# JEE4360 – Energy Alternatives

- Solar Thermal Lecture Topic
- Assignment
  - Due
- Quiz / Project Presentation



# Solar Thermal Systems Overview

For large-scale, centralized solar energy generation systems:

- Resemble fossil fuel combustion, except different means of heating working fluid
- Possible to have hybrid solar/gas systems
- Capital costs dominate system. In order of cost:
  1. Collector System
  2. Power conversion system
  3. Receiver system
  4. Transport-storage system
- Land, structure, & control costs are small, but not negligible

Examples of decentralized applications:

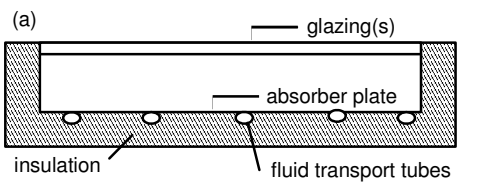
- Domestic hot water (DHW) generation
- Solar cooking, etc.

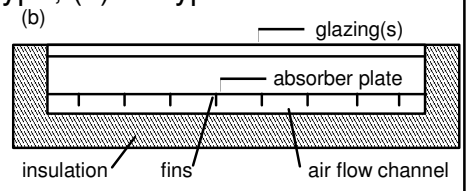
# Examples of Large-Scale Solar Thermal Application: Mojave Desert, CA

*Source: NREL Pix Service. Picture No.00036. Reprinted with permission.*



## Figure 11-1. Section views of flat-plate solar collector types: (a) water-type, (b) air-type



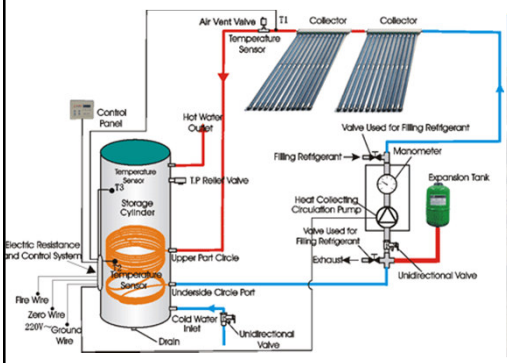
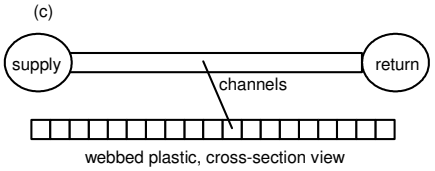




Figure 11-1. Section views of unglazed water (swimming pool) type





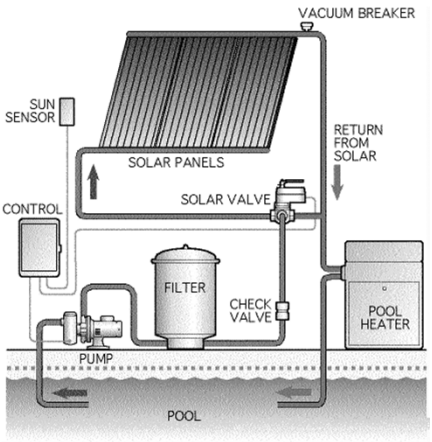



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Figure 11-4. Section view of glass/metal evacuated-tube solar collector

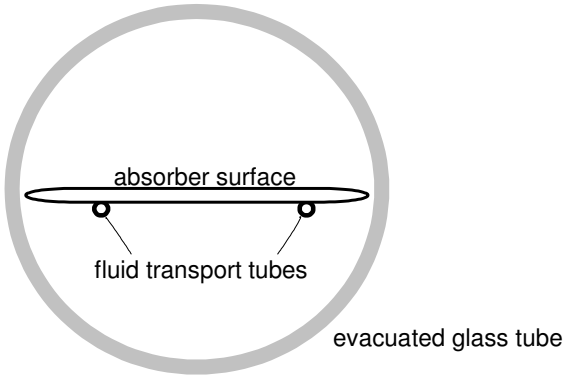


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Figure 11-7. Example efficiency graphs for single- and double-glazed, flat-plate solar collectors

