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IFAC-PapersOnLine 48-24 (2015) 034–038

The Balance Point and Passive Heating for residential buildings in Kosovo

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Abstract: The end use energy in buildings is a large share of total energy consumed in residential and commercial sector. In total, 76 % of the world produced energy is used on the buildings and from the buildings, therefore the highest carbon emissions comes from the buildings.

Knowing how and when a building is used is very critical for knowing heating and cooling requirements. When we determine these building requirements, we can choose the proper strategies that will allow us to smartly use the energy within the building. In Kosovo, the energy sector is facing a lot of challenges. The energy production is based on lignite, resulting in high environmental pollutions. In addition, the energy is still used for heating from a large number of residential consumers which creates additional challenges in managing the energy demand during the winter.

Therefore the questions raised in this paper are: considering Kosovo climate, what building design strategies could reduce energy consumption on residential building. How and when can climate conditions be used in Kosovo to create comfor inside the building, without using energy for heating or cooling? How much energy could be saved if we apply this strategy, on the residential buildings in Kosovo?

1. INTRODUCTION

Knowing when and how the buildings are occupied, helps us to understand heating and cooling requirements. Buildings that have low level of use generate low internal heat and their cooling and heating need depends a lot on climate characteristics. In a mixed climate during the year the building will need both heating and cooling on certain periods. While in in certain periods the outside temperature changes can be used to create comphort for habitants without using mechanical cooling and heating.

Buildings with high levels of use, generate heat by itself that sometimes needs a cooling no matter how cold is outside. People give off heat themselves and also when they enter on the building they turn on different appliances and lights, which are also a source of heat. Some building have equipments that generate heat no matter if the pople are in, such as computing centers or automated factories (Source: Brown, DeKay,2001) Depending on the timing of use, different buildings gain heat on different periods. Offices, for example may experience high levels of heat in the morning and during the day. Domestic building gain heat on early afternoon and during the weekends.

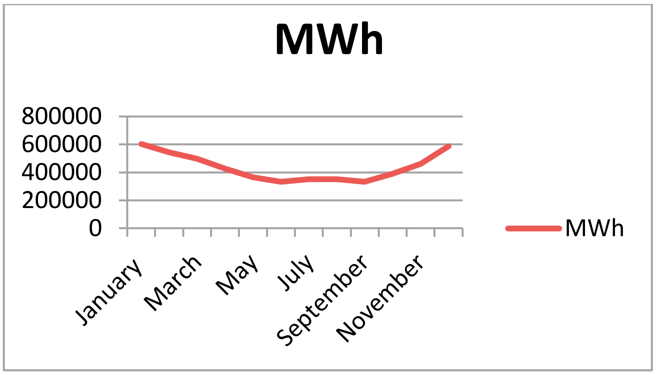
When the heat gain inside of buildings coincides with heat gain from climate, that will increase the cooling requirement, or when the building heat loss level is high when the climate is cold, that will increase the heating requirement, therefore energy supply companies will experience peak periods. Building design strategies that reduce cooling and heating loads during these peak periods, not only that reduce the building needs for energy, but helps reduce also the need for energy generating capacity and efficient usage of natural sources.

2. BUILDINGS ENERGY CONSUMPTION IN KOSOVO

Kosovo Energy Sector is facing a lot of dificulties as a result of fast growing Energy Demand and Low Production Capacities. Therefore the Energy Demand Management is one issue that mostly concerns this Sector (Source: Dugolli, 2010) The energy production in Kosovo is basen on lignjite production therefore increasing the energy production also amplifies pollution emitted on the air.

Central Heating System, is very narrow and located only on the main cities (Source: Dugolli, 2013). It hasn't been any capital investments for a long period, on the infrastructure while on the other hand cities have expanded and developed very fast. Therefore the major energy consumers in Kosovo are residential buildings and the demand for energy increases a lot during the cold periods. The energy demand for Kosovo during one year: during the January, February, November and December, the energy consumes increases almost 50% comparing to the summer months (Graphic 1). The energy consumption decreases from January to June, each month for approximately 10-15%. However, months such as April and October, are considered as transition periods from cold to warmer, when the temperatures outside are lower during the mornings and evenings, but increase enough on the midday. The energy consumed in April is higher than energy consumed on May for Approximately 25% in.

