# Evaluation Of Overall Heat Transfer Coefficient For A Composite 3d Panel Using Fem

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***Abstract-*** *The overall heat transfer coefficient(Uoverall) of an object is a measure of heat ability to flow taking into consideration both conductive part of material and convective part of liquid surrounded. The value of Uoverall indicates how much heat can enter the system from the surroundings.Evaluating the overall heat transfer coefficient is very easy for 2D planes with simple heat transfer equations , but when two or three materials are sandwiched to form a complex object, it is difficult to evaluate the overall heat transfer coefficient by hand calculations and simplying the system from 3D to 2D plane also involves more generalization and assumptions there by ending up with inaccurate results of overall heat transfer coefficient. This paper throws a light on how to accurately and easily evaluate the Uoverall of system through FEM concepts using Solid Works Simulation.*

***Keywords***- Overall Heat Transfer Coefficient, Solid Works, Solid Works Simulation, Thermal Analysis, FEM

## I. INTRODUCTION

[1]The overall heat transfer coefficient represents the total resistance to heat transfer from one fluid to another. SI units of Overall Heat transfer Coefficient is $W/m^2K$. In a control flow system [2] Both the overall heat transfer coefficient (OHTC) and local heat transfer coefficient (LHTC) of increase with increasing inlet mass flow rates. The general heat transfer *equation which relates heat flux (Q'in W/m2) , overall heat* transfer coefficient($U_{overall}$in $W/m^2K$ ) and temperature difference ($\Delta T$ in Kelvin) is

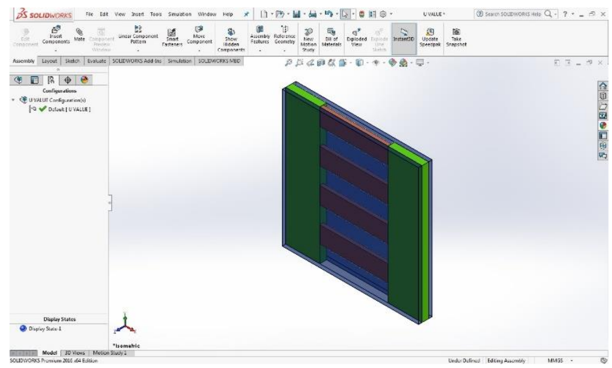
$$Q^{`} = U_{overall}\Delta T$$

In this paper a composite panel of 200 mm x 200 mm X 20 mm is considered, the panel is made up of three metals , for finding out the overall heat transfer coefficient, air of convective heat transfer coefficient of 25 $W/m^2K$ is considered as fluid medium on both sides of the panel.

## II. MODELLING

The composite panel is modelled using user friendly CAD software Solid Works, the deigned model and is detailed in 1a and its components with material are detailed in table 1.

| S.No | Material | Colour |
|---|---|---|
| 1 | Steel (Top and bottom covers) | Blue |
| 2 | Aluminium (Vertical brackets) | Green |
| 3 | Copper (Horizontal brackets) | Brown |



## III. THERMAL SIMULATION-FEM ANALYSIS

Modelling of Composite Panel is followed by Thermal analysis, to evaluate the overall heat transfer coefficient . The following steps are followed in analysis:
Solid Works initial settings and methodology:

- Open solid works and select Thermal under simulation as shown in Fig 2a.
- Now from thermal loads select temperature , assign 25 °c for one face of model and on opposite face assign a temperature of 26 °C as shown in Fig 2b.(therefor $\Delta t$= 1K)
- Now from same loads select convective load and on both sides of model assign a convective heat transfer of 25 $W/m^2K$as shown in fig 2c, generally this convective heat transfer coefficient of air varies from 5 to 100 depending on geometry and flow, here a value of 25 is considered.
- Now using Solid work default mesh parameters discretization/meshing of model is done and is shown in Fig 2d.
- Now run the Simulation and the results get automatically gets loaded in the results column of simulation tree as shown in Fig 2e.
- Now right click on results and export the heat flux along Z axis , the values of heat flux of all elements are obtained in a excel file, get the average of the all

the values of heat flux to get value of the overall heat transfer coefficient as shown in Fig 2f.

