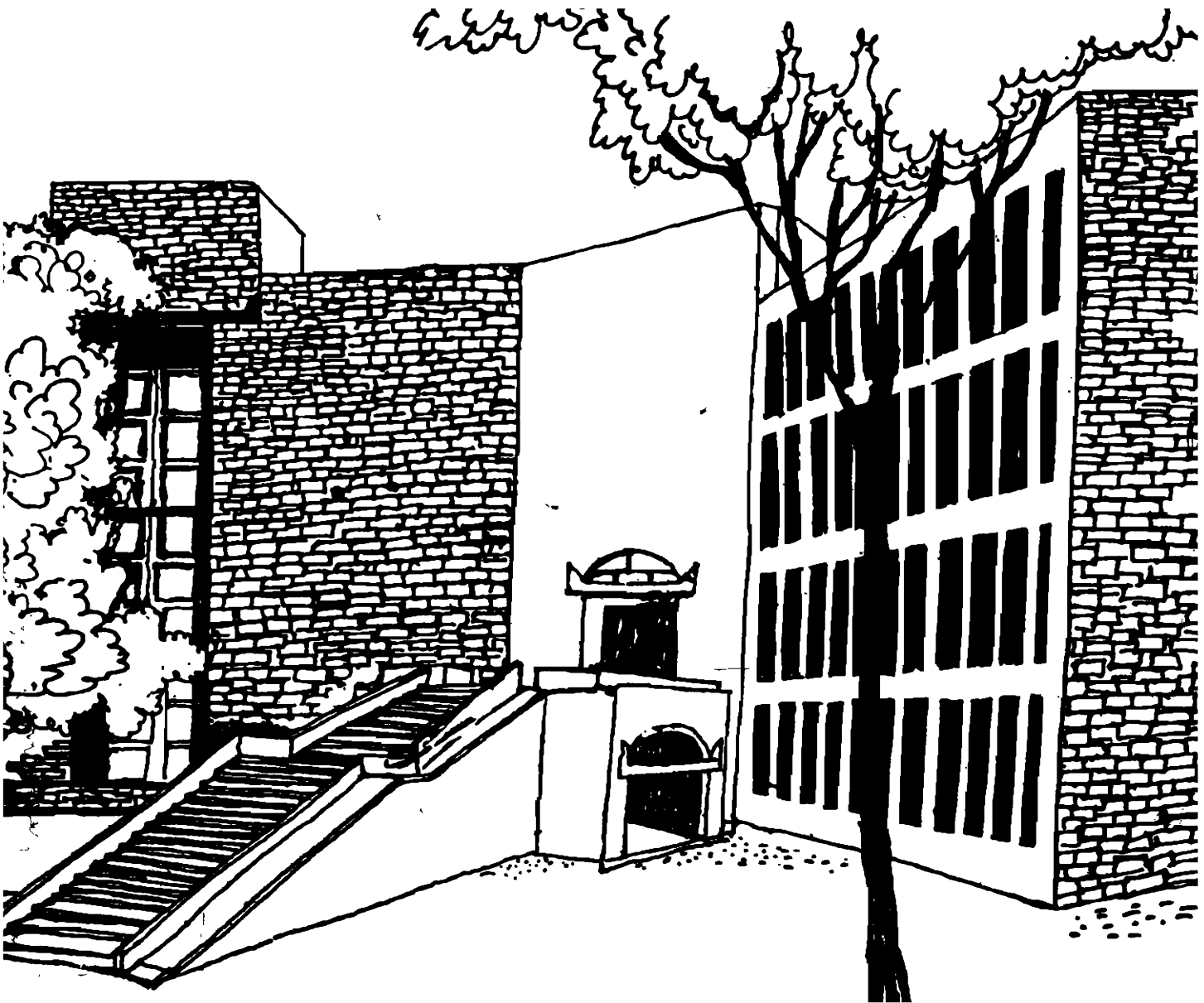




# Working Paper



**ENVIRONMENTAL CONTROL OF GREENHOUSE AT  
BHUJODI**

By

**Girja Sharan  
Vasant R. Pilare**

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# **Environmental Control of Greenhouse at Bhujodi**

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## **Abstract**

This write-up contains air temperature data and preliminary analysis of cooling requirement for greenhouse at Bhujodi. Examination of the temperature data showed that night time temperatures remain high enough most of the time. Heating of the greenhouse perhaps will not be required. Day time temperatures on the other hand, remains high enough most of the time to require cooling. Forced ventilation does seem effective, but only for part of day. Evaporation cooling and misting appears necessary. Design of fan-pad system was carried out. It consists of two fans (size 24 inch and 1/3 HP) and cross fluted pad (area 5 m<sup>2</sup>). Water loss is estimated to be about 1000 lit/day in the cooling system, which works out to about 10 lit/m<sup>2</sup> of floor area per day.

## **Environmental control**

Environmental control in greenhouses involves control of temperature, relative humidity and light intensity. Most plants require that temperature do not go above 30°C and not fall below 18°C [1]. Low relative humidity increases water requirements of crops. On the other hand, excess humidity causes rapid development leaf mold, fruit and stem rot. A relative humidity of 50 to 80% should be maintained inside greenhouse.

One of the major determinants of plant growth is light in both outdoor and protected agriculture. The three light influenced processes are: photosynthesis, photomorphogenesis, and photoperiodism. A light intensity of 6,000-60,000 lux is considered favourable for plant growth [2].

## **Ambient Temperatures at Bhujodi**

Daily temperature data of Bhuj (6 km from Bhujodi) were obtained from India Meteorological Department, Ahmedabad for the year 1997 and is given in **appendices 1 to 12 [3]**.

**Figure 1** shows maximum and minimum temperature at fortnightly interval during the year. Examination of the figure reveals that day time temperature remains high for most part of the year, going beyond 40°C in summers. Night temperature does not fall below 5°C. Tentatively, it can be stated that control of temperature, in Bhujodi will essentially mean cooling. Heating may not be necessary. **Figure 2** shows the maximum dry bulb and wet bulb temperatures (2:30 P.M) at fortnightly interval during the year. Examination of wet-bulb temperature shows that maximum rarely exceeds 30°C. This means evaporative cooling would be effective.

## **Greenhouse Cooling Systems**

Systems used for greenhouse cooling usually consist of one or more of the following.

- (a) Shading
- (b) Ventilation
  - Natural
  - Forced
- (c) Evaporative Cooling
  - Fan-pad
  - Misting or Fogging

We will first assess the cooling need of greenhouse at Bhujodi. It will be followed by the design of the system required.

## Cooling Requirement at Bhujodi

**Figure 3** shows the variation of air temperature on a typical day of January month. This data is the average of values over the month (**appendix 1**). Air temperature inside the greenhouse would be higher than the outside. The difference will vary from month to month and also depend on some other factors like location, wind speed, relative humidity, etc. Raman. et.al.[4]conducted experiment on the greenhouse at Navasari (Gujarat) and found that inside temperature of greenhouse remains higher by 2 to 15°C in absence of cooling system. IPCL Baroda.[5], says temperature inside greenhouse exceeds nearly by 20 per cent. Studies on empty greenhouse at Udaipur (Rajasthan) indicated 18 to 22°C rise in temperature over outside temperature.[6]. For preliminary assessment of cooling needs, we will take the difference to be a constant 15°C.

**Figure 3** shows the expected day time temperature inside the greenhouse. This is obtained by adding 15°C to the actual outside temperature. It is seen that greenhouse temperature goes above 30°C from 9:30 A.M. to 5:30 P.M. that is the entire day time. To bring down the greenhouse air temperature to desired levels, say 30°C, cooling will be needed. This can be achieved by forced ventilation with two air change rate per minute. With this change rate, the difference between outside and inside can be reduced to about 2°C. This graph is also shown in the figure.

Examination of the three graphs shows that in January, forced ventilation will be adequate to keep the greenhouse temperature near 30°C through out the day and evaporation cooling will need to be resorted to. Similarly, graphs were plotted for other months too and are given in figures 4 to 14. These observations, the duration for which forced ventilation will be sufficient and times when evaporation cooling will be needed is summarised in table 1.

Months	Maximum temperature of airtight greenhouse (°C)	Duration for which greenhouse temperature stays above 30°C (hrs)	Whether forced ventilation is sufficient to cool the greenhouse	Whether fan-pad is needed to cool greenhouse
January	42	9.30 - 5.30	Yes	No
February	46	8.30 - 5.30	Yes	No
March	49	8.30 - 5.30	Yes (8.30 - 11.30)	Yes (11.30 - 5.30)
April	57	8.30 - 5.30	Yes (8.30 - 10.00)	Yes (11.30 - 5.30)
May	54	8.30 - 5.30	No	Yes
June	51	8.30 - 5.30	No	Yes
July	50	8.30 - 5.30	No	Yes
August	49	8.30 - 5.30	No	Yes
September	48	8.30 - 5.30	No	Yes
October	48	8.30 - 5.30	Yes (8.30 - 10.00)	Yes (10.00 - 5.30)
November	46	8.30 - 5.30	Yes	No
December	40	9.30 - 5.30	Yes	No

Table 1 broadly indicates that cooling of one sort or other will be needed during the day time all through the year in Bhujodi. Forced ventilation alone is able to provide sufficient cooling only in winter months i.e., November to February. Beyond these months, fan-pad system and misting will be needed. In March-April, i.e. the beginning of summer, ventilation will still be sufficient in the mornings. But after about 11:30 A.M., fan-pad will be needed. As summer is at peak, May-June and even when rainy season sets in July to September, fan-pad will be needed throughout the day.

As stated earlier, though the evaporation cooling will be effective, the question of costs and water consumption will need to be looked into.

### **Design of Fan-Pad Cooling System**

Paul and Nelson [7] had given a complete design procedure for fan-pad system. We will use their procedure.

Let,

SAR	Standard rate of air removal ( $\text{m}^3/\text{min}$ ) SAR is usually taken to be $2.5 \text{ m}^3/\text{min}$ per $\text{m}^2$ of greenhouse floor area
TAR	Total rate of air removal ( $\text{m}^3/\text{min}$ )
$F_{\text{ele}}$	Elevation factor (dimensionless), depends on altitude
$F_{\text{light}}$	Light intensity factor (dimensionless)
$F_{\text{temp}}$	Temperature rise factor (dimensionless)
$F_{\text{vel}}$	Velocity factor (dimensionless), depends on the fan to pad distance
$F_{\text{house}}$	Greenhouse factor (dimensionless)
$P_a$	Pad area ( $\text{m}^2$ )
$P_l$	Pad length (m)
$P_h$	Pad height (m)
QW	Capacity of water distribution line (lit/hr)
$Q_s$	Sump capacity (lit)
ER	Water evaporation rate (lit/hr)
$Q_d$	Water consumed per day (lit)
L	Length of greenhouse (m)
W	Span of greenhouse (m)
$V_g$	Air speed inside greenhouse (m/sec)
$A_g$	Cross-sectional area of greenhouse ( $\text{m}^2$ )

The proposed structure to be installed at Bhujodi is straight wall gable roof structure.

