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How to Exploit the Heat Pump Soil-Water to Heat a Building?

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***Abstract* – We live energy crises and we need to find solutions to assure the heat in residential buildings. An option is to use the heat pump soil-water. We intend to make an analysis about the efficience of heat pump soil- water in climatic conditions of Brasov for winter month january 2022. The plant system was design in University Transivania of Brasov.The system work efficient when when external temperature is between 0 and 10 °C.**

Keywords – buildings, energy, heat-pump, soil water

1. INTRODUCTION

The thermal comfort in ours homes totay would not have existed without the exploitation of various energy sources. Today, the main concer is starting to turn the environment, and classical sources such as fossil fuels are exhaustible and .have a negative impact on the environment. Green energy becomes the energy of the future. Generated from natural resources, green energy does not harm the environment and contributes to improving people"s quality of life. The systems types we analized are ground source heat pumps (GSHP). GSHP systems can be installed to serve almost any building type, but there are differences between the residential and social buildings application of the technology. [1]. The GSHPs are proven renewable energy technology for space heating and cooling. This paper provides a technical design solution to a GSHP system, according with new technologycal development. GSHPs are proven renewable energy technology for space heating and cooling. A short analysis of operating the GSHP systems with their operational limits is presented below. The GSHP technology as we design it assure the comfort parameters in cold and hot weather time and the energy saving potential is significant as well [2].

Climatic conditions are important when we choose a GSHP system. The performance of a GSHP system, more precisely the cefficient of performance varies between 3 and 5. There are areas where the climate is milder, in this case the performance coefficient is high and the comfort parameters are stable [3]. The soil represents an inexhaustible source of energy in the conditions where heat extraction is controlled. For the horizontal ground heat exchanger or ground drilling hole, the thermal response depends by the structure and thermal conductivity of soil. Many studyes presently existing are reviewed counting the heat transfer progressions inside and outside the holes [4], [5].

Along to the GSHP system the GWHP (ground water heat pump) system offers high performance due to the constat temperature to the ground water. The performance evaluation of GSHP system as well to the GWHP system using the energy and exergy analysis method helps to identify the components where inefficiencies occur [6].The best rezults are obtain based on masurements in situ.

In our projet, design in University Transivania of Brasov, we present a system GSHP operating to heat a building with three levels with a with a heat system by radiation. We will detailed the thermo-mechanical schema and we demonstrate that our system assure the heat of the building when external temperature is between 0 and 10 °C.

2. EXPERIMENT DESCRIPTION

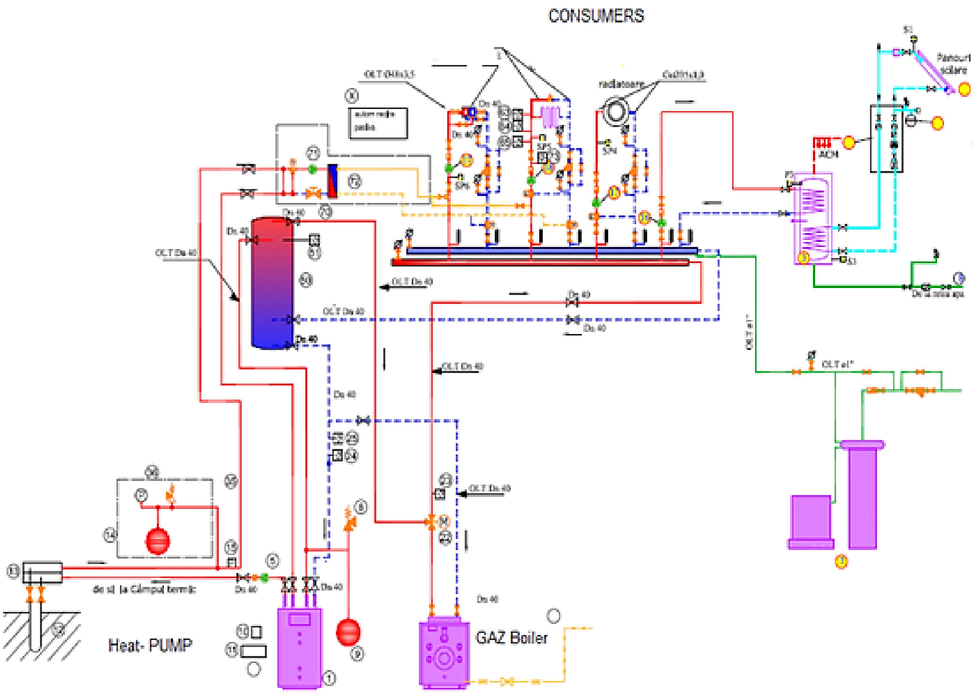

Fig.1 The thermo-mechanical schema of GSHP

In the above image we present the termo-mechanical schema of plant system using the energy from the soil. The heat pump soil – water operate with a gas boiler as a background source to assure the heat of a building.

The necessary heat load for our building in different external temperature according with SE EN 1907 (Romanien standard “The calculs of heat load for heating “) is presented in the Table 1.

The heat pump GSHP used, for heat the analyzed building, is Vitocal 300, 21.2 kW. The pump efficiency and the building”s heat consumption/requirement depend by change of outside temperature. The energy requirement provided by the pump for the month of January 2022 is shown below by applying the method of temperature intervals (bin method). The method establishes the hourly frequency of temperatures during the month of January 2022 by summing the hours characterized by a certain temperature interval. Table 4 show the application of the bin method and the calculation of the resulting energy requirement [7].

