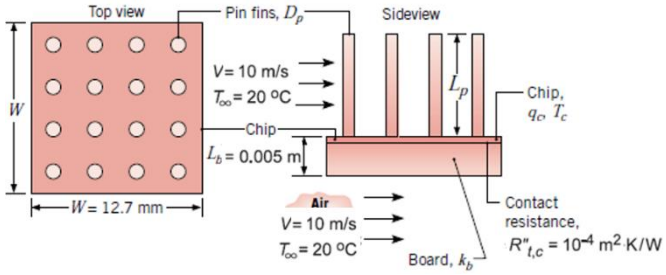
ME 4313-Spring2020 Heat Transfer Design Projects
Reports Due 4/16/2020

Design Problem Statement

You are asked to design a chip cooling scheme that consists of $N \times N$ array of pin fins to be aligned and metallurgically joined to the outer surface of a square chip that is 12.7 mm on a side. An insulated top wall to be placed at the pin tips to force airflow across the pin array. A schematic example of the cooling system consisting of 4×4 array of pin fins is shown in the following diagram.



The chip, which is very thin, is joined to a circuit board at its inner surface. The thermal contact resistance per unit area between the chip and the board is 10^{-4} m^2.K/W, and the board thickness and thermal conductivity are L_b = 5 mm and k_b = 1 W/m.K, respectively. Air enters the array at 20°C with a velocity V=10 m/s. The pin fin geometry, which includes the number of pins in the N x N square array, as well as the pin diameter D_p and length L_p, may be varied. However, the number of pins multiplied by the diameter of the pins cannot exceed 9 mm. Your design must consider at least three different kinds of materials to be used for the fins. The goal of the design is to maximize the rate of heat removal from the fins while keeping the weight of fins used minimum and satisfying the constraint that temperature of the chip does not exceed 75 °C. Air flow temperature is assumed to remain at 20 °C as it flows over the array of pins. For simplicity,

choose N=12 if your last name starts with a letter between A to C of the alphabet;
choose N=16 if your last name starts with a letter between D to G of the alphabet;
choose N=18 if your last name starts with a letter between H to L of the alphabet;
choose N=20 if your last name starts with a letter between M to P of the alphabet;
choose N=22 if your last name starts with a letter between Q to U of the alphabet;
choose N=24 if your last name starts with a letter between V to Z of the alphabet.

Your design variables are: the fin diameter D_p (note: ND_p<9 mm), the fin length L, and fin materials used.

Deliverables

You are required to submit a detailed report describing all design alternatives (use 12 point font size and 1,5 or double spacing). Limit the text section to 20 pages maximum.

The Text section of the report must be divided into several sections and subsections (include headings and sub-headings) that includes the followings:

- Abstract: include a few sentences that briefly describes the design project and the final design.
- Problem statement (you may just copy the statement provided to you)
- Introduction (define design specifications, realistic constraints, and design variables) define:
  - design specifications and standards
  - realistic constraints,
  - design variables
- Analysis (include main equations, main diagrams, and tables in the text section. Number equations, figures, and tables (use the textbook format as a guide). Included the detailed calculations, computer programs, in the appendices.
  - alternative design considerations
- Results and discussion (include figures and tables in the text section). Continue numbering figures, and tables in sequence)
- Conclusion describe the final selected design
  - Student Outcome 2 (SO-2) in the course syllabus states "an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors." Describe which one of these topics are addressed in your design
- List of references. References must be linked to the statements used in the text.
- Appendices. Include detailed calculations, program listings, and outputs that supports your design.
- Include captions for table and figure and paginate the report (use the textbook as a guide).

ME 4313-Design Project Evaluation Sheet (attach to the front of your report)

Points	1	3	5	Basic Score	Factor 1-4	Full Score
Report divided into sections	Not divided into meaningful sections		Divided into meaningful sections		2	
References	No reference provided	A reference list provided, but not linked to information in the text	A reference list provided and linked to text content		2	
Pagination	Report not paginated		Paginated Report is		1	
Equations and numbered	Presented	Not numbered	Numbered		1	
Figures and Tables are numbered and provided captions	Not numbered and has no caption	Numbered, but has no caption	Numbered and has caption		1	
Writing quality	Not clear, has many grammar and punctuation errors	Clear, but has many grammar and punctuation errors	Clear and have no or very few grammar and punctuation errors		2	
Design problem statement	Not included	Included, but it is complete or very clear	Clearly stated		1	
Design specifications and engineering standards	None specified	Specified, but incomplete	Clearly specified		1	
Design constraints	Not identified	Identified, not all realistic	Identified and all are realistic		1	
Design variables	Not identified	Identified but incomplete	Well defined		1	
Alternative design consideration	None considered	Limited consideration	Several considerations		4	
Method of approach	None or poor description	Adequate description	Well described		3	
Design analysis	Incomplete	Limited	Complete		5	
Student Outcome -2.	Not discussed	Discussed, but very few components addressed	All areas were fully discussed		1	
Quality of report	Poor	Acceptable	Excellent		4	
			Total		30	

Print Name: _____

Signature:_____ **Date :_____**