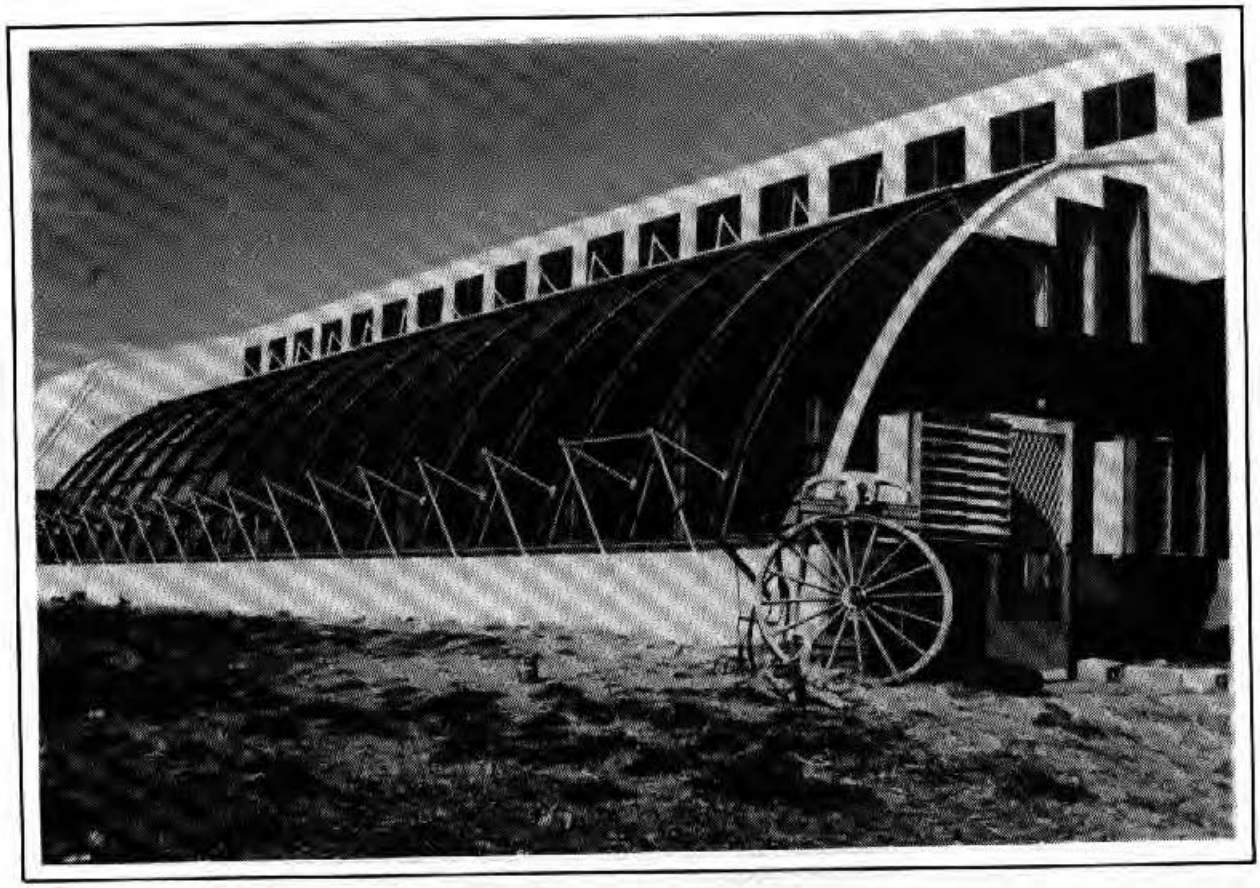
COLSON

NORTH PLATTE

DOUBLE SHELL



The Colson home, built by the owner in August 1981 for the exceedingly low cost of under $15 per square foot (not including his labor), is an innovative low-cost double shell residence that is also used as a church.

The airflow in the roof plenum in the Colson home is through the cavity of the roof truss system that supports a 26-gauge steel roof which is used in place of conventional residential roof decking and shingles. The truss system, also used in the floor, was designed by Components Inc. of North Platte. 2x6 stringers were placed between the truss and roof (opposite left) to create sufficient space for the installation of 6" batt insulation.

The high, vaulted ceiling of the Colson house and its expansive greenhouse space of over 2000 sq ft create an outdoors feeling indoors. Although the greenhouse glazing appears to be curved, closer inspection reveals that, in reality, the illusion is the result of flat panes of glass installed in an arc (opposite right). Unfortunately, intense temperatures and exposure to direct sunlight have caused the wood in the window framing to dry out and split, resulting in a weakened frame system. During the summer, a swimming pool cover is placed over the curved greenhouse glazing to reduce unwanted solar heat gain.

In the Colson house, the plenum chamber typically located under the floor of most double shells has been replaced by a series of underground air tubes, 2 feet on center, which connect the north wall plenum to the south greenhouse wall. Air flow through the air tubes is not fan assisted, and, despite the fact that no auxiliary heat is supplied to the greenhouse, no freezing has occurred. Three portable 1500 watt electric heaters supply backup heat to living spaces.