Table 1 Heat load variation with external temperature

External temperature	Heat Load	External temperature	Heat Load
-22	35.556	0	18.110
-20	34.715	2	16.404
-18	33.464	4	14.698
-16	31.348	6	12.992
-14	29.665	8	11.286
-12	27.982	10	9.580
-10	26.289	12	7.874
-8	24.615	14	6.168
-6	23.228	16	4.462
-4	21.522	18	2.756
-2	19.816		

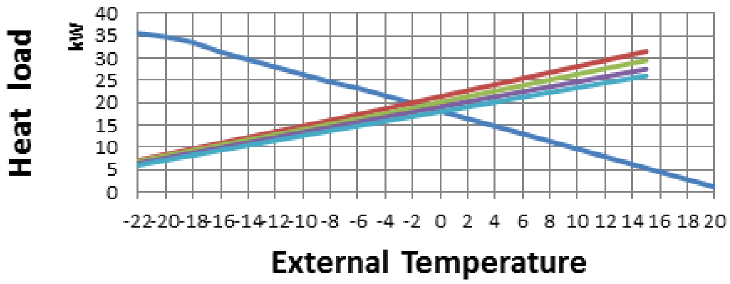

Fig 2 Heat load of Heat pump at different temperature of termal agent for heating at 35 °C, 45 °C, 55 °C and 65 °C (red, green, blue) and the heat load of building (blue)

Table 2 External temperature for January 2022(day / night, internet source)

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D	L	M	M	J	V	S
26	27	28	29	30	31	1
7° -1°	0° -1°	0° -1°	0° -2°	3° -1°	6° 1°	13° 3°
2	3	4	5	6	7	8
10° 0°	12° 2°	13° 2°	15° 3°	16° 1°	6° 2°	4° 0°
9	10	11	12	13	14	15
6° 3°	5° 1°	1° -2°	-1° -7°	0° -7°	6° -4°	9° -5°
16	17	18	19	20	21	22
6° -7°	9° -2°	6° -1°	5° -6°	9° -3°	6° -3°	4° -6°
23	24	25	26	27	28	29
1° -6°	1° -7°	2° -8°	2° -6°	8° -4°	10° -2°	8° -3°

Table 3 Bin method to calculate de energy consumption

Interval temperature ^{0}C	Temperature ^{0}C	Hours	Interval temperature ^{0}C	Temperature ^{0}C	Hours
-9/-7	-8	8	1/3	2	24
-7/-5	-6	24	2/4	3	24
-8/-6	-7	21	3/5	4	16
-5/-3	-4	16	5/7	6	40
-4/-2	-3	24	7/9	8	16
-3/-1	-2	24	8/10	9	24
-2/0	-1	16	9/11	10	8
-1/1	0	16	11/13	12	8
1/3	1	40	15/17	16	8

3. RESULTS AND SIGNIFICANCES

Table 4 The performances of Heat pump Vitocal 300

Temperature	Hours	q_{bin}[w]	q_{bin}[kw]	Capaciatea integrata Integral Capacity	x	FACC	Capaciate ajustata	Putere absorbita Power	Cop stand	Cop real	Fractiune a de timp	Caldura furnizat a [kWh] Heat produce	Consumul de energie electrica corespunzator caldurii furnizate Energy consumption	Sarcina de incalzire a cladirii [kWh] Heat load of building	Necesarul de caldura suplimentar a [kWh] Additional thermal load
0	16	7191,60	7,19	-6,00	-1,19860	0,450350	-2,70	2,492	-2,41	-1,08	-2,661486	115,07	-106,12	115,07	0,00
1	40	6801,60	6,80	13,00	0,52320	0,880800	11,45	2,485	5,23	4,61	0,594005	272,06	59,04	272,06	0,00
2	24	6411,60	6,41	12,70	0,50485	0,876213	11,13	2,477	5,13	4,49	0,576173	153,88	34,25	153,88	0,00
3	24	6021,60	6,02	12,40	0,48561	0,871403	10,81	2,470	5,02	4,37	0,557277	144,52	33,04	144,52	0,00
4	16	5631,60	5,63	12,10	0,46542	0,866355	10,48	2,462	4,91	4,26	0,537218	90,11	21,16	90,11	0,00
6	40	4851,60	4,85	11,56	0,41969	0,854922	9,88	2,455	4,71	4,03	0,490909	194,06	48,21	194,06	0,00
8	16	4071,60	4,07	10,86	0,37492	0,843729	9,16	2,448	4,44	3,74	0,444357	65,15	17,40	65,15	0,00
9	24	3681,60	3,68	9,92	0,37113	0,842782	8,36	2,440	4,07	3,43	0,440362	88,36	25,79	88,36	0,00
10	8	3291,60	3,29	9,00	0,36573	0,841433	7,57	2,433	3,70	3,11	0,434655	26,33	8,46	26,33	0,00
12	8	2511,60	2,51	8,48	0,29618	0,824045	6,99	2,425	3,50	2,88	0,359421	20,09	6,97	20,09	0,00
16	8	951,60	0,95	7,97	1,00000	1,000000	7,97	2,418	3,30	3,30	1,000000	63,76	19,34	7,61	-56,15
0	0	7191,60	7,19	7,46	1,00000	1,000000	7,46	2,411	3,09	3,09	1,000000	0,00	0,00	0,00	0,00
0,00	0	7191,60	7,19	6,95	1,00000	1,000000	6,95	2,402	2,89	2,89	1,000000	0,00	0,00	0,00	0,00

4. CONCLUSIONS

The conclusions about how we exploit a heat pump GSHP are:

1. The heat pump cover the necessary heat load of a building when the external temperature are between 0 and 10^{0}C (Figure 2).
2. The heat pump operating in January 2022 according with the variation of external temperature (Table 3) can assure the necessary heat load of building -1233.39 kWh > 1127,24 kWh according with Table 4 column 13 and 15.

5. References

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