International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 09 Issue 11 ǁ 2021 ǁ PP. 41-46

Heating Solution

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Abstract
Abstract Low-temperature heating provides an efficient way of heating our buildings. to get a high efficiency it's important that the heating systems within the buildings are operated with both low supply and return temperatures. This study taken off to analyse how typical assumptions within the modelling of warmth emissions from existing hydraulic radiant affects the heating plant return temperatures calculated in an exceedingly building simulation model. An existing single-family house with hydraulic radiant was modelled within the simulation program LOOPCAD 2019. Simulations were performed with various levels of detail and also the calculated indoor temperature and water return temperatures were compared to temperatures measured within the case house. The results showed that the detail of the simulation model incorporates a large influence on the results obtained. The estimated return temperatures from the radiant varied by up to 16-25 °C looking on the assumptions made within the simulation model. The results indicated that an in-depth building simulation model can provide a decent estimate of the particular heating plant operation, on condition that actual radiant and realistic indoor temperatures are taken into consideration within the model.

Keywords: *Efficiency, Heating system, Supply and return temperature, Modelling, Simulation, Indoor temperature, Loopcad 2019*

Date of Submission: 08-11-2021 Date of acceptance: 24-11-2021

I. INTRODUCTION

Over 25% of the ultimate energy consumption within the globe is attributed to households. The households are thereby the arena with the second largest final energy consumption within the globe, which makes the world a central focus area for energy consumption reductions. a method of reducing the energy consumption of households in cold climates is to boost the efficiency of the heating systems. Low-temperature heating provides one promising solution to how this could be done. By reducing the heat temperatures, it's possible to extend the efficiency of warmth production from heating solution. Furthermore, the warmth loss from the distribution systems inside both new and existing buildings is reduced. the very best heating efficiencies are obtained when both supply and return temperatures are as low as possible. Recent research has therefore described the advantages of using heating plant supply and return temperatures as low as 50° C / 20° C. However, while the provision temperature is usually controlled in line with a weather compensation curve, the return temperature is extremely passionate about the planning and operation of the heating plant. This study therefore embarked on to check methods for evaluation of the chance to get a coffee return temperature in heating systems with supply temperatures of 55° C or lower This project, comparative study of building having different floors, walls and circuits. during this work, it'll study the behaviour of building with different combinations of the wall and floors with regard to circuits. The analysis of the building with insulation floors, walls and circuits and having different combinations is meted out by the warmth load. the entire modelling and analysis are done by using LOOPCAD 2019.

1.1 Materials and methods

1.1.1 Materials

The materials used in the constructions of various models. The materials used for floors are as follows- Concrete Thin Slab, Gypsum Thin Slab, Heat Transfer Plate; Circuits are as follows- Counterflow, Serpentine, Modulated Spiral; Walls are as follows- Frame Wall or Partition Wall, Foam Concrete Matrix, Block Wall.

1.1.2 Floors

- Concrete Thin Slab- A concrete slab could be a common structural element of contemporary buildings, consisting of a flat, surface product of cast concrete. Steel-reinforced slabs, typically between 100 and 500 mm thick, are most frequently accustomed construct floors and ceilings. In many domestic and industrial buildings, a thick concrete slab supported on foundations or directly on the subsoil, is employed to construct the bottom floor. These slabs are generally classified as ground-bearing or suspended. A slab is ground-bearing if it rests directly on the muse, otherwise the slab is suspended. For multi-story buildings, there are several common slab designs. Beam and block, also said as rib and block, is usually utilized in residential and industrial applications. This slab type is formed from pre-stressed beams and hollow blocks and are temporarily propped until set, typically after 21 days. Standard weight of concrete thin slabs adds about 8.6 kg per sq ft (at 1.5” thickness).

