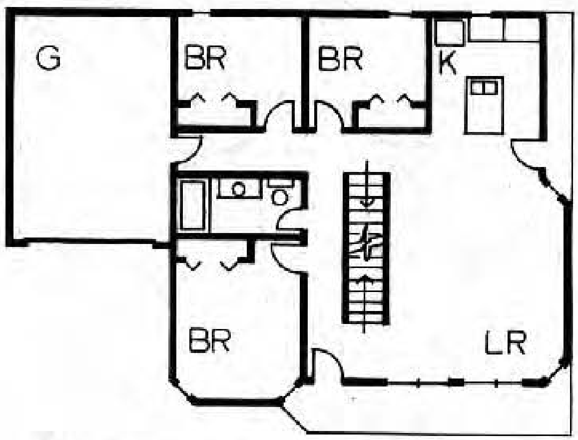
The Singer Residence is the first of three Jim Bowman (owner) Lee Schriever (architect) residential project collaborations. Each project represents an evolutionary stage in the development of an energy efficient/solar design philosophy.

Designed in 1975, the principal goal of the Singer house design was conservation; minimal use was made of then-untested passive solar techniques. For example, although the house is oriented to the south and windows are primarily located to take advantage of solar gain, the house has no thermal mass to absorb and store heat generated by the sun. Backup heat is supplied by an electric forced-air furnace.

Heating loads were reduced through a combination of reduced transmission losses -- 2x6 side wall framing allowed for higher than then-customary insulation levels -- and reduced air infiltration. Earth bermed against the north side of the house helps the building present a low profile that forces winter winds from the northwest up over the roof of the structure, a strategy designed to reduce infiltration losses resulting from wind loads.

Thoughtfully conceived ventilation strategies combined with shading techniques reduced cooling loads. The basic ventilation pattern of the house is north to south/low to high. Because windows are fixed/non-operable, air flow is enhanced by the use of screened ventilation panels (opposite right). This technique also helps reduce unwanted air infiltration in winter. Cooling by ventilation is aided by a central clerestory which functions like a chimney in drawing hot air from the home in summer. Operable shading devices protect the central clerestory from unwanted solar gain (opposite left).



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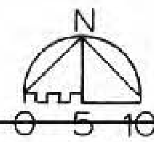

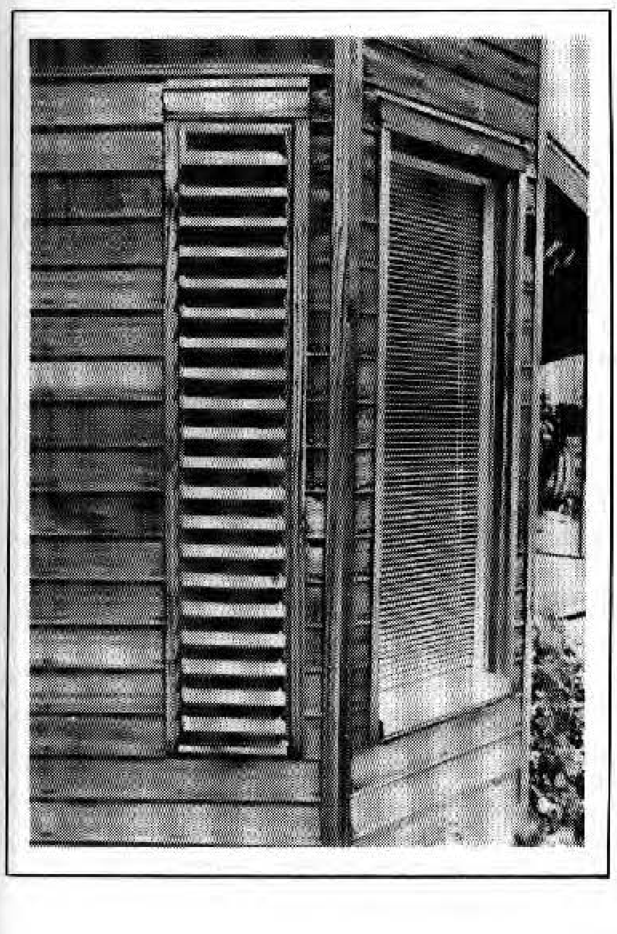

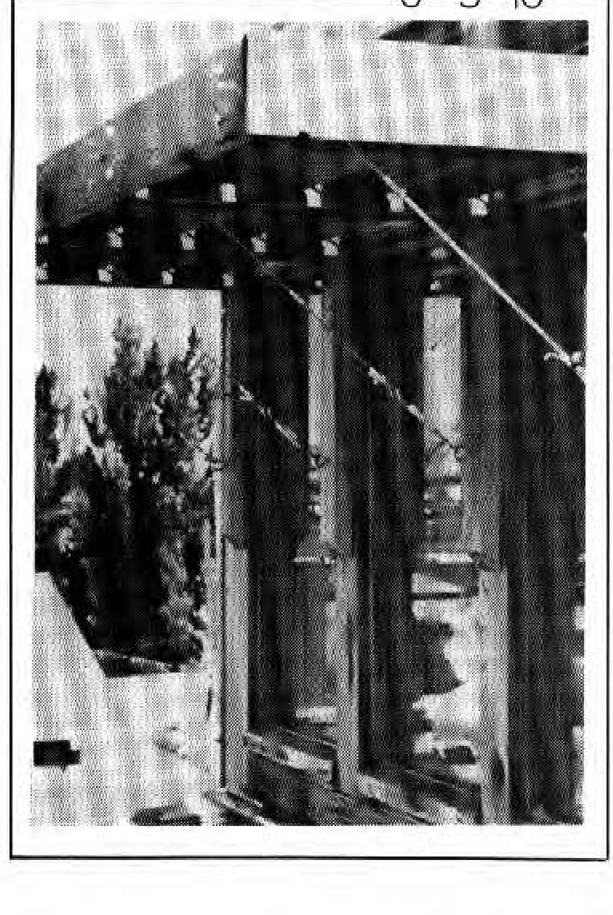

COMBS

The Combs house, the second of the three Jim Bowman/Lee Schriever residential projects, repeats several energy efficiency strategies used in the Singer residence. These include earth berming, ventilation strategies, and long roof slope to the north (opposite left). In addition, direct gain passive solar techniques were incorporated.

Sunlight entering through windows in the two-story south wall brightens the living room/dining area which is open to the second floor and generates considerable direct solar gain. A unique catwalk (opposite right) was constructed along the second floor perimeter of the open living room/dining area to make upper windows more accessible for the nightly installation of shutters.

The Combs house does not have a conventional central heating system. Instead, solar heated air is distributed throughout the house as follows: the sun warmed air rises to the top of the open living room/dining area where it is drawn through duct openings in the top of a two-story, floor to ceiling rock mass wall located at the back of the room. A variable speed fan (with air filter) draws the warmed air from a central plenum and blows it under the floor slab where it is distributed to perimeter registers.

Backup heat for north bedrooms is provided by a mid-sized, air-tight, Timberline wood stove located in front of the masonry wall; baseboard heaters in the rooms have not been used. Backup heat to the bathrooms is provided by 220 volt electric baseboard heaters.

Domestic hot water is provided by an active solar air heating system. The two site-built flat plate collectors utilize an air to water heat exchanger. Bowman feels that a liquid flat plate collector system would work better than the air to water system.

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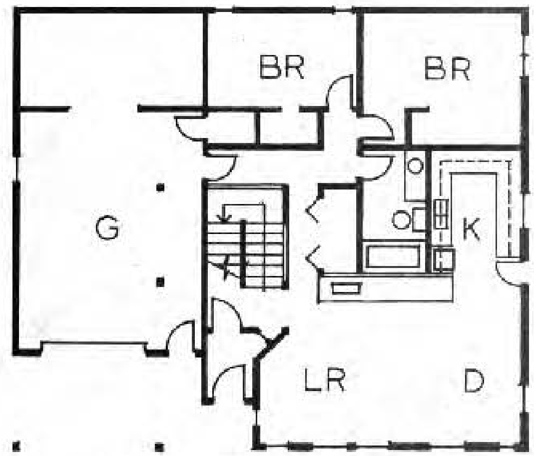

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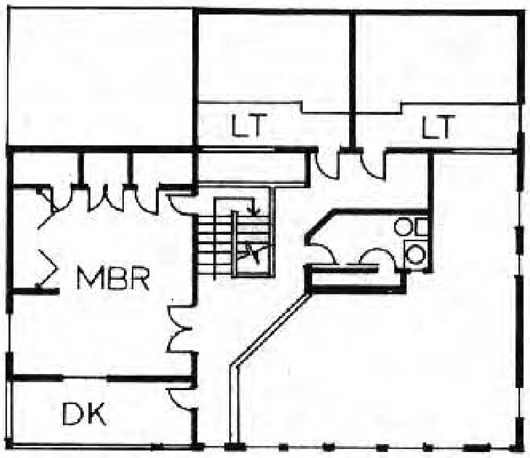

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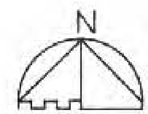


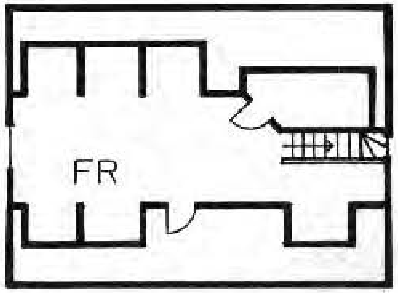
BOWMAN

The third Jim Bowman/Lee Schriever residential project is Bowman's current home in Lincoln. Unlike the Singer and Combs houses which were new construction, this project is the retrofit of a home built in 1896. Like the two preceding homes, however, the house utilizes energy conservation strategies and employs direct gain passive solar techniques. The pre-retrofitted home was not energy efficient, and both the interior and exterior of the building were in poor condition. However, the house was structurally sound and had good solar access.

