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Design and Temperature analysis of Flow Honey Hive

Udaya Kumar K R[1] , Dr. K Gopalakrishnan[2]

[1]*M. Tech Scholar, Dept.of Mechanical Engineering, NHCE, Bangalore,*
[2]*Professor and Dean-R & D, Dept.of Mechanical Engineering, NHCE, Bangalore,*

Abstract— Bees have been around for millions of years and human have always had a taste for honey. There's a theory the calorie-dense super food even had a part to play in the evolution of the human brain. But in recent years, our relationship with bees has become fraught. Our impact on the planet has led to a decline in bee populations, with potentially dire consequences for all plants and animals on Earth, including humans. If you're new to the hobby, you'll find, as many do, that it quickly becomes addictive. Aside from the honey, keeping your own hive will also assist your other gardening efforts, as the pollination service bees provide will increase the abundance of your fruit and nut trees, and most plants you have in the garden. Bees are a vital part of our food supply chain and the broader ecosystem. The more bees we have, the better off we are. In the summer the temperature has been moved to 40˚C Which the bees cannot be alive so they fan themselves and reduce the temperature inside the brood box due to this there is an reduce in the efficiency of the bees so we use insulating material to reduce the temperature inside the bees brood box. The insulating material is been used as a sandwich panel and magnesium oxide board which is been used in pharmaceutical industry to keep the room cool this panels are been used and temperature drop is been measured and temperature distribution will been done by use of Ansys workbench 14.5.

Keywords—Honey Bee, Calorie-dense, Insulating Material, Sandwich panel, Magnesium oxide, Ansys 14.5.

I. INTRODUCTION

In the Honey hive the Brood nest temperature is of extreme importance to the colony and is controlled with utmost precision. Honey bees maintain the temperature of the brood nest between 32°C and optimally 35°C so that the brood develops normally. When the temperature in the nest is too high the bees ventilate by fanning the hot air out of the nest or use evaporative cooling mechanisms. When the temperature is too low bees generate metabolic heat by contracting and relaxing their flight muscles (having uncoupled the wings from them). The resulting vibration generates heat in those muscles. Many insects heat up their flight muscles before taking off, but bees have exploited this function to thermo regulate their environment[1].So we use insulating materials to reduce the temperature inside the flow honey hive, the insulating material used is sandwich panels and Magnesium oxide board is used. The design of the insulating material is been modelled and Thermal analysis is do

II. PROBLEM STATEMENT

- Honeybee sustain temperature from 10°c to 35°c
- In summer temperature rises to 40°c
- The bees ventilate by fanning the hot air out of the nest or use evaporative cooling mechanisms because of this it reduces its strength(Winston 1987,tautz,2008)
- To improve the efficiency there should be reduce the temperature inside the Flow Hive
- How the problem is solved?

III. OBJECTIVE

1. To maintain the safe temperature inside the Flow Honey Hive
2. To study the different insulating material
3. To install the insulating material in the Flow Honey Hive
4. Theoretical calculation to find the temperature with and without insulating material
5. Thermal analysis of Flow Honey Hive model without Insulating material
6. Thermal analysis of Flow Honey Hive model without Insulating material

