FACTORS ASSOCIATED WITH THE DECISION TO LIVE IN AN EARTH SHELTERED HOUSE

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John 14:2 In my Father's house . . .

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CHAPTER I

INTRODUCTION

The past few years show a steady increase in the cost of fossil fuel. Former President Carter stated the following in a speech.

> Our nation's energy problem is serious and it's getting worse . . . . Energy prices are high and going higher, no matter what we do. . . . The energy crisis is real. I said so in 1977, and I say it again tonight, . . . the fundamental cause of our nation's energy crisis is petroleum (Carter Broadcasting Energy Address, 1979, p. 661).

An authority in the area of earth sheltered housing writes:

> Now that fossil fuel supplies are dwindling and fuel prices rapidly rising, it appears time to reconsider what the earth has to offer. With standard modern construction techniques, there is no need for a return to cave dwelling. The goal of earth sheltered houses is to keep or improve the relationship to the outdoors and the comfort of conventional houses while pulling the earth as a blanket around as much of the house as possible. The earth then acts as a barrier to wind chill and unwanted infiltration as well as direct heat loss (Sterling, 1978, p. 4).

The cost of fuel is such an important problem that various modes of action are necessary to adequately meet these energy needs. In the area of housing some people have participated in activities which have helped ease their energy problem. Some of these actions include the installation of insulation, weather-stripping, wood-burning stoves, and double-pane glass. As an encouragement to conserve natural resources, the government has provided tax incentives to home owners who install energy conserving materials and devices. A variety of weatherization programs have been expanded to aid poor people by assisting them in

making their homes more energy efficient (Carter Broadcasting Energy Address, 1979).

The cost to heat and cool space in the home has increased so dramatically in recent years that it is demanding a significant percentage of the family income. Statistical data show how this is true. A chart on the Retail Price Indexes of Fuel and Utilities: 1965 to 1979 (U.S. Department of Commerce-Bureau of the Census, 1979) shows the cost of fuel more than doubled over the entire 14 year period. At times the price tripled depending upon the type of fuel energy used. The Consumer Price Indexes of Selected Items and Groups: 1965 to 1979 show that piped gas and electricity more than doubled in cost while fuel oil, coal and bottled gas more than tripled and was almost four times as much in 1979 as in 1965.

As a response to the increased percentage of the family's budget going for energy, many people are building alternative forms of housing that are more energy efficient. City councilmen, Black and Streng from Davis, California presented to the subcommittee on Energy and Power what their town did to conserve energy. One of their projects was to build seven solar design houses (Local Energy Policies, 1978). Their report demonstrates the importance of alternative energy efficient housing. The public and government are both interested in the development and usage of alternative energy efficient housing systems. The United States Department of Housing and Urban Development has awarded nearly $8.5 million in grants for the purchase and installation of solar equipment in 6,851 residences (U.S. Department of Housing and Urban Development, 1979c).

Besides solar, another increasingly popular form of alternative housing is the earth sheltered house. Malcom Wells (1978) wrote that conservation of energy, natural resources and money are the important reasons to build underground. In such construction, the earth is used as a temperature moderator allowing the structure to be significantly more energy efficient (Wells, 1978). Bligh stated that in earth sheltered dwellings

> . . . the temperature varies only slightly from the yearly average temperature. Hence, less heating in winter and cooling in summer is required. In addition, subsurface construction avoids direct sun radiation which in summer can contribute significantly to cooling load. In winter, wind chill and excessive infiltration are avoided (Bligh, 1976, p. 5).

Even though earth sheltered housing is not a familiar type, families who have built this alternative type house are now receiving many benefits such as reduced energy usage, reduced exterior maintenance and improved noise control. Many have had to overcome constraints, such as unique site requirements, inapplicability of standard codes, and difficulty in obtaining financing that are not typically encountered in the building of a conventional home. There is little information available about people who live in earth sheltered housing, and their satisfaction with their situation. Such information could be used to increase public awareness and aid in the marketing of earth sheltered houses as an energy conserving alternative.

Attendance for earth sheltered housing seminars on the Oklahoma State University campus has been quite good. A total of 1393 people attended these seminars during 1978 and 1979. These well-attended seminars show a high level of interest in earth sheltered housing.

Purpose and Objectives

The purpose of this study was to analyze the responses of a group of individuals who expressed interest in earth sheltered housing to identify factors related to the decision to live or not live in an earth sheltered house. Five objectives were developed to guide this study. The objectives were:

1. To analyze the differences in various socio-economic characteristics of respondents who had made a decision to live in an earth sheltered house and those who had not decided to live in an earth sheltered house.
2. To analyze the differences in importance of selected housing aspects and housing decision factors for respondents who had decided to live in earth sheltered housing and those who had not decided to live in an earth sheltered house.
3. To analyze the differences in perceived adequacy of present housing for those who live in an earth sheltered house and those who do not.
4. To identify constraints experienced by those who had decided to live in an earth sheltered house and those who had not decided to live in such a house.
5. To provide recommendations for further research in the area of earth sheltered housing.

Hypotheses

In order to handle the objectives effectively, null hypotheses were developed in relation to objectives 1, 2, and 3. The first three null

hypotheses relate to differences in various factors thought to be involved in a family's decision to live in an earth sheltered house. The last null hypothesis relates to objective 4 and deals with an analysis of the perceived adequacy of housing by persons who live in earth sheltered housing and persons who do not.

H_1: There are no significant differences between respondents who had decided to live in an earth sheltered house and those who had not in terms of age, education, marital status, income and rural or nonrural residential location.

H_2: There are no significant differences between respondents who had decided to live in an earth sheltered house and those who had not in terms of the importance of selected aspects of housing.

H_3: There are no significant differences between respondents who had decided to live in an earth sheltered house and those who had not in terms of the importance attached to 12 housing decision factors.

H_4: There are no significant differences between respondents who actually live in earth sheltered houses and those who do not in terms of perceived adequacy of selected aspects of housing.

Assumptions

The following assumptions were made for this study:

1. It was assumed that persons who attended one of the earth sheltered housing seminars given by Oklahoma State University Architectural Extension during the years of 1978 and

1979, were interested in some aspect of earth sheltered housing.

2. It was assumed that the respondents who have lived in their earth sheltered homes for at least six months of time could and would accurately report their evaluation of the adequacy of the home.
3. It was assumed that respondent's recall was accurate in reporting the details about the decision to build underground and the constraints experienced in the process.
4. Some of the seminar participants were contractors, lenders and others related to the building professions. It was assumed that respondents of the sample answered the questions from a personal interest aside from a professional interest.

Limitations

Information for this study was gathered from people who attended an earth sheltered housing seminar. The findings are limited as follows:

1. This study was limited to the state of Oklahoma and the sample was purposive rather than random so findings cannot be generalized to a broad population.
2. Sample sizes were not large so some data had to be collapsed for the analysis.
3. The study was limited to persons who were sufficiently interested in earth sheltered housing to attend seminars on the subject.

4. Nearly one-half of the earth sheltered housing dwellers failed to answer "adequacy" and "importance" questions, thus the analysis of those questions was based on those who responded.

Definition of Terms

The following terms are used throughout this study:

Earth sheltered house or earth sheltered housing - "can be fully recessed into the earth or partially recessed with earth berms formed against the outside walls" (Sterling, 1978, p. 38).

Bermed - the type of earth sheltered house which is semi-recessed. It is typified by pushing the dirt onto the house instead of digging into the hillside (Sterling, 1978).

Presidential Challenge Grant (PCG) Study of Earth Sheltered Housing in Oklahoma - a study conducted in 1979-1980 by Oklahoma State University Department of Housing, Design and Consumer Resources and Architectural Extension. The data were collected from 47 residents of earth sheltered houses in Oklahoma. These data were used for this study.

Group One - refers to the 47 earth sheltered dwellers in the PCG Study plus 35 more drawn for this study (see pp. 28-29) who were planning or building earth sheltered homes. The total for group one is 82.

Group Two - refers to respondents in the sample drawn for this study who had no plans to build or buy an earth sheltered home at this time. The total for group two is 74.

Group One-A - refers to the 47 respondents in the PCG Study who were actually living in an earth sheltered home.

Group Two-A - refers to the 109 respondents in the sample drawn for this study. It includes those who were planning or building an earth sheltered home as well as those who had no such plans.

Group One-B - refers to the 35 respondents from the sample drawn for this study who were planning or building an earth sheltered home.

Group Two-B - refers to the 74 respondents in the sample drawn for this study who had no plans to build or buy an earth sheltered house.

CHAPTER II

REVIEW OF LITERATURE

> Our society is using up our favorite non-renewable fossil fuels - oil and natural gas - at a furious pace. This situation has created a number of new problems and concerns: about 40% of our oil is currently imported at prices which are rising steadily and are expected to go higher; our supply of natural gas is running low. . . . All of this suggests that we will need other solutions to our energy needs (United States Department of Housing and Urban Development, 1978, p. 3).

Americans have been involved in a steady increase in the cost of living. A larger portion of income is going for energy today than in prior years. Monthly utility payments are often as high or higher than the mortgage payment. These developments have encouraged many homeowners and persons associated with the housing industry to look at alternative forms of housing that may be more energy efficient. An increasingly popular form of alternative housing has been the earth sheltered house. The literature has information on the the advantages, disadvantages, and constraints of earth sheltered housing. Deciding to live in an earth sheltered house depends upon what is important to the residents. The following contains information on factors important in housing.

Important Factors of Housing

The literature provides information on housing research which evaluates people's preferences on various housing factors. The factors chosen for this study include site, entrance, exterior appearance,

community and neighbor acceptance, flexibility of the environment for space expansion and different usage, room arrangement, storage, privacy from family members and neighbors, structural safety, fire exits, elimination of noise from outside and inside mechanical systems, natural and artificial light, view, materials, comfortable air temperature, humidity, condensation of walls and windows, air circulation, and natural ventilation.

Site

A document for minimum property standards has the following information concerning the site. "A site design shall be provided which includes an arrangement of all site facilities necessary to create a safe, functional, convenient, healthful, durable and attractive living environment for residents" (U.S. Department of HUD, 1979a, pp. 3-5). Researchers have found that the site location of a house is an important characteristic as well as having it included in government standards. McCray (1977) supported this idea when he discussed that the proper site location for a home is of such prime importance that it is a strong indicator of high and lasting satisfaction.

Room Arrangement

Arranging rooms into specific zones according to activities is important in a house. Resident's satisfaction is dependent on this and other characteristics (McCray, 1977). Families need to study their "norms of behavior . . . to determine . . . unique traits" (Agan, 1965, pp. 77-78). After the norms of behavior in a family are categorized, areas can be planned for the various functions in a house.

Inside Storage

Storage space is also necessary for an orderly and organized living arrangement. The amount of storage space inside the home should be adequate for the resident so that tools, equipment and other items are easily accessible. Organization of items is important and easier when adequate storage space is available (Agan, 1965). Storage has been reported as an important satisfaction associated with housing. In a study of urban and rural families, urban families were more satisfied with inside storage than were rural families (McCray, 1977).

Privacy from Family and Neighbors

Research documents the fact that general satisfaction with one's environment comes when one has privacy from family and neighbors (McCray, 1977). Hemple (1979) found that respondents considered greater privacy from neighbors to be important, but there was not a significant difference about the respondent's opinions.

Some studies perceive privacy as having multiple components. Two of these components involve aural privacy and visual privacy. Comments of residents have revealed that visual privacy was not as hard to achieve as aural privacy nor was it as irritating when not achieved (U.S. Department of Housing and Urban Development, 1979a).

Structural Safety and Fire Exits

A house needs to be structurally sound and safe for its inhabitants. Various factors are important in housing, but this characteristic is required above other characteristics (Marsh, 1977). Not only does the structure of the house need to be safe, but it is also

important that proper fire exits be available. A quote from a government Standards book says that

> Every living unit shall be (a) constructed so as to reduce fire hazards, (b) separated from every other living unit by construction or distance to restrict the spread of fire, and (c) be designed to provide means of safe egress in the event of a fire (U.S. Department of Housing and Urban Development, 1979a, pp. 4-29).

McCray (1977) also considers proper fire protection and exits to be characteristics which contribute to "environmental quality". He also reported that a healthy and safe home was considered to be the number one item of importance for value rankings of urban dwellers and number three for rural residents.

Mechanical and Outside Noises

Noise level surveys have been done to study the effects of noise and how it annoys people. The following is one definition of noise.

> Noise may be defined as a subjectively annoying sound. Intensity and duration of the sound do not matter in this definition. If a person says that a sound is annoying or disturbing, it can be considered a noise (Moos, 1967, p. 176).

Noise in the environment can come from transportation, industry and mechanical equipment in the home. Negative psychological responses are often produced by noise.