The retrofitting process began with the gutting of the building early in 1981. Insulation was added to the roof and walls, and new double paned glass was installed to increase the solar gain and to brighten the interior of the house. The south facing living room and dining room are the collection area of the direct gain system, and a passive solar collecting panel was added to the south wall. Solar heated air rising from the dining room, passes through a grill in the first floor ceiling (opposite left) to the bedroom spaces on the second floor. Warm air from the third floor is recirculated to lower floors through the former chimney which has been converted for this use after a new gas pulse combustion furnace was installed. The measured TIF after conversion is under 2.3.

Two site-built active liquid flat plate collectors by Morningstar were incorporated to provide domestic hot water.

A sunspace addition of 256 sq ft of heated floor space and 132 sq ft of storage is currently under construction (opposite right). Included in this addition are a second bathroom and loft. Backup heating to the addition will be provided by a small wood stove.



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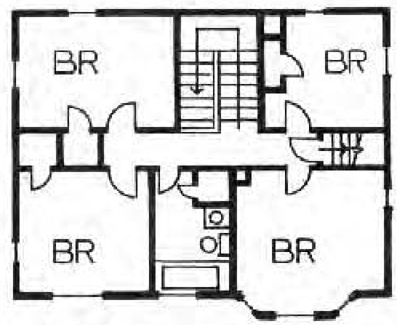

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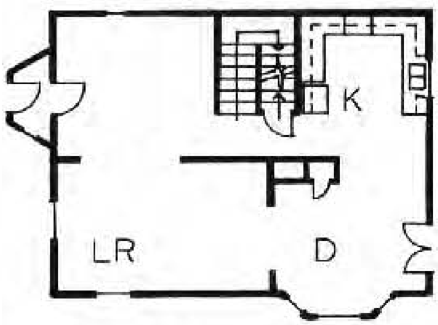

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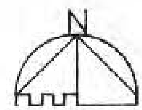
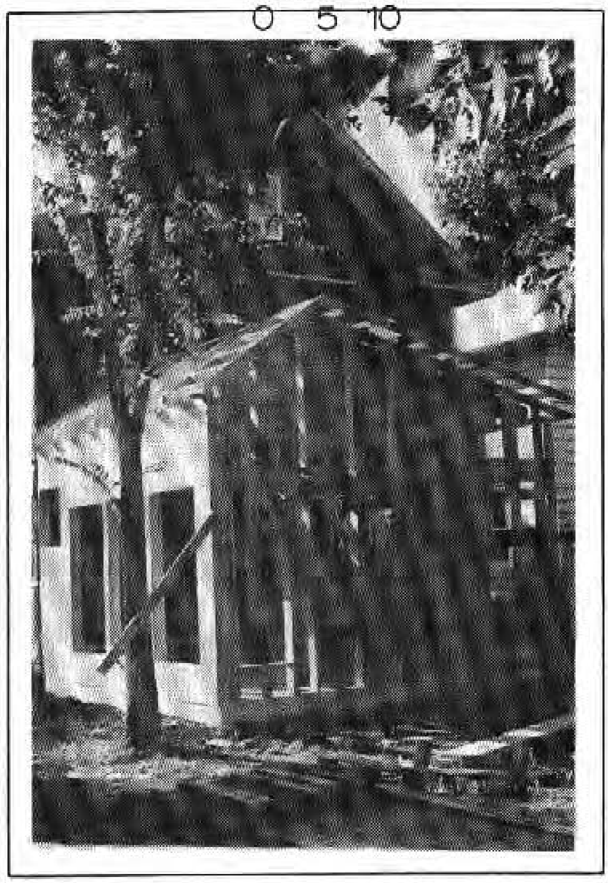




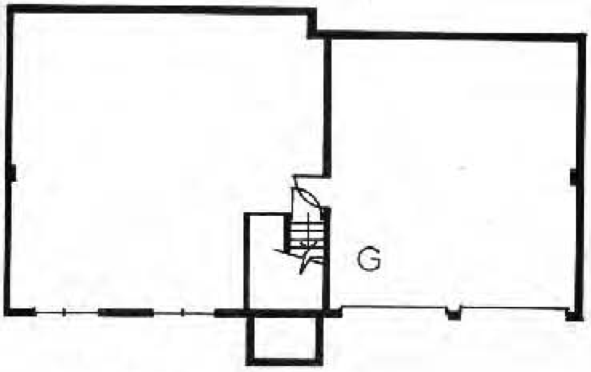
BUSSEY

The Bussey home, like the Henley home also described in this inventory, is one of the solar models being offered by Pacesetter Homes of Omaha. The Bussey home, the Riviera model, is a three bedroom, split-level house with 1344 sq ft of living space on the main level. A two car garage and basement that can be finished to provide additional living space are on the lower level. From the outside, the Riviera model looks like a typical attractive suburban house, however, its energy conservation and passive solar features make it distinguishable from typical tract housing. For example, the standard insulation levels for this energy conscious structure are R-25 in the walls and R-36 in the ceiling.

The Riviera model is a simple direct gain passive solar heated building designed so that the front of the structure faces south, with the option of reversing the floor plan (compare the photo above with the floor plan opposite). There are no east or west windows and all north facing windows are triple glazed. Two of the bedrooms and the living and dining areas all have southern exposures (opposite); to optimize solar gain in the dining room, south facing patio doors are used in place of conventional windows.

There is little thermal mass in the upper floor, and no night shutters are used in the Bussey home. Initial calculations from actual energy consumed show the Riviera, as inhabited by the Bussey's, to have a TIF value of approximately 4.2.

Pacesetter Homes has begun a complete solar subdivision in Omaha, and solar envelopes are being developed to show where buildings can be built and vegetation can be grown on each of the lots in the subdivision so as not to shade the solar collecting surfaces of houses within the subdivision.



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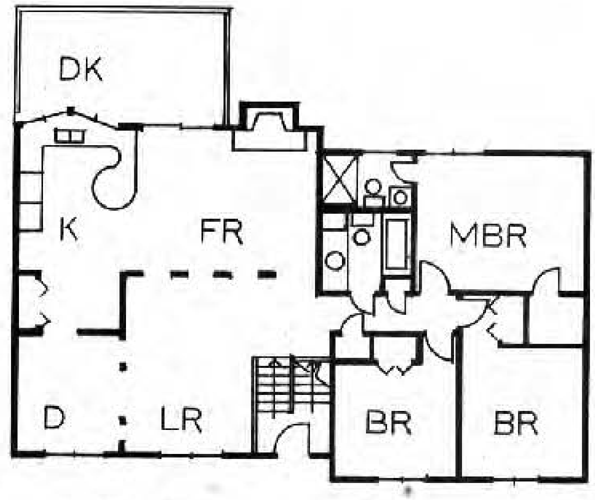

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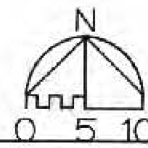


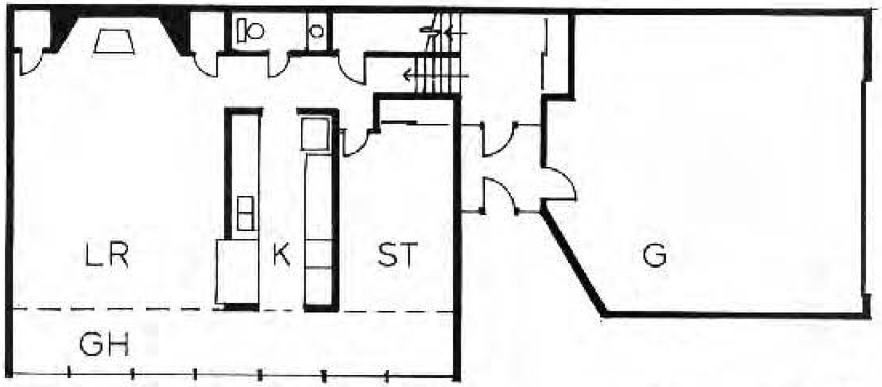
R. DAY

The Day home is an energy conserving two-story home with direct gain passive solar heating features. On the north side of the house (opposite left), unwanted air infiltration is eliminated and heat loss is reduced by the earth that is bermed above the main level. The two north facing thermal paned windows provide lighting and aid in cross ventilation.

