Evaporating Cooling Potential in the Residential Sector of Greece

Methodology

Due to the nature of the project, which is bibliographic, the methodology that will be followed is almost be prescribed. Searching the background literature would be a general plan of great importance, and after its presentation, the approach of the project's particularities by our personal research is required to be done.

Specifically, after a meeting with the supervisor, which would be very beneficial in order to discuss and comprehend the selected subject, a research based to the background literature is necessary to be done. The collected learning material would be the theoretical part of our project. At the next stage of our research, a more deep examination of the above material would be done in order to make clear which parts of the literature would be useful for our work. From this point, our personal research will be begun. Firstly, the estimation of the evaporating cooling potential in various climatic zones of Greece seems to be absolutely necessary. This would be achieved by the collection and study of climate information from each of the

Aims and objectives

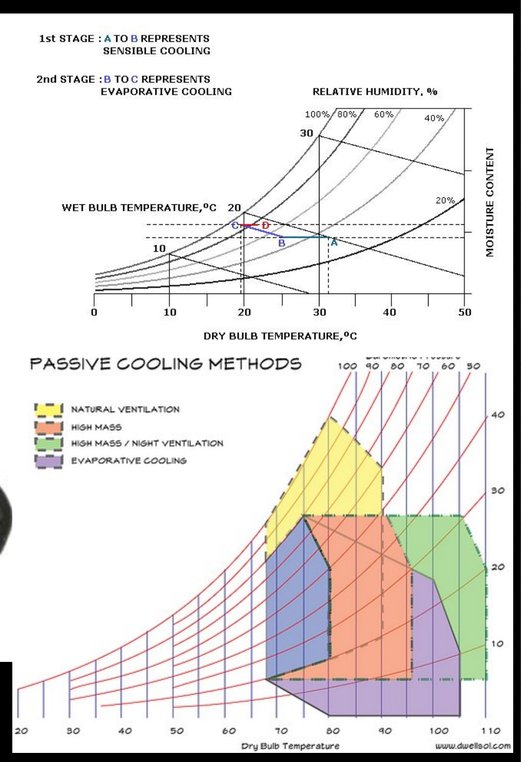
The main aim of the current project is to reduce the energy demand for cooling at residential sector of Greece during the summer period. This reduction intends to decrease the CO_2 emissions which are in debt from the usage of the air conditioning and stabilize the electrical network (lower peak demand).The secondary aim of this research is to propose suggestions in order to reduce the capital cost of the cooling equipments which are used in the domestic sector.

In order to achieve this aim a set of objectives has been established as follows:

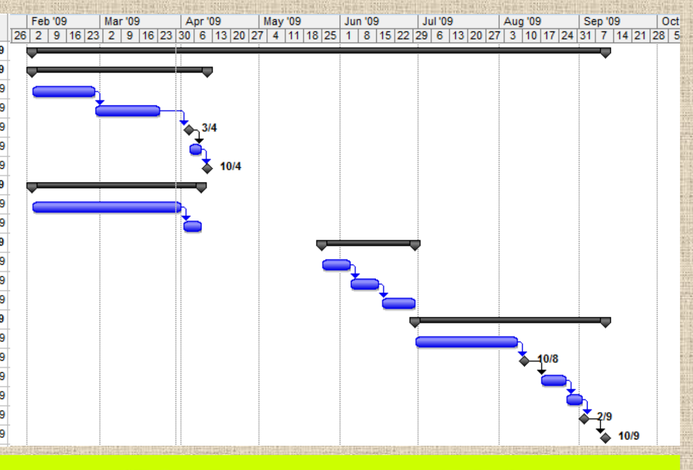
- Estimate the evaporative cooling potential in various climatic zones of Greece in relevance to the residential sector.
- Evaluate the energy performance and cost effectiveness of Evaporative Cooling units in the above framework.
- Propose which method of evaporating cooling and which equipment is more suitable for each climatic zone of Greece.
- Propose (if such a solution proved to be economically advantageous) an integrated hybrid system to incorporate both Air Conditioning and Evaporative Cooling units, each of them appropriately dimensioned.

