# A FACTOR ANALYSIS AND COMPARISON OF ATTITUDES TOWARD EARTH SHELTER AND PASSIVE SOLAR HOUSES

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# PREFACE

The purpose of this study was to promote further development of earth shelter and passive solar houses by learning about attitudes of potential customers. The primary objective was to identify dimensions underlying attitudes toward the houses--dimensions which can be interpreted as important product attributes in consumers' evaluation of the houses. Other objectives concerned the measurement of attitudes among homeowners in one community. Those objectives were: assess overall favorability toward the houses, identify perceived advantages and disadvantages, and find segments with the most favorable attitudes.

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# CHAPTER I

## INTRODUCTION

Two needs of American society in the 1980s are to reduce energy use and to reduce the costs of home ownership so that more people can afford to own homes. Earth shelter and passive solar houses are two unconventional kinds of houses which have shown potential for helping meet both these needs--by using less energy than conventional houses and thereby lowering home utility costs. Because of their potential benefits, earth shelter and passive solar houses offer public relations opportunities to any person, company, or organization that builds or promotes them.

Before most home buyers will accept houses so different from what they are accustomed to, they need to see examples of these houses--to see what the houses look like, how they perform, and what they cost to build and operate. Before home builders will risk time and money on these unproved and unfamiliar houses, they need to know the attitudes of buyers in their market--whether there is a demand for the products.

This study examined and compared attitudes toward earth shelter and passive solar houses on two levels. It was exploratory in that it examined the nature of attitudes

toward these houses by trying to identify underlying dimensions of those attitudes. What dimensions, or product attributes, were used by consumers to compare one energy-efficient house with another? The study also was descriptive in that it measured attitudes among current homeowners in one community.

It is hoped these findings will be used in the design and marketing of earth shelter and passive solar houses. Even if such houses were not immediately profitable, the builder not only would gain knowledge and experience that would become increasingly valuable, but also would improve his image in the community and the industry by showing initiative in trying to meet the needs of consumers and society.

## Background

### Home Building Industry

Owning a home has always been part of the "American dream." It is an essential element in most people's ideal way of life. However, the costs of owning a home have risen so much in recent years that the proportion of Americans who can afford to own homes is shrinking. At the same time, demand for housing is increasing because population and number of new households are increasing.[1]

While much of the increased cost of home ownership comes from costs other than construction materials and

labor--e.g., interest rates, land, taxes, insurance, utilities--it is the home building industry which is faced with resolving the dilemma of increasing demand and decreasing affordability.

Home builders in the speculative market are both high-risk and conservative businessmen. Their risk level is high because they borrow most of the money to build their houses. They can lose a lot of money if construction is delayed, if construction costs or interests rates increase, or if they misjudge market preferences or conditions.[2] So most home builders focus their activities in a single market where they are familiar with the building code, land use requirements, and local tastes in housing design. They generally will concentrate on houses in a specific price range, and the houses will often be similar in style, layout, and amenities. Basic models which have sold well are modified slowly.[3]

Even though home builders always look for a competitive edge in the market, very few speculative builders can afford to experiment with large-scale innovations in design or construction techniques. Most innovation in home building has occurred in custom residences, away from the risks of the marketplace.[4]

Today, however, there is more and more experimentation throughout the home building industry, as builders try to make homes affordable to more people. There are smaller houses on smaller lots and with fewer amenities.

Builders are trying more economical ways of construction, such as prefabricated panels. House kits are available in a variety of styles. Some builders offer uncompleted house "shells" for buyers who want to save by doing part of the construction. And a wide range of new financing methods have been developed to meet different buyers' needs.

These kinds of adaptation and experimentation are becoming more widespread throughout the home building industry. But the focus of most innovation in the past decade has been on the reduction of energy use.

## Reducing Energy Use in Heating and Cooling

With all costs of home ownership rising and builders trying to make houses more affordable, reducing energy consumption has been a steady trend in the home building industry--especially energy used for heating and cooling. Common ways builders reduce heating and cooling costs are by building smaller houses with fewer windows, thicker walls, and more insulation, and by using weatherstripping, insulating glass, and heat pumps.

While home builders try to reduce energy use so they can sell houses and stay in business, homeowners do so because it is one of the few areas of burdensome housing costs over which they have some control. Homeowners cannot affect the cost of land, money (interest rates), construction materials, skilled labor, insurance, or taxes. But

they can do some of their own repairs, in some cases they can do part of the construction, and they can hold down their energy use.

In the past decade homeowners have held down energy consumption by using woodburning and kerosene stoves, energy-efficient fireplaces, storm windows, weatherstripping, solar energy systems, and ceiling fans. They have added insulation to the ceiling, walls, floor, ducts, pipes, and hot water heater. And, of course, the most common method of reducing energy use for heating and cooling is to set the thermostat higher or lower.

Reduction of energy use in houses has benefits of energy conservation and lower home ownership costs. When energy is conserved, supplies last longer and less waste is released into the environment. Lower demand for energy helps hold down rising costs and relieves the associated inflationary pressure.

If energy use were reduced in a way that lowered the net costs of home ownership, consumers and home builders would benefit. Builders would sell more houses because single-family houses--the most preferred type of housing--would become affordable to more people. Homeowners could afford larger homes, more amenities, and more comfortable thermostat settings. Or energy savings could be used as extra discretionary income.

## Natural Energy Design

The author uses the term "natural energy design" to describe building design in which the use of the sun, earth, air, or water to add or conserve energy is a major influence in the overall design. Where used in this paper it means earth shelter and passive solar design, although other kinds of design also fit the definition.

Earth Shelter Houses. An earth shelter house, often called an underground house, is one with earth in contact with the walls or roof. It can be bermed (i.e., dirt piled against a house above ground) or excavated, and earth can cover part or all of any number of walls and/or the roof. The earth cover lowers energy requirements by reducing air infiltration, heat gain, and heat loss. Additional advantages reported for earth shelter houses include storm protection, noise reduction, and privacy.

Reporting on a study of existing earth shelter houses in Oklahoma, Boyer and Grondzik of Oklahoma State University said the average reduction in energy use was about 40 percent and that figure could be improved. Also, construction costs were equivalent to conventional houses.[5]

There are signs of increasing interest in earth shelter houses. The Oklahoma State University Office of Architectural Extension says thousands of earth shelter houses have been built in the United States in the past six or seven years. There are probably 800 earth shelter buildings

in Minnesota and at least 250 in Oklahoma.[6] From 1977 to 1981, Oklahoma State University sponsored more than 25 seminars in earth shelter design. More than 2,000 laymen and professionals attended.[7]

There has been an increasing number of books about earth shelter houses, as well as newspaper and magazine articles. Journals and magazines which commonly contain articles on earth shelter design include Underground Space, Earth Sheltered Living, and New Shelter.

Passive Solar Houses. A passive solar house lets heat from the sun in through a window to heat a space directly, or to be stored in a massive wall, floor, or roof. It uses natural, "passive" methods of heat transfer--convection, conduction, and radiation. Heat is stored in thermal mass--heavy materials such as concrete, stone, adobe, or water.

Nichols and Nichols describe the basis concepts of passive solar design as follows: Face the building south and place glass on the south side to let the winter sun in. Build substantial mass into the interior to absorb and store heat for nighttime use. Add movable insulation on the south glass so heat is trapped inside the structure at night and heat loss from the glass is reduced.[8] Anderson and Wells describe five basic passive solar heating systems which they call the solar window, solar wall, solar room, solar chimney, and solar roof.[9]

Passive solar can reduce the conventional energy needed for heating in any climate from 70 to 90 percent over conventional structures, say Nichols and Nichols.[10] Anderson and Wells say the effect of passive solar systems on energy use varies, depending on size and design of the system, climate, and number of sunny days. Costs also can vary greatly, depending on type and size of system, and on design, materials, and construction methods.[11]

Interest in passive solar houses has grown substantially the past decade. In 1980, a study for the U.S. Department of Housing and Urban Development reported that passive solar design and construction techniques were gaining momentum among professional builders.[12] Towle found that builders of passive solar houses reported a substantial increase in market appeal.[13] Passive solar homes have been built in all areas of the United States, but greatest activity has been in areas with cold and sunny winters, such as New Mexico and Colorado.

There has been a steady increase in recent years in the number of books, newspaper stories, and magazine articles about passive solar. Magazines in which articles are commonly seen range from Solar Age and Mother Earth News to Popular Science and Better Homes and Gardens.

Need for Prototypes or Examples. Because earth shelter and passive solar houses are unfamiliar products and buying a house is a great financial risk, potential home

buyers will search extensively for information. They will read about the house, ask questions, discuss it with friends, and, if possible, examine it for themselves. If there is a demand for such houses, it likely will remain latent until there are actual products for people to see. And if there is a latent demand, the longer it takes to discover it, the longer it will be before benefits to consumers and society are realized.

The need for examples of natural energy houses has been mentioned frequently by other writers. Boyer and Grondzik said public acceptance of earth shelter houses "continues to hinge on the need for demonstrated proof" of their livability and habitability.[14] A research focus group on the commercialization of passive solar agreed that there is a need for "real world" examples and cross-temporal studies of such homes with people living in them.[15]

"Real world" examples of natural energy houses would increase awareness and interest among consumers by allowing them firsthand experience and generating more word-of-mouth discussion. Consumers could see the actual houses--feel their natural heat. People would become more familiar with the variety of designs and perhaps change their stereotypes. Confusion over what constitutes passive solar design would begin to clear, and the "basement-syndrome" image of earth shelter houses as being cave-like would

begin to change. Home buyers would see that such houses could be built of high quality.

Examples would show home builders the actual energy performance of different designs in their climate and whether people in their market would buy them. Builders and subcontractors would find what the construction problems are and how to get around them.

Consumer reaction to examples of earth shelter and passive solar houses would be valuable to architects and designers in helping them meet consumer needs, and to lenders and appraisers in helping them set a market value.

Benefits to Home Builders and Community. If a company were to build examples of natural energy design houses, banks, government offices, universities, and community organizations might want to be involved visibly in the project. Such widespread support would present an image of a socially progressive community.

The building company itself would project an image of leadership and progressiveness by showing a willingness to change to meet the changing needs of home buyers. The company would be a source of information about the houses to consumers, lenders, city officials, real estate professionals, community groups, and other builders.

If examples of natural energy design houses were built and there was not a great demand, still the houses would attract media coverage and serve as magnets to draw

customers to the builder's other houses. If a significant demand did develop later, a company that had built them would have a competitive edge because of experience and image.

Finally, there are long-term benefits of the houses. Anything in the long-term interest of the public is also in the interest of business. Conserving energy and making homes more affordable would, in the long run, tend to improve the general economy and expand the housing market.

## Purpose and Objectives

### The Problem

The market for earth shelter or passive solar houses is in a stalemate. Home builders want to be certain that people will buy the houses before they risk building. Home buyers cannot be certain they want the houses until actual examples are available.

The way to promote wider acceptance of natural energy houses is to build more. The way to get more built is to identify people who are interested and show how to appeal to them. This study was designed to work toward that goal by providing a better understanding of how people perceive earth shelter and passive solar houses.

First, factor analysis identified underlying dimensions in people's attitudes toward natural energy design houses. Dimensions can be thought of as product attributes

on which consumers perceive a product as positive or negative and which help explain why some people perceive the product favorably and some unfavorably.

Second, the study measured overall attitudes of homeowners in one community toward earth shelter and passive solar houses, and identified differences in attitudes based on demographic and socioeconomic variables. Such information can be of direct use to home builders in that community. And while the information cannot be assumed to hold true outside the study population, it can be of general use in helping to understand attitudes in other populations.

## Questions the Study Tries to Answer

The following list of questions gives a brief view of the study's scope. Other than the first question about dimensions of attitudes, findings cannot be generalized beyond the study population.

What dimensions underlie attitudes toward earth shelter and passive solar houses, or what product attributes do consumers use to evaluate these houses as products?

Which dimensions of earth shelter and passive solar houses are perceived most favorably and which least favorably?

On what dimensions are earth shelter and passive solar perceived to be most similar? Different?

Is there a difference in overall attitudes toward earth shelter and passive solar houses?

Can differences in attitudes be explained in part by differences in demographic or socioeconomic variables, or by interaction among these variables?

Would people read information about, visit a model of, or consider buying an earth shelter or passive solar house?

How much have people read about earth shelter or passive houses?

## Possible Uses of Findings

Information from the study can be used by Stillwater, Oklahoma, home builders in considering whether to build earth shelter or passive solar houses and in convincing lenders of demand for the product. The study identified people who would be the most likely buyers. It showed positive beliefs which should be reinforced and negative beliefs which might be changed.

Findings can be used in a general way by the home building industry, architects, designers, real estate salespersons, lenders, and appraisers. The information could be valuable to energy conservation groups interested in the promotion of alternative forms of energy. And it might provide a basis for future research in design and marketing of earth shelter and passive solar houses.

ENDNOTES

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# CHAPTER II

# REVIEW OF LITERATURE

The first part of this chapter is a brief discussion of how attitudes are connected to behavior, how knowledge of attitudes is useful in marketing and promotion, and how attitudes are measured. The final section is a review of literature on earth shelter, passive solar, and active solar houses, with emphasis on their perceived advantages and disadvantages.

## Theoretical Structure of Attitude

Forty-seven years ago Allport called attitude "the most distinctive and indispensable concept in contemporary American social psychology."[1] Rokeach more recently said the concept of attitude is indispensable to the psychology of personality.[2] In 1975, Fishbein and Ajzen wrote, "The centrality of the attitude concept remains unchallenged and, if anything, its importance has increased."[3]

Interest in attitudes undoubtedly arose from the intuitive connection between attitude and behavior. If a person feels more favorable toward one object than a second object, it seems reasonable to predict his behavior toward the first object will be more favorable.

Negative evidence of a relation between attitude and behavior has been reported by LaPiere,[4] Festinger,[5] and others. However, much negative evidence has been explained by problems in the measuring instrument,[6] failure to consider attitudes toward the situation,[7] and attempts to predict specific intentions or behaviors rather than their overall favorability.[8]

There is positive evidence to support the notion of a relationship between attitude and behavior. Examples in marketing literature include reports that good commercials lead to an effect on attitude and behavior,[9] that attitudes toward financial outlook are related to spending behavior,[10] and that attitudes toward trading stamps reflect trading stamp usage.[11]

Although attitude remains a familiar and much used concept in behavioral research, distinctions often have been clouded between attitude and concepts such as opinion, prejudice, intention, value, and belief. Those distinctions can be clarified by looking at the way the terms are used in conceptual models by Rokeach and by Fishbein and Ajzen.

Rokeach defines attitude as "a relatively enduring organization of beliefs around an object or situation predisposing one to respond in some preferential manner."[12]

Beliefs are elements which underlie attitudes. Rokeach describes five types of beliefs which can be ordered along a central-peripheral continuum, with the more central

beliefs (e.g., those about one's own existence and identity) being more resistant to change.[13] Each belief has cognitive, affective, and behavioral components: it represents a person's knowledge; it is capable of arousing effect; and it is a response predisposition which leads to some action when suitably motivated.[14]

Beliefs, then, are organized into attitudes which, in turn, are connected to behavior by Rokeach's "two-attitude theory." This theory states that a preferential response to an attitude object must occur within the context of some social situation about which the person also has attitudes. Therefore, behavior is a function of the interaction between two attitudes--attitude-toward-object and attitude-toward-situation.[15]

Another element in the model is values, which Rokeach divides into two classes: instrumental values, which are preferable modes of conduct, and terminal values, which represent preferable end-states of existence.[16] Values are more basic than attitudes; people have fewer values than attitudes and values are used in developing and maintaining attitudes.[17]

Values, beliefs, and attitudes make up what Rokeach terms the "belief system," which functions as follows: A social object is encountered within a social situation, activating an attitude-toward-object and an attitude-toward-situation. Each of these attitudes activates a set of values with which it is functionally connected. The number

and relative importance of these values determines the relative importance of the two attitudes, which, in turn, determines behavior.[18] Attitudes thus determine behavior. If a person acts contrary to one attitude, Rokeach says that it must mean that another attitude overrode the first in importance.[19]

Fishbein and Ajzen have developed a theoretical structure of attitude that attempts to incorporate and explain as much of the diverse literature in the area as possible. Their conceptual framework distinguishes between four distinct variables which often have been used interchangeably--beliefs, attitudes, intentions, and behavior.[20]

Such a classification is suggested by the common distinction among cognitive, affective, and conative (behavioral) components of a broad definition of attitude. Cognition denotes a person's knowledge, opinions, or beliefs about the objects. Fishbein and Ajzen call this variable "belief." Affect refers to the person's feelings toward and evaluation of some object, so this variable is called "attitude." Conation refers to behavioral intentions and actions toward some object. Since attitudes deal with predispositions to behave, rather than actual behavior, a distinction is made between behavioral intention and actual behavior. The variable representing the conative dimension of the broad definition of attitude is thus called "intention." The fourth variable, "behavior," refers to observable overt acts.[21]

Fishbein and Ajzen define the variables as follows: A belief links an object to some attribute. People may differ in belief strength, so a measure of belief should place the subject along a dimension of subjective probability relating an object to an attribute. An attitude is a person's favorable or unfavorable evaluation of an object, and should be measured so as to place the subject on a bipolar affective dimension with respect to the object. Intention refers to a person's intentions to perform various behaviors. It should be measured by a procedure which places the subject along a subjective probability dimension relating himself and some action.[22]

Another element in the formation of attitudes is attribute salience, or an individual's evaluations of attributes. Fishbein and Ajzen state, ". . . a person's attitude toward some object is determined by his beliefs that the object has certain attributes and by his evaluations of those attributes."[23] This "evaluation of attributes" is generally analogous to the role that values play in Rokeach's theory.