- Gypsum Thin Slab-There are several methods of putting in hydronic radiant heat systems over a traditional wood-framed floor. one in every of the foremost common is termed a skinny slab system. Thin slabs contains either a specially formulated concrete or poured gypsum underlayment. Both forms of slabs have installation requirements that has got to be carefully coordinated with the building design process. One requirement that has got to be accommodated is that thin-slabs typically add 1.25 to 1.5 inches to the ground height. Another issue that has got to be addressed is that the added weight of the thin-slab. Poured gypsum thin-slabs typically add 5.8 to 6.8 kg per square measure to the “dead loading” of a floor structure
- Heat Transfer Plate- Heat Transfer Plates are employed in so called “staple up systems” where the ground is warmed by placing heating tubes underneath the ground. Aluminium material wraps round the heating tube then spreads out and attaches to the underside of the heated floor. the aim of warming system are going to be to form heat within the sort of warm water (in an efficient manner) then transfer that heat. Some process must take that heat aloof from the tubing and apply it to the underside of the ground in order that the ground can heat the world above. Aluminium may be a material that transfers heat exceptionally well but it's expensive, and its use should be carefully balanced against other methods of doing the identical thing, and its application should be optimized for performance and value effectiveness.

1.1.3 Walls

Table 1: R-value and U-Value of respective walls

Walls	R-VALUE (F° · sq. Ft. · hr/Btu)	U-VALUE (W/m2K)
Frame wall or Partition wall (Fiberglass)	2.59	0.386
Foam Concrete Matrix	5.18	0.193
Block Wall	0.3	3.316

