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Introduction.

One year ago, Zamil Air Conditioners decided to build a new Factory in the second industrial city (Dammam) .This project was assigned to the CES Dept. (Corporate engineering Services) to prepare a feasibility study. In that study which I was involved in preparing a concept design and estimating cost, which the result was that the project was feasible with an estimated area of 33,000 M² and estimated cost of 12,000,000 Saudi Riyal.

After our submission of that study, the high management approved the project and we assigned this project to An A/E to prepare the required drawings and specifications documents.

Six months ago we received the drawings and we had begun to prepare a detailed estimate which showed us that the cost will be about 16,000,000 Saudi Riyal which was refused from our high management and for that it was essential to review the drawings and reduce the cost to a maximum limit of 13,000,000 Saudi Riyal.

As a result of the above it was required to make a Value engineering study in order to reduce the cost without sacrificing any of the required functions. For that was created a work team to conduct this study.

Since I'm one of this VE team study, it was assigned to me to study the parking shade system and see how to reduce its cost with out scarifying any of its functions.

Job Plan.

In any VE study, Job Plan is an essential tool to investigate the problem and the functions in order to generate ideas and evaluate them in a systematic procedure.

In this study I divided the job plan to the following phases:

1-Information Phase

2-Functional Phase

3-Creative Phase

4-Judicial Phase

5-Development Phase

6-Implementation Phase

Information Phase:**Study Premise****Study Title:**

Parking Shade

Name	Title
Team Leader	Dept.Head
Abbass Doueik	
Team Members	
Ali Moussa	Arch.Eng

Describe Item to be studied.

The project is in the pre-bidding phase and all the drawings and specifications are ready. The parking is designed to accommodate about 127 cars as shown in Fig.1. The parking divided into 3 rows, 2 rows consist of 40 cars each and one row consists of 47 cars. Each car parking is inclined 60° to facilitate the access of the car as we can see in Fig.2.the length for each car parking is 5.25 meters and 2.8 meters of width and as a result the area of each car is about 19.2 square meters. But since the parking is inclined 60° ,so the area for each car will be about 19.2 square meters. And as a result the minimum shading area required for each car is 19.2 square meters as shown

in Fig 2.so for 127 cars we need as a minimum shading area of

$$127 * 19.2 = 2438 \text{ M}^2.$$

The designer recommended using a complete steel structure as shown in

Fig3.

