

External temperatures BIN intervals evaluation procedure proposal

Propunerea procedurii de evaluare a intervalelor BIN temperaturi exterioare

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Abstract. *The external temperatures BINs are a couple of components, the external air temperature, t_e , representative of a relatively small range of values and the duration of appearance of these external temperature values within each month of a year. The establishment of these couples assumed an analysis of the behavior of the outside temperature throughout the whole year but also during each month of the year and also of daily oscillations within each month. It resulted as a representative number of 5 BINs per month and in this hypothesis the monthly BINs were established. It turned out that the locality in Romania has a distinct importance in the effective establishment of the BINs, which is why they are different depending on: locality, month of the year, average monthly outdoor temperature and the amplitude of the daily oscillation of the outdoor temperature. The external temperature BINs are useful in energy analysis studies on buildings for utilities such as space heating and the preparation of daily hot water, an example being the implementation of an air-water or air-air heat pumps.*

Key-words: *external temperature BIN, energy analysis studies*

1. Introduction

The establishment of BINs of outdoor air temperatures represents a sorting of outdoor air temperatures depending on their values and the duration of their occurrence. The BIN is therefore a two elements component - the value of the external temperature and the duration of its occurrence. The outside temperature we are referring to is an average value within a range of several degrees. The BINs are established separately for each month of the year, thus resulting in a detailed identification of the cold and warm periods within each month of the year. An

important utility of this type of sorting can be in the case of evaluating the energy performances of the heating systems of buildings and the preparation of hot water related to them. The use of non-conventional heating and hot water preparation systems that include air-water or air-air heat pumps was also considered.

2. Procedure description

It should be mentioned from the beginning that the establishment of the BINs is based on 3 data strings, namely the number of days in each month, n_{zl} , the monthly average outdoor temperatures, t_{em} , and the monthly average amplitudes of the diurnal oscillation of the outdoor temperature, a_{te} . Based on these 3 types of data, the outside temperature field is evaluated for each month of the year, establishing the weight of high, medium and low temperatures. More precisely, the monthly outdoor temperature field was divided into 5 zones: the area of extreme high outdoor temperatures, the area of moderate high outdoor temperatures, the area of monthly average outdoor temperatures, the area of moderately low outdoor temperatures and the area of extremely low outdoor temperatures. More, the difference between the maximum external temperature of the month and the minimum outdoor temperature of the month was divided into 5 equal intervals. For each of these 5 intervals of the monthly outdoor temperature fields, the average representative value of t_{emz} and the duration in hours related to the respective zone, n_{hz} , were established. In this way, each of the months of the year contains 5 BINs (pairs of values: (t_{emz}, n_{hz})). The sum of the number of hours within the 5 monthly BINs is equal to the number of hours related to the respective month. The zonal average outdoor temperatures within a month, considered with the weight corresponding to the number of zonal hours, led by summation to the monthly monthly average outdoor temperature, t_{emp} . Given that two of the monthly data series: the monthly average outdoor temperatures, t_{em} and the monthly average amplitudes of the diurnal oscillation of the outdoor temperatures, a_{te} , are different from locality to locality, the set of annual BINs also differs being locally dependent. These being the principles of establishing the monthly BINs, an automatic calculation program that evaluates the 60 annual BINs for 3-5 representative cities in Romania, such as, for example: Resita, Slatina, Zalau, Bistrita and Sfantu Gheorghe.

3. Software tool:

The table of BINs presented in fig. 1 below, refers to the city of Sfantu Gheorghe and, as can be seen, contains a first group of 4 columns, the first of which are the names of the months and the last 3 on the right, Entry Data, referring to the number of monthly days, N_{zile} , at the average monthly external temperature, t_{em} , and at the average amplitudes of daily external temperatures, a_{te} . Using the evaluation tool requires selecting the locality from the list of localities accessible from the cell to the right of the Location cell. The series of monthly average outdoor temperatures, t_{em} ,

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and the average amplitude of the diurnal outdoor temperature oscillation are automatically loaded.

