

**A summary of "Factors Affecting Construction  
Practices in Makkah Al-Mukkaramah, Saudi Arabia"**

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## **Abstract**

The Holy City of Makkah receives millions of pilgrims and visitors every year. A detailed study has been conducted to identify the most relevant factors affecting construction practices in Makkah. Eleven factors have been identified. The effects of each factor on the five construction resources have been also statistically analyzed by statistical analysis system (SAS). It has been found that the factors including location and topography, Hajj season, structure and building tissues, coordination problems among agencies, government budget time limit conflicts, and Ramadan have moderate effects on construction practices in Makkah. Other factors (restriction on non-Muslims, land-ownerships, climate, master plan availability, and building laws) have slight effects. Results also disclosed that the eleven factors may increase the overall costs of a project by more than 20%.

## **Introduction**

Construction is a complex industry in which planners, designers, contractors, materials, manpower, and equipment are involved. Enhancing the construction proficiency usually requires a full understanding of the factors affecting construction management's resources (i.e. time, costs, manpower, materials, and equipment ). Such factors create challenges to construction. The challenges include:

- 1) Rising costs (salaries, materials, equipment, inflation)
- 2) Time (design and construction schedules, delivery)
- 3) Quality (design, skill of labors, quality of materials)
- 4) Coordination and control between owner, engineers and contractors

## **Objectives**

The main objectives of this research are

- 1) To define the factors affecting construction practices in the Holy city of Makkah.
- 2) To evaluate how each factor affects construction management resources and thereafter its overall effect on construction practices in Makkah.

## **Method of Study**

The author distributed first a preliminary questionnaire to the participants of the Second Saudi Engineering Conference, KFUPM, November 1985 (Appendix-A).

The outcome of this survey resulted in defining eleven factors affecting construction practices in Makkah.

Afterwards, a second detailed questionnaire (Appendix–B) was distributed in 1986 to contractors, consultants and government departments such as the Hajj Research Center, Umm-al-Qura University, Municipal of Makkah. The survey was undertaken to evaluate the influence of each factor on the construction time, costs, manpower, materials, and equipment. The obtained data have been statistically analyzed by a statistical analysis system package (SAS). Thereafter, factors were categorized into strong-, moderate-, slight-, no- effects.

### **Discussion of the Eleven Factors**

A brief description of the eleven factors obtained from the preliminary survey is outlined as follows:

#### **1) Location and Topography**

The Holy city of Makkah is located in the Western Province of Saudi Arabia. The Holy Mosque is located in the central part of the city in the middle of Wadi Ibrahim, at an elevation of 277 meters above sea level.

In general, topography refers to the several mountains and valleys forming the Makkah region. In fact, steep mountains create a great difficulty in construction excavation while valleys subject to floods during heavy storms of rain. Makkah's mountains include:

- **Jabal Hira:** It is of 634m elevation, with steep slopes in all directions. It contains the cave in which Prophet Mohammad received the first message of the Quran.
- **Jabal Thawr:** It is of 759m elevation. It contains the cave in which Prophet Mohammad and the Caliph Abu-Bakr hid from Khofar Makkah who rejected Islam. Construction in this Jabal as well as in Jabal Hira is not allowed.
- **Jabal Abu Qubays:** It is of 372m elevation, with steep slope along its east side. At its peak, there is Bilal Mosque. Many houses with steep stairs are built on its slopes.
- **Jabal Qaa'l-et-Jiyad:** It is of 406m elevation with gentle slope in the north side.
- **Jabal Omar:** It is of 380m elevation, highly populated, mainly on its sides facing the Holy Mosque.

- **Jabal Al-Kaa'ba:** It is of 340m elevation with gentle slopes in all directions.
- **Jabal Hindi:** It is of 427m elevation with steep slopes in all directions.
- **Jabal Adhakhir:** It is of 442m elevation with steep slope in the east side.