Expected Outcomes

Evaporating cooling is a proven effective cooling technique. Its main advantage is that it consumes minimal energy during its operation, in comparison with the classic ways of air conditioning which are used almost exclusively in the domestic sector (air conditioning). Another but equally important advantage is that doesn't use refrigerants fluids that pollute the environment and are responsible for the hole of the ozone in the atmosphere. Nevertheless, there are two very important restrictions that should be kept in our minds during its application. The already mentioned restrictions are caused by the humidity. According to the first one as long as there is high humidity level in a region, as much the efficiency of this technique is decreased. The second restriction has to do with the human health and the comfort conditions. The mentioned limitation can affect only direct evaporating cooling applications which use direct units and they increase considerably the humidity of space that we cool. According to recent research that has been developed on this subject, the findings show that the case of a hybrid system which will also incorporate evaporating cooling unit and air conditioning unit, is a much better choice. Firstly, because it can cover large cooling loads that cannot be confronted only by evaporating cooling. Secondly, the above-mentioned problem of increased moisture of the space is significantly reduced with the dehumidifying which is made possible by the operation of air conditioning.



Task Name	Duration	Start	Finish
Dissertation	159 days?	Tue 3/2/09	Thu 10/9/09
Critical analysis and research preparation	50 days?	Tue 3/2/09	Fri 10/4/09
Literature review	18 days?	Tue 3/2/09	Thu 26/2/09
Portofolio writing	17 days?	Fri 27/2/09	Mon 23/3/09
Hand in portofolio	1 day?	Fri 3/4/09	Fri 3/4/09
Poster preparation	4 days?	Sat 4/4/09	Wed 8/4/09
Poster presentation	1 day?	Fri 10/4/09	Fri 10/4/09
Literature research	48 days?	Tue 3/2/09	Wed 8/4/09
Collection of the Literature (continued)	41 days?	Tue 3/2/09	Tue 31/3/09
Evaluation of the Literature	6 days?	Thu 2/4/09	Wed 8/4/09
Preparation of the main boby of the dissertation	26 days?	Mon 25/5/09	Mon 29/6/09
Estimation of the evaporative cooling potential	9 days?	Mon 25/5/09	Thu 4/6/09
Evaluation of the energy performance and the cost effectiveness of E/C units	7 days?	Fri 5/6/09	Mon 15/6/09
Evaluation of the performance of a hubrid air conditioning system	9 days?	Wed 17/6/09	Mon 29/6/09
Writing up and dissertation submission	53 days?	Tue 30/6/09	Thu 10/9/09
Writing up	29 days?	Tue 30/6/09	Fri 7/8/09
Hand in to the supervisor	1 day?	Mon 10/8/09	Mon 10/8/09
Final corrections	8 days?	Mon 17/8/09	Wed 26/8/09
Preparation of the presentation	4 days?	Thu 27/8/09	Tue 1/9/09
Oral presentation	1 day?	Wed 2/9/09	Wed 2/9/09
Dissertation submission	1 day?	Thu 10/9/09	Thu 10/9/09



Background

Nowadays, it is commonly known that the need to decrease energy consumption has become obligatory, in order to obviate climate changes. A large amount of energy is consumed at the domestic sector. According to research conducted by Mr. Santamouri, being mentioned to a published article [1], 1000 public and commercial buildings were submitted to investigation in 1992 and the results revealed an annual increase of 86-110 kWh/m^2 to air conditioned buildings, compared to others, where air conditioning systems had not been applied.

Alternative ways for cooling that had been previously rejected should be reexamined for their efficiency. An alternative cooling method is evaporating cooling, whose application could deduct the effect of the aforementioned problems. The advantages of this method are being ensured by published simulations. N.Klitsikas, M. Santamouris, A. Argiriou, D.N. Asimakopoulos, conducted a simulation [3] at 1994 that underlined an increase of the comfort hour when using "air coolers". They concluded that the use of such devises could accomplish a reduction of the environmental temperature, leading to a rise of the mean monthly number of comfort hours. R. Belarbi and the F. Allard detected during their simulation [4], Coefficient of performance (COP) for direct 6 and for indirect 4.7. The COP of this cooling mechanism appears to be comparable to the corresponding of air-conditioning, enhancing further research. It would be wise to examine the method and appreciate its effect to the climate of the domestic sector.