> It is important for designers of the environment to be aware that latent annoyance can be at levels below which people would make formal complaints, but which never the less represent a diminution of the quality of their lives. . . . Thus there exist criteria for sound insulation of houses against noise from neighbors, for noise in factories, for industrial noise reaching residential areas, and so on . . . (Canter, 1975, pp. 64, 67).

Problems related to noise are difficult to identify because people are not likely to complain about noise until they are questioned about it. Another interesting finding was that noise at work was tolerated much better than noise at home (Moos, 1967).

Natural and Artificial Lighting and View

The most important decision to be made when designing the luminous environment is the decision between natural and artificial lighting. When people were given a choice between the type of lighting they wanted in their home, there was no doubt that sunlight was preferred over artificial light (Markus, 1965). Sunlight was so important that a major proportion of the housewives preferred to have a living room with good sunlight and a poor view as contrasted to a good view and no sunlight (Markus, 1975). In the study by Markus (1975), sunlight was at the top of the list while a good view was twelfth and last. Although a good view is very important to many people, but it does not seem to be so important in comparison to environmental conditions that are more directly related to the comfort of the occupant such as heating, lighting and noise (Canter, 1975).

Materials

Materials used in a home need to be carefully selected. When making selections it is important to study the intended purpose of the area where the materials will be placed. Consideration should be given to: "tactile quality, appearance, color and cost" (U.S. Department of Housing and Urban Development, 1979a, p. 116). Many materials are available for use but choices are usually determined by cost limitations.

Humidity, Condensation, Air Circulation and Ventilation

Proper ventilation is very important. When humidity is high, moisture may condense within fibers used in the home. Proper air

circulation will assist in evaporating the moisture and prevent problems that might occur. Materials may be chosen which are moisture resistant. A durable surface that absorbs a minimal amount of moisture is important for the floor. Moist air will rise, therefore careful consideration of the ceiling materials is important to avoid condensation (Croome, 1972).

Body comfort is highly related to the air temperature, air movement and humidity. Humans as warm-blooded animals strive to maintain a constant internal thermal level and are extremely sensitive to heat and cold sensations on the skin. It is therefore important to maintain a comfort zone in the home (Canter, 1975).

Air circulation can make the body cooler when temperatures rise if the air temperature is cooler than the body temperature. Reverse affects occur when the air temperature is warmer than body temperature. Warmth sensations likewise may result from moisture in the air. A moderate humidity level provides the greatest thermal comfort (Canter, 1975).

Mechanical ventilation was not available years ago, therefore architects designed structures to provide the best possible natural ventilation by the choice of windows and doors. Many modern buildings are designed with mechanical ventilation systems which control the temperature, humidity and air flow. This control makes the living environment more comfortable for the inhabitants. Mechanical ventilation on the other hand, can cause noise which could be irritating (Croome, 1972).

Neighbor/Community Acceptance

In a HUD study of housing satisfaction, those who had similarities with their neighbors were more satisfied and accepting of their neighbor's

residence (U.S. Department of Housing and Urban Development, 1979a). "Appearance of a neighbor's home" (Hempel, 1979, p. 417) was a variable which proved to be of major concern to home buyers. This attribute was considered to be of relative importance for an "ideal home." The appearance and value of nearby homes are more important than personal characteristics of the residents (Hempel, 1977).

Exterior Appearance and Entrance Design

In the housing literary research there is a consistency between the attractiveness of the dwelling and satisfaction of the resident. Acceptance of the dwelling is highly associated with aesthetic attractiveness of the exterior and entrance of the house. Dwellers are particularly aware of the "specific features of the architectural design, landscaping, and maintenance" (U.S. Department of Housing and Urban Development, 1979a, pp. 5-10). Findings from the HUD research study revealed that "attractiveness of the physical environment should be considered as a social need and not just an abstract aesthetic concern" (U.S. Department of Housing and Urban Development, 1979a).

Advantages of an Earth Sheltered House

As some people have built or thought about building an earth sheltered house, they have observed various advantages and disadvantages. For some the advantages made the earth sheltered house their first preference. Sometimes the disadvantages had such undesirable characteristics that a decision was made against living in an earth sheltered house. In other situations constraints other than personal preferences led to a decision against this type of house.

Conservation of energy is important on a national scale as well as to the individual. Sixteen percent of the nation's energy usage goes to space heating and cooling. Seventy percent of residential energy goes to space heating and cooling. This idea is supported by Edelhart (1980, p. 54) when he said, "among homeowners, the biggest advantage of earth sheltered housing is the extraordinary energy saving". Conserving energy in the cooling and heating of homes has a potential for substantial energy savings (Bligh, 1976).

Heat is transmitted out of the house through roofs, walls, doors, windows and cracks. Approximately 64 percent of the outflow of energy from a house occurs in this manner. Air of a different temperature coming into the house by infiltration represents 15 percent of the energy loss. Unwanted heating and cooling of the surrounding environment takes a lot of energy. Earth sheltered houses reduce this air flow because most of the walls and ceiling are covered by earth (Bligh, 1976). Air temperature in above ground houses is effected more significantly by varying weather conditions than in earth sheltered houses. Fluctuations in outside air temperature have minimal effect on the earth's temperature. The more stable temperature surrounding the earth sheltered house results in a lower energy loss (Bligh, 1976). Because of this, the total lifecycle cost of an earth sheltered house is greatly reduced (Bennett, 1977).

Soil is not a desirable insulator, but it is an excellent temperature moderator. A stable environment can result when the earth is used in combination with insulation. Also soil is slow to change in temperature as the seasons rotate. This has positive effects on an earth sheltered house because the earth is still warm during the winter as a

result of the hot summer sun. The earth is cool during the summer from the effects of the winter cold (Wells, 1978).

Not only are savings experienced in an earth sheltered house from reduced utility bills, but there is also a reduction in the cost of exterior maintenance. An earth sheltered house usually has earth along its exterior walls and often on the roof eliminating the need for exterior painting or other routine upkeep (Eskridge, 1980).

Initial building costs for an earth sheltered house have been reported to be lower in some cases, but they are usually higher as more structural strength is required (National Science Foundation, 1975). Even though initial costs are as much as 10 percent higher, a payback comes through the duration of a 10 year period in terms of energy savings (Wells, 1978).

Bermed structures are less expensive than conventional houses, but total earth covered houses are more expensive because of the additional structural requirements (Fairhurst and Sterling, p. 1979). Some phases of construction are more economical as less money and materials are required to finish off the exterior of the house. Maintenance is dependent upon proper construction of the home. Water problems and uncalculated pressure can cause cracks and other problems. Situations such as this can greatly increase costs.

The United States Navy did a two-phase study using computers to analyze the comparison of three earth sheltered building types. The housing types studied included unbermed, bermed to the roofline and a totally earth sheltered home. It was found that the more berming present, the greater the energy savings from the effects of air infiltration, thermal lag and wind.

Control of one's environment has positive connotations. In an earth sheltered house a person is better able to regulate the temperature, light, noise, distractions, quality of the air, and provide security from crime. As mentioned in the section on energy, an earth sheltered house is less affected by climatic conditions allowing a more stable temperature environment (Jones, 1977).

In a research study, it was found that good lighting for underground homes can be acquired from the combined use of natural and artificial light (Simmons, 1980). An adequate amount of windows and proper placement of them is helpful. Skylights can give extra natural light wherever it is desired. In the event that an exterior view would create unnecessary distractions, the room may be built without windows. This will make the house even more energy efficient.

An earth sheltered house provides a natural and significant decrease of exterior sounds. Mason (1976) reported that the quietness of an earth sheltered house was one of the most important advantages for going underground. It is particularly beneficial when the structure is near an area of intense noise such as a free-way system, a factory, or a power plant.

Control of air quality is quite easy in an earth sheltered house. Dust and pollen do not intrude as in a conventional home. This may bring relief and be a distinct advantage to allergy sufferers (Ingersol, 1980).

Earth sheltered houses provide natural protection from environmentally adverse situations since they require stronger structures than conventional houses. Boyer (1979) has said that an earth sheltered house is an excellent storm shelter and earthquake shelter. Fires are

less menacing as construction materials are usually fire-resistant or fireproof. Some earth sheltered homeowners have experienced a reduction in fire insurance premiums according to Eskridge (1980). During a period of civil defense this house would, in many cases, become an excellent place of safety from nuclear attack. Some homes have been built with this as the main intent (Ford, 1969).

From a developer's or builder's point of view, earth shelterd houses could be mass produced without having a "mass produced" appearance since most of the structure would be underground. A variety of natural settings, size and shapes of sites and landscaping would create individual environments. Land could be better utilized, especially where there are corner or odd-shaped lots. The surface would then be available for a variety of service or aesthetic uses (Smay, 1974).

Earth sheltered housing allows for aesthetics in housing. Malcolm Wells (1978, pp. 2-3) says that he went underground for many reasons, one of which was that architecture

> had always seemed brittle and naked to me. Unfinished . . . it didn't take me long to imagine how beautiful underground architecture could be. Living rooftops. Buildings back in the earth again, where they belong . . .

Frank Lloyd Wright, too, was aware of how structures should be integrated into their surroundings for a beautiful setting. "No house should ever be on a hill or on anything. It should be of the hill, belonging to it, so hill and house could live together each the happier for the other" (Johnson, 1978, p. 1). Many authors advocate natural blending of the house to the land for earth sheltered housing or even conventional housing.

Disadvantages of an Earth Sheltered House

Housing under the ground is of such a unique nature that it can have some disadvantages. Some of these may seem to be directly tied to earth sheltered housing when actually any building situation is sure to create some of these obstacles.

Building codes and subdivision regulations have been developed primarily for conventional construction. Many of these do not allow for the conditions required for an earth sheltered house and may even prohibit such a structure (Sterling, 1977).

Deciding to build in an area that permits earth sheltered structures may make it difficult to locate a proper site for the design that an individual desires (Sterling, 1978). Some, on the other hand have located a site, but have been unable to acquire a suitable design. Lane (1979) reported that a need exists for more cost-competitive, efficient and well planned designs for earth sheltered houses.

Few contractors or architects are experienced in the area of underground houses. The structures they have built are rather recent and have not withstood the test of time. It is expected however, that materials and construction techniques need to be developed to a higher level of efficiency. Factors such as these may cause the initial cost for an earth sheltered house to be higher than for a conventional house (Newsweek, 1978). Adding on to an earth sheltered house can also be quite expensive because of the thick outer walls and the soil that must be used. In addition, lenders in many areas are unfamiliar with earth sheltered housing alternatives, and are hesitant to provide financing. Loans are sometimes hard to get because the resale value has not been clearly established.

Because of the particular nature of an earth sheltered house some characteristics may have psychological disadvantages. Some say they do not like the idea of such a house because of the image of a cave; being dark, damp and cold (Wells, 1965). The absence of light may adversely affect some people. Because of housing codes, all sleeping rooms must have an operable window as a means of escape in case of a fire and this would give at least some light. The nature of an earth sheltered house creates a situation where there probably would not be as many windows as in a conventional home. Skylights can sometimes be used when windows cannot, therefore some light would be provided.

Some people suffer from claustrophobia. Physical and mental enclosure associated with an earth sheltered house may produce discomfort from knowing there is so much rock and dirt surrounding and on top of the structure. Some anxiety may come from the fear of not being able to escape in the case of a fire. Characteristics such as claustrophobia are different for each person and depend upon the type of situation (Wells, 1965).

Acoustics may not be efficient, even though an earth sheltered house provides a typically "quiet" environment. Mechanical systems seem to be louder in contrast to the silence. This effect may have to be dealt with by dampening these normally unnoticed sounds, or providing a slight amount of background music and or noise (Sterling, 1978).

Airing the rooms may be a problem because of a decreased number of windows and reduced cross ventilation. The air may be damp and moist. This may be good for ferns and complexions, but disastrous to woodwork and wallpaper because of condensation. Dehumidifiers or a salt-like chemical may assist in solving this problem. It is also important that

poured concrete have a curing period before construction is completed (Sterling, 1978). Leaks that may come through time will be expensive to fix. Tree roots go where water is, therefore it is even more important that proper water proofing techniques be used. Roots are very destructive to concrete when they get into moist cracks (Wells, 1978).

Impressive architecture is an important factor to some people (Janson, 1977, p. 122) reported that the "non-architecture" appearance of a house hidden under the ground may not display proper social prestige. The building may not be visible or only minimally visible from the street and therefore not as satisfying to some people.

A growing concern of some who live in houses in the ground is the fact that so many tourists and curious people invade their privacy. On the other hand, the person who has not lived in an earth sheltered house very long is usually proud and happy for others to see their home (Newsweek, 1978).

Constraints of Earth Sheltered Housing

Since earth sheltered houses are not a "normal" house design, constraints arise for those who desire to live in such a house. A constraint is defined as "confinement" or "restriction" (Guranik, 1973, p. 128). Those who have built an earth sheltered house, or attempted to build, have probably encountered some constraints that may have discouraged them from building a house of this type. A variety of obstacles such as unique site, building codes, insurance and financing must be conquered before the goal of an earth sheltered house can become reality.