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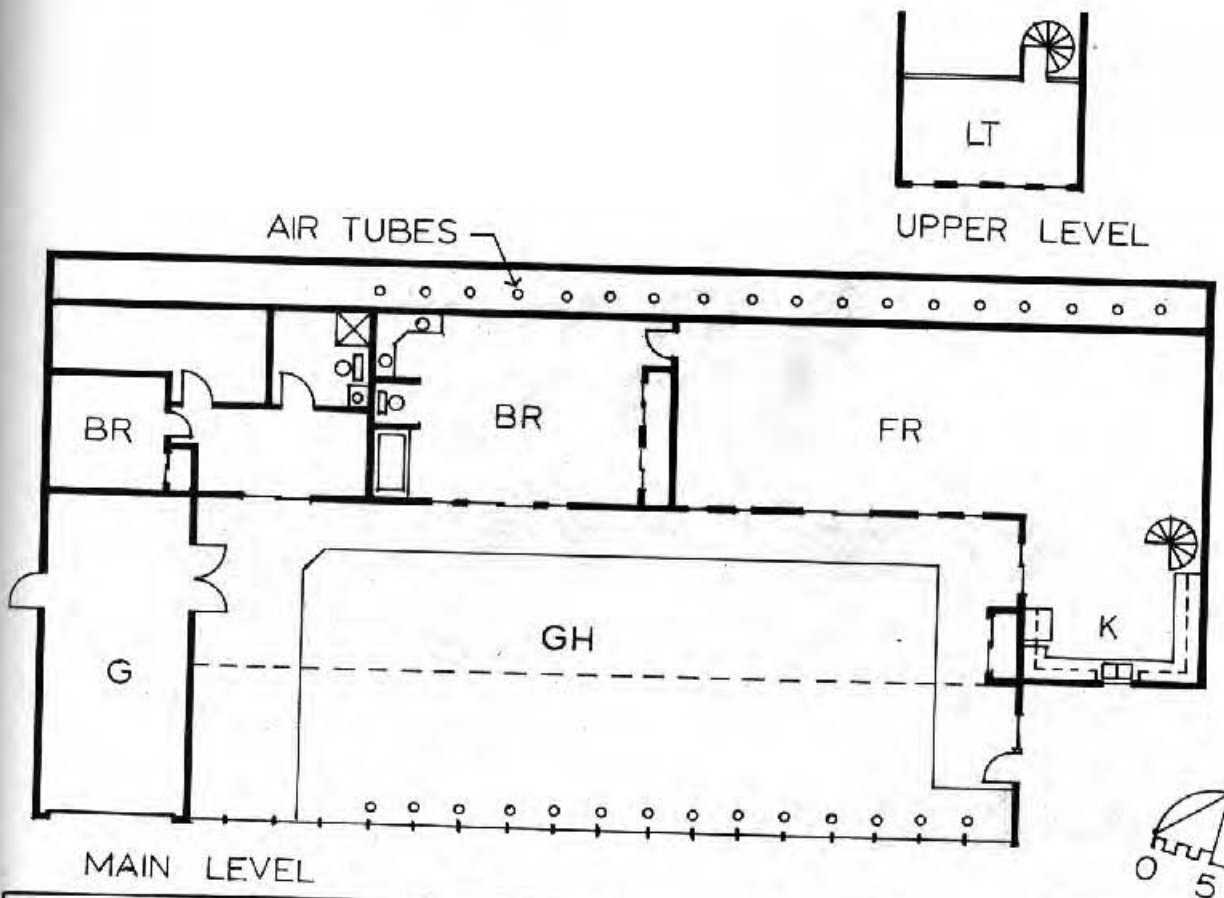
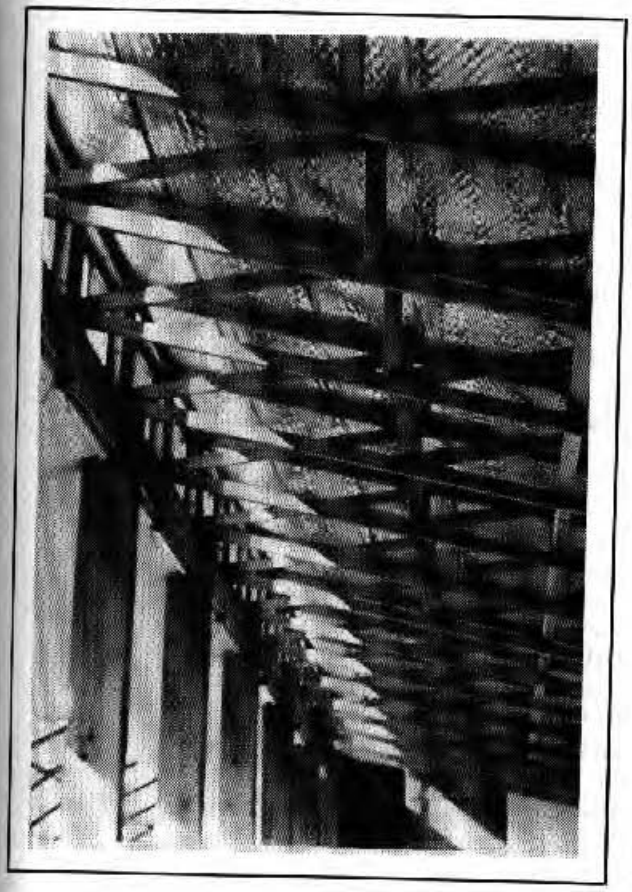




DEMMEL

Heating bills that have averaged less than $20 per year attest to the energy efficiency of the Demmel home which, when built in 1979, was one of the first double shell homes constructed in Nebraska. The three-story Demmel home has a number of interesting features: fans to duct air directly into the home, a unique shutter system for the sloped glazing, a thermosiphon domestic hot water heater, and sill pans for window condensation.

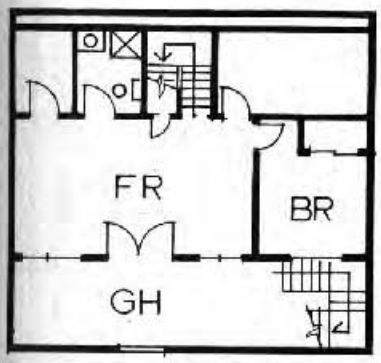
A very low rate of convective airflow in the Demmel house air plenum resulted in lower than desired interior temperatures. To improve thermal performance, a fan was installed in the attic, and, when sunspace air temperatures are high enough, warm air is blown directly into the home.

The shutters for the sloped glazing slide in a garage door track and are raised and lowered by means of a pulley system. The control ropes for operating the shutters (opposite left) are accessible from the balcony on the upper level.

A thermosiphon collector panel in the sloped glazing opening above the main entrance heats water that is stored in a tank located (opposite right) in the open plenum above the bedrooms.

High humidity levels in the house, and moisture condensing on windows were initial problems in the home. Humidity levels were reduced by placing a vapor barrier over the earth in the crawlspace beneath the lower level. Specially fabricated metal pans, attached to each window sill to collect water condensing on the south glass and emptied to the floor through a network of thin plastic tubes, collected nearly one gallon of water at the dewpoint temperature before humidity levels were reduced.

SHELL



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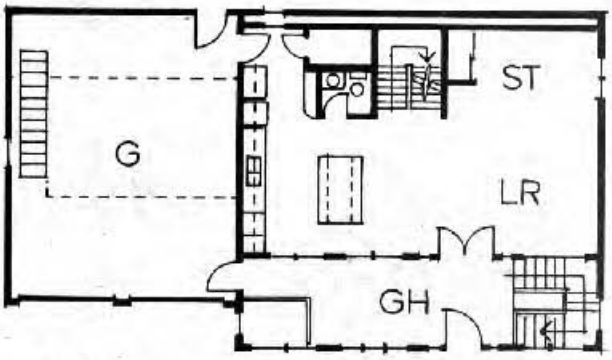

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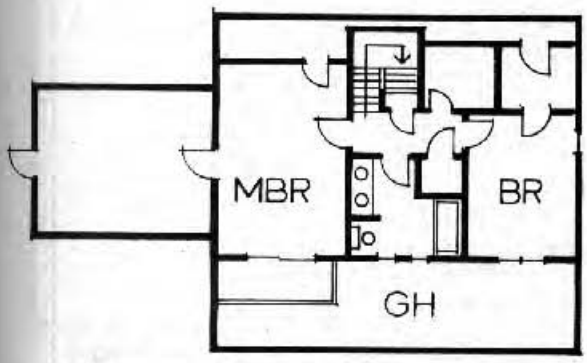

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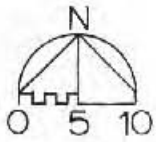