Sfantu Gheorghe Z5				Rezultate - BIN-uri (cupluri - temperatura exterioara- durata, - teB-NoreB)									
Input Data				BIN 1		BIN 2		BIN 3		BIN 4		BIN 5	
Month	Nzile	tem	amp	teB1	NoreB1	teB2	NoreB2	teB3	NoreB3	teB4	NoreB4	teB5	NoreB5
Jan	31	-0.27	3.48	-3.3749	59.52	-1.82084	178.56	-0.26677	267.84	1.287288	178.56	2.84135	59.52
Feb	28	-0.86	4.80	-5.90219	53.76	-3.37923	161.28	-0.85628	241.92	1.666674	161.28	4.189628	53.76
Mar	31	4.57	6.32	-2.18146	59.52	1.195434	178.56	4.572325	267.84	7.949217	178.56	11.32611	59.52
Apr	30	7.64	5.93	1.244291	57.6	4.440722	172.8	7.637153	259.2	10.83358	172.8	14.03001	57.6
May	31	12.80	6.57	6.048251	59.52	9.423776	178.56	12.7993	267.84	16.17483	178.56	19.55035	59.52
Jun	30	15.13	6.37	8.95511	57.6	12.04021	172.8	15.12531	259.2	18.2104	172.8	21.2955	57.6
Jul	31	18.16	6.12	12.4762	59.52	15.3179	178.56	18.15961	267.84	21.00132	178.56	23.84302	59.52
Aug	31	17.27	6.56	10.96796	59.52	14.12079	178.56	17.27362	267.84	20.42644	178.56	23.57927	59.52
Sept	30	12.87	5.69	6.522825	57.6	9.69644	172.8	12.87006	259.2	16.04367	172.8	19.21729	57.6
Oct	31	8.28	5.76	1.851914	59.52	5.065688	178.56	8.279462	267.84	11.49324	178.56	14.70701	59.52
Nov	30	3.77	5.00	-2.15068	57.6	0.808237	172.8	3.767153	259.2	6.726069	172.8	9.684984	57.6
Dec	31	-1.30	3.25	-5.12138	59.52	-3.21254	178.56	-1.3037	267.84	0.605145	178.56	2.513987	59.52
Montg	Nzile	tem	amp	teB1	NoreB1	teB2	NoreB2	teB3	NoreB3	teB4	NoreB4	teB5	NoreB5

Fig.1

The following 10 columns refer to the resulting BINs and for each month separately, on the corresponding line of the month, the values of the 5 BINs composed of (teB1, NoreB1)...(teB5, NoreB5) are observed. Fig. 2 presents an annual global picture of the outdoor temperature values related to the BINs for each month of the year. You can see the high values of the group of 5 external temperatures of the BINs in the summer months and the low values of the winter months, and also within each month the differences between the external temperatures of the 5 BINs.