A unique site with proper characteristics is important for an earth sheltered house. Given the wrong combinations, it would be impossible to build such a house. The soil and ground water conditions must be carefully studied. This includes where the groundwater table is located, how the soil transfers moisture-the percolation rate, and soil composition-sand, gravel, clay, peat fill and chemical characteristics. A person needs to find soil conditions by: soil survey, checking with the neighbors on adjacent lots, or by a testing firm. It is important to know the properties of the surrounding soil also. Is it going to shift? Is it going to expand or shrink? The soil should give good load-bearing strength, good drainage and be a sufficient distance from the water table. It is wise to avoid the flood plain, humic soil and extremely expansive clay (Lane, 1979).

Building codes have been constraints to some who have made the decision to live in an earth sheltered house. There are over 1700 building codes in the United States which makes generalizations difficult, however, these codes primarily refer to the structural and fire safety of the building. Other problems which relate to the codes come from politics and local distrust. Most communities require special approval to build an earth sheltered house. The procedures to obtain special approval can be quite frustrating (Moreland, 1975).

Insurance may be difficult to obtain at a reasonable price. One underwriter stated that rates apply to the building's contents instead of the earth cover. Jay Swayze, an earth sheltered housing designer-builder, says that particular risks cannot be selected. Earth sheltered housing owners often desire only part of the coverage offered, but must take the package to get the desired coverage (Moreland, 1975). These

dwellers, therefore, feel that they are not receiving the insurance rates they deserve.

Financing is a constraint for many who desire to build an earth sheltered house. Examples are limited from which appraisers can draw conclusions. A manual published by the government titled "Housing Programs" is what appraisers usually use as their guide. Earth sheltered houses are considered "a high-risk investment and thus may require a higher down payment or interest rate for a conventional loan" (McKown, 1980, p. 233). Since lending institutions tend to not grant mortgage loans for earth sheltered housing because there is not a set resale value, people tend to not build them unless they have their own resources to use (McKown, 1980).

In a research study, the people who were most positive about financing included those who had an education above high school. Also included in this group were families who were in a stable or contracting stage (McKown, 1980).

Determining the construction cost of earth sheltered housing can be difficult to determine because of the numerous variables. The total life-cycle cost of the house is not a highly important consideration for lenders. It is growing in importance as a consideration for buyers, especially in terms of energy savings. In the past little attention was given to life cycle cost because of the low cost of energy. More people are becoming aware of the importance of a life cycle cost but presently it is not considered to be a valuable characteristic (Bennett, 1977).

Life cycle costs and construction costs are increasingly becoming valuable factors to evaluate in an earth sheltered housing decision because they have an impact on financing. Lenders are more likely to

allow people to borrow money for a house that has a good resale value. Construction of such a house may or may not be more expensive than conventional construction. It is important to look at the life cycle costs and operating costs over a period of time along with the initial cost to make an evaluation. As energy prices continue to increase, it is important to look at life cycle costs instead of just construction cost to get the true value of such a home (Fairhurst, 1979). Financing has become easier to obtain since 1978 because people are becoming more familiar with this type of housing. Many agencies are careful because of the lack of market data and a concern for quality control in design and construction (Sterling, 1980).

Summary

The steady rise in the price of fuel has caused many to look at the alternatives and options available in housing. Some people have chosen to live in earth sheltered houses. This type of house has various advantages, disadvantages and constraints.

Major advantages of earth sheltered housing include energy savings and decreased exterior maintenance because part of the house is covered by earth. Because the house is partially covered by soil, the structure must be stronger than a conventional house. A stronger structure is advantageous during times of civil unrest. The materials required for an earth sheltered house include such items as concrete blocks and steel which are fire resistant. Other advantages include the fact that these homes can easily avoid looking mass-produced since most of the home is not seen anyway. The land may be better utilized and add to the aesthetic appearance of the house. The temperature, air quality, light,

noise and distractions can be dialed or controlled. As with all design decisions, not only does one receive advantages, but disadvantages are also apparent.

Finding the proper site for an earth sheltered house can be difficult. Many factors are involved. Some building codes create problems or prohibit building. In the area of earth sheltered houses, there are few architects and contractors who are familiar with the specifics needed. Materials and construction techniques are in the early stages of development. Some people imagine an earth sheltered house as being a cave. This can be a detriment as well as possibly a false idea. Acoustics in an earth sheltered house can be so good that some unwanted sounds are heard such as indoor mechanical noises. Air moisture can also be a problem that requires special attention. Claustrophobia is felt by some and may make a situation impossible for them. Some earth sheltered housing dwellers have moved into their unique homes to have privacy. This has sometimes been intruded upon by tourists, researchers and other interested persons.

Constraints are unavoidable in any construction project. Earth sheltered houses seem to have constraints which are unique to them. The site which has been picked out for an earth sheltered house may make it impossible to build such a house. Some have thought insurance rates would be less, only to find that they may be more expensive. Codes have eliminated some from building an earth sheltered house. Financing an earth sheltered house is usually more difficult than a conventional house because of the unfamiliarity of lending institutions with this type of house. Construction costs for an earth sheltered house may be more or less than what is traditionally expected for a house. Building

and insurance costs have prohibited some people from living in an earth sheltered house.

The authors of the literature reviewed tend to agree on certain items associated with earth sheltered housing and to disagree on others. Agreements include the fact that these houses are more energy efficient and have an environment that is easier to control than a conventional house. Some disagreement is seen related to cost of building, safety, comfort, and aesthetic appearance when compared to a surface house. These factors and research is lacking related to identification of factors that are most important in a person's decision about living in an earth sheltered house.

CHAPTER III

RESEARCH PROCEDURE

Research Design

Descriptive survey research has been implemented in this study. Survey research probably has been the most commonly used method of research for obtaining the opinions and attitudes of people. This study deals with people's opinions and attitudes toward earth sheltered housing.

The Population and Sample

Data for this study came from two sources. Data from persons who lived in earth sheltered houses were obtained from the PCG Study of Earth Sheltered Housing. The remaining data were obtained from a sample of persons who attended seminars on earth sheltered housing conducted by Architecture Extension at Oklahoma State University.

The PCG data were collected in the fall of 1979. Efforts were made to identify all known earth sheltered houses in the state. Two primary methods were made to obtain this information. First, all of the agricultural county agents were asked to send in addresses of the earth sheltered houses they were aware of in their counties. Second, Architectural Extension at Oklahoma State University provided names and addresses of persons who had attended the seminars and indicated that they lived in an earth sheltered house. A total of 84 earth sheltered houses were located and residents of all of these were contacted and asked to

participate in the PCG study conducted by Architectural Extension and the department of Housing, Design and Consumer Resources. Data were collected from 47 (56%) of these earth sheltered housing dwellers. These data were used in this study.

For this study a sample was drawn from persons who attended earth sheltered housing seminars conducted by Architecture Extension at Oklahoma State University. Names and addresses of most of the persons who attended the seminars since 1978 had been recorded. Records were not kept during the first few seminars. Names and addresses were obtained for 918 of the 1393 total people who attended the seminars during 1978 and 1979. The first year that complete records of participant's addresses were kept was 1978. By selecting 1978 and 1979, at least one year had passed since the respondents attended the workshop. The one to two year time lag gave respondents time to have made a decision following exposure to information provided in the seminar. A systematic sample of 306 was chosen by drawing every third name on the list of participants. These participants were sent a three-page questionnaire. A total of 109 useable questionnaires were returned.

In response to a question about their future plans, some of the sample drawn for this study reported that they were already building an earth sheltered home or planning one. Therefore 35 who were in this process were grouped with 47 who already lived in an earth sheltered house. The total of 82 respondents living in, planning or building an earth sheltered house is described as Group One. The second group of 74 was then composed of those who had no plans for an earth sheltered house and is described as Group Two.

Instrumentation

Data from the PCG Study were obtained by questionnaire. The selected questions used in this analysis are shown in Appendix A. Not all of the questions used for the original study were used in this study. The instrument for collecting data from the sample of earth sheltered seminar participants was developed by the author in consultation with earth sheltered housing researchers at Oklahoma State University. It was modeled after the instrument used in the PCG Study. The instrument covers three categories of information: socio-economic characteristics of the participants, selected attitudes and expectations about earth sheltered housing, constraints experienced by persons who did not choose to live in an earth sheltered house, and constraints by those who bought or built an earth sheltered house.

The instrument was reviewed for validity and clarity by a panel of experts: four professors of architecture, two professors of housing, and two developers who have built earth sheltered houses.

The instrument was pretested with a group of individuals who had displayed an interest in earth sheltered housing but was not included in the sample. Comments on the form, clarity and readability of the questionnaire guided the revisions made in the instrument.

Data Collection

Data from the earth sheltered dwellers in the PCG Study were collected by questionnaire during the fall of 1979 by by Architecture Extension. Data from the sample of seminar participants were collected by questionnaire during the fall of 1980. A cover letter and questionnaire were mailed to the 306 persons in the sample (see Appendixes B and

C). The cover letter stated the purpose of the study and a date when the questionnaire should be returned. The questionnaire, cover letter and return envelope were mailed, first class, in October of 1980. This pre-addressed, stamped envelope was enclosed in an effort to increase the return rate. The returned questionnaires included 109 of the 306 that were mailed. This figure represents 35.62 percent return rate. As questionnaires were returned, they were edited and then coded onto Fortran data sheets. This information was keypunched onto computer cards for analysis using the Statistical Analysis System (SAS) computer program.

Data Analysis

Frequencies and percentages were used to describe the respondents and their responses to questions about importance of housing aspects, importance of housing decision factors, adequacy of housing and constraints to the building of an earth sheltered house. The chi square statistic was used to test the four null hypotheses. The alpha level for significance was .05 or less. The SAS computer program was used for the analysis.

CHAPTER IV

FINDINGS AND DISCUSSION

The major purpose of this study was to identify differences between persons who had made a decision to live in an earth sheltered home and those who had not. Thus, the persons who were planning or building an earth sheltered home were grouped with the persons who were already living in one to form Group One. Group Two was composed only of those persons who had not decided to build or buy an earth sheltered home or at least had no plans for constructing such a home in the near future.

Characteristics of the Respondents

Table I shows the socioeconomic characteristics of respondents in Group One and Group Two. Over two thirds of the respondents in each group were male and over eighty percent in each group were married. Ages ranged from 22 to 74 years of age and the mode for both categories was 30 to 39 years.

Group One had the lowest educational level with almost one half of the group having no more than a high school education while 16 percent of Group Two had a high school education or less. Group Two had a higher education with 65 percent of the respondents having some college or technical school training or were college graduates compared to 53 percent of Group One.

TABLE I

CHARACTERISTICS OF RESPONDENTS IN GROUP ONE AND GROUP TWO

Characteristic	Group One Earth Sheltered Housing Frequencies	Percent	Group Two Non-Earth Sheltered Housing Frequencies	Present
Age				
22-29	15	(19)	22	(30)
30-39	24	(30)	28	(38)
40-49	23	(29)	8	(11)
50-74	17	(22)	16	(21)
No Response	3			
Education				
High School or less	37	(47)	12	(16)
1-3 years college/ tech school	22	(28)	23	(32)
college graduate	12	(15)	24	(33)
masters/doctorate	8	(10)	14	(19)
No Response	3			
Marital Status				
Single	11	(15)	10	(14)
Married	63	(84)	64	(86)
Widow(er)	1	(1)	0	(0)
Residential Location				
Open country rural	56	(68)	12	(16)
1000 population or above	26	(32)	62	(84)
Tenure				
Own	73	(89)	60	(81)
Rent	9	(11)	14	(19)
Income				
$4,999-14,999	14	(18)	7	(10)
15,000-19,999	16	(21)	9	(12)
20,000-24,999	12	(16)	14	(19)
25,000-29,999	9	(12)	14	(19)
30,000-34,999	8	(11)	12	(17)
35,000 & over	17	(22)	17	(23)
No Response	6		1	
Family Size				
1	3	(9)	7	(11)
2	11	(31)	23	(31)
3	6	(17)	17	(23)
4	8	(23)	18	(24)
6	7	(20)	8	(11)
No Response	47*		1	

*Family size was not used in the questionnaire for earth sheltered housing dwellers.

The majority of respondents in Group One lived in open country/ rural areas. Most of the respondents in Group Two lived in communities of 1000 or more. Over eighty percent in both Group One and Group Two owned their homes.

Almost 40 percent of the respondents in Group One had family incomes of $19,999 or less compared to only 22 percent of Group Two. Almost 25 percent in Group Two earned $35,000 or more while 22 percent of Group One was at the same income level.

The majority of respondents in both groups had two to four people living in the home. The mode for both Group One and Group Two was two people.

