

DESIGN OF SOLAR HEATING AND HOT  
WATER SERVICES FOR A RESIDENTIAL HOUSE

Project Report Submitted by

CHARALAMBOS PROUNTZOS

in part satisfaction of the conditions for the  
award of Diploma of Technician  
Engineer in Mechanical Engineering  
of the Higher Technical Institute

Project Supervisor: Symeou Theodoros

Individual Project

12 June 1989



## General Introduction

The main objective of this study is the design of solar heating and hot water services for a residential house.

To reach and successfully expedite this purpose we have to go through the following steps:

1. The calculation of the heat losses of the building and the determination of the energy requirements of the heating of the hot water services of it. After succeeding these we will be able to find out the quantities of energy needed to satisfy the heating and hot water needs of the building.
2. The examination of the solar radiation as an energy source especially in our country. The study of the various ways it can be collected and used to cover in the maximum degree the above requirements of this project.
3. The determination of (a) the size of the various equipment for the solar heating of the water and its storage, (b) the type and output of the auxiliary source it can be used, (c) the size of the circulating pumps of the hot water, (d) the size of the heat emitters, (e) the type and diameter of the piping system, its way of installation and insulation, (f) all the electrical and control requirements of the system, (g) all the other components for the successful operation of the system such as valves, auxiliarys chimney etc and (h) the way of co-operation of both the heating and the hot water systems.
4. The drawing of all the above mention mechanical services and their details.

5. The presentation of all the necessary tables, symbols and explanations for the purpose of reading the drawings.
6. The estimation of the cost of the various parts of the system which will finally result to the total cost.
7. The presentation of leaflets, informations and capacities tables given by the proposed manufacturers.
8. Finally we will present our conclusion and summary of the proposed design of the systems.

## CONTENTS

	<u>Page</u>
INTRODUCTION	
CHAPTER 1	
1.1 Introduction .....	1
1.2 Structural losses .....	2
1.3 Ventilation losses .....	2
1.4 U-value .....	3
1.5 Estimation of various losses .....	11
CHAPTER 2	
2.1 Introduction .....	29
2.2 Collection of solar energy .....	29
2.3 Storage of solar energy .....	60
CHAPTER 3	
3.1 Introduction .....	65
3.2 Operational design characteristics .....	66
3.3 Control systems of heating system .....	68
CHAPTER 4	
4.1 Introduction .....	71
4.2 Sizing of solar collectors .....	74
4.3 Storage tank sizing .....	82
4.4 Auxiliary heating source sizing .....	82
4.5 Heat-emitters sizing .....	83
4.6 Collector arrangement .....	84
4.7 Collector positioning .....	86

## CHAPTER 5

5.1	Introduction .....	88
5.2	Pipe sizing: distribution circuit .....	88
	collection circuit .....	93
5.3	Pump sizing: distribution circuit .....	96
	collection circuit .....	98
5.4	Auxiliary source piping .....	99

## CHAPTER 6

6.1	Introduction .....	102
6.2	Hot water demand .....	102
6.3	Solar hot water system .....	104
6.4	Pipe sizing .....	105
6.5	Auxiliary demand .....	108
6.6	Cold water tank .....	108

## CHAPTER 7

7.1	Cost-estimate of space heating system .....	111
7.2	Cost-estimate of hot water system .....	113

## CHAPTER 8

8.1	Appendices .....	
8.2	References .....	

## CHAPTER 9

9.1	Drawings .....	
-----	----------------	--

## SUMMARY

## CONCLUSIONS