Layout of the structure is shown in **fig. 15** with it's dimensions. Using these dimensions,

$$\begin{aligned} \text{SAR} &= 2.5 \times 5 \times 20 \\ &= 250 \text{ m}^3/\text{min} \end{aligned}$$

Total rate of air removal is product of standard rate of air removal and maximum of factors ( $F_{\text{house}}$  or  $F_{\text{vel}}$ ).

$$\begin{aligned} \text{TAR} &= \text{SAR} \times F_{\text{house}} \text{ or } F_{\text{vel}} \\ F_{\text{house}} &= F_{\text{ele}} \times F_{\text{light}} \times F_{\text{temp}} \end{aligned}$$



Bhujodi is located at an altitude of 80m from mean sea level. Average light intensity inside greenhouse at Bhujodi would be 60 klux. A temperature rise of 4°C is accepted between pad to fan inside greenhouse.

$$F_{\text{ele}} = 1.0 \quad (\text{from table 4.1 of Paul and Nelson [7] for elevation 55 m})$$

$$F_{\text{light}} = 1.2 \quad (\text{from table 4.2 of P and N for light intensity of 60 klux})$$

$$F_{\text{temp}} = 1.0 \quad (\text{from table 4.3 of P and N for temperature rise of 4°C})$$

$$F_{\text{vel}} = 1.234 \quad (\text{from table 4.4 of P and N for a fan distance of 20 m})$$

$$F_{\text{house}} = 1.2$$

As  $F_{\text{vel}}$  is greater than  $F_{\text{house}}$ , factor.  $F_{\text{vel}}$  is considered in calculation of total rate of air removal.

$$\begin{aligned} \text{TAR} &= 250 \times 1.234 \\ &= 308.5 \text{ m}^3/\text{min} \approx 310 \text{ m}^3/\text{min} \end{aligned}$$

### Pad Area

We will select cross-fluted cellulose pad. The 4 inch thick pad has capacity to pass 75 m<sup>3</sup>/min of air per square meter of pad.

$$\text{hence, } P_a = \text{TAR} / 75$$

$$P_a = 310 / 75 = 4.13 \text{ m}^2 \approx 5 \text{ m}^2$$

Pad will be installed in whole width of greenhouse. So length of pad will be equal to width or span of greenhouse i.e.  $P_l = 5 \text{ m}$ .

$$P_h = \text{Pad area} / \text{Pad length}$$

$$= 5 / 5 = 1 \text{ m}$$

Standard pads are available of this height.

Pad is installed at a height slightly above the plant level to achieve satisfactory cooling. We will install it 0.5 m above ground.

Location of fan and pad in greenhouse (figure16) also plays important role on efficiency of cooling system. Fan should always be located on leeward side and pad in the prevailing wind direction at the site. By this arrangement, outside air will enter greenhouse and removed more easily.

### Selection of Fan

We will use two fans, putting door in between fans. Two fans are selected to achieve uniform cooling and avoiding warm pocket inside greenhouse which otherwise will form with one fan.

$$\begin{aligned} \text{Capacity per fan} &= \frac{TAR}{2} \\ &= 155 \text{ m}^3 / \text{min} \end{aligned}$$

From table 4.5, (of P and N) fan suitable to air removal rate of 155 m<sup>3</sup>/min has following specification.

$$\text{fan HP} = 1/3$$

$$\text{fan size} = 24 \text{ inch}$$

Air speed inside greenhouse is calculated as

$$V_g = \frac{TAR}{A_g}$$

$$\text{for } A_g = 16.25 \text{ m}^2, \quad TAR = 310 \text{ m}^3/\text{min}$$

$$V_g = 19.07 \text{ m/min}$$

Air speed influences transpiration, evaporation leaf temperature and carbondioxide availability. In general air speed of 6 - 32 m/min is desired inside greenhouse [8]. Thus, the arrangement worked out here will also be satisfactory from this view point.

### Capacity of Water Distribution Line and Sump

Standard flow rate though water line feeding water to 4 inch thick pad is 7.4 lit per linear meter of pad per minute. Sump volume should have capacity to accommodate 18.6 lit per meter length of pad.

$$Q_w = 7.4 \times 5 = 37 \text{ lit/min}$$

$$Q_s = 18.6 \times 5 = 93 \text{ lit, say 100 lit}$$

32 mm pipe (1¼ inch) is recommended for water distribution to pad.

### Water Evaporation Rate

Usually water evaporation rate from pad area is 0.4 lit per square meter per minute

$$\begin{aligned} \text{ER} &= 0.4 \times 5 \\ &= 2 \text{ lit/min} \\ &= 120 \text{ lit/hr} \end{aligned}$$

In Bhujodi, fan-pad will run for 8 hours a day in summer season.

$$\begin{aligned} \text{Water evaporated} &= 960 \\ &= \text{say, } 1000 \text{ lit/day.} \end{aligned}$$

### Summary and Conclusion

A preliminary analysis of cooling required for greenhouse at Bhujodi was made. The following are the main conclusions.

1. Heating will most likely not be needed even in winter month.
2. Cooling will be needed during day-time throughout the year.
3. Only forced ventilation is sufficient to cool the greenhouse in months of November, December, January, February, i.e. winter months.
4. Fan-pad system would have to be turned on in rest of the months (March to October). There is possibility of using forced ventilation for cooling in months like March and April. This will be used in early part of day (before noon).

Fan- pad system will run for full duration (8.30 A.M. to 5.30 P.M.) in month of April, May, June, July, August, September. Fan-pad system specification are as follows.

#### Pad

Type	-	Cross-fluted cellulose
Area	-	5 m <sup>2</sup> (5m x 1m)

**Fans**

Nos.	-	2
HP	-	1/3
Size	-	24 inch
Capacity of water distribution line	-	37 lit/min
Capacity of sump	-	100 lit
Size of water distribution pipe	-	32 mm
Water evaporated	-	1000 lit per day

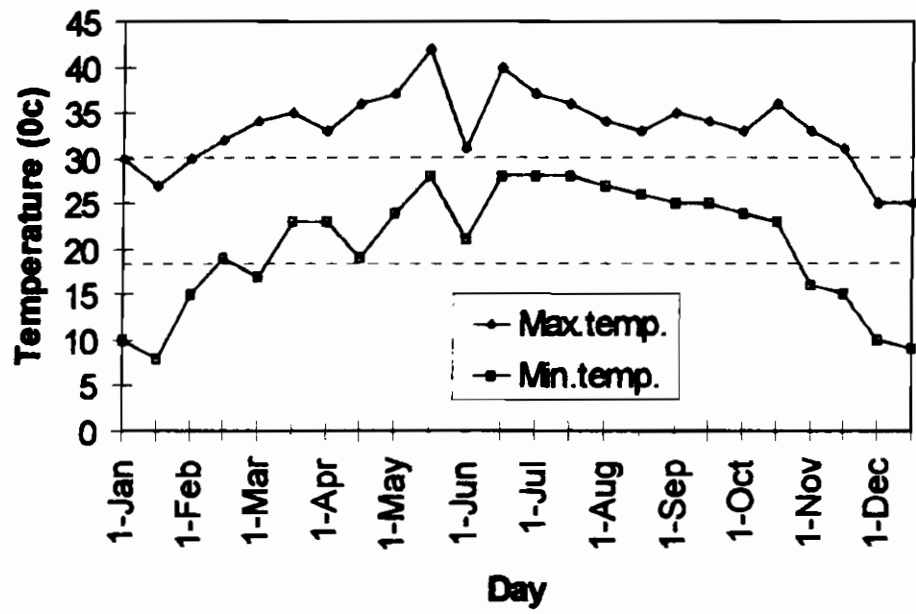
Even though, fan-pad systems seems to be suitable for greenhouse cooling, following problems may arise at Bhujodi.

1. Continuous operation may not be possible due to frequent interruptions in electricity supply.
2. Deposition of salt on the pad area, thereby reducing the life and efficiency of cooling.

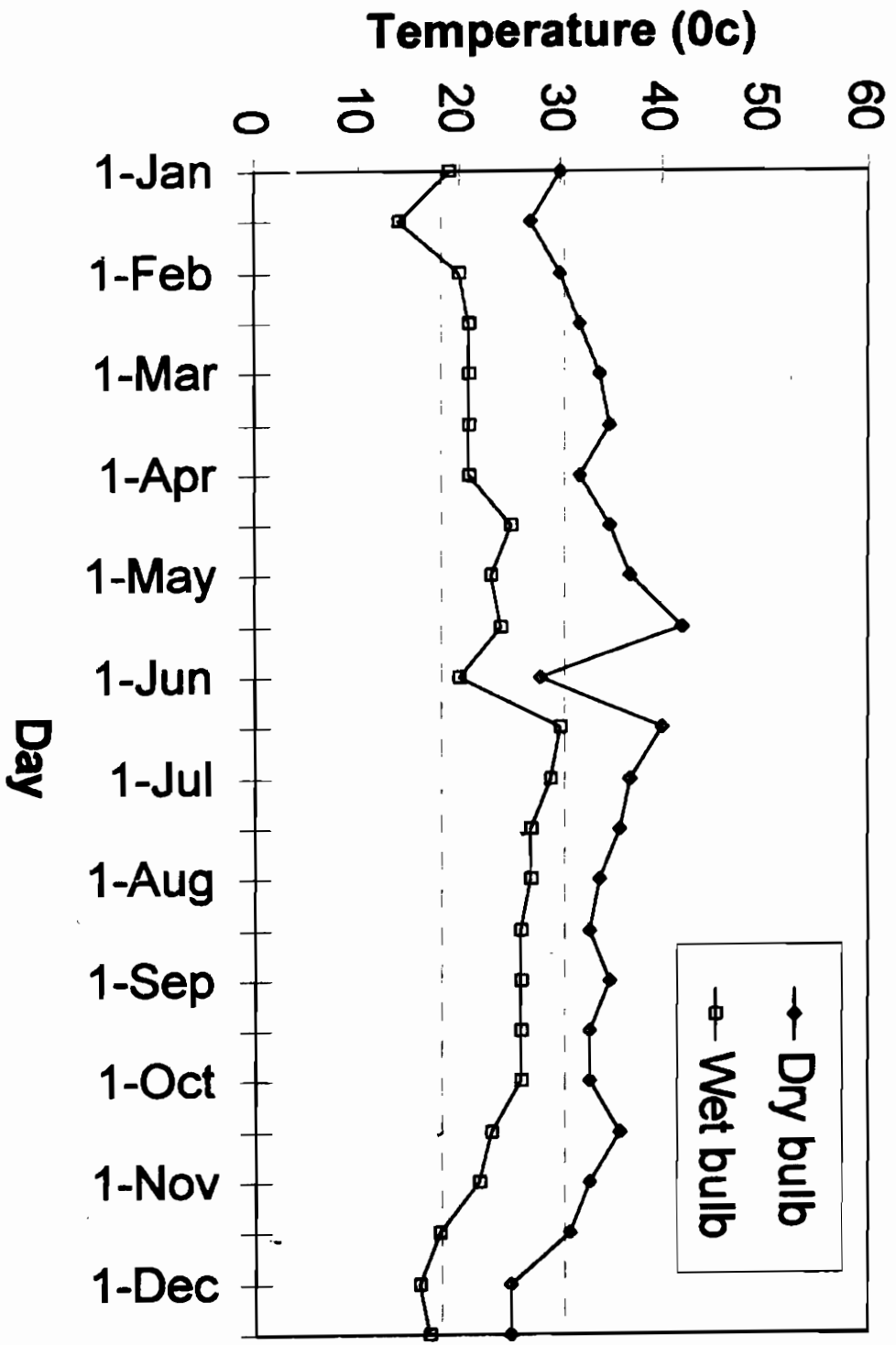
### **Refinement of Design Procedure**

Analysis given here is a preliminary one. It would desirable to refine the procedure, to make it more specific to the location and meteorological conditions prevailing there. This will be done in the next stage.