Fishbein and Ajzen's theoretical structure of attitude assumes a causal chain linking beliefs, formed on the basis of available information, to the person's attitudes, attitudes to intentions, and intentions to behavior.[24] The authors stress that attitude is a general predisposition related to a set of beliefs, a set of intentions, and a set of behaviors. One cannot predict attitude from a

single belief, nor can one predict a specific intention or a specific behavior from an attitude. However, attitude should influence the general level of favorability expressed by the person's intentions and behavior.[25]

Change in any variable, "in the final analysis," say Fishbein and Ajzen, is initiated by changes in beliefs, and such changes are brought about by exposing a person to new information.[26]

## Attitude in Marketing and Promotion

### Consumer Decision Process

Because attitude is directly related to behavior, marketing scholars give attitude a central role in their explanations of the consumer decision process. A five-stage model of the decision process is contained within a model of consumer behavior developed by Engel, Kollat, and Blackwell (the EKB model),[27] and Kotler has described the consumer decision process using a similar five-stage model. The five stages, as named by Kotler, are problem recognition, information search, information evaluation, purchase decision, and postpurchase behavior.[28]

Problem recognition can be activated by external stimuli, such as promotion or friends, or by internal motives.[29] The marketer at this stage is interested in what kinds of needs arise, what brings them about, and how they lead to his product.[30]

In the information search, a consumer may undertake no search, some search, or very active search. The marketer's interest is in information sources consumers use and the relative influence of each source. Sources are divided into four groups by Kotler: personal, commercial, public, and experiential. Commercial sources generally provide the most information about a product, but personal sources provide the most effective information.[31]

In the information evaluation stage, the consumer evaluates information about alternative products.[32] The consumer processes beliefs about evaluative criteria, or attributes, to arrive at attitudes and thus intention.[33] In this stage the marketer is interested not only in assessing beliefs, attitudes, and intentions, but also in identifying evaluative criteria, measuring their importance, and determining what evaluative procedure is used to evaluate alternatives.[34]

As in the Fishbein and Ajzen theoretical structure of attitude, Engel, Warshaw, and Kinnear use belief, attitude, and intention to represent the cognitive, affective, and behavioral components of the broad concept of attitude. Beliefs about the product concerning evaluative criteria are combined in some way with importance ratings for those criteria to arrive at attitudes.[35]

Many writers use the term "salience" when discussing the relative influence of an evaluative criterion on attitude formation. Kotler, however, draws a distinction

between an attribute's salience and its importance. Salient attributes are those which come to mind first but are not necessarily the most important. Kotler points out that the marketer should be more concerned with attribute importance than with attribute salience.[36]

A number of evaluative procedures are used by different consumers at different times, and they can be classified as compensatory or noncompensatory models. In a compensatory model, such as Fishbein's expectancy-value model, an overall attitude score is computed using beliefs about evaluative criteria and importance weights. A product's strength on one attribute can compensate for weakness on another. In a noncompensatory model there is no compensation for weakness on an important attribute. An example is the lexicographic model, in which the consumer arranges attributes in order of importance and chooses the brand with the highest value on the most important attribute.[37]

When the consumer has arrived at an attitude, it is acted on by his normative compliance and anticipated circumstances to arrive at an intention--the subjective probability that a specific product will be selected. Then, in the fourth stage of the consumer decision process--purchase decision--intention and unanticipated circumstances combine to determine actual choice.[38] As Kotler points out, neither preferences nor purchase intentions are completely reliable predictors of actual buying behavior. They give direction

to behavior but fail to include a number of additional factors that may intervene.[39]

In the final stage of the model--postpurchase behavior--the consumer's satisfaction or dissatisfaction will affect the probability of his purchasing the product again, what he says to others, and his efforts to reduce dissonance.[40]

The function of attitudes in consumer behavior is the same as in any kind of behavior--economy. Engel, Warshaw, and Kinnear say attitudes "promote an adjustive economy by providing the individual with the ready basis for making decisions" and, therefore, "confer greater stability and social predictability on an individual."[41] Attitudes economize on energy and thought, Kotler says, by enabling an individual to have a fairly consistent behavior toward similar classes of objects.[42]

## Strategies Based on Attitude Data

Hughes says marketing strategies based on attitude measurement are a logical extension of two practices--the marketing concept and market segmentation.[43] The marketing concept, he writes, is a management orientation that begins with identification of consumers' needs, then adapts products and promotion to these needs. Market segmentation--which goes hand in hand with the marketing concept--attempts to isolate homogeneous subsets of the market and develop products and promotion to meet needs of those segments.[44]

The need arises for marketing strategies based on segmentation by attitude components when an economy has met the physical needs of most of its members and their social and psychological needs are dominant, Hughes says.[45] Tull and Hawkins say the attitude concept is interesting to marketers because each of the three attitude components--cognitive, affective, and behavioral--tends to remain in balance with the other two. Presuming such a consistent relationship, if a marketer can measure the cognitive or affective components, he might be able to predict behavior. Also, if he changes one of those components, he might be able to change behavior.[46]

Measurement of attitudes can help assess demand for a product and predict consumer behavior. Hughes notes that attribute salience, or importance, determines generic demand while attitude valence determines brand demand.[47]

A market can be segmented according to the attributes of primary importance to different customer groups, Kotler says.[48] Such segmentation, according to Hughes, enables marketing or promotion strategists to identify segments with importance weights which best fit the product characteristics,[49] or to design products or promotion for market segments with homogeneous importance weights.[50]

A market also can be segmented by attitudes. Information on attitudes was used by Neidell and Teach to predict brand share.[51] Assael and Day found that changes in preference predict changes in market share.[52] And Kotler notes

that information on buyer intentions is of segmentation value for industrial products, consumer durables, products whose purchase requires advanced planning, and new products where past data do not exist.[53]

Another use for attitude measurement is identification of attitude elements that need changes. Attitude change is a valid goal, say Engel, Warshaw, and Kinnear, because change in attitude can lead to change in behavior.[54] However, changing attitudes can be difficult for a marketer, so those authors recommend attitude change as a strategy under the following circumstances only: (1) when attitudes are not based on a strong foundation of information about the product; (2) when they are not intimately related to the person's self-concept, important values, or motives; and (3) when they have not been reinforced by a long history of experience with the product.[55]

Two elements of attitude the marketer might want to change are beliefs and attribute importance weights. Kotler states that if a marketer found that some of the beliefs about his product were wrong and inhibited purchase, the marketer would want to use promotion to correct them.[56] He also says a marketer must provide information to reduce perceived risk before purchase and to reduce dissatisfaction or dissonance after purchase.[57] Hughes says a marketer can promote to alter attribute importance weights, which will restructure the attitudinal components of demand for a product. An increase in importance of an attribute will

favor all brands strong on that attribute and hurt all brands which are not.[58]

## Measurement of Attitude

Fishbein and Ajzen define attitude as a person's favorable or unfavorable evaluation of an object. Therefore, it should be measured by a procedure which locates the person on a bipolar affective or evaluative dimension with respect to the object.[59] Hughes says that to arrive at such a measure of a buyer's attitude toward a product requires three steps: (1) identify the attributes the buyer considers during the decision process, (2) measure his evaluation of the importance of each attribute, and (3) measure his belief or evaluation of how much of that attribute is contained in the product.[60]

While many techniques for measuring attitudes exist, the present discussion focuses on the Likert or summated rating scale.

### Identification of Attributes

Hughes says that to measure an attitude toward a product or service, salient attributes of the object must first be identified, because it is attributes that are evaluated by the buyer--not the object itself.[61] Engel, Warshaw, and Kinnear suggest that a good beginning point for studying attributes is with evaluative criteria mentioned by consumers. These criteria usually are identified through some type of direct questioning.[62]

Construction of a Likert scale usually involves some type of pretest and item analysis to arrive at a list of important attributes. Those items which discriminate between low and high scorers are considered important determinants of attitudes and those which do not are discarded.[63] A criticism of the Likert scale item selection procedure, noted by Fishbein and Ajzen, is that it may eliminate belief statements that are important determinants of attitude.[64] The authors note that, on the other hand, an advantage of the Likert scale is that, because it can assign negative values to beliefs, it can identify disbeliefs which contribute to the person's attitude.[65]

Measurement of Attribute Importance

Engel, Warshaw, and Kinnear state that measurement of evaluative criteria usually includes a ranking of their relative importance, either through a scaling procedure or through statistical procedures which infer their relative weights.[66] The semantic differential is one technique often used as a means of measuring attribute importances, Hughes notes.[67]

However, Fishbein and Ajzen state that most standard scaling procedures do not measure attribute evaluations, but, instead, assume they are the same for all subjects. In fact, one purpose of scaling procedures is to identify items having the same attitudinal meaning for everyone.[68] And while some scaling procedures do assign different

weights to individual items, Kerlinger points out that the Likert scale assigns all items an equal attitude value. One item has the same importance as any other.[69]

An example of a statistical procedure for inferring importance weights was demonstrated in a study of buyer attitudes by Hughes and Guerrero. Multiple regression analysis yielded beta coefficients that were estimates of attribute importance to buying behavior.[70]

Measurement of Belief

Once important attributes are identified, the next step in attitude measurement, according to Hughes, is to measure subjects' belief that an object possesses an attribute.[71] He says this belief can be measured by Likert scale statements of relative agreement.[72]

The purpose of the total set of statements in a Likert scale, says Kerlinger, is to place an individual somewhere on an agreement continuum of the attitude in question.[73] Fishbein and Ajzen say a sum or average across many items will give a more accurate reflection of the "true" attitude than a single measure. Each item score contains some measurement error. Therefore, as the number of items increases, measurement errors cancel each other out.[74]

The Likert scale allows for intensity of expression. Kerlinger says the main advantage of this is that greater variance can be obtained. But the variance can contain response-set variance--tendencies in individuals to use

certain types of responses. The researcher needs to be cognizant of the possibilities and threats of response set, says Kerlinger, but its importance is somewhat overrated.[75]

Reduction of Redundancy in Data

Engel, Warshaw, and Kinnear say a good starting point in attitude measurement is analysis of evaluative criteria mentioned by consumers. These criteria then can be reduced to a smaller, more basic set of criteria.

> . . . the total set of criteria is analyzed statistically in order to reduce redundancy and arrive at the basic set of factors. One helpful statistical technique is factor analysis, a procedure which assesses intercorrelations between answers and arrives at the smallest set of dimensions inherent within the data.[76]

Hughes states that factor analysis is used to reduce a large number of attitude dimensions or measures to a few uncorrelated dimensions, called factors, that contain most of the information in the original dimensions.[77] It is a data reduction technique that reduces the number of dimensions required to describe an object. In a strict sense, he says, it does not identify attributes of the object, but reduces them to a manageable number.[78]

As examples of factors, Kerlinger points out that verbal and mathematical aptitude are two factors found behind many measures of aptitude and intelligence. Also, religious, economic, and educational factors have been found in measuring social attitudes.[79]

Guilford suggests that if a researcher is studying an area where he has no prior information regarding underlying dimensions, he might simply test hypotheses that there are or are not underlying dimensions. If the results indicate the acceptance of a multiple-factor hypothesis, the next study would look for the number of factors and the properties of each factor.[80]

While factor analysis searches for unities or dimensions behind many measures, cluster analysis is a similar technique that focuses on objects or persons, grouping together those with similar profiles along several dimensions.[81] Kerlinger defines a cluster as a subset of objects, members of which are more similar or closer to each other than to members outside the cluster.[82] Hughes notes that, "in practice, factor analysis is sometimes used to reduce the number of dimensions around which cluster analysis will group objects."[83]

Fishbein and Ajzen state that a major problem with factor analysis is that it identifies only those dimensions underlying a given set of judgments. Any dimension not represented in that set cannot be identified.[84]

Following are two examples of factor analyses of attitudes:

In a study of social attitudes, Kerlinger gave a 50-item summated rating scale to 530 teachers.[85] Each item was a single word or short phrase (e.g., private property, religion, Social Security) with either a liberal or

conservative connotation. The item responses were intercorrelated and factor analyzed with the principal factors method. Six factors were obtained, three with conservative and three with liberal referents. Conservative factors were Religiosity, Educational Traditionalism, and Economic Conservatism; liberal factors were Civil Rights, Child-Centered Education, and Social Liberalism. The correlations among the factors themselves were then analyzed--a second-order factor analysis. Two factors were obtained--Liberalism and Conservatism.

Schlinger reported how Leo Burnett, Inc., used factor analysis to develop a Viewer Response Profile--a rating instrument which gauges affective reactions to advertisements.[86] Scale items were evaluative statements about commercials that were drawn from people's verbatim responses to television commercials and the brands advertised in them. Six hundred statements were reduced to 139 by subjective judgment. The remaining statements then were subjected to a series of five factor analyses and three analyses of variance--factor analysis to discover what underlying dimensions the items were measuring, and analysis of variance to find which items did not discriminate between commercials. The analyses ended up with 32 items and seven factors. Four stable factors which recurred in all five factor analyses were Entertainment, Confusion, Relevant News, and Brand Reinforcement. Three factors

which appeared in three or four of the analyses were Empathy, Familiarity, and Alienation.

## Attitudes Toward Earth Shelter and Passive Solar Houses

While one focus of this research was to assess consumer attitudes toward passive solar and earth shelter houses, the main focus was an exploration of underlying dimensions of these attitudes. Therefore, instead of limiting this review to studies of consumer attitudes, the following areas were covered: experts' assessments of barriers and advantages to commercialization of natural energy design houses; builders' experiences with marketing such houses; and evaluations of such houses by users, consumers, and housing-related groups.

Although this study was concerned only with earth shelter and passive solar houses, this review includes literature on houses with active solar heating systems. One reason is the availability of data on active solar houses. Another is that active solar houses are similar to the other types in the following ways: they use energy directly from the environment, thereby conserving conventional forms of energy; they represent a new product in the housing industry; and consumers have questions about their initial cost, energy savings, operation, maintenance, aesthetics, etc.

This review of housing literature begins with a discussion of experts' opinions, followed by studies of users, consumers, and housing-related groups.

Anderson and Sullivan in 1978 presented an extensive list of barriers, advantages, and incentives to the implementation of passive solar design.[87] Attitude-related barriers include questions about initial cost, operating and maintenance costs, thermal performance, comfort, resale value, quality of engineering, quality of construction, lifestyle changes, and financing. The authors noted a general lack of data on cost and performance. Advantages identified include relative simplicity of passive solar design, association with an aesthetic of nature, general enthusiasm for large expanses of glass, potential for energy conservation and savings, and cost-effectiveness of passive solar compared with active systems.

Balcomb, a passive solar home owner, discusses the desirability and feasibility of passive solar houses as seen by the American homeowner.[88] She says people choose solar homes for one of two reasons: either as part of a basic commitment to lifestyle change and ecological involvement, or to get relief from fuel shortages and high heating bills. Her experience is that a passive solar home offers comfortable temperatures, convenient operation, low utility bills, a lack of repair bills, attractive design, and a sense of being in tune with nature. However, she says many consumers believe that living in a passive solar house

means putting up with wide temperature fluctuations and inconvenient operation requirements. Other concerns are long payback periods, resale value, aesthetics, and community acceptance.

Passive solar housing developers Wayne and Susan Nichols discovered from their marketing experience that buyers of passive solar houses are motivated by needs for prestige, economy, comfort, and control over the immediate environment.[89] Other concerns which will affect attitudes are architectural style, site development, quality of solar system design, quality of construction, and financing.

In The Underground House Book, Campbell discusses a number of concerns for people interested in earth shelter houses.[90] Concerns related to construction include building codes, zoning, and financing. Other concerns are related to livability and cost of earth shelter houses. These include aesthetics, privacy, acoustics, insurance, maintenance, initial cost, life-cycle costs, and market value.

In a study of user evaluations of passive solar homes, Towle asked occupants to evaluate their homes on aesthetics, thermal comfort, lifestyle changes, financial concerns, system performance, and overall satisfaction.[91] She found that most occupants were pleased with thermal performance, low utility bills, and favorable reactions of other people.

Boyer and Grondzik studied habitability and energy performance of earth shelter houses in Oklahoma.[92]

Respondents assessed their homes on, and rated the importance of, aspects such as comfortable air temperature, noise control, safety, maintenance, community acceptance, exterior appearance, lighting, storm protection, lifestyle modifications, and energy consumption. Thermal aspects of respondents' homes received the highest assessments and also were rated most important. Other questions concerned cost, construction, financing, and insurance.