1.1.4 Circuits

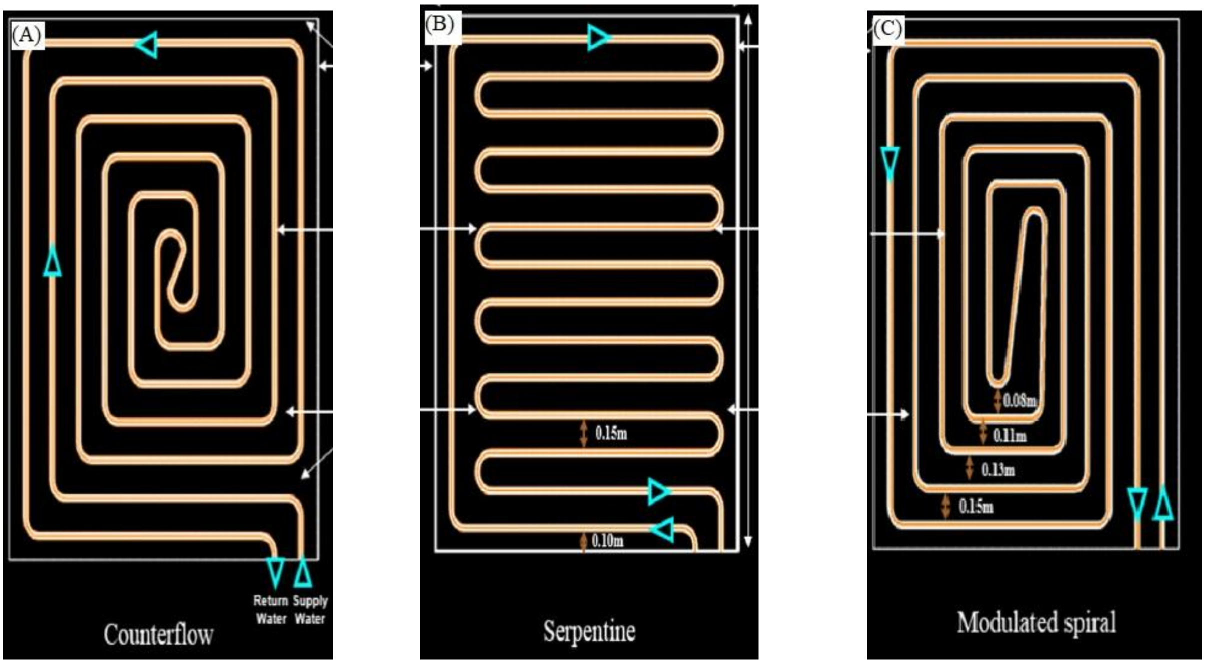

Figure 1 (A) Counterflow (B) Serpentine (C) Modulated spiral

1.1.4 TEST METHOD

Firstly, the location of manifolds in ground floor and first floor are explained briefly, besides this the analysis of all the 27 models which has been divided into 3 cases taking circuits in reference explanatory tables have been made all the models which tells is about the head loss, flow rate and load for all the manifolds; which is used to analyze all the models and bring out the most efficient models among the all-in terms of load.

Distribution Manifolds: the situation of the distribution manifold is vital. Long runs between the manifolds and also the radiant panels can reduce the number of tubing available for the radiant panel and increase the pump capacity requirements. Poor accessibility to the manifold can complicate the installation and servicing of the system. Complicated distribution piping can add cost and complexity to the system. the subsequent criterion should be considered when selecting a manifold location. It should be in a very position that permits the runs to be made to the individual zones without excess leader lengths. Normally, it's best to locate the manifold on an enclosed wall where the tubing are often routed from each side of the wall to the manifold. It should be mounted high enough to allow easy connections from below, particularly in concrete or poured floor underlayment applications where the tubing is embedded and a not easily be moved while connecting or reconnecting the fittings.

The study is being performed using LOOPCAD 2019 in three circuit types, and the results will be compared by using three different cases i.e.; case 1, case 2, case 3. The cases are made in combinations with three different walls and floors including the three circuits types.

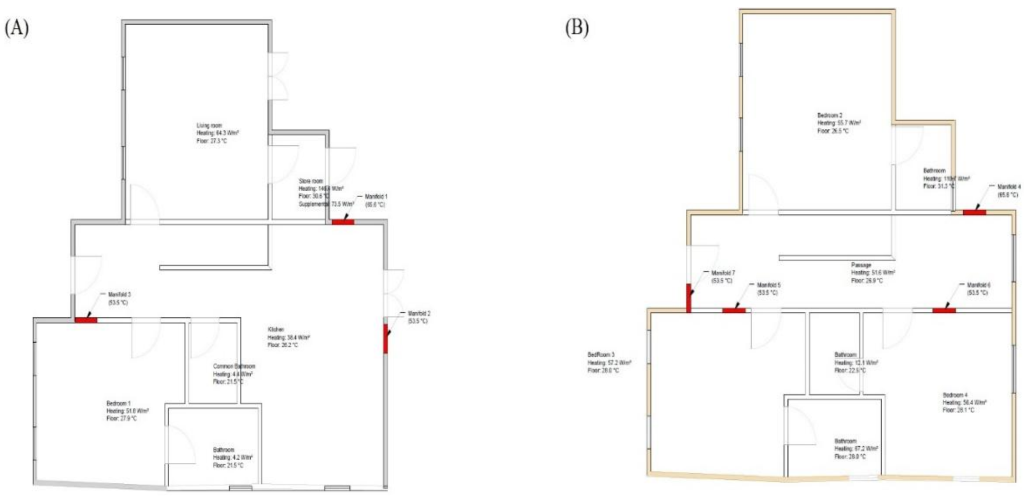

Figure 2 Manifold location (A) Ground floor (B) First floor

Table 2 Combination used in models for case 1

Model	Circuit	Floor	Wall
Model 1	Counterflow	Concrete Thin Slab	Frame Wall or Partition Wall
Model 2	Counterflow	Concrete Thin Slab	Foam Concrete Matrix
Model 3	Counterflow	Concrete Thin Slab	Block Wall
Model 4	Counterflow	Gypsum Thin Slab	Frame Wall or Partition Wall
Model 5	Counterflow	Gypsum Thin Slab	Foam Concrete Matrix
Model 6	Counterflow	Gypsum Thin Slab	Block Wall
Model 7	Counterflow	Heat Transfer Plate	Frame Wall or Partition Wall
Model 8	Counterflow	Heat Transfer Plate	Foam Concrete Matrix
Model 9	Counterflow	Heat Transfer Plate	Block Wall