The south wall of the Day home is almost entirely glass, and the 375 sq ft of vertical glazing significantly expands the 1900 sq ft of living space. The two bedrooms on the upper level have views to the living space below. Quarry tile floors and brick walls serve as storage mass and store heat during the day. Air ducts at the top of the living space permit solar heated air to be drawn into the house mechanical system, thereby providing excellent distribution of heat during sunny periods in winter. The backup heating system is a gas-fired furnace with pilotless ignition, the type particularly recommended for all homes with minimum levels of air infiltration using natural gas for backup heating.

"Window Quilts", one of a number of commercially available night insulation products for windows, are used on the south glazing (opposite right) to reduce heat loss at night. The use of night insulation schemes in direct gain buildings is crucial as thermal performance without night insulation is seriously degraded.

The overhangs which shade the south glazing (opposite right) prevent unwanted direct gain in summer. Summertime cooling loads are minimized by opening the operable windows at the bottom of the south wall glazing (opposite right) to help create cross ventilation.



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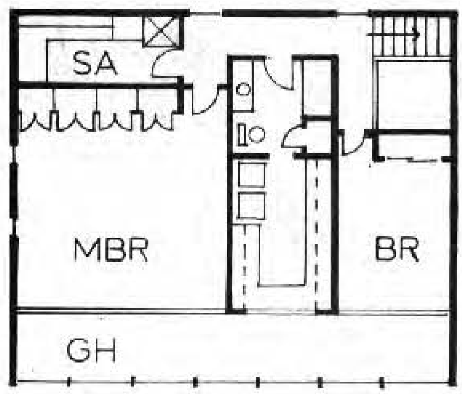

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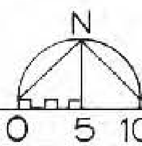

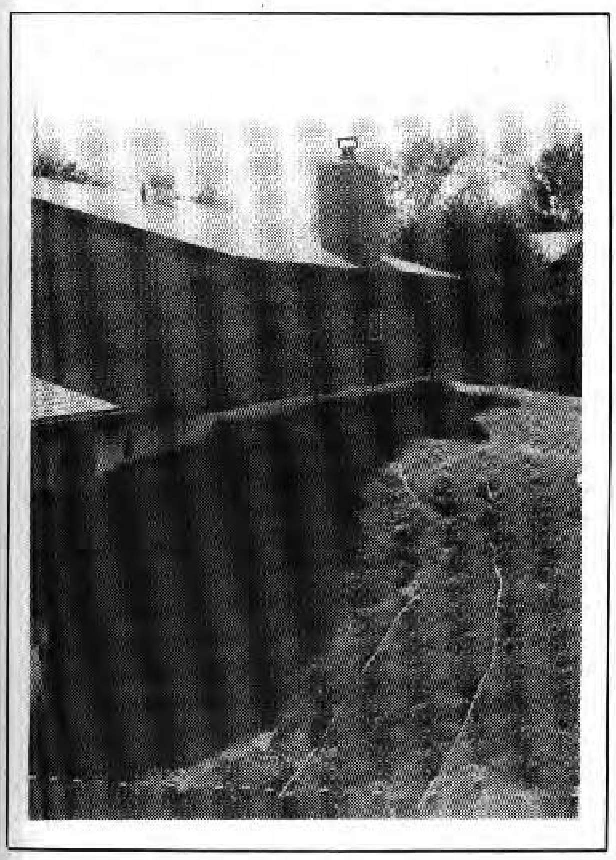

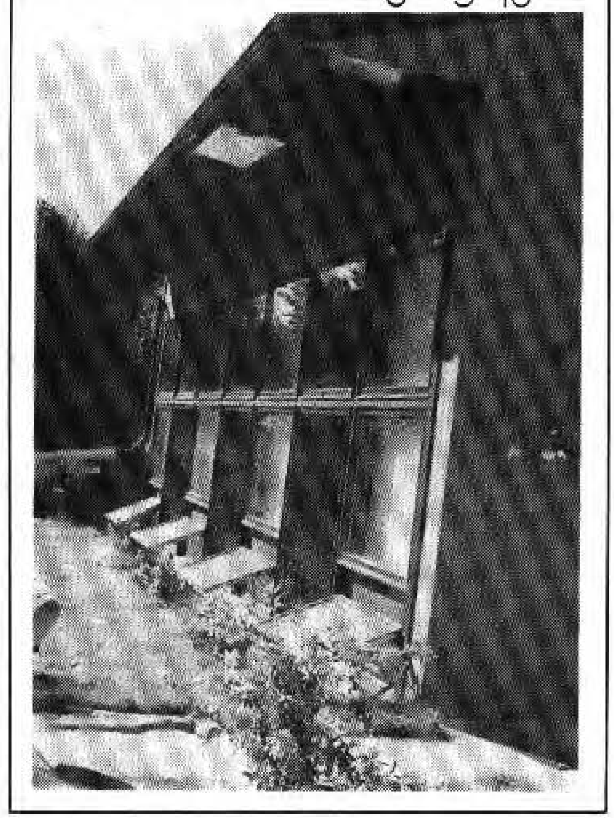

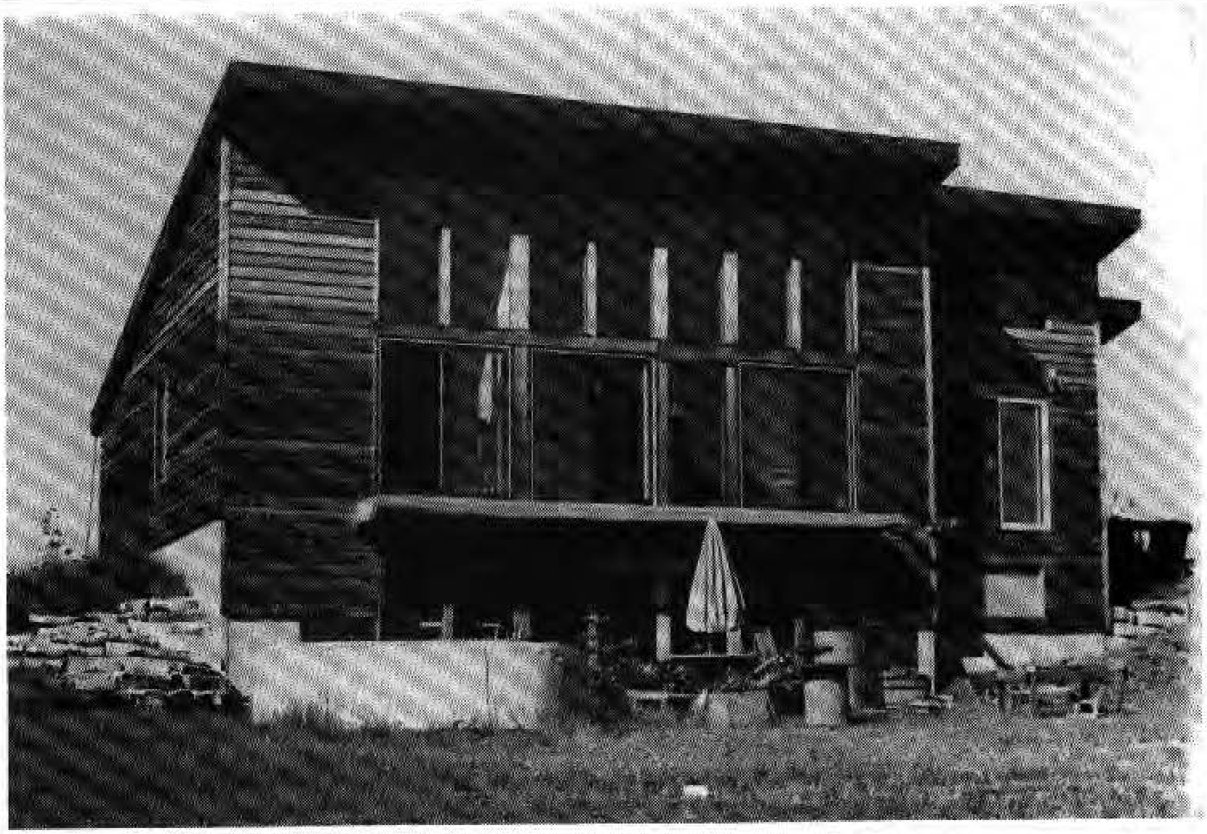

The 1320 sq ft Jaksha home is an energy conserving -- R-28 side walls and R-32 roof -- direct gain passive solar house with some mass storage. The owner-designed and owner-contracted house is basically a single story dwelling with a walk-out basement that contains a family room, office, laundry, and storage -- both thermal and conventional.