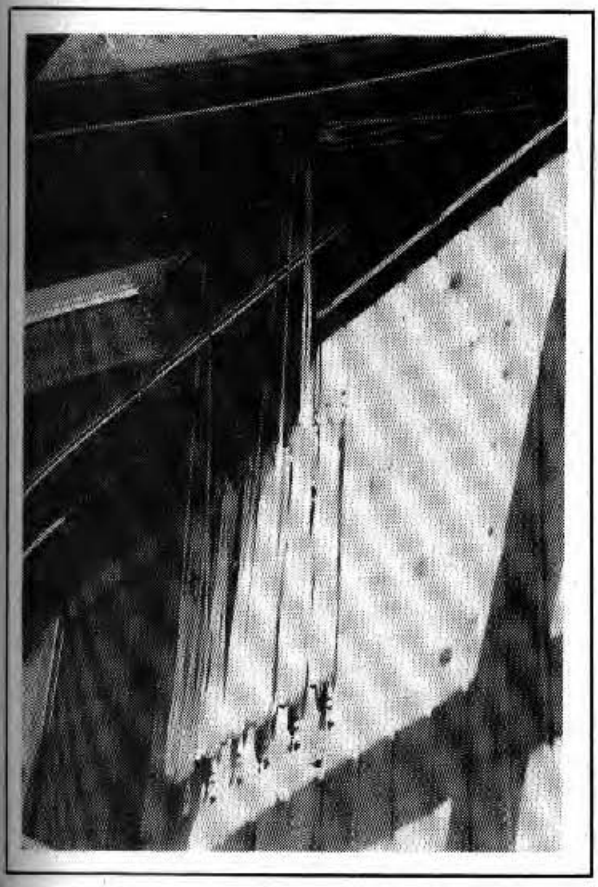

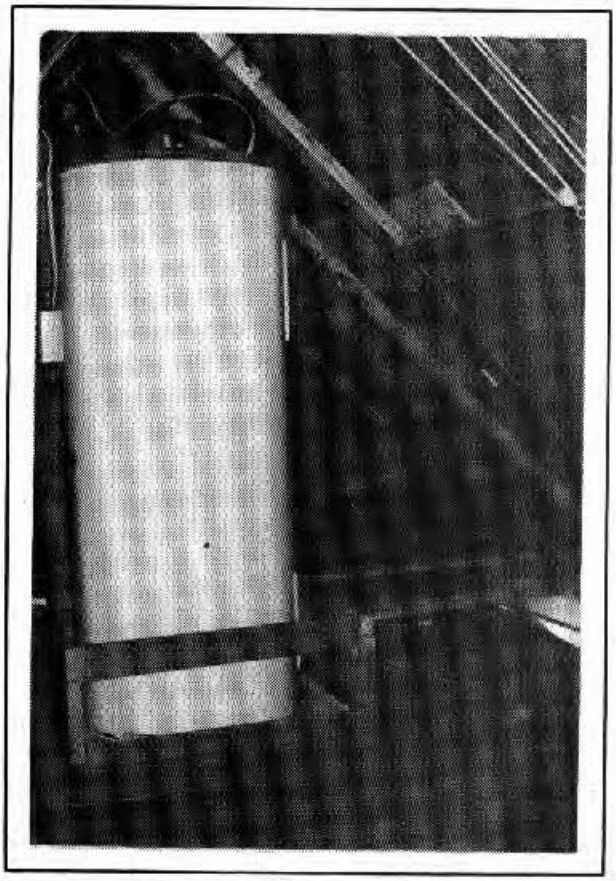

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DORWART

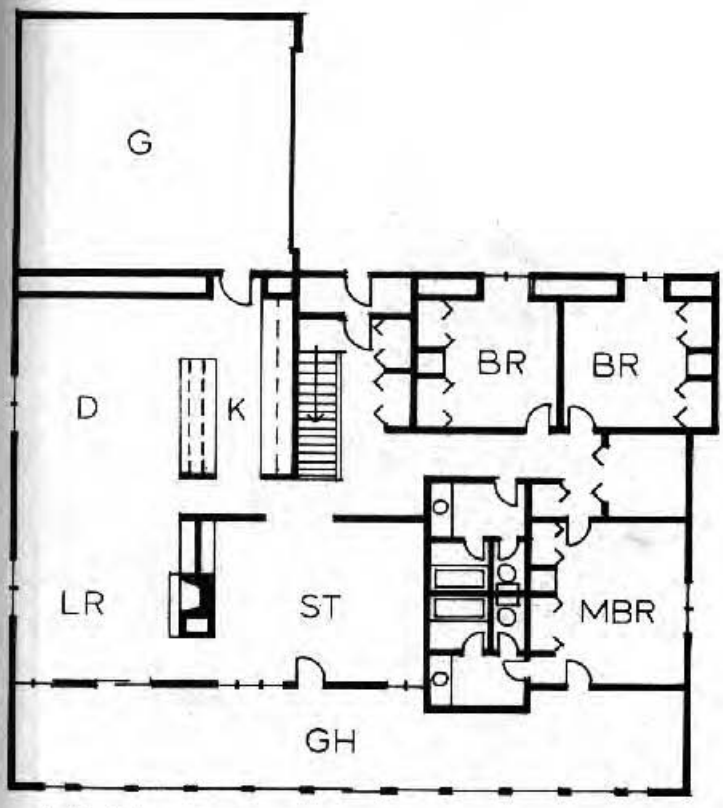
SIDNEY

DOUBLE SHELL

The 2700 sq ft Dorwart home, which, like the Empson house also in this inventory, was built by Sandstead Custom Solar Homes of Alliance, is different from most other double shell houses in that it has no sloped glazing. The usual sloped glazing collecting area is replaced in the Dorwart house by a greenhouse -- with 311 sq ft of vertical glazing -- that spans the entire front of the house like a corrider (opposite right and left).

According to the builder the performance of the double shell design during the heating season has been satisfactory, undoubtedly due in part to high insulation levels. The walls are insulated to R-26, the ceiling (R-19) and the roof (R-30) have a combined insulation level of R-49, and all doors are R-12 or better. The only backup heat used in the house is provided by a Defiance woodburning stove (Masters Choice model). During the 1982-83 winter, the one cord of cottonwood that was burned was sufficient to keep the home at 68°F.

The builder has indicated that high humidity levels in the house have been a problem. In fact, the use of a dehumidifier may be required year round. In the summer, however, this creates another problem, because the operation of the dehumidifier adds heat to the cooling loads. The current cooling strategy involves drawing cool air from the basement directly into living space in the following manner: fresh outside air, drawn into the plenum through the greenhouse, is cooled by earth contact as it passes through the crawl space plenum, and then is fan forced into the basement where it is drawn up the stairwell to the main floor. The use of a small air conditioning unit to decrease humidity and help cool the inner shell is being considered for the future.



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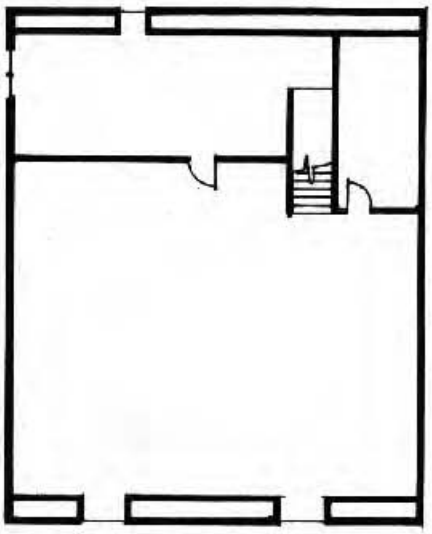

