

HIGHER TECHNICAL INSTITUTE

MECHANICAL ENGINEERING DEPARTMENT

DIPLOMA PROJECT

**ENERGY CONSERVATION IN A COMMERCIAL
BUILDING**

M/942

BY: KYRIACOS HADJIYIANNIS

JUNE 2002

HIGHER TECHNICAL INSTITUTE	PROJECT NO. 3364
----------------------------------	---------------------

ENERGY CONSERVATION IN A COMMERCIAL BUILDING

by

Kyriacos Hadjiyianni

Project report

Submitted to

the department of mechanical engineering

of the higher technical institute

Nicosia-Cyprus

in partial fulfilment of the requirements

for the diploma of

TECHNICAL ENGINEER

in

MECHANICAL ENGINEERING

June 2002

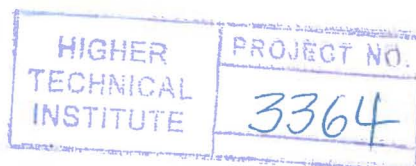


TABLE OF CONTENTS

ACKNOWLEDGEMENT	1
INTRODUCTION	2
OBJECTIVES	3
CHAPTER 1 Estimate the Energy Consumption Pattern in the Building	5
1.1 Introduction	5
1.2 Energy consumption analysis	5
1.3 Energy consumption analysis per sector	7
1.4 Calculation of energy for every sector in the building	9
1.4.1 Lighting	9
1.4.2 Thermal uses	12
1.4.3 Cantina sector	14
1.4.4 Ventilation	15
1.4.5 Electronic Appliances	16
1.4.6 Heat losses	17
Sankey Diagram	18
CHAPTER 2 Areas for Possible Energy Conservation	20
2.1 Introduction	20
2.2 Air-to-air heat exchangers	20
2.3 Water chiller and VRV-units	22
2.4 Shading devices	22
2.4.1 Exterior roller blinds	23
2.4.2 Awnings	24
2.5 Lighting	25
2.5.1 Localised switching	25
2.5.2 Time switching	26
2.5.3 Occupancy linking	26
2.5.4 Daylight linking	26
2.6 Glazing	27
2.6.1 Low-e glazings	28
2.6.2 Spectrally selective coatings	29
2.6.3 Heat absorbing glazings	30
2.6.4 Reflective coatings	31
2.7 Insulation of external walls	31
2.7.1 Externally applied insulation	33
2.8 Roof insulation	35
2.8.1 Reflective roof coatings	36

CHAPTER 3 Energy Conservation Advices	39
3.1 Office equipment	39
3.2 Lighting	39
3.3 Heating/Ventilation/Air Conditioning Systems	40
3.4 Refrigeration	42
3.5 Windows	43
3.5.1 Sunlight	44
3.5.2 Radiant heat	44
3.5.3 Conduction	44
3.5.4 Convection	45
3.5.5 Infiltration	46
CHAPTER 4 Energy Savings and Cost Required for some Methods and Strategies	48
4.1 Introduction	48
4.2 Heating-Cooling	48
4.3 Insulation	48
4.4 Lighting	49
4.5 Refrigeration	49
4.6 Windows	49
CONCLUSION	50
APPENDIX 1	51
APPENDIX 2	54
APPENDIX 3	67
REFERENCES	72

ACKNOWLEDGMENTS.

I would like to express my personal thanks to the personnel of the Guildhall of Strovolos who offered me all their help and all the information that helped me accomplish this project. I would also like to thank the Electricity Authority of Cyprus and Kaytel Ltd for the valuable information they offered.

Finally, I would like to thank my project supervisor Mr. Symeou for his help, in finding information for the completion of this project.

Kyriakos Hadjiyiannis
June 2002
Nicosia, Cyprus.

INTRODUCTION

The reason that forced Government Department in recent years to look into alternative energy sources is the continuous annual increase in energy consumption, which costs a lot of money to the Government. The problem is that all this money is wasted in a way, since we could have the same quality of life, consuming less energy. The same applies to private individuals. It should be stated that the availability of existing energy sources is finite.

Unfortunately, in Cyprus the availability of energy efficient products and methods is minimal. Moreover, people do not have energy consciousness and as a result they waste a lot of energy every day. A very good example is the bad use of air-conditioners in summer. People may have the air-conditioner working all day while they have the windows open or leave it working while they are away. Another example is overuse of lighting when there is no need for it.

Because of all this energy unconsciousness, from 1991 to 2000 the energy consumption was increased by 1 508 080 kWh in all sectors. In the commercial sector, the increase was 250 409 kWh. This over consumption in the year 2000, cost £81 640 000 for the production of 3373,7 GWh to the government, in contrast to the year 1999 when the consumption was 3139,3 GWh and cost to the government £43 567 000.

In the commercial sector the consumption of energy in the last years was very high. For this reason all the new commercial buildings in the future must be energy efficient. In order to satisfy their needs for cooling, lightning, heating, ventilation and electric appliances, they must use energy saving products and methods. Last but not least, the personnel of these buildings must develop energy consciousness otherwise nothing of the above would make any difference.

OBJECTIVES

- To estimate the energy consumption pattern in the building.
- To draw up typical Sankey diagrams for the energy consumption in the building.
- To identify the areas for possible energy conservation.
- To suggest energy conservation methods and techniques.
- To estimate the cost required to establish the methods and strategies suggested.