In light of the above mentioned rugged topography, construction in Makkah is restricted mostly in the valleys and along the slopes of the mountains. This would require massive excavation and leveling which in turn would lead to

- a) Destruction of the natural landscapes of Makkah
- b) An increase in the overall construction costs. Special equipment are required to excavate the hard igneous rocks (granite, basalt,...) forming the mountains, and more time and labors needed to move the equipment to the steep sides of the mountains.

## **2) Structure and Building Tissues**

This scientific term refers to the overall characteristics of an area in terms of the shape and size of its major roads, streets, and buildings. Makkah has a unique structure and building tissue. It contains the Kaa'ba and the Holy Mosque. People have a strong desire to live close to the Holy Mosque. Therefore, the central area around the Holy Mosque is a dense residential area with seasonal housing units and commercial shops. In contrast, areas around Makkah are with less population. For sites on the steep slopes of the mountains, it is very difficult to move equipment to the site and the only way to transport equipment and materials is by labors and/or donkeys resulting in higher costs and longer time.

## **3) Climate and Temperature**

The weather of Makkah is influenced by its proximity to the Red Sea and the mountains of Taif. It is very hot and humid in the summer and cold in the winter. The maximum temperature in the summer is 45°c. Evaporation in the summer may reach 16mm/day and in the winter 6mm/day. Wind speed is high in the summer.

The Hot weather of Makkah increases the construction costs because contractors have to provide air-conditioning system for offices and residential units. Furthermore, certain equipment are not designed to operate in high temperatures environment. Also mixing and placement of concrete require special treatment in hot weather.

#### **4) Building Laws and Regulations**

The building laws specify items related to site preparation, ground floor level relative to street level, maximum area of a building, number of floors, ventilation, electrical wiring, color of exterior walls, fire and flood protection. In fact, no building can be built without a permit from the municipal. In general, the building laws affect the construction methods as well as the materials and equipment.

#### **5) Master Plan**

The master plan is an official document adopted by the local government as a guide to decisions about the physical development of the community. Construction companies use the master plan to set their long-term policies concerning future expansion, types and sizes of projects the company is willing to work on in the future, the company's future need for equipment and labor.

#### **6) Construction Problems among Agencies**

The following problems among agencies working in Makkah have been noticed:

- a) Cooperation is not clearly defined, and sometimes is missing. Indeed, lack of coordination causes waste of time and money. As an example, roads in the Holy city of Makkah are continuously excavated for placing pipes or wire, paved and later on dug up again for another public services.
- b) Most projects are undertaken by private contractors. The work of government agencies is limited to official communication related to time schedule and completion date.
- c) Tenders are often awarded to contractors submitting the lowest bid regardless of their skills and experience. This drawback has a negative impact on the quality of the work.
- d) Some projects have to be suspended temporarily during Umrah and Hajj seasons.
- e) Lengthy administrative procedures at ministry level cause suspension of projects as a result of delay in allocating the needed funds.

#### **7) Land-Ownership Problems**

The types of land in Makkah include a) state-owned land to Ministries such as Defense, Education, Hajj, Agriculture, National Guard, etc. b) private –owned land.

In general, land in Makkah is very expensive. More than two-third of the total cost of public projects as roads, tunnels goes as a compensation to land owners. Furthermore, when planners base their calculations on the basis that certain land is not owned by anybody, sometimes later on, a person comes and claims his ownership to the land. Consequently, construction has to stop for some time until a solution is found for the dispute.

#### **8) Restriction on Non-Muslim Labors**

Non-Muslims are not allowed to enter the Holy city of Makkah, Therefore, all labors working in Makkah are Muslims. Consequently, the religious holidays of Ramadan and Al-Hajj, and the daily breaks for prayer all affect the construction activities. The restriction on non-Muslims also reduces the degree of competition among contractors. Such less competitive market would increase the cost of bids and/or decrease the overall quality of the work. Of course, this negative effect would be eliminated if skilled Muslim workers dominate the market.