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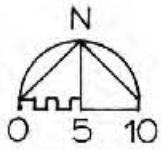
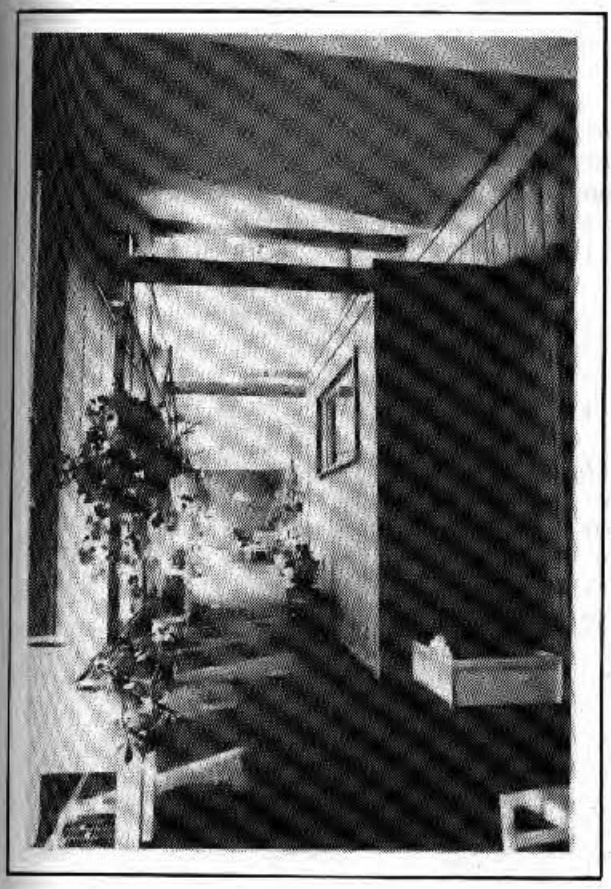
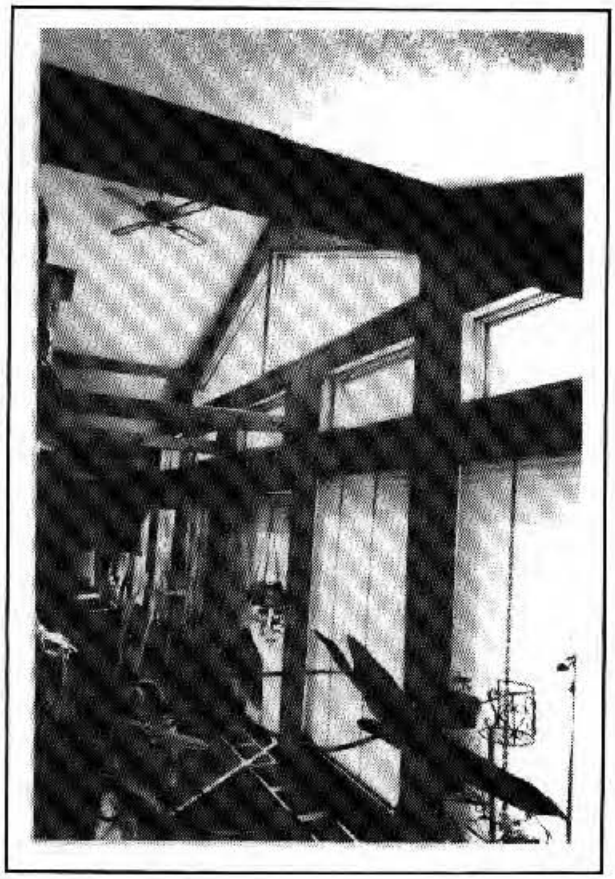






EMPSON

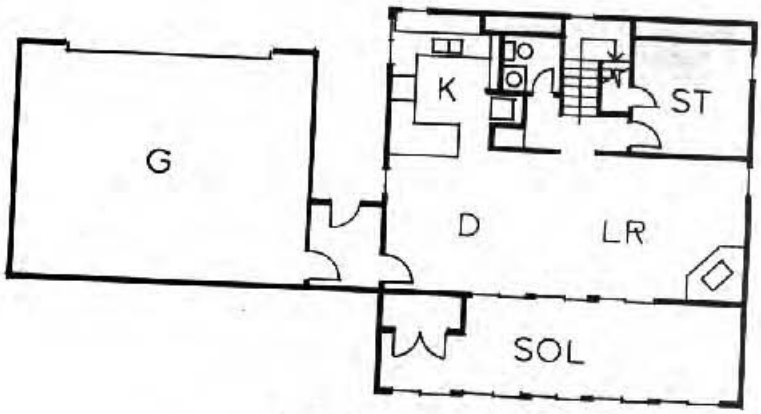
CHADRON

DOUBLE SHELL

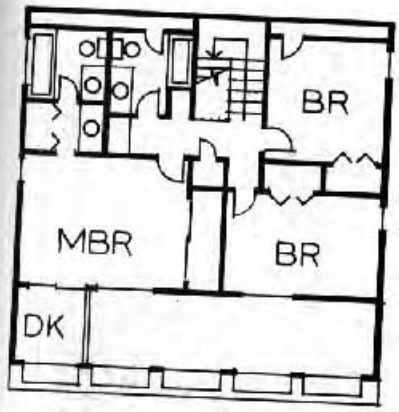
The Empson home, like the Dorwart house, is a double shell passive solar house built by Sandstead Custom Solar Homes of Alliance. Unlike the Dorwart house, however, the Empson home is a double shell design of the classic style as developed by Tom Smith of Positive Technologies, Lake Tahoe, California, with one exception: the Empson house also has vertical glazing -- slightly more than 300 sq ft -- rather than sloped glazing, although sloped glazing was incorporated in the design when it was built in 1981. However, after problems with overheating (the major reason why sloped glazing is no longer recommended for double shell designs) and leaks, the builder retrofitted the structure by replacing the sloped glazing with the vertical glazing currently in place.

Like the Dorwart house, the performance of the Empson house during the heating season has been satisfactory, again undoubtedly due in part to high insulation levels -- inner walls (R-11) and outer walls (R-19) combine for an R-30 value, and ceiling (R-19) and roof (R-30) combine for an R-49 value -- and conservation features like an airlock entrance (opposite left). A Defiance woodburning stove is the only backup heating system used in the 1500 sq ft house with a 380 sq ft sunspace (opposite right). In the severe northwestern climate of Chadron a total of 3/4 cord of hardwood was burned during the 1981-82 winter period. The calculated TIF for the home was under 1.

During summer months, hot air from the house is vented directly outdoors and is replaced by cool air that is drawn up the stairway from the basement, which, in the Empson house functions as the belowgrade plenum -- there is no crawlspace.



