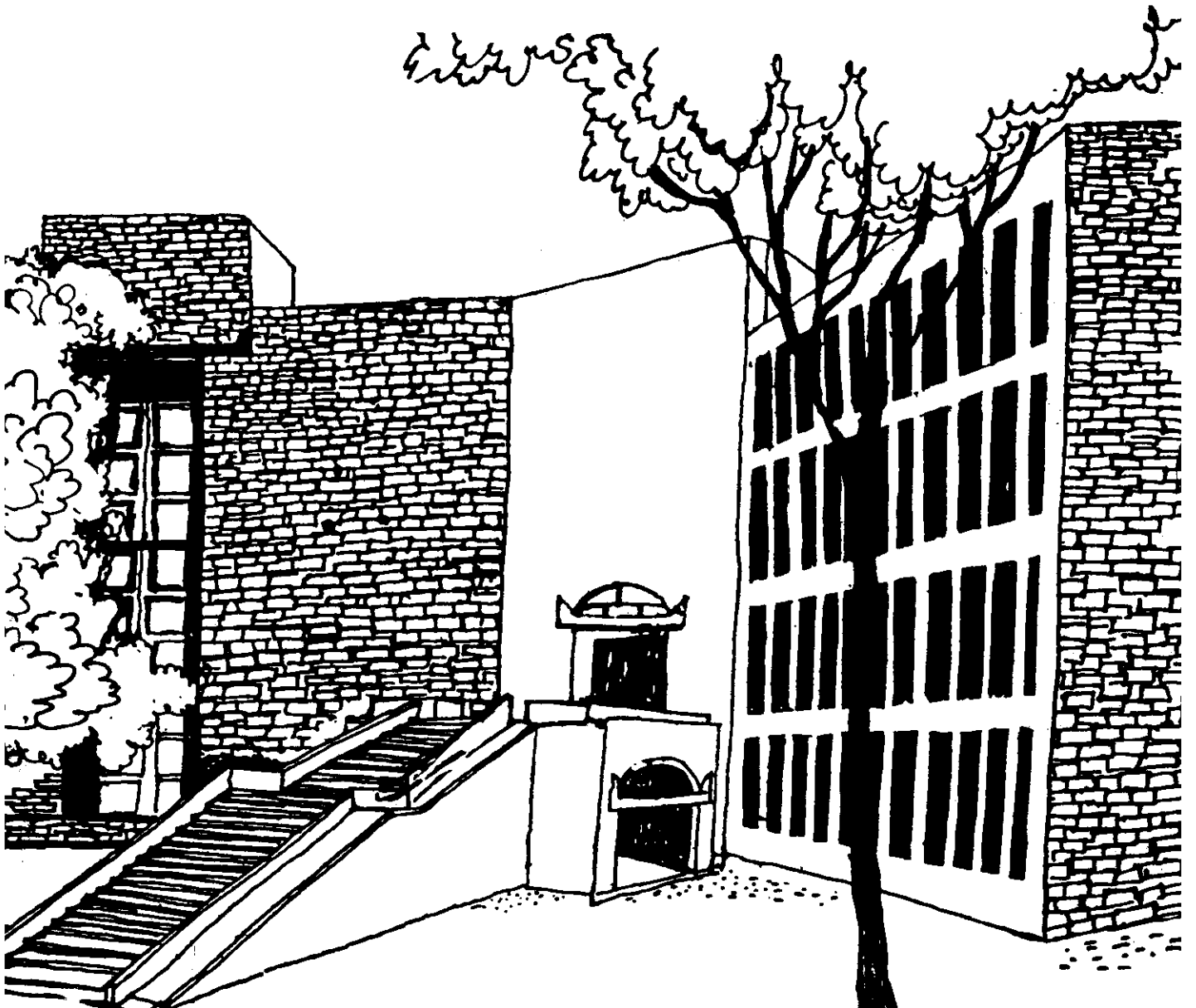




Working Paper




OPERATING CHARACTERISTICS OF EMPTY SOLAR
COOKER

By

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Operating Characteristics of Empty Solar Cooker

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Abstract

In this report we present some of the operating characteristics of an empty box solar cooker, under climatic conditions of Ahmedabad.