Table 3 Combination used in models for case 2

Model	Circuit	Floor	Wall
Model 10	Serpentine	Concrete Thin Slab	Frame Wall or Partition Wall
Model 11	Serpentine	Concrete Thin Slab	Foam Concrete Matrix
Model 12	Serpentine	Concrete Thin Slab	Block Wall
Model 13	Serpentine	Gypsum Thin Slab	Frame Wall or Partition Wall
Model 14	Serpentine	Gypsum Thin Slab	Foam Concrete Matrix
Model 15	Serpentine	Gypsum Thin Slab	Block Wall
Model 16	Serpentine	Heat Transfer Plate	Frame Wall or Partition Wall
Model 17	Serpentine	Heat Transfer Plate	Foam Concrete Matrix
Model 18	Serpentine	Heat Transfer Plate	Block Wall

Table 4 Combination used in models for case 3

Model	Circuit	Floor	Wall
Model 19	Modulated Spiral	Concrete Thin Slab	Frame Wall or Partition Wall
Model 20	Modulated Spiral	Concrete Thin Slab	Foam Concrete Matrix
Model 21	Modulated Spiral	Concrete Thin Slab	Block Wall
Model 22	Modulated Spiral	Gypsum Thin Slab	Frame Wall or Partition Wall
Model 23	Modulated Spiral	Gypsum Thin Slab	Foam Concrete Matrix
Model 24	Modulated Spiral	Gypsum Thin Slab	Block Wall

Model 25	Modulated Spiral	Heat Transfer Plate	Frame Wall or Partition Wall
Model 26	Modulated Spiral	Heat Transfer Plate	Foam Concrete Matrix
Model 27	Modulated Spiral	Heat Transfer Plate	Block Wall

II. RESULT AND DISCUSSION

The heating solution, water temperature, total fluid volume, head loss and load comparison of findings for case 1, case 2 and case 3 are accomplished in this chapter by assessing various scenarios with different walls, floors and circuits.

The comparison of different models in case 1 is done by loopcad 2019 software is shown in Table 5, Table 6 and Table 7

The G+1 structure is carried out in three circuits types i.e.; Circuit 1, circuit 2 and circuit 3 by using LOOPCAD 2019 software. Comparative study of building wall having different size of the opening and it will also compare the behavior of building with different walls and floor insulations. In this work, it will study the behavior of building with different size and thickness of the wall. Building without insulation wall and floor and building with an insulation walls and floors will have a different condition.

Table 5 Head loss and load comparison in case 1

Model	Head Loss	Load(W)
Model 1	14.6	8262
Model 2	15.1	7456
Model 3	34.3	10662
Model 4	17.6	8262
Model 5	15.1	7456
Model 6	31.3	10398
Model 7	17.4	8562
Model 8	14.7	7456
Model 9	32.8	10753

Table 6 Head loss and load comparison in case 2

Model	Head Loss	Load(W)
Model 10	17.9	8369
Model 11	15.4	7563
Model 12	45.7	13621
Model 13	17.9	7188
Model 14	15.4	6382
Model 15	37.4	12252
Model 16	17.8	8369
Model 17	15.2	7563
Model 18	16.1	9563

Table 7 Head loss and load comparison in case 3

Model	Head Loss	Load(W)
Model 19	24.3	7308
Model 20	21.3	7551
Model 21	28.3	13396
Model 22	26.9	9002
Model 23	19.03	6713
Model 24	21.2	9563
Model 25	23.1	8163
Model 26	21	10662
Model 27	45.7	13621

2.1 Discussion of different models in case 1

Since we can conclude from the table 1, about the R-value & U-value of the walls. Greater the R-value greater will be the insulating power. Above result, we get the same temperature at same environment condition and same energy production but as we can see that the load generated is minimum in this case 1 so we can take model (8) as most efficient as it is producing very minimum load as compared to others.

