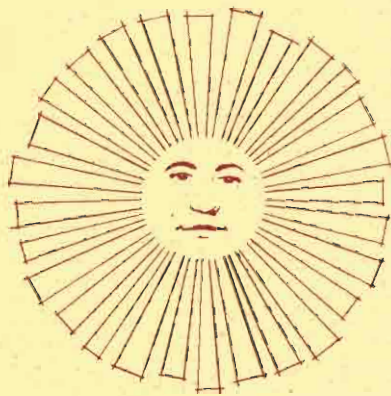
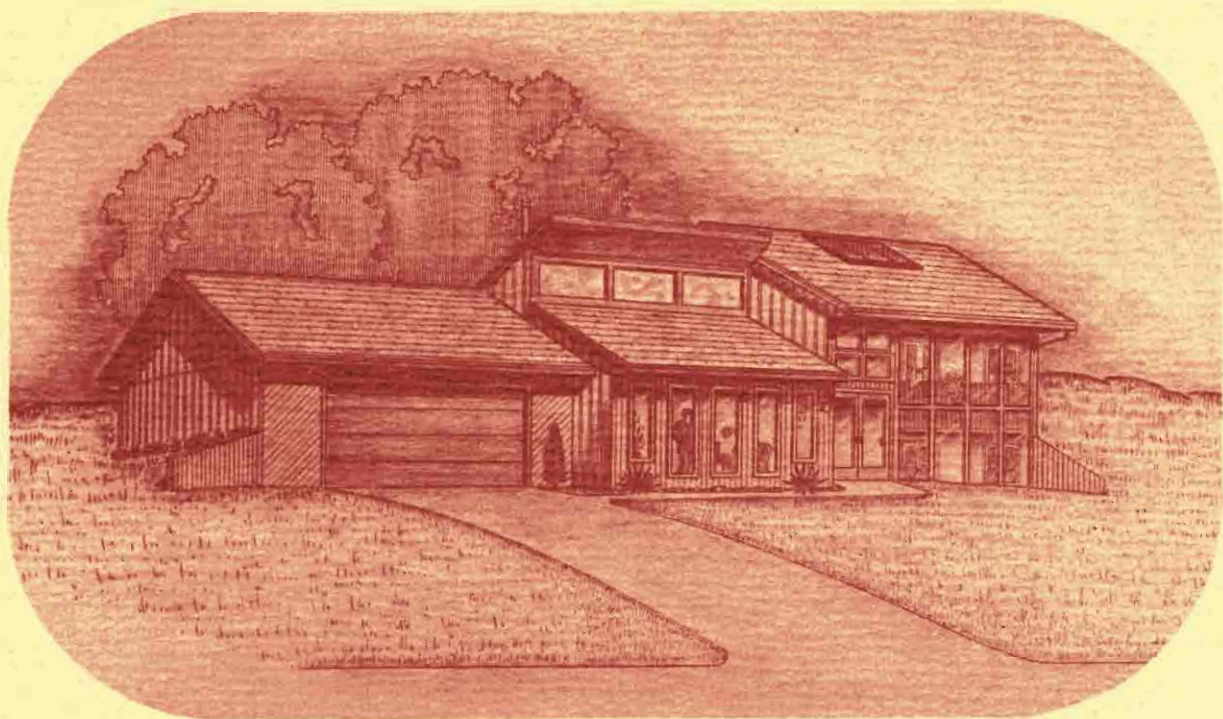


# Craig Wolfe Solar Design & Construction

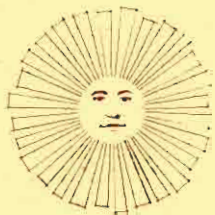


Introduces

## *The Energy 1 Concept Home*



Creating Kansas City's *Leading Edge* . . .