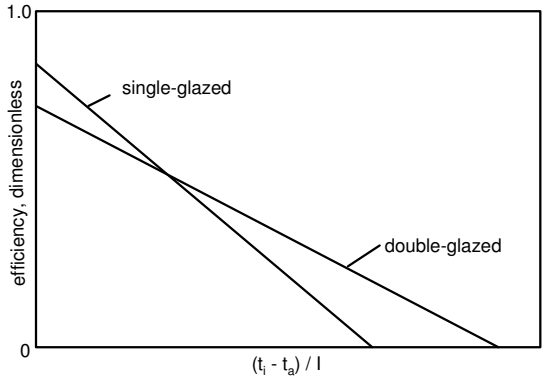


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Figure 11-8. Example of critical insolation during an idealized solar day

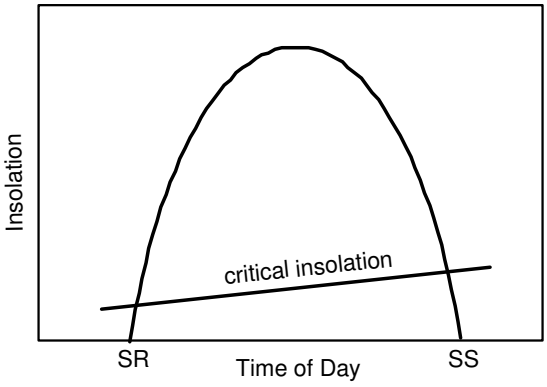


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Figure 11-9. Sketch of heat exchanger, liquid system

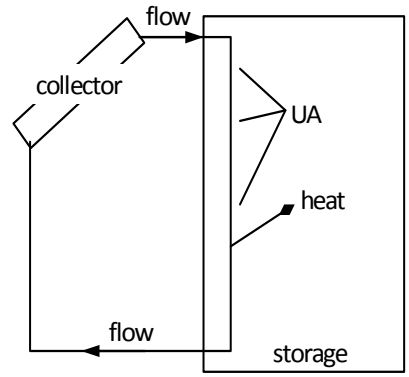




Figure 11-10. Heat exchanger effectiveness as a function of UA, fluid flow on one side of the exchanger. Mass flow rate = 0.15 kg/s and fluid heat capacitance = 3500 W $K^{-1}$