The Real Estate Research Corporation surveyed purchasers of active solar houses built in a demonstration program of the U.S. Department of Housing and Urban Development.[93] Important factors in the purchase decision were: use of energy-saving materials, house value, solar system design, resale value, house quality, house price, house style, financing, and builder reputation. The authors suggested builders stress energy savings, ease of operation, reasonable repair and service costs, and resale value. The most common reasons for dissatisfaction included lower-than-expected utility cost savings and high frequency of repair and service problems.

Rivers, Warde, and Helm studied assessments of earth shelter houses by owners and people considering earth shelter housing in eight states surrounding, but not including, Oklahoma.[94] Respondents gave reasons for considering earth shelter houses, assessed construction, maintenance, and energy costs of the houses, and rated them on habitability factors. Considerers were generally younger, more educated,

more likely to be employed in white-collar and building-related professions, and in higher income brackets than owners. Primary reasons for considering earth shelter housing were reduction of energy and maintenance requirements and protection from storms. Considerers and owners both rated earth shelter houses superior on insurance costs, energy and maintenance requirements, and comfort. Considerers thought construction costs would be higher and insurance costs and energy requirements lower than owners reported they actually were.

A thesis by Bell studied consumer attitudes toward a house with a solar greenhouse and an earth shelter solar house.[95] The sample comprised visitors to two demonstration houses. Three factors were significant in the desire to live in both houses: acceptability in the community, evaluation of adequacy of access, and impression of solar system design. Education also was found to be related to desire to live in the earth shelter solar house, and age was related to desire to live in the house with a solar greenhouse. Overall, the house with a solar greenhouse was favored over the earth shelter solar house.

Consumer evaluations of that same earth shelter solar house were studied by Stewart and McKown.[96] Two subsamples were selected from visitors to the demonstration house. Both groups were asked identical questions about personal characteristics and desire to live in such a house, but each group was asked to respond to different aspects of the

house. Variables most strongly related to desire for earth shelter housing in the first group were: evaluation of amount of light, marital status, expected cost of repair and maintenance, education, and income. For the second group, the most significant variables were: acceptability in the community, accessibility, and evaluation of the solar system.

In a study for the U.S. Department of Energy, Market Facts, Inc., organized a focus group to discuss barriers and advantages to commercialization of passive solar energy.[97] Key individuals were chosen from six organizations involved in development, marketing, and use of passive solar energy. Barriers identified were lack of hard data on performance, belief that initial cost was high, long payback period, lack of appraisal data, and unfavorable building and zoning controls. Positive features were status symbol image, conservation of other resources, and furthering of the concept of community self-sufficiency.

Lundahl et al. studied attitudes of New Mexico consumers, architects, contractors, financiers, energy suppliers, and government officials toward acceptance of solar energy.[98] Respondents generally had one of two attitudes: that solar energy technology is sufficiently developed today--that it is possible to build a dependable, efficient, and attractive solar home; or that initial costs of solar energy systems will never be comparable to conventional systems, repair costs will never be low, and

solar energy systems cannot be functional without backup systems. The researchers also searched the literature for factors that influence acceptance of solar energy systems. Among those factors were the following: initial cost, dependability, availability, aesthetics, maintenance costs, modifications in house construction, temperature fluctuations, repair costs, warranties, social acceptability, pride, financing, building codes, and availability of information.

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# CHAPTER III

# DESIGN AND METHODOLOGY

## Survey Design

### Population

This survey was designed to explore underlying dimensions in attitudes toward two kinds of natural energy house design. A secondary purpose was to measure attitudes for possible use in marketing and public relations programs. For these reasons--along with reasons of time, cost, and convenience--the population of the survey was restricted to current homeowners in Stillwater, Oklahoma. More precisely, the population was defined as owners of property within the city limits of Stillwater who filed for homestead exemptions in 1981.

One reason for choosing to use homeowners only was that their experience with buying, living in, and maintaining a home may make them more thoughtful and realistic in apparaising possible advantages and disadvantages of earth shelter and passive solar houses. A second reason was that homeowners--because of their homeowning experience--may have less difficulty in answering hypothetical questions about an unfamiliar kind of house. A third reason was that

existing homeowners buy the majority of new houses. Knowledge of their attitudes would be important in developing marketing and public relations programs aimed at potential home buyers.

A potential bias among homeowners was that, when comparing natural energy design houses to conventional houses, there might have been a tendency to respond more favorably toward the product the person owned (i.e., a conventional house).

The survey was restricted to one community for several reasons. The main reason was that the major purpose of the study was exploratory rather than descriptive. Any underlying dimensions in attitudes of the general population likely would have been present in any fair-sized population. Further studies still are necessary to define more clearly the nature of the dimensions and to corroborate their existence in other populations.

Other reasons for studying just one community included the following: detailed information about attitudes in a segment of one housing market might be of immediate use for marketing and public relations; the survey could be completed more quickly because all mailings were local; and it was possible to appeal to community loyalty or neighborliness to induce response.

Findings cannot be generalized beyond the study population--either to people who do not own homes, or to other cities or rural areas.

## Variables

Type of House. Attitudes toward earth shelter and passive solar houses were studied using two treatment groups. One group of homeowners received a questionnaire about earth shelter houses and the other group received a similar questionnaire about passive solar houses. Each questionnaire gave a brief, general description of the type of house being studied. (Copies of both questionnaires are shown in Appendix A.)

The earth shelter questionnaire defined an earth shelter house as follows:

> If you're not sure what an 'earth shelter' house is, let me give a brief definition. An earth shelter house is a house covered by earth on one or more walls or the roof. It's really about the same thing as an underground house, but the term 'earth shelter' has become popular in recent years because, among other reasons, it doesn't imply that the house has to be completely underground.
>
> One kind of earth shelter house may have only a 4-foot bank of earth along the north wall, and another may be completely underground. Or another may be built into a hillside with only one wall and the roof exposed. Whatever design is used, the purpose of earth shelter design is to reduce energy requirements by modifying the temperature of the air reaching the earth-covered portion of the house and by reducing heat loss and air infiltration.
>
> In responding to the statements about houses, just assume that the house uses some degree of earth sheltering.

The definition of a passive solar house was presented in the questionniare as follows:

> If you're not sure what 'passive solar' is, first I should explain that not all solar energy systems are passive solar systems. What many people think of when they think of solar energy is an 'active' solar system--it uses mechanical (or 'active') devices such as pumps, fans, and blowers to circulate air or water which is heated in solar panels attached to the house.
>
> 'Passive' solar is a name for a number of design techniques to allow a building to collect, store and circulate heat from the sun by using only natural (or 'passive') methods--convection, conduction and radiation. Basically, it involves placing glass on the south side of the house to let the winter sun in and building substantial mass into the interior of the house (for instance, a thick wall of concrete, stone or adobe) to absorb and store the heat for night-time use.
>
> One kind of passive solar house may let sunlight directly into rooms through south windows, and another may use an attached greenhouse or sunroom to collect the heat. Or another may not use south windows, but collect heat in the south wall itself by placing glass in front of it. Whatever design is used, the purpose of passive solar design is to reduce energy requirements by using heat from the sun.
>
> In responding to the statements about houses, assume that the houses use some form of passive solar design but do not use active solar systems.

Both types of design were chosen because they offer potentials for energy conservation and reduction of housing costs, because interest in them has grown steadily for a number of years, and because builders' interest in them seems to have been slowed by lack of confidence of their acceptance by consumers.

Attitude Dimensions. The primary focus of this study was to isolate dimensions underlying attitudes toward earth shelter and passive solar houses to get a better understanding of the attitudes. Factor analysis of Likert scale

belief statements isolated dimensions and showed the belief statements most strongly related to each dimension. Attitude dimension scores for both kinds of houses were calculated and compared. Correlations between dimension and attitude scores were calculated to find the dimensions most strongly related to attitudes.

Attitude dimension scores were calculated by the following formula (with loadings rounded to two decimals):

$$\text{dimension score} = \frac{\text{sum of } \left[\begin{matrix}\text{factor loadings} \\ \text{X item values}\end{matrix}\right]}{\text{sum of factor loadings}}$$

All negative loadings were treated as positive values. When an item had a negative loading on a dimension, the loading was treated as a positive value and the polarity of the five-point item scale was reversed by subtracting the item score from six. In this way, the higher the score an item received, the lower the item's value on a dimension on which it was negatively loaded.

Overall Mean Attitude. Overall Mean Attitude toward earth shelter or passive solar houses was the average score over 35 positive and negative attitude statements. The statements covered a wide variety of housing aspects, such as cost, performance, livability, and acceptability. The attitude scale items were rated on a five-point scale using the following qualifiers: Definitely Agree, Probably Agree, Don't Know, Probably Disagree, Definitely Disagree.

Overall Interest. Overall Interest in earth shelter or passive solar houses--a second measure of attitude--was the average score on three interest scale items: would you read information about, would you go to see a model of, and would you consider buying an earth shelter (or passive solar) house? The interest scale items were rated on a five-point scale running from Definitely Yes to Definitely No. Overall Interest was used to check reliability of the 35-item attitude scale and to get an idea of the strength of relationship between attitude dimensions and Overall Mean Attitude.

How Much Read. This variable was measured by a question asking how much the respondent had read about earth shelter or passive solar houses. The four categories of response ran from Nothing At All to Much.

Personal and Household Data. Sex and age of the respondent were asked. Age was divided into four levels with the youngest being 34 Or Younger and the oldest being 55 Or Older.

Information requested about the household included: household income, education, number of adults, and number of children. Household income was divided into five levels which ran from Less Than $10,000 a year to $40,000 Or More. The highest level of education of any current member of the household was sought, with four levels: High School Or Less, 60 Credit HOurs Or More of College, Bachelor's Degree, and Master's Degree Or More.

The number of adults in the household was measured using three categories: Yourself Only, Yourself And Your Spouse Only, and Other (at least one other adult who is not your spouse or your child). The latter category was meant to include unmarried couples, unrelated co-owners, or households with more than two adults. Number of children in the household had four categories ranging from None to Three Or More.

## Hypotheses

This study tested the following hypotheses (some quasi):

1. There would be underlying dimensions in attitudes toward natural energy design houses.

2. Dimension scores for the two kinds of houses would differ on at least one dimension.

3. Overall attitudes toward earth shelter and passive solar houses would be favorable, but attitudes toward passive solar would be more favorable than attitudes toward earth shelter.

4. Attitudes would differ by age, education, income, and sex. More positive attitudes toward both kinds of houses would be found in younger respondents, those with higher levels of education and income, and males.

5. Interest scores for both earth shelter and passive solar houses would be high, but would be higher for passive solar.

## Development of Likert Scale

From study of the literature on earth shelter and passive solar design, a list was made of advantages and disadvantages, benefits and costs of the houses. Statements by experts and laymen, proponents and skeptics--along with the author's own ideas--were made into a list of positive and negative statements covering topics such as cost, performance, acceptability, and livability. The statements were written to be equally applicable to earth shelter and passive solar houses, so there were no questions about earth shelter houses being dark or damp, or about passive solar houses being too bright or too hot in the summer.

Helpful comments about the clarity of the statements were received from friends, family, and interested Oklahoma State University faculty.

A final list of 35 statements was selected to cover a wide variety of possible advantages and disadvantages of earth shelter and passive solar houses.

The normal criterion for item selection for a Likert scale is item reliability as measured in a pretest, but the author chose not to select items on this basis. The result was that there were probably items which were scored unfavorably by persons with favorable attitudes and vice versa--items that would normally be thrown out because they failed to discriminate between those with

favorable attitudes and those with unfavorable attitudes. However, identifying positive and negative beliefs and understanding the nature of attitudes were considered to be more important purposes of this study than maximizing the distance on an attitude continuum between persons with favorable and unfavorable attitudes. If an item was going to be perceived unfavorably even by those with favorable attitudes, that information was valuable to this study.

Because the questionnaire was fairly long and respondents possibly would have difficulty answering questions about an unfamiliar subject, the author thought that a five-point response scale would be easier than a seven-point scale. The particular scale used (Definitely Agree, Probably Agree, Don't Know, Probably Disagree, Definitely Disagree) was chosen because it seemed easy to respond to and interpret. No negative comments were received from people asked to criticize or fill out a preliminary version of the questionnaire.

## Sample Selection

Sample subjects were to be randomly assigned to two groups. One group would get a mail questionnaire about earth shelter houses and the other group about passive solar houses. The author estimated that 100 subjects per group would be enough to show significant differences between the groups. Figuring a response rate of 70 to 75 percent, it was determined that a sample size of 300--150

per group--would provide about 100 good responses for each kind of house.

The population was defined as owners of property within the Stillwater city limits who filed for homestead exemptions in 1981 (the last year for which records were complete). Names were chosen from the tax rolls for Stillwater city limits in the office of the Payne County assessor. These rolls comprise 10 books which list housing addition, property description, owner, and tax information for each piece of property in the city.

First, the number of property owners taking the homestead exemption was counted (4,727). While these were counted, the name of the owner, the property description, and the addition were written down for every 25th listing to serve as a guide for locating those chosen by random selection.

Three hundred numbers were chosen at random. By flip of a coin, the first number was assigned to the passive solar treatment group, then the second went to the earth shelter treatment group, the third to passive solar, and so on. Fifty extra numbers were drawn to serve as replacements for duplicates or for selections where no mailing address could be found.

Using the list of every 25th homeowner, the chosen homeowners were located in the tax rolls and the name or names listed as owner were written down. The list was

then taken to the Payne County treasurer's office to get mailing addresses.

The addresses in the treasurer's office were on cards filling about 20 drawers and were filed alphabetically by the property owners' names. The author took the first file drawer, went through it for names on the passive solar list, then went through it for names on the earth shelter list. When addresses had been obtained for names listed in that drawer, he went to the next drawer and repeated the process. If no mailing address was listed, or a card for the owner could not be found, he consulted the telephone directory, then the city directory. No mailing address could be found for seven homeowners, so those were replaced with the next seven numbers from the replacement list.

Another element of the selection process was the choice of one name when there was more than one owner. In fact, most homes were owned by married couples, with the husband's name listed first, then the wife's. This selection was made as follows: When the first two-owner home was encountered, a flip of a coin decided whether the first or second name was taken. From then on, whenever an address was found for a home with two owners, the author alternated between taking the first and second name. Homes with more than two owners were very rare and were treated as two-owner homes.

## Mailing

The questionnaires for both treatment groups included a description of the kind of house being examined and 45 questions. Printing was on the front and back of two sheets of paper. At the top of the first page was an introduction and a description of the particular kind of house. Following were the 35 attitude items, three questions about interest, one about "how much read," and one each about sex, age, income, education, number of adults in the household, and number of children. (See Appendix A.)

The mailing piece included the questionnaire, a cover letter, and a stamped return envelope. The first mailing--300 questionnaires--was made on March 29, 1982. A second mailing was made 12 days later and comprised 121 questionnaires. A final mailing of 74 questionnaires was made 10 days later. Different cover letters were used for each mailing.

## Response Rate

Of the 300 questionnaires mailed to Stillwater homeowners, 207 usable responses were received for a response rate of 69 percent. Seventeen questionnaires (six earth shelter and 11 passive solar) were undeliverable--they were returned either by the post office or by residents who reported the addressee no longer lived there. For the earth shelter group, 108 usable responses were received, while 99 were received from the passive solar group.

Attitude or interest items left blank were counted as "don't know" (a value of three on the five-point scale). Blanks on How Much Read and personal and household variables were counted as no response. If more than 30 of the 35 attitude scale items were marked "don't know," the questionnaire was not used.

## Methods of Analysis

Since the main purpose of this study was to learn about underlying dimensions of attitudes toward earth shelter and passive solar houses, the principal focus of analysis was a factor analysis of the 35 attitude scale items and identification of the dimensions that were found. The earth shelter and passive solar treatment groups were combined and treated as one group for the factor analysis, so that Item 1 of the earth shelter scale and Item 1 of the passive solar scale were treated as one item with 207 responses.

The method of factor analysis was principal components. Factors with eigenvalues of 1.0 or greater were retained and rotated orthogonally to simple structure.

Two-factor analyses of variance were used to study Type of House by How Much Read and personal and household variables. The method of unweighted means was used to adjust for unequal cell frequencies. The .05 level of probability was used to determine significance in all analyses of variance and t-tests.

One-way analyses of variance were used to study differences among levels of How Much Read and personal and household variables within the earth shelter and passive solar groups.

Two-way analyses of variance, treatments by subjects, were run for the earth shelter and passive solar attitude scales to get a measure of reliability for the scales. A reliability coefficient was calculated using the following formula:

$$r = \frac{\text{between subjects mean square - error mean square}}{\text{between subjects mean square}}$$

This coefficient is a measure of the proportion of observed differences between individuals which are "true" differences rather than the result of random error.