#### **9) Ramadan and Umrah season**

The month of Ramadan affects the duration time and the total costs of the projects. During Ramadan, the working hours are 36 hours/week instead of 48 hours/week. The productivity of fasting labors would be less than average. Furthermore, the last ten days of Ramadan are always crowded with people coming to perform Umrah.

#### **10) Hajj**

The Hajj season has positive and negative effects on construction.

Negative effects include increasing construction costs due to

a) crowds of people and traffic jams: construction in areas close to the Holly Mosque has to stop because labors who live far away from AL-Haram can not reach the site as well as the materials which are stored in places outside Makkah.

b) time breaks: construction has to stop for Hajj and Eid vacation.

On the other hand, positive effects of Hajj on construction include:

- a) Increasing the demand for more modern roads, tunnels, bridges, buildings.
- b) Continuous demand for effective maintenance to the existing facilities.
- c) Improving the economical environment in Makkah.

d) Increasing the capital expenditure on construction. For example, the total capital expenditure for the Mina Development project over the period from 1975 to 1983 was SR 3.367 Billion.

### **11) Government Budget-Time Conflict**

The announcement of the government budget on the first of Rajab was imposing an extra effort on construction companies to complete projects in time and within the available budget. Fortunately, at the present time the budget is announced on the 22<sup>nd</sup> of December every year.

#### **Data Analysis and Interpretation**

As mentioned before, the preliminary questionnaire resulted in the identification of eleven factors affecting construction practices in Makkah (Appendix-A). A second detailed questionnaire was conducted and consisting of three parts:

- a) The first part consists of five questions related to the educational and experience backgrounds of the respondents (Q1 to Q5, Appendix-B).
- b) The second part consists of one question (Q6, Appendix-B). Responses of this question have to be entered into a tabulated matrix. The eleven factors of Appendix-A are listed along the y-axis. The author divided the three factors: restriction on non-Muslims, Ramadan, and Hajj, into sub factors to simplify the analysis. The construction management recourses (time, money, manpower, materials, and equipment) are listed along the x-axis. Time is divided into planning/scheduling time and duration time.
- c) The third part consists of two questions: Q7 and Q8. Question Q7 refers to the percentage by which the factors affect the overall cost of projects in Makkah. The second question Q8 refers to comments and recommendations.

The author distributed (120) questionnaires (Appendix-B) to contractors, consultants, and Government offices operating in Makkah. The respondents were asked to give one single value for each question according to the following point system:

<u>Factor Effect</u>	<u>Value</u>
Strong	1
Moderate	2
Slight	3
No effect	4
No opinion	5



In order to clearly understand the statistical analysis of the results, the following range-system was specified:

<u>Factor Effect</u>	<u>Range</u>
Strong	1.00-1.59
Moderate	1.60-2.59
Slight	2.60-3.59
No effect	3.60-4.00

Out of the 120 questionnaires, the author received 64 ones of full complete information. The 64 questionnaires were then analyzed by the Statistical Analysis System (SAS) on the KFUPM mainframe computer. The SAS was used to determine the frequency, standard deviation, and the mean (average) of the results of the questionnaires.

### **Statistical Analysis Results and Interpretation**

In summary, the following represents the findings from the statistical analysis.

- 1) Effects of location and topography on construction management resources.

The effects of this major factor are outlined in the following table:

<u>Resource</u>	<u>Mean</u>	
Machines (size and type)	1.25	
Costs	1.39	
Duration time (increased)	1.48	Strong effects
-----		
Planning and scheduling time	1.80	
Manpower	2.52	Moderate effect
-----		
Materials	2.83	Slight effect
Average mean = 1.87		Moderate effect

2) Effects of structure and building tissues on construction management resources. It has been found that this factor affects the duration time and then planning and scheduling time. Machines, costs, manpower, and materials are followed as indicated in the following table:

<u>Resource</u>	<u>Mean</u>	
Duration time (increased)	1.71	
Planning and schedule time	1.72	
Machines	1.72	
Costs	1.88	
Manpower	2.58	Moderate effect
-----		
Materials	2.88	Slight effect
Average mean = 2.12		Moderate effect

3) Effects of climate and weather temperatures.