IV. METHODOLOGY

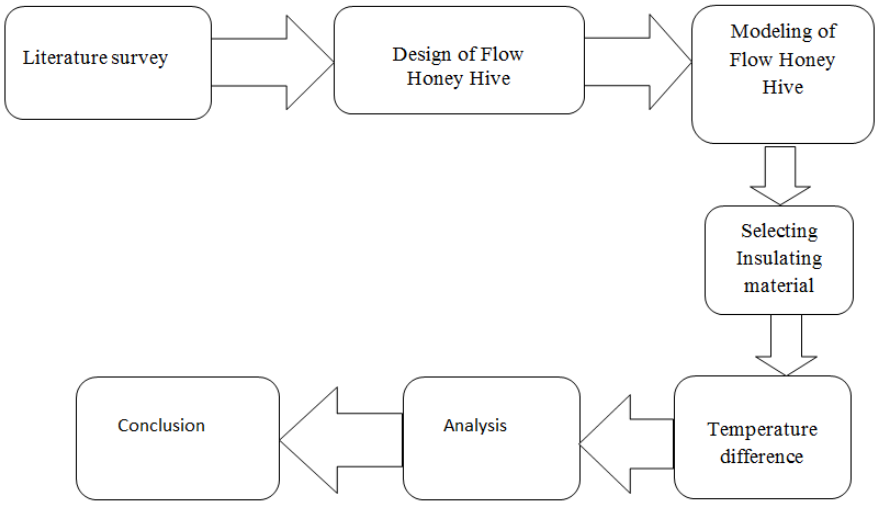

Fig. 1 Project Flow Chart

Designing and Modeling of the Flow Honey Hive: The first stage of the project is to design the Flow Honey Hive as per the approximate suitable dimensions. The design of the honey hive is done with the help of CATIA v5 CAD software.

Selecting Insulating Material: The second stage of the project is to select the insulating material for the bees at summer there will be high temperature so to decrease the temperature we use the insulating material and the insulating material are been manufactured as per the box dimension and placed inside the fabricated box.

Fabrication of Insulating Material: The third step is that once the insulating material is been selected these material has to been manufactured as per the required dimension and placed inside the box.

Meshing and Analysis of Flow Honey Hive: After the first step of the project the model is imported in the Ansys software. The mesh generation process depends on the model prepared in CATIA. Thin Solids mesh enables the automatic hexa or penta dominant mesh. Fine meshing of the model is done using Hyper Mesh software which helps if finding the better results. Meshing is done for the box and all three insulating materials and temperature difference is been given in outer surface and inner surface. Hence finding the Temperature distribution is found in all the material with and without insulating material of the materials.

Results and discussion: Once the fabrication is done the temperature difference is been noted for all the insulating material and without insulating material and the difference in temperature is placed in analysis software and result is been noted.

V. DESIGN OF FLOW BOX

In the Catia tool there are different workbench, part modeling work bench is been used for the modeling, before the product is manufactured the design is been designed use of Cad software once the modeling is completed drafting drawings are done.To create the 3dimentional model in the Catia tool we have to go the sketcher tool then by use of profile tool bar we select the rectangle tool, draw the rectangle tool by use of coordinates at the centre and by use of constrain tool all the dimensions are been given and all the geometries are constrained use of exit workbench the part modeling workbench is been opened by use of pad option the height is been given in the software.

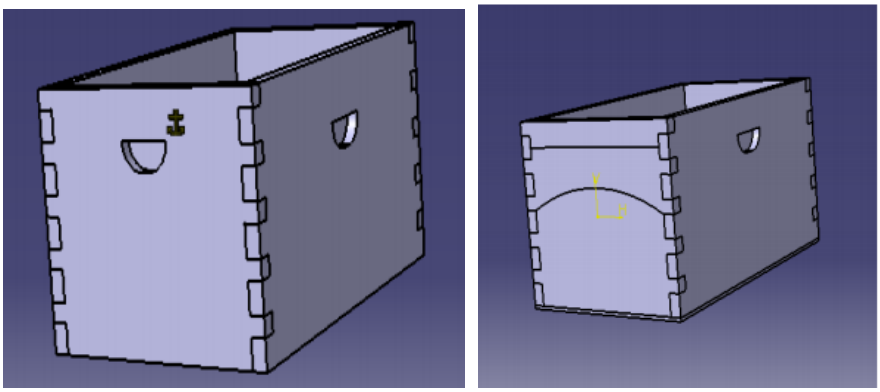

Fig. 2 CAD Model of Flow hive Box

To calculate Temperature Distribution

Formula

$$\frac{T1 - Tx}{T1 - T2} = \frac{x}{L}$$

T1=Temperature of outer surface

T2=Temperature of inner surface

Tx=Temperature at distance x

x=distance from wall

L=Thickness

TABLE I

FOR SOLVING GRAPH FOR DIFFERENT MATERIAL

Distance	Mgo board	Box	sandwich panel
0	32	34	35
2	31.6	33.9	34
4	31.2	33.8	33
6	30.8	33.7	32
8	30.4	33.6	31
10	30	33.5	30