To compare attitudes toward earth shelter and passive solar houses, t-tests were run between the two groups for the 35 individual scale items, attitude dimension scores, Overall Mean Attitude, and Overall Interest. t-tests were also used to measure differences between males and females, and as gap tests in analyses of variance.

Product-moment correlation coefficients were calculated between dimensions and Overall Mean Attitude and between dimensions and Overall Interest. These correlations were used as measures of strength of relationship between attitude dimensions and overall attitude.

A measure of item discriminatory power was calculated for attitude scale items in both the earth shelter and passive solar questionnaires, to see how well each item separated those with favorable and unfavorable attitudes. First, the two treatment groups were divided into quartiles based on Overall Mean Attitude scores. Then Overall Mean Attitude and item scores for each of the 35 items were calculated for the highest and lowest quartiles. The difference between the high and low quartiles on Overall Mean Attitude was treated as a critical difference and was subtracted from the difference between the quartiles on each item. If the difference between the quartiles on an item was less than their difference on Overall Mean Attitude, the measure of discriminatory power was negative; if the item difference was greater than the difference on the overall attitude score, the measure was positive. The lower the number, the less the item discriminated between persons with favorable and unfavorable attitudes.

# CHAPTER IV

# FINDINGS

## Sample Characteristics

A sample return of 207 Stillwater homeowners was studied. From the earth shelter group, 108 responded, and 99 responded from the passive solar group. Chi square tests showed no significant differences between the earth shelter and passive solar groups on personal and household variables. Table I shows how much respondents had read about earth shelter and passive solar houses and describes the sample by personal and household characteristics.

Of the 108 persons who returned the earth shelter questionnaire, 77.8 percent said they had read "nothing at all" or only "a little" about earth shelter houses, while 22.2 percent had read "a fair amount" or "much." Ninety-eight persons responded to the question on How Much Read in the passive solar questionnaire, with 73.4 percent reporting having read "nothing at all" or "a little" about passive solar houses and 26.5 percent having read "a fair amount" or "much."

From the total of 207 persons, it is possible to get an approximate description by personal and household variables of the total population of Stillwater homeowners at

TABLE I

EARTH SHELTER AND PASSIVE SOLAR TREATMENT GROUPS AND TOTAL SAMPLE DESCRIBED BY HOW MUCH READ AND PERSONAL AND HOUSEHOLD VARIABLES

| Level | Percentage (No.)* Earth Shelter | Passive Solar | Total Sample |
|---|---|---|---|
| **How Much Read** | | | |
| Nothing at all | 9.3 (10) | 12.2 (12) | N.A.** |
| A little | 68.5 (74) | 61.2 (60) | N.A. |
| A fair amount | 18.5 (20) | 20.4 (20) | N.A. |
| Much | 3.7 (4) | 6.1 (6) | N.A. |
| Total | 100.0 (108) | 99.9 (98) | |
| **Sex** | | | |
| Male | 43.6 (46) | 49.5 (49) | 45.9 (95) |
| Female | 57.4 (62) | 50.5 (50) | 54.1 (112) |
| Total | 100.0 (108) | 100.0 (99) | 100.0 (207) |
| **Age** | | | |
| 34 and younger | 22.2 (24) | 21.2 (21) | 21.7 (45) |
| 35-44 | 14.8 (16) | 16.2 (16) | 15.5 (32) |
| 45-54 | 18.5 (20) | 12.1 (12) | 15.5 (32) |
| 55 and older | 44.4 (48) | 50.5 (50) | 47.3 (98) |
| Total | 99.9 (108) | 100.0 (99) | 100.0 (207) |
| **Household Income** | | | |
| Less than $10,000 | 11.2 (12) | 13.2 (12) | 12.1 (24) |
| $10,000-$19,999 | 20.6 (22) | 14.3 (13) | 17.7 (35) |
| $20,000-$29,999 | 23.4 (25) | 26.4 (24) | 24.7 (49) |
| $30,000-$39,999 | 19.6 (21) | 19.8 (18) | 19.7 (39) |
| $40,000 or more | 25.2 (27) | 26.4 (24) | 25.8 (51) |
| Total | 100.0 (107) | 100.1 (91) | 100.0 (198) |
| **Highest Level of Education in Household** | | | |
| High school degree or less | 14.0 (15) | 23.7 (23) | 18.6 (38) |
| 60 hrs. college or more | 15.0 (16) | 16.5 (16) | 15.7 (32) |
| Bachelor's degree | 25.2 (27) | 22.7 (22) | 24.0 (49) |
| Master's degree or more | 45.8 (49) | 37.1 (36) | 41.7 (85) |
| Total | 100.0 (107) | 100.0 (97) | 100.0 (204) |

TABLE I (Continued)

| Level | Percentage (No.)* Earth Shelter | Passive Solar | Total Sample |
|---|---|---|---|
| **Number of Adults in Household** | | | |
| One adult only | 21.3 (23) | 17.3 (17) | 19.4 (40) |
| Married couple only | 69.4 (75) | 74.5 (73) | 71.8 (148) |
| Other | 9.3 (10) | 8.2 (8) | 8.7 (18) |
| Total | 100.0 (108) | 100.0 (98) | 99.9 (206) |
| **Number of Children in Household** | | | |
| None | 66.7 (72) | 70.4 (69) | 68.4 (141) |
| One | 12.0 (13) | 17.3 (17) | 14.6 (30) |
| Two | 15.7 (17) | 8.2 (8) | 12.1 (25) |
| Three or more | 5.6 (6) | 4.1 (4) | 4.9 (10) |
| Total | 100.0 (108) | 100.0 (98) | 100.0 (206) |

*Total percentage may not equal 100 because of rounding.

**N.A. = Not applicable.

the time of the study. Because of sampling error, the percentages in the sample are likely to differ slightly from percentages in the actual population.

Of the homeowner respondents, 54.1 percent were female and 45.9 percent male. By age, 47.3 percent were 55 and older, 30.9 percent were 35 to 54, and 21.7 percent were 34 and younger.

About 45.5 percent of the sampled Stillwater homeowners had household incomes of $30,000 or more and 25.8 percent had incomes of $40,000 or more. The highest level of education in the household was a bachelor's degree or more

for 65.7 percent of the respondents, and a master's degree or more for 41.7 percent.

About 19.4 percent of the households had only one adult, while 71.8 percent reported a married couple as the only adults. As to the number of children aged 18 or younger in the homeowners' households, 68.4 percent had no children in the household, 26.7 percent had one or two children, and only 4.9 percent had three or more children.

## Attitude Dimensions

Factor analysis identified eight dimensions which explained 21.1 percent of the variance in attitudes toward earth shelter and passive solar houses. This supported the hypothesis that there were underlying dimensions in attitudes toward natural energy design houses.

The dimensions, in order of how much variance they explained, were as follows: Ease of Living (4.7%), Energy Efficiency (3.8%), Ease of Ownership (3.5%), Attractiveness (2.9%), Comfort (1.8%), Predictability of Energy Efficiency (1.5%), Initial Cost (1.5%), and Ease of Construction (1.4%). These dimensions can be thought of as product attributes or evaluative criteria on which energy-efficient houses are compared by consumers. Figure 1 depicts the dimensions as continuums, giving descriptions of the positive and negative poles.

To understand the nature of each attitude dimension, one needs to look at the dimension loadings, or factor

| Negative Pole | Dimension Name | Positive Pole |
|---|---|---|
| Much trouble to live in | EASE OF LIVING | Little trouble to live in |
| Uses much energy | ENERGY EFFICIENCY | Uses little energy |
| Much trouble to own | EASE OF OWNERSHIP | Little trouble to own |
| Unattractive | ATTRACTIVENESS | Attractive |
| Uncomfortable | COMFORT | Comfortable |
| Cannot predict energy use | PREDICTABILITY OF ENERGY EFFICIENCY | Can predict energy use |
| High initial cost | INITIAL COST | Low initial cost |
| Difficult to build | EASE OF CONSTRUCTION | Easy to build |

Figure 1. Description of Positive and Negative Poles of Eight Attitude Dimensions

loadings, of the attitude scale items. Table II lists the items with significant loadings (.3 or greater or -.3 or less) for each dimension. The higher the factor loading, the stronger was the relationship between the item and the attitude dimension. (The rotated factor matrix is shown in Appendix B.)

Before this discussion it should be stated that, while it is likely these dimensions have meaning beyond the study population, actual measures of relation between items and dimensions and between dimensions and attitude were unique to this study. If other studies were made using the identical set of scale items, but with different populations or attitude objects, the percentage of variance explained by each dimension and the loadings of individual items on the dimensions would be different from those in this study.

Ease of Living

The Ease of Living dimension explained the most variance (4.7%) in attitudes toward earth shelter and passive solar houses among respondents. It is a measure of how easy or how difficult it is to live in a house--how little or how much trouble it is. The more trouble a house is to live in, the lower its rating on Ease of Living.

Fifteen attitude scale items had significant loadings on Ease of Living (Table II). The items with the heaviest loadings seemed to relate to the dimension as follows: The more the temperature of a house fluctuates,

TABLE II

ATTITUDE SCALE ITEMS WITH DIMENSION LOADINGS OF .3 OR GREATER OR -.3 OR LESS BY ATTITUDE DIMENSION

| Item* | Loading |
|---|---|
| **Ease of Living** | |
| 14. Keeps steady temperature | .79 |
| 17. Takes little extra time or effort | .73 |
| 22. Won't make life more complicated | .69 |
| 16. Needed in this climate | .61 |
| 30. High quality of construction | .58 |
| 21. No sacrifice in comfort | .49 |
| 4. Proof of savings exists | .49 |
| 7. Long-term savings | .48 |
| 19. Won't become obsolete | .48 |
| 1. Good investment | .47 |
| 15. Structural problems not likely | .46 |
| 10. No extra maintenance problems | .40 |
| 35. Would feel at home in | .38 |
| 9. Can be built to provide most heating | .38 |
| 20. Would seem practical to friends | .35 |
| **Energy Efficiency** | |
| 29. Makes more self-sufficient | .73 |
| 25. Lessens dependence on utilities | .66 |
| 32. Conserves energy | .63 |
| 31. Healthy | .54 |
| 26. Would feel close to nature in | .54 |
| 7. Long-term savings | .52 |
| 9. Can be built to provide most heating | .49 |
| 28. Will someday be common | .46 |
| 34. Would like to see more | .43 |
| 13. Resale value will increase | .39 |
| 1. Good investment | .34 |
| 19. Won't become obsolete | .31 |
| 18. Naturally appealing | .31 |
| **Ease of Ownership** | |
| 12. Not difficult to finance | .74 |
| 27. Building codes are no obstacle | .70 |
| 33. Not difficult to get worked on | .63 |
| 20. Would seem practical to friends | .60 |
| 23. Not difficult to resell | .55 |
| 2. Acceptable to neighbors | .43 |
| 15. Structural problems not likely | .37 |
| 35. Would feel at home in | .34 |
| 19. Won't become obsolete | .33 |
| 13. Resale value will increase | .32 |

TABLE II (Continued)

| Item* | Loading |
|---|---|
| **Attractiveness** | |
| 3. Enhances prestige | .68 |
| 2. Acceptable to neighbors | .63 |
| 6. Attractive | .61 |
| 18. Naturally appealing | .46 |
| 34. Would like to see more | .46 |
| 35. Would feel at home in | .41 |
| 1. Good investment | .39 |
| 15. Structural problems not likely | .37 |
| 28. Will someday be common | .37 |
| 26. Would feel close to nature in | .32 |
| **Comfort** | |
| 5. Comfortable interior atmosphere | .72 |
| 18. Naturally appealing | .53 |
| 21. No sacrifice in comfort | .47 |
| 31. Healthy | .30 |
| 26. Would feel close to nature in | .30 |
| **Predictability of Energy Efficiency** | |
| 24. Can estimate energy use | .72 |
| 4. Proof of savings exists | .45 |
| 6. Attractive | .30 |
| **Initial Cost** | |
| 11. No extra initial cost | .75 |
| 10. No extra maintenance problems | .42 |
| 13. Resale value will increase | -.33 |
| 33. Not difficult to get worked on | .33 |
| **Ease of Construction** | |
| 8. Not difficult to build | .77 |
| 9. Can be built to provide most heating | .34 |
| 10. No extra maintenance problems | -.33 |
| 1. Good investment | -.32 |
| 13. Resale value will increase | .31 |

*See Appendix A for exact wording of attitude scale items.

the less easy it is to live in. The less time and effort a person must spend on a house, the less trouble it is to live in the house. The less trouble a house is to live in, the less it will complicate the lives of the people living in it. The easier a kind of house is to live in, the more that kind of house is "needed in this climate." The lower the quality of construction of a house, the more trouble it will be to live in. And the more comfortable a house is, the easier it is to live in.

Again, it is pointed out that the higher the loading of an item is on a dimension, the stronger the relationship is between the item and the dimension. For instance, beliefs about whether the house keeps a steady temperature would have a greater influence on the score for Ease of Living than would beliefs about quality of construction.

Energy Efficiency

Energy Efficiency is a measure of the extent to which a house produces the best heating and cooling results--the most comfortable environment--for the least amount of energy. The less energy a house uses to produce the desired level of comfort, the more energy-efficient it is.

Thirteen attitude scale items had significant loadings on the Energy Efficiency dimension (Table II). The three items with heaviest loadings gave a clear picture of the dimension. The more energy-efficient a house is, the

more self-sufficient its owners are. The more energy-efficient a house is, the less its owners or occupants are dependent on utility companies. And the less energy a house uses for heating and cooling, the more it will conserve energy.

Other items with significant loadings showed that the more energy-efficient a house is, the more it is perceived to be healthful, give a feeling of closeness to nature, and offer long-term savings.

Ease of Ownership

Ease of Ownership concerns how easy or difficult it is to buy, own, or sell a house. How much trouble would it be to be the owner?

Looking at the 10 items with significant loadings on Ease of Ownership (Table II), the first five items clearly illustrated the nature of the dimension. The easier it is to get financing for a house, the less trouble it is to own. The more that building codes are a problem, the more trouble a house is to own (for the owner involved in the building process). The more difficult it is to get work done on a house, the more trouble the house is to own. The less trouble connected with owning a house, the more likely that friends would consider it a practical purchase. And the less difficult it is to resell a house, the less trouble it is to be the owner.

Attractiveness

The Attractiveness dimension concerns the appearance of a house--whether it is appealing. How attractive is a house? To what extent does it draw people to it by exciting feelings of interest, pleasure, or admiration?

Table II shows 10 attitude scale items with significant loadings on Attractiveness. The most significant items related to the dimension as follows: The more attractive a house is, the more it will enhance its owners' prestige. The more attractive a house is, the more it will be approved by neighbors. Obviously, the more attractive a house is, the greater its attractiveness. The less attractive a house is, the less it is naturally appealing. And the less attractive a house is, the less likely it is that people would like to see more houses like it.

Comfort

The Comfort dimension describes the interior environment of the house. Is it comfortable or uncomfortable? To what extent do occupants of the house feel warm, relaxed, pleasant?

Of the five attitude scale items with dimension loadings of .3 or greater on Comfort (Table II), the loading of the first item was substantially heavier than the next item, and the loadings of the second and third items were

quite a bit heavier than the last two items. Keeping in mind that the item with the heaviest loading has the strongest relationship to the dimension, the five items said the following about Comfort: The more comfortable the interior atmosphere of a house, the more comfortable the house. The more comfortable a house is, the more naturally appealing it is. The less comfortable a house is, the more comfort the owners sacrifice. The less comfortable a house is, the less healthful it is. And the more comfortable a house is, the more it would provide a feeling of being close to nature.

Predictability of Energy Efficiency

Predictability of Energy Efficiency simply concerns the degree to which one can predict or estimate how much energy a house will use to produce a desired level of comfort. How accurately can one predict how much energy a house will use?

There were only three items with significant loadings on this dimension (Table II). The first item was by far the most significant and gave the dimension its name. To the extent it is possible to estimate how much energy a house will use, its energy efficiency is easy to predict. The other items had significant, but weaker, relationships to the dimension: The easier it is to predict the energy efficiency of a house, the more likely proof of savings exists. And the easier it is to predict the energy efficiency of a house, the more attractive the house is.

## Initial Cost

Initial Cost concerns the cost of building or buying a house, and the cost of initial repair or service work. It is the cost to purchase a house and make it ready to live in. Attitude scale items concerning energy use (Item 32, "Conserves energy") and life-cycle costs (Item 7, "Long-term savings") were not significantly related to the dimension. (The rotated factor matrix is shown in Appendix B.)

Three items had significant positive loadings on Initial Cost and one item had a significant negative loading (Table II). By far the most significant item was "No extra initial cost." The other items were related to Initial Cost as follows: The fewer maintenance problems (initial repair or service) a house has, the lower its initial cost. The lower the initial cost of a house, the less its resale value is likely to increase. And the less difficult it is to get work (initial repair or service) done on a house, the lower the initial cost.

## Ease of Construction

Ease of Construction describes how easy or difficult it is to build a house. How much trouble would it be to construct? Could it be built by most any builder, or only by an expert few?