Considerable sunlight penetrates through the 420 south facing vertical double paned glazing to provide light and heat. Some of that heat, in 250 gallons of water mass storage located in the basement, supplies backup heating. The water in storage is heated by solar warmed air drawn, by a fan located in the basement, through the unfilled cores of an 8' high concrete block wall in the living room. When the water storage is incapable of providing sufficient heat to the living spaces, a woodburning stove, located between the living room and dining room, provides backup heating. The stove is on the living room side of a waist high, semi-circular brick mass wall (opposite right).

Nighttime heat loss through the dining room windows is minimized by the use of movable insulation on the inside of the windows (opposite left). In this case, the movable insulation is an owner-designed innovation that is also available commercially. The "INSULIDER" window shutter is 3/4" thermax backed with nylon/herculon upholstery fabric. The shutter rolls not unlike a conventional shade and, when not in use, stores in a compact housing unit that is located above the window. The shutter, which slides in its own side tracks, can be operated manually or, with the appropriate mechanical modifications, automatically. The Insulider, with a maximum width of almost nine feet and a maximum length (or height) of twenty feet, is available in a number of sizes.

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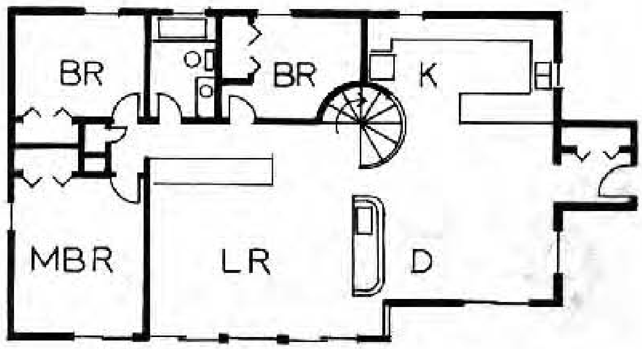
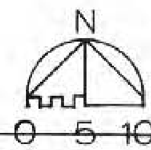
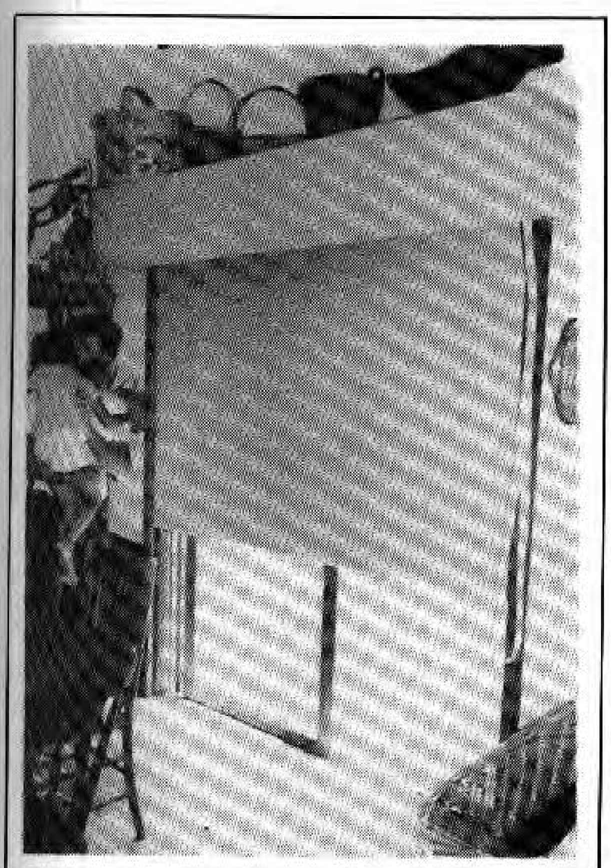
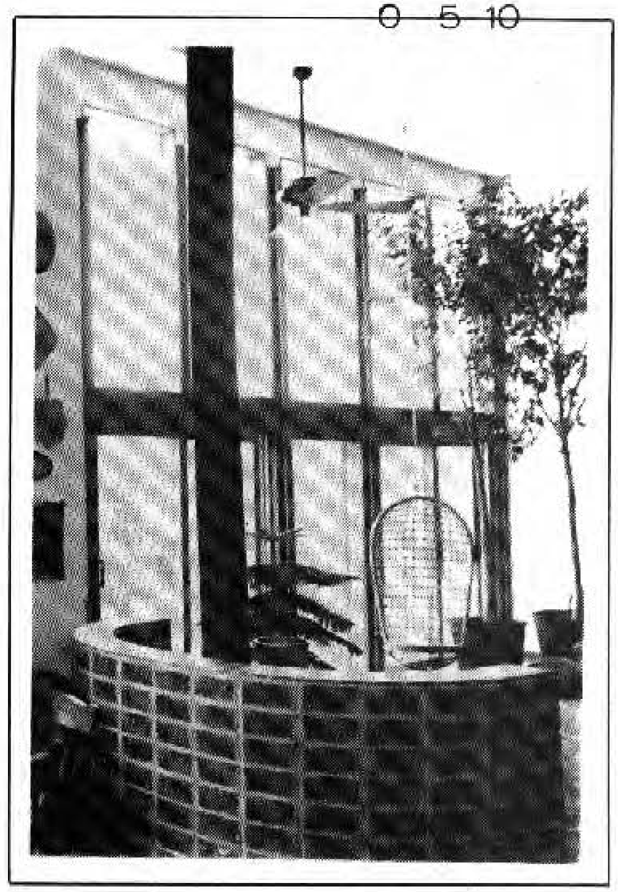
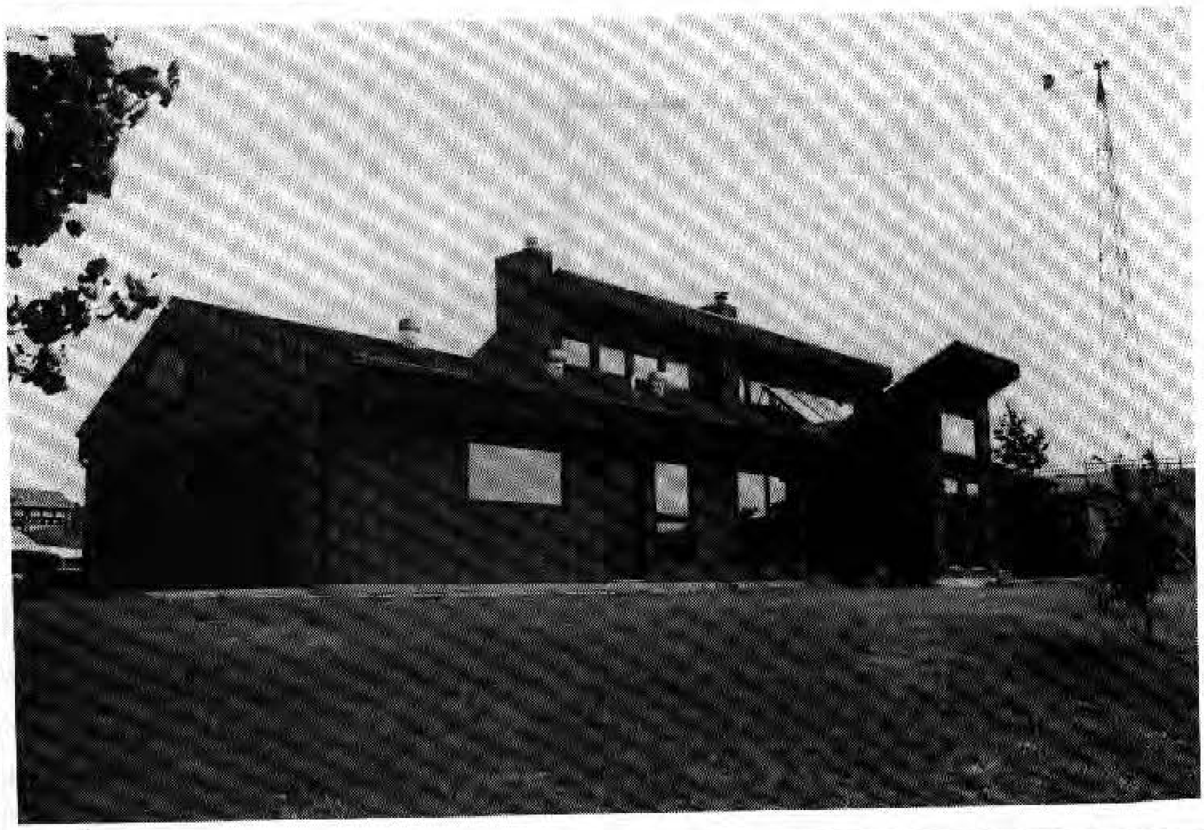