Peer review under responsibility of International Federation of Automatic Control.
10.1016/j.ifacol.2015.12.052



Graphic 1. Energy consume in Kosovo through the year

The residential consumers in Kosovo account 84% of the total number of the consumers since the industrial consumers are very few, therefore we can assume that 25 % of the total energy, is used for heating only in April.

3. KOSOVO CLIMATE

Kosovo has a central geographical position in the Balkan Peninsula. In North geographical latitude lies between 41º 50' 58'' and east geographical latitude on 20 º 01'30'' and 21 º48'02''.The climate in Kosovo can be classified as mixed climate, with cold winters and hot summers during a year, therefore for a comfort indoor climate, the buildings have to use the heating during the winter and cooling during the summer (Source: Dugolli, 2012). The warmest months in Kosovo are June, July and August, while the coldest months are January, February, March, November and December (Table 1) (Source: Tahirsylaj, 2010).

Table 1. Air temperature in Kosovo measured in Celsius (˚C),

City	Elevation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Peja	523	0.1	1.3	5.9	11.5	15.4	19.5	22.2	20.9	17.7	12.6	7.9	0.8	11.3
Prizren	436	1.4	3.1	7.8	12.9	16.8	21.1	23.7	22.8	19.3	14	9.3	2.5	12.9
Mitrovica	521	-0.7	0.5	5.3	10.5	14.9	18.9	21.5	20.3	16.8	11.9	7.2	0.5	10.6
Prishtina	630	-0.9	0.1	4.8	10.5	14.9	19.1	21.1	20	16.3	11.8	7.1	0.3	10.4

4. HEAT FLOW ON RESIDENTIAL BUILDINGS

In order to plan the adequate bioclimatic techniques for using the climate conditions, on residential buildings, we analysed the energy flow inside and outside one residential buildings as an example.

4.1 Month Selection

The characteristics of the climate, buildings form, and buildings usage can be used to develop daily heating and cooling patterns that presents building performance (Source: Brown, DeKay, 2001). In this paper we analysed the performance of the building in two months, we compared the graphs and considered the posibilities to apply a bioclimatic strategies so we can reach the comphor inside the building only by using the climatic conditions, characteristic for Kosovo. We have selected March and April, as transition months from cold to warm period, so we can identify which month we could use pasive heating techniques without using mechanical tools.

4.2 Assumed building form

We will consider the rectangular shape 10 x 12 m that represents our building. The purpose of this analyse is to inform the design, not the evaluation after the building is constructed. We will consider the longer axis to be south – east and asuming that 20% of the area is glazing.

4.3 Building Internal Heat Gain

Buildings can gain heat from the people, lights, equipments and sun. The metabolic energy of people can contribute on the amount of heat generated on the building (Source: Utzinger, Wasley, 1997). This type of heat generated from people depends on activity, age and other factors. The building heat gain rate due to people is a function of both: the heat generation rate per person and the density of people in the building. On residential building we asume that there are in average 4 occupants, therefore we calculate 4 persons / 120 m^2. A sensible heat gain for a moderate activity from is 250 Btu/hr (73W). This indicates that heat gain from people in a house is 1.3 Btu/hr,m^2 (W/m^2) (Source: Brown, DeKay, 2001) The visual task on residential buildings is asumed to be of medium contrast of small size therefore average efficiency full-size fluorscent lights produces approximately 2 Btu/h,m^2 (W/m^2). All of electric energy that goes into equipment ends up as waste heat in the space. The heat gain from the equipments for residential buildings, is estimated to be in average 2 Btu/h,m^2 (W/m^2), (Source ASHRAE, 1997) Therefore, when the above heat gains are applied on the formula we can calculate that buidings Internal heat gain from people, lights and equipment are Q_{IHG}= 5.3 Btu/h,m^2 (W/m^2),