One way is the direct evaporative cooling of the outdoor air which then is introduced into the building. The temperature of the air is lowered and the water vapor content is elevated following a constant wet bulb temperature (WBT). As being mentioned in HVAC Application Hand book by ASHRAE [8] the direct evaporating cooling process is an adiabatic exchange of heat. The second way is an indirect one [7], for instance the roof of the building can be cooled evaporatively by having a shaded pond over the roof and the ceiling then acts as a passive, very effective, cooling element for the space below.

REFERENCES

[1] N. Bowman, K. Lomas, M. Cook, H. Eppel, B. Ford, M. Hewitt, M. Cucinella, E. Francis, E. Rodriguez, R. Gonzalez, S. Avlarez, A. Galata, P. Lanarde, R. Belardi (1996) *Application of Passive Downdraught Evaporative Cooling (PDEC) to Non-Domestic Buildings,* Renewable Energy, vol.10, pp.191-196.

[2] Morna Issac, Detlef P.van Vuuren (2009) *Modeling global residential sector energy demand for heating and air conditioning in the context of climate change*, Energy Policy, vol.*37,* pp.507-521.

[3] N.Klitsikas, M. Santamouris, A. Argiriou, D.N. Asimakopoulos (1994) *Perfomance of an indirect evaporative cooler in Athens,* Energy and Buildings, vol.21, pp.55-63.

[4] R. Belardi, F. Allard, (2001) *Development of feasibility approaches for studying the behavior of passive cooling systems in buildings,* Renewable Energy, vol.22, pp.507-524.

[5] M.F. El-Refaie, S.Kaseb (2009) *Speculation in the feasibility of evaporative cooling,* Bulding and Enviroment , vol.44, pp.826-838.

[6] Roger W. Haines, C. Lewis Wilson (1998) *HVAC Systems design, Handbook,* 3nd ed. Mc. Graw-Hill.

[7] Baruch Givoni (1992) *Comfort-Climate analysis and building design guideline,* Energy and Buildings, vol.18, pp. 11-23.

[8] ASHRAE (1999) *HVAC Application Hand book (chapter 50),* ASHRAE.

[9] M. Santamouris, D. Asimakopoulos (1995) *Passive Cooling in Buildings-Case studies,* European Commission.

[10] ASHRAE (2000) *HVAC Systems and equipment (chapter 19),* ASHRAE.

BUSINESS NAME

Primary Business Address
Your Address Line 2
Your Address Line 3
Your Address Line 4

Phone: 555-555-5555
Fax: 555-555-5555
E-mail: someone@example.com

We're on the Web!
example.com

Organization

Your business tag line here.

This would be a good place to insert a short paragraph about your organization. It might include the purpose of the organization, its mission, founding date, and a brief history. You could also include a brief list of the types of products, services, or programs your organization offers, the geographic area covered (for example, western U.S. or European markets), and a profile of the types of customers or members served.

It would also be useful to include a contact name for readers who want more information about the organization.

Back Page Story Headline

This story can fit 175-225 words.

If your newsletter is folded and mailed, this story will appear on the back. So, it's a good idea to make it easy to read at a glance.

A question and answer session is a good way to quickly capture the attention of readers. You can either compile questions that you've received since the last edition or you can summarize some generic questions that are frequently asked about your organization.

Caption describing picture or graphic.

A listing of names and titles of managers in your organization is a good way to give your newsletter a personal touch. If your organization is small, you may want to list the names of all employees.

If you have any prices of standard products or services, you can include a listing of those here. You may want to refer your readers to any other forms of communication that you've created for your organization.

You can also use this space to remind readers to mark their calendars for a regular event, such as a breakfast meeting for vendors every third Tuesday of the month, or a biannual charity auction.

If space is available, this is a good place to insert a clip art image or some other graphic.