

Heating/Cooling Blanket

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Type: Design project
Time: Four weeks
Location: Take home work with discussion in class

Summary

The objective of this project is to design a blanket that can provide both warming and cooling. Such a blanket must be economical, safe, and comfortable for use during sleeping. The heating/cooling blanket would allow one to keep home thermostat settings higher in the summer and lower in the winter while providing comfort.

ABET Descriptors

Engrg. Sci. Content: Fluid Mechanics and/or Heat Transfer
Type: System
Elements: Develop criteria and specifications, planning, synthesis, analysis
Features: Formulation of problem statement and specifications, creativity, feasibility, alternative solutions, open-ended, concurrent design, detailed system description
Constraints: Economics, ease of use, comfort, safety
Effort: Team

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Problem Statement:

The energy consumption of a typical home can possibly be reduced if the thermostat is set as high as possible in the summer and as low as possible in the winter. One possibility of reducing heating costs during the winter is to use an electric blanket so that one can be comfortable sleeping while allowing the indoor temperature to decrease below normal levels. This concept could be extended by developing a heating and cooling blanket that could attain a similar air conditioning related energy reduction during the summer. Further, a blanket with heating/cooling capability could increase comfort, especially for two people sharing a bed.

The objective of this project is to design a blanket that can provide both heating and cooling and that can be controlled to provide at least two temperature zones. The blanket must be economical, light weight, and flexible.

The following constraints apply:

- The blanket must be sized for use on a standard king size bed.
- The blanket must be safe.
- The blanket must be comfortable to use.
- The blanket must be rugged enough to withstand twisting, pulling, etc. typical of normal sleeping.
- The blanket must be economically competitive with existing electric blankets and it must certainly be cost effective in comparison to energy savings provided.

The following reports are required:

- A preliminary design report showing all original alternative designs and the final design selection.
- Final design report that includes drawings, supporting analysis, bill of materials, economic analysis of energy saved versus blanket cost, and a description of design features that will ensure safe operation of the blanket.
- Short (5 minute) oral summary of design to class.

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Engineering Notes:

One possibility for the blanket is to utilize a large number of small thermoelectric devices to provide the heat sources/sinks required. Can thermoelectric devices be manufactured to be light and flexible enough for the requirements of the blanket? Of course students may well come up with totally different concepts. The design should include some indication of how the blanket will be controlled. If EE students are involved, the control function can be increased.

Objectives and Comments:

An initial analysis to determine the maximum rate of heat production/removal required is an obvious starting place for the students to define specifications for the system.

Expected Outcome:

A written technical report describing the proposed blanket should be submitted by each group. The design presented should be supported by analysis and should be presented with typical engineering drawings.

Oral presentations are optional if class time permits.

Discussion and follow-on activities:

Oral and/or written summaries of all designs can be provided to the class and the advantages and disadvantages of each discussed.