2.2 Discussion of different models in case 2

Since we can conclude from the table 1, about the R-value & U-value of the walls. Greater the R-value greater will be the insulating power. Above result, we get the same temperature at same environment condition and same energy production but as we can see that the load generated is minimum in this case 2 so we can take model (14) as most efficient as it is producing very minimum load as compared to others and has also very less head loss among all. Since lesser the head loss greater will be the efficiency of the fluid system, here we can conclude that the model with minimum load have less head loss.

2.3 Discussion of different models in case 3

Since we can conclude from the table 1, about the R-value & U-value of the walls. Greater the R-value greater will be the insulating power. Above result, we get the same temperature at same environment condition and same energy production but as we can see that the load generated is minimum in this case 2 so we can take model (14) as most efficient as it is producing very minimum load as compared to others and has also very less head loss among all. Since lesser the head loss greater will be the efficiency of the fluid system, here we can conclude that the model with minimum load have less head loss.

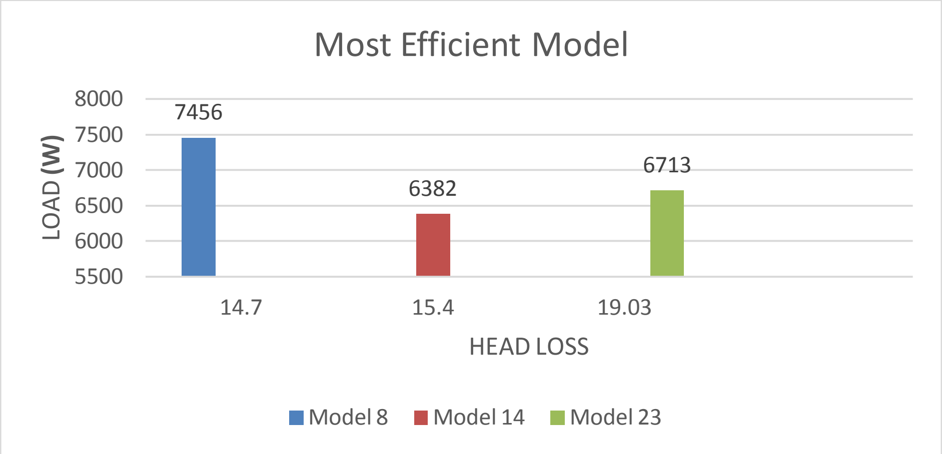

Figure 3 Load on Most Efficient Model

III. CONCLUSION

1. By performing the various tests for heating solutions using LOOPCAD 2019 software, the various different combinations were aligned through three different types of walls, floors and circuits i.e., walls- Frame wall or Partition wall, Foam Concrete Matrix and Block wall; floors- Concrete thin Slab, Gypsum Thin Slab and Heat Transfer Plate; circuit- Counterflow, Serpentine and Modulated Spiral respectively. Considering 3 cases comprising of 9 models each.
2. In this analysis the loads were calculated, keeping the indoor temperature constant at 21°C among all the 27 models
3. The efficient structures in terms of load are the Model no. 8, (wall- Foam Concrete Matrix, floor- Heat Transfer Plate and circuit- Counterflow). Model no.14 (wall- Foam Concrete Matrix, floor- Gypsum Thin Slab and circuit- Serpentine). and Model no. 23 (wall- Foam Concrete Matrix Wall, floor- Gypsum Thin Slab and circuit- Modulated Spiral).
4. From the result we got the most efficient model among all the above mentioned three models model no. 14 with load being the minimum i.e., 6382 W with Head loss of 15.4 m/s^2 is considered to be the most efficient among all the others.

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