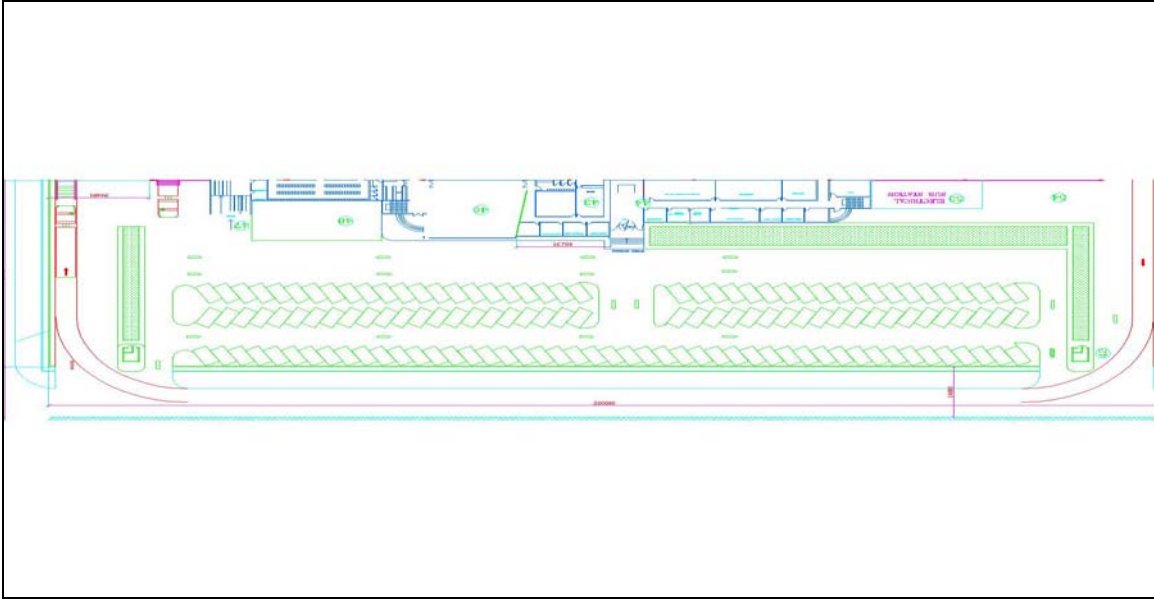


Figure1

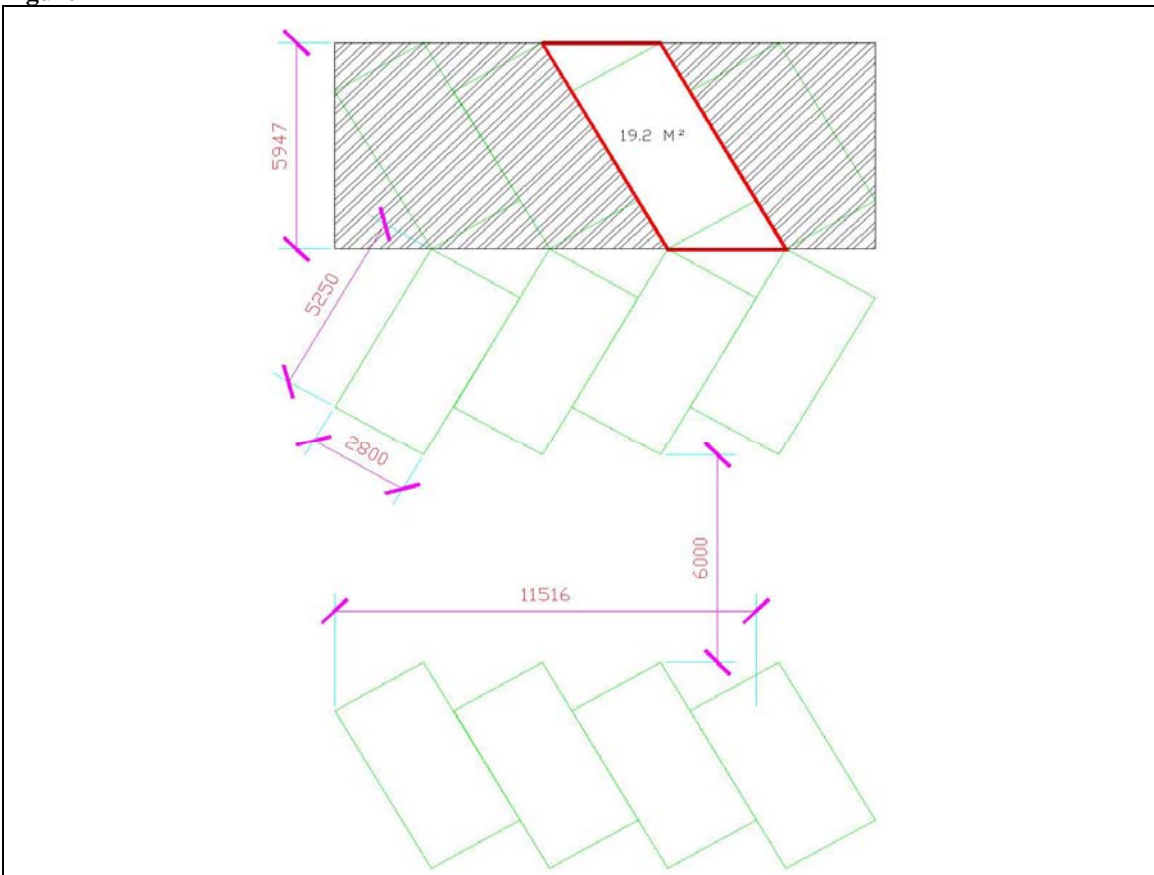
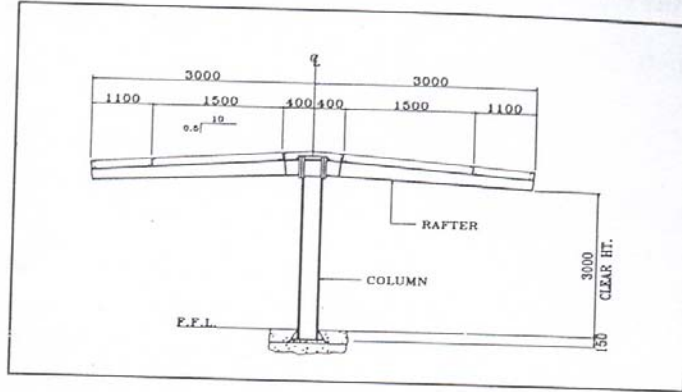