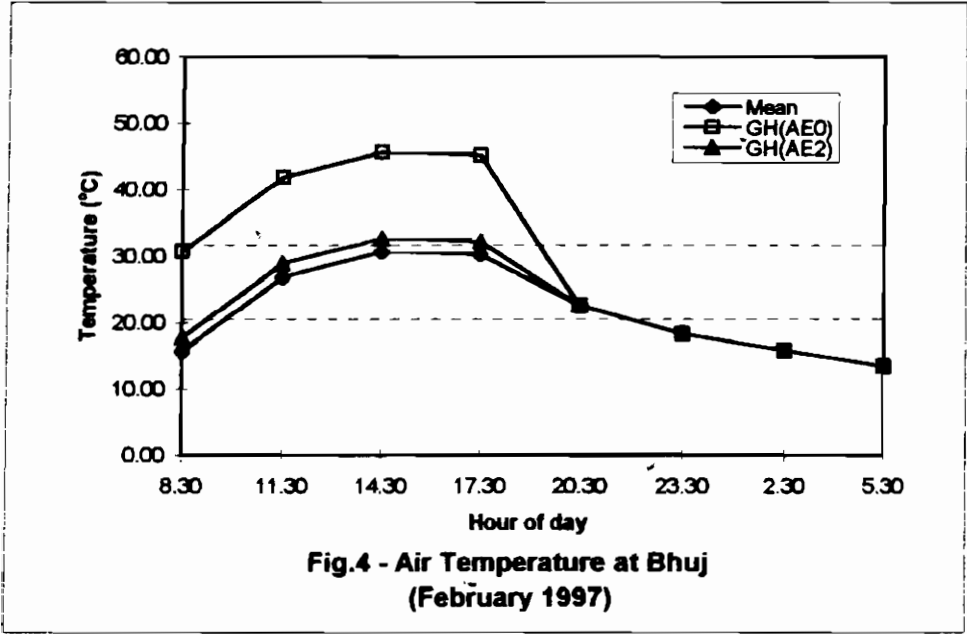
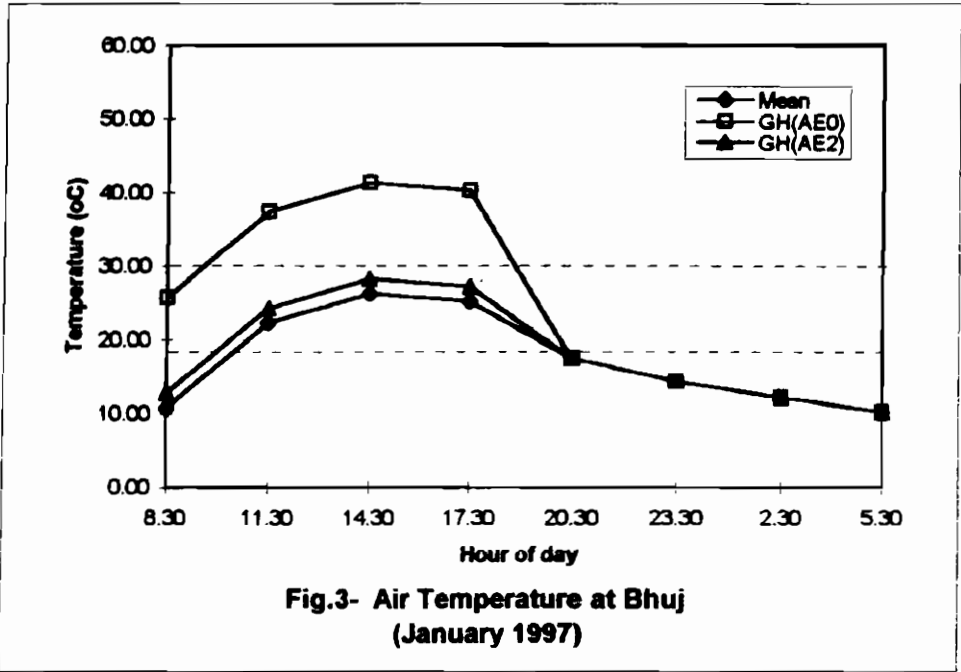
The procedure given by Paul and Nelson does of course also take into account locational features via the factors-- $F_{cle}$ ,  $F_{house}$ . But these can not be expected to be very as sensitive as would be desirable. It would be more appropriate to use a mathematical model of empty greenhouse and compute the inside environment by using local climatic data.

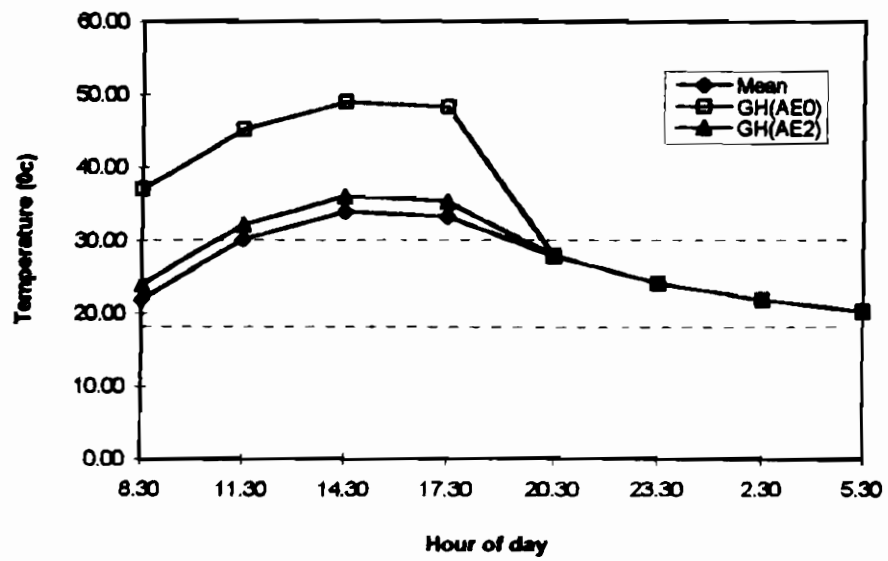


**Fig. 1 - Air temperature at Bhujodi (1997)**

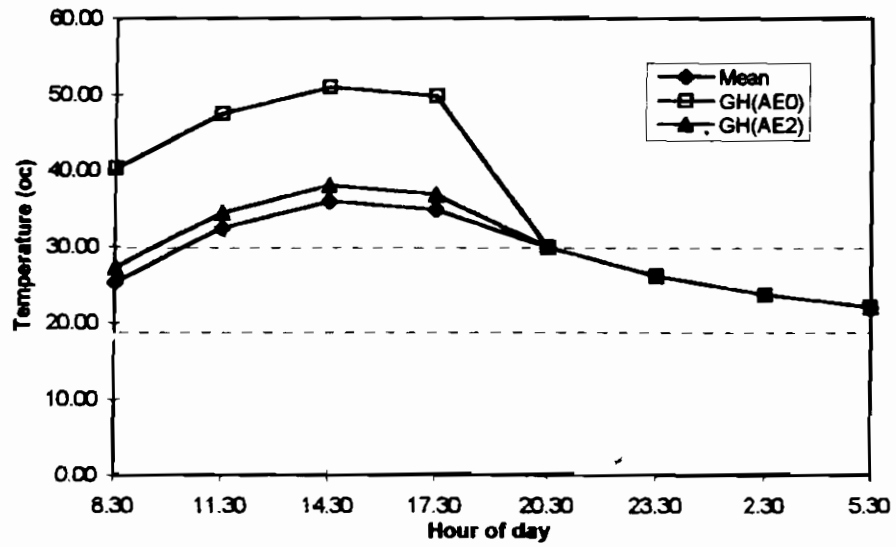


**Fig. 2 - Air temperature at 2.30PM in Bhuj (1997)**



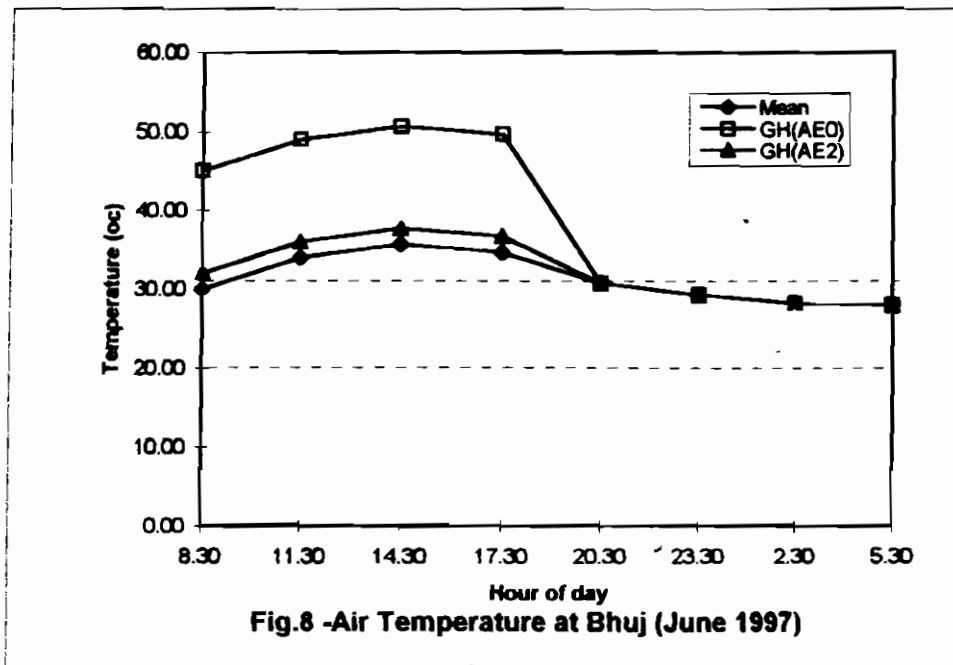
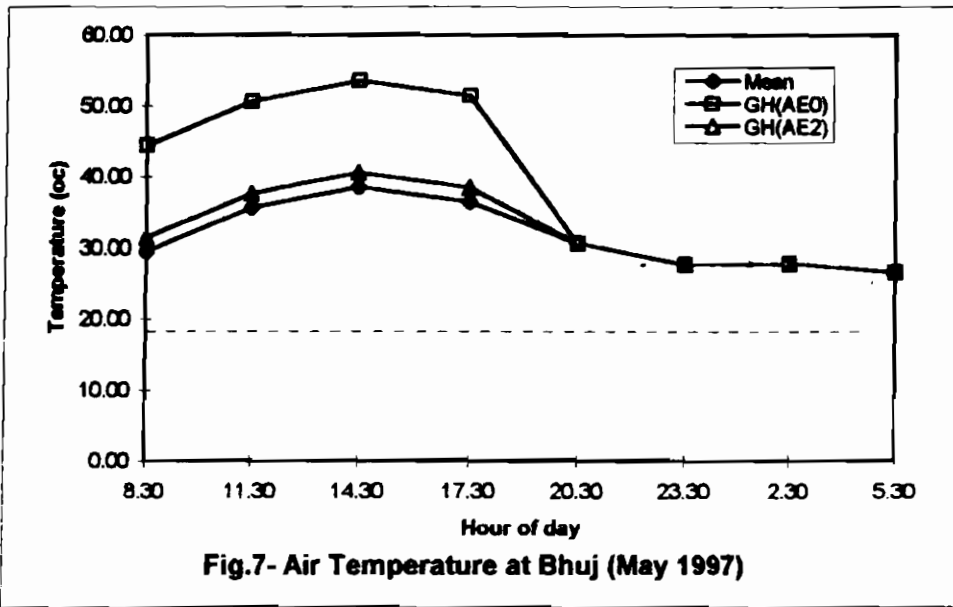