MAIN LEVEL



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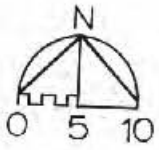

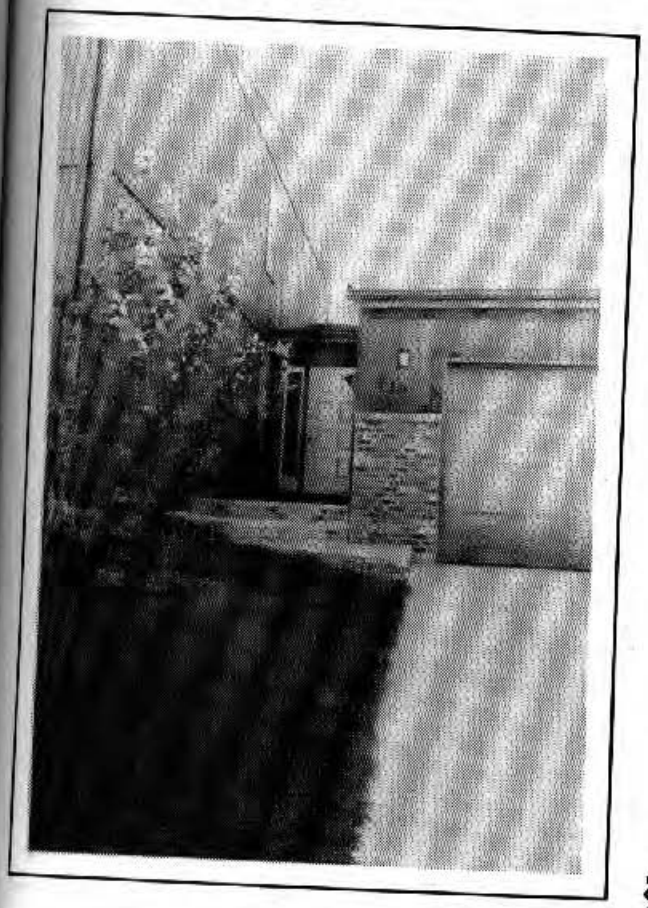

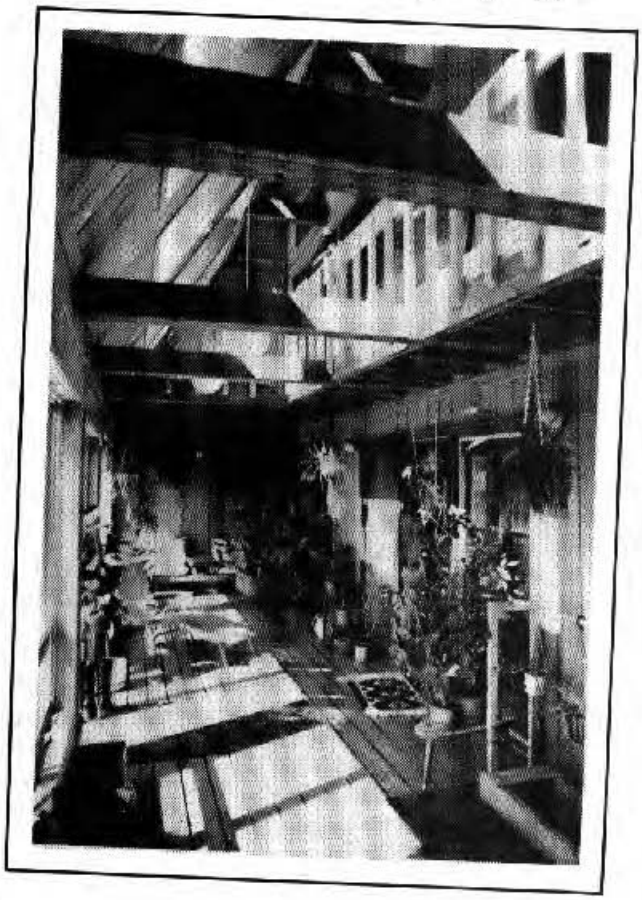

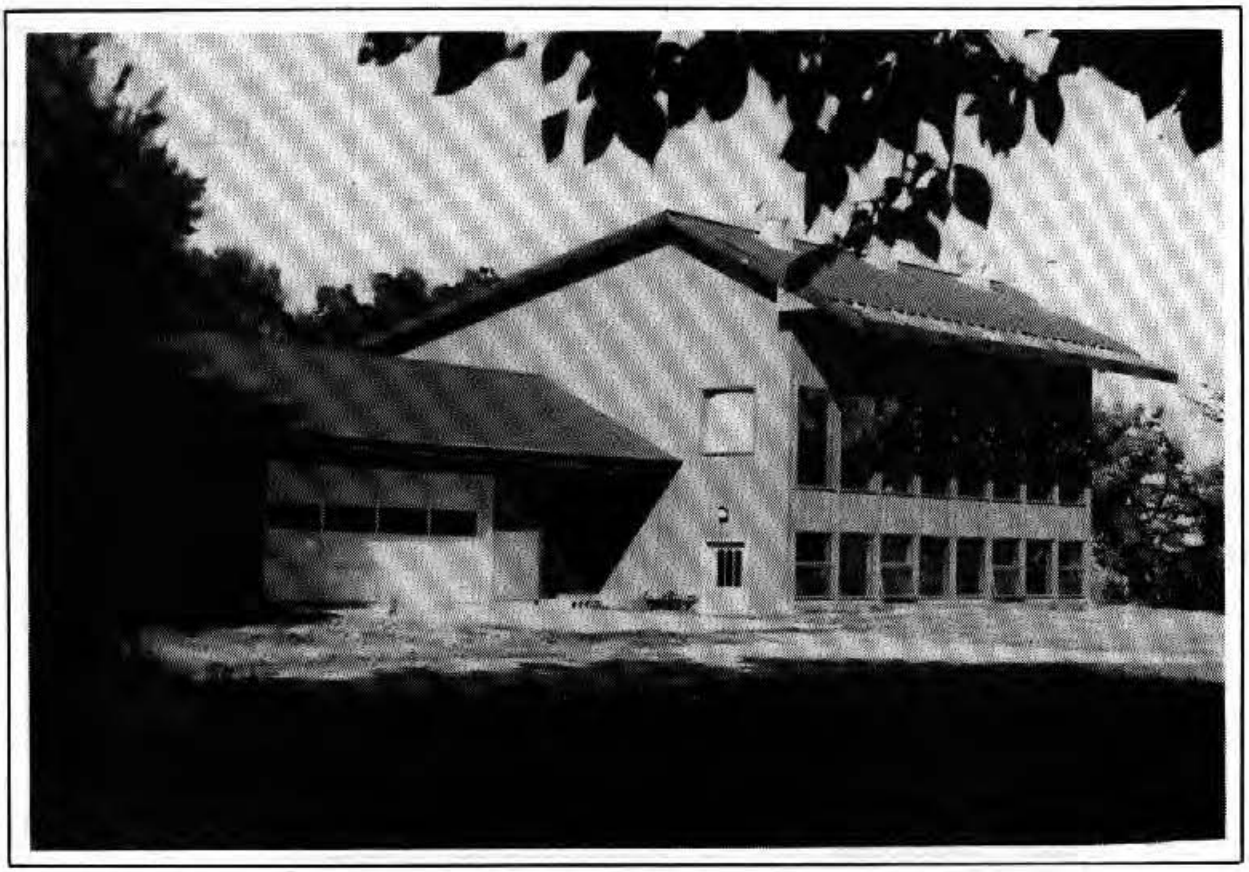

The Kucera double shell passive solar home, designed by Solar Energy Associates of Omaha, is a two-story 1900 sq ft building that is fronted by a two-story 300 sq ft greenhouse (opposite left) with balcony. As recommended for passive solar buildings with vaulted ceilings, bedrooms are located on the lower level.

The Kucera house is well insulated as the insulation level in the east and west walls is R-27, and it is R-19 in the south wall. Both the living space ceiling and the roof are insulated to R-18, giving a combined insulation level of R-36+ counting the airspace.