Three items had significant positive loadings on Ease of Construction and two items had significant negative

loadings (Table II). "Not difficult to build" had by far the heaviest loading on the dimension. The other four items had the following relationships to the dimension: The easier a house is to build, the more likely it can be built to provide most of the heating. The more difficult it is to build a house--the fewer builders who can built it--the fewer maintenance problems it will have, and the better investment it will be. And the easier it is to build a house, the more likely its resale value will increase.

## Relative Influence of Dimensions on Overall Attitude

Since Overall Mean Attitude and Overall Interest both were measures of attitude, product-moment coefficients of correlation were calculated between the attitude dimensions and the two attitude scores to get two measures of relation between the dimensions and attitude (Table III). The purpose was to find the relative influence of each dimension on attitude, or, if dimensions are thought of as product attributes, to find the relative importance of each attribute.

Correlations with Overall Mean Attitude were very high for six dimensions. Ease of Living, Energy Efficiency, Ease of Ownership, and Attractiveness were about equal with correlations of .94 or .95. Comfort had a correlation of .90, and Predictability of Energy Efficiency had a

correlation of .85. Initial cost had a somewhat lower, but still moderate, correlation of .68. Ease of Construction had a comparatively low correlation of .31.

TABLE III

CORRELATIONS BETWEEN ATTITUDE DIMENSIONS AND OVERALL MEAN ATTITUDE AND BETWEEN ATTITUDE DIMENSIONS AND OVERALL INTEREST

| Dimension | Correlation With Overall Mean Attitude | Correlation With Overall Interest |
|---|---|---|
| Ease of Living | .95 | .63 |
| Energy Efficiency | .95 | .66 |
| Ease of Ownership | .95 | .59 |
| Attractiveness | .94 | .68 |
| Comfort | .90 | .66 |
| Predictability of Energy Efficiency | .85 | .58 |
| Initial Cost | .68 | .36 |
| Ease of Construction | .31 | .12 |

The rank order of the dimension correlations is more meaningful than the magnitude of the correlation coefficients. Part of the correlation was probably due to the fact that dimension scores and Overall Mean Attitude were based on the same item scores (except where a negative

loading reversed the five-point scale, thereby changing the item score).

While Overall Interest was considered a measure of attitude toward earth shelter and passive solar houses, it was a less accurate measure than Overall Mean Attitude because there were fewer items in the interest scale. However, correlations between dimensions and Overall Interest followed the same general pattern as correlations with Overall Mean Attitude.

Six dimensions had moderate correlations with Overall Interest: Attractiveness (.68), Energy Efficiency (.66), Comfort (.66), Ease of Living (.63), Ease of Ownership (.59), and Predictability of Energy Efficiency (.58). Initial Cost (.36) correlated less heavily, and Ease of Construction (.12) showed almost no correlation.

In general, the relative influence of attitude dimensions on attitude toward earth shelter and passive solar houses in this study was as follows: The most important dimensions, in no certain order, were Ease of Living, Energy Efficiency, Ease of Operation, and Attractiveness. Almost as important as the first four dimensions was Comfort, followed closely by Predictability of Energy Efficiency. Beliefs about Initial Cost had less effect on Overall Mean Attitude, while beliefs about Ease of Construction had very little effect at all.

In future studies, the importance of each dimension--its relative influence on attitude--will vary, depending

on the values of the individual or population doing the evaluating, the objects being evaluated, and the evaluation situation.

As examples: Attractiveness may be more important to one sex or age group than another. Beliefs about Energy Efficiency may be more important in the evaluation of a house designed to be energy-efficient than a house not particularly designed for energy efficiency. Initial Cost may be more important to someone shopping for a house than to someone who is not. Ease of Construction may be more important to someone planning to build their own home than to someone looking at completed homes.

While the importance of these attitude dimensions will vary, and while there may be other important dimensions not identified here, these eight dimensions may be important, not just in attitudes toward earth shelter or passive solar houses, but in attitudes toward any kind of energy-efficient house--even in attitudes toward houses not designed for energy efficiency. If an attitude scale accurately measured beliefs on each dimension, any house could be placed at some point on each dimension continuum. That information, combined with knowledge of dimension importance, would help predict behavior toward the house.

One is reminded, however, that the attitude dimensions discussed here were the result of this one study and were affected by the attitude objects, scale items, and study population. Further research is needed to corroborate the

identity of the dimensions and to demonstrate their usefulness in predicting behavior.

## Attitude Scores

Before discussion of the attitude measurement results, a few statements should be made about interpretation of the attitude scores.

Although it is common for earth shelter and passive solar design techniques to be used together or in combination with other energy-saving techniques, in this study earth shelter and passive solar houses were considered as separate attitude objects so that general beliefs about them could be assessed and compared. The purpose of the attitude measures was to show areas of strength and weakness in images of earth shelter and passive solar houses, not to compare the merits of one type of design with the other.

Homeowners in the study were given general definitions of earth shelter or passive solar houses, but no descriptions of specific houses. Each homeowner was rating his or her image of an earth shelter or passive solar house. Scores should not be interpreted as saying that an actual earth shelter house would receive this rating and a passive solar house that rating. Scores only tell how homeowners rated their image of the typical, or average, earth shelter or passive solar house. Any specific example of either type of house design might be rated much differently.

Another note concerns the comparison of item or dimension scores within a treatment group. If a wide range of attitude objects were studied using this attitude scale, it might be found that particular items or dimensions consistently receive higher scores than others. If so, an item or dimension that appeared to have a high score for one kind of house might actually have a relatively low score compared to other kinds of houses, and an apparently low score might be relatively high. Therefore, even though it is of interest to compare items or dimensions within a treatment group, more emphasis should be given to comparisons of like scores between the groups.

The mean attitude scores discussed in this chapter--scores for dimensions, scale items, Overall Interest, and Overall Mean Attitude--were based on five-point scales. The scales were interpreted as running from 1 to 5, unfavorable to favorable, with 3 being neutral.

All differences in attitudes reported as significant were significant at or beyond the .05 level. This means that no more than one in 20 samples of this size would have shown a difference as large as was found unless there was, in fact, a difference in the population.

Finally, it is emphasized that all attitude scores of the earth shelter and passive solar treatment groups and all comparisons between the groups pertain to the study population only and should not be generalized to other populations. However, if combined with other available

knowledge and personal insight, the findings can be useful in forming hypotheses about attitudes in other populations.

Overall Mean Attitude

The hypothesis about overall attitudes said that attitudes toward both earth shelter and passive solar houses would be favorable, but passive solar houses would be perceived more favorably. This hypothesis was supported. The Overall Mean Attitude for earth shelter houses was 3.46 and for passive solar houses was 3.64. The difference was significant at the .05 level.

Two-factor analyses of variance showed no interaction between Type of House and How Much Read or between Type of House and personal and household variables. Within the treatment groups, analyses of variance showed significant differences in a few variables, but most of the personal and household variables were not significantly related to attitudes toward earth shelter or passive solar houses. (See Appendix C for analysis of variance tables which show significant differences.) Table IV shows Overall Mean Attitude toward earth shelter and passive solar houses for levels of How Much Read and personal and household variables.

For the earth shelter group, there were significant differences (at the .05 level) in three variables. For the variable How Much Read, those who had read "a fair amount" about earth shelter houses had an Overall Mean Attitude of 3.82, which was more favorable than the attitudes of those

TABLE IV

OVERALL MEAN ATTITUDE FOR LEVELS OF HOW MUCH READ AND PERSONAL AND HOUSEHOLD VARIABLES BY TYPE OF HOUSE

| How Much Read | | |
|---|---|---|
| Level | Earth Shelter* | Passive Solar* |
| Nothing at all | 3.21 | 3.41 |
| A little | 3.38 | 3.55 |
| A fair amount | 3.82 | 3.97 |
| Much | 3.73 | 3.99 |
| **Sex** | | |
| Level | Earth Shelter** | Passive Solar** |
| Male | 3.48 | 3.56 |
| Female | 3.45 | 3.72 |
| **Age** | | |
| Level | Earth Shelter* | Passive Solar** |
| 34 or younger | 3.71 | 3.94 |
| 35-44 | 3.69 | 3.63 |
| 45-54 | 3.46 | 3.57 |
| 55 or older | 3.26 | 3.53 |
| **Household Income** | | |
| Level | Earth Shelter* | Passive Solar** |
| Less than $10,000 | 3.32 | 3.66 |
| $10,000-$19,999 | 3.30 | 3.62 |
| $20,000-$29,999 | 3.72 | 3.81 |
| $30,000-$39,999 | 3.31 | 3.65 |
| $40,000 or more | 3.52 | 3.63 |
| **Highest Level of Education in Household** | | |
| Level | Earth Shelter** | Passive Solar** |
| High school graduate or less | 3.44 | 3.51 |
| At least 60 hours of college | 3.63 | 3.87 |
| Bachelor's degree | 3.53 | 3.66 |
| Master's degree or more | 3.37 | 3.60 |

TABLE IV (Continued)

| Number of Adults in Household | | |
|---|---|---|
| Level | Earth Shelter** | Passive Solar** |
| One adult only | 3.30 | 3.69 |
| Married couple only | 3.49 | 3.62 |
| Other | 3.61 | 3.75 |
| **Number of Children in Household** | | |
| Level | Earth Shelter** | Passive Solar** |
| None | 3.42 | 3.62 |
| One | 3.44 | 3.70 |
| Two | 3.72 | 3.86 |
| Three or more | 3.29 | 3.34 |

*Some of the differences between levels of this variable for this type of house were significant at the .05 level.

**Differences on this variable for this type of house were not significant.

who had read only "a little" (3.38) or "nothing at all" (3.21). Those who had read "much" had a high mean attitude (3.73), but there were only four persons in the category, so differences from those who had read less were not significant.

For the variable Age, homeowners aged 34 and under (Overall Mean Attitude 3.71) and 35 to 44 (3.69) had more favorable attitudes toward earth shelter houses than those aged 55 and older (3.26). The 45-to-54 age group (3.46) was not significantly different from any other age group.

The third variable significantly related to attitude toward earth shelter houses was Household Income. The most favorable attitude score appeared in the middle group of the five income groups. Homeowners with household incomes of $20,000 to $29,999 (Overall Mean Attitude 3.72) had significantly more favorable attitudes toward earth shelter houses than did three income groups: less than $10,000 (3.32), $10,000 to $19,999 (3.30), and $30,000 to $39,999 (3.31). Owners with incomes of $40,000 or more had a mean attitude score of 3.52, which was not significantly different from other income groups.

For the earth shelter treatment group, then, the hypothesis that younger homeowners would have more favorable attitudes was generally supported, but there was no support for the hypotheses that more favorable attitudes would be found in males and persons in households with higher income and education levels.

For the passive solar group, only the variable How Much Read was significantly related to attitudes toward passive solar houses. Those who had read "a fair amount" (3.97 Overall Mean Attitude) perceived passive solar houses more favorably than those who had read "a little" (3.55) or "nothing at all" (3.41). Those who had read "much" had the highest mean attitude (3.99) and were significantly more favorable in their attitudes than those who had read "a little." But because of the small number of persons in the "nothing at all" and "much" categories,

the sizable difference in the mean attitudes of those groups was not significant.

There was no support in the passive solar treatment group for the hypotheses that more favorable overall attitudes would be found in males, younger persons, and persons in households with higher income and education levels.

It is of interest to note variable levels in which attitude scores for both earth shelter and passive solar houses tended to be high or low even though analysis of variance showed no significant difference on the variable. However, in reporting these instances, it is emphasized that they should be interpreted as nothing more than possible tendencies in the study population. Where no significant difference was found between levels of a variable, chances are greater than one in 20 that differences did not exist in the actual population.

Although there were no significant differences among these variables, the following tendencies were noted: As with the earth shelter group, where age differences were significant, homeowners 34 and younger tended to have the most favorable attitudes toward passive solar houses. Also similar to significant findings for earth shelter houses, homeowners with household incomes of $20,000 to $29,999 tended to have the most favorable attitudes toward passive solar houses. While differences on the education variable were not significant for either type of house, the most favorable attitudes toward both types tended to be

among owners of homes where the highest level of education in the household was at least 60 hours of college. And, finally, on Number of Children in Household, owners with two children residing at home tended to be most favorable toward both types of houses, while owners with three or more children at home registered the least favorable attitude.

Attitude Dimensions

Passive solar houses were perceived more favorably than earth shelter houses on four attitude dimensions--Attractiveness, Energy Efficiency, Ease of Ownership, and Ease of Construction (differences significant at the .05 level). This supports the hypothesis that the two treatment groups would have significantly different scores on at least one dimension. There were no significant differences between the two groups on the other four dimensions. Table V lists attitude dimension scores for the two kinds of houses.

Passive solar houses were perceived as being significantly more attractive, more energy-efficient, easier to own, and easier to build than earth shelter houses. Earth shelter and passive solar houses were perceived as being equally easy to live in, equally comfortable, as having about the same initial cost, and as being equal in how well their energy use can be predicted.

The dimension which showed the greatest difference in Stillwater homeowners' perceptions of passive solar and

earth shelter houses was Attractiveness, with a mean of 3.67 for passive solar compared to 3.28 for earth shelter. The next greatest difference was on Energy Efficiency (3.82 to 3.54, passive solar to earth shelter), followed by Ease of Ownership (3.59 to 3.33), and Ease of Construction (3.21 to 3.08).

TABLE V

ATTITUDE DIMENSION MEAN SCORES BY TYPE OF HOUSE

| Dimension | Mean Score | |
|---|---|---|
| | Earth Shelter | Passive Solar |
| Ease of Living | 3.65 | 3.61 |
| Energy Efficiency | 3.54 | 3.82* |
| Ease of Ownership | 3.33 | 3.59* |
| Attractiveness | 3.28 | 3.67* |
| Comfort | 3.31 | 3.45 |
| Predictability of Energy Efficiency | 3.35 | 3.34 |
| Initial Cost | 3.13 | 3.13 |
| Ease of Construction | 3.08 | 3.21* |

*Dimension score was significantly higher at the .05 level than the score for the other kind of house.

The rank of a dimension score within a treatment group does not give a complete picture of favorability toward the dimension, because a high score for one kind of house may be low when compared to other kinds of houses, and a low score may be comparatively high. Nevertheless, it is

helpful in understanding attitudes toward earth shelter and passive solar houses to see which attitude dimensions were perceived most and least favorably for each kind of house.

For the earth shelter group, the rank order of dimension scores was as follows:

Ease of Living (3.65)
Energy Efficiency (3.54)
Predictability of Energy Efficiency (3.35)
Ease of Ownership (3.33)
Comfort (3.31)
Attractiveness (3.28)
Initial Cost (3.13)
Ease of Construction (3.08)

Dimension scores for the passive solar group were ranked in the following order:

Energy Efficiency (3.82)
Attractiveness (3.67)
Ease of Living (3.61)
Ease of Ownership (3.59)
Comfort (3.45)
Predictability of Energy Efficiency (3.34)
Ease of Construction (3.21)
Initial Cost (3.13)

Keeping in mind the significant differences between the two groups on four dimensions, one can say that two of the dimensions on which both kinds of houses were perceived most favorably were Energy Efficiency and Ease of Living, while Ease of Construction and Initial Cost were the two dimensions on which the houses were perceived least favorably.

## Attitude Scale Items

To understand more clearly the difference in dimension

scores for the two types of houses, one must look at the specific beliefs on which the houses were perceived most differently. Of the 35 attitude scale items, 18 showed significant differences between the groups. Table VI gives item mean scores for the earth shelter and passive solar treatment groups. (Note: All discussion of attitude scale items uses abbreviated item descriptions. See Appendix A for exact wording of the items.)