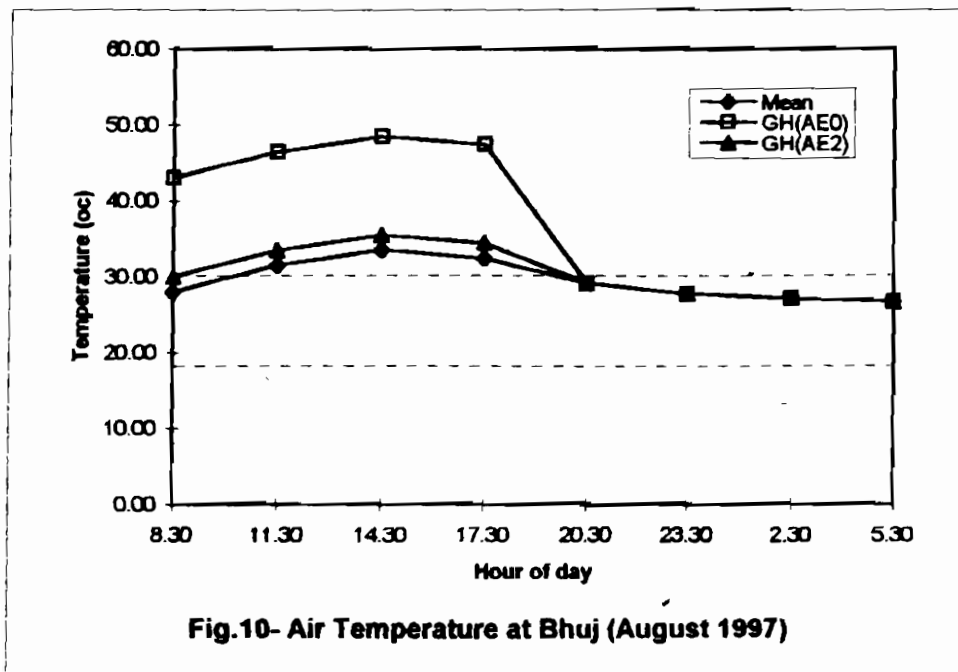
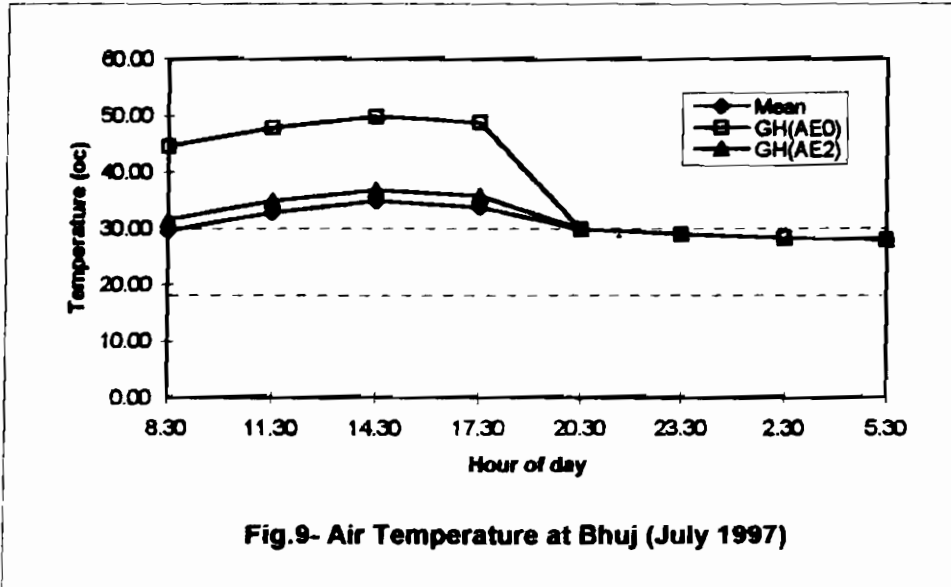
**Fig.5 - Air Temperature at Bhuj  
(March 1997)**



**Fig.6 - Air Temperature at Bhuj  
(April 1997)**







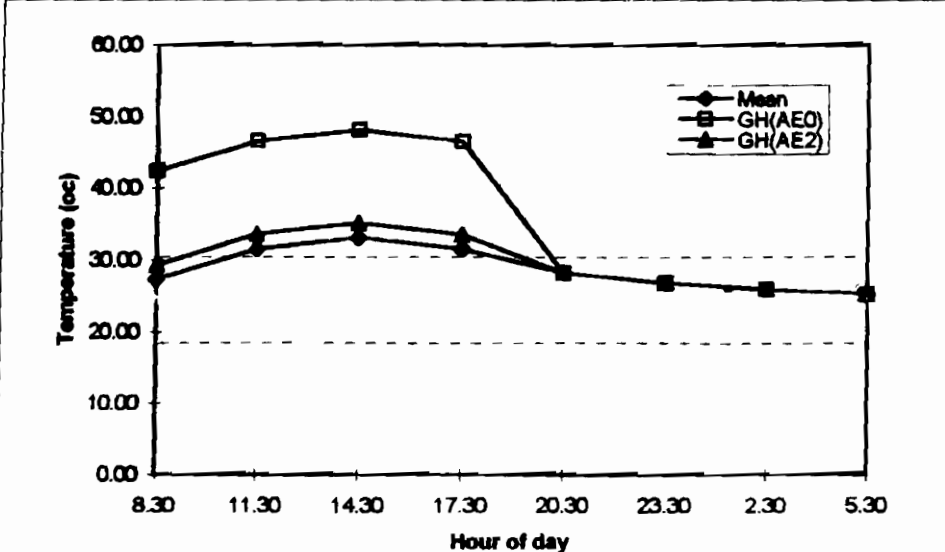


Fig.11- Air Temperature at Bhuj (September 1997)

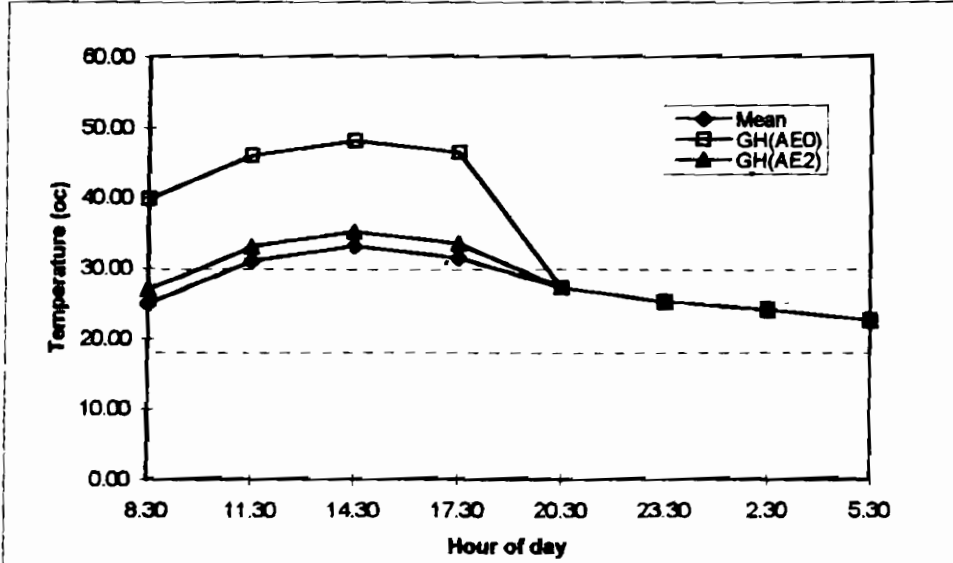
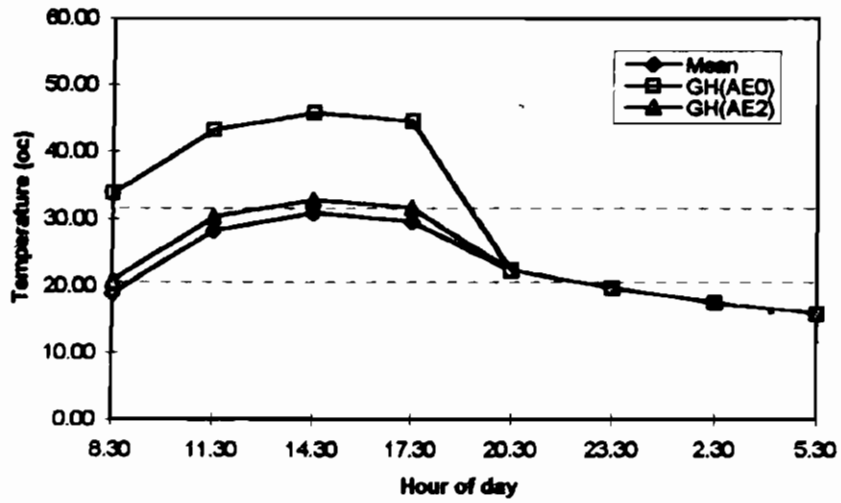
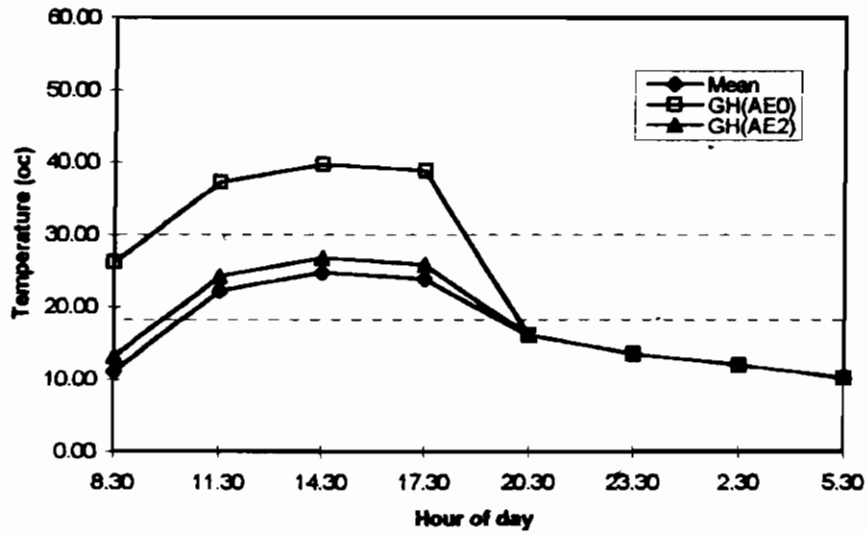