Considerable solar heat can be generated by sunlight entering the greenhouse through approximately 500 sq ft of vertical south facing exterior glass. A woodburning stove, located in the greenhouse rather than in the living space, provides backup heating.

The cooling of the house during summer is achieved through a combination of strategies. Overhangs (opposite right) shade the glazing from unwanted solar gain. A small window air conditioner, vented to the sunspace, is used to help cool the living space. Roof turbines, a modification to the original design undertaken by the owner as a less expensive cooling alternative to north facing clerestory windows, vent heat from the sunspace. Operable windows (opposite right) at the bottom of the south facing glazing can be opened for ventilation as well.

One rather unique and functional feature of the home, the root cellar located just under the breezeway, provides excellent storage for vegetables and serves as a shelter during violent weather.

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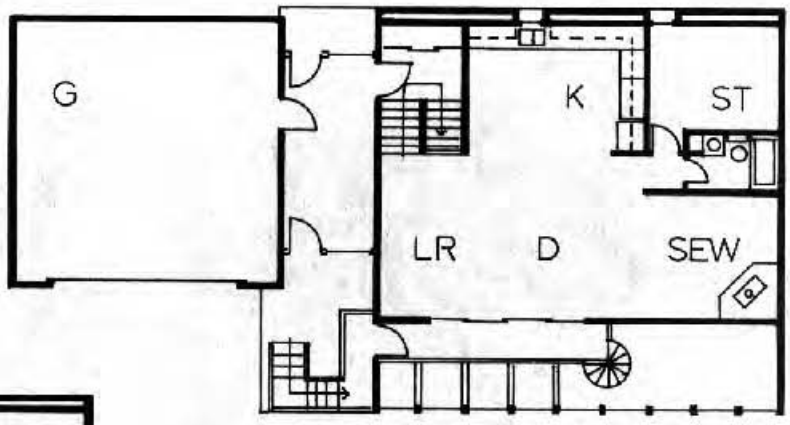

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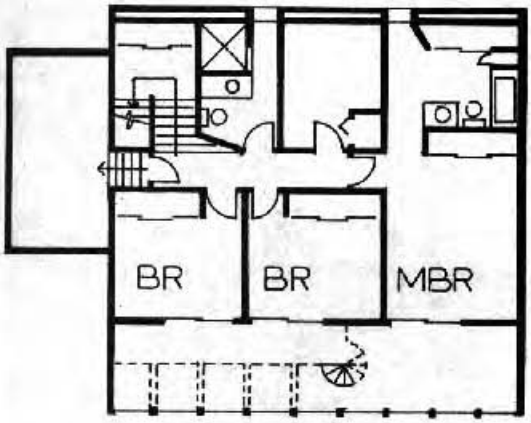

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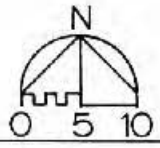

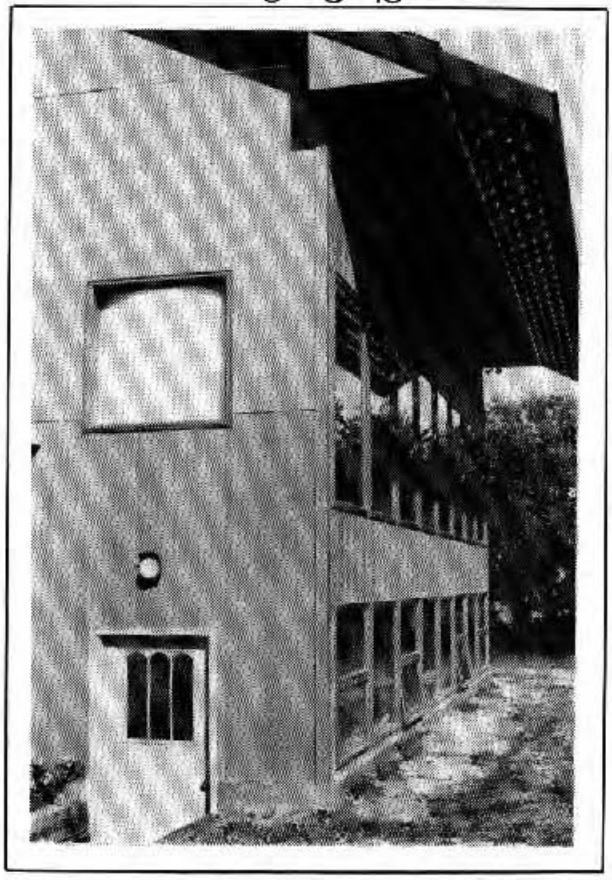

NYHOLM

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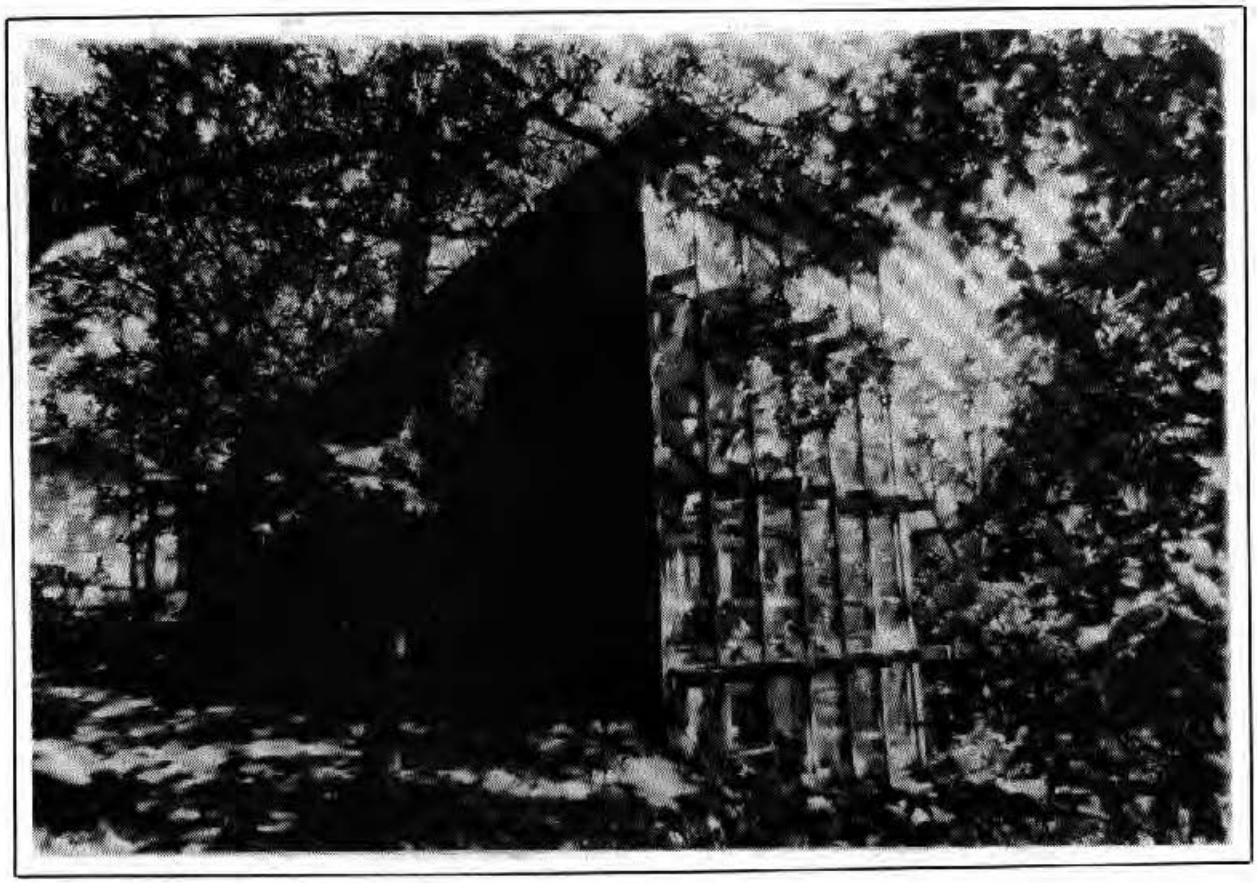
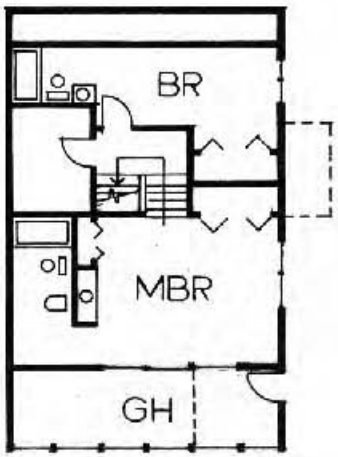
DOUBLE SHELL