Climatic Conditions

Global solar radiation on horizontal surface and ambient temperature data was converted into Fourier Series. **Tables 1 and 2** give the coefficients.

Plate Temperature and Time Graph

Simulations are done using model developed by Sharan and Chaudhuri (W.P. 1423). **Figures 1-12** show the rise and fall of plate temperature as the day advances in each of the twelve months under climatic conditions of Ahmedabad

Table 3 shows a summary of information obtained from the temperature time simulations. It is seen that cooker will not permit satisfactory cooking around August when plate temperature rises slowly and barely touches 120°C by 1:00 P.M. Problems will also be experienced in July and again in November, December and January when, although the temperature does rise above 120°C, it does so only late in the morning or near noon leaving very little time (<2 hours) to cook lunch which users generally like to finish by 1:00 P.M.

Cooker Indoor

Figure 13 shows the plate temperature and time graph, when cooker is placed indoor and heating is done by the back-up source. With a back-up source of 100 W, plate temperature reaches a maximum of 120°C. As the source strength is increased, maximum temperature achieved also rises. However, the rise is not in proportion to the strength. As the strength is increased, losses increase more than proportionately. This is only expected, as the cooker is not designed for large inputs.

We thank Mr. Vasant R. Pilare for computational assistance.

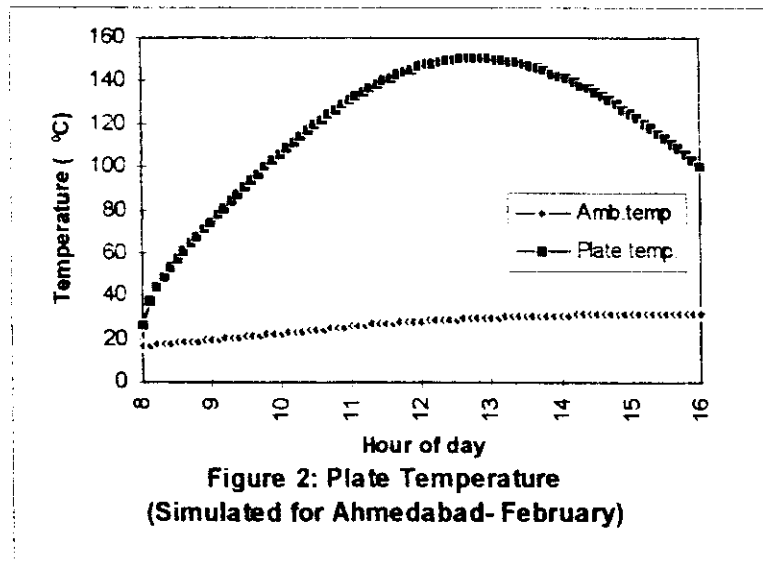
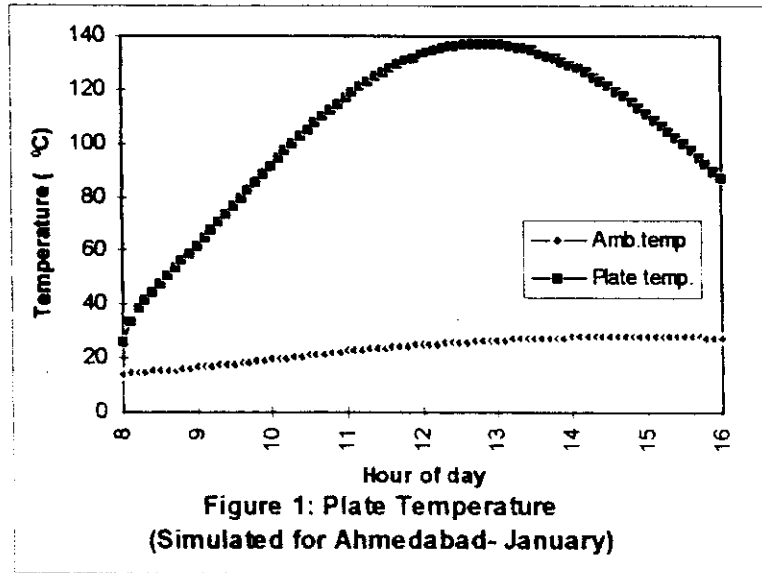
Table 1
Fourier Coefficients for Global Solar Radiation Series
Ahmedabad