Figure 2

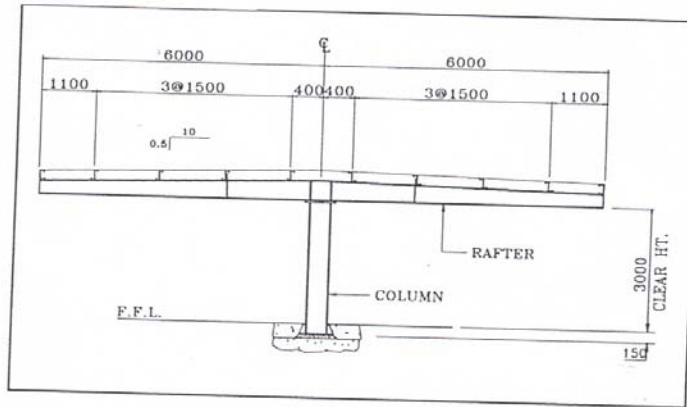
CHAPTER 8 : CAR CANOPIES

SECTION 8.2 CAR CANOPY

FALCON (I)



FALCON (II)



CARACAL

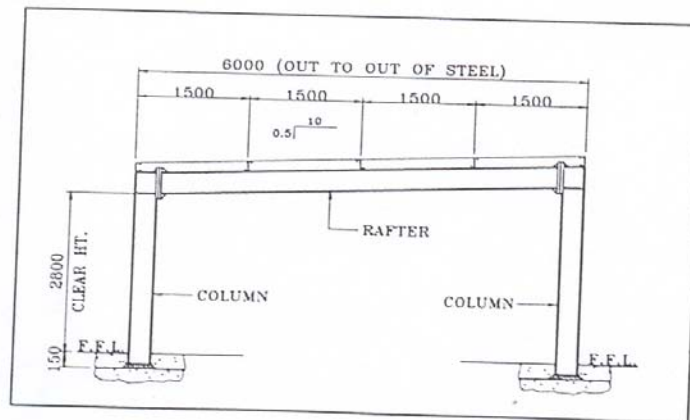


Figure 3

Information Phase:

Consultation Record

Study Title:

Parking Shade

Contact	Tel.No.	Major Points
CES		
Local providers		Design
Contractor		concrete prices
Historical data		pricing

Information Phase:

Performance Criteria

Study Title:

Parking Shade

Objectives or required Criteria

1. Provides shade and temperature control.
2. Provides hail protection.
3. Fire proof.
4. Reasonable initial Cost.
5. Maintenance Cost.
6. Nice look.

Goals, Desired Criteria or Features

1. local Provider.
2. price stability.

Information Phase:

Cost Data

Study Title:

Parking Shade

After investigating the local market I found that the parking shade systems available are two types. Steel structure with Steel Shade (Fig.4) and Steel Structure with Cloth Shade.

Steel Structure with steel shade.

This system is available in three types, Standard (4 supporting Columns), single canopy (2 supporting Columns) and double canopies in case of two adjacent rows of car parking. The length of the rafter is available up to 6 meters and the span between the columns up to 12 meters and the Cover shade is consist of steel panels . The average cost of this system including instillation is about **120 SR/M²** for the standard and the single canopy types and **110 SR/M²** for the double canopies type. Additional cost will be charged for the foundations which the cost depends on the type of the structure. As per my rough calculation, we need the following foundation Size for each type:

1-single Canopy (12 meters span and 6 meters Rafter) : 4 Cubic Meters of foundations with the total cost of 3000 SR.