The luxurious and contemporary styled Nyholm double shell home was designed by the owner after considerable research. The research included a trip to Lake Tahoe to visit the home of Tom Smith whose double shell house was the first one built in the United States. Slightly less than 1400 sq ft of floor space is divided among the multiple levels of the house, and each level is open to the three-story sunspace (looking up, opposite right) across the front of the house. The greenhouse is combined with an open floor plan -- with few walls or partitions -- to allow excellent views from everywhere in the house (opposite left).

Almost the entire south wall of the Nyholm house is glazing -- over 800 sq ft of double paned glass -- which might be considered excessive for a house of this size. However, the glazing is needed to let in light and solar energy because the house is located on a lot in a heavily wooded area overlooking a park and shading is a problem, even in winter. Although normally only leaves present shading problems, the branches of some deciduous trees can also cast thick shadow patterns. Obviously, trees are desirable for shading, but their preferred location is west or east of south as opposed to due south.

Despite any shading problems, the thermal performance of the Nyholm double shell has been good. Backup heating to the Nyholm house is provided by a natural gas furnace. For 1981, the total heating bill was under $119 for the entire winter. The total non-electric utility bill for the 12 month period from January through December of 1982 was $342. This bill covered the cost of gas used for space heating, the cost of gas used for heating water for domestic purposes -- including the hot tub located off the master bedroom on the lower level, and the cost of water used for all purposes.



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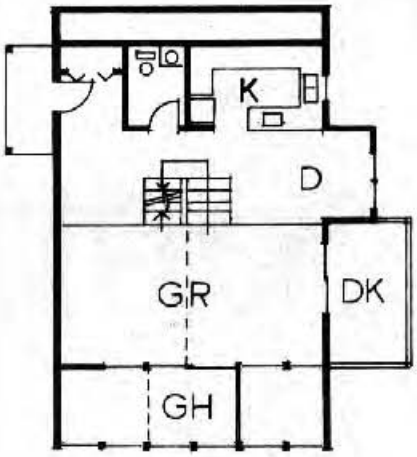
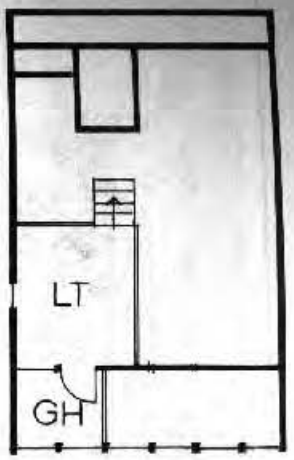
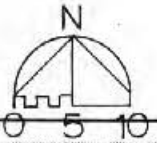
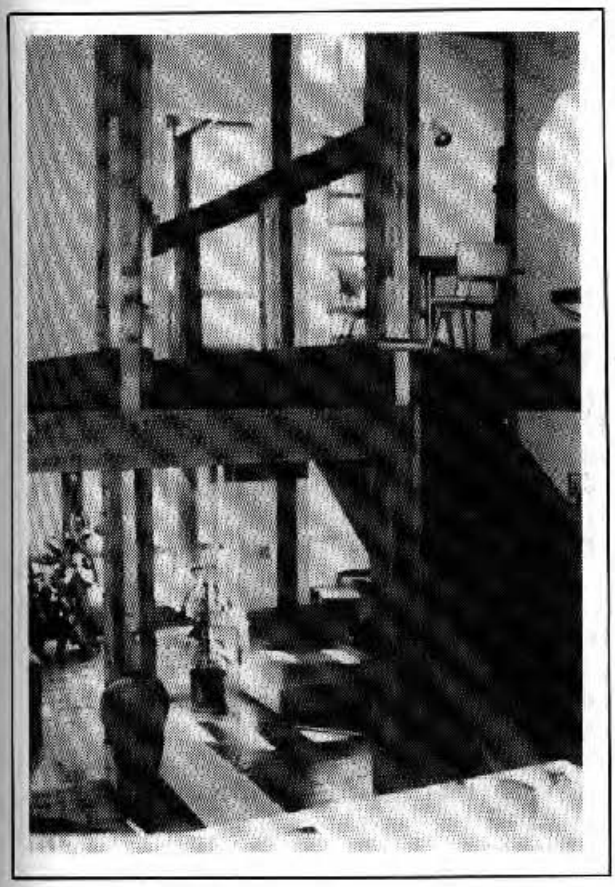