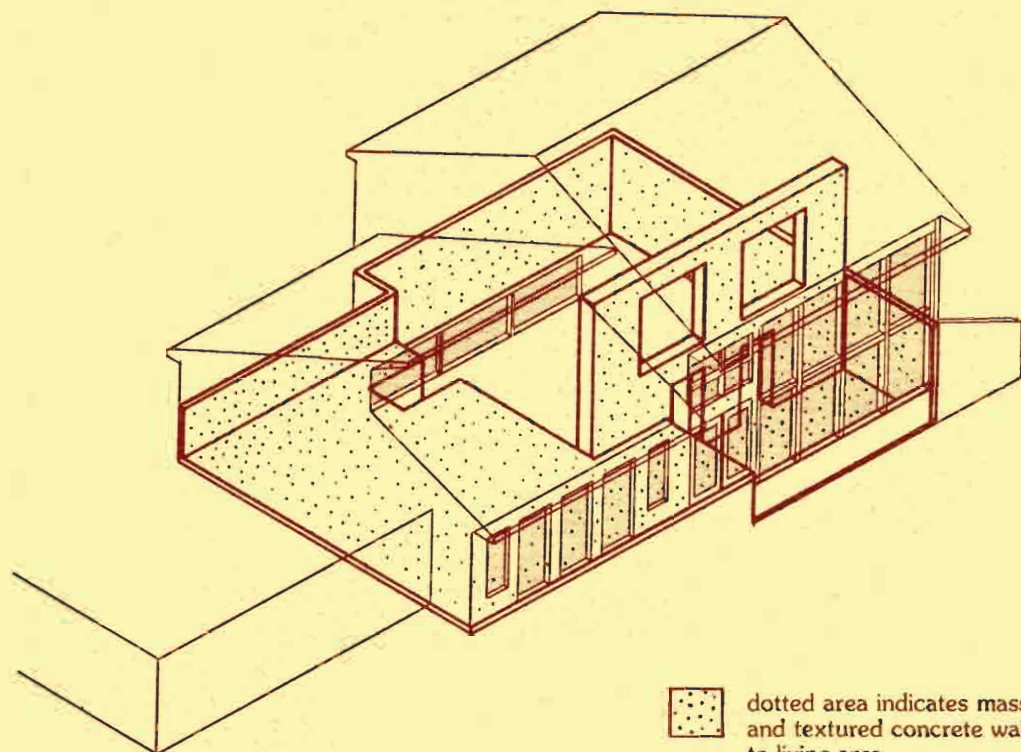
# Craig Wolfe Solar Design & Construction



**The Energy 1 Concept Home** refers not to any particular model but is, instead, descriptive of a unique design and construction approach to home building. This concept relies on a thorough understanding of passive solar principles as well as a complete knowledge of the true nature of heat loss in today's homes. The unparalleled performance is dependent upon revolutionary energy conserving construction techniques and an exacting design process rather than the complex and expensive heating and cooling systems used in other "energy efficient homes". The residence of Tom and Ann Staggs is the first representation of the *Energy 1 Concept Home* and has now been in operation through the severe winter of 1981-1982. The drawings and data of this text will often refer to the Staggs Residence.