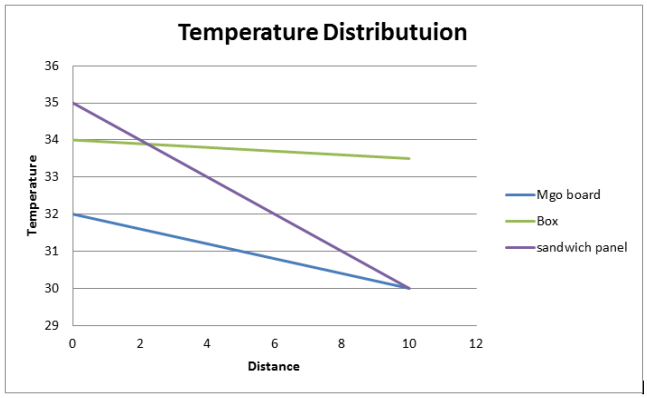

Fig. 3 Temperature drop graph of different materials

VI. DESIGN OF FLOW BOX FABRICATION

Prototype model has been designed as per the required dimension and the next step is to fabricate the cad model. Three models are been manufactured by using wood in form of 5 side face closed box with one side as open. Insulating materials are been used in form of sandwich panels and the Magnesium oxide board are been manufactured as per the required dimensions.

Fig. 4 Fabricated models of different materials

VII. TEMPERATURE ANALYSIS

In the Ansys Workbench 14.5 for the thermal analysis the steady state thermal analysis is been selected and dragged to the workbench and steady state analysis is been obtained in the workbench. The steady state thermal analysis is been selected and double click on the Engineering data so that the required materials are been selected as per the analysis is been done and the Engineering data is been selected or the required data is been added in the steady state thermal analysis. In the next step the geometry is been selected and in the geometry the required units is been selected, the units selected is in Millimetre and right click and edit the geometry tool which will open design modeller workbench where the geometry file is imported into design modeller Select the Model workbench and right click and edit the model workbench which opens into Mechanical workbench where there is an meshing option select the mesh and select all the required surface of the model and meshing is done by giving the size of 80 and Fine meshing is been done. The solution is selected and Mechanical workbench is been opened and there is an steady state thermal analysis right click and insert the initial temperature and insert the another Temperature 2 and there is an two temperatures have been obtain select the initial temperature and select the outside temperature of the model and give the temperature of 35℃ and select the inside temperature and give the 30℃. Select the solution in the ansys workbench and right click insert and thermal and Thermal and Total heat flux and solve the solution ant the results are been obtained as show in the figure in the Mechanical workbench the result is been obtain in the result report there is an plot obtain and select all the graph and all the graph are plotted and comparison is been done.

