variable and to express these counts in percentages terms. It also helps to determine the extent of item non-response and indicates the shape of the empirical distribution of the variable such as a histogram, or a vertical bar chart in which the values of the variable are portrayed along the X-axis and the absolute or relative are frequencies of the values are placed along Y-axis. The frequencies procedure is used to find and graph the number of cases falling into different response categories for discontinuous variables. In addition, the procedure allows one to obtain the appropriate descriptive statistics, for example mean, median, mode and

standard deviation which are associated with the variables Organizing & summarizing data in the form are:

Percentages
Averages
Dispersion.

The various advantages of using field questionnaire survey techniques are:

Field research is suitable to gain an inside understanding of events from the point of view of participants.
Field research has flexibility to study changing and dynamic situations.
Field research can be adapted when resources are limited.
Field research can be used when a situation involves interrelated events that must be studied as a whole.
Field research can be conducted without utilizing expensive and elaborative tools and equipments.
Time is the major resource consumed in field research.
It is important to preserve the natural order of events as they occur.

2.3.3 BIVARIATE CORRELATION

The Bivariate Correlations procedure computes Pearson's correlation coefficient, Spearman's rho, and Kendall's tau-b with their significance levels. Correlations measure how variables or rank orders are related. Before calculating a correlation coefficient, screen your data for outliers(which can cause misleading results) and evidence of a linear relationship. Pearson's correlation coefficient is a measure of linear association. Two variables can be perfectly related, but if the relationship is not linear, Pearson's correlation coefficient is not an appropriate statistic for measuring their association.

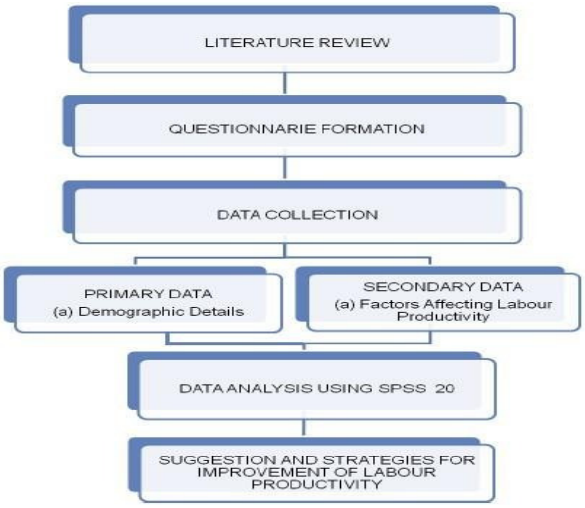

Fig: 2.3 Flow Chart showing Research Methodology

3. DATA COLLECTION AND DATA ANALYSIS

3.1 DATA ANALYSIS

Primary questionnaire helps in obtaining information regarding the demographic details of the respondent. The demographic details include name of the respondent, age of the respondent, experience of the respondent and designation of the respondent. The primary questionnaire provides the background information of the respondents. Secondary questionnaires are used to collect data regarding the factors affecting labor productivity. In the secondary questionnaire an ordinal measurement scale 1 to 5 was used to determine the effect level. Respondents were asked to rank factors affecting labor productivity according to the degree of importance (1=No impact; 2 =Low impact; 3 =Average impact; 4=High impact; 5 =Very High impact). For analyzing data SPSS 20, statistical analysis software was used.

3.1.1 MODE OF ANALYSIS

Analysis of data is done using SPSS software the result obtained can be obtained by using SPPSS software

3.1.2 DEMOGRAPHIC DETAILS

In the primary questionnaire the information regarding the demographic details of the respondents are collected. The various demographic details are age, designation and years of the experience of the respondents.

3.2 DESIGNATION OF THE RESPONDENTS

Data regarding the designation age of the respondents are collected using questionnaire survey.

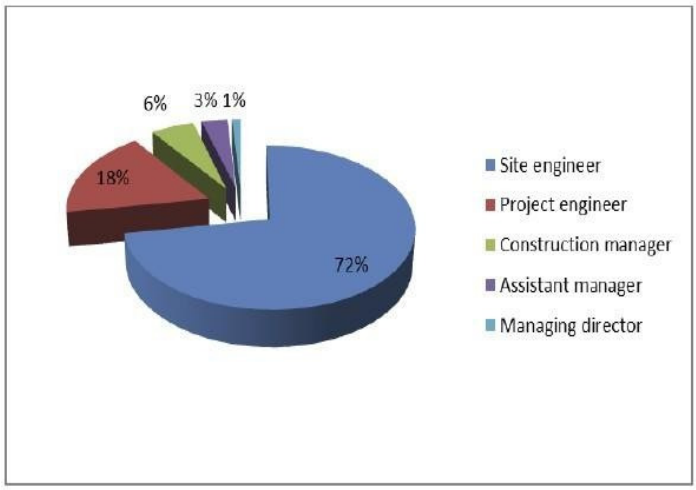

Fig: 3.2 Designation of the respondents

3.3 AGE OF THE RESPONDENTS

Data regarding the age of the respondents are collected using questionnaire survey. The results are shown in table 3.2

Age	Percentage (%)
20 -30	74
31-40	22
41-50	3

From table 3.2 It is found that most of the respondents (75%) are in the age group 20 - 30.

