



DEPARTMENT OF MECHANICAL ENGINEERING
PONDICHERRY ENGINEERING COLLEGE
Pillaichavady, Pondicherry – 605 014, INDIA

E Vijayakrishna Rapaka, B.Tech (Mech.), M.Tech. (Energy)
Senior Lecturer
rapaka01@sify.com

To
Jean Korstange,
FWE Secretary
P.O. Box 297
Saxtons River VT 05154
USA
Email : kotangi@sover.net

September 10, 2005

Dear Sir,

I am thankful to the Board of the Foundation for World Education for granting me US\$1000 for the CPC-Earthen Vaults Solar Kitchen Project Engineering Study under my direct supervision in our college. I am herewith submitting the project completion report and the accounts for your kind perusal.

I would also like to extend my sincere thanks to Mr. Joel H Goodman from Wisconsin who has submitted the proposal to your foundation on my behalf. I once again sincerely thank the appropriate authorities of the Board of the Foundation for World Education for releasing me the grant in connection with the above-mentioned project.

Sincerely yours,

E Vijayakrishna Rapaka

cc: Joel H Goodman

FINAL REPORT

Details of the Project

1. Name of the Project Investigator

E Vijayakrishna Rapaka

2. Address for communication

Senior Lecturer
Department of Mechanical Engineering
Pondicherry Engineering College
Pillaichavady, Pondicherry – 605 014
INDIA
rapaka01@sify.com
rapakaitm@hotmail.com

3. Title of the Project

Theoretical and Experimental Studies on a 1:5 Model Half Truncated CPC
Solar Cooking Oven with and without End-Wall Reflectors

4. Amount of grant received :

US \$ 1000 (INR 44768 as on 19.06.2004)

Outcome of the Project

5. What was learned

The Compound parabolic concentrator (CPC) is a non-imaging type of collector like a flat plate collector with plane reflector. Introducing the two end wall reflectors can increase the solar flux incident on the absorber of the CPC. In this project, experimental investigations were carried out on half truncated CPC type solar cooking oven with and without end wall reflectors. Three different profiles of end wall reflectors have been considered for our experimental investigation. They are

1. Planar profile (Fig.2a)
2. Parabolic profile (Fig.2b)
3. Elliptic profile

The introduction of end-wall reflector has enhanced the amount of incident solar energy flux falling on the cooking oven. It was observed that the introduction of end-wall reflector as shown in Fig. 1(b) enhances the temperature achieved inside the Cooking Oven.

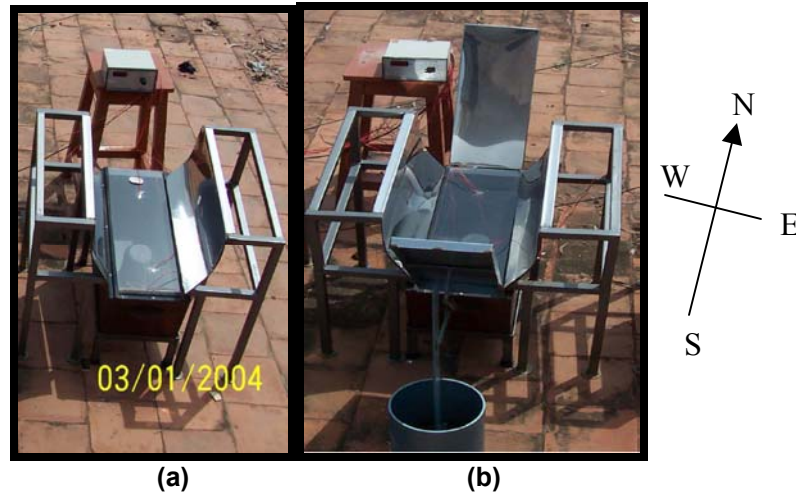


Fig. 1 Photographs of Solar CPC
a) without end wall reflector and b) with end wall reflector

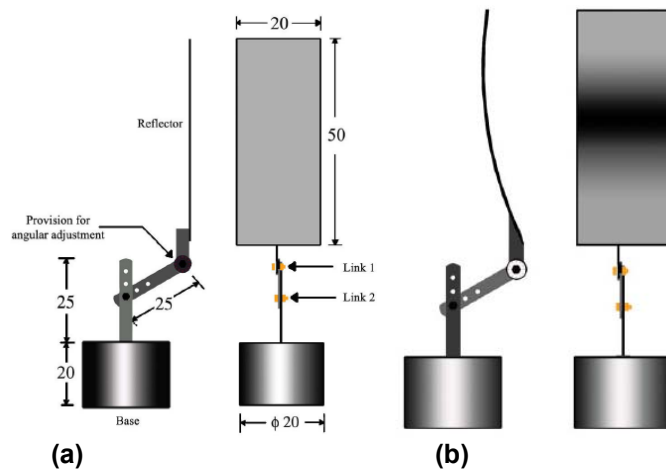


Fig. 2 Schematic diagrams of Solar CPC End-Wall reflectors
a) Planar and b) Parabolic

6. What was particularly successful

The 3-D view of the model Solar CPC along with its dimensions in centimeters is shown in Fig. 3. Figure 4 shows the 3-D view of the Solar CPC model with end wall reflectors. From the outcome of the experimental investigations, it was

observed that the results of the Elliptic profile and parabolic profile end-wall reflectors were almost similar and hence the experimental investigations with elliptic profile end-wall reflector were discarded.