MILLER

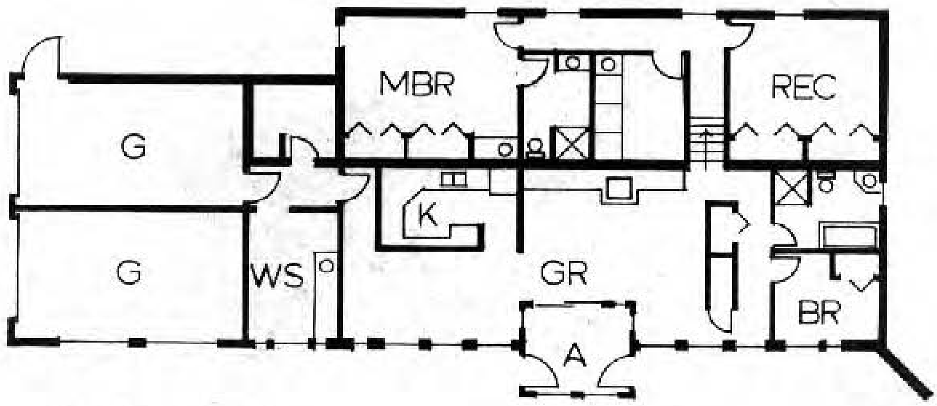


The super energy efficient Miller home effectively combines energy conservation strategies with passive solar energy, active domestic water heating, and wind generation in its scenic location just outside Kearney. The owner-designed home feels more spacious than its 1640 sq ft plus of floor space because rooms tend to be partitioned rather than completely walled off. There is a loft over the kitchen, and other lofts are located in the bedrooms.

The home is primarily a direct gain passive solar structure with 260 sq ft of glazing, and backup heating is supplied by a wood stove (opposite left). Heat is circulated throughout the house by an internal convective loop system in the following manner: warm air rises to the elevated north rooms in the bi-level structure and is drawn through ducts in these rooms and returned beneath them to the front rooms. Air circulation aided by ceiling fans helps circulate warm air in winter and cool air in summer. Considerable thermal mass in the floors (opposite right) and walls helps to keep temperatures stable. The house also has double door entries.

Approximately three cords of wood have been burned each of the past three winters to supply backup heat. Electricity is supplied by the wind generator, and electric bills have averaged under $38 per month for the three years the Millers have lived in their house. If night shutters are used, the predicted TIF for the Miller home is under 1.0, making it one of the most thermally efficient homes in the state.

An active collector panel by A.O. Smith heats water needed for domestic use. The Millers estimate that nearly 70% of the total family hot water heating requirements are supplied by the system.



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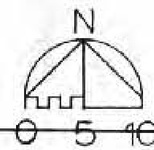

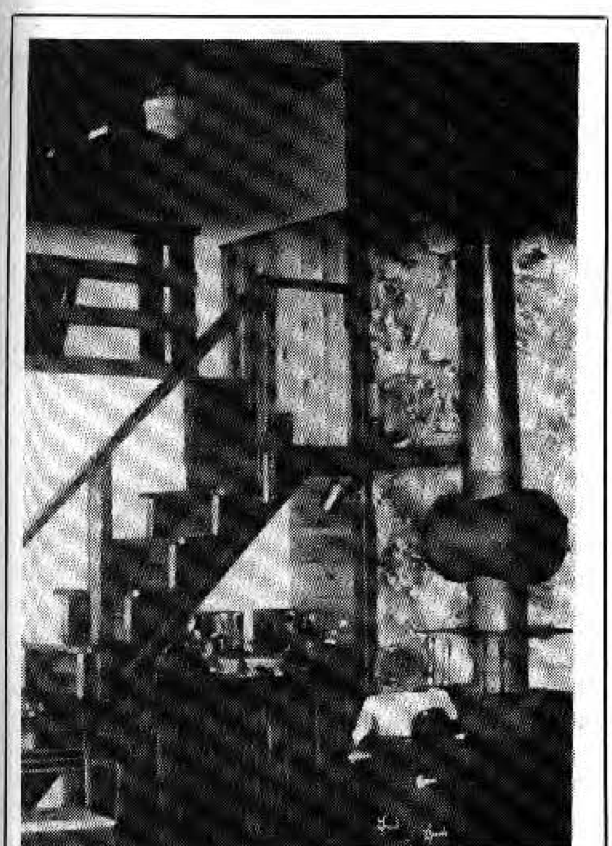

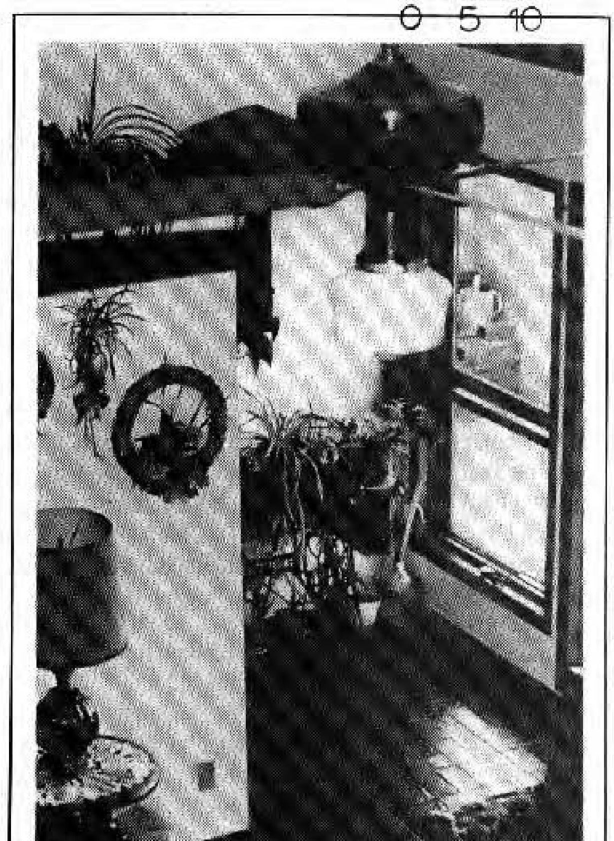

C. NELSON

OMAHA

DIRECT GAIN

The Nelson residence is the California Sun house, a solar and all gas -- heat and appliances -- demonstration home built by Marquis Quality Construction of Omaha. The exterior walls of the approximately 2400 sq ft house are 2x6 framing stud walls with an insulation level of R-29. The ceiling insulation level is R-38.

The primary passive solar heating strategy is direct gain, with most of the south wall glazed (opposite left). Clerestory windows allow sunlight to penetrate and heat the bedrooms located to the back (north) of the house. Warm air, mostly solar heated, is also collected in an exposed duct at the peak of the house (opposite right) to be circulated throughout the house.

The home has considerable thermal mass, and, therefore, is not as likely to overheat as most direct gain houses. In fact, it is one of the few direct gain structures in Nebraska that was designed with sufficient thermal mass to reduce the temperature swings normally associated with direct gain buildings, and the owner confirms that the house functions as designed in this regard.

The Nelsons moved into the home in September of 1982, and, since then, their largest utility bill has been approximately $100. The owners believe that the energy performance of the home will improve with some modification to conservation strategies and/or operations. For example, some of the solar quilts (opposite right) that are used for night insulation were mismeasured and consequently did not fit properly. Properly fitting quilts have been installed for the next heating season, and the Nelsons expect an additonal 20% decrease in their energy use. The owners also feel that using the fireplace, which has never been used for heating purposes, will decrease reliance on the conventional backup heating system.