Fig.12- Air Temperature at Bhuj (October 1997)



**Fig.13- Air Temperature at Bhuj  
(November 1997)**



**Fig.14- Air Temperature at Bhuj  
(December 1997)**

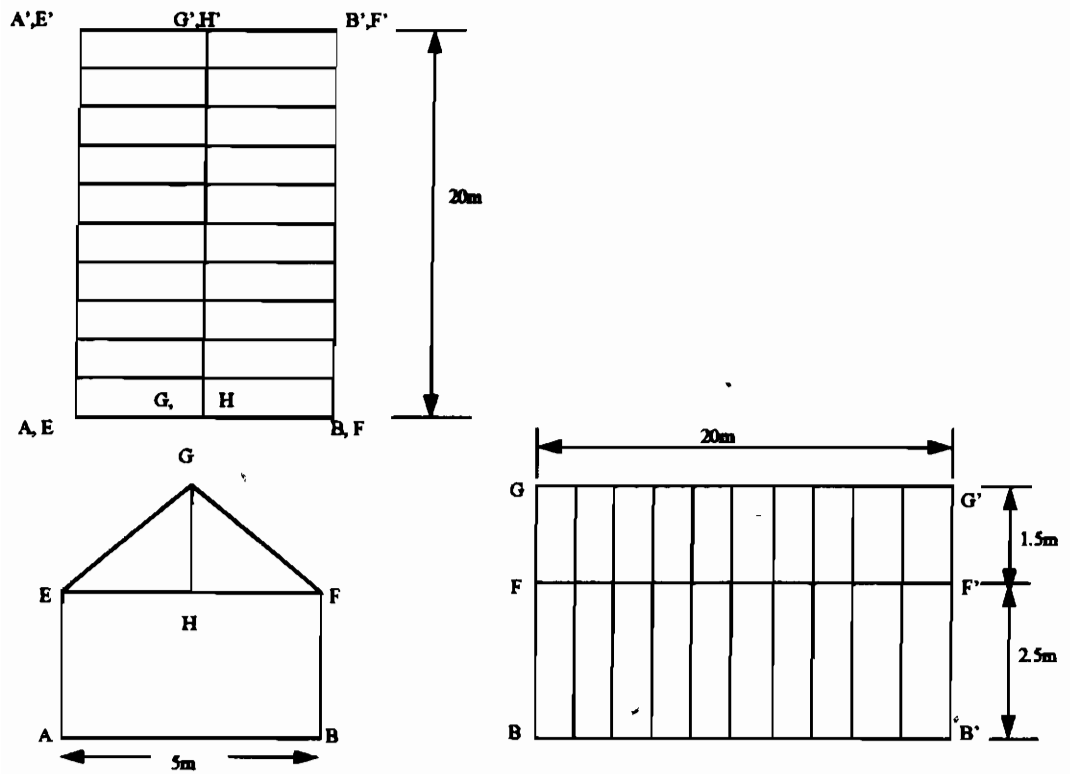
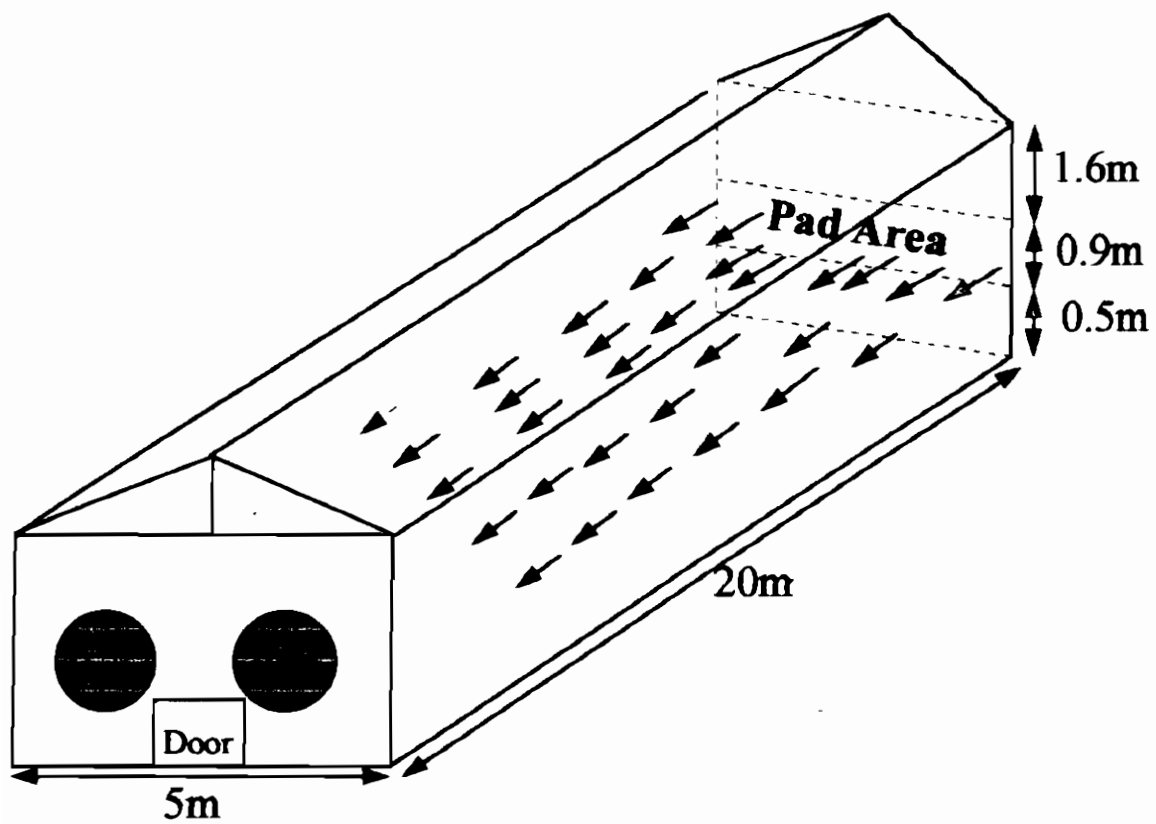


Figure 15 : Straight Wall Gable Roof Structure



**Figure 16 : Location of Fan - Pad System**

**Appendix 1- Dry bulb temperature(oC) at Bhuj (January)**

of Month	Hour of day							
	8.30	11.30	14.30	17.30	20.30	23.30	2.30	5.30
1-Jan	10.20	27.00	29.80	28.20	16.40	12.00	11.50	10.50
2-Jan	11.20	25.20	29.00	27.00	16.40	15.00	9.20	10.60
3-Jan	11.40	25.60	28.60	27.90	18.40	13.50	11.00	9.40
4-Jan	12.00	24.00	28.00	27.20	21.00	19.80	12.00	10.60
5-Jan	13.40	24.00	27.40	26.00	16.60	15.00	15.00	15.00
6-Jan	11.80	23.00	27.80	26.00	19.00	14.40	13.80	12.20
7-Jan	14.00	23.40	25.80	25.20	22.20	18.40	15.40	14.40
8-Jan	13.40	21.80	25.80	24.40	20.20	14.00	14.60	12.00
9-Jan	9.00	20.60	25.40	24.60	18.00	15.00	11.20	9.00
10-Jan	12.00	20.60	25.60	24.40	18.60	19.00	13.80	11.40
11-Jan	9.20	22.20	27.00	25.40	14.00	10.40	12.60	9.60
12-Jan	6.00	22.00	26.00	26.00	14.80	15.40	8.00	4.20
13-Jan	8.80	23.00	27.00	26.40	15.40	11.00	9.20	8.00
14-Jan	8.00	22.00	27.00	26.00	13.60	10.40	8.40	7.80
15-Jan	10.20	22.40	27.00	26.00	14.40	10.40	9.40	8.00
16-Jan	10.40	23.40	27.00	26.00	14.40	10.20	10.00	8.40
17-Jan	8.20	23.60	27.00	26.40	14.20	12.80	8.00	6.00
18-Jan	10.00	25.00	30.00	27.00	21.00	21.80	10.60	12.40
19-Jan	15.20	16.20	22.20	21.40	16.80	12.00	20.60	18.40
20-Jan	9.60	19.40	23.40	23.80	14.00	12.00	13.60	10.60
21-Jan	8.40	20.00	23.00	22.60	14.20	8.20	11.80	6.00
22-Jan	7.20	20.00	23.20	22.60	19.00	15.60	6.60	5.00
23-Jan	11.00	21.80	25.40	25.00	20.00	15.40	15.00	10.40
24-Jan	12.00	21.40	25.30	24.40	16.40		16.20	11.20
25-Jan	8.60	22.00	25.00	24.80	17.40	12.00	9.00	6.80
26-Jan	11.20	24.40	28.00	28.00	20.00	18.20	9.60	8.20
27-Jan	14.00	20.60	24.40	15.80	19.00	17.80	18.20	17.40
28-Jan	13.00	20.00	25.00	24.60	16.00	12.00	15.60	12.00
29-Jan	8.40	21.20	25.60	26.00	20.60	11.20	13.00	7.00
30-Jan	10.00	22.40	26.80	26.60	21.40	18.00	8.40	8.80
31-Jan	17.80	24.00	26.60	26.60	19.20	19.40	16.00	17.40