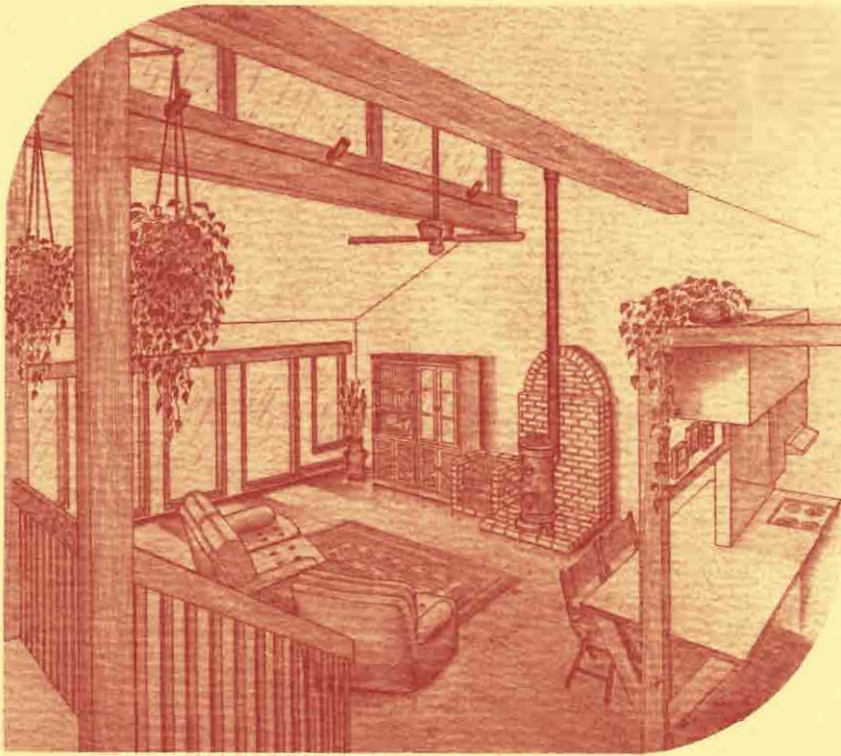
## The Performance

A computerized analysis of every *Energy 1 Concept Home* is standard procedure. However, this analysis is based upon theory and must be supported by actual performance. The Staggs Residence speaks for itself. The temperature of the home's 1568 square feet of conditioned living area was maintained at a constant 68°-70°F. range, day and night. Because the home's heating requirements were so low, four small localized electric baseboard units were used for backup heat, drastically reducing the cost of the heating equipment.

The total electric heating bill for the time period between December 1, 1981 and March 1, 1982 was \$110. It should be noted that the present cost of heat delivered from electric baseboard resistance heat is more than twice that of natural gas. This means that the total auxiliary heating requirement for the record-breaking severe weather between December 1, 1981 and March 1, 1982 is equivalent to only \$51 of natural gas! Current projections of energy rates indicate that natural gas prices will overtake electric resistance heat prices by 1990. It should be further noted that Kansas City Power and Light is using the Staggs Residence as a test case because of its unique design. As a result, the Staggs were under contract with K.C.P.&L. not to use their wood-burning stove so as to insure the accuracy of their testing. How has this remarkable performance been accomplished?



-  dotted area indicates mass brick floors and textured concrete walls exposed to living area.
-  shaded area indicates south glazing.



## The Approach

Let's begin with a discussion of the principles of passive solar and an analysis of the *Energy 1 Concept Home* approach. In simplest terms, there are three elements in a passive solar home. They are the home's shell, the glazing, and its thermal mass or heat storage.

### 1. The Shell

The home's shell is responsible for its thermal protection. By using the approach referred to as "super insulation", the *Energy 1 Concept Home* has greatly minimized its energy losses. Super insulation, of course, implies a large insulation package. But even more important is the "super infiltration" package that attacks the movement of air through cracks in the home's walls and ceilings. This is accomplished through the use of true "double wall construction". Our true double wall uses an outer 2 x 4 wall and an inner 2 x 2 or 2 x 4 wall with a 6 mil polyethylene vapor barrier sandwiched between the two. Both walls are filled with fiberglass batts with one inch of rigid Thermax insulation on the outside of the outer 2 x 4 wall. Using terminology familiar to Kansas City, this would be considered a "triple wall" system. Since all wiring and plumbing is located in the inner wall, the vapor barrier is never penetrated. This vapor barrier is continuous, enveloping the entire house from the foundation to, and including, the ceilings. It is our meticulous attention to detail of these super insulation and super infiltration packages that enables the *Energy 1 Concept Home* to achieve its unprecedented performance.

### 2. The Glazing

The second element of a passive solar home is its glazing system through which the Sun's rays enter the structure. What sets the *Energy 1 Concept Home* apart from other solar homes is the standard use of Window Quilt insulation on all glass surfaces. The effect is three-fold. First, the Window Quilt insulation system has a major impact in reducing conduction losses on winter nights and cloudy days. Second, it is equally effective in reducing conduction losses and in blocking unwanted direct and reflected sunlight on hot summer days. Third, in winter our bodies will experience greater comfort in the room with Window Quilt insulated glass when compared with the room without insulated glass, even though equal temperatures are maintained in both rooms. Simply put, our bodies give off radiant heat which will literally be "sucked" away by the uninsulated glass. The elimination of east and west glass and the use of properly designed overhangs on south glass add to the *Energy 1 Concept Home's* excellent summer performance.