Objective One

The Null Hypothesis developed in relation to the first objective was:

H_1: There are no significant differences between respondents who had decided to live in an earth sheltered house and those who had not in terms of age, education, marital status, income and rural or non-rural residential location.

This hypothesis was tested by chi square and the findings are summarized in Table II.

The first null hypothesis was accepted for marital status. There were no significant differences between Group One and Group Two for this variable.

The first null hypothesis was rejected for age, education and rural/non-rural residential location. Significant differences were

TABLE II

SUMMARY OF SIGNIFICANT DIFFERENCES IN SOCIOECONOMIC CHARACTERISTICS BY GROUP

Variable	X^2	Significance
AGE	8.766	.033
EDUCATION	18.205	.0004
RESIDENTIAL LOCATION (Rural/Non-Rural)	42.900	.0001

found between Group One and Group Two based on the chi square tests for these variables. The largest proportion of those who live in or plan to live in earth sheltered houses (Group One) was in the middle age brackets (30-49). The largest proportion of those who had no plans to live in earth sheltered houses was in the younger age brackets (22-29).

There was a significant difference between groups according to their level of education. Those who had decided to live in earth sheltered houses were generally of a lower educational level than those who had no plans to live in an earth sheltered house. Group One represented 47 percent of the respondents with a high school education or less while Group Two had 16 percent.

There was a significant difference between Group One and Group Two according to the size of the community in which the respondents resided. Sixty-eight percent of those who decided to live in earth sheltered houses, lived in open country rural areas compared to only 16 percent of Group Two.

Objective Two

Objective Two examined differences in (1) importance of housing aspects and (2) importance attached to housing decision factors. It was believed that those who had decided to live in earth sheltered housing might rate certain aspects higher than would those who had not decided to live in an earth sheltered house.

Importance of Housing Aspects

The importance of 24 housing aspects was measured by asking respondents to think about the "ideal home" and then indicate the degree of importance they associated with each of the 24 selected aspects of housing. Importance was measured on a Likert type scale with "one" indicating "not important" and "five" indicating "very important". The 24 selected housing aspects and the frequencies and percentages of responses for each group are shown in Table VII, Appendix D.

When necessary the data were collapsed because the cells were too small for accurate chi square analysis. The chi square analysis was then done with the collapsed data. The categories that were combined for this analysis are indicated by brackets in Table VII, Appendix D.

The null hypothesis developed to test for difference in importance attached to these housing aspects by respondents in the two groups was:

H_2: There are no significant differences between respondents who decided to live in an earth sheltered house and those who did not in terms of the importance of selected aspects of housing.

Chi square analysis tested this hypothesis. The findings are summarized in Table III.

TABLE III

SUMMARY OF SIGNIFICANT DIFFERENCES IN IMPORTANCE OF SELECTED HOUSING ASPECTS BY GROUP

VARIABLE	X^2	Significance
Flexibility of interior space for expansion and different useage.	13.218	.0013
Elimination of noise from outside.	10.584	.0050
Exterior appearance from street or highway.	8.383	.0150

The second null hypothesis was rejected for only three of the 24 housing aspects. Based on chi square tests, significant differences between Group One and Group Two were found for flexibility of interior space, elimination of noise from outside and exterior appearance from street or highway.

Flexibility of interior space for expansion and different usage was considered more important by Group Two (those who had made no plans to live in an earth sheltered house) than by Group One. The largest percentage of Group One rated flexibility at the midpoint - neither important nor unimportant.

Group Two may have decided not to live in an earth sheltered house, since being able to expand and use the house differently was important to those who decided not to live in an earth sheltered house. Options for expanding an earth sheltered house are more limited as compared to a conventional home.

Elimination of noise from the outside was important for both Group One and Group Two. However, 46 percent of Group One rated this factor as "very important" compared to only 29 percent of Group Two. The largest proportion of respondents in Group Two rated this factor as being "important". Elimination of outside noise was therefore a very important factor for almost one-half of those who had decided to live in an earth sheltered house.

The exterior appearance of one's house from the street or highway was most important to the respondents in Group Two. Seventy-two percent of Group Two thought exterior appearance was "very important", compared to 23 percent of Group One. This finding may give an important understanding of why some respondents have decided not to live in an earth sheltered house. The exterior of an earth sheltered house may differ considerably from the usual exterior appearance of a conventional home. If exterior appearance is important as a status symbol, then an earth sheltered house may not be the most desirable option.

The following information highlights other aspects studied in relation to this objective. Significant differences were not found between these factors, but an interesting analysis has been made.

The site locale of the house was very important to Group One and Group Two. Over 65 percent in each group rated this characteristic as "very important".

Close to 90 percent of the respondents in each group considered amount of inside storage space as being either "important" or "very important". Almost 50 percent of the respondents in both groups considered arrangement of rooms and amount of inside storage space as "very important".

Over 75 percent of the respondents in both groups indicated that the safety of the structure was "very important". Almost all the respondents in both groups considered having a safe structure of some importance. The sufficiency of fire exits was considered "very important" by over 55 percent of the respondents in both groups. Over 80 percent in both groups considered this characteristic to be "important" or "very important". Those who had not decided to live in earth sheltered houses had a higher concentration of responses showing fire exits as important to them. Almost 20 percent of those who decided to live in an earth sheltered house were indifferent or did not think fire exits to be very important in earth sheltered housing.

Over 95 percent of the respondents in both groups indicated that comfortable air temperature in the living space was important. The following housing aspects were considered as quite important to respondents in both groups: comfortable humidity level; prevention of condensation on walls; prevention of condensation on windows; air circulation within house and; natural outdoor ventilation effects. Over 75 percent of the respondents in both groups considered these characteristics as being either "important" or "very important".

Importance of Housing Decision Factors

The importance of 12 factors was measured by asking respondents to indicate, on a five point scale, how important each factor was in their decision as to whether or not to live in an earth sheltered house. The frequencies and percentages of responses for both groups are shown in Table VIII, Appendix D.

The null hypothesis that was developed to test for differences in importance attached to these housing decision factors by respondents in the two groups was:

H_3: There are no significant differences between respondents who decided to live in an earth sheltered house and those who did not in terms of the importance attached to 12 housing decision factors.

A summary of the chi square tests for hypothesis three is shown in Table IV.

TABLE IV

SUMMARY OF SIGNIFICANT DIFFERENCES IN IMPORTANCE OF HOUSING DECISION FACTORS BY GROUP

VARIABLE	X^2	Significance
Personal privacy	14.552	.0057
Insurance reduction/elimination	13.928	.0075
Environmental noise reduction	12.661	.0131
Improved lifestyle	10.62	.0312
Enhanced alternative energy potential	8.765	.0326
Land preservation	12.277	.0154

Hypothesis Three was rejected for six of the twelve housing decision factors where significant differences were found between groups. A

larger proportion of respondents in Group One than in Group Two rated five of these factors as "very important" in their decision: personal privacy, reduction in insurance costs, reduction in environmental noise, improvement in life style and the enhanced alternative energy potential. A larger proportion of Group Two than Group One were in the mid-point or "undecided" category for these same factors.

The sixth factor that differed significantly between groups was the importance of land preservation. The largest proportion of Group Two was in the mid-point category, indicating that land preservation was neither important or unimportant in their decision. The largest proportion of Group One indicated that land preservation was "unimportant" in their decision. Thus it can be concluded that preserving the land was not one of the strong motivators for those who decided to live in an earth sheltered house.

No significant differences were found between the groups for the remaining six factors. Respondents in both groups tended to rate all of these factors as "important" or "very important" with the exception of one factor - concept demonstration/experimentation. The largest percentage of both groups were indifferent about this variable.

Objective Three

The third objective examined the perceived adequacy of housing for people who actually lived in an earth sheltered house and those who lived in conventional housing. Thus, the respondents were regrouped for this analysis. Group One-A included only persons who were living in an earth sheltered home. Group Two-A included all persons who were living in a conventional home at the time of the survey.

Respondents were asked to rate the adequacy of their home according to 24 selected housing aspects. Adequacy of the home was measured on scale with "one" indicating "not important" and "five" indicating "very important". The 24 housing aspects with the frequencies and percentages of responses for both groups are shown in Table IX, Appendix D.

The null hypothesis that was developed to test for differences in evaluation of adequacy for these housing aspects by the two groups was:

H_4: There are no significant differences between respondents who actually live in earth sheltered houses and those who do not in terms of perceived adequacy of selected aspects of housing.

A summary of the chi square tests for hypothesis four is shown in Table V. Hypothesis four was rejected for 18 of the 24 aspects of housing.

Sixty-eight percent of Group One-A rated their house "very adequate" for the site locale. Group Two had a more even distribution with the largest percentage giving this variable a mid-point rating.

Adequacy of views to outside from living area, main house entrance design and amount of inside storage space was rated very high for more than 40 percent of the earth sheltered housing dwellers. The largest percent of persons who did not live in earth sheltered houses gave their homes a mid-point rating or one category above that.

Over 50 percent of the earth sheltered dwellers rated their homes as "very adequate" for arrangement of rooms, privacy of family members from neighbors and privacy of family members from each other. The largest category of responses for Group Two-A were again at the mid-point.

TABLE V

SIGNIFICANT DIFFERENCES IN RATING OF ADEQUACY OF SELECTED ASPECTS OF PRESENT DWELLING BY EARTH SHELTERED AND NON-EARTH SHELTERED DWELLERS

VARIABLE	X^2	LEVEL OF SIGNIFICANCE
Site locale of the house.	22.22	.0001
Adequacy of views to outside from living areas.	6.58	.037
Main house entrance design.	12.30	.002
Arrangement of rooms.	27.95	.0001
Amount of inside storage space.	10.70	.005
Privacy of family members from neighbors.	21.06	.0001
Privacy of family members from each other.	10.25	.006
Safety of structure.	31.78	.0001
Elimination of noise from outside.	69.45	.0001
Control of mechanical equipment noises.	9.80	.008
Natural lighting design.	11.70	.003
Artificial lighting levels.	21.96	.0001
Materials used on walls, floor and ceiling.	20.62	.0001
Comfortable air temperature in living space.	37.98	.0001
Comfortable humidity level.	13.28	.0003
Prevention of condensation on walls.	17.28	.0002
Prevention of condensation on windows.	19.09	.0001
Air circulation within house.	15.37	.0005

Over 50 percent of the respondents in Group One-A rated the following aspects of their homes in the two highest categories: control of mechanical equipment noises, natural lighting design, artificial lighting levels and materials used on walls, floor and ceiling. Once again, all of these aspects, except the mechanical equipment noise were given a mid-point rating by the largest percentage of respondents in Group Two-A.

Over 90 percent of the respondents in Group One-A rated comfortable air temperature in living space and prevention of condensation on walls in the two highest categories. Only 47 percent of Group Two-A gave their homes a similar rating.

Comfortable humidity level, prevention of condensation on walls, prevention of condensation on windows, and air circulation in the house received an "adequate" or "very adequate" rating for over 70 percent of the respondents in Group One-A. The largest percent in Group Two-A was again at the mid-point.

No significant differences were found for six of the housing aspects: nearby neighbors' acceptance of your house type; community/town acceptance of your house type; exterior space for expansion and different usage; sufficiency of fire exits; and natural outdoor ventilation effects.

Overall those who lived in earth sheltered houses rated the adequacy of their house higher than those who did not live in earth sheltered houses. Repondents who did not live in earth sheltered houses usually give very high or very low ratings. They most often rated their homes at the mid-points on the scales.

Objective Four

The fourth objective of this research was:

> To identify constraints experienced by those who decided to live in an earth sheltered house and those who had not decided to live in such a house.

No null hypothesis was developed for the fourth objective. The questions about constraints were not included in data gathered from residents of earth sheltered houses. Thus, the descriptive analysis in Table VI includes only the 109 respondents who did not yet live in an earth sheltered house. Group One-B includes those who were building or planning to build an earth sheltered house. All other respondents are in Group Two-B. Approximately 35 percent of respondents did not answer the questions about constraints. This was particularly true of persons who had no plans to live in an earth sheltered house. Statistical analysis of differences between groups was not possible because of limited cell size, but Table VI shows the frequencies and percentages for each constraint.

Obtaining financing was evaluated as a major problem by the largest percentage of both groups. Those who had no specific plans for an earth sheltered house rated financing as an even more serious constraint than did those who were in the process of getting an earth sheltered home.

Obtaining plans for construction of an earth sheltered house was a minor problem for the largest percentage in both groups. Building code regulations which complicated construction was classed as a minor problem by over 40 percent of those who had no plans to build an earth sheltered home, but it was seen as no problem by nearly 40 percent of those who were in the process of obtaining an earth sheltered house.