Appendix 2 - Dry bulb temperature(oC) at Bhuj (February)								
Day of Month	Hour of day							
	8.30	11.30	14.30	17.30	20.30	23.30	2.30	5.30
1-Feb	15.80	26.00	29.60	27.80	22.00	20.40	17.80	13.80
2-Feb	20.80	26.40	28.80	28.00	22.60	21.00	20.00	19.80
3-Feb	11.00	23.40	26.60	26.80	21.00	14.80	19.80	12.60
4-Feb	11.00	24.00	27.00	26.40	18.00	13.00	12.00	10.00
5-Feb	10.40	24.60	27.80	27.00	16.80	13.00	10.00	8.00
6-Feb	10.00	25.40	28.80	28.80	22.00	16.00	10.00	7.40
7-Feb	11.40	25.40	30.00	30.60	23.00	19.40	12.60	9.40
8-Feb	20.40	27.60	29.20	29.20	23.00	18.40	20.00	20.00
9-Feb	30.60	22.20	27.00	26.80	21.00	16.00	17.00	16.40
10-Feb	11.00	23.00	26.80	27.00	17.20	13.00	15.20	10.60
11-Feb	9.00	23.00	29.00	25.60	15.20	9.80	9.80	6.60
12-Feb	9.20	24.20	27.00	27.40	16.00	11.80	7.80	6.40
13-Feb	12.60	27.00	29.60	30.40	20.00	17.40	10.00	7.60
14-Feb	19.40	29.40	34.60	32.80	26.20	22.00	13.40	13.40
15-Feb	20.00	27.80	31.20	29.20	23.20	20.60	18.40	19.00
16-Feb	19.00	25.80	29.80	30.80	24.40	20.80	19.40	17.40
17-Feb	19.00	25.60	29.00	28.40	23.40	20.00	20.40	19.00
18-Feb	14.80	26.20	30.00	28.40	21.40	20.40	18.40	14.60
19-Feb	10.40	24.60	29.20	28.20	18.00	13.40	15.60	10.40
20-Feb	13.00	26.40	29.80	29.40	20.60	14.60	11.00	9.40
21-Feb	14.00	27.40	31.40	31.00	22.80	16.40	11.60	9.60
22-Feb	12.40	27.80	32.00	32.80	23.80	20.60	11.40	9.60
23-Feb	14.60	30.00	35.60	35.80	28.00	21.40	17.80	13.40
24-Feb	16.40	31.60	35.40	34.80	26.40	21.40	19.00	16.00
25-Feb	22.00	33.40	36.40	34.60	28.40	22.80	19.40	18.60
26-Feb	22.60	31.40	35.20	34.90	27.20	25.00	21.00	20.00
27-Feb	21.00	31.60	36.20	36.40	30.40	25.00	21.60	19.40
28-Feb	19.00	31.00	36.00	36.40	29.40	24.40	21.00	17.80



Appendix 3- Dry bulb temperature(oC) at Bhuj (March)								
Day of Month	Hour of day							
	8.30	11.30	14.30	17.30	20.30	23.30	2.30	5.30
1-Mar	19.20	31.00	33.80	33.40	27.40	23.00	22.40	17.00
2-Mar	19.00	27.60	32.00	34.60	27.20	20.00	21.00	18.00
3-Mar	15.00	31.40	33.40	34.00	25.60	18.80	18.40	17.60
4-Mar	15.00	28.80	33.80	33.60	28.00	24.40	16.00	14.60
5-Mar	17.60	28.40	30.80	31.20	26.40	21.40	17.80	16.00
6-Mar	18.00	27.00	30.20	31.40	24.60	19.60	17.40	16.40
7-Mar	17.20	28.00	33.20	33.80	27.80	22.40	18.40	17.00
8-Mar	19.00	31.00	34.80	34.80	26.60	21.00	19.20	17.00
9-Mar	19.00	30.60	34.60	35.40	28.60	24.20	20.00	18.00
10-Mar	22.40	29.80	35.80	36.40	28.00	25.40	20.60	20.40
11-Mar	26.00	35.40	37.00	37.40	31.20	26.60	21.40	21.20
12-Mar	25.60	35.00	37.50	36.40	31.40	28.80	24.40	26.00
13-Mar	25.00	34.00	36.80	35.40	29.80	25.40	24.40	22.00
14-Mar	26.00	32.00	35.40	33.40	27.80	26.40	24.40	21.20
15-Mar	23.40	31.20	34.80	33.60	29.00	27.00	24.60	23.00
16-Mar	22.00	30.40	33.00	33.20	28.40	26.00	24.40	20.00
17-Mar	23.00	31.20	34.40	35.00	29.40	24.60	24.40	20.80
18-Mar	24.00	26.40	35.00	34.00	28.20	25.00	24.00	24.00
19-Mar	24.80	30.80	35.40	32.60	25.00	22.80	23.20	24.00
20-Mar	24.20	27.00	30.40	26.20	25.00	23.20	20.80	22.20
21-Mar	23.20	22.40	29.00	28.60	23.40	22.00	22.20	22.00
22-Mar	21.00	29.00	32.20	32.40	26.80	22.80	19.20	17.20
23-Mar	21.00	28.80	30.60	29.80	26.00	24.60	22.00	19.20
24-Mar	22.00	30.80	33.40	34.00	29.40	26.00	23.60	20.60
25-Mar	23.40	32.00	35.80	25.80	30.40	26.00	23.40	21.00
26-Mar	24.60	32.80	36.00	37.20	31.40	27.40	23.60	22.40
27-Mar	25.00	31.00	36.60	32.40	27.40	26.00	25.40	24.00
28-Mar	24.80	28.60	32.40	33.60	29.40	25.40	25.00	24.00
29-Mar	23.00	30.60	34.00	34.00	26.80	23.40	22.00	21.20
30-Mar	23.60	33.00	36.00	35.60	30.00	24.00	20.00	18.00
31-Mar	23.20	30.00	33.40	31.00	27.80	25.40	23.00	21.60

Appendix 4- Dry bulb temperature(°C) at Bhuj (April)								
Day of Month	Hour of day							
	8.30	11.30	14.30	17.30	20.30	23.30	2.30	5.30
1-Apr	25.00	29.40	31.80	33.00	27.00	24.40	23.80	23.20
2-Apr	24.20	28.00	30.80	31.00	26.80	23.00	22.80	19.00
3-Apr	23.00	29.40	32.40	31.00	27.40	23.40	21.00	18.00
4-Apr	22.00	32.00	35.00	37.80	29.40	25.60	20.80	17.60
5-Apr	24.60	32.80	35.40	35.00	30.40	27.40	21.00	22.00
6-Apr	26.40	33.00	36.00	36.00	31.20	26.80	25.40	20.40
7-Apr	24.20	33.00	36.60	36.80	30.00	24.60	24.20	29.20
8-Apr	23.40	31.80	35.40	24.80	27.60	24.20	22.80	21.00
9-Apr	25.40	32.60	36.40	34.00	27.60	25.00	23.60	22.60
10-Apr	25.20	33.80	36.60	34.40	28.40	24.40	23.40	22.40
11-Apr	25.40	33.40	36.40	35.00	28.20	25.20	23.00	22.40
12-Apr	25.60	34.00	37.00	35.00	27.60	25.40	23.40	22.80
13-Apr	26.00	35.20	37.20	35.40	28.00	24.80	24.00	23.20
14-Apr	26.20	31.40	33.80	32.00	26.40	24.60	24.00	23.40
15-Apr	23.40	30.80	34.40	35.80	29.40	25.00	22.00	18.80
16-Apr	23.00	30.60	34.80	34.00	29.00	23.60	22.00	17.00
17-Apr	23.20	31.00	34.80	35.40	30.00	26.00	19.00	19.20
18-Apr	23.40	31.80	35.40	32.60	29.20	25.40	22.00	19.00
19-Apr	24.20	31.40	36.40	34.40	30.00	26.40	24.00	21.00
20-Apr	25.00	31.40	35.00	34.80	29.80	26.80	24.40	21.00
21-Apr	25.60	32.20	36.80	37.00	31.60	28.40	23.60	21.40
22-Apr	26.40	33.00	38.80	37.00	32.00	26.40	25.40	22.40
23-Apr	25.00	32.40	38.60	39.40	33.40	28.40	25.60	22.00
24-Apr	26.60	34.60	40.60	40.00	34.40	29.40	24.40	24.40
25-Apr	29.30	35.80	40.00	38.00	32.40	30.60	26.40	25.60
26-Apr	28.40	32.80	34.40	34.00	31.00	28.00	27.40	27.40
27-Apr	29.00	33.40	36.80	37.40	32.00	28.20	26.40	26.00
28-Apr	24.40	33.00	36.40	30.40	33.00	29.00	26.40	24.00
29-Apr	27.80	33.40	37.00	38.40	32.40	27.40	25.60	23.20
30-Apr	27.00	34.40	37.40	34.80	30.20	27.00	24.00	22.20

Appendix 5 - Dry bulb temperature(oC) at Bhuj (May)								
Day of Month	Hour of day							
	8.30	11.30	14.30	17.30	20.30	23.30	2.30	5.30
1-May	27.40	32.40	37.00	24.40	28.00	25.40	25.00	24.20
2-May	26.00	31.60	37.00	34.20	28.00	26.00	25.00	24.40
3-May	27.00	34.20	37.00	30.20	27.40	27.00	25.60	24.80
4-May	28.00	34.40	37.40	37.00	31.00	27.00	26.00	24.80
5-May	27.20	32.00	37.40	37.00	30.40	27.00	26.20	25.00
6-May	27.20	33.80	38.40	38.20	29.80	26.20	25.00	24.40
7-May	27.40	34.00	37.00	35.00	29.80	27.40	25.00	23.80
8-May	28.20	36.00	39.00	38.60	33.20	28.40	26.60	25.60
9-May	28.20	37.00	39.60	39.00	32.60	29.00	25.00	25.20
10-May	28.40	36.00	39.60	38.40	33.00	28.80	26.80	25.40
11-May	28.80	36.40	39.80	37.80	30.80	24.00	26.00	24.80
12-May	29.00	37.00	40.00	40.40	33.40	28.00	25.60	25.40
13-May	29.20	37.00	40.40	41.00	35.40	30.40	28.00	25.40
14-May	29.00	37.00	42.00	41.00	34.40	31.00	28.40	24.40
15-May	37.20	39.00	41.40	42.00	28.60	28.00	36.60	31.40
16-May	32.20	38.40	42.00	41.80	31.40	26.80	36.80	31.80
17-May	31.40	40.00	42.00	40.40	30.60	24.40	34.00	29.80
18-May	29.00	37.20	41.00	39.60	30.00	25.40	33.20	28.40
19-May	29.60	35.80	38.60	36.40	30.20	28.00	27.60	27.00
20-May	29.80	35.00	38.00	35.20	30.00	28.40	27.00	27.00
21-May	30.00	34.60	37.00	34.60	30.00	28.40	27.00	27.40
22-May	29.60	35.00	37.80	35.20	30.20	28.60	27.60	27.00
23-May	30.20	35.80	38.40	35.80	30.00	28.20	27.60	28.00
24-May	30.20	35.40	37.40	35.00	29.60	28.00	27.40	26.80
25-May	30.00	35.40	37.80	35.20	29.80	28.00	27.00	26.90
26-May	30.20	37.00	39.40	36.20	30.00	28.40	27.40	26.60
27-May	30.40	37.00	38.00	35.80	30.00	28.40	27.60	27.00
28-May	30.20	35.00	36.40	34.40	29.60	28.40	27.60	27.20
29-May	29.80	34.80	36.40	34.80	29.40	28.40	27.00	27.40
30-May	30.20	34.40	35.40	33.40	30	28.80	28.00	28.40
31-May	31	34.8	36.8	33.4	30.2	28.8	28.2	28