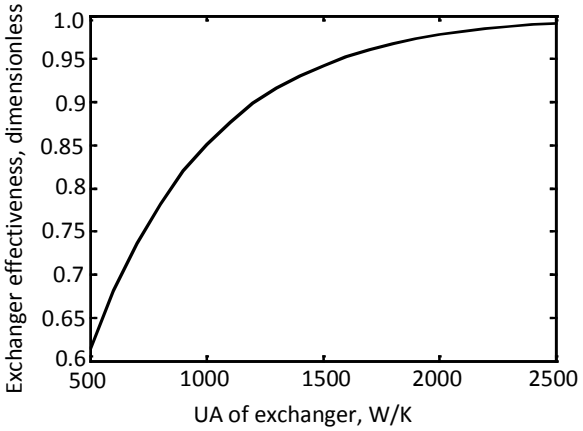

Figure 11-11. f-value comparisons between liquid and air solar collectors

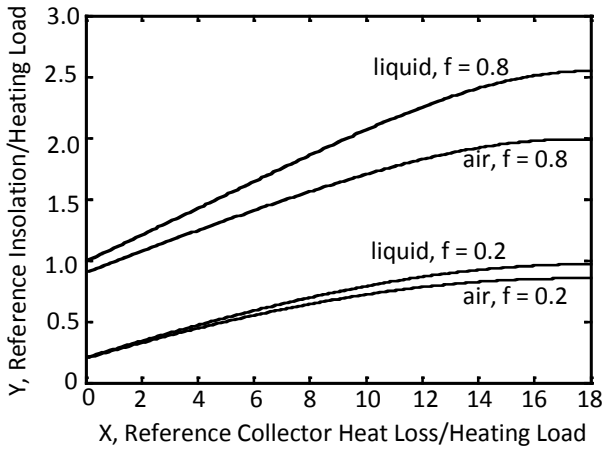




Figure 11-12. Liquid Systems f-chart

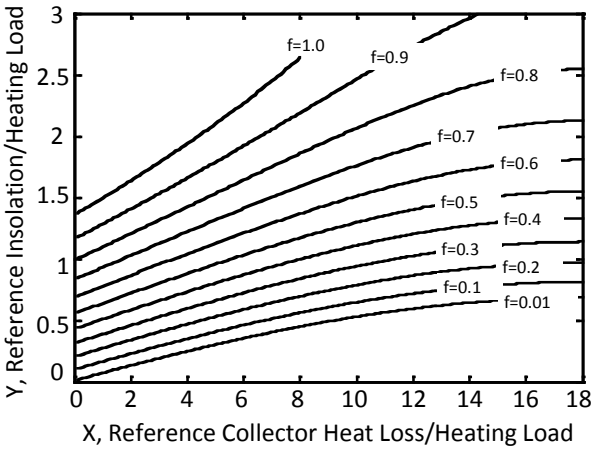

Figure 11-17. Air Systems f-chart

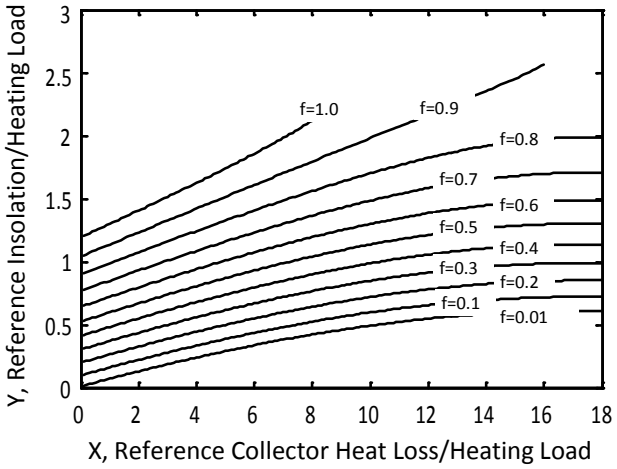




Figure 11-14. Net yearly benefit of example solar collector system

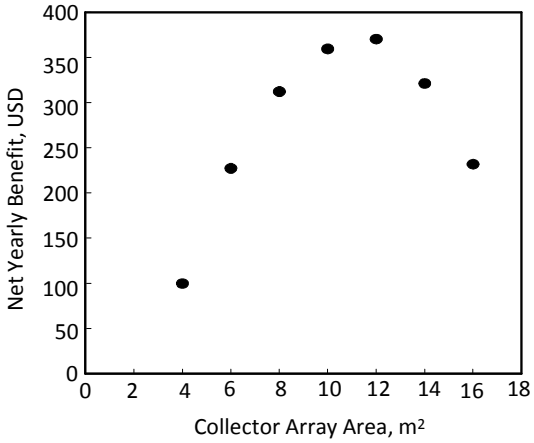

Figure 11-17. Correlation of measured and adjusted monthly heating degree data for Ithaca, NY, USA (2006 daily weather data)

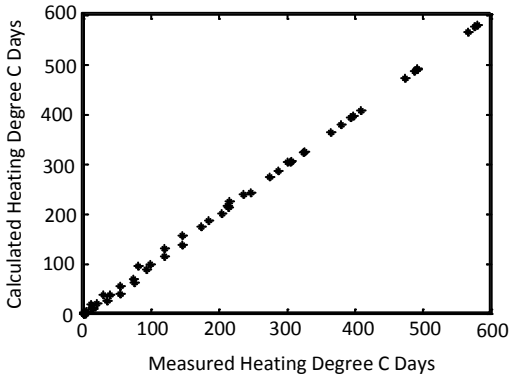




Figure 11-18. Section schematic of direct gain solar building for winter heating, northern hemisphere (arrow points north in southern hemisphere)

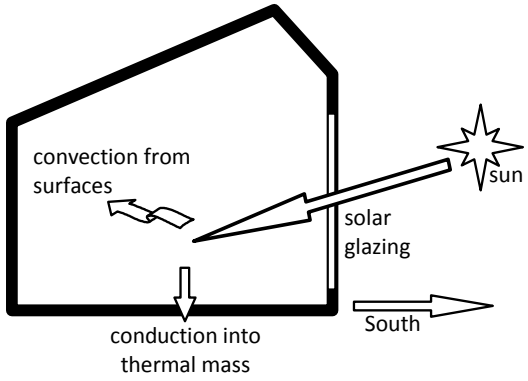

Figure 11-19. Section schematic of Trombe wall solar building for winter heating, northern hemisphere (arrow points north in southern hemisphere)