2. Double Canopies (12 meters span and 6 meters rafter): 3 Cubic Meters of foundations with the total cost of 2250 SR.

3. Standard type (12 meters Span and 6 meters rafter): 2 Cubic Meters of foundations with the total cost of 1500 SR.

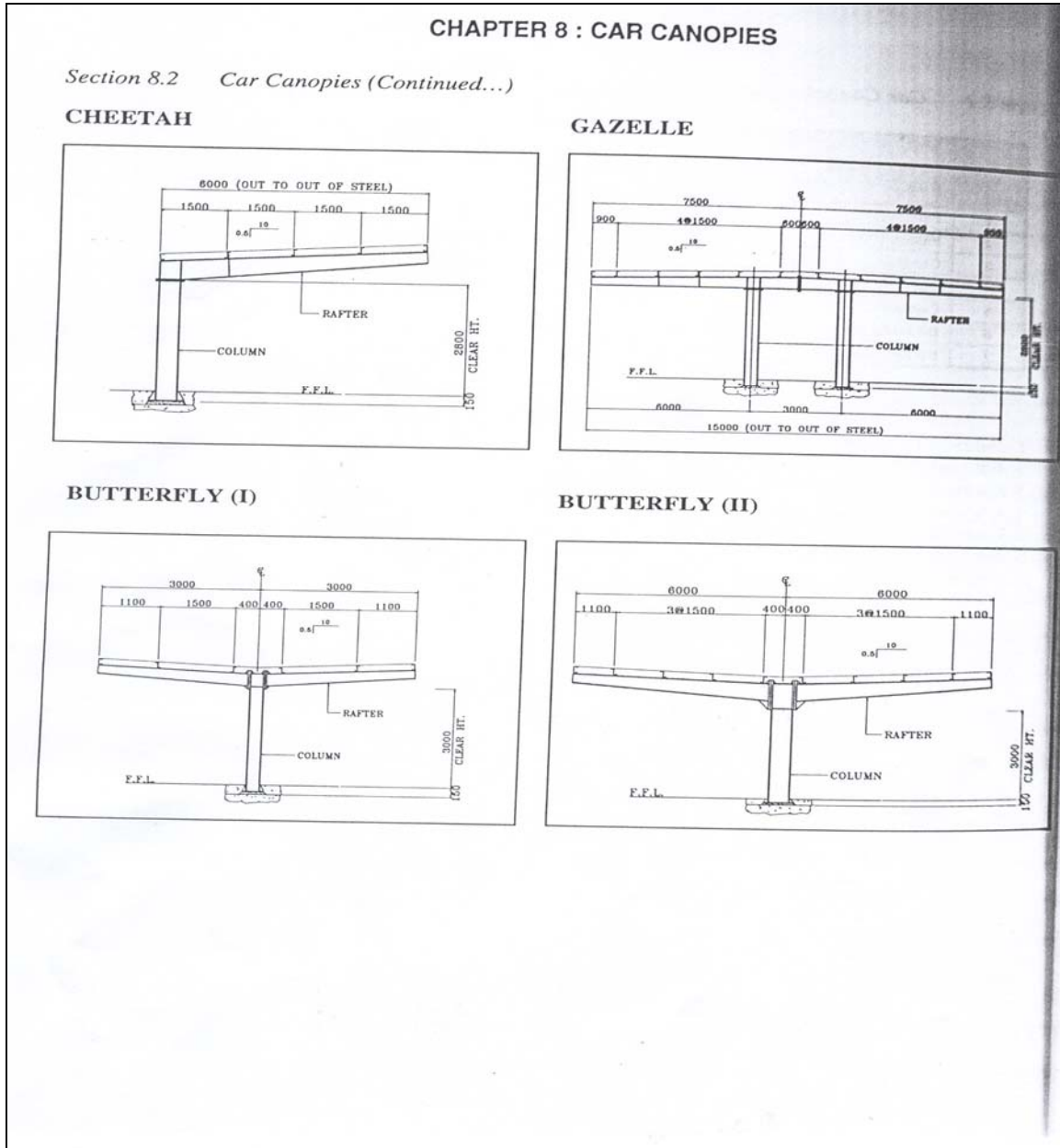


Figure 4

Steel Structure with Cloth Shade.

This system is available in three types, Standard (4 supporting Columns) (Fig 5) ,single canopy (2 supporting Columns)Fig 6 and double canopies in case of two adjacent rows of car parking (Fig 7). The length of the rafter is available up to 6 meters and the span between the columns up to 10 meters and the Cover shade is consist of cloth, covering fabric made of high density polyethylene. The cost for the single canopy is **120 SR/M²** and **100 SR/M²** for the double Canopies and **80 SR/M²** for the standard type. These costs including the installation and foundations.