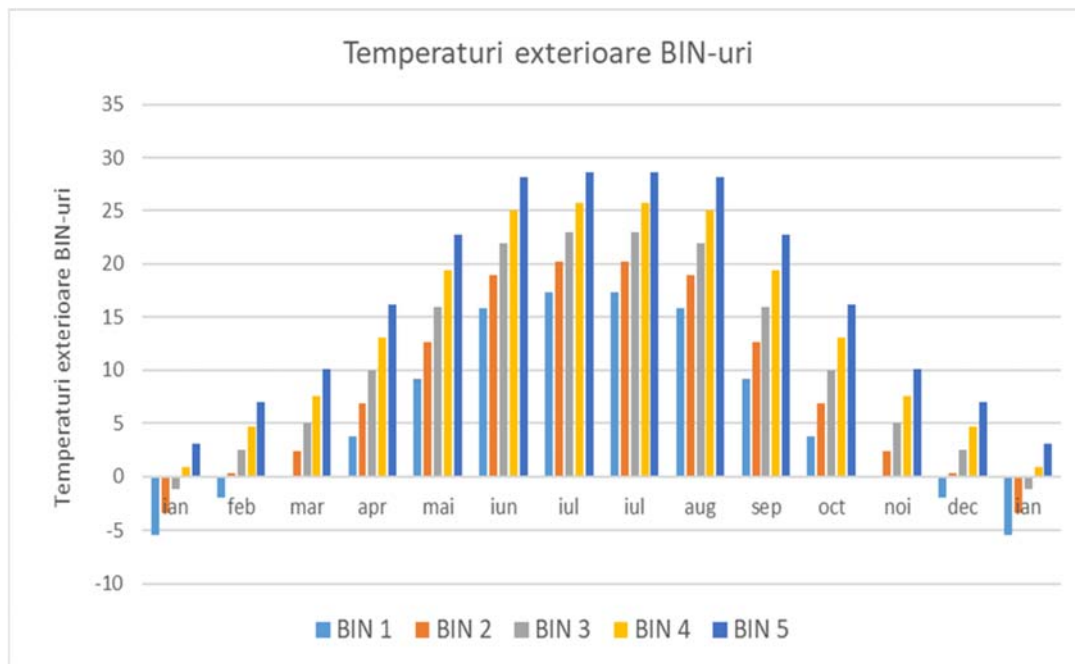


Fig. 2

In fig. 3 graphically shows the number of hours related to the 60 BINs in a year. It is observed that the number of hours related to extreme monthly BINs is approx. 50 hours, the number of hours related to moderate BINs approx. 180 hours, and the number of hours related to median BINs approx. 260 hours, which means a total of approx. 720 hours per month.

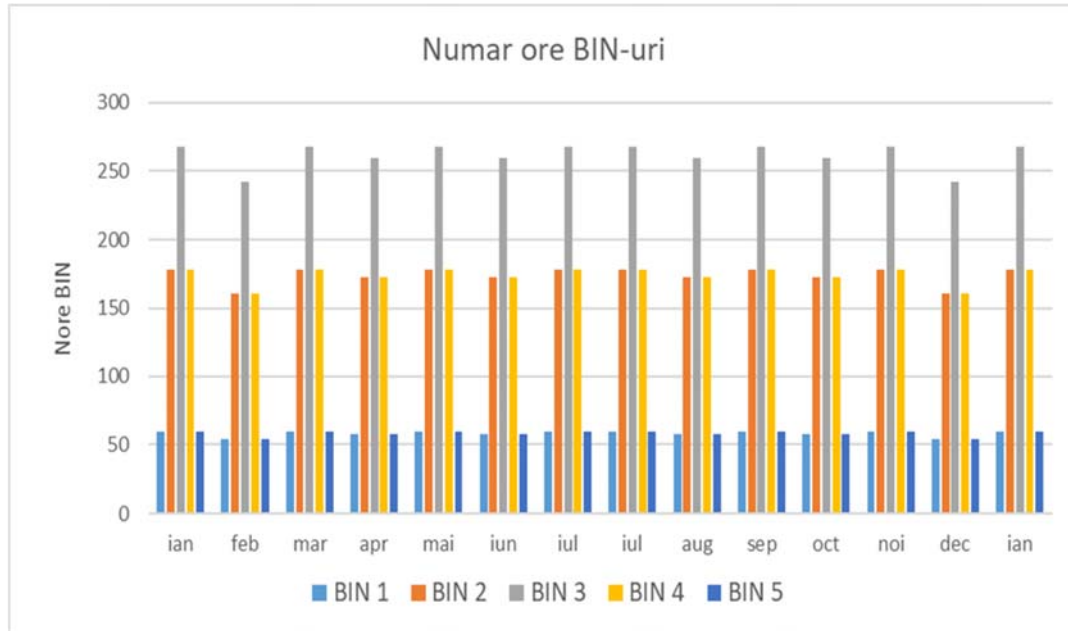


Fig.3

4. Discussions

The tool described in the work, contains only 5 representative cities from Romania: Resita, Slatina, Zalau, Bistrita and Sfantu Gheorghe. The average monthly outdoor temperatures can be extracted from SR 4838/2014 for a number of over 200 localities in Romania. Regarding the values of the amplitudes of the diurnal external temperature oscillations, a corresponding processing of a database that the authors own was undertaken. The external temperature BINs are useful in several types of works aimed at the energetics of buildings for several types of utilities. The integration of heat pumps in the non-conventional source system represents only one of the possible uses of BINs for outdoor temperatures.

Referance

1. Revised Mc001 - Methodology for energy certification of buildings from 2022;
2. The standard of degree days - SR 4839 from 2014