TABLE VI

CONSTRAINTS TO CONSTRUCTION OF EARTH SHELTERED HOME

CONSTRAINTS	Group One Planning or Building an Earth Sheltered House		Group Two No Plans for an Earth Sheltered House		TOTALS	
	Number n=35	Percent	Number n=74	Percent	Number n=109	Percent
1. Obtaining plans for construction of an earth sheltered house.						
5 Major Problem	2	(6)	3	(6)	5	(6)
4	1	(3)	9	(20)	10	(13)
3 Minor Problem	14	(45)	18	(39)	32	(42)
2	2	(7)	4	(9)	6	(8)
1 No Problem	12	(39)	12	(26)	24	(31)
No Response	4		28		32	
2. Building code regulations which complicated construction.						
5 Major Problem	3	(10)	1	(3)	4	(6)
4	3	(10)	6	(16)	9	(13)
3 Minor Problem	6	(21)	15	(41)	21	(32)
2	6	(21)	5	(13)	11	(17)
1 No Problem	11	(38)	10	(27)	21	(32)
No Response	6		37		43	
3. Obtaining insurance for an earth sheltered house.						
5 Major Problem	2	(8)	2	(6)	4	(6)
4	4	(16)	3	(8)	7	(11)
3 Minor Problem	5	(20)	17	(46)	22	(36)
2	3	(12)	6	(16)	9	(15)
1 No Problem	11	(44)	9	(24)	20	(32)
No Response	10		37		47	

TABLE VI (Continued)

CONSTRAINTS	Group One-B Planning or Building an Earth Sheltered House		Group Two-B No Plans for an Earth Sheltered House		TOTALS	
	Number n=35	Percent	Number n=74	Percent	Number n=109	Percent
4. Obtaining a contractor or construction workers willing to work with an earth shelterd house.						
5 Major Problem	4	(14)	7	(16)	11	(16)
4	3	(11)	10	(23)	13	(18)
3 Minor Problem	3	(11)	15	(35)	18	(25)
2	5	(18)	5	(12)	10	(14)
1 No Problem	13	(46)	6	(14)	19	(22)
No Response	7		31		38	
5. Obtaining information regarding design to minimize energy consumption of an earth sheltered house.						
5 Major Problem	3	(10)	5	(11)	8	(11)
4	5	(17)	9	(21)	14	(19)
3 Minor Problem	10	(33)	11	(25)	21	(28)
2	1	(3)	7	(16)	8	(11)
1 No Problem	11	(37)	12	(27)	23	(31)
No Response	5		30		35	
6. Obtaining construction and mortgage financing.						
5 Major Problem	7	(28)	16	(37)	23	(34)
4	6	(24)	7	(16)	13	(19)
3 Minor Problem	5	(20)	14	(33)	19	(28)
2	3	(12)	4	(9)	7	(10)
1 No Problem	4	(16)	2	(5)	6	(9)
No Response	10		31		41	

The following factors: (1) obtaining a contractor or construction workers willing to work with an earth sheltered design and (2) obtaining information regarding design to minimize energy consumption of an earth sheltered house, were rated as minor problems or no problem by the largest percentage of both groups.

The largest percentage of those who did not have any plans to build an earth sheltered house rated most all of the factors as minor problems. This same group, however, did evaluate the obtaining of construction and mortgage financing as a major problem. These factors which were considered to be problems, either minor or major, may have been important in their decision not to build an earth sheltered house.

The largest percent of the respondents who were planning or building an earth sheltered house evaluated most of the factors as being "no problem" or only "minor problems".

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary and Conclusions

The purpose of this study was to analyze differences between individuals who had decided to live in an earth sheltered house in terms of (1) socioeconomic characteristics, (2) importance of selected aspects of housing and (3) importance of housing decision factors. Further analysis was made of differences between individuals who were already living in an earth sheltered house and those who were not in terms of adequacy of selected aspects of housing. In addition, constraints to the obtaining of an earth sheltered house were examined. The data for residents of earth sheltered houses was obtained from a Presidential Challenge Grant (PCG) Study of earth sheltered housing conducted 1979-80 by Oklahoma State University (OSU) Department of Housing, Design and Consumer Resources and Architectural Extension. Data for non-earth sheltered dwellers were collected by mailed questionnaire from a systematic sample of 109 respondents drawn from the list of participants in Earth Sheltered Housing Seminars conducted by Architectural Extension at OSU during 1978 and 1979. The chi square statistic was used to determine significant differences.

Hypothesis One examined socio-economic factors to see if there were significant differences between those who had decided to live in an earth sheltered house (Group One) and those who had not (Group Two).

There were no significant differences between the groups for marital status. There were significant differences between the groups for age, education and rural/ non-rural residential location. The largest proportion of those who had decided to live in earth sheltered houses were in the middle age bracket (30-49). The largest proportion of those who had no plans to live in earth sheltered houses were younger (22-29). Perhaps the middle age group is better able to finance an earth sheltered house with their own resources while the younger group may have to depend on lending agencies for financing. Agencies are slow to fund earth sheltered houses, making the situation even more complicated for the younger age group. Other possible reasons for the age group may be that the middle age group may have a higher tendency toward do-it-yourself projects. Earth sheltered houses are often designed and built by the owners. This group of earth sheltered housing dwellers also had less education and therefore may include a higher concentration of skilled workers who are more likely to have building skills. Also, being older, this age group is probably overall more stable and consider such a house as a permanent home. This study and past literature reveal that financing is a problem for many desiring an earth sheltered house. Those who had decided to live in an earth sheltered house had less education than those who had no plans to live in such a house. Perhaps those with lower education had lower buying power, therefore, they wanted to make the best use of their money. An important advantage of earth sheltered housing is the fact that it saves on utility bills. The larger percentage of those who had decided to live in earth sheltered houses were located in rural areas. Building codes and restriction inhibit many from building an earth sheltered house within urban areas.

Respondents in this study were asked to rate the importance of 24 housing factors for an "ideal" home. Hypothesis Two examined these ratings to see if there were differences between groups. All but three of these variables were evaluated as important by the majority of respondents in both groups. Significant differences were found between those who had decided to live in an earth sheltered house (Group One) and those who had not (Group Two) for three variables. These three variables (exterior appearance, flexibility of interior space and elimination of noise) were considered important or very important by a larger percentage of Group Two than Group One. Exterior appearance from the street or highway probably was not as important to those who had decided to live in an earth sheltered house because the respondents in this group were aware that an earth sheltered house may not even be visible from the street or road. Less than half of those in Group One considered this variable as "very important" compared to 75 percent of Group Two. Elimination of noise from outside was considered "important" or "very important" by most of the respondents in both groups. However, 46 percent of Group One considered elimination of outside noise to be "very important" compared to only 29 percent of Group Two. Perhaps elimination of outside noise was a major reason in the decision of those who have decided to live in an earth sheltered house. Earth sheltered houses provide excellent modification of or elimination of outside noise.

Hypothesis Three examined differences in the importance attached to 12 housing decision factors by the two groups. Significant differences were found between those who had decided to live in earth sheltered houses (Group One) and those who had not (Group Two) for six of the 12 housing factors.

The largest proportion of respondents in Group One considered land preservation as "unimportant" in their decision to live in an earth sheltered house. Respondents in Group Two were indifferent on their rating of land preservation. The literature reveals that preservation of the land is an important advantage of earth sheltered housing - particularly in areas where land is scarce. However, the respondents in this study did not consider land preservation to be important in their decision. The respondents in this study live in Oklahoma, which is not as heavily populated as some areas. Therefore, since land is more readily available, those who have decided to live in an earth sheltered house may not consider this as an important reason for living in such a house.

The other five factors (personal privacy, insurance reduction/ elimination, environmental noise reduction, improved lifestyle and enhanced alternative energy potential) were rated higher in importance by Group One than by Group Two. These decision factors were the ones that made a difference for these Oklahoma families who already lived in earth sheltered houses or were planning for such a home.

Hypothesis Four examined differences between those who live in an earth sheltered house and those who do not concerning perceived adequacy of 24 selected aspects of housing. Significant differences between Group One-A and Group Two-A were found for 18 of these aspects.

Those who live in an earth sheltered house (Group One-A) rated these aspects as more adequate than did Group Two-A. Respondents in Group One-A lived in earth sheltered houses and often these people had been involved in the planning and construction of their homes. Because these people were perhaps better able to control their environment, they

may have been more satisfied with the adequacy of their dwelling. Those in Group Two-A may not have been as involved or perhaps not involved at all in the planning and construction of their home.

Objective Four was designed to identify constraints experienced by those who decided to live in an earth sheltered house and those who had not. Obtaining construction and mortgage financing was considered to be a major problem by both groups, but was viewed as somewhat less serious a problem by those who were already planning or building an earth sheltered home. Obtaining plans for an earth sheltered house was considered to be a minor problem by both groups. Building code regulations, obtaining insurance and obtaining contractor or construction workers for an earth sheltered house was rated as a "minor problem" by Group Two-A while Group One-A most often rated these as "no problem".

A conclusion from this research suggests that financing may be a bigger problem for the younger age bracket who are more likely to have to rely upon loans to finance housing. More persons in the older age bracket were found to live in earth sheltered houses. This age group is more likely to have sufficient personal resources and or credit from which loans for an earth sheltered house can be made. Therefore, construction and mortgage financing is not so serious a problem for them.

Earth sheltered housing dwellers rated the adequacy of their homes high in most aspects. Non-earth sheltered housing dwellers tended to rate the adequacy of their homes around the midpoint. Perhaps making the decision to live in an earth sheltered house caused the individuals to carefully evaluate what was most important to them. These earth sheltered housing dwellers may have realized that all design problems have tradeoffs. No plan can offer the ultimate ideal in all respects. They

may have been able to better decide and design what was most important to them. This way they achieved a higher level of satisfaction with the adequacy of their home.

Supporters of earth sheltered housing have stated what they see to be important advantages of this housing alternative. The residents of earth sheltered housing in this study agreed that these were advantages. Disadvantages and constraints which were identified in the literature on earth sheltered housing were also experienced by respondents in this study.

Recommendations

Recommendations from this study indicate that further research could be done. In depth analysis of each variable in this study could be helpful to the housing industry and the consumer. Specific recommendations that may reflect these needs may fall within the areas of marketing, finance, codes and policy, consumer economics, construction technology, applicability and behavioral sciences.

In the area of marketing, research information could be collected regarding resale of units, changes in attitudes of residents, reason for turnover, patterns of behavior for the second generation residents, and various characteristics of earth sheltered housing dwellers. The characteristics which could be researched may include those in this study or other aspects of interest or concern. Using a control group of those who have built custom, surface level homes could be useful to study the differences between the groups.

Since financing was found to be the most important constraint for both earth sheltered housing and non-earth sheltered housing dwellers,

it should be carefully considered. Financial institutions could be studied, particularly in the areas where earth sheltered housing is being built. Types and sources of financing could be studied as to what earth sheltered housing dwellers have used in the past. Future studies should examine the type and source of financing used by people who have built earth sheltered houses.

Educational seminars for lending agencies and the public can provide factual information. Assumed and real disadvantages and constraints may be dealt with in such a way to provide possible solutions.

Codes and policies determine if a certain type of house can be built and how it should be constructed. Policy changes may need to be made to allow for effective and efficient alternative housing. City leaders need to carefully examine the purpose of city building codes. Policies and codes perhaps should be based on performance rather than the product. Some codes are not particularly relevant to earth sheltered housing. Some policies that may need to be reevaluated include such factors as: sewer line depths; roofing materials; set backs and total square footage. Earth sheltered houses may provide answers to problems of the city. For example, this type of house can fit well into an odd-shaped lot. Earth sheltered houses are able to greatly reduce exterior noises such as those created by a city. Such a house can be mass-produced without having that kind of appearance. More research using the mass-produced method should be researched to evaluate its characteristics.

Change is difficult to accept and/or seemingly impossible to produce. Awareness, creditable information and experience can be useful avenues in which acceptance may come for ultimate change.

SELECTED BIBLIOGRAPHY

Agan, T. and Luchsinger, E. The House. New York: J. B. Lippincott Company, 1965.

Bennett, D. and Bligh, T. P. The energy factor-a demension of Design. Underground Space, 1977 (July), 1 (4), 1-17.

Bligh, T. P. Energy conservation by building underground. Underground Space, 1976, 1, 19-33.

Camter, D. and Stringer, P. Environmental Interaction. New York: International Universities Press, Inc., 1975.

"Carter Broadcasting Energy Address." Congressional Quarterly Weekly, 1979, 37 (14), 661, 2672.

Coleman, C. Looking to the future. Homes and Gardens, 1977 (Mar.), 58 (9), 48-53.

Compton, H., and Hall, A. Foundations of Home Economics Research: A Human Ecology Approach. Minnesota: Burgess Publishing Company, 1972.

Croome, D. and Sherratt, A. (Eds.). Condensation in Buildings. London: Applied Science Publishers LTD, 1972.

Dempewolff, R. G. Underground housing. Science Digest, 1975 (Nov.), 78(5), 40-53.