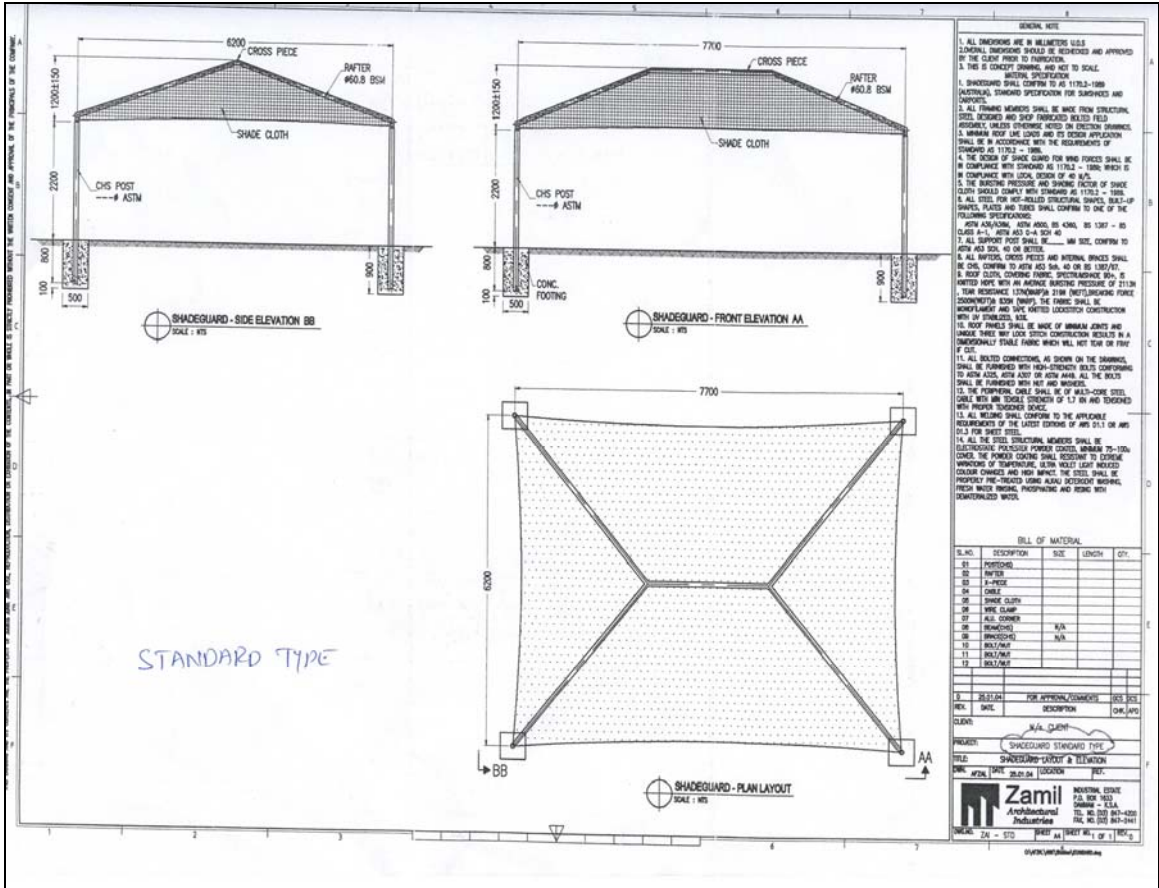


Figure 5

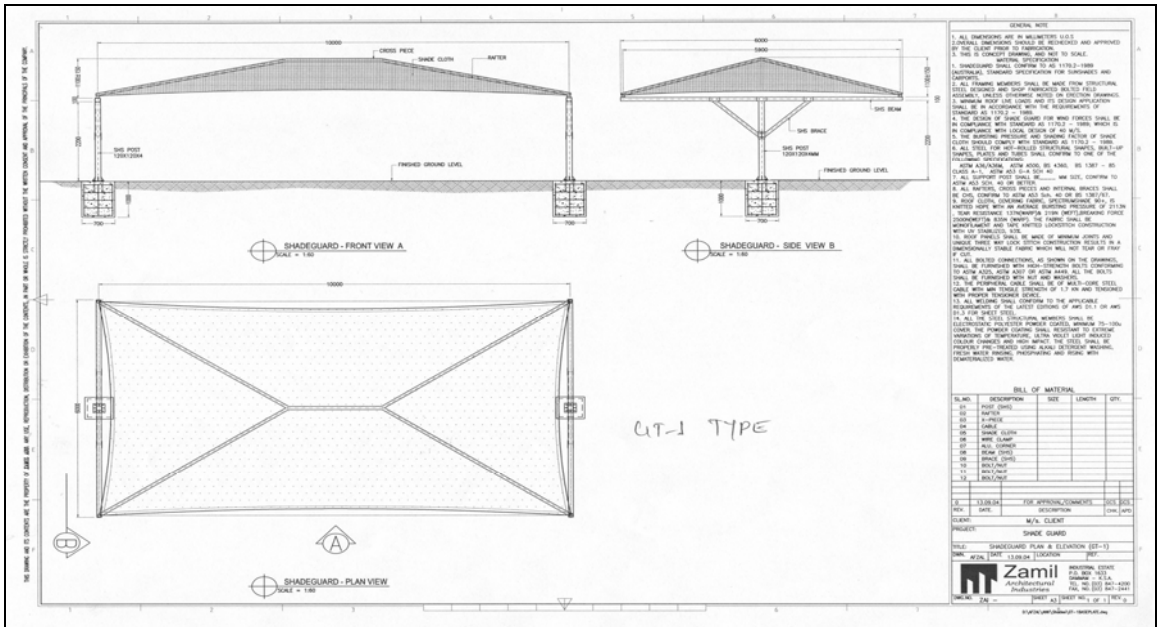


Figure 6

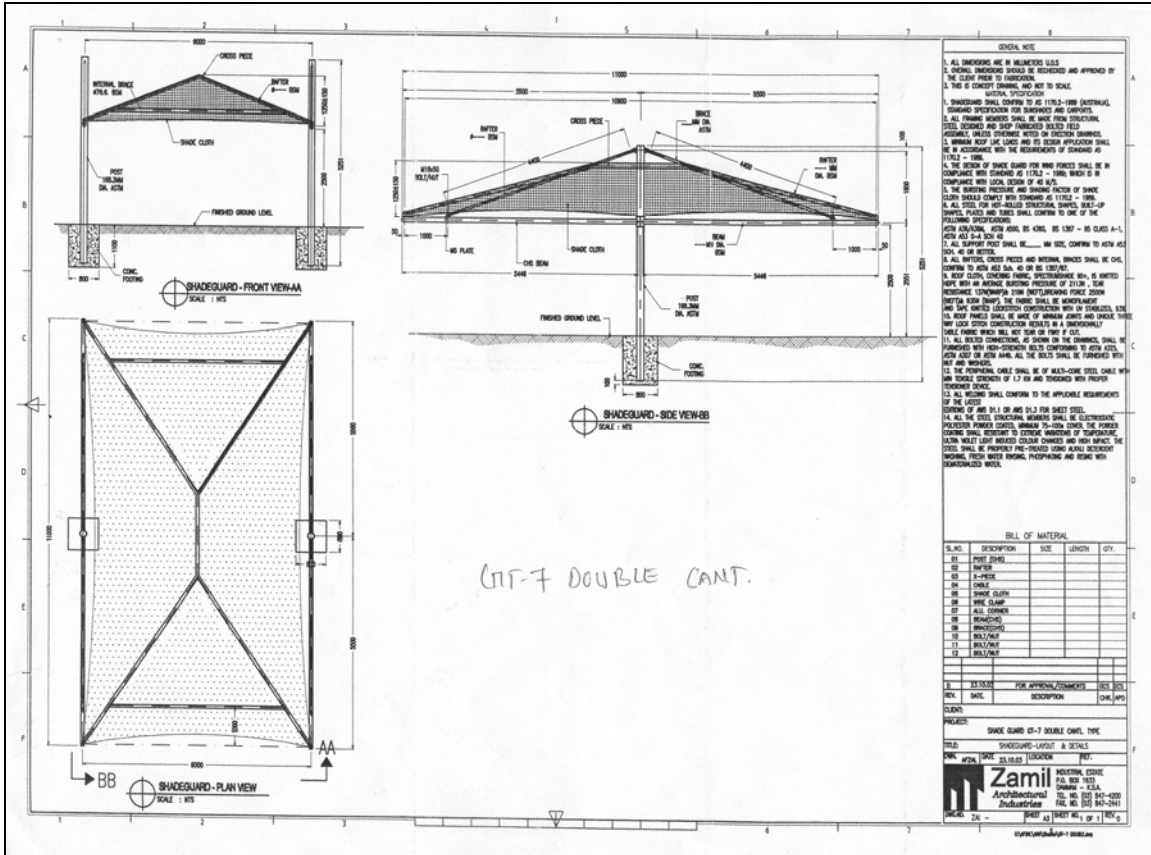


Figure 7

Steel Structure with PVC Shade.

This system is available in three types, Standard (4 supporting Columns), single canopy (2 supporting Columns) and double canopies in case of two adjacent rows of car parking. The length of the rafter is available up to 6 meters and the span between the columns up to 10 meters and the Cover shade is consist of P.V.C waterproof membrane . The cost for the single canopy is **240 SR/M²** and **200 SR/M²** for the double Canopies and

160 SR/M² for the standard type. These costs including the installation and foundations.

No.	Particular	Area/M²	area/car	Cost/M²	cost/car
1	Steel Structure with Steel Shade (standard type)	2438	19.2	128	2463
2	Steel Structure with Steel Shade (single canopy)	2438	19.2	137	2630
3	Steel Structure with Steel Shade (Double canopies)	2438	19.2	135	2592
4	Steel Structure with Cloth Shade (standard type)	2438	19.2	90	1728
5	Steel Structure with Cloth Shade (single canopy)	2438	19.2	120	2304
6	Steel Structure with Cloth Shade (Double canopies)	2438	19.2	100	1920
7	Steel Structure withPVC Shade (standard type)	2438	19.2	180	3456
8	Steel Structure with PVC Shade (single canopy)	2438	19.2	240	4608
9	Steel Structure withPVC Shade (Double canopies)	2438	19.2	200	3840