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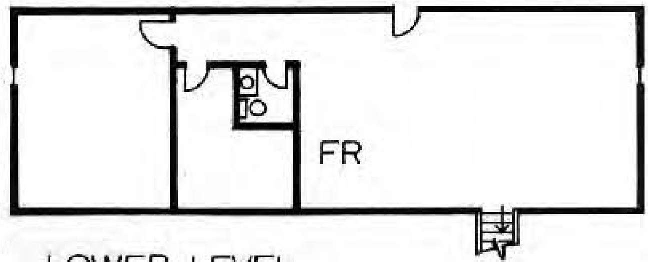

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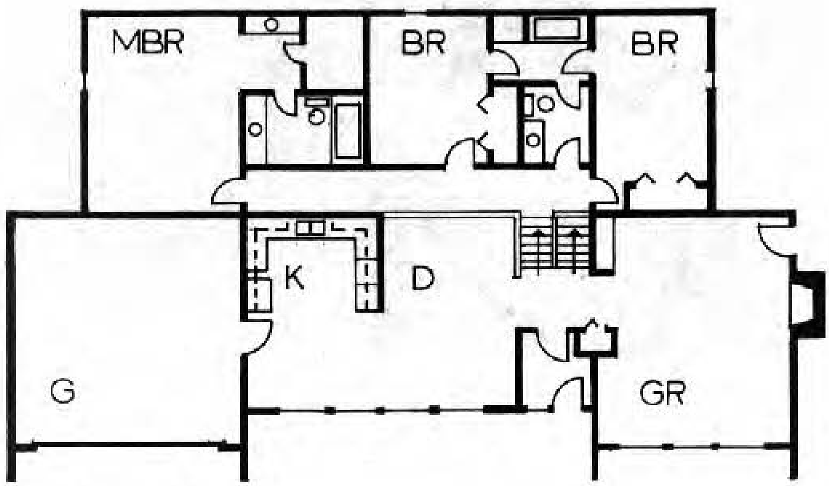

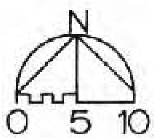

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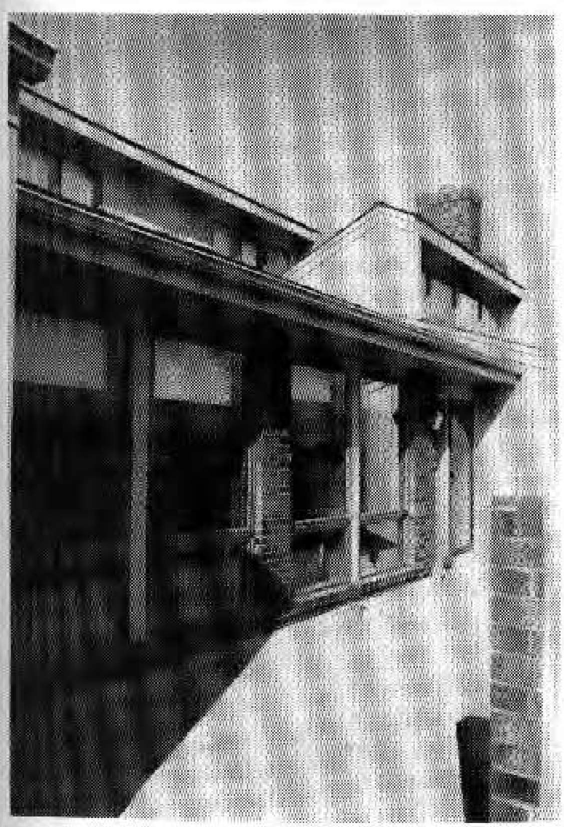

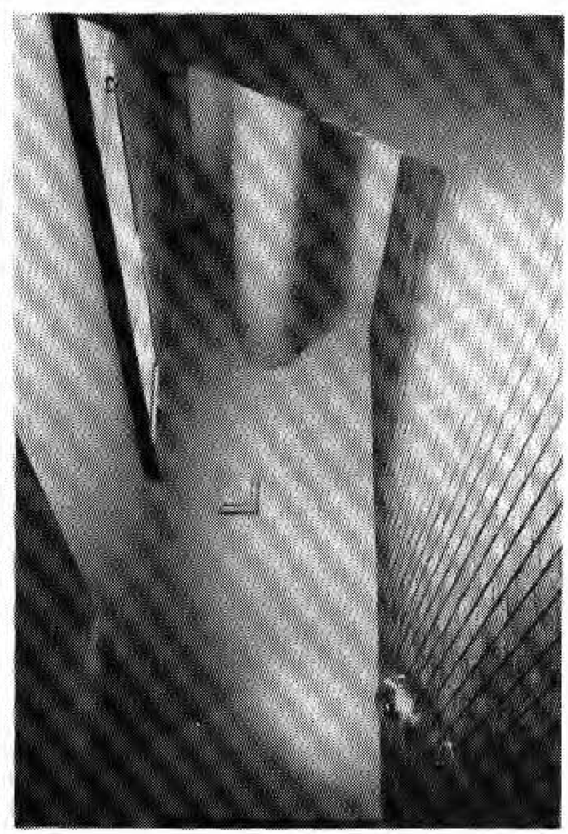

PETERSON

The Peterson home was one of the first solar houses built by Peterson Construction of Lincoln. This design, the creation of Charlie Thomsen -- then of the Clark Enersen Partners, also of Lincoln -- was a HUD Cycle V solar design award winner. The 1600 sq ft house has 2x6 framing in the side walls with insulation levels of R-19. The sloped ceilings have insulation levels equating to R-32.

For solar heating, the house relies primarily on direct solar gain through the south glass and clerestory windows. The house also has water wall mass storage, and a modest greenhouse functions as a vestibule/entry. The clerestory glazing is a translucent Kalwall material. The upper portion of the south walls in the bedrooms is glazing, so sunlight penetrating the clerestory windows reaches the north walls of the bedrooms. Brick walls in the north bedrooms absorb solar heat, and the incoming light provides daylighting to the normally dark north rooms. Warm air is collected at the peak of the house and returned through a cold air return to be circulated throughout the house. A wood burning stove is used for supplemental heating.

Solar shading and control devices are important cooling strategies in the Peterson house. For example, the clerestory windows are recessed to prevent unwanted summer sun penetration. Vertical wingwalls (opposite left) are used to eliminate unwanted solar gain in the late afternoon. Attached overhangs also provide shading to non-clerestory windows (opposite right).

Two different movable insulation systems -- one automatic and motorized, the other manually operated --are used on the south windows. The multi-layered shutters create air pockets when unrolled and provide an insulation value of approximately R-13.

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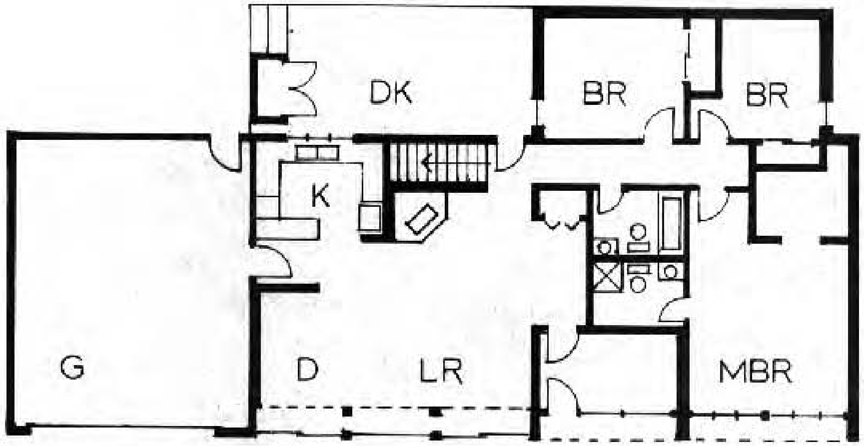