### 3. Thermal Mass

The thermal mass is responsible for the storing of the Sun's energy. It can be brick, concrete, stone, tile, adobe, or even water in containers. Without thermal mass, even on a cold sunny winter day, a passive solar home would overheat and would also require more auxiliary heat at night. Thus, thermal mass acts as a heat sponge, absorbing excess solar heat during the day and releasing its radiant heat at night as temperatures decline.

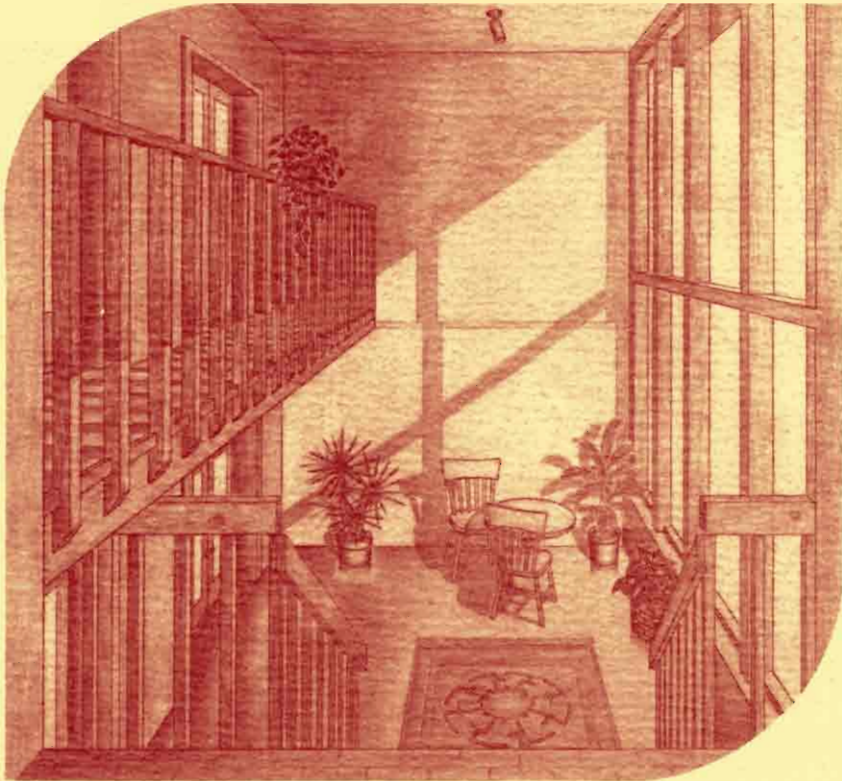
Since the *Energy 1 Concept Home* surrounds our bodies in this radiant heat, we will be able to feel comfortable at lower room air temperatures which would cause discomfort in the home without adequate thermal mass. In the Staggs Residence there are over fifty tons of mass in the brick floors, the 16-inch thick mass wall, and the perimeter mass walls exposed to the living spaces. We will also be able to utilize this thermal mass in the summer by cooling it with cool night air and storing this "coolth" for use during the day.

## Earth Contact

Where terrain permits, earth contact is another effective tool for the *Energy 1 Concept Home*. Heat which passes through the insulated earth contact walls creates a warm cushion of earth around the home, while heat which passes through above grade walls is immediately lost to the winds. The "lag time" associated with earth contact is of further benefit since ground temperatures at a depth of 8 feet don't reach their coldest until April and don't reach their warmest until October.

## Air-To-Air Heat Exchanger

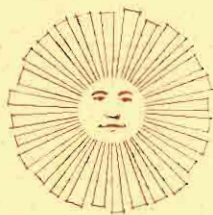
Because the *Energy 1 Concept Home* is so extremely air-tight, the air-to-air heat exchanger is used to bring in fresh air. In a "normal" home we get plenty of cold fresh air in the form of infiltration. The air-to-air heat exchanger controls the amount of fresh air and preheats it with the warm stale air it is exhausting.