It is believed that climate and weather temperatures strongly affect construction in Makkah. However, the table below indicates that this factor has moderate to slight effects.

<u>Resource</u>	<u>Mean</u>	
Duration time (increased)	2.02	
Planning and scheduling time	2.59	Moderate effect
-----		
Manpower	2.66	
Costs	2.80	
Materials	2.86	
Machines	3.59	Slight effect
Average mean= 2.70		Slight effect

4) Effects of building laws and regulations.

The effects of this factor range from moderate to slight

<u>Resource</u>	<u>Mean</u>	
Planning and scheduling time	2.50	
Duration time	2.58	Moderate effect
-----		

Costs	2.85	
Materials	2.88	
Machines	3.34	Slight effect
-----		
Manpower	3.67	No effect
	Average mean = 2.97	Slight effect

5) Effects of master plan availability.

The effects of this factor also range from moderate to slight

<u>Resource</u>	<u>Mean</u>	
Planning and scheduling time	1.76	
Duration time (increased)	2.53	Moderate effect
-----		
Costs	3.00	
Machines	3.39	
Manpower	3.53	
Materials	3.59	Slight effect
	Average mean = 2.96	Slight effect

6) Effects of coordination problems among agencies.

The following table shows that this factor affects mostly planning and scheduling time. Duration time, costs, manpower, machines, and materials followed consequently.

<u>Resource</u>	<u>Mean</u>	
Planning and scheduling time	1.35	Strong effect
-----		
Duration time (increased)	1.69	
Costs	1.89	Moderate effect
-----		
Manpower	2.72	
Machines	3.03	
Materials	3.08	Slight effect
	Average mean = 2.39	Moderate effect

7) Effects of land-ownership problems.

This effect has strong effects on planning/scheduling time and duration time. It has no effects on other resources. However, about 83% of respondents indicated that this factor strongly affects the costs, especially in road and tunnel projects.

<u>Resource</u>	<u>Mean</u>	
Planning and scheduling time	1.48	
Duration time (increased)	1.55	Strong effect
-----		
Costs	1.78	Moderate effect
-----		
Machines	3.63	
Manpower	3.64	
Materials	3.94	No effect
Average mean = 2.67		Slight effect

8) Effects of restriction on non-Muslim labor.

This factor is divided into the following sub-factors:

- a) Reduced competitive bidding
- b) Lack of skilled labor
- c) Immigration problems

The effects of reduced competitive bidding are outlined below.

<u>Resource</u>	<u>Mean</u>	
Costs	2.02	
Duration time (increased)	2.32	Moderate effect
-----		
Planning and scheduling time	2.63	
Machines	2.83	
Materials	2.91	
Manpower	3.08	Slight effect
Average mean = 2.63		Slight effect

The lack of skilled labor affects costs, planning and scheduling, duration time and manpower.

<u>Resource</u>	<u>Mean</u>	
Costs	1.91	
Planning and scheduling time	1.94	
Duration time (increased)	2.02	
Manpower	2.13	Moderate effect
-----		
Materials	2.81	
Machines	2.89	Slight effect
Average mean = 2.28 Slight effect		

The immigration problems have slight effects on construction resources

<u>Resource</u>	<u>Mean</u>	
Costs	2.37	Moderate effect
-----		
Manpower	2.62	
Duration time (increased)	2.88	
Planning and scheduling time	3.02	
Materials	3.55	
Machines	3.55	Slight effect
Average mean = 2.99 Slight effect		

#### 9) Effects of Month of Ramadan

The effects of Ramadan on construction practices in Makkah are divided into three sub-factors: working hours, productivity, and efficiency. Their effects are outlined in the three tables below, respectively.