Passive solar houses were perceived more favorably than earth shelter houses on 15 items (differences significant at or beyond the .05 level). Listed in order of the greatest difference between passive solar and earth shelter mean scores, the items were as follows:

23. Not difficult to resell
2. Acceptable to neighbors
34. Would like to see more
3. Enhances prestige
26. Would feel close to nature in
28. Will someday be common
25. Lessens dependence on utilities
18. Naturally appealing
8. Not difficult to build
12. Not difficult to finance
29. Makes more self-sufficient
27. Building codes are no obstacle
13. Resale value will increase
32. Conserves energy
15. Structural problems not likely

Although many of these items had significant loadings on more than one attitude dimension, they loaded most heavily on the four dimensions on which passive solar houses were perceived more favorably. (See Table II for attitude dimension loadings.) Passive solar houses were perceived sufficiently more favorably on these 15 items

TABLE VI

ATTITUDE SCALE ITEM MEAN SCORES AND OVERALL MEAN ATTITUDE BY TYPE OF HOUSE

| Item** | Mean Score: Earth Shelter | Mean Score: Passive Solar |
|---|---|---|
| 1. Good investment | 3.72 | 3.76 |
| 2. Acceptable to neighbors | 2.96 | 3.87* |
| 3. Enhances prestige | 2.69 | 3.33* |
| 4. Proof of savings exists | 3.93* | 3.51 |
| 5. Comfortable interior atmosphere | 3.09 | 3.27 |
| 6. Attractive | 3.40 | 3.68 |
| 7. Long-term savings | 3.80 | 4.02 |
| 8. Not difficult to build | 3.55 | 4.00* |
| 9. Can be built to provide most heating | 4.06 | 3.99 |
| 10. No extra maintenance problems | 3.41 | 3.41 |
| 11. No extra initial cost | 2.83 | 2.64 |
| 12. Not difficult to finance | 2.88 | 3.31* |
| 13. Resale value will increase | 3.42 | 3.77* |
| 14. Keeps steady temperature | 4.25* | 3.38 |
| 15. Structural problems not likely | 3.22 | 3.56* |
| 16. Needed in this climate | 4.06 | 4.02 |
| 17. Takes little extra time or effort | 3.73 | 3.57 |
| 18. Naturally appealing | 3.19 | 3.66* |
| 19. Won't become obsolete | 4.07 | 4.04 |
| 20. Would seem practical to friends | 3.63 | 3.70 |
| 21. No sacrifice in comfort | 3.71* | 3.35 |
| 22. Won't make life more complicated | 3.56 | 3.23 |
| 23. Not difficult to resell | 2.66 | 3.58* |
| 24. Can estimate energy use | 3.38 | 3.29 |
| 25. Lessens dependence on utilities | 3.84 | 4.22* |
| 26. Would feel close to nature in | 2.98 | 3.47* |
| 27. Building codes are no obstacle | 2.82 | 3.21* |
| 28. Will someday be common | 3.49 | 3.97* |
| 29. Makes more self-sufficient | 3.61 | 4.01* |
| 30. High quality of construction | 3.85 | 3.65 |
| 31. Healthy | 3.59 | 3.70 |
| 32. Conserves energy | 4.13 | 4.47* |
| 33. Not difficult to get worked on | 2.93 | 3.09 |
| 34. Would like to see more | 3.27 | 3.94* |
| 35. Would feel at home in | 3.45 | 3.75 |
| Overall Mean Attitude | 3.46 | 3.64* |

*Item score or Overall Mean Attitude score was significantly higher at the .05 level than the score for the other kind of house.

**See Appendix A for exact wording of attitude scale items.

to result in a more favorable rating on Energy Efficiency, Ease of Ownership, Attractiveness, and Ease of Construction.

Six of the 15 items were most heavily loaded on Energy Efficiency: "Will someday be common," "Lessens dependence on utilities," "Naturally appealing," "Makes more self-sufficient," "Resale value will increase," and "Conserves energy." Four items were loaded most heavily on Attractiveness: "Acceptable to neighbors," "Would like to see more," "Enhances prestige," and "Naturally appealing." Three items had their heaviest loadings on Ease of Ownership: "Not difficult to resell," "Not difficult to finance," and "Building codes are no obstacle." "Not difficult to build" was loaded most heavily on Ease of Construction. "Structural problems not likely" was loaded most heavily on Ease of Living, but also had heavy loadings on Ease of Ownership and Attractiveness.

Three items were perceived significantly more favorably for earth shelter houses than for passive solar houses. They are listed below in order of the greatest difference between earth shelter and passive solar mean scores:

14. Keeps steady temperature
4. Proof of savings exists
21. No sacrifice in comfort

All three of these items were loaded most heavily on Ease of Living, which would have tended to make earth shelter houses score higher than passive solar on that dimension. However, since there was no difference between earth shelter and passive solar houses on Ease of Living,

passive solar houses apparently scored high enough on other items loaded on Ease of Living to balance out their less favorable rating on these three items.

Why a type of house was rated high or low on an attitude dimension is understandable if one looks at the scores of significantly loaded items. However, before discussing the effect of individual items on dimension scores, it sould be explained that the item scores listed in Table VI were not always used to calculate a dimension score.

In order to use negatively loaded items in calculating dimension scores, negative loadings were treated as positive and the polarity of the five-point item scale was reversed. In this way, the higher the score an item received, the lower was its value for a dimension on which it loaded negatively.

As examples: Item 1, "Good investment," had a positive loading on Attractiveness and a negative loading on Ease of Construction. In calculating dimension scores for the earth shelter group, the item value was 3.72 for Attractiveness, but for Ease of Construction it was 2.28 (6 minus 3.72). Item 13, "Resale value will increase," loaded positively on Energy Efficiency and negatively on Initial Cost. Therefore, for the passive solar group, the item's value was 3.77 for Energy Efficiency and 2.33 for Initial Cost. (See Table II for significant dimension loadings, and Appendix B for the rotated factor matrix.)

Having explained how dimension scores were calculated, it is possible to discuss which specific beliefs had the greatest effect on those scores.

The highest rated attitude dimensions for earth shelter houses were Ease of Living (3.65 dimension mean score) and Energy Efficiency (3.54). Two items with high scores for earth shelter houses and high loadings on Ease of Living were "Keeps steady temperature" (4.25 item mean score) and "Needed in this climate" (4.06). On Energy Efficiency, two influential items were "Conserves energy" (4.13) and "Lessens dependence on utilities" (3.84).

The lowest rated dimensions for earth shelter houses were Ease of Construction (3.08) and Initial Cost (3.13). Two items with heavy loadings on Ease of Construction and rated low for earth shelter houses were "Good investment" (2.28 mean value when reversed because of negative loading) and "No extra maintenance problems" (2.59 when reversed). Two items which contributed significantly to the earth shelter group's low score for Initial Cost were "Resale value will increase" (2.58 when reversed) and "No extra initial cost" (2.83).

For passive solar houses, dimensions perceived most favorably were Energy Efficiency (3.82 dimension mean score) and Attractiveness (3.67). Two items with high scores in the passive solar group and high loadings on Energy Efficiency were "Conserves energy" (4.47) and "Lessens dependence on utilities" (4.22). Two items

contributing to the high score for Attractiveness in the passive solar group were "Would like to see more" (3.94) and "Acceptable to neighbors" (3.87).

The dimensions perceived least favorably for passive solar houses were Ease of Construction (3.21) and Initial Cost (3.13). "Good investment" (2.24 mean value when reversed for negative loading) and "No extra maintenance problems" (2.59 when reversed) were items which contributed to the low score for Ease of Construction. On Initial Cost, two of the most significant low item scores for the passive solar group were "Resale value will increase" (2.59 when reversed) and "No extra initial cost" (2.64).

Another way to study attitudes toward earth shelter and passive solar houses is to look at the items which were rated highest and lowest for the two groups. The range of item scores for earth shelter houses was from a low of 2.66 ("Not difficult to resell") to a high of 4.25 ("Keeps steady temperature"). Five items had mean scores of 4.00 or greater and eight items had scores of less than 3.00.

For passive solar houses, the range of item scores was from 2.64 ("No extra initial cost") to 4.47 ("Conserves energy"). Seven items had a mean score of 4.00 or greater and one item had a score of less than 3.00.

The 10 items perceived most favorably for earth shelter and passive solar houses are listed below.

Ten highest rated items for earth shelter houses:

14. Keeps steady temperature (4.25)
32. Conserves energy (4.13)
19. Won't become obsolete (4.07)
9. Can be built to provide most heating (4.06)
16. Needed in this climate (4.06)
4. Proof of savings exists (3.93)
30. High quality of construction (3.85)
25. Lessens dependence on utilities (3.84)
7. Long-term savings (3.81)
17. Takes little extra time or effort (3.73)

Ten highest rated items for passive solar houses:

32. Conserves energy (4.47)
25. Lessens dependence on utilities (4.22)
19. Won't become obsolete (4.04)
7. Long-term savings (4.02)
16. Needed in this climate (4.02)
29. Makes more self-sufficient (4.01)
8. Not difficult to build (4.00)
9. Can be built to provide most heating (3.99)
28. Will someday be common (3.97)
34. Would like to see more (3.94)

Six items had mean scores among the highest 10 for both groups: "Conserves energy," "Lessens dependence on utilities," "Won't become obsolete," "Long-term savings," "Needed in this climate," and "Can be built to provide most heating."

The 10 items perceived least favorably for earth shelter and passive solar houses are listed below.

Ten lowest rated items for earth shelter houses:

18. Naturally appealing (3.19)
5. Comfortable interior atmosphere (3.09)
26. Would feel close to nature in (2.98)
2. Acceptable to neighbors (2.96)
33. Not difficult to get worked on (2.93)
12. Not difficult to finance (2.88)
11. No extra initial cost (2.83)
27. Building codes are no obstacle (2.82)
3. Enhances prestige (2.69)
23. Not difficult to resell (2.66)

Ten lowest rated items for passive solar houses:

14. Keeps steady temperature (3.38)
21. No sacrifice in comfort (3.35)
3. Enhances prestige (3.33)
12. Not difficult to finance (3.31)
24. Can estimate energy use (3.29)
5. Comfortable interior atmosphere (3.27)
22. Won't make life more complicated (3.23)
27. Building codes are no obstacle (3.21)
33. Not difficult to get worked on (3.09)
11. No extra initial cost (2.64)

Six items were on both lists of lowest rated items: "Enhances prestige," "Not difficult to finance," "Comfortable interior atmosphere," "Building codes are no obstacle," "Not difficult to get worked on," and "No extra initial cost."

Whether an item was rated high or low for one kind of house does not tell whether its score in comparison to another kind of house was high or low. "Conserves energy" and "Lessens dependence on utilities" were among the highest rated items for both groups, but both items were rated significantly lower for earth shelter than for passive solar. "Not difficult to get worked on," "Building codes are no obstacle," and "Enhances prestige" were among the items rated lowest by both groups, but all three items were rated significantly higher for passive solar houses than for earth shelter.

## Overall Interest

Overall interest was the average score of three interest scale items asking if homeowners would look at information about earth shelter or passive solar houses, if they

would visit a model house, and if they would consider buying such a house.

Overall Interest toward earth shelter houses was 3.94 and toward passive solar was 4.04. This supported the hypothesis that interest scores would be high for both kinds of houses. However, the hypothesis that interest scores would be higher for passive solar was not supported. There was no significant difference between the groups on any interest item or Overall Interest. (Table VII shows scores for interest items and Overall Interest.)

TABLE VII

INTEREST SCALE ITEM MEAN SCORES AND OVERALL INTEREST BY TYPE OF HOUSE

| Item** | Mean Score* | |
|---|---|---|
| | Earth Shelter | Passive Solar |
| 36. Would you look at information? | 4.15 | 4.26 |
| 37. Would you visit a model house? | 4.31 | 4.16 |
| 38. Would you consider buying? | 3.35 | 3.70 |
| Overall Interest | 3.94 | 4.04 |

*There was no significant difference between the two groups on interest scale items or Overall Interest.

**See Appendix A for exact wording of interest scale items.

For the question, "Would you look at information?", the earth shelter group had a mean score of 4.15 and the passive solar group 4.26. (See Appendix A for exact wording of interest scale items.) A rating of 4 on the interest scale was for the answer "probably yes" and 5 was for "definitely yes," so both scores showed a high level of interest. Mean scores for the question, "Would you visit a model house?", were in the same range: 4.31 for earth shelter and 4.16 for passive solar. Scores were lower for both groups on the question, "Would you consider buying such a house?" The score for earth shelter was 3.35 and for passive solar was 3.70. Again, none of the differences between the groups were significant.

Also of interest were the percentages of earth shelter and passive solar respondents who replied "probably yes" or "definitely yes" to the interest items. However, since t-tests showed no differences between groups on any of the interest items, the percentages should only be interpreted as general indicators of interest, and not as evidence that one type of house was perceived more favorably than the other.

Eighty-six percent of the homeowners in both the earth shelter and passive solar groups answered "probably yes" or "definitely yes" to the question, "Would you look at information?" When asked, "Would you look at a model house?", 87 percent of each group answered "probably yes" or "definitely yes." When asked if they would consider

buying such a house, 29 percent of the homeowners in the earth shelter group said they "definitely" would consider buying an earth shelter house, and 22 percent said they "probably" would consider buying one. In the passive solar group, 39 percent reported they "definitely" would consider buying a passive solar house, and 23 percent said they "probably" would consider one.

## Reliability of Attitude Scale

Reliability of the attitude scale of 35 belief statements was inferred somewhat from the fact the scale successfully differentiated between the earth shelter and passive solar treatment groups on item scores, dimension scores, and Overall Mean Attitude. Because the attitude objects of the two groups were different, it was assumed there would be differences in attitudes. The scale showed this.

Another way scale reliability was checked was to calculate a reliability coefficient (between-subjects mean square minus error mean square, divided by between-subjects mean square) for each treatment group, based on treatments-by-subjects analyses of variance. (See Appendix C for analysis of variance tables.) For the earth shelter group the reliability coefficient (r) was .92, while for the passive solar group it was .93. Within these groups, 92 percent and 93 percent of the observed differences between individuals were "true" differences--caused by systematic

variance. Only 8 percent and 7 percent of the differences, respectively, were due to random error.

Reliability of the attitude scale further was checked by a product-moment coefficient of correlation between Overall Mean Attitude and Overall Interest. Since both the attitude and interest scales were measures of attitude, substantial correlation between the two sets of scores was expected. There was, in fact, a moderate correlation (.66) between the two scales, which indicated both were fairly reliable. If the interest scale was at all reliable, it can be assumed the attitude scale was quite a bit more reliable, because, with a much larger number of items in the attitude scale, random error would tend to cancel itself out.

Many items in the attitude scale were not as strongly related to overall attitude as were others. Those items did not separate persons with favorable attitudes from those with unfavorable attitudes as clearly as did other items. The less discriminating items might have been deleted from other attitude scales, but they were included in this scale because beliefs about the items were of interest, and because the factor analysis required a list of a wide variety of possible advantages and disadvantages of earth shelter and passive solar houses.

The result of including the less discriminating items, however, was that overall attitude scores fell in a narrower range than would they if some of the items had been

deleted. Therefore, significant differences in overall attitude might have been hidden. This was especially likely in the analyses of variance between levels of personal and household variables, where small differences in mean attitudes were combined with small numbers of persons in variable categories.

Table VIII shows a measure of the discriminatory power of scale items for the earth shelter and passive solar treatment groups. For each group, the 25 percent of the persons with the most favorable attitudes were compared with the 25 percent with the least favorable. For each treatment group, the Overall Mean Attitude of the least favorable quartile was subtracted from that of the most favorable to yield a critical difference (1.45 for the earth shelter group, 1.58 for passive solar). This number then was subtracted from the quartiles' difference on each item mean score to arrive at the measure of item discriminatory power.

A negative number meant the difference between low and high scorers on that item was less than their difference on Overall Mean Attitude. A positive number meant the difference on the item was greater than the overall attitude difference. The lower the number, the less the item discriminated between high and low scorers, and vice versa.

Ten items that discriminated best between the high and low scorers for both groups were the following:

TABLE VIII

DISCRIMINATORY POWER OF ATTITUDE SCALE ITEMS BY TYPE OF HOUSE

| Item** | Measure of Discriminatory Power* | |
|---|---|---|
| | Earth Shelter | Passive Solar |
| 1. Good investment | .54 | .27 |
| 2. Acceptable to neighbors | -.26 | -.11 |
| 3. Enhances prestige | -.85 | -.48 |
| 4. Proof of savings exists | -.13 | .21 |
| 5. Comfortable interior atmosphere | -.31 | .24 |
| 6. Attractive | .75 | .27 |
| 7. Long-term savings | -.06 | .14 |
| 8. Not difficult to build | -.85 | -.57 |
| 9. Can be built to provide most heating | -.42 | -.14 |
| 10. No extra maintenance problems | .08 | -.19 |
| 11. No extra initial cost | -.71 | -.37 |
| 12. Not difficult to finance | .04 | -.30 |
| 13. Resale value will increase | .12 | -.42 |
| 14. Keeps steady temperature | -.35 | -.02 |
| 15. Structural problems not likely | .40 | .46 |
| 16. Needed in this climate | .47 | .38 |
| 17. Takes little extra time or effort | .01 | .06 |
| 18. Naturally appealing | .08 | .30 |
| 19. Won't become obsolete | .40 | .22 |
| 20. Would seem practical to friends | .19 | .08 |
| 21. No sacrifice in comfort | .54 | .65 |
| 22. Won't make life more complicated | .87 | .56 |
| 23. Not difficult to resell | .12 | .43 |
| 24. Can estimate energy use | .01 | -.20 |
| 25. Lessens dependence on utilities | -.28 | -.41 |
| 26. Would feel close to nature in | .08 | -.08 |
| 27. Building codes are no obstacle | -.46 | -.16 |
| 28. Will someday be common | -.10 | -.55 |
| 29. Makes more self-sufficient | -.03 | -.14 |
| 30. High quality of construction | -.31 | -.60 |
| 31. Healthy | -.35 | -.36 |
| 32. Conserves energy | -.28 | -.54 |

TABLE VIII (Continued)

| Item** | Measure of Discriminatory Power* | |
|---|---|---|
| | Earth Shelter | Passive Solar |
| 33. Not difficult to get worked on | -.38 | -.48 |
| 34. Would like to see more | .79 | .49 |
| 35. Would feel at home in | .76 | .87 |

*The higher the number, the more the item discriminated between persons with favorable attitudes and those with unfavorable attitudes. The lower the number, the less the item discriminated.