Functional Phase:**Function Work Sheet****Study Title:**

Parking Shade

Why	Function	How
To protect cars from: Sun Rays and Hails	Provide Shade for car parking	Cover the car parking

What Does it now do?**VERB****NOUN**

Provide

Shade

Protect

hail

Creative Phase:

Generate Ideas

Study Title:

Parking Shade

During this phase I concentrate my attention on the functional issue with out taking in consideration any constraint or limit and that to generate many ideas.

1. Steel Structure with Steel Shade (standard type)
2. Steel Structure with Steel Shade (single canopy)
3. Steel Structure with Steel Shade (Double canopies)
4. Steel Structure with Cloth Shade (standard type)
5. Steel Structure with Cloth Shade (single canopy)
6. Steel Structure with PVC Shade (standard type)
7. Steel Structure with PVC Shade (standard type)
8. Steel Structure with PVC Shade (single canopy)
9. Steel Structure with PVC Shade (Double canopies)
10. Wooden Structure with Cloth Shade
11. Wooden Structure with Wooden Shade
12. Planting trees in appropriate design to provide shade

Judicial Phase:

Feasibility Ranking

Study Title:

Parking Shade

Stability

Potential Cost

Probability of implementation

Time to implement

Fire proof

							Tot. Ra.
1. Steel Structure with Steel Shade (standard type)	10	5	7	7	10	39	4
2. Steel Structure with Steel Shade (single canopy)	10	6	8	6	8	38	5
3. Steel Structure with Steel Shade (Double canopies)	10	7	8	5	9	39	4
4. Steel Structure with Cloth Shade (standard type)	8	8	9	10	9	44	2
5. Steel Structure with Cloth Shade (single canopy)	8	9	10	8	7	42	3
6. Steel Structure with Cloth Shade (Double Canopies)	8	10	10	9	8	45	1
7. Steel Structure with PVC Shade (standard type)	7	8	5	5	9	34	6
8. Steel Structure with PVC Shade (single canopy)	7	9	5	3	7	31	8
9. Steel Structure with PVC Shade (Double canopies)	7	10	5	4	7	33	7
10. Wooden Structure with Cloth Shade	4	8	3	8	6	29	9
11. Wooden Structure with Wooden Shade	3	8	3	8	6	28	10
12. Planting trees in appropriate design to provide shade	7	1	1	10	10	29	11

Judicial Phase:**Idea Comparison****Study Title:**

Parking Shade

Idea	Advantages	Disadvantages	Rank
Steel with cloth (Double Canopies)	Free space Nice Looking	Fire Proof	1
Steel with Cloth (standard type)	Low Cost Stability	Post every 10 m Fire Proof	2
Steel with Cloth (single Canopy)	Free space Nice looking	Stability Fire Proof	3
Steel with Steel Shade (Standard type)	Stability Fire Proof	Post every 12 m Generate Heat	4
Steel with Steel Shade (Double type)	Stability Fire Proof	Generate Heat	4
Steel with Steel Shade (single Type)	Stability Fire Proof	High cost Generate Heat	5
Steel with PVC (Standard Type)	Nice looking	Very High Cost Post every 10 m Fire Proof	6

Judicial Phase:

Evaluation Matrix

Study Title:

Parking Shade

Development Phase:

Study Title:

Savings

Parking Shade

As per the design (Fig8), the double canopies applicable only on 80 cars and a single canopy or standard type shade applicable on 47 cars. For this I will select cloth shading(double canopies) for the 80 cars and Cloth shading (single canopy) for the 47 car.

Item

cloth shading(double canopies)	$80 * 1920 = 153600$
Cloth shading (standard type)	$47 * 1728 = \underline{81216}$
Total	234816 SR

Steel Shading (double Canopies)	$80 * 2592 = 207360$
Steel shading (single canopy)	$47 * 2630 = \underline{123610}$
Total	330970 SR

Saving in initial cost = 96154 = 29% reduction.

Since the two combinations have same annual rate of maintenance so the result of the life cycle cost will be effected only by the initial cost assuming the saving cost is Zero for both.