Working Hours: <u>Resource</u>		<u>Mean</u>	
Duration time (increased)		1.52	
Planning and scheduling time		1.58	Strong effect
-----			
Costs		1.94	
Manpower		2.63	Slight effect
-----			
Machines		3.72	
Materials		3.73	No effect
Average mean = 2.99 Slight effect			

Productivity:	<u>Resource</u>	<u>Mean</u>
	Costs	1.56 Strong effect
-----		
	Duration time (increased)	1.68
	Planning and scheduling time	1.83
	Manpower	2.25 Moderate effect
-----		
	Machines	3.41 Slight effect
	Materials	3.67 No effect
	Average mean = 2.99 Slight effect	

Efficiency:	<u>Resource</u>	<u>Mean</u>
	Duration time (increased)	1.94
	Costs	2.14
	Planning and scheduling time	2.29
	Manpower	2.49
	Machines	3.50 Moderate effect
-----		
	Materials	3.65 Slight effect
	Average mean = 2.40 Moderate effect	

If we take the average means of the top three tables, then the average mean of Ramadan would be 2.53 with moderate effects on all construction management resources in Makkah.

#### 10) Hajj Effects

The positive effects of Hajj on construction practices are clearly stated before. Results of analysis revealed the following negative effects:

a) Crowds and traffic jams: This factor strongly affects the duration time. Other resources are also affected to different degrees as outlined in the table below.

<u>Resource</u>	<u>Mean</u>
Duration time (increased)	1.41 Strong effect
-----	
Planning and scheduling time	1.61
Costs	2.02
Manpower	2.25

Machines 2.36 Moderate effect

Materials 2.97 Slight effect

Average mean = 2.10 Moderate effect

b) Breaks and interruptions: The following table indicates the effects of this factor

<u>Resource</u>	<u>Mean</u>
Planning and scheduling time	1.17
Duration time	1.25 Strong effect
-----	
Costs	1.70
Manpower	2.03 Moderate Effect
-----	
Machines	3.08
Materials	3.59 Slight effect
Average effect = 2.13 moderate effect	

Temporary use of project phases: The demand to complete a certain phase of a project to be used during Hajj requires careful planning and scheduling. In addition, other resources are affected to different degrees as outlined below.

<u>Resource</u>	<u>Mean</u>
Costs	1.70
Duration time (increased)	1.77
Planning and scheduling time	1.84
Manpower	1.9
Materials	2.41 Moderate effect
-----	
Machines	3.09 Slight effect
Average mean = 2.12 Moderate effect	

### 11) Government Budget Time Limit Conflicts

This factor has a strong effect on planning and scheduling time. About 60% of the respondents said that this factor strongly affects planning and scheduling time. Most the respondents were contractors and consultants. The following table indicated how other resources are affected.

<u>Resource</u>	<u>Mean</u>
Planning and scheduling time	1.44 Strong effect
-----	
Duration time (increased)	1.97
Costs	2.16 Moderate effect
-----	
Manpower	2.67
Materials	2.84
Machines	3.08 Slight effect
Average mean = 2.36 Moderate effect	

In summary, the table below shows the eleven factors arranged by the values of their means. The smaller mean reflects stronger effect on construction practices in Makkah.

<u>Factor</u>	<u>Mean</u>
Location and topography	1.87
Hajj season	2.11
Structure and building tissues	2.12
Coordination problems	2.29
Government budget	2.36
Ramadan	2.52 Moderate effects
-----	
Restriction on non-Muslims	2.63
Lands-ownerships	2.67
Climate and weather	2.70
Master plan availability	2.96
Building laws and regulations	2.97 Slight effects



## **Conclusions**

The following conclusions have been drawn from the conducted research:

1. Eleven factors affecting construction practices in Makkah have been identified and analyzed.
2. The effects of each factor on the five resources of construction management (time, money, manpower, materials, machines) have been discussed and analyzed .
3. Results revealed that each factor has unique effects on construction practices. The summarized results indicated that the first six factors have moderate effects and the remaining five factors have slight effects. The location and topography has the strongest effects on construction in Makkah.
4. Results also indicated that the combined effects of the eleven factors may increases the overall cost of a project by 20% or more.