**See Appendix A for exact wording of attitude scale items.

35. Would feel at home in
22. Won't make life more complicated
34. Would like to see more
21. No sacrifice in comfort
6. Attractive
15. Structural problems not likely
16. Needed in this climate
1. Good investment
19. Won't become obsolete
23. Not difficult to resell

Ten items that discriminated the least for both groups, starting with the least discriminatory, were as follows:

8. Not difficult to build
3. Enhances prestige
11. No extra initial cost
30. High quality of construction
33. Not difficult to get worked on
32. Conserves energy
31. Healthy
25. Lessens dependence on utilities
28. Will someday be common
27. Building codes are no obstacle

If the purpose of a future study is mainly to separate persons with favorable attitudes toward some kind of house from those with unfavorable attitudes, or to study relations between overall attitude and other variables, then it is recommended that a scale be used which includes at least the 10 most discriminating items and excludes a minimum of 10 least discriminating items. This should produce a wider range of scores than would the whole scale. However, if information on attitude dimensions is desired, even the least discriminating items should be included, because they have some of the heaviest dimension loadings. If the items were excluded, dimension scores would be less accurate.

If the purpose of a study is to get ratings of an object on attitude dimensions, it should be possible to get meaningful measures by using the 35-item attitude scale and calculating dimension scores from the loadings in this study. However, it would improve reliability of the scale for measuring attitude dimensions if each dimension had several items with very heavy loadings (say, .6 or greater), and if dimension loadings were arrived at by averaging studies of different populations and attitude objects. Such a scale could give reliable measures of attitude dimensions for any kind of house and in any population.

# CHAPTER V

# SUMMARY AND CONCLUSIONS

## Summary of Findings

Attitudes toward earth shelter and passive solar houses were studied in a sample of 300 Stillwater, Oklahoma, homeowners. Half of the sample received a questionnaire about earth shelter houses, and half received one about passive solar houses. Of the 300 homeowners in the sample, usable responses were received from 207--108 from the earth shelter group and 99 from the passive solar group.

Both the earth shelter and passive solar questionnaires contained a general description of the type of house being studied, 35 items concerning beliefs about the houses, three questions about interest in the houses, and a question about how much the respondent had read about the houses. Also requested were: sex, age, household income, highest level of education in the household, and number of adults and children in the household. The mean score for the 35-item attitude scale was called Overall Mean Attitude, and the mean score for the three-item interest scale was called Overall Interest.

The earth shelter and passive solar groups were combined for factor analysis of the 35 attitude scale items to find dimensions underlying attitudes toward both kinds of houses. Eight attitude dimensions were identified, which explained 21 percent of the variance in attitudes toward the two kinds of houses. These dimensions can be thought of as product attributes, or evaluative criteria, on which energy-efficient houses are compared.

In order of how much variance they explained, the attitude dimensions were as follows: Ease of Living, Energy Efficiency, Ease of Ownership, Attractiveness, Comfort, Predictability of Energy Efficiency, Initial Cost, and Ease of Construction. Ease of Construction had by far the weakest relation to overall attitude, while Initial Cost had a notably weaker relation to overall attitude than did the other six dimensions.

Attitudes toward passive solar houses were slightly more favorable (significant at the .05 level) than attitudes toward earth shelter. On a scale running from 1 (unfavorable) to 5 (favorable), passive solar houses elicited an Overall Mean Attitude of 3.64, compared to 3.46 for earth shelter houses.

For the passive solar group, the only variable significantly related to Overall Mean Attitude was How Much Read. Persons who had read "a fair amount" (3.97 Overall Mean Attitude) or "much" (3.99) about passive solar houses were significantly more favorable than persons who had

read "a little" (3.55). Persons who had read "a fair amount" were also more favorable than persons who had read "nothing at all" (3.41).

For the earth shelter group, How Much Read, Age, and Household Income were all significantly related to Overall Mean Attitude. Persons who had read "a fair amount" (3.82 Overall Mean Attitude) about earth shelter houses had more favorable attitudes than those who had read "a little" (3.38) or "nothing at all" (3.21). Homeowners aged 34 or younger (3.71) and 35 to 44 (3.69) had more favorable attitudes toward earth shelter houses than those aged 55 or older (3.26). And homeowners with household incomes of $20,000 to $29,999 were more favorable toward earth shelter houses than those with incomes of less than $20,000 and $30,000 to $39,999.

Passive solar houses were perceived more favorably than earth shelter houses on four dimensions: Attractiveness, Energy Efficiency, Ease of Ownership, and Ease of Construction. The two highest rated dimensions for earth shelter houses were Ease of Living (3.65) and Energy Efficiency (3.54), and for passive solar houses were Energy Efficiency (3.82) and Attractiveness (3.67). The two lowest rated dimensions for earth shelter houses were Initial Cost (3.13) and Ease of Construction (3.08). Lowest for passive solar houses were Ease of Construction (3.21) and Initial Cost (3.13).

Passive solar houses were perceived more favorably than earth shelter houses on 15 attitude scale items:

Not difficult to resell
Acceptable to neighbors
Would like to see more
Enhances prestige
Would feel close to nature in
Will someday be common
Lessens dependence on utilities
Naturally appealing
Not difficult to build
Makes more self-sufficient
Building codes are no obstacle
Resale value will increase
Conserves energy
Structural problems not likely

Earth shelter houses were perceived more favorably than passive solar houses on three items: "Keeps steady temperature," "Proof of savings exists," and "No sacrifice in comfort."

The three highest rated attitude scale items for the earth shelter group were "Keeps steady temperature" (4.25), "Conserves energy" (4.13), and "Won't become obsolete" (4.07). The three highest rated items for the passive solar group were "Conserves energy" (4.47), "Lessens dependence on utilities" (4.22), and "Won't become obsolete" (4.04). The three items perceived least favorably by the earth shelter group were "Building codes are no obstacle" (2.82), "Enhances prestige" (2.69), and "Not difficult to resell" (2.66). For the passive solar group, the three least favorably perceived items were "Building codes are no obstacle" (3.21), "Not difficult to get worked on" (3.09), and "No extra initial cost" (2.64).

There was no significant difference between the earth shelter and passive solar groups on Overall Interest or on any of the three interest questions. Overall Interest scores for the earth shelter and passive solar groups were 3.94 and 4.04, respectively. On the question, "Would you look at information?", 86 percent of the homeowners in both groups answered either "probably yes" or "definitely yes." When asked, "Would you look at a model house?", 87 percent of both groups answered "probably" or "definitely" yes. And when asked if they would consider buying such a house, 51 percent of the earth shelter group and 62 percent of the passive solar group answered either "probably" or "definitely" yes.

## Implications for Marketing to Stillwater Homeowners

This attitude survey measured attitudes toward respondents' images of earth shelter and passive solar houses. Findings suggested how favorably Stillwater homeowners would behave toward the houses. However, actual examples of either type of house might be perceived much more favorably or less favorably than the images evaluated in this study. For houses perceived much differently, these findings would be less applicable.

Since Overall Mean Attitude and Overall Interest were favorable for both kinds of houses, the response of Stillwater homeowners to either kind probably would be

favorable. The houses probably would arouse much interest and be considered legitimate housing choices.

For both kinds of houses, most favorable response probably would be from homeowners who have read quite a bit about them. Consumer responses to earth shelter houses probably would be more favorable among homeowners under age 45 than those 55 and over, and more favorable in households with incomes of $20,000 to $29,999 than in those with incomes of less than $20,000 or $30,000 to $39,999.

The higher Overall Mean Attitude for passive solar houses indicated that general favorability of response would probably be higher for passive solar than for earth shelter. The difference was due primarily to beliefs that passive solar houses were more attractive, more energy-efficient, and less trouble to own. Passive solar houses also were considered easier to build, but that dimension had little effect on overall attitude.

The most important attributes of the houses for Stillwater homeowners were Ease of Living, Energy Efficiency, Ease of Ownership, and Attractiveness--all about equal in importance. A change in beliefs on one of those dimensions probably would have a greater effect on overall attitude than would a proportionate change on one of the other four dimensions.

## General Recommendations for Marketing and Promotion

A builder interested in marketing earth shelter or passive solar houses should do the following:

- Assess demand. Is there sufficient interest in the houses?

- Identify a target segment. What are the characteristics of consumers with the highest interest? What attributes besides energy efficiency are important to them? What are their preferences in style, location, price range, etc.?

- Design houses to meet the needs of the target segment.

- Measure attitudes toward his own houses and competing houses. What are the perceived advantages and disadvantages of his houses?

- Promote to increase the importance of attributes on which his houses are perceived favorably. The more important an attribute becomes, the more favorable are attitudes toward a product rated high on that attribute. Promotion to increase the importance of energy efficiency as an evaluative criterion will increase the demand for all energy-efficient houses.

- Promote to change beliefs where perceived disadvantages are based on wrong beliefs. A positive change in beliefs will cause a positive change in attitude.

- Change future designs to correct real disadvantages.

- Disseminate a large amount of information about the houses, through popular information sources and in an interesting form. The more consumers know about the houses, the more favorable their attitudes will be. Home buyers search extensively for information to reduce perceived risk. An unconventional house poses extra risk, because the consumer lacks experience with the product. A model home is a way to provide personal experience with a house. Unconventional houses have an advantage in getting media coverage, because their novelty makes them newsworthy.

- Maintain a public relations program to prevent or correct problems with financing, servicing, neighbors, building codes, zoning, etc. Also, advantage should be taken of any opportunities to get the support of local institutions or community groups.

- Keep customers satisfied after purchase. Personal reports from product users are an important source of information for shoppers, and can be even more important if the shopper lacks personal experience with the product. A way to help insure satisfaction with a house designed for energy efficiency is to understate the expected energy savings. Lower-than-expected energy savings is often the prime source of dissatisfaction.

- Stay abreast of changes in consumer attitudes, competitors' behavior, market conditions, and housing trends.

## Recommendations for Further Research

First, it is recommended that this factor analysis be repeated in different populations, and that similar studies be made using a variety of energy-efficient houses as attitude objects. Will the same dimensions emerge? What number of dimensions gives the most efficient explanation of differences in attitudes toward energy-efficient houses? Model homes of energy-efficient design or other actual houses would be good to use as attitude objects to see if dimensions or dimension importance would change if actual houses rather than images were evaluated.

Factor analyses might also be conducted using conventional houses as attitude objects. Such studies would show whether dimensions used by consumers to compare conventional houses are similar to those for energy-efficient houses. If the present attitude scale were used to study attitudes toward conventional houses, many items would need to be rewritten to eliminate phrases such as "compared to a conventional house." Also, it probably would be beneficial to add or subtract items to guard against a scale too heavily weighted toward energy efficiency.

Another area for research would be the further development of the present attitude scale. Adding new items might allow emergence of other important dimensions. Also, new items might turn up with heavy

dimension loadings. This would improve scale reliability and would help the researcher better identify specific beliefs that contribute most to favorability or unfavorability of dimension scores.

Ideally, a scale could be developed that measures attitudes toward houses on an optimum number of dimensions, with at least five or six heavily loaded items for each dimension. If items consistently loaded on the same dimensions, and if dimension loadings were averaged over studies of various houses, such a scale could be a standard tool for consumer evaluation of houses.

Studies also should address dimension importance. Are certain dimensions always more important than others in determining overall attitude? Is dimension importance related to other variables?

Comparison of attitudes toward earth shelter and passive solar houses should be made in other geographical areas and among groups other than homeowners. Groups whose attitudes are of value to study include home builders, lenders, building inspectors, appraisers, and real estate professionals.

Finally, studies should be made to determine the most important sources of information for home buyers in general, and for buyers of energy-efficient houses.

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# APPENDIX A

## EARTH SHELTER AND PASSIVE SOLAR QUESTIONNAIRES

# Earth Shelter Questionnaire

## QUESTIONNAIRE

This questionnaire is seeking your opinions about "earth shelter" design in single-family houses. How much you know about the subject is not important.

If you're not sure what an "earth shelter" house is, let me give a brief definition. An earth shelter house is a house covered by earth on one or more walls or the roof. It's really about the same thing as an underground house, but the term "earth shelter" has become popular in recent years because, among other reasons, it doesn't imply that the house has to be completely underground.

One kind of earth shelter house may have only a 4-foot bank of earth along the north wall, and another may be completely underground. Or another may be built into a hillside with only one wall and the roof exposed. Whatever design is used, the purpose of earth shelter design is to reduce energy requirements by modifying the temperature of the air reaching the earth-covered portion of the house and by reducing heat loss and air infiltration.

In responding to the statements about houses, just assume that the houses use some degree of earth sheltering.

Please respond to all 45 items -- 2 sheets, front and back. Don't be shy about marking the definitely" agree or disagree categories. If you really can't decide which category fits best, just pick one that's probably close. Your guess is much better than mine.

| For questions 1 thru 35 use the agree-disagree scale at the right. | Definitely Agree | Probably Agree | Don't Know | Probably Disagree | Definitely Disagree |
|---|---|---|---|---|---|
| 1. An earth shelter house would be a bad investment compared to a conventional house. | ___ | ___ | ___ | ___ | ___ |
| 2. Most homeowners would prefer not to have an earth shelter house in their own neighborhood. | ___ | ___ | ___ | ___ | ___ |
| 3. An earth shelter house would add to its owner's prestige in the community. | ___ | ___ | ___ | ___ | ___ |
| 4. There is no real proof that an earth shelter house can actually produce significant energy savings. | ___ | ___ | ___ | ___ | ___ |
| 5. The interior atmosphere of an earth shelter house would be more comfortable than that of a conventional house. | ___ | ___ | ___ | ___ | ___ |
| 6. Earth shelter houses are generally unattractive. | ___ | ___ | ___ | ___ | ___ |
| 7. Any extra initial cost for an earth shelter house will pay for itself in long-term energy savings. | ___ | ___ | ___ | ___ | ___ |
| 8. Building an earth shelter house would not be too difficult for any good builder. | ___ | ___ | ___ | ___ | ___ |
| 9. It is quite possible to build an earth shelter house that will require very little heating. | ___ | ___ | ___ | ___ | ___ |

(see other side)

| | Definitely Agree | Probably Agree | Don't Know | Probably Disagree | Definitely Disagree |
|---|---|---|---|---|---|
| 10. An earth shelter house is more likely than a conventional house to have a lot of minor maintenance problems. | ___ | ___ | ___ | ___ | ___ |
| 11. The initial cost of an earth shelter house would be much higher than a comparable conventional house. | ___ | ___ | ___ | ___ | ___ |
| 12. It would be more difficult to finance an earth shelter house than a conventional house. | ___ | ___ | ___ | ___ | ___ |
| 13. Earth shelter design in a house would add to its resale value in 10 years. | ___ | ___ | ___ | ___ | ___ |
| 14. Temperatures in an earth shelter house would fluctuate too much. | ___ | ___ | ___ | ___ | ___ |
| 15. An earth shelter house is more likely than a conventional house to have major structural problems. | ___ | ___ | ___ | ___ | ___ |
| 16. An earth shelter house is just not needed in this climate. | ___ | ___ | ___ | ___ | ___ |
| 17. The time and effort required for normal operation and maintenance of an earth shelter house would be much more than for a conventional house. | ___ | ___ | ___ | ___ | ___ |
| 18. There is something naturally appealing about the idea of living in an earth shelter house. | ___ | ___ | ___ | ___ | ___ |
| 19. An earth shelter house would be obsolete in 10 years. | ___ | ___ | ___ | ___ | ___ |
| 20. If I bought an earth shelter house, most of my friends and family would think I was being impractical. | ___ | ___ | ___ | ___ | ___ |
| 21. Living in an earth shelter house would require some sacrifice in comfort. | ___ | ___ | ___ | ___ | ___ |
| 22. Life would be less complicated in a conventional house than in an earth shelter house. | ___ | ___ | ___ | ___ | ___ |
| 23. An earth shelter house would be more difficult to resell than a conventional house. | ___ | ___ | ___ | ___ | ___ |
| 24. It's impossible to accurately estimate the energy requirements of an earth shelter house before it's built. | ___ | ___ | ___ | ___ | ___ |
| 25. A family living in an earth shelter house would be less dependent on utility companies than a family living in a conventional house. | ___ | ___ | ___ | ___ | ___ |
| 26. Living in an earth shelter house would make me feel closer to nature. | ___ | ___ | ___ | ___ | ___ |

| | Definitely Agree | Probably Agree | Don't Know | Probably Disagree | Definitely Disagree |
|---|---|---|---|---|---|
| 27. Local building codes would likely present serious obstacles to someone trying to build an earth shelter house. | ___ | ___ | ___ | ___ | ___ |
| 28. Earth shelter houses may someday be as common as conventional houses. | ___ | ___ | ___ | ___ | ___ |
| 29. An earth shelter house would make its owners more self-sufficient. | ___ | ___ | ___ | ___ | ___ |
| 30. On the average, the quality of construction of earth shelter houses is likely to be lower than that of conventional houses. | ___ | ___ | ___ | ___ | ___ |
| 31. The natural heating of an earth shelter house would be more healthy than conventional heating methods. | ___ | ___ | ___ | ___ | ___ |
| 32. The owner of an earth shelter house is contributing more to energy conservation than the owner of a conventional house. | ___ | ___ | ___ | ___ | ___ |
| 33. It would be more difficult to get repair or service work done on an earth shelter house than on a conventional house. | ___ | ___ | ___ | ___ | ___ |
| 34. I would be pleased if a greater proportion of new houses were earth shelter houses. | ___ | ___ | ___ | ___ | ___ |
| 35. I don't think I could ever feel as much at home in an earth shelter house as I could in a conventional house. | ___ | ___ | ___ | ___ | ___ |

| For questions 36 thru 38 use the yes-no scale at the right. | Definitely Yes | Probably Yes | Don't Know | Probably No | Definitely No |
|---|---|---|---|---|---|
| 36. Would you look at information on earth shelter houses if you came across it in your newspaper, magazines or mail? | ___ | ___ | ___ | ___ | ___ |
| 37. Would you go to see a model earth shelter house if there was one in your community? | ___ | ___ | ___ | ___ | ___ |
| 38. Would you consider buying an earth shelter house if you were looking for a new house? | ___ | ___ | ___ | ___ | ___ |

39. How much have you read about earth shelter houses?

___ nothing at all
___ a little
___ a fair amount
___ much

(see other side)

40. What is your sex?

___ male
___ female

41. What is your age?

___ 34 or younger
___ 35 to 44
___ 45 to 54
___ 55 or older

42. What is your yearly household income?

___ less than $10,000
___ $10,000 to $19,999
___ $20,000 to $29,999
___ $30,000 to $39,999
___ $40,000 or more

43. What is the highest education level of any person in your current household?

___ high school graduate or less
___ at least 60 credit hours of college work but no degree
___ bachelor's degree
___ master's degree or more

44. How many adults are members of this household?

___ yourself only
___ yourself and your spouse only
___ other (at least one other adult who is not your spouse or your child)

45. How many children 18 or younger are members of this household?

___ none
___ one
___ two
___ three or more

# Passive Solar Questionnaire

## QUESTIONNAIRE

This questionnaire is seeking your opinions about "passive solar" design in single-family houses. How much you know about the subject is not important.