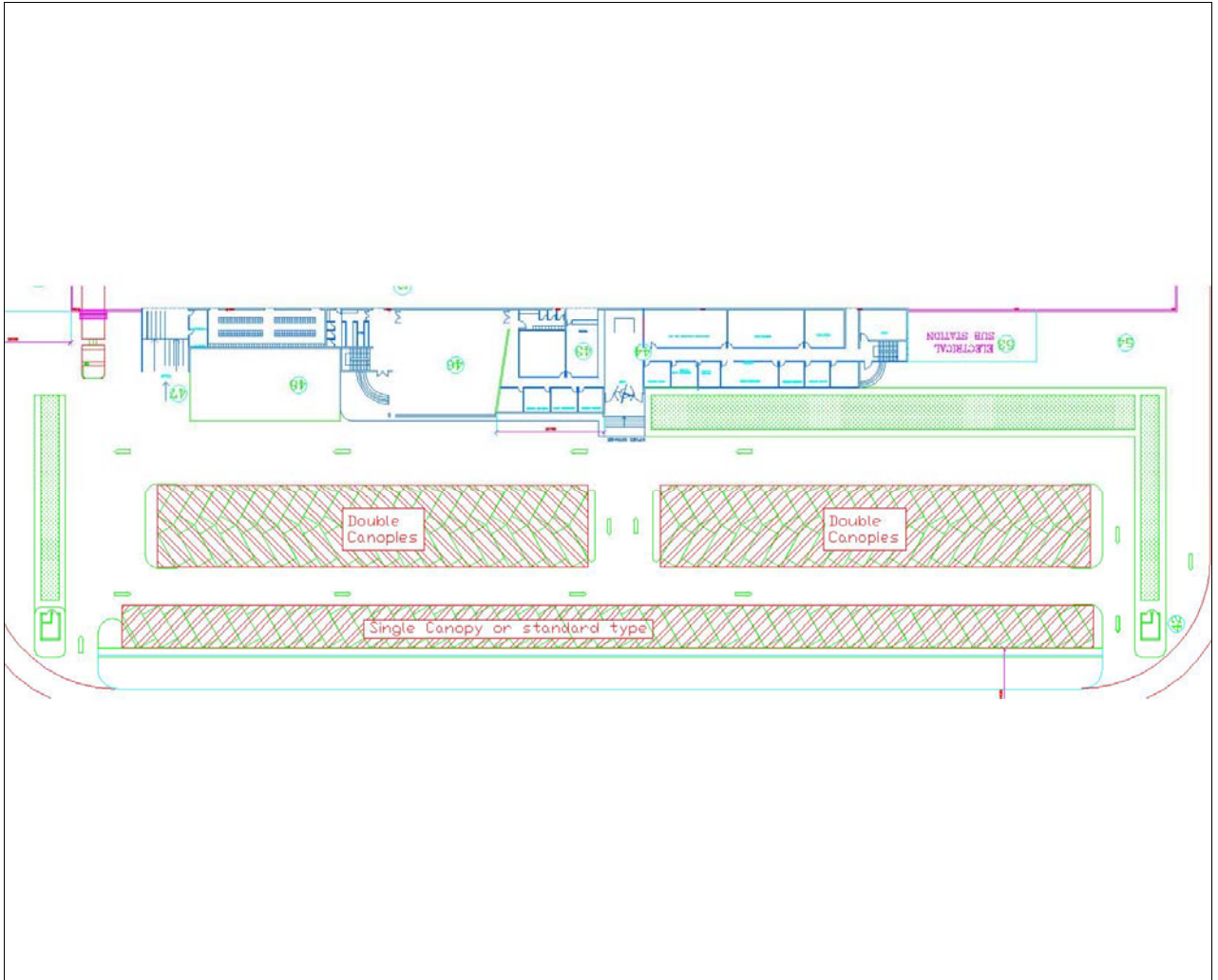


Figure 8

Development Phase:

Value study Summary

Study Title: Parking Shade

The selection of the combination of the Cloth shading (double canopies) and Cloth shading (standard Type) will meet all the requirements and criteria which will reduce the cost to the minimum possible cost maintaining the functionality of the project. This result is subjective and relative to this case and that it could be different if the parking is residential or commercial where the aesthetic factor is very important.

Implementation Phase:

Implementation Plan

Study Title: Parking Shade

1. How should be implemented?

The proposed result will be discussed with my manager and with the administration department to take their approval.

2. What should be changed and in what sequence?

Since the structure is not mentioned in the drawings because this is not a customized design, and it's the responsibility of the Manufacturer to provide his design and the shop drawing, so nothing will be changed.

3. Who should do it ?

CES Dept. should follow up this with the contractors.

4. How long it should take?

2 weeks for bidding and 40 days for supplying and installation.

5. Implementation cost?

20 man hours. (50 SR / hr)