	n	0	1	2	3	4	5	6	Max abs dev (%)
Jan	A	204.00	-338.23	181.47	-42.61	-17.21	14.71	1.42	12.31
	B		-41.58	44.65	-14.90	-10.61	10.81	1.58	
Feb	A	240.63	-392.23	197.26	-35.04	-23.92	13.02	4.58	9.22
	B		-48.16	48.42	-11.77	-14.29	9.54	4.67	
Mar	A	280.71	-448.12	207.89	-23.61	-28.71	8.56	7.25	7.48
	B		-54.54	50.50	-7.34	-16.09	5.54	7.17	
Apr	A	305.33	-476.38	201.47	-9.08	-29.33	2.20	8.17	6.34
	B		-57.02	47.79	-1.48	-15.88	0.53	8.00	
May	A	316.54	-485.23	191.02	-0.06	-26.46	-2.29	7.08	4.85
	B		-62.47	50.45	-0.85	-14.36	-1.55	6.50	
Jun	A	265.71	-405.17	156.52	0.90	-20.75	-1.65	3.75	3.99
	B		-55.21	45.48	-3.41	-9.81	-1.78	4.50	
Jul	A	201.42	-307.80	119.41	1.85	-18.12	-0.55	4.58	5.37
	B		-44.68	37.99	-4.22	-8.01	-0.59	3.75	
Aug	A	185.88	-287.54	117.54	-2.73	-17.17	0.91	3.58	5.31
	B		-45.99	40.92	-5.92	-9.38	0.55	5.17	
Sep	A	230.83	-364.81	162.70	-13.87	-23.04	5.32	4.42	6.64
	B		-49.01	44.06	-4.69	-14.94	4.43	6.08	
Oct	A	240.25	-388.49	189.58	-29.41	-23.54	9.85	5.83	9.11
	B		-47.73	46.29	-8.95	-15.08	8.26	5.33	
Nov	A	207.21	-342.21	181.09	-40.68	-17.42	13.32	2.25	8.60
	B		-39.12	40.72	-11.58	-11.55	9.81	2.33	
Dec	A	190.88	-318.26	174.50	-44.73	-13.92	14.03	0.58	15.88
	B		-38.45	42.04	-15.03	-9.38	10.78	0.67	

Table 2 Fourier Coefficients for Air Temperature Series Ahmedabad									
	n	0	1	2	3	4	5	6	Max abs dev (%)
Jan	A	20.01	-3.92	0.89	-0.44	0.23	0.07	-0.18	10.92
	B		-6.07	1.63	0.35	-0.48	0.20	0.08	
Feb	A	23.12	-3.97	0.98	-0.36	0.35	0.14	-0.27	9.75
	B		-6.70	1.67	0.60	-0.48	0.17	0.15	
Mar	A	27.37	-3.54	0.79	-0.40	0.20	0.17	-0.18	4.91
	B		-6.42	1.36	0.59	-0.44	-0.05	0.09	
Apr	A	31.55	-2.94	0.69	-0.30	0.16	0.13	-0.08	2.21
	B		-6.12	1.15	0.55	-0.31	-0.05	0.06	
May	A	33.77	-2.53	0.31	-0.08	0.11	0.13	-0.04	1.33
	B		-5.90	1.20	0.39	-0.14	-0.09	0.03	
Jun	A	31.83	-2.08	0.06	0.11	0.04	0.00	-0.08	0.85
	B		-3.74	1.07	0.20	-0.12	-0.08	0.06	
Jul	A	28.74	-1.24	0.08	0.04	0.00	0.01	-0.04	0.71
	B		-2.07	0.54	0.10	-0.12	-0.03	0.06	
Aug	A	28.03	-1.12	0.12	0.02	0.03	0.01	-0.03	0.66
	B		-2.07	0.50	0.06	-0.10	-0.03	0.04	
Sep	A	28.00	-1.76	0.34	0.00	0.04	0.01	-0.08	1.21
	B		-2.60	0.71	0.13	-0.17	-0.03	0.08	
Oct	A	27.69	-4.02	1.02	-0.13	0.03	0.07	-0.18	3.86
	B		-4.65	1.33	0.55	-0.51	0.01	0.19	
Nov	A	24.27	-4.73	1.27	-0.26	0.03	0.07	-0.17	7.31
	B		-5.31	1.48	0.48	-0.65	0.11	0.23	
Dec	A	21.03	-4.20	0.99	-0.26	0.20	0.00	-0.23	9.28
	B		-5.47	1.70	0.31	-0.58	0.08	0.16	

