Arch 463
ECS
Fall 2001 Name_____

Quiz #3

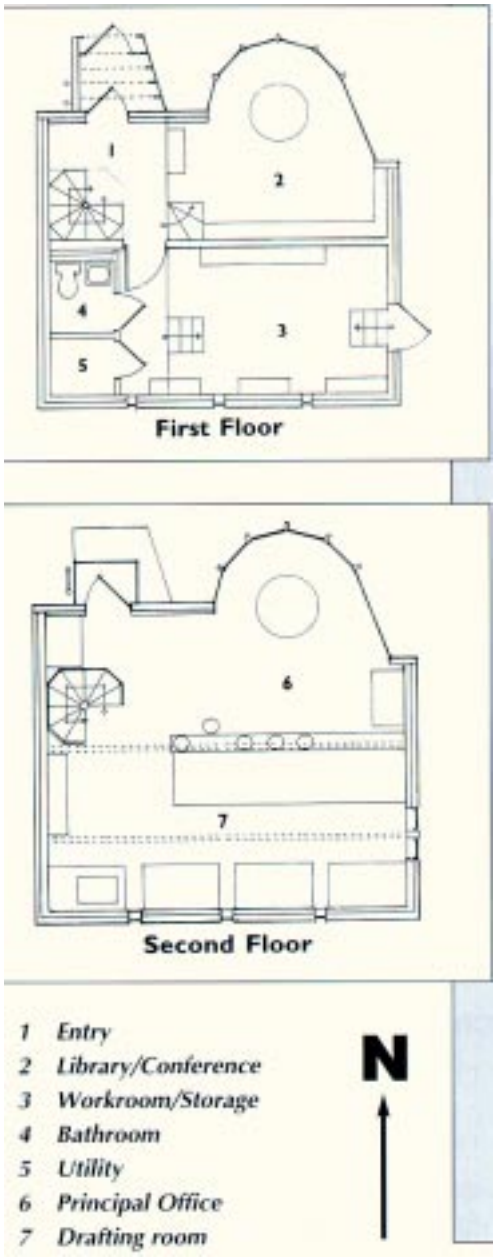
"Improving a Solar Building"

For this problem you are the energy consultant for an architect who wants to improve the annual thermal performance of the building that houses his architecture firm. The building is located in Chicago, Illinois. Currently the building uses about 60% of the energy that a code compliant building of the same size would use. However, the building has the potential to save much more energy.

The Building. The current east, west, and south walls feature exterior insulation over 8" thick grout-filled CMUs, resulting in an R-31 wall. The north wall is metal stud construction and insulated to R-30. The roof is standing seam metal over rigid insulation and rated R-46. The majority of the windows are double pane clear glass, but the 245 square feet of northerly-facing glazing is low-e argon-filled R-7 insulating glass. The entire south wall of the builidng is exposed to the noon sun on the winter solstice. All of the windows except the vented north bay are operable for cross ventilation.

Kit-of-Parts. The architect designed the office himself based on his experience working for the Keck brothers, Chicago-based, post-WWII pioneers in solar home architecture. He also learned a great deal from Ed Mazria's *Passive Solar Energy Book*. In order to improve the building's energy efficiency you may add one or more of the following systems:

Direct gain
Trombe wall
Isolated gain
Roof pond (skytherm)
Photovoltaics



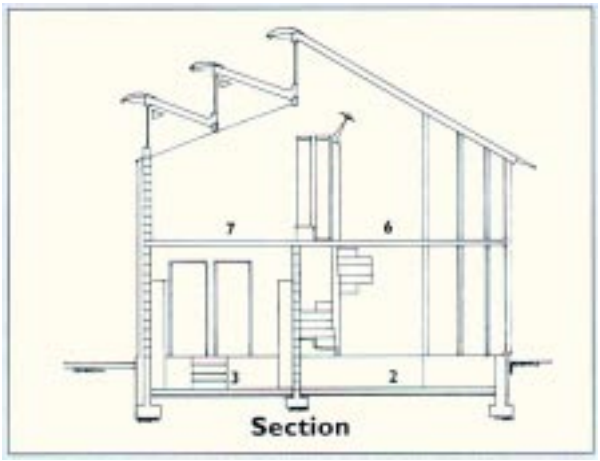
Office plans as published in ***Solar Today****, Sept/Oct 1998.*

The Climate Context. Chicago is located at 42º NL and has a cool humid climate with 6125 heating degree days and 923 cooling degree days. Nonetheless, it is sunny for about 40% of daylight hours in the winter. Prevailing winds blow from the SW, but the site is located only 1.5 miles west of Lake Michigan and experiences diurnal off- and on-shore breezes.

6 points

1. Currently the solar heating system consists of 164 sqft of vertical south-facing windows that heat mainly the second floor area. Thermal mass on the second floor includes five water tubes (1728 Btu/ºF capacity), the 4½" thick 2nd floor concrete slab (5579 Btu/ºF), and CMU walls (7450 Btu/ºF). Do not change the floor plan. Suggest modifications to increase the amount of solar heating. Explain how your suggested system(s) will improve the building's energy efficiency. Show how your suggestion is integrated with the building in section and elevation.

Water tubes used as thermal mass separate the principal's office from the drafting room.



South-facing clerestories collect solar heat in the winter and exhaust hot air in the summer.

4 points

2. Critique the design of the north bay window wall. Redesign the wall for better thermal performance, while maintaining its role in daylighting and allowing views of the garden. You may change glazing types and/or aperture sizes. Show your improvements in a sketch.

The glazing on the north side of the building affords a view to the garden, provides daylighting to office and library/conference areas, and the vent panels below the fixed glass of the bay allow cross ventilation.