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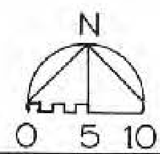
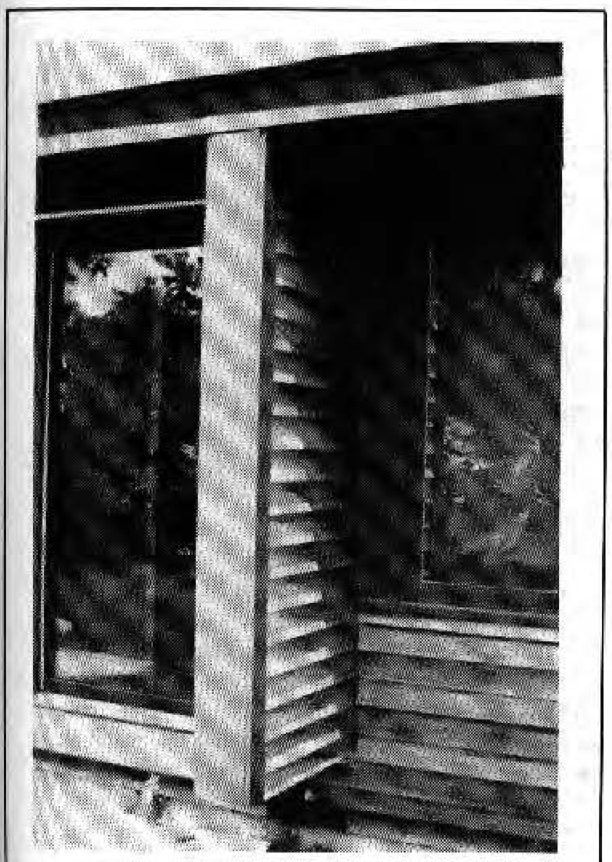
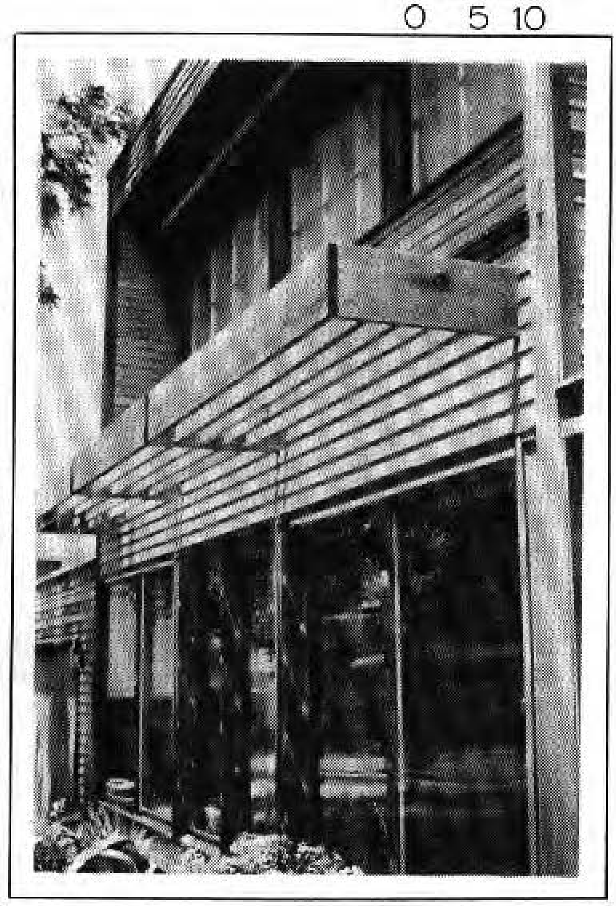






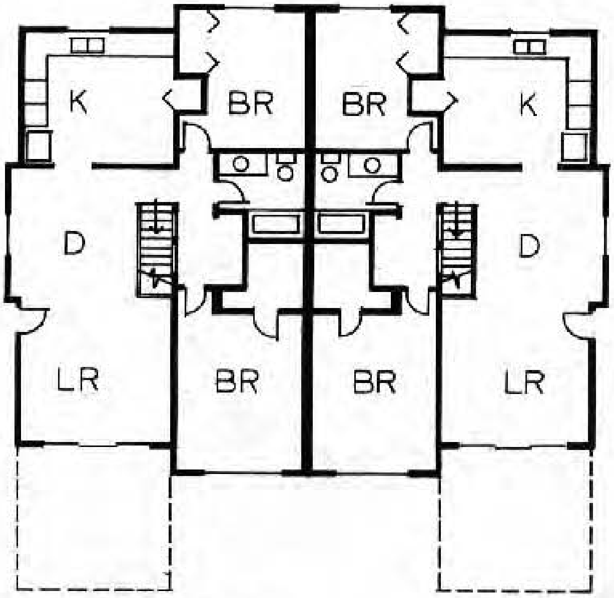
TOWNHOMES

Energy efficency and passive solar design strategies are available to Lincoln residents choosing townhouse living thanks to the foresight and commitment of Bob Peterson of Peterson Construction.

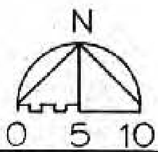
The townhouses are intended to have wide appeal and are offered in a number of different models and designs. They range in size from 860 sq ft for a one story home to 1200 sq ft for a three bedroom home on two levels. Inner units of the townhomes are 16' wide and outer units are 24' wide. Purchasers also have the choice of one or two car garages. In some models, the garage is situated to function as a wind break, thereby reducing heat loss resulting from wind load air infiltration.

Common wall construction, typical in townhouse design, can have a major impact on energy consumption; common walls result in less surface area of the structure exposed to outside temperature extremes and consequently have lower heat losses. In the Peterson townhomes, common walls have double stud wall framing. Insulation levels are R-21 in the exposed walls, R-30 in the cathedral ceiling roofs, and R-38 in the other roofs; below grade walls are insulated with 2" of rigid insulation. Metal doors have an insulation value of R-14. Backup heating is supplied by electric furnaces or heat pumps, at the option of the owner.

The south glazing in the units varies from approximately 50 sq ft to 90 sq ft, and all windows are double glazed casement windows. The townhouses are a simple direct gain system, although owners of certain units with the back facing south have an option to replace the deck (opposite) with a greenhouse.



MAIN LEVEL



SYBOUTS

The Sybouts moved into their direct gain passive solar home in April of 1983. The owner, influenced by THE PATH TO PASSIVE: NEBRASKA'S PASSIVE SOLAR ENERGY PRIMER and other resource materials, designed the house, and the floor plan reflects the lifestyle of a couple with grown children -- the master bedroom is located on the 1500 sq ft main level.

The Sybouts house, which from the street (opposite left) gives no indication that it is a passive solar design, incorporates a number of energy conservation features. For example, the house has an airlock entry, it has only 23 sq ft of glazing on the north side of the house and only 6 sq ft of glazing on the west, and it has 9" of batt insulation in the sloped roof and 12" of batt insulation in the flat roof.

Solar gain is through 240 sq ft of south facing glazing which includes the clerestory windows. Heat is stored in the brick mass walls (opposite right) in the great room, and ceiling fans (opposite right) circulate sun warmed air. Motorized "Insulider" night shutters (opposite right) are used on all south facing windows to reduce the significant heat losses that can occur through windows with relatively low R values. Although the house has a high efficiency gas furnace, backup heat is primarily supplied by a Lincoln woodburning stove (Papa Bear model) that is located in the basement and is connected to the ductwork of the mechanical system.

To reduce air conditioning loads during the cooling season, the owner lowers the motorized night shutters during the day to block direct gain, and, after the sun sets and outdoor temperatures fall, the operable windows in the clerestory are opened to allow warm air at the peak of the house to vent.

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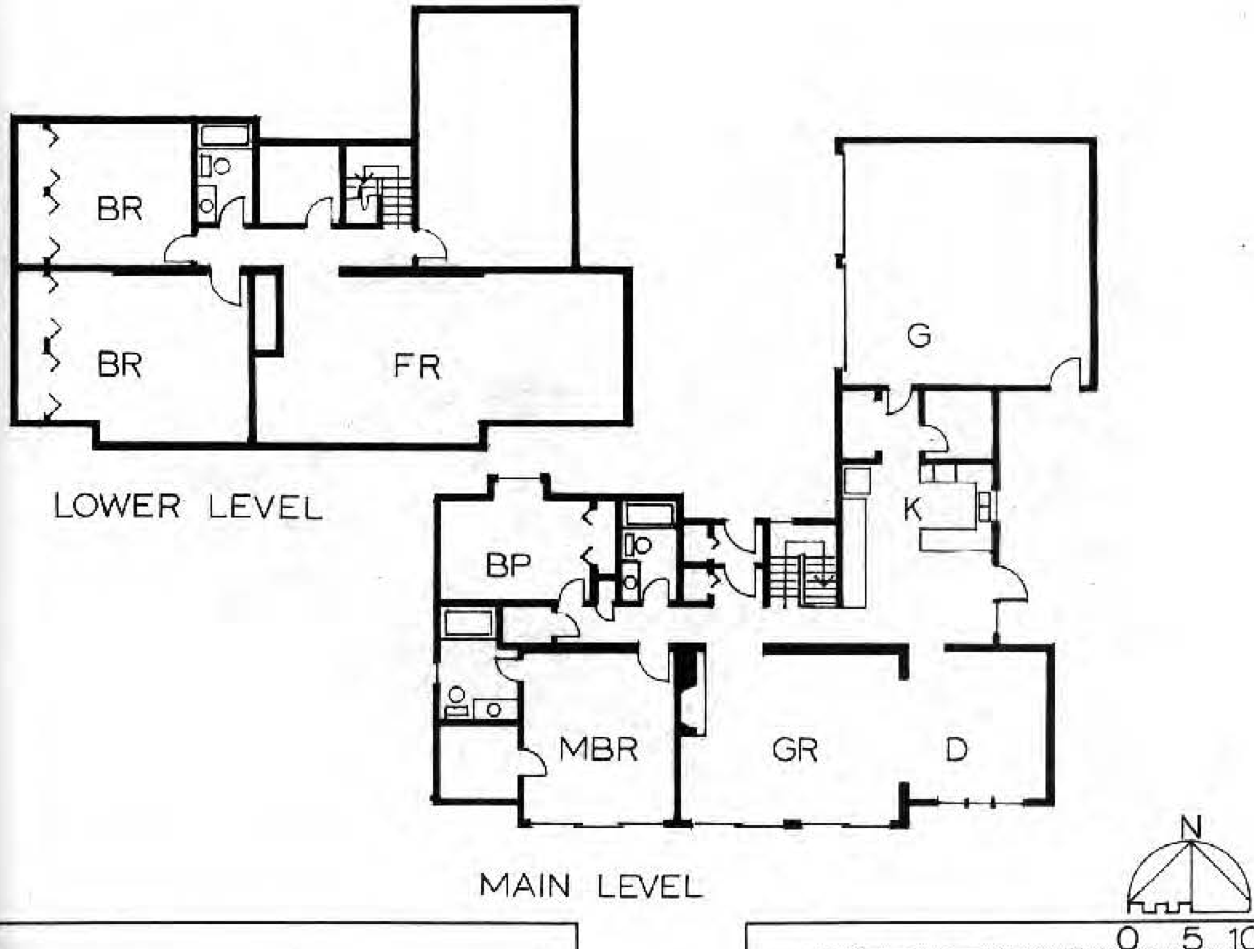