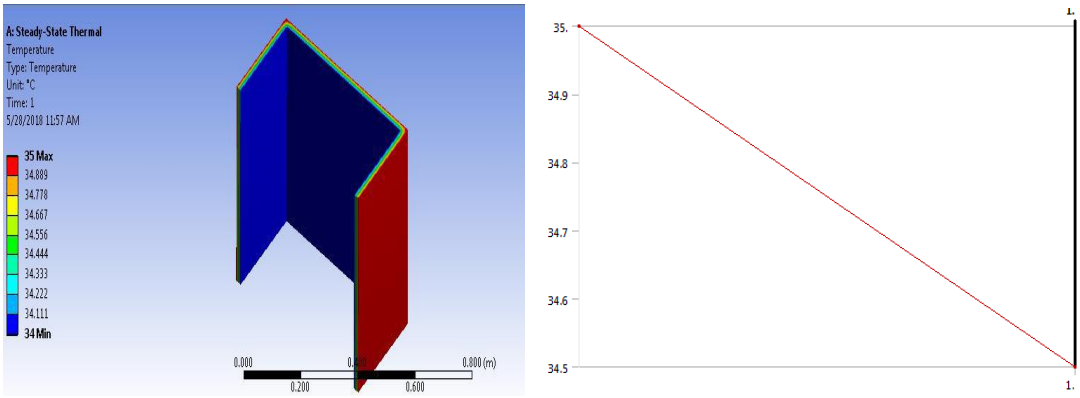

Fig. 5 Steady state analysis of box

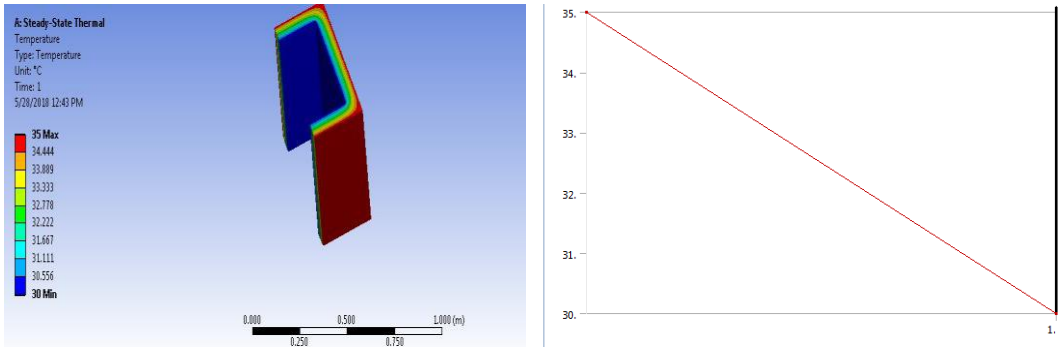

Fig. 6 Steady state thermal flow for Sandwich panel

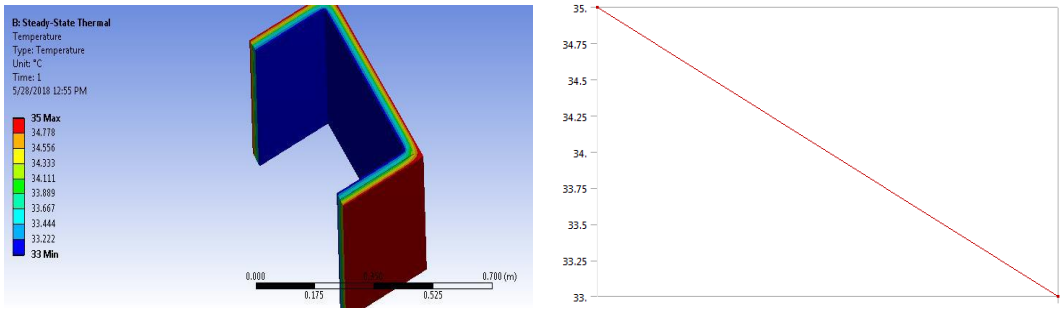

Fig. 7 Steady state thermal flow for mgo panel

VIII. CONCLUSIONS

From the problem statement it clearly indicates that the honey bee broad box has to maintain 35˚C so we used different insulating material and concluded the best insulating material from the calculation trial and error method and analysis. The box and the different insulating material is been manufactured and temperature difference of the box and the box with insulating temperature is been measured and calculated.

SLNo.	Materials	Outside Temperature of box	Inside Temperature of box	Temperature difference
1	Box	34^0C	33.5^0C	0.5^0C
2	Sandwich panel	34^0C	29^0C	5^0C
3	Magnesium oxide board	32^0C	30^0C	2^0C

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