Edelhart, M. The good life underground. Omni, 1980 (Jan.) 2(4), 50-55, 92.

Eskridge, J. Underground housing moves to the forefront. Oklahoma Business, 1980 (Mar.) 3, 20-21.

Fairhurst, C. and Sterling, R. (Eds.). Earth-Sheltered Cost and Code Study of Underground Building: A Report to the Minnesota Energy Agency. Underground Space, 1979, 4(3), 133.

Fairhurst, C. and Sterling, R. (Eds.). Earth-Sheltered Homes: Weighing the Advantages. Underground Space, 1981, 5(4), 200-204.

Fairhurst, C. and Sterling, R. (Eds.). Study shows lower energy and construction costs from earth-sheltering. Underground Space, 1981, 5(4), 197.

Ford, B. Safe city; apartment living inside a mountain. Science Digest, 1969 (Aug.), 66, 16-19.

Groseclose, E. Room at the bottom: More schools, houses are built underground. Wall Street Journal, 1966 (Jan. 21).

Guranik, D. D. (Ed.). Webster's New World Dictionary. New York: The World Publishing Company, 1973.

Hamilton, M. Soleri: Architect-designer. Industrial Design, 1964, 11, 56-61.

Hempel, D. and Tucker, L., Jr. "Citizen Preferences for Housing as Community Social Indicators," Environment and Behavior. New York, New York. Sage Publications, Inc. 11(3) 1979, pp. 399-428.

Ingersoll, J. 12 subterranean pioneers report: "It's great to live underground", Popular Mechanics. 1980 (May), (5), 114-117, 240, 242.

Jansson, B. and Torbjorn Winquist. Planning of subsurface use. Stockholm, Statens rad for byggnadsforskning. 1977.

Japan: underground movement. The Economist, 1966 (Dec. 24), 221, (6435) 1323.

Johnson, Pam. "Down home: living underground has its advantages". Dallas Morning News, 1978 (July 23), Sect. F., p. 1.

Jones, L. Underground space-another resource. The Military Engineer, 1977 (Nov./Dec.), 400.

Kennedy, M. Subterranean living: it was worth her wait. Dallas Times Herald, 1978 (Nov. 26), Sect. G. 1,6.

Kerlinger, F. N. Foundations of Behavioral Research. New York: Holt, Rinehart and Winston, Inc., 1964.

Lane, C. A. An essay-frequently asked questions on earth sheltered housing. Underground Space, 1979, 4(3),143-152.

Living underground. Newsweek, 1979, 91(23), 106, 109.

Local Energy Policies. Washington D.C.: United States Government Printing Office, 1978, 134.

Marsh, P. Air and Rain Penetration of Buildings. New York: The Construction Press, Ltd., 1977.

Markus, T. A. Building Performance Research Unit. New York: John Wiley and Sons, 1972.

Mason, R. Underground Architecture: What lies ahead may be beneath us. The Futurist, 1976 (Feb.), (10), 16-20.

McCray, J. and Day, S. "Housing Values, Aspirations, and Satisfactions as Indicators of Housing Need", Home Economics Research Journal, 1977, 5(4), 244-254.

McKown, C., and Stewart, K. Consumer attitudes concerning construction features of an earth sheltered dwelling. Underground Space, 1980 (Mar./Apr.), 4(5).

Miller, F., Tsemberis, S., Malia, G. and Grega, D. "Neighborhood Satisfaction Among Urban Dwellers." Journal of Social Issues. 36(3) 1980, 101-117.

Moos, R. The Human Context; enviromental determinants of behavior. New York: John Wiley and Sons Inc., New York, 1967.

Moreland, F. (Ed.). Alternatives in Energy Conservation: The use of earth covered buildings. In Proceedings and Notes of a Conference Held in Ft. Worth, Texas, July 9-12, 1975. Washington, D.C.: U.S. Government Printing Office, 1976.

National Science Foundation. Symposium on the Development and Utilization of Underground Space, Proceedings. Kansas City, Missouri: 1975 (Mar. 5).

Olmstead, L. A. Human mole: Baldasare Forestiere's underground underground gardens. American Mercury, 1960, 90, 137-140.

Parker, J. Stockton. Interiors of underground houses: suggestions for consumers. Lubbock, Texas. Center for energy research, 1979 (Aug.), 25-27.

Rokeach, Milton. Beliefs, Attitudes, and Values. San Francisco, Ca.: Jossey-Bass, Inc., 1976, 133-141.

Simmons, J. D., Newman and Godbey, L. Light Distribution in Three E-Embanked Houses. Proceedings Earth S. Building Design Innovations. (April 18-19, 1980), p. 1-17.

Smay, E. Underground Living. Popular Science, 1974 (June), 88,89.

Sommer, R. Tight Spaces: Hard Architecture and How to Humanize It. Englewood Cliffs, New Jersey: Prentice Hall, Inc., 1974.

Sterling, R. Earth Sheltered Housing Design: Guidelines, Examples and References. Minneapolis, Minnesota: American Underground Space Association, 1977.

Sterling, R., Aiken, R., and Carmody, J. Earth Sheltered Housing: Code, Zoning, and Financing Issues. U.S. Government Printing office, Washington, D.C., 1980, 16.

Stewart, K., McKown, C., and Peck, C. Consumer attitudes concerning an earth sheltered house. Underground Space, 1979 (July/Aug.), 3, 7.

Thorndike, L., and Hagan, E. Measurement and Evaluation in Psychology and Education. New York: John Wiley and Sons, Inc., 1967.

U.S. Department of Commerce-Bureau of the Census. Statistical Abstract of the U.S., 100th Edition. Washington, D.C.: U.S. Government Printing Office, 1979.

U.S. Department of Housing and Urban Development. Solar Energy and Your Home. Washington, D.C.: U.S. Government Printing Office, 1978.

U.S. Department of Housing and Urban Development. Minimum Property Standards - One and Two Family Dwellings. Washington, D.C.: U.S. Government Printing Office, 1979a.

U.S. Department of Housing and Urban Development. Residents' Satisfaction in HUD-Assisted Housing: Design and Management Factors. Washington, D.C.: U.S. Government Printing Office, 1979b.

U.S. Department of Housing and Urban Development. Solar Heating and Cooling Demonstration Program. Washington, D.C.: U.S. Government Printing Office, 1979c.

APPENDIXES

APPENDIX A

SELECTED QUESTIONS USED FROM THE PCG STUDY

Please provide the following data for the person who is filling out the questionnaire:

Family Member	Sex	Age	Marital Status	Highest Grade or Degree Completed	Occupation

1 Which of the following describes the population area in which your earth sheltered dwelling is located?

_____ open country-rural
_____ under 1000
_____ 1000-9999
_____ 10,000-49,999
_____ Over 50,000

2 Check the appropriate category that best indicates the total annual income for your family?

_____ $4999 and under
_____ $5000-9999
_____ $10000-14999
_____ $15000-19999
_____ $20000-24999
_____ $25000-29999
_____ $30000-34999
_____ $35000 and over

3 Where did you live before moving into your present earth sheltered dwelling?

_____ Single family home
_____ Apartment
_____ Mobile home
_____ Condominium
_____ Duplex
_____ Other, please specify _____

4 Was your previous home _____ owned _____ rented _____ other, please specify _____

5 What was the approximate square footage of your previous home (without garage)?
_____ square feet

6 Were any problems encountered with the following?

	No Problem		Minor Problem		Major Problem
a. Obtaining plans for construction of earth sheltered housing	1	2	3	4	5
b. Building code regulations which complicated construction of your house	1	2	3	4	5
c. Obtaining contractor or construction workers willing to work with an earth sheltered design	1	2	3	4	5
d. Obtaining insurance for your sheltered house	1	2	3	4	5
e. Obtaining information regarding design to minimize energy consumption of your earth sheltered house	1	2	3	4	5

7 The following factors seem to be important to those considering earth sheltered housing. How important was each factor in <u>your</u> decision to build with earth shelter?

	not imp									very imp
Land preservation	1	2	3	4	5	6	7	8	9	10
Improved lifestyle	1	2	3	4	5	6	7	8	9	10
Reduced cooling load	1	2	3	4	5	6	7	8	9	10
Reduced heating load	1	2	3	4	5	6	7	8	9	10
Maintenance reduction	1	2	3	4	5	6	7	8	9	10
Environmental noise reduction	1	2	3	4	5	6	7	8	9	10
Personal privacy	1	2	3	4	5	6	7	8	9	10
Concept demonstration/experimentation	1	2	3	4	5	6	7	8	9	10
Storm protection	1	2	3	4	5	6	7	8	9	10
Enhanced alternative energy potential	1	2	3	4	5	6	7	8	9	10
Security from vandalism/crime	1	2	3	4	5	6	7	8	9	10
Insurance reduction/elimination	1	2	3	4	5	6	7	8	9	10

8 How do you feel about the following statement? "There is a very real and increasingly serious energy shortage facing the United States."

5 4 3 2 1 0 1 2 3 4 5

strongly disagree — neutral — strongly agree

The following series of questions on the next several pages will ask you to provide two (2) ratings for a number of different parameters. The rating on the left side deals with your opinion about an ideal situation. The rating on the right side deals specifically with your earth sheltered house. You are not expected to give extremely high ratings on all the items listed. The house which could obtain consistently high ratings on all items has probably not been built nor will ever be built, since all buildings are really a compromise between competing design parameters. We plead for your honest appraisal.

9 Rate the importance you would assign each of the following factors according to your personal preference in an ideal living habitat. Also rate your earth sheltered house with respect to these factors.

Relative Importance					Community Setting	Rating for Your House				
not imp				very imp		low rating				high rating
1	2	3	4	5	Nearby neighbors' acceptance of earth sheltered housing	1	2	3	4	5
1	2	3	4	5	Community/town acceptance of earth sheltered housing	1	2	3	4	5
1	2	3	4	5	Site locale of the house	1	2	3	4	5
1	2	3	4	5	Exterior appearance from street or highway	1	2	3	4	5
1	2	3	4	5	Privacy of family members from neighbors	1	2	3	4	5
1	2	3	4	5	Main house entrance design	1	2	3	4	5

10 Rate the importance of the following factors according to your personal preference in an ideal living habitat. Then circle your rating of these factors in your earth sheltered house.

Relative Importance					Habitability Factors	Rating for Your House				
not imp				very imp		low rating				high rating
1	2	3	4	5	Arrangement of rooms	1	2	3	4	5
1	2	3	4	5	Amount of inside storage space	1	2	3	4	5
1	2	3	4	5	Flexibility of interior space for expansion & different useage	1	2	3	4	5
1	2	3	4	5	Adequacy of views to outside from living areas	1	2	3	4	5
1	2	3	4	5	Safety of structure	1	2	3	4	5
1	2	3	4	5	Sufficiency of fire exits	1	2	3	4	5

11 Rate the importance of the following factors according to your personal preference in an ideal living habitat. Then circle your rating of these factors in your earch sheltered house.

Relative Importance					Habitability Factors (cont)	Rating for Your House				
not imp				very imp		low rating				high rating
1	2	3	4	5	Privacy of family from each other	1	2	3	4	5
1	2	3	4	5	Elimination of noise from outside	1	2	3	4	5
1	2	3	4	5	Control of mechnical equipment noises	1	2	3	4	5
1	2	3	4	5	Natural lighting design	1	2	3	4	5
1	2	3	4	5	Artificial lighting levels	1	2	3	4	5
1	2	3	4	5	Materials used on walls, floor and ceiling	1	2	3	4	5
1	2	3	4	5	Comfortable air temperature in living space	1	2	3	4	5
1	2	3	4	5	Comfortable humidity level	1	2	3	4	5
1	2	3	4	5	Prevention of condensation on walls	1	2	3	4	5
1	2	3	4	5	Prevention of condensation on windows	1	2	3	4	5
1	2	3	4	5	Air ciruculation within house	1	2	3	4	5
1	2	3	4	5	Natural outdoor ventilation effects	1	2	3	4	5

Space for Explanatory Comments:

12 Overall, how happy are you with your present housing environment?

5 4 3 2 1 0 1 2 3 4 5

very unhappy — "so so" — very happy

APPENDIX B

COVER LETTER

Oklahoma State University

DIVISION OF HOME ECONOMICS
Department of Housing, Design and Consumer Resources

STILLWATER, OKLAHOMA 74078
HOME ECONOMICS WEST BUILDING
(405) 624-5048

September 30, 1980

Hello,

I am a graduate student in Housing, Design and Consumer Resources at Oklahoma State University. In the last few years, many Oklahoma people have expressed interest in learning more about earth sheltered housing as an energy saving alternative.

As my graduate research project, I am exploring the factors involved in people's decision about living in an earth sheltered house. You have been selected as a respondent for this study because of your interest in earth sheltered housing.