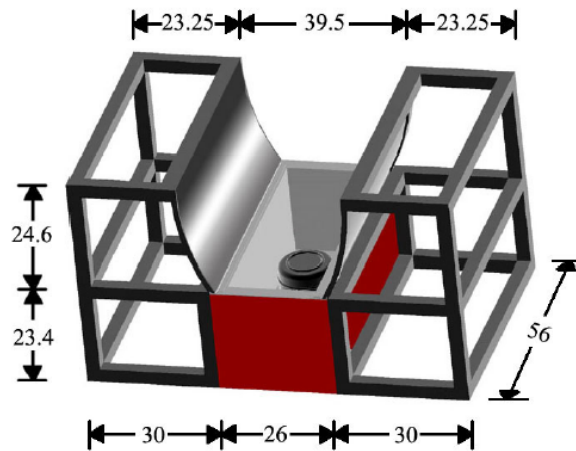


Fig. 3 Half Truncated CPC Cooking Oven Assembly without End-wall Reflector

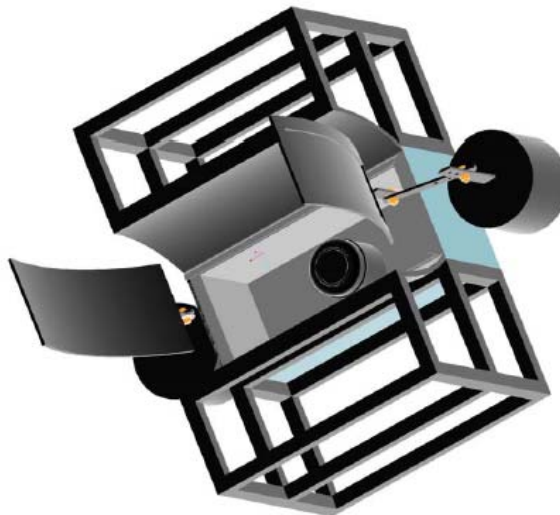


Fig. 4 Half Truncated CPC Cooking Oven Assembly with Parabolic End-wall Reflector

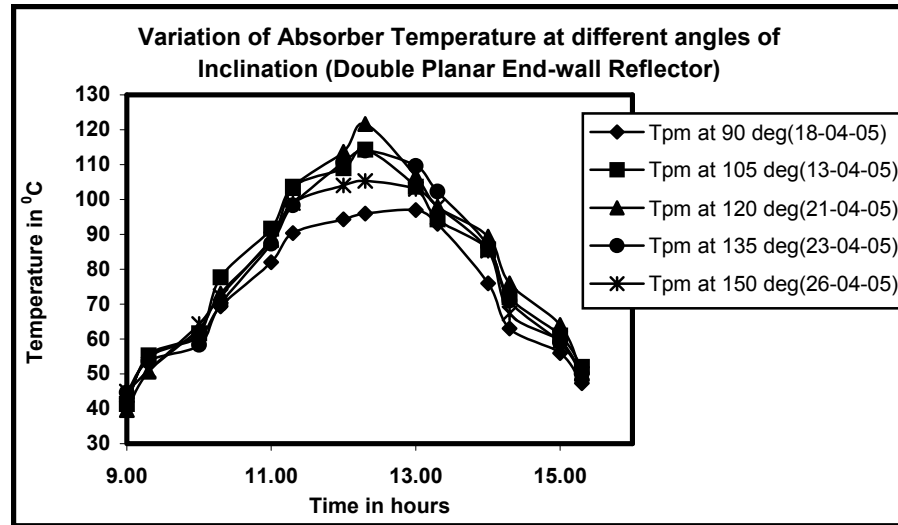


Fig. 5 Variation of Absorber Temperature at different angles of Inclinations (Double Planar End-wall Reflector)

From Fig. 5, the maximum absorber temperature of 97 °C at 90° inclination of the end wall reflectors at 13.00 hours, 114 °C at 105° (12.30 hours), 122 °C at 120° (12.30 hours), 114 °C at 135° (12.30 hours) and 105 °C at 150° (12.30 hours) was observed in the half CPC cooking oven with double planar end-wall reflector. The maximum temperature was achieved for an angle of 120° inclination of the planar end wall reflector.