Months	Time to reach 120°C (hrs)	Maximum Temp. (°C)	Time to fall below 120°C (hrs)	Total available time (hrs)	Available cooking time (hrs)
Jan	11.20	137	14.5	3.3	1.8
Feb	10.60	150	15.2	4.6	2.4
Mar	10.00	162	15.7	5.7	3
Apr	9.70	167	16.0	6.3	3.3
May	9.50	169	16.0	6.5	3.5
Jun	10.20	149	15.7	5.5	2.8
Jul	11.90	124	14.0	2.1	1.1
Aug	12.80	120	13.2	0.4	0.2
Sep	10.70	140	15.0	4.3	2.3
Oct	10.40	150	15.2	4.8	2.6
Nov	10.90	140	14.6	3.7	2.1
Dec	11.40	133	14.3	2.9	1.6

Note : Total available time-duration for which temp. stays above 120°C during day.
Available cooking time-duration for which temp. stays above 120°C till 1:00 P.M.



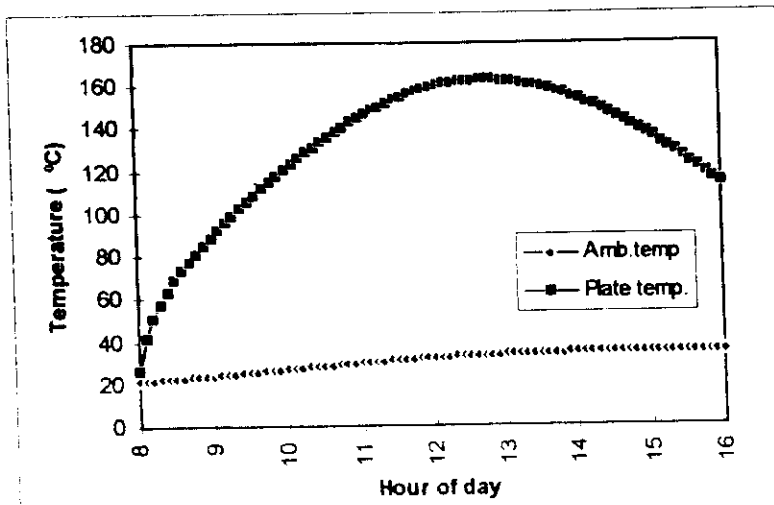


Figure 3: Plate Temperature (Simulated for Ahmedabad- March)

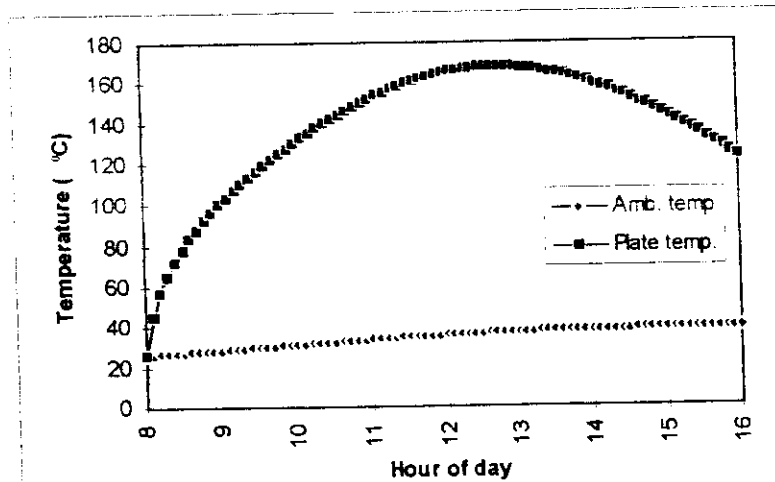


Figure 4: Plate Temperature (Simulated for Ahmedabad-April)