Your opinions are very valuable in increasing knowledge as to whether or not earth sheltered housing is a viable alternative for Oklahoma families. Your responses will be analyzed only in group data to assure confidentiality.

If you do not live in an earth sheltered house now, please complete the enclosed 3 page questionnaire and return it within a week. I need your help and very much appreciate your taking a few minutes to answer these few questions.

If you already live in an earth sheltered house and are willing to have your name identified for research purposes, please fill out the enclosed form. It may be returned in the envelope provided.

Thank you very much.

Cordially,

Marcia Cook

Marcia Cook

Kay Stewart

Dr. Kay Stewart, Advisor

APPENDIX C

QUESTIONNAIRE

QUESTIONNAIRE

This questionnaire is to be answered by those persons who have shown an interest in earth sheltered housing but do not live in an earth sheltered house.

1. Please provide the following data for the person who is filling out the questionnaire:

Family Member	Sex	Age	Marital Status	Highest Grade or Degree Completed	Occupation
a	b	c	e	f	g

2. Which of the following describes the population area in which you are located?

_____1 open country-rural
_____2 under 1000
_____3 1000-9999
_____4 10,000-49,999
_____5 Over 50,000

3. Check the appropriate category that best indicates the total annual income for your family.

_____1 $4999 and under
_____2 $5000-9999
_____3 $10000-14999
_____4 $15000-19999
_____5 $20000-24999
_____6 $25000-29999
_____7 $30000-34999
_____8 $35000 and over

4. In what type of home do you live?

_____1 Single family home
_____2 Apartment
_____3 Mobile home
_____4 Condominium
_____5 Duplex
_____6 Other, please specify_____

5. Do you rent or own your home?

_____1 rent _____2 own _____3 other (SPECIFY)_____

6. What is the approximate square footage of your home (without garage)?_____

7. How many people live in your home? _____

The following series of questions will ask you to provide two (2) ratings for a number of different parameters. The rating on the left side deals with your opinion about an IDEAL situation. The rating on the right side deals specifically with your PRESENT house. You are not expected to give extremely high ratings on all the items listed. The house which could obtain consistently high ratings on all items has probably not been built nor will ever be built, since all buildings are really a compromise between competing design parameters. We plead for your honest appraisal.

8. Rate the importance of each of the following factors according to your personal preference in an ideal living habitat by circling a number to the left of the statement. Also rate your present home by circling a number to the right of the statement.

Relative Importance for IDEAL						Rating for PRESENT House					
not impt.				very impt.		low rating					high rating
1	2	3	4	5	a. Nearby neighbors' acceptance of your house type.	A. 1	2	3	4	5	
1	2	3	4	5	b. Community/town accaptance of your house type.	B. 1	2	3	4	5	
1	2	3	4	5	c. Site locale of the house.	C. 1	2	3	4	5	
1	2	3	4	5	d. Exterior appearance from street or highway.	D. 1	2	3	4	5	
1	2	3	4	5	e. Privacy of family members from neighbors.	E. 1	2	3	4	5	
1	2	3	4	5	f. Main house entrance design.	F. 1	2	3	4	5	
1	2	3	4	5	g. Arrangement of rooms.	G. 1	2	3	4	5	
1	2	3	4	5	h. Amount of inside storage space.	H. 1	2	3	4	5	
1	2	3	4	5	i. Flexibility of interior space for expansion & different useage.	I. 1	2	3	4	5	
1	2	3	4	5	j. Adequacy of views to outside from living areas.	J. 1	2	3	4	5	

(Continued #8 from previous page).

Relative Importance for IDEAL (not impt. 1 2 3 4 5 very impt.)		Rating for PRESENT House (low rating 1 2 3 4 5 high rating)
1 2 3 4 5	k. Safety of structure.	K. 1 2 3 4 5
1 2 3 4 5	l. Sufficiency of fire exits.	L. 1 2 3 4 5
1 2 3 4 5	m. Privacy of family from each other.	M. 1 2 3 4 5
1 2 3 4 5	n. Elimination of noise from outside.	N. 1 2 3 4 5
1 2 3 4 5	o. Control of mechnical equipment noises.	O. 1 2 3 4 5
1 2 3 4 5	p. Natural lighting design.	P. 1 2 3 4 5
1 2 3 4 5	q. Artificial lighting levels.	Q. 1 2 3 4 5
1 2 3 4 5	r. Materials used on walls, floor and ceiling.	R. 1 2 3 4 5
1 2 3 4 5	s. Comfortable air temperature in living space.	S. 1 2 3 4 5
1 2 3 4 5	t. Comfortable humidity level.	T. 1 2 3 4 5
1 2 3 4 5	u. Prevention of condensation on walls.	U. 1 2 3 4 5
1 2 3 4 5	v. Prevention of condensation on windows.	V. 1 2 3 4 5
1 2 3 4 5	w. Air circulation within house.	W. 1 2 3 4 5
1 2 3 4 5	x. Natural outdoor ventilation effects.	X. 1 2 3 4 5

Space for Explanatory Comments:

9. Overall, how happy are you with your present housing environment? Not Happy 1 2 3 4 5 Very Happy

10. How do you feel about the following statement? "There is a very real and increasingly serious energy shortage facing the United States." Strongly Disagree 1 2 3 4 5 Strongly Agree

11. The following factors have been identified as considerations by people who are deciding whether or not to build or buy an earth sheltered house. How important is each factor to you in your decision?

	not important 1 2 3 4 5 very important
Land preservation.	a. 1 2 3 4 5
Improved lifestyle.	b. 1 2 3 4 5
Reduced cooling load.	c. 1 2 3 4 5
Reduced heating load.	d. 1 2 3 4 5
Maintenance reduction.	e. 1 2 3 4 5
Environmental noise reduction.	f. 1 2 3 4 5
Personal privacy.	g. 1 2 3 4 5
Concept demonstration/experimentation.	h. 1 2 3 4 5
Storm protection.	i. 1 2 3 4 5
Enhanced alternative energy potential.	j. 1 2 3 4 5
Security from vandalism/crime.	k. 1 2 3 4 5
Insurance reduction/elimination.	l. 1 2 3 4 5
Please list any other factors that are important to you.	
_____	m. 1 2 3 4 5
_____	n. 1 2 3 4 5
_____	o. 1 2 3 4 5

12. Which of the following best describes your interest in living in an earth sheltered house?

a. None- Have no interest in living in an earth sheltered house. _____

Why? _____

b. Was interested at one time but am no longer interested. _____

c. Interested, but have not as yet planned an earth sheltered house. _____

d. Interested, and have planned or am planning an earth sheltered house. _____

e. Interested, and have started construction of an earth sheltered house. _____

13. As you were exploring the possibility of building or buying an earth sheltered house, did you encounter any constraints or problems that may have slowed you down or kept you from obtaining an earth sheltered house? Rate each of the following factors as to the degree of problem you experienced. Add any problems not included on the list and rate those too.

		No Problem			Minor	Major
Obtaining plans for construction of an earth sheltered house.	a.	1	2	3	4	5
Building code regulations which complicated construction.	b.	1	2	3	4	5
Obtaining insurance for an earth sheltered house.	c.	1	2	3	4	5
Obtaining a contractor or construction workers willing to work with an earth sheltered design.	d.	1	2	3	4	5
Obtaining insurance for a sheltered house.	e.	1	2	3	4	5
Obtaining information regarding design to minimize energy consumption of an earth sheltered house.	f.	1	2	3	4	5
Obtaining construction and mortgage financing.	g.	1	2	3	4	5
_____	h.	1	2	3	4	5
_____	i.	1	2	3	4	5

14. If you have decided <u>not</u> to build or buy an earth sheltered house, what are the 3 major reasons for that decision?

1. _____

2. _____

3. _____

15. If you are planning to build or buy an earth sheltered house within the near future- how did you overcome each problem or constraint that you identified in Question #14? Please be as complete as possible with this information.

_____

_____

_____

_____

_____

_____

_____

_____

_____

THANK YOU FOR YOUR ASSISTANCE.

APPENDIX D

TABLES

TABLE VII

IMPORTANCE OF SELECTED HOUSING ASPECTS BY GROUP

VARIABLE	Group One: Living in or Planning an Earth Sheltered House Number (n=82)	Group One Percent	Group Two: No Plans for an Earth Sheltered House Number (n=74)	Group Two Percent
Nearby neighbors' acceptance of your house type.				
5 very important	5	(8)	4	(5)
4	10	(16)	23	(32)
3	21	(35)	25	(34)
2	9	(15)	11	(15)
1 very unimportant	16	(26	10	(14)
No Response	21		1	
Community/town acceptance of your house type.				
5 very important	5	(8)	4	(5)
4	11	(18)	16	(22)
3	19	(32)	29	(40)
2	13	(22)	14	(19)
1 very unimportant	12	(20)	10	(14)
No Response	22		1	
Site locale of the house.				
5 very important	39	(65)	49	(67)
4	16	(27)	20	(28)
3	3	(5)	3	(4)
2	0	(0)	0	(0)
1 very unimportant	2	(3)	1	(1)
No Response	22		1	
Exterior appearance from street or highway.				
5 very important	14	(23)	18	(25)
4	15	(25)	34	(47)
3	16	(27)	14	(19)
2	10	(17)	6	(8)
1 very unimportant	5	(8)	1	(1)
No Response	22		1	
Privacy of family members from neighbors.				
5 very important	31	(52)	34	(47)
4	15	(25)	28	(38)
3	7	(12)	9	(12)
2	3	(5)	2	(3)
1 very unimportant	4	(6)	0	(0)
No Response	22		1	

TABLE VII (Continued)

VARIABLE	Group One: Living in or Planning an Earth Sheltered House Number (n=82)	Percent	Group Two: No Plans for an Earth Sheltered House Number (n=74)	Percent
Main house entrance design.				
5 very important	22	(37)	17	(23)
4	24	(40)	32	(44)
3	7	(12)	18	(25)
2	5	(8)	3	(4)
1 very unimportant	2	(3)	3	(4)
No Response	22		1	
Arrangement of rooms.				
5 very important	33	(56)	45	(63)
4	17	(29)	22	(31)
3	8	(13)	3	(4)
2	1	(2)	1	(1)
1 very unimportant	0	(0)	1	(1)
No Response	23		2	
Amount of inside storage space.				
5 very important	28	(48)	43	(59)
4	25	(42)	22	(30)
3	6	(10)	6	(8)
2	0	(0)	2	(3)
1 very unimportant	0	(0)	0	(0)
No Response	23		1	
Flexibility of interior space for expansion and different useage.				
5 very important	12	(20)	19	(26)
4	16	(27)	28	(39)
3	20	(33)	17	(23)
2	9	(15)	8	(11)
1 very unimportant	3	(5)	1	(1)
No Response	22		1	
Adequacy of views to outside from living areas.				
5 very important	19	(32)	30	(41)
4	23	(38)	25	(34)
3	11	(18)	9	(12)
2	4	(7)	9	(12)
1 very unimportant	3	(5)	1	(1)
No Response	22		0	

TABLE VII (Continued)

VARIABLE	Group One: Living in or Planning an Earth Sheltered House Number (n=82)	Percent	Group Two: No Plans for an Earth Sheltered House Number (n=74)	Percent
Safety of structure.				
5 very important	53	(88)	57	(78)
4	5	(9)	13	(18)
3	2	(3)	3	(4)
2	0	(0)	0	(0)
1 very unimportant	0	(0)	0	(0)
No Response	22		1	
Sufficiency of fire exits.				
5 very important	35	(58)	53	(73)
4	14	(23)	13	(18)
3	8	(14)	6	(8)
2	2	(3)	1	(1)
1 very unimportant	1	(2)	0	(0)
No Response	22		1	
Privacy of family from each other.				
5 very important	20	(34)	17	(23)
4	16	(28)	34	(47)
3	17	(29)	17	(23)
2	4	(7)	5	(7)
1 very unimportant	1	(2)	0	(0)
No Response	24		1	
Elimination of noise from outside.				
5 very important	27	(46)	21	(29)
4	15	(25)	39	(53)
3	14	(24)	10	(14)
2	3	(5)	3	(4)
1 very unimportant	0	(0)	0	(0)
No Response	23		1	
Control of mechanical equipment noises.				
5 very important	22	(39)	20	(27)
4	16	(28)	32	(44)
3	16	(28)	16	(22)
2	2	(3)	5	(7)
1 very unimportant	1	(2)	0	(0)
No Response	25		1	

TABLE VII (Continued)