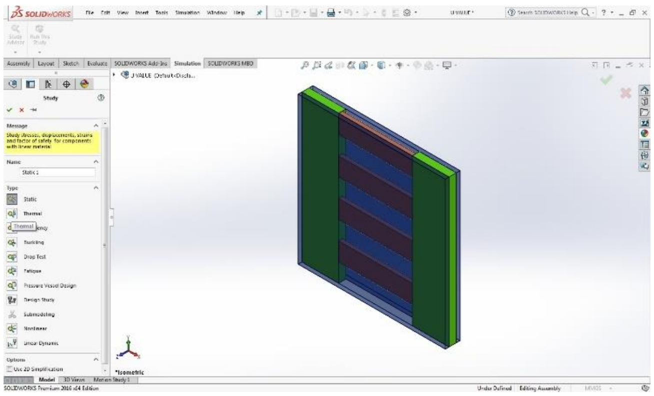


Fig.2a- initializing Thermal Simulation

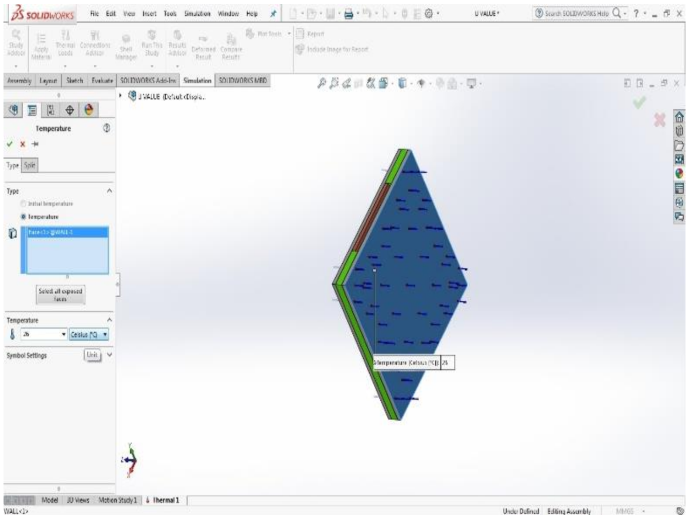


Fig.2b- Defining temperature in Thermal loads

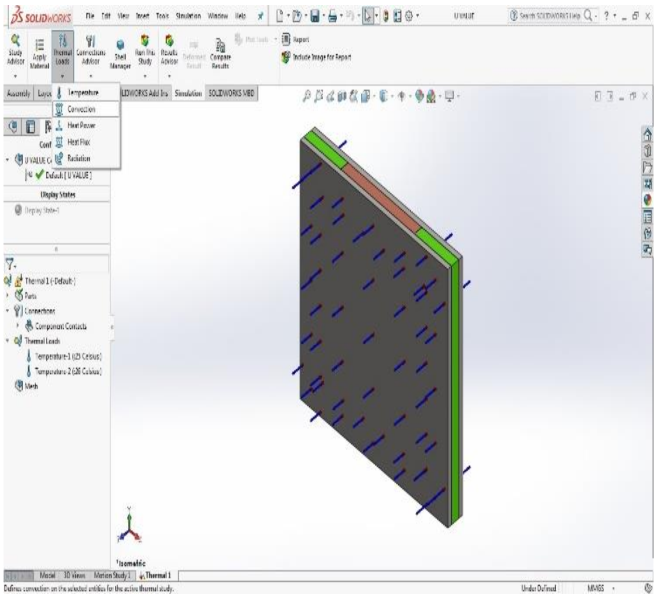


Fig.2c- Defining convective constant in Thermal loads

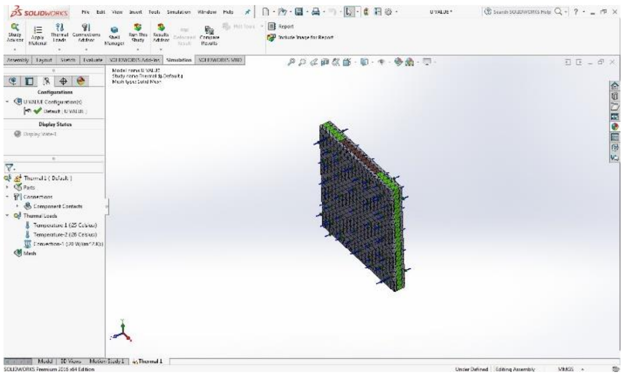


Fig 2 d : Meshing of Composite Panel

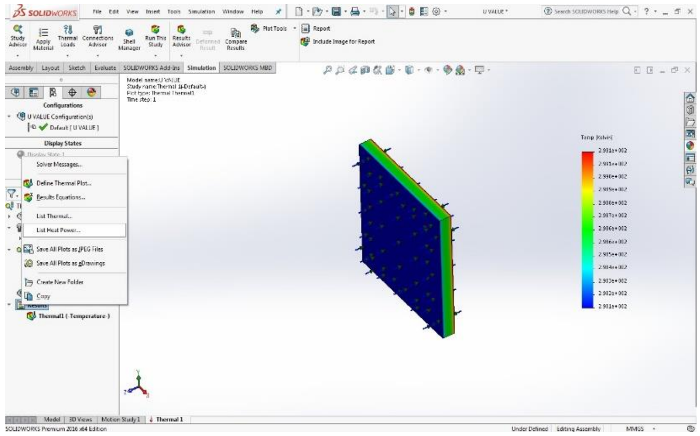
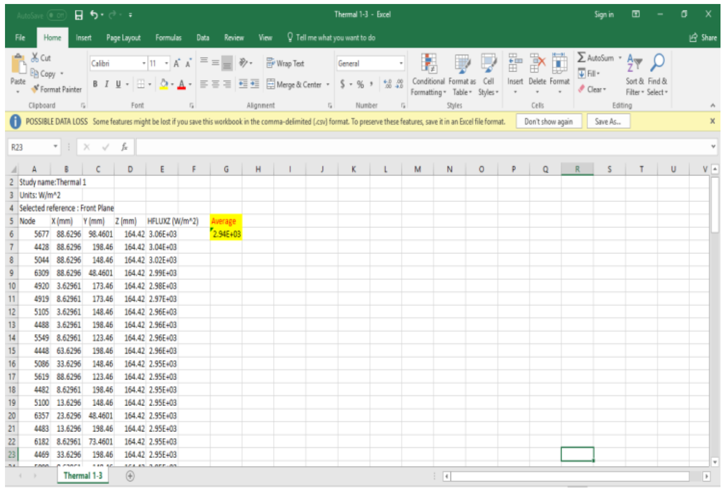


Fig 2 e :Results of Thermal simulation



| | | | | | | |
|---|---|---|---|---|---|---|
| Study name:Thermal 1 | | | | | | |
| Units: W/m^2 | | | | | | |
| Selected reference : Front Plane | | | | | | |
| Node | X (mm) | Y (mm) | Z (mm) | HFLUXZ (W/m^2) | | Average |
| 5677 | 88.6296 | 98.4601 | 164.42 | 3.06E+03 | | 2.94E+03 |
| 4428 | 88.6296 | 198.46 | 164.42 | 3.04E+03 | | |
| 5044 | 88.6296 | 148.46 | 164.42 | 3.02E+03 | | |
| 6309 | 88.6296 | 48.4601 | 164.42 | 2.99E+03 | | |
| 4920 | 3.62961 | 173.46 | 164.42 | 2.98E+03 | | |
| 4919 | 8.62961 | 173.46 | 164.42 | 2.97E+03 | | |
| 5105 | 3.62961 | 148.46 | 164.42 | 2.96E+03 | | |
| 4488 | 3.62961 | 198.46 | 164.42 | 2.96E+03 | | |