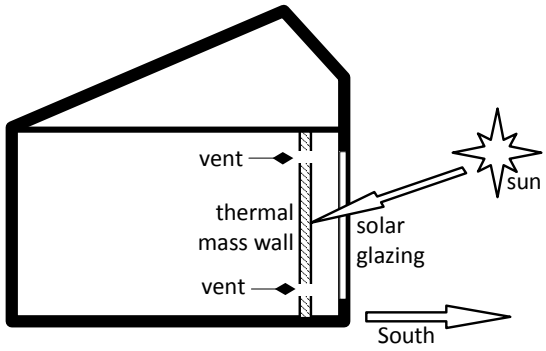


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Figure 11-20. Section schematic of sunspace on a solar building for winter heating, northern hemisphere (arrow points north in southern hemisphere)

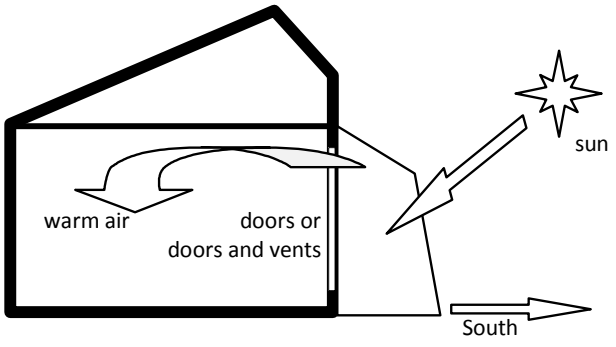


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Figure 11-21. Heat loss paths through a double-glazed window

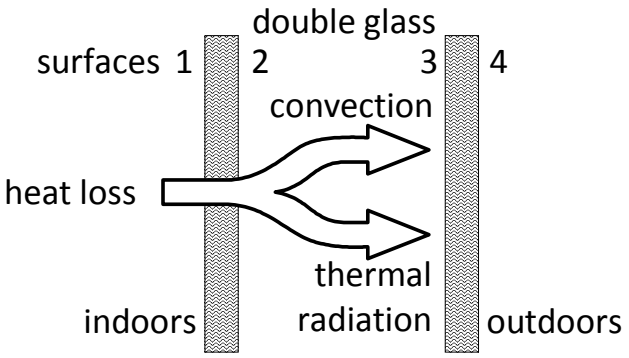




Figure 11-22. Solar savings fraction as a function of Load:Collector Ratio for passive solar wall type TW C3 in Billings, Montana

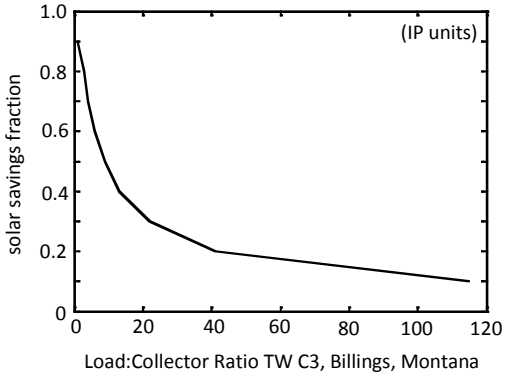

Figure 11-23. Sectional view of building ventilated passively by thermal buoyancy

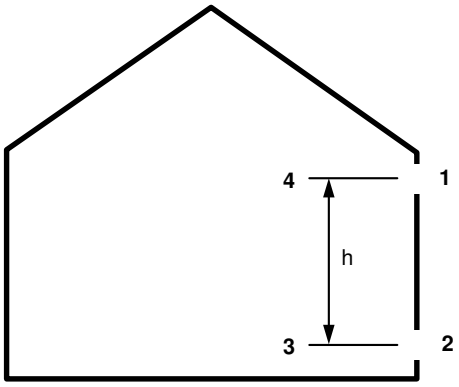




Figure 11-25. Sketch of overhang for summer shade and winter sun