Appendix 6 - Dry bulb temperature(oC) at Bhuj (June)								
Day of Month	Hour of day							
	8.30	11.30	14.30	17.30	20.30	23.30	2.30	5.30
1-Jun	24.00	28.40	28.00	30.60	27.40	25.20	22.00	21.80
2-Jun	29.00	34.00	35.40	33.40	29.40	28.20	25.40	26.00
3-Jun	29.40	33.80	35.00	34.00	30.00	29.20	27.80	27.40
4-Jun	30.40	35.40	37.00	36.80	31.60	29.00	28.40	27.40
5-Jun	29.80	34.40	38.00	36.80	31.20	29.20	28.40	27.40
6-Jun	30.40	35.00	36.00	35.60	27.00	27.00	28.00	28.00
7-Jun	30.00	34.80	36.40	35.00	30.40	29.20	28.40	27.40
8-Jun	30.60	35.20	36.20	35.20	30.40	29.00	28.40	28.00
9-Jun	30.40	35.40	36.40	34.40	30.40	29.00	28.00	27.40
10-Jun	30.20	35.00	36.20	35.40	31.00	29.20	29.80	28.00
11-Jun	30.20	35.00	37.00	31.20	30.60	29.00	28.40	28.00
12-Jun	30.40	35.00	37.00	35.60	31.40	29.40	28.40	27.80
13-Jun	30.20	34.40	38.40	37.00	32.00	31.20	28.40	27.80
14-Jun	30.00	39.40	38.80	41.00	34.00	30.40	30.40	27.60
15-Jun	30.20	35.40	39.80	32.40	33.20	30.20	29.00	28.00
16-Jun	30.60	35.40	38.80	38.40	33.40	30.40	29.60	28.80
17-Jun	30.60	35.00	38.40	37.00	31.60	29.80	29.40	29.00
18-Jun	31.20	35.40	38.00	37.80	32.20	30.00	27.00	28.30
19-Jun	31.60	36.80	39.00	38.40	33.00	30.40	29.40	29.00
20-Jun	31.00	34.80	38.60	38.00	32.80	31.00	29.40	29.20
21-Jun	30.80	35.40	35.00	36.60	31.00	29.40	30.00	29.80
22-Jun	38.40	30.00	29.40	29.40	29.20	28.00	28.00	28.00
23-Jun	27.00	27.00	26.80	28.40	28.00	28.20	27.40	27.40
24-Jun	24.60	30.40	33.40	31.80	29.60	29.00	28.20	28.40
25-Jun	29.00	30.40	32.00	31.40	29.80	29.40	28.40	28.40
26-Jun	29.40	33.00	33.80	32.60	30.00	29.40	29.00	28.40
27-Jun	30.20	32.40	33.40	33.40	30.40	29.20	28.80	28.80
28-Jun	30.60	34.20	35.40	33.00	30.40	29.40	23.00	28.80
29-Jun	30.20	34.40	35.40	33.20	30.40	30.00	29.00	28.80
30-Jun	30.40	34.40	36.20	35.60	31.00	29.40	29.40	29.00

Appendix 7 - Dry bulb temperature(oC) at Bhuj (July)								
Day of Mo	Hour of day							
	8.30	11.30	14.30	17.30	20.30	23.30	2.30	5.30
1-Jul	30.40	34.60	36.40	30.00	29.20	30.00	29.00	28.20
2-Jul	30.20	35.00	38.00	38.00	33.00	30.20	29.00	28.40
3-Jul	30.60	35.60	37.00	37.40	32.00	30.20	29.20	28.40
4-Jul	30.60	34.25	37.80	37.40	32.40	29.80	29.00	28.40
5-Jul	30.00	35.20	37.80	37.40	32.40	30.40	29.00	28.40
6-Jul	30.60	36.00	38.40	36.40	31.40	30.00	29.20	29.00
7-Jul	31.00	34.60	38.20	29.00	28.00	28.40	29.80	29.40
8-Jul	29.00	28.20	28.80	31.40	29.20	28.60	28.60	28.40
9-Jul	29.00	31.40	32.00	32.00	29.00	28.60	28.20	27.60
10-Jul	29.40	33.00	33.40	32.60	30.00	29.40	28.60	28.00
11-Jul	29.60	33.00	34.40	32.40	30.00	29.60	29.00	28.80
12-Jul	29.60	32.40	35.40	34.20	30.00	29.20	29.00	28.80
13-Jul	30.00	33.00	35.00	33.40	30.00	29.40	28.80	28.20
14-Jul	30.00	33.40	36.00	33.60	30.00	28.80	28.80	28.60
15-Jul	30.00	33.00	35.20	34.00	30.00	29.00	28.40	28.40
16-Jul	30.00	33.60	36.40	33.40	30.00	28.80	28.40	28.40
17-Jul	29.60	33.20	35.20	34.80	30.00	29.00	27.80	28.80
18-Jul	30.40	34.80	35.40	34.00	30.00	29.20	28.00	27.80
19-Jul	29.20	32.80	36.00	38.80	30.40	29.00	28.60	27.80
20-Jul	28.60	27.80	32.00	32.00	29.40	27.80	28.40	28.20
21-Jul	28.80	33.20	34.80	34.00	29.80	28.20	27.00	26.60
22-Jul	29.20	33.80	35.20	34.60	30.40	28.80	27.60	27.00
23-Jul	29.60	34.20	37.60	35.20	30.80	28.80	28.20	27.40
24-Jul	29.40	34.00	36.80	35.20	30.40	29.00	28.00	27.80
25-Jul	30.00	32.40	35.40	35.00	30.60	29.40	28.00	28.40
26-Jul	30.40	34.60	35.60	32.00	28.60	29.00	28.00	28.40
27-Jul	27.20	29.00	32.40	30.20	25.40	26.00	27.20	27.40
28-Jul	28.00	28.80	26.80	27.20	26.60	26.60	26.20	26.40
29-Jul	27.00	26.40	27.40	30.00	28.00	26.80	26.00	25.40
30-Jul	28.40	34.00	33.00	32.00	29.00	28.40	26.80	26.00
31-Jul	28.6	32.4	35.2	38.4	29.8	28.6	27.6	27.6

Appendix 8- Dry bulb temperature(oC) at Bhuj (August)								
Day of Month	Hour of day							
	8.30	11.30	14.30	17.30	20.30	23.30	2.30	5.30
1-Aug	28.40	30.80	33.20	33.80	29.20	28.00	28.20	27.60
2-Aug	28.00	31.40	32.00	30.20	28.60	28.40	28.20	27.40
3-Aug	28.40	29.80	32.40	30.80	28.40	28.00	27.00	27.80
4-Aug	28.60	32.00	33.80	31.80	28.80	27.80	27.60	27.00
5-Aug	29.00	32.60	37.20	32.00	29.20	27.80	27.40	27.20
6-Aug	27.80	32.40	33.80	34.00	29.40	27.80	27.00	26.60
7-Aug	28.40	32.80	34.00	33.00	29.40	28.40	27.00	26.80
8-Aug	27.60	31.00	33.80	32.00	28.80	27.40	28.00	26.80
9-Aug	28.40	31.80	35.00	33.20	29.00	27.60	27.00	26.00
10-Aug	28.00	32.40	33.20	32.80	28.80	27.60	26.60	26.00
11-Aug	28.40	32.80	34.40	32.60	28.80	28.00	26.60	26.00
12-Aug	28.00	32.20	30.60	29.20	27.20	27.60	27.60	27.00
13-Aug	27.40	29.80	31.40	30.20	28.20	27.80	27.00	26.20
14-Aug	28.20	27.60	32.20	31.40	28.40	28.00	27.40	27.60
15-Aug	28.00	29.40	32.40	31.20	28.40	27.40	27.80	26.00
16-Aug	28.00	32.00	33.00	32.00	28.40	26.80	27.00	26.60
17-Aug	28.20	32.00	34.40	32.00	28.60	28.00	27.00	27.00
18-Aug	28.00	31.00	31.60	30.60	28.40	29.40	27.40	26.80
19-Aug	28.00	29.80	32.00	31.60	28.80	26.80	27.00	26.00
20-Aug	27.40	28.40	33.80	35.00	29.00	27.80	26.60	26.00
21-Aug	28.80	32.00	33.40	34.00	32.20	30.40	27.20	27.00
22-Aug	29.60	34.40	36.40	35.40	32.20	29.60	29.00	27.80
23-Aug	26.20	30.00	33.00	34.40	25.00	26.20	26.00	26.00
24-Aug	26.20	32.00	35.00	31.80	29.00	26.00	25.40	25.40
25-Aug	28.20	32.80	33.20	32.00	29.00	25.40	27.40	27.40
26-Aug	28.40	32.80	33.00	31.00	29.20	27.40	27.40	27.00
27-Aug	28.00	31.60	32.60	31.00	28.80	27.40	26.00	27.00
28-Aug	27.00	31.40	34.40	34.40	29.80	28.00	26.40	25.60
29-Aug	27.80	31.80	35.00	34.60	30.00	28.00	27.00	26.40
30-Aug	28.00	32.00	34.20	35.00	34.40	27.20	27.00	26.00
31-Aug	28	31.8	33.2	33	28	26.8	25.2	26

Appendix 9 - Dry bulb temperature(oC) at Bhuj (September)								
Day of Month	Hour of day							
	8.30	11.30	14.30	17.30	20.30	23.30	2.30	5.30
1-Sep	28.00	32.80	34.40	34.20	29.40	27.00	25.80	25.00
2-Sep	27.60	32.40	34.60	33.00	28.60	26.60	25.80	25.40
3-Sep	28.00	32.80	35.00	33.40	28.40	27.00	25.40	25.00
4-Sep	28.00	32.40	35.60	33.60	28.60	26.40	26.00	25.40
5-Sep	27.40	33.40	34.20	33.60	28.80	26.80	25.80	25.00
6-Sep	27.80	33.40	34.20	33.60	29.00	27.40	26.00	25.00
7-Sep	28.00	31.80	34.00	32.40	29.40	27.20	26.00	25.40
8-Sep	28.00	32.20	35.00	33.00	28.40	28.40	26.00	25.60
9-Sep	28.60	34.00	35.00	28.40	28.40	25.80	27.80	27.00
10-Sep	28.80	32.00	25.60	25.40	25.80	26.40	25.60	25.40
11-Sep	28.80	28.60	29.40	26.00	22.80	24.20	26.60	26.60
12-Sep	25.00	24.40	24.40	24.00	25.80	26.00	24.00	24.80
13-Sep	27.00	28.40	30.00	29.40	27.20	26.80	26.40	26.40
14-Sep	27.20	31.40	33.00	30.40	28.00	26.60	25.60	25.40
15-Sep	27.00	31.40	32.40	32.00	33.20	27.40	25.80	25.40
16-Sep	27.00	30.40	34.00	32.00	28.00	26.40	26.00	25.40
17-Sep	27.60	31.40	33.40	31.40	28.00	26.40	26.00	25.40
18-Sep	26.80	32.00	33.80	31.80	28.60	26.60	25.60	25.20
19-Sep	28.00	31.60	33.60	32.60	28.00	26.20	25.60	25.40
20-Sep	27.20	32.00	34.00	32.00	28.00	26.40	25.80	25.60
21-Sep	26.80	31.00	34.60	32.40	28.20	26.20	25.60	25.00
22-Sep	27.40	32.00	33.40	33.40	29.00	27.20	25.00	23.40
23-Sep	27.60	31.00	33.00	33.00	30.00	33.20	26.20	25.20
24-Sep	28.00	32.20	34.20	34.40	29.20	27.20	31.00	26.20
25-Sep	27.40	32.40	34.40	33.40	28.60	26.10	26.00	25.00
26-Sep	26.40	32.00	34.40	32.00	28.00	25.60	25.00	23.80
27-Sep	27.00	31.80	33.60	31.40	27.40	26.00	24.60	23.60
28-Sep	27.40	31.80	33.60	31.40	27.40	26.20	25.00	25.60
29-Sep	27.00	31.60	32.00	31.00	27.40	26.40	25.20	25.00
30-Sep	27.00	31.80	33.00	30.40	27.40	27.00	25.40	24.40