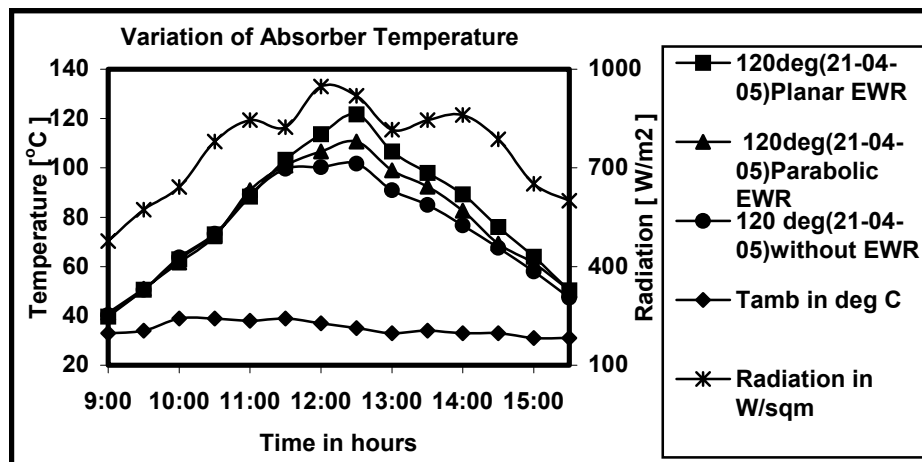


Fig. 6 Variation of absorber Temperature for Half CPC cooking oven (Double planar, parabolic and without End wall reflector) at 120° on 21-04-05

From Fig. 6, it is observed that the maximum temperature achieved in the absorber is 122°C (12.30 hours) for half CPC with double planar end-wall reflector, 111°C (12.30

hours) for half CPC with double parabolic end-wall reflector, 102°C (12.30 hours) for half CPC cooking oven without end-wall reflector was observed.



Fig. 7 Schematic diagrams of Solar CPCs with parabolic, linear End-Wall reflectors and without End-Wall reflectors

Out of the Planar profile and Parabolic profile (Fig.7), the planar profile end-wall reflector (EWR) performed well and the maximum temperature achieved inside the cooking oven was 11° more than that of parabolic profile EWR and an enhancement of 22°C was achieved with Solar CPC with parabolic end wall reflectors when compared with Solar CPC without end-wall reflectors.

7. Role of FWE grant

The FWE grant was very useful for the fabrication of the model Solar CPC and its associated accessories. A personal computer along with a printer was purchased. The PC is currently used for data analysis and its has been envisaged to use the PC for data acquisition as soon as the DAQ card is purchased. Mr.I.Jayasankar, who has completed his M.Tech. degree in Energy Technology in July 2005 under my guidance has carried out his Major Project Work in the area of Solar CPC Earthen Vaults Solar Kitchen Project.

8. Follow up on the project

The previous work was carried out for a N-S oriented Solar half truncated CPC, now similar studies are carried out for a E-W oriented Solar half truncated CPC for varying slopes of the base in order to find out the optimum inclination of the device with respect to various months of a year. Currently, one of my Post Graduate student, Mr.V.T.Pazhani Thirukumaran, who is undergoing his M.Tech. degree in Energy Technology is working on E-W oriented Solar CPC Earthen Vaults Solar Kitchen Project. He is likely to complete his study by July 2006. It has been decided to publish the outcome of the research work in conferences/journals.

Financial report

9. Expenditures

Sl.No.	Date	Particulars	Income	Expenditure
1.	19.06.04	By FWE grant (\$1000)	44768.00	
2.	15.12.04	Computer (Item 15)		19990.00
3.	15.12.04	Printer (Item 16)		8600.00
4.	02.03.05	Half truncated CPC 3 pairs (Item 17)		6000.00
5.	10.03.05	Cooker box assembly 4 nos(Item 18)		3000.00
6.	10.03.05	Cooker Box stand 4 nos (Item 19)		1600.00
7.	10.03.05	Cooking vessel 4 nos (Item 20)		200.00
8.	24.03.05	Endwall reflectors 3 pairs (Item 21)		6000.00
9.	31.03.05	Tarpaulin cover (Item 22)		240.00
		Total	44768.00	45630.00

10. Grants from other and in kind contributions

A total grant of US\$ 1410 has been received as donation through Joel H Goodman for the Solar CPC Earthen vaults project.

11. Remaining funds

An amount of US \$ 1000 (INR 44768 as on 19.06.2004), the expenditure incurred was INR 45630. An excess of INR 862 has been spent. There are no remaining funds from the FWE grant received as on 31.03.2005.