3.4 SECONDARY QUESTIONNAIRE SURVEY

The secondary questionnaire is used to find the major factors affecting labor productivity. Nearly 45 factors are used for the preparation of the questionnaire. 5 point Linker scale is used for impact measurement :(1=No impact; 2 =Low impact; 3 =Average impact; 4 =High impact; 5 =Very High impact). Questionnaires are distributed in various construction project sites across Hot and Arid region.

3.5 ANALYSIS OF DATA USING SPSS

The data collected from the respondent are analyzed using SPSS software.

4. RESULTS AND DISCUSSIONS

Questionnaire was collected from various nature of projects such as;

Industrial construction projects
Commercial construction projects

4.1 CORRELATION ANALYSIS FOR HIGH IMPACT FACTORS

Questionnaire survey was conducted across the industrial constructions like nuclear power plants, office buildings, atomic power stations and other industrial sectors projects. Six groups have been identified which affects the construction activities and productivity to develop the model. All the data's are entered in SPSS to find the correlation analysis.

Table 4.1 Descriptive statistics

	Mean	Std. Deviation	N
Reinforcing	9.396	1.2302	56
Labours health	9.386	1.2287	56
labour tiredness	9.050	1.3273	56
Concreting works	8.870	.7153	56
Blockage	8.848	.5871	56

Table 4.2 Bivariate correlation

		Reinforcing	Labours health	labour tiredness	Concreting works	Blockage
Reinforcing	Pearson Correlation	1				
	Sig. (2-tailed)					
	N					
Labours health	Pearson Correlation	.151	1			
	Sig. (2-tailed)					
	N					
labour tiredness	Pearson Correlation	-.091	.009	1		
	Sig. (2-tailed)					
	N					
Concreting works	Pearson Correlation	-.148	.323*	-.011		
	Sig. (2-tailed)					
	N					
Blockage	Pearson Correlation	.057	-.001	-.314*	-.12	1
	Sig. (2-tailed)					
	N					

					Concreting works	Blockage
Reinforcing	Pearson Correlation	1				
	Sig. (2-tailed)					
	N					
Labours health	Pearson Correlation	.151	1			
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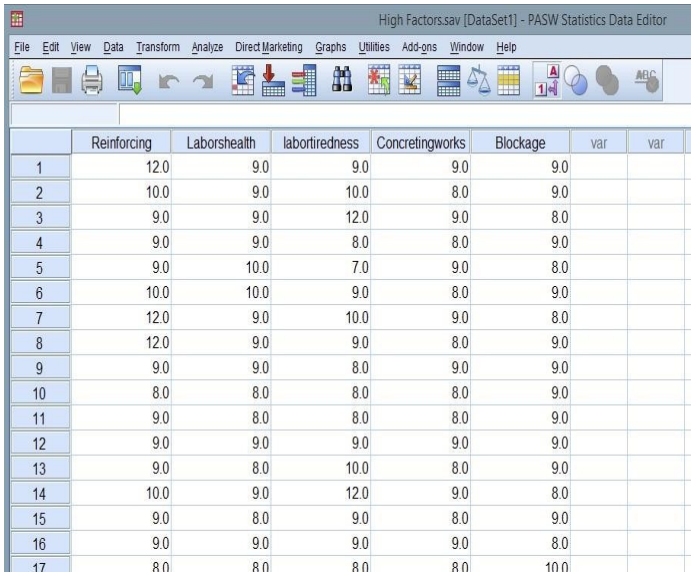
	N					
labour tiredness	Pearson Correlation	-.091	.009	1		
	Sig. (2-tailed)					
	N					
Concreting works	Pearson Correlation	-.148	.323*	-.011	1	
	Sig. (2-tailed)					
	N					
Blockage	Pearson Correlation	.057	-.001	-.314*	-.128	1
	Sig. (2-tailed)					
	N					

Table 4.2 describes the correlation analysis used in the spss software. Pearson correlation method is carried out to correlate each factors such as, Reinforcing the bars, Labors health, Labor tiredness, Major Concreting works and Block age in pipe lines. The maximum value for correlation is 1, and the result values corresponding the variables indicates how far the factor affects the construction projects activities and productivity.



	Reinforcing	Laborshealth	labortiredness	Concretingworks	Blockage	var	var
1	12.0	9.0	9.0	9.0	9.0		
2	10.0	9.0	10.0	8.0	9.0		
3	9.0	9.0	12.0	9.0	8.0		
4	9.0	9.0	8.0	8.0	9.0		
5	9.0	10.0	7.0	9.0	8.0		
6	10.0	10.0	9.0	8.0	9.0		
7	12.0	9.0	10.0	9.0	8.0		
8	12.0	9.0	9.0	8.0	9.0		
9	9.0	9.0	8.0	9.0	9.0		
10	8.0	8.0	8.0	8.0	9.0		
11	9.0	8.0	8.0	8.0	9.0		
12	9.0	9.0	9.0	9.0	9.0		
13	9.0	8.0	10.0	8.0	9.0		
14	10.0	9.0	12.0	9.0	8.0		
15	9.0	8.0	9.0	8.0	9.0		
16	9.0	9.0	9.0	9.0	8.0		
17	8.0	8.0	8.0	8.0	10.0		

Fig 4.1 SPSS data view dialog box

In fig 4.1 data view of SPSS software has been shown. The high critical impact factors are shown.