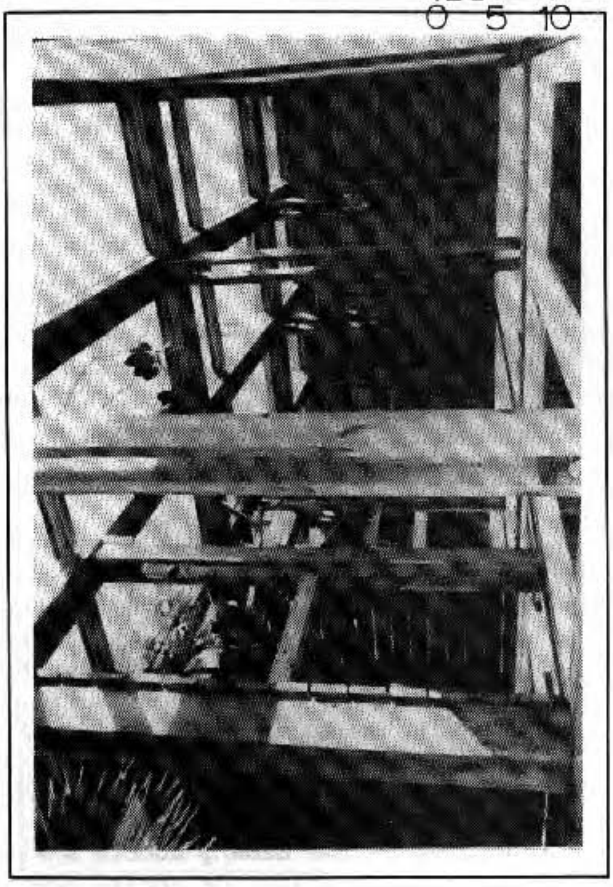
MAIN LEVEL



UPPER LEVEL







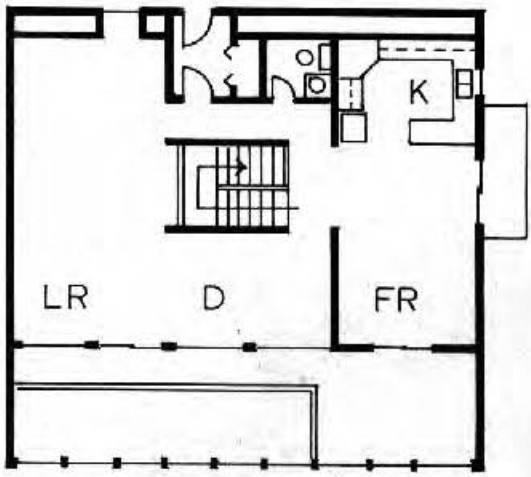
The Seberg double shell home, completed at the end of 1982, is significantly different from other double shell houses. In the Seberg double shell, the central flow of air through the roof plenum chamber is interrupted by a cupola (opposite left) which is located over a central stairwell. Light, admitted through the clerestory windows in the cupola, floods the main level -- with open floor plan and high ceilings (opposite right) -- and also reaches to the lower level.

The two-story Seberg house has 2200 sq ft of floor area, and the 360 sq ft greenhouse has a walkout from the lower level. The interior wall of the north plenum has 2x4 framing, and the exterior wall has 2x6 framing. Combined, their insulation level exceeds R-27. The roof consists of a 2x6 ceiling and a 2x6 roof.

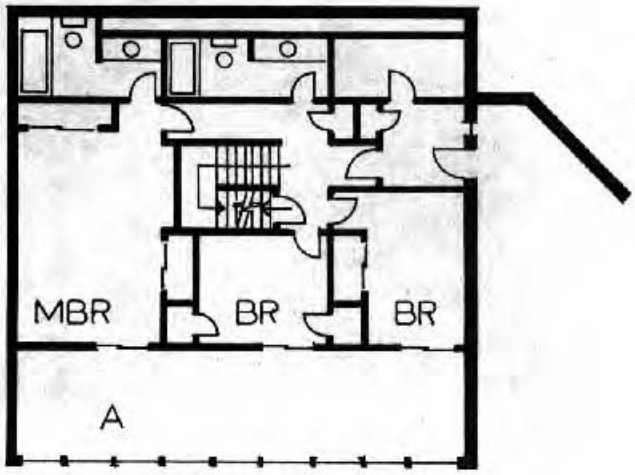
All glazing in the Seberg double shell is vertical including the entire south wall and consists of nearly 500 sq ft of tempered glass panels of the type usually used in sliding glass doors. On sunny winter days, the greenhouse temperature rises to over 100°F, and the main level living space temperature easily reaches the high 70's with no backup heat. Ceiling fans are used to circulate the warm air. Backup heat to the main level is provided by a centrally located wood stove (opposite right), and the bedrooms are heated, as needed, with a small quartz space heater. A forced air propane furnace, available for backup heating, is not needed or used.

Cooling the structure is a little more difficult than heating it, as shading is lacking for the most part -- the roof is the only overhang and shade trees to the south of the house have not yet matured. Hot air is vented from the structure through windows and a 3 ton air conditioning system is also used.

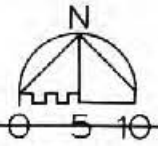
SHELL

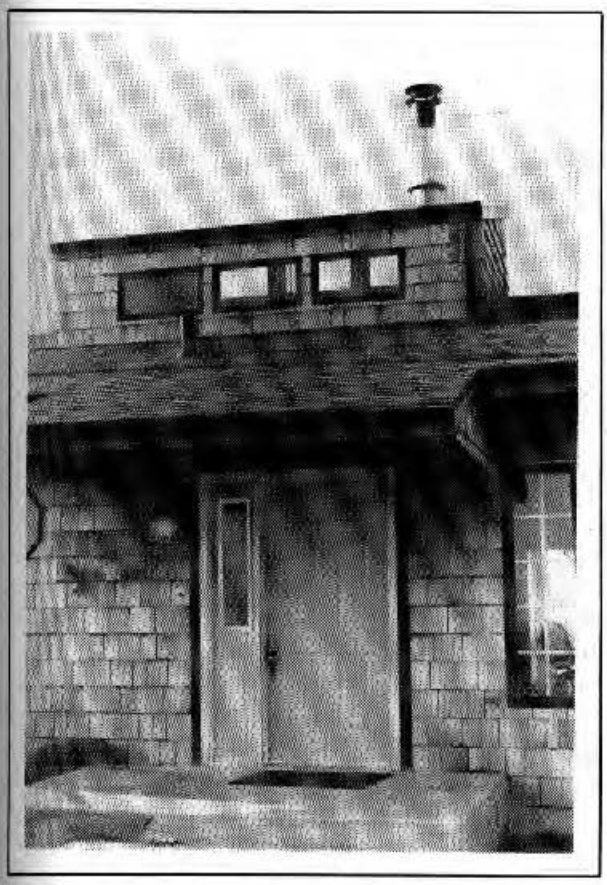


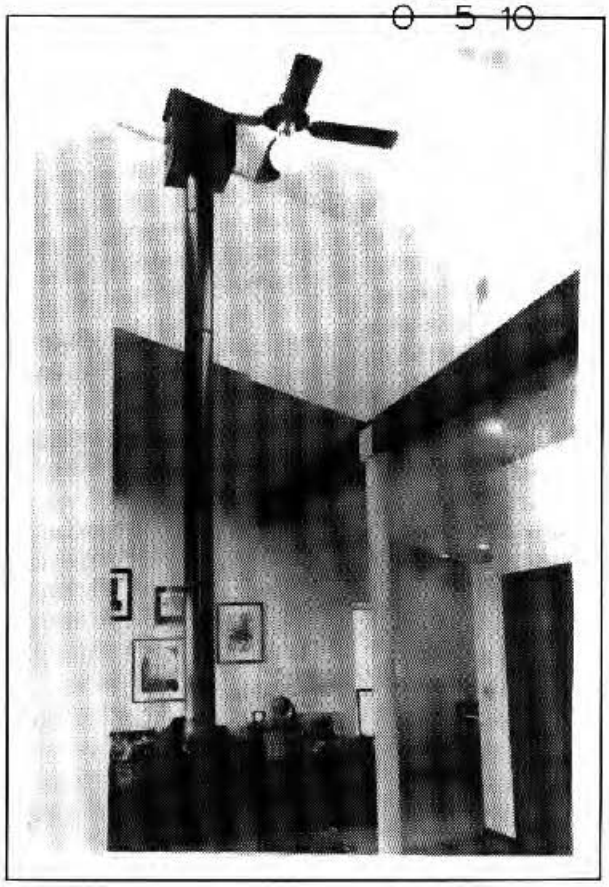
MAIN LEVEL



LOWER LEVEL







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