## Design For Living

The *Energy 1 Concept Home* utilizes solar and energy conservation principles for efficiency, but also coordinates these principles to harmonize the routines of our lives with the operation and performance of the home. Individual needs are included into this design process. The Great Room and Kitchen areas of the Staggs Residence are part of the Direct Gain System of the home. This means that these areas will be rapidly charged by the Sun's energy for the winter morning, day, and early evening when they will be most in use. The Staggs Residence Bedrooms rest comfortably behind the 16-inch thick concrete mass wall which separates them from the Greenhouse. As the Sun enters the Greenhouse and strikes the darkened surface of this mass wall, the wall begins to absorb the Sun's heat energy and conducts it to the wall's interior surface, a process which takes about 8 to 10 hours. This interior surface will be its warmest during the night and early morning hours when its heat will be needed most. Every room of the Staggs Residence has direct access to this Greenhouse space which also serves as the home's front air lock entry.

# Staggs Residence Specifications



## Area Data

Latitude: 39°  
Elevation: 740 ft.  
Degree Days: 4711

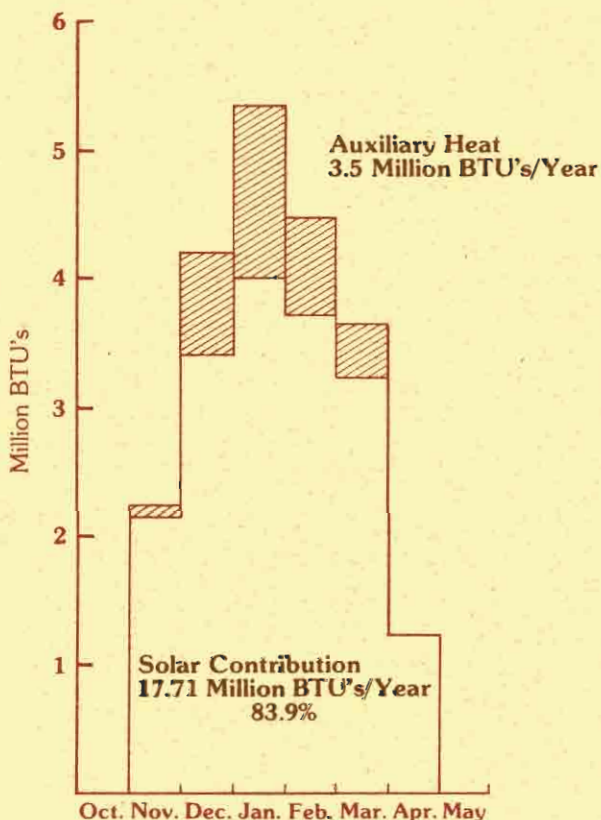
## House Data

Size: 1568 sq. ft.  
with Greenhouse 1760 sq. ft.  
Rooms: 3 bedrooms, great room, kitchen, dining  
room, 2 baths, utility, greenhouse  
Garage: 2 car

## Heating and Solar Systems Data

Heat load coefficient: 6826 BTU's/Degree Day  
4.35 BTU's/sq. ft./Degree Day  
Design heat load: 17,350 BTU's/hr. at 61° ΔT  
Auxiliary heat load: 3.5 Million BTU's/Year  
45 BTU's/sq. ft./Degree Day  
Collector area: 245 sq. ft. isolated gain  
128 sq. ft. direct gain  
Thermal mass volume: 248 cu. ft. brick floor  
383 cu. ft. mass wall  
84 cu. ft. perimeter wall  
exposed to living area  
Thermal mass weight: 103,000 lbs.  
Storage capacity: 20,592 BTU's/degree  
Storage to collector ratio: 276 pounds per sq. ft.  
of glazing

## Heat Load Profile



## Energy Conservation Data

Walls: 2x4 studs + 2x2 on 16" centers — 3/8" fiber-glass batt; 2 1/2" fiberglass batt compressed to 1 1/2"; 1" rigid Thermax insulation. R-value of 28.3  
Ceilings: 1. Flats—blown fiberglass. R-value of 45  
2. Vaults—2x12 joists with fiberglass batt R-value of 38  
Vapor barrier: 6 mil polyethylene, continuous cocoon  
Perimeter: 2" extruded polystyrene. R-value of 10  
Slabs: Perimeter only. 1 1/2" extruded polystyrene R-value of 7.5  
Induced air exchange rate: 2.1 ACH at 50 pascals  
Estimated actual exchange rate: 1/3 ACH  
Glazing: Double glazed casement and fixed units  
night insulation on direct gain  
Entry: Greenhouse front air lock  
Garage rear air lock