Appendix 10 - Dry bulb temperature(oC) at Bhuj (October)								
Day of Month	Hour of day							
	8.30	11.30	14.30	17.30	20.30	23.30	2.30	5.30
1-Oct	27.40	32.00	32.60	31.40	27.60	26.60	25.60	24.20
2-Oct	26.80	31.80	33.40	31.60	27.40	25.80	26.00	24.80
3-Oct	26.80	31.60	32.20	31.00	28.00	27.40	24.80	24.40
4-Oct	27.20	32.40	33.20	30.40	27.40	26.20	25.80	24.60
5-Oct	19.60	28.20	32.60	32.00	28.00	25.40	25.20	25.40
6-Oct	25.40	31.00	33.20	32.60	25.40	26.40	25.00	23.20
7-Oct	26.20	31.00	34.00	32.80	29.80	27.20	25.00	24.00
8-Oct	22.20	32.00	34.60	34.40	30.00	27.60	25.40	24.40
9-Oct	27.40	32.60	35.40	34.60	30.80	29.60	25.60	24.40
10-Oct	28.00	34.80	36.20	34.60	30.00	26.60	27.00	24.80
11-Oct	26.00	31.00	34.60	25.20	29.60	27.00	25.80	25.40
12-Oct	27.40	32.40	36.80	35.40	30.80	27.60	25.40	25.20
13-Oct	26.60	34.00	37.40	36.40	34.00	27.00	27.40	24.40
14-Oct	26.20	33.00	36.40	35.20	30.40	26.60	26.00	24.00
15-Oct	25.20	32.00	35.40	34.00	27.80	25.00	25.20	23.40
16-Oct	25.80	31.20	35.00	25.00	22.00	20.40	25.40	24.00
17-Oct	22.80	30.80	32.20	31.00	26.20	22.60	20.00	19.60
18-Oct	24.40	30.60	33.40	32.00	26.00	24.40	20.00	21.60
19-Oct	24.60	29.00	31.80	30.00	24.40	20.20	22.00	24.00
20-Oct	23.40	30.20	33.60	31.00	28.20	25.00	20.40	18.80
21-Oct	25.00	32.00	34.40	33.00	28.80	26.00	24.00	21.00
22-Oct	26.20	31.00	32.60	28.20	24.80	25.20	24.00	22.40
23-Oct	25.00	30.40	32.20	31.00	27.40	26.40	23.60	22.00
24-Oct	23.60	30.40	31.80	29.20	22.28	21.80	23.60	22.80
25-Oct	24.60	29.80	31.40	31.00	24.20	21.60	19.40	18.40
26-Oct	23.20	28.00	31.40	30.40	27.40	25.00	20.00	21.00
27-Oct	23.00	28.00	31.00	30.60	25.20	25.60	23.60	21.40
28-Oct	23.40	30.40	32.40	31.40	25.40	24.40	24.00	21.00
29-Oct	22.80	29.60	21.40	29.50	22.60	24.40	23.40	18.80
30-Oct	22.40	29.80	31.80	30.00	25.40	25.40	23.00	16.40
31-Oct	23	29	31.4	30.1	25	21	23.6	21



Appendix 11 - Dry bulb temperature(oC) at Bhuj (November)								
Day of Month	Hour of day							
	8.30	11.30	14.30	17.30	20.30	23.30	2.30	5.30
1-Nov	23.60	30.40	33.00	31.00	24.40	21.00	18.80	16.60
2-Nov	22.00	31.00	32.80	31.40	22.40	20.60	18.40	16.00
3-Nov	22.00	31.80	34.00	32.00	22.40	21.00	19.00	16.40
4-Nov	22.40	32.20	34.80	32.00	22.60	19.60	19.00	17.80
5-Nov	20.20	30.60	33.40	32.00	22.60	20.00	17.20	15.60
6-Nov	20.40	33.40	34.40	32.40	23.40	19.40	17.00	16.20
7-Nov	20.80	30.00	34.00	32.60	22.40	20.20	21.00	16.20
8-Nov	20.60	31.60	34.40	32.60	23.40	21.80	18.40	16.20
9-Nov	21.40	31.20	33.40	33.40	27.40	23.80	19.60	17.40
10-Nov	20.80	31.00	33.20	31.40	22.60	20.00	20.80	20.20
11-Nov	21.40	28.00	31.80	30.00	20.20	23.40	18.80	16.40
12-Nov	20.00	28.00	29.40	27.80	19.60	16.40	17.20	15.00
13-Nov	17.00	28.40	30.00	27.40	19.00	15.00	14.20	13.40
14-Nov	17.00	27.60	30.00	28.40	19.00	17.20	13.40	12.40
15-Nov	16.40	27.60	31.00	30.00	20.40	17.20	15.00	15.20
16-Nov	19.00	28.60	31.20	30.60	20.20	18.00	15.60	15.00
17-Nov	18.00	30.00	32.40	39.80	26.00	23.40	16.40	16.40
18-Nov	21.80	27.40	30.40	29.00	26.60	24.40	21.00	19.60
19-Nov	17.40	27.80	30.20	28.00	19.00	16.40	22.00	16.20
20-Nov	15.00	27.00	27.40	27.60	19.60	18.40	16.00	15.00
21-Nov	17.00	28.00	30.00	28.20	24.60	20.00	16.40	16.00
22-Nov	15.00	27.00	30.80	28.60	22.60	22.40	19.80	17.00
23-Nov	18.00	27.40	31.00	29.00	23.40	19.40	21.00	16.00
24-Nov	19.60	28.40		29.00	23.20	21.40	18.40	17.60
25-Nov	17.00	21.20	24.60	24.60	20.00	17.00	18.20	16.60
26-Nov	16.20	24.20	26.20	25.00	19.00	16.40	15.00	14.00
27-Nov	15.20	25.60	26.40	25.00	20.40	13.40	15.00	12.40
28-Nov	15.60	22.40	27.40	25.50	19.00	20.40	14.20	13.00
29-Nov	17.60	24.00	27.40	26.60	29.60	19.00	14.60	14.80
30-Nov	14.80	24.00	27.40	26.40	22.10	22.40	12.40	15.40

Appendix 12 - Dry bulb temperature(oC) at Bhuj (December)								
Day of Month	Hour of day							
	8.30	11.30	14.30	17.30	20.30	23.30	2.30	5.30
1-Dec	13.00	24.20	25.00	23.40	15.80	12.80	14.00	10.60
2-Dec	12.00	22.00	25.80	24.40	15.80	13.00	12.20	11.00
3-Dec	13.00	24.80	26.40	25.70	20.40	19.80	11.80	9.80
4-Dec	12.80	22.40	26.00	26.40	17.00	13.20	15.20	10.60
5-Dec	12.60	23.40	25.80	24.00	16.40	12.40	11.20	12.20
6-Dec	13.00	22.00	25.40	24.80	17.60	15.20	11.40	13.40
7-Dec	14.60	22.00	25.40	25.00	18.60	19.20	12.80	10.40
8-Dec	13.00	22.00	24.80	24.00	20.40	19.00	18.00	12.80
9-Dec	11.80	23.40	26.00	24.60	16.40	12.80	18.20	11.20
10-Dec	11.40	24.40	27.40	25.40	19.40	13.40	11.20	10.40
11-Dec	10.40	24.00	25.40	24.60	17.00	14.80	11.60	9.80
12-Dec	12.20	23.20	26.40	24.60	18.60	16.00	13.40	12.20
13-Dec	14.00	23.40	26.40	25.00	17.00	14.40	14.20	12.80
14-Dec	11.60	26.60	24.20	23.00	14.60	10.00	12.00	10.80
15-Dec	9.20	20.40	24.20	23.50	14.80	12.20	10.00	9.00
16-Dec	10.80	20.40	24.40	23.40	16.40	17.20	11.20	12.00
17-Dec	10.80	21.00	22.40	21.40	14.00	10.60	13.00	11.60
18-Dec	8.80	20.40	23.00	22.00	13.00	11.20	10.00	8.40
19-Dec	11.00	20.80	24.40	23.00	14.20	10.60	10.00	8.40
20-Dec	8.60	19.00	24.00	22.00	14.40	10.00	8.60	7.60
21-Dec	7.80	20.20	24.40	23.40	12.60	10.00	8.80	6.40
22-Dec	8.60	23.20	26.20	25.00	16.80	15.00	8.00	6.40
23-Dec	15.00	24.40	26.80	25.40	17.00	14.00	15.00	14.60
24-Dec	11.60	23.80	26.60	24.70	16.00	13.80	12.00	11.00
25-Dec	11.60	23.40	26.20	24.60	14.60	11.20	11.40	10.60
26-Dec	8.00	23.00	26.20	24.40	15.00	11.20	8.60	7.40
27-Dec	8.60	21.40	25.00	24.70	15.20	13.80	11.00	8.20
28-Dec	11.00	24.40	27.00	25.00	17.80	14.60	10.40	10.20
29-Dec	11.60	20.40	23.60	22.40	16.40	17.20	12.40	11.00
30-Dec	7.60	17.40	11.20	18.20	12.60	11.00	15.00	10.40
31-Dec	9.4	17.2	21	18	13.4	8.2	9	6.6

## References

1. Ashrae Handbook (1985). Fundamentals. USA: American Society of Heating, Refrigeration and Airconditioning Engineers, Inc. Publication.
2. Jensen M. and A. Matter (1995). Protected agriculture: A global review. World Bank Technical Paper No.253. Washington DC: The World Bank.
3. India Meteorological Department (1997). Climate data of Bhuj. Ahmedabad: Branch Office.
4. Raman S., B.R. Patel, K.P. Gohil, B.K. Dhadule, and P.M. Vaghasingh (1996). Initial observations of performance of some vegetables and flowers under greenhouse. Proceedings of Symposium on Controlled Environment: Agriculture in Arid Areas. Ahmedabad: Institution of Engineers (Gujarat Chapter), pp 8-13.
5. Hasmukh Shah Greenhouse. Indian Petrochemicals Corporation Limited, Baroda.
6. Ashok Sonune (1996) Nursery raising inside the greenhouse. Unpublished M.E (Ag) thesis submitted to CTAE, Udaipur (Rajasthan).
7. Paul V. Nelson (1985). Greenhouse operation and management, 3rd edition. Reston Virginia: Reston Publishing Company, Inc.
8. NABARD (1998). Sectoral study of 100% EOU floricultural (Rose) unit. Investment Credit Department.