VARIABLE	Group One: Living in or Planning an Earth Sheltered House Number	Percent	Group Two: No Plans for an Earth Sheltered House Number	Percent
	n=82		n=74	
Natural lighting design.				
5 very important	26	(45)	29	(40)
4	19	(33)	31	(42)
3	8	(14)	11	(15)
2	4	(7)	2	(3)
1 very unimportant	1	(1)	0	(0)
No Response	24		1	
Artificial lighting levels.				
5 very important	23	(40)	19	(26)
4	19	(33)	36	(49)
3	12	(21)	14	(19)
2	1	(2)	2	(3)
1 very unimportant	2	(4)	2	(3)
No Response	25		1	
Materials used on walls, floor and ceiling.				
5 very important	29	(50)	32	(44)
4	22	(38)	29	(40)
3	7	(12)	10	(13)
2	0	(0)	2	(3)
1 very unimportant	0	(0)	0	(0)
No Response	24		1	
Comfortable air temperature in living space.				
5 very important	40	(70)	38	(52)
4	15	(26)	31	(43)
3	2	(4)	3	(4)
2	0	(0)	1	(1)
1 very unimportant	0	(0)	0	(0)
No Response	25		1	
Comfortable humidity level.				
5 very important	31	(53)	27	(37)
4	20	(34)	33	(45)
3	5	(9)	13	(18)
2	1	(2)	0	(0)
1 very unimportant	2	(4)	2	(3)
No Response	25		1	

TABLE VII (Continued)

VARIABLE	Group One: Living in or Planning an Earth Sheltered House Number (n=82)	Group One: Percent	Group Two: No Plans for an Earth Sheltered House Number (n=74)	Group Two: Percent
Prevention of condensation on walls.				
5 very important	45	(76)	56	(77)
4	10	(17)	15	(20)
3	3	(5)	2	(3)
2	1	(2)	0	(0)
1 very unimportant	0	(0)	0	(0)
No Response	23		1	
Prevention of condensation on windows.				
5 very important	34	(59)	42	(58)
4	16	(28)	20	(27)
3	6	(10)	11	(15)
2	2	(3)	0	(0)
1 very unimportant	0	(0)	0	(0)
No Response	24		1	
Air circulation within house.				
5 very important	36	(61)	42	(58)
4	20	(34)	27	(37)
3	3	(5)	4	(5)
2	0	(0)	0	(0)
1 very unimportant	0	(0)	0	(0)
No Response	23		1	
Natural outdoor ventilation effects.				
5 very important	27	(47)	28	(38)
4	17	(30)	32	(44)
3	10	(18)	10	(14)
2	2	(3)	3	(4)
1 very unimportant	1	(2)	0	(0)
No Response	25		1	

TABLE VIII

IMPORTANCE OF HOUSING DECISION FACTORS BY GROUP

VARIABLE	Group One: Living in or Planning an Earth Sheltered House n=82 Number	Percent	Group Two: No Plans for an Earth Sheltered House n=74 Number	Percent
Personal privacy.				
5 very important	30	(45)	19	(26)
4	14	(21)	28	(38)
3	8	(12)	18	(25)
2	12	(18)	8	(11)
1 very unimportant	3	(4)	0	(0)
No Response	15		1	
Insurance reduction/ elimination.				
5 very important	31	(44)	23	(32)
4	16	(23)	26	(36)
3	6	(8)	15	(20)
2	15	(21)	4	(6)
1 very unimportant	3	(4)	4	(6)
No Response	11		2	
Environmental noise reduction.				
5 very important	22	(31)	13	(18)
4	21	(30)	27	(37)
3	10	(14)	24	(33)
2	13	(18)	8	(11)
1 very unimportant	5	(7)	1	(1)
No Response	11		1	
Improved lifestyle.				
5 very important	23	(35)	18	(25)
4	16	(24)	25	(35)
3	8	(12)	19	(27)
2	16	(24)	7	(10)
1 very unimportant	3	(5)	2	(3)
No Response	16		3	
Enhanced alternative energy potential.				
5 very important	47	(62)	40	(55)
4	16	(21)	27	(37)
3	5	(7)	5	(7)
2	8	(10)	1	(1)
1 very unimportant	0	(0)	0	(0)
No Response	6		1	

TABLE VIII (Continued)

VARIABLE	Group One: Living in or Planning an Earth Sheltered House Number (n=82)	Percent	Group Two: No Plans for an Earth Sheltered House Number (n=74)	Percent
Land preservation				
5 very important	9	(16)	15	(21)
4	9	(16)	18	(25)
3	13	(22)	26	(35)
2	15	(25)	10	(14)
1 very unimportant	12	(21)	4	(5)
No Response	24		1	
Reduced cooling load.				
5 very important	61	(75)	48	(66)
4	13	(16)	22	(30)
3	4	(5)	2	(3)
2	3	(4)	1	(1)
1 very unimportant	0	(0)	0	(0)
No Response	1		1	
Reduced heating load.				
5 very important	62	(76)	48	(66)
4	12	(15)	23	(31)
3	4	(5)	2	(3)
2	3	(4)	0	(0)
1 very unimportant	0	(0)	0	(0)
No Response	1		1	
Maintenance reduction.				
5 very important	45	(57)	37	(51)
4	23	(29)	22	(31)
3	3	(4)	9	(12)
2	8	(10)	2	(3)
1 very unimportant	0	(0)	2	(3)
No Response	3		2	
Concept demonstration/ experimentation.				
5 very important	14	(22)	9	(13)
4	13	(21)	10	(14)
3	18	(29)	29	(40)
2	12	(19)	19	(26)
1 very unimportant	6	(9)	5	(7)
No Response	19		2	

TABLE VIII (Continued)

VARIABLE	Group One: Living in or Planning an Earth Sheltered House Number (n=82)	Group One Percent	Group Two: No Plans for an Earth Sheltered House Number (n=74)	Group Two Percent
Storm protection.				
5 very important	48	(59)	31	(42)
4	22	(27)	28	(38)
3	5	(6)	8	(11)
2	6	(8)	4	(6)
1 very unimportant	0	(0)	2	(3)
No Response	1		1	
Security from vandalism/crime.				
5 very important	27	(36)	27	(38)
4	17	(23)	24	(33)
3	10	(14)	12	(17)
2	15	(20)	6	(8)
1 very unimportant	5	(7)	3	(4)
No Response	8		2	

TABLE IX

RATING OF ADEQUACY OF SELECTED ASPECTS OF PRESENT DWELLING BY EARTH SHELTERED AND NON-EARTH SHELTERED DWELLERS

VARIABLE	Group One-A Earth Sheltered n=47 Number	Percent	Group Two-A Non-Earth Sheltered n=109 Number	Percent
Site locale of the house.				
5 high rating	17	(68)	22	(20)
4	3	(12)	33	(31)
3	5	(20)	36	(33)
2	0	(0)	17	(16)
1 low rating	0	(0)	0	(0)
No Response	22		1	
Adequacy of views to outside from living areas.				
5 high rating	11	(41)	12	(11)
4	6	(22)	29	(27)
3	4	(15)	41	(38)
2	6	(22)	25	(24)
1 low rating	0	(0)	0	(0)
No Response	20		2	
Main house entrance design.				
5 high rating	12	(48)	8	(7)
4	5	(20)	27	(25)
3	3	(12)	49	(46)
2	5	(20)	23	(22)
1 low rating	0	(0)	0	(0)
No Response	22		2	
Arrangement of rooms.				
5 high rating	14	(54)	13	(12)
4	8	(31)	25	(23)
3	4	(15)	49	(46)
2	0	(0)	21	(19)
1 low rating	0	(0)	0	(0)
No Response	21		1	
Amount of inside storage space.				
5 high rating	11	(42)	9	(8)
4	7	(27)	33	(31)
3	7	(27)	31	(29)
2	1	(4)	20	(18)
1 low rating	0	(0)	15	(14)
No Response	21		1	

TABLE IX (Continued)

VARIABLE	Group One-A Earth Sheltered Number	Percent	Group Two-A Non-Earth Sheltered Number	Percent
	n=47		n=109	
Privacy of family members from neighbors.				
5 high rating	14	(58)	16	(15)
4	4	(17)	29	(27)
3	4	(17)	33	(31)
2	2	(8)	29	(27)
1 low rating	0	(0)	0	(0)
No Response	23		2	
Privacy of family members from each other.				
5 high rating	12	(50)	10	(10)
4	5	(21)	28	(26)
3	5	(21)	41	(38)
2	2	(8)	28	(26)
1 low rating	0	(0)	0	(0)
No Response	23		2	
Safety of structure.				
5 high rating	21	(78)	23	(21)
4	4	(14)	38	(35)
3	1	(4)	29	(27)
2	1	(4)	18	(17)
1 low rating	0	(0)	0	(0)
No Response	20		1	
Elimination of noise from outside.				
5 high rating	20	(80)	7	(6)
4	4	(16)	30	(28)
3	0	(0)	39	(36)
2	1	(4)	17	(16)
1 low rating	0	(0)	15	(14)
No Response	22		1	
Control of mechanical equipment noises.				
5 high rating	8	(33)	9	(9)
4	5	(21)	29	(27)
3	10	(42)	29	(27)
2	1	(4)	28	(27)
1 low rating	0	(0)	11	(10)
No Response	23		3	

TABLE IX (Continued)

VARIABLE	Group One-A Earth Sheltered Number n=47	Percent	Group Two-A Non-Earth Sheltered Number n=109	Percent
Natural lighting design.				
5 high rating	8	(33)	6	(6)
4	8	(33)	26	(24)
3	5	(21)	43	(40)
2	3	(13)	33	(30)
1 low rating	0	(0)	0	(0)
No Response	23		1	
Artificial lighting levels.				
5 high rating	9	(41)	2	(2)
4	9	(41)	29	(27)
3	1	(4)	54	(50)
2	3	(14)	23	(21)
1 low rating	0	(0)	0	(0)
No Response	25		1	
Materials used on walls, floor and ceiling.				
5 high rating	14	(58)	8	(8)
4	6	(25)	27	(25)
3	4	(17)	47	(44)
2	0	(0)	25	(23)
1 low rating	0	(0)	0	(0)
No Response	23		2	
Comfortable air temperature in living space.				
5 high rating	18	(72)	15	(14)
4	5	(20)	36	(33)
3	0	(0)	33	(31)
2	2	(8)	24	(22)
1 low rating	0	(0)	0	(0)
No Response	22		1	
Comfortable humidity level.				
5 high rating	14	(56)	11	(10)
4	4	(16)	24	(22)
3	5	(20)	50	(47)
2	2	(8)	23	(21)
1 low rating	0	(0)	0	(0)
No Response	22		1	

TABLE IX (Continued)

VARIABLE	Group One-A Earth Sheltered Number n=47	Percent	Group Two-A Non-Earth Sheltered Number n=109	Percent
Prevention of condensation on walls.				
5 high rating	20	(80)	37	(35)
4	4	(16)	44	(41)
3	1	(4)	26	(24)
2	0	(0)	0	(0)
1 low rating	0	(0)	0	(0)
No Response	22		2	
Prevention of condensation on windows.				
5 high rating	13	(54)	15	(14)
4	4	(17)	31	(29)
3	5	(21)	33	(30)
2	2	(8)	19	(18)
1 low rating	0	(0)	10	(9)
No Response	23		1	
Air circulation within house.				
5 high rating	13	(54)	20	(19)
4	6	(25)	25	(23)
3	5	(21)	41	(38)
2	0	(0)	22	(20)
1 low rating	0	(0)	0	(0)
No Response	23		1	
Nearby neighbors' acceptance of your house type.				
5 high rating	11	(42)	24	(22)
4	5	(19)	34	(32)
3	1	(4)	36	(33)
2	9	(35)	14	(13)
1 low rating	0	(0)	0	(0)
No Response	21		1	
Community/town acceptance of your house type.				
5 high rating	10	(39)	21	(19)
4	4	(15)	31	(29)
3	4	(15)	39	(36)
2	8	(31)	17	(16)
1 low rating	0	(0)	0	(0)
No Response	21		1	

TABLE IX (Continued)

VARIABLE	Group One-A Earth Sheltered Number n=47	Percent	Group Two-A Non-Earth Sheltered Number n=109	Percent
Exterior appearance from street or highway.				
5 high rating	4	(15)	16	(15)
4	5	(19)	43	(40)
3	10	(39)	33	(31)
2	7	(27)	15	(14)
1 low rating	0	(0)	0	(0)
No Response	21		2	
Flexibility of interior space for expansion and different useage.				
5 high rating	0	(0)	0	(0)
4	8	(32)	18	(17)
3	7	(28)	40	(37)
2	5	(20)	31	(29)
1 low rating	5	(20)	18	(17)
No Response	22		2	
Sufficiency of fire exits.				
5 high rating	9	(33)	23	(21)
4	5	(19)	37	(34)
3	8	(29)	32	(30)
2	5	(19)	16	(15)
1 low rating	0	(0)	0	(0)
No Response	20		1	
Natural outdoor ventilation effects.				
5 high rating	3	(13)	13	(12)
4	2	(9)	24	(23)
3	13	(56)	41	(38)
2	5	(22)	29	(27)
1 low rating	0	(0)	0	(0)
No Response	24		2	

VITA[2]

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