If you're not sure what "passive solar" is, first I should explain that not all solar energy systems are passive solar systems. What many people think of when they think of solar energy is an "active" solar system -- it uses mechanical (or "active") devices such as pumps, fans and blowers to circulate air or water which is heated in solar panels attached to the house.

"Passive" solar is a name for a number of design techniques to allow a building to collect, store and circulate heat from the sun by using only natural (or "passive") methods -- convection, conduction and radiation. Basically, it involves placing glass on the south side of the house to let the winter sun in and building substantial mass into the interior of the house (for instance, a thick wall of concrete, stone or adobe) to absorb and store the heat for night-time use.

One kind of passive solar house may let sunlight directly into rooms through south windows, and another may use an attached greenhouse or sunroom to collect the heat. Or another may not use south windows, but collect heat in the south wall itself by placing glass in front of it. Whatever design is used, the purpose of passive solar design is to reduce energy requirements by using heat from the sun.

In responding to the statements about houses, assume that the houses use some form of passive solar design but do not use active solar systems.

Please respond to all 45 items -- 2 sheets, front and back. Don't be shy about marking the "definitely" agree or disagree categories. If you really can't decide which category fits best, just pick one that's probably close. Your guess is much better than mine.

| For questions 1 thru 35 use the agree-disagree scale at the right. | Definitely Agree | Probably Agree | Don't Know | Probably Disagree | Definitely Disagree |
|---|---|---|---|---|---|
| 1. A passive solar house would be a bad investment compared to a conventional house. | ___ | ___ | ___ | ___ | ___ |
| 2. Most homeowners would prefer not to have a passive solar house in their own neighborhood. | ___ | ___ | ___ | ___ | ___ |
| 3. A passive solar house would add to its owner's prestige in the community. | ___ | ___ | ___ | ___ | ___ |
| 4. There is no real proof that a passive solar house can actually produce significant energy savings. | ___ | ___ | ___ | ___ | ___ |
| 5. The interior atmosphere of a passive solar house would be more comfortable than that of a conventional house. | ___ | ___ | ___ | ___ | ___ |
| 6. Passive solar houses are generally unattractive. | ___ | ___ | ___ | ___ | ___ |

(see other side)

| | Definitely Agree | Probably Agree | Don't Know | Probably Disagree | Definitely Disagree |
|---|---|---|---|---|---|
| 7. Any extra initial cost for a passive solar house will pay for itself in long-term energy savings. | ___ | ___ | ___ | ___ | ___ |
| 8. Building a passive solar house would not be too difficult for any good builder. | ___ | ___ | ___ | ___ | ___ |
| 9. It is quite possible to build a passive solar house that will require very little heating. | ___ | ___ | ___ | ___ | ___ |
| 10. A passive solar house is more likely than a conventional house to have a lot of minor maintenance problems. | ___ | ___ | ___ | ___ | ___ |
| 11. The initial cost of a passive solar house would be much higher than a comparable conventional house. | ___ | ___ | ___ | ___ | ___ |
| 12. It would be more difficult to finance a passive solar house than a conventional house. | ___ | ___ | ___ | ___ | ___ |
| 13. Passive solar design in a house would add to its resale value in 10 years. | ___ | ___ | ___ | ___ | ___ |
| 14. Temperatures in a passive solar house would fluctuate too much. | ___ | ___ | ___ | ___ | ___ |
| 15. A passive solar house is more likely than a conventional house to have major structural problems. | ___ | ___ | ___ | ___ | ___ |
| 16. A passive solar house is just not needed in this climate. | ___ | ___ | ___ | ___ | ___ |
| 17. The time and effort required for normal operation and maintenance of a passive solar house would be much more than for a conventional house. | ___ | ___ | ___ | ___ | ___ |
| 18. There is something naturally appealing about the idea of living in a passive solar house. | ___ | ___ | ___ | ___ | ___ |
| 19. A passive solar house would be obsolete in 10 years. | ___ | ___ | ___ | ___ | ___ |
| 20. If I bought a passive solar house, most of my friends and family would think I was being impractical. | ___ | ___ | ___ | ___ | ___ |
| 21. Living in a passive solar house would require some sacrifice in comfort. | ___ | ___ | ___ | ___ | ___ |
| 22. Life would be less complicated in a conventional house than in a passive solar house. | ___ | ___ | ___ | ___ | ___ |
| 23. A passive solar house would be more difficult to resell than a conventional house. | ___ | ___ | ___ | ___ | ___ |

| | Definitely Agree | Probably Agree | Don't Know | Probably Disagree | Definitely Disagree |
|---|---|---|---|---|---|
| 24. It's impossible to accurately estimate the energy requirements of a passive solar house before it's built. | ___ | ___ | ___ | ___ | ___ |
| 25. A family living in a passive solar house would be less dependent on utility companies than a family living in a conventional house. | ___ | ___ | ___ | ___ | ___ |
| 26. Living in a passive solar house would make me feel closer to nature. | ___ | ___ | ___ | ___ | ___ |
| 27. Local building codes would likely present serious obstacles to someone trying to build a passive solar house. | ___ | ___ | ___ | ___ | ___ |
| 28. Passive solar houses may someday be as common as conventional houses. | ___ | ___ | ___ | ___ | ___ |
| 29. A passive solar house would make its owners more self-sufficient. | ___ | ___ | ___ | ___ | ___ |
| 30. On the average, the quality of construction of passive solar houses is likely to be lower than that of conventional houses. | ___ | ___ | ___ | ___ | ___ |
| 31. The natural heating of a passive solar house would be more healthy than conventional heating methods. | ___ | ___ | ___ | ___ | ___ |
| 32. The owner of a passive solar house is contributing more to energy conservation than the owner of a conventional house. | ___ | ___ | ___ | ___ | ___ |
| 33. It would be more difficult to get repair or service work done on a passive solar house than on a conventional house. | ___ | ___ | ___ | ___ | ___ |
| 34. I would be pleased if a greater proportion of new houses were passive solar houses. | ___ | ___ | ___ | ___ | ___ |
| 35. I don't think I could ever feel as much at home in a passive solar house as I could in a conventional house. | ___ | ___ | ___ | ___ | ___ |

| For questions 36 thru 38 use the yes-no scale at the right. | Definitely Yes | Probably Yes | Don't Know | Probably No | Definitely No |
|---|---|---|---|---|---|
| 36. Would you look at information on passive solar houses if you came across it in your newspaper, magazines or mail? | ___ | ___ | ___ | ___ | ___ |
| 37. Would you go to see a model passive solar house if there was one in your community? | ___ | ___ | ___ | ___ | ___ |
| 38. Would you consider buying a passive solar house if you were looking for a new house? | ___ | ___ | ___ | ___ | ___ |

39. How much have you read about passive solar houses?

___ nothing at all
___ a little
___ a fair amount
___ much

40. What is your sex?

___ male
___ female

41. What is your age?

___ 34 or younger
___ 35 to 44
___ 45 to 54
___ 55 or older

42. What is your yearly household income?

___ less than $10,000
___ $10,000 to $19,999
___ $20,000 to $29,999
___ $30,000 to $39,999
___ $40,000 or more

43. What is the highest education level of any person in your current household?

___ high school graduate or less
___ at least 60 credit hours of college work but no degree
___ bachelor's degree
___ master's degree or more

44. How many adults are members of this household?

___ yourself only
___ yourself and your spouse only
___ other (at least one other adult who is not your spouse or your child)

45. How many children 18 or younger are members of this household?

___ none
___ one
___ two
___ three or more

# APPENDIX B

## ROTATED FACTOR MATRIX

TABLE IX

ROTATED FACTOR MATRIX

| Item** | Factor Loadings* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | F1 | F2 | F3 | F4 | F5 | F6 | F7 | F8 | $h^{2}$+ |
| 1 | 47 | -13 | 22 | 34 | 05 | -32 | 39 | 00 | .657 |
| 2 | 11 | -20 | 43 | 13 | -05 | -04 | 63 | -13 | .674 |
| 3 | -01 | 14 | -07 | 22 | -05 | 13 | 68 | -04 | .563 |
| 4 | 46 | -16 | 15 | 18 | -10 | -06 | 13 | 45 | .548 |
| 5 | 21 | 72 | 15 | 14 | 00 | -01 | 08 | -09 | .620 |
| 6 | 29 | 15 | 23 | 02 | 15 | 03 | 61 | 30 | .648 |
| 7 | 48 | 04 | 14 | 52 | 07 | 16 | 04 | -18 | .588 |
| 8 | -04 | -03 | 15 | 17 | 19 | 77 | 15 | 06 | .703 |
| 9 | 38 | 02 | 04 | 49 | -12 | 34 | 01 | 07 | .520 |
| 10 | 40 | -02 | 19 | 22 | 42 | -33 | 10 | 22 | .596 |
| 11 | 23 | 09 | 13 | 09 | 75 | 18 | 00 | 00 | .676 |
| 12 | 14 | 09 | 74 | 14 | 08 | 03 | -01 | 11 | .613 |
| 13 | 28 | 09 | 32 | 39 | -33 | 31 | 28 | -16 | .651 |
| 14 | 79 | 20 | -06 | 05 | 06 | 04 | -19 | 08 | .720 |
| 15 | 46 | -03 | 37 | 10 | 20 | 16 | 37 | 06 | .560 |
| 16 | 61 | 26 | 28 | 21 | 12 | -07 | 22 | 12 | .647 |
| 17 | 73 | -01 | 03 | 12 | 23 | 01 | 24 | 01 | .655 |
| 18 | 06 | 53 | 05 | 31 | 10 | 03 | 46 | 19 | .641 |
| 19 | 48 | 17 | 33 | 31 | 10 | 11 | 14 | 15 | .524 |
| 20 | 35 | 08 | 60 | 06 | 01 | -02 | 15 | 13 | .535 |
| 21 | 49 | 47 | 23 | 14 | 11 | 01 | 02 | 25 | .606 |
| 22 | 69 | 29 | 20 | 02 | 14 | 05 | 14 | 06 | .648 |
| 23 | 09 | 19 | 55 | 30 | 16 | -01 | 29 | 01 | .546 |
| 24 | 18 | 07 | 27 | 18 | 08 | 06 | 01 | 72 | .675 |
| 25 | 06 | -02 | 04 | 66 | 10 | 16 | -01 | 28 | .559 |
| 26 | 08 | 30 | -06 | 54 | -16 | 10 | 32 | 19 | .560 |
| 27 | 13 | 09 | 70 | 11 | -24 | 07 | 04 | 07 | .594 |
| 28 | 07 | 23 | 11 | 46 | -03 | 13 | 37 | -16 | .455 |
| 29 | 07 | 07 | 14 | 73 | 07 | 08 | 20 | 20 | .651 |
| 30 | 58 | -02 | 22 | -06 | -27 | -19 | 07 | 05 | .501 |
| 31 | 15 | 30 | 11 | 54 | 20 | -24 | 05 | -26 | .589 |
| 32 | -01 | 06 | 27 | 63 | 06 | -18 | 18 | 04 | .544 |
| 33 | 02 | 00 | 63 | 02 | 33 | 07 | 09 | 08 | .521 |
| 34 | 26 | 28 | 26 | 43 | -01 | -09 | 46 | 09 | .619 |
| 35 | 38 | 29 | 34 | 15 | -04 | -06 | 41 | 29 | .625 |

Note: Decimals have been omitted from factor loadings.

+Communality; proportion of variance in item score explained by all factors.

*Factors: F1=Ease of Living, F2=Comfort, F3=Ease of Ownership, F4=Energy Efficiency, F5=Initial Cost, F6=Ease of Construction, F7=Attractiveness, F8=Predictability of Energy Efficiency.

**Attitude scale items are shown in Appendix A.

# APPENDIX C

## ANALYSIS OF VARIANCE TABLES

TABLE X

ONE-WAY ANOVA FOR LEVELS OF HOW MUCH READ FOR EARTH SHELTER GROUP

| Source | df | SS | MS | F | P< |
|---|---|---|---|---|---|
| Between Levels of How Much Read | 3 | 3.95 | 1.32 | 4.40 | .006 |
| Within (error) | 104 | 31.12 | .30 | | |
| Total | 107 | 35.07 | | | |

TABLE XI

ONE-WAY ANOVA FOR LEVELS OF AGE FOR EARTH SHELTER GROUP

| Source | df | SS | MS | F | P< |
|---|---|---|---|---|---|
| Between Levels of Age | 3 | 4.32 | 1.44 | 4.88 | .003 |
| Within (error) | 104 | 30.74 | .30 | | |
| Total | 107 | 35.07 | | | |

TABLE XII

ONE-WAY ANOVA FOR LEVELS OF HOUSEHOLD INCOME FOR EARTH SHELTER GROUP

| Source | df | SS | MS | F | P< |
|---|---|---|---|---|---|
| Between Levels of Household Income | 4 | 3.10 | .78 | 2.48 | .048 |
| Within (error) | 102 | 31.94 | .31 | | |
| Total | 106 | 35.04 | | | |

TABLE XIII

ONE-WAY ANOVA FOR LEVELS OF HOW MUCH READ FOR PASSIVE SOLAR GROUP

| Source | df | SS | MS | F | P< |
|---|---|---|---|---|---|
| Between Levels of How Much Read | 3 | 4.04 | 1.35 | 3.82 | .012 |
| Within (error) | 94 | 33.18 | 35 | | |
| Total | 97 | 37.23 | | | |

TABLE XIV

TWO-WAY ANOVA (TREATMENTS BY SUBJECTS) FOR EARTH SHELTER ATTITUDE SCALE ITEMS BY EARTH SHELTER SUBJECTS

| Source | df | SS | MS | F | P< |
|---|---|---|---|---|---|
| Between Items | 34 | 709.60 | 20.87 | 22.75 | .0001 |
| Between Subjects | 107 | 1227.28 | 11.47 | 12.51 | .0001 |
| Residual (error) | 3638 | 3336.86 | .92 | | |
| Total | 3779 | 5273.74 | | | |

TABLE XV

TWO-WAY ANOVA (TREATMENTS BY SUBJECTS) FOR PASSIVE SOLAR ATTITUDE SCALE ITEMS BY PASSIVE SOLAR SUBJECTS

| Source | df | SS | MS | F | P< |
|---|---|---|---|---|---|
| Between Items | 34 | 450.45 | 13.25 | 14.81 | .0001 |
| Between Subjects | 98 | 1303.49 | 13.30 | 14.87 | .0001 |
| Residual (error) | 3332 | 2980.01 | .89 | | |
| Total | 3464 | 4733.94 | | | |

# VITA

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