4.2 CORRELATION ANALYSIS FOR LOW CRITICAL FACTORS

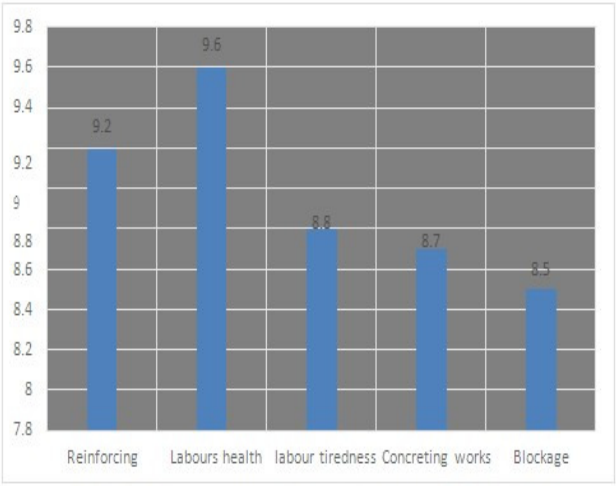


Fig 4.2 Chart showing high critical impact factors

4.3 COTROL MEASURES AND DISCUSSION

From data analysis it is found that the most critical factors such as Reinforcing bars has the highest impact compared to the other factors in the table. Labors health, Labor tiredness, Major Concreting works and Blockage in pipe lines are the further factors which affects the construction activities and productivity.

Table 4.3 Descriptive Statistics

	Mean	Std. Deviation	N
Maintenance of Vehicles	2.725	.9622	56
Planning schedule	2.907	.6682	56
Powercutoff	2.998	.8529	56
Time Delaying	3.09	.668	56

From the table 4.3 the descriptive statistics of low critical factors are described by running a correlation in SPSS software. Various factors have been ranked according to the analysis and outputs.

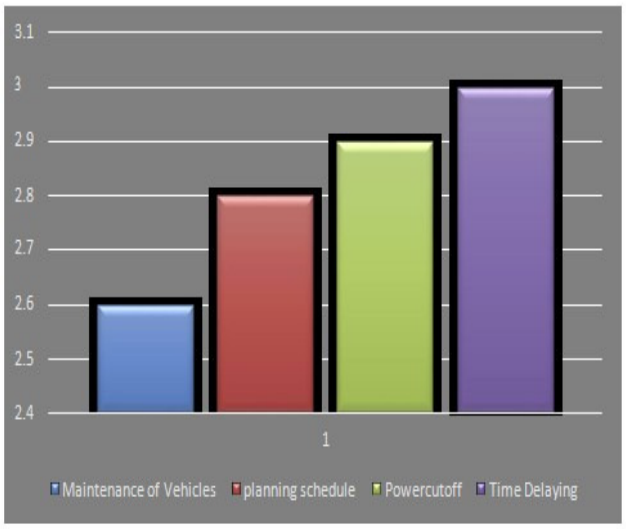


Fig 4.3 Chart showing lowest critical impact factors

In fig 4.3 Maintenance of vehicles factor has the lowest ranking in the construction projects and the other factors has the secondary impact compared to the manpower.

4.4 MITIGATION STRATEGIES

The various mitigation strategies to be followed to reduce hazards are:

Proper safety training and precautions must be taken at the site to avoid accidents.

Conduct the work when the risk has reduced. E.g. wait for the environment to cool down.

Organize work to reduce exposure. E.g. use work-rest schedules, job rotation, team rotation, more employees on job.

Provide welfare facilities. E.g. first aid and emergency equipment and procedures, extra rest rooms

5. CONCLUSION

The data collection is done in several project sites across Hot and Arid region. The major respondents are Site engineers, Project engineer, constriction manager, Assistant manager and managing director, most of the respondent fall under the age group of 20 to 30 and more than 50% of them are having an experience of 0 - 5 years. The data analysis is done using SPSS 20.From data analysis it is found that the most critical factors such as Reinforcing bars has the highest impact compared to the other factor in the table. Labors health, Labor tiredness, Major Concreting works and Blockage in pipe lines are the further factors which affects the construction activities and productivity.

Labor and Materials are the important resources required for successful completion of a project. So they should be given proper importance. The various strategies to improve labor productivity are suggested they are as follows

Proper communication should be ensured between labors and management

Clear and detailed instructions must be given ,

Proper training must be given to all the laborers according to the type of work they are involved.

Provide welfare facilities,

Proper safety training and precautions must be taken at the site to avoid accidents;

Reinforcements and materials should be placed in a closed environment,

Proper schedule must be prepared and it should be communicated to all the persons working in a particular project.

Large volume of placing concrete should be done in night times

Control of Working Time (CWT). The organization should follow the strategies in order to overcome the heat stress.

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