| 5549 | 8.62961 | 123.46 | 164.42 | 2.96E+03 | | |
| 4448 | 63.6296 | 198.46 | 164.42 | 2.96E+03 | | |
| 5086 | 33.6296 | 148.46 | 164.42 | 2.95E+03 | | |
| 5619 | 88.6296 | 123.46 | 164.42 | 2.95E+03 | | |
| 4482 | 8.62961 | 198.46 | 164.42 | 2.95E+03 | | |
| 5100 | 13.6296 | 148.46 | 164.42 | 2.95E+03 | | |
| 6357 | 23.6296 | 48.4601 | 164.42 | 2.95E+03 | | |
| 4483 | 13.6296 | 198.46 | 164.42 | 2.95E+03 | | |
| 6182 | 8.62961 | 73.4601 | 164.42 | 2.95E+03 | | |
| 4469 | 33.6296 | 198.46 | 164.42 | 2.95E+03 | | |

Fig 2 f : Exported Results of Thermal simulation

## IV. CONCLUSION

- The modeling of Composite Panel is done using solid works followed by thermal analysis using solid works simulation.
- The overall heat transfer coefficient along Z -axis is found out indirectly by using heat flux results (refer equation 1) for a temperature difference of 1 degree and its value is 2900W/$m^2$K.

**REFERENCES**

[1] http://www4.ncsu.edu/~doster/NE400/Text/HeatExchangers/HeatExchangers.PDF

[2] Comparative Investigation on the Heat Transfer Characteristics of Gaseous CO 2 and Gaseous Water Flowing Through a Single Granite Fracture(Article) - Bai B.