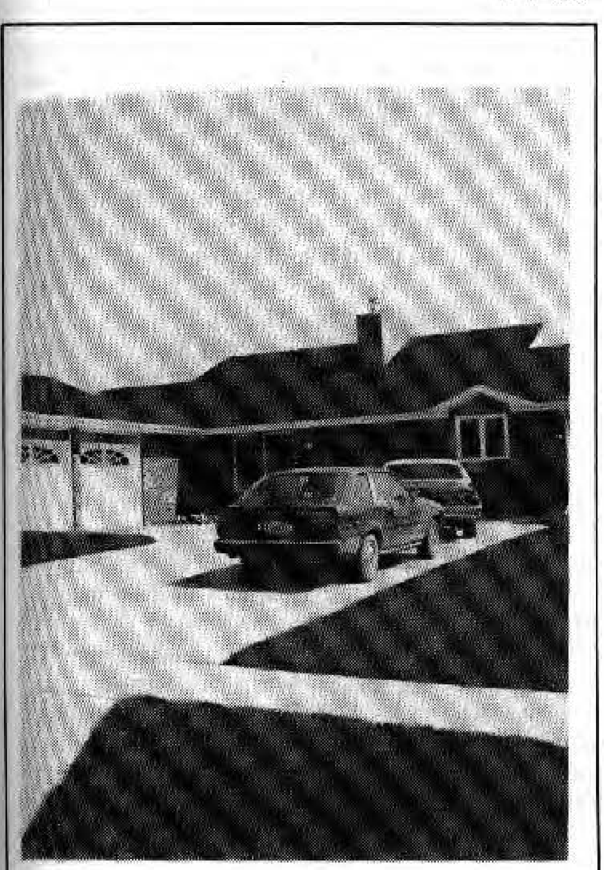

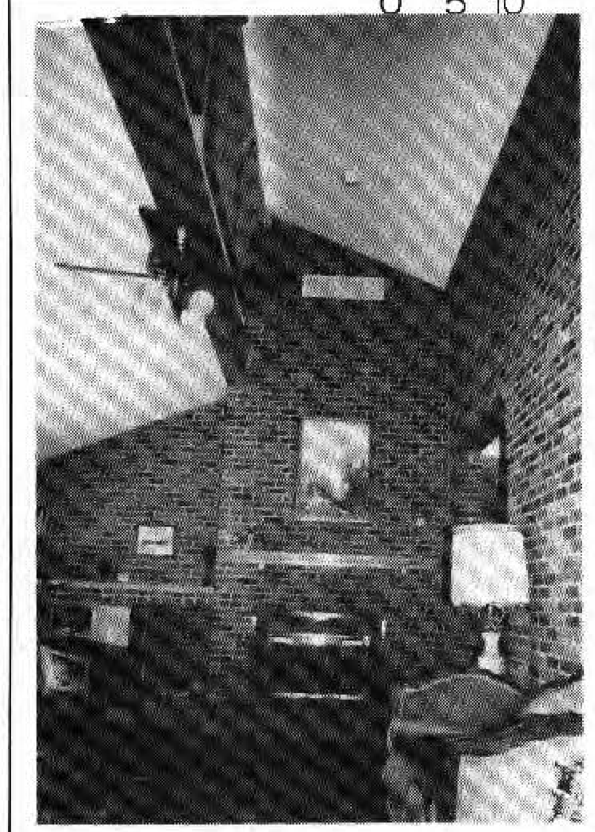

WRAITH

The Wraith home, Solar 1, is an American Wood Council "Idea House" built in conjunction with the Metropolitan Omaha Builders Association. This direct gain passive solar design demonstration home features a basement foundation of treated wood. The house was designed and engineered by Ionic Solar and built by Grace-Cizek Construction, both of Omaha. The home has 3400 sq ft of living space divided between two levels.

The passive solar heating strategy used is direct gain with vertical glazing. Sun heated air is drawn to the east wall by a squirrel cage fan and redistributed to the rest of the house. The primary source of backup heat is a Lennox gas pulse combustion furnace. The house also has a fireplace, and there is a wood burning stove in the basement.

The most unique feature of the house is the bead wall window insulation system which is used in the windows of the first floor and some of the windows of the second floor (opposite left and right). Basically, a bead wall window insulation system functions like any other window insulation system; the windows are left uninsulated when the sun is shining, and they are insulated when the sun goes down. A beadwall window insulation system is unique, however, in that the insulation is applied to neither the exterior nor the interior of the window. Rather, styrofoam beads are blown from a storage compartment into the cavity of each specially constructed fixed-pane oversized window when insulation or shading is desired, or sucked from between the windows when sunlight in the rooms is wanted. Static electricity can sometimes prevent the removal of the beads.

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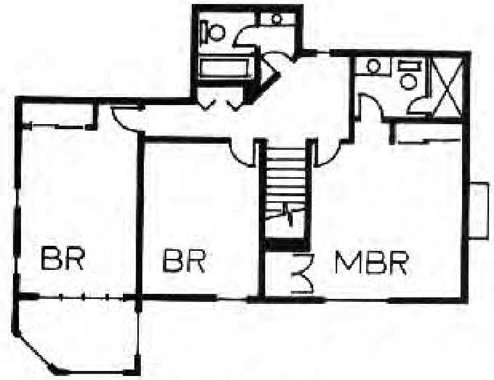
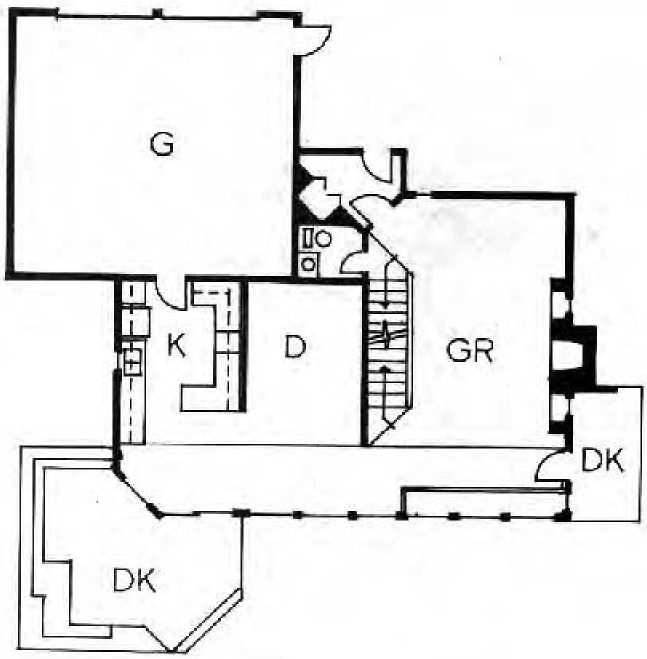


UPPER LEVEL



MAIN LEVEL