GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION
SPONSORED PROJECT INITIATION

Date: June 17, 1976

Project Title: Advantage of Rugs and Carpeting in Energy Conservation in Residential and Commercial Structures

Project No: A-1846 (Sub-project E-27-643/T.E./Dr. L. H. Olsen

Project Director: Mr. J. L. Birchfield

Sponsor: Carpet and Rug Institute, Inc.

Agreement Period: From May 17, 1976 Until September 16, 1976

Type Agreement: Standard Industrial Research Agreement dated 4/14/76

Amount: $8,221 (Total Authorized Funding $19,707; $11,846 budgeted in Sub-project E-27-643/Olsen)

Reports Required: Final Report

Sponsor Contact Person (s):

Technical Matters

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Contractual Matters
(thru OCA)

Same as Technical

Defense Priority Rating: None

Assigned to: Productivity & Technology Applications (School/Laboratory)

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SPONSORED PROJECT TERMINATION

Date: June 29, 1977

Project Title: Advantage of Rugs and Carpeting in Energy Conservation in Residential and Commercial Structures

Project No: A-1846 (Sub-project D-27-643/TE/Olson)

Project Director: Mr. J. L. Birchfield

Sponsor: Carpet and Rug Institute, Inc.

Effective Termination Date: 12/15/76

Clearance of Accounting Charges: 12/31/76

Grant/Contract Closeout Actions Remaining: NONE

_ Final Invoice and Closing Documents
_ Final Fiscal Report
_ Final Report of Inventions
_ Govt. Property Inventory & Related Certificate
_ Classified Material Certificate
_ Other _____

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ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

July 21, 1976

The Carpet and Rug Institute
310 South Holiday Drive
Dalton, Georgia 30720

Attention: Mr. Barry Torrence
Director of Technical Services

Subject: Project A-1846 - "Advantage of Rugs and Carpeting in Energy Conservation in Residential and Commercial Structures"

Monthly Status Report

Gentlemen:

A meeting with representatives of the CRI technical review committee was held on June 23rd to confirm the selection of carpet samples to be used for conductivity testing. A majority of these samples have been received and initial physical testing completed in preparation for the conductivity tests which will be carried out by an independent testing firm (Dynatech R & D Co., Cambridge, Massachusetts). These samples were misnumbered and are being held for a short while before shipping to enable (1) renumbering of carpet samples and (2) confirmation that the samples are correct and valid according to the review committee's selection. Testing of samples will continue at Georgia Tech concurrently with the conductivity testing being done externally.

Work on computer simulation of residential heating requirements is progressing on schedule. Tabulated data values which will be used for evaluation of overall heat load and fuel cost have been selected. The selection was based upon five heating zones defined by the National Bureau of Standards using three major cities from each of these zones. The output will cover the full range of heating season energy requirements formed in the continental United States.

Sincerely,

Richard S. Combes
Assistant Research Engineer

cc: J. Birchfield
Dr. H. Olson

A-1846

1 of

ADVANTAGES

of

CARPET & RUGS

in

ENERGY CONSERVATION

ADVANTAGES OF CARPET AND RUGS IN ENERGY CONSERVATION

prepared for: Carpet and Rug Institute

by: Jerry L. Birchfield
Richard S. Combes
Engineering Experiment Station

L. Howard Olson
School of Textile Engineering
Georgia Institute of Technology

November 1976

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ACKNOWLEDGEMENTS

The guidance of the Carpet and Rug Institute Thermal Subcommittee in selecting carpets representative of those currently on the market and the assistance of Mr. Barry Torrence, technical representative from CRI, in obtaining carpet samples if most appreciated by the Georgia Tech research team conducting this project. Members of the CRI Thermal Subcommittee are as follows:

Mr. Bob Dawson, E. T. Barwick, Chairman

Mr. Murray Hall, Carpet Manufacturers Association of the West

Dr. Jim Hendrix, Deering Milliken

Mr. Dexter Ware, American Cyanamid, Man-Made Fiber Producers Association

Mr. John Maguire, Carpet Yarn Association

Mr. Bob Cannon, Trend Carpets

Mr. Roger McNamara, WestPoint Pepperell, American Textile Manufacturers Institute

Mr. Mac Jenkins, Dixie Manufacturing, Carpet Cushion Council

Mr. Barry Torrence, Carpet and Rug Institute

Sponsors of this program were as follows:

American Textile Manufacturers Institute

Carpet and Rug Institute

Carpet Cushion Council

Carpet Manufacturers Association of the West

Carpet Yarn Association

Man-Made Fiber Producers Association

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I. SUMMARY

In today's energy-conscious society, the American consumer is becoming increasingly aware of the value of products from the standpoint of energy efficiency. This study was initiated by member organizations of the carpet and rug industry to investigate the potential of carpet and underlayment in reducing energy requirements, and consequently reducing utility costs of residential and light commercial buildings.

The results of the program demonstrate that carpeting is of value as a floor insulation material. Thermal tests of selected carpet samples indicate that the best carpet-pad combination tested will reduce floor heat loss by as much as 54% when installed on an uninsulated wood floor over a ventilated crawl space, and by as much of 72% when installed on an uninsulated, exposed edge concrete slab on grade.

The percentage of energy saved due to carpet insulation relative to energy requirements for an entire structure is dependent on the configuration of the structure. Overall percentage savings are reported for several different types of structures in differing climates and with a range of carpets of thermal resistance. In all cases, carpeting was found to provide insulation value for any installation on a floor surface exposed to outside temperatures. In extreme climates, the dollar value of this insulation effect can be significant. The insulation value of a carpet was found to be proportional to its thickness and pile density.

II. INTRODUCTION

In recent years, the impact of increasing energy costs has emphasized the need for a reevaluation of the efficiency with which energy is utilized. The residential sector of the American society currently consumes approximately 12% of the nation's total annual energy consumption for space heating and air conditioning. It has been proven that a significant amount of the energy consumed for residential heating and cooling can be eliminated by improving the thermal insulation of the structure. Ideally, all structural components of a residence exposed to the temperature of the air outside the residence should be insulated.

This report evaluates the effectiveness of carpet and carpet underlayment as a floor insulation. Since insulation is of value only when installed on a surface which is exposed to a higher temperature on one side and a lower temperature on the other side, only carpet installations on floors at ground level will be addressed. The types of carpet installations which were chosen for evaluation are:

1. Carpet or carpet underlayment combinations installed on a wooden floor over a ventilated crawl space,
2. Carpet or carpet underlayment combination installed on a concrete slab laid on grade.

The maximum value of the carpet as thermal insulation is evaluated by assuming no previously installed insulation on the floors.

In order to determine the insulating properties of carpet and underlayment, carpet and underlayment samples representative of products which were being marketed at the time of this report were selected for testing. The selection of the samples was made by members of the Thermal Subcommittee of the Carpet and Rug Institute. The selected samples were then tested by Dynatech, Inc. of Cambridge, Mass., an independent testing laboratory, to determine the thermal conductance of each sample. The effectiveness of the samples for reducing energy requirements for heating and cooling a residence or a small commercial building was then evaluated by using a computer simulation of a typical structure and by estimating the energy savings due to carpet installation for an annual heating season for 15 different cities in the U.S.

Energy savings during a cooling season due to carpet installation were estimated for different floor areas in nine cities. The estimated values of energy savings for both heating and cooling seasons were then converted into dollar savings using utility rates in effect during August, 1976.

III. TECHNICAL APPROACH

General

The program to evaluate carpet as a floor insulation was divided into three phases:

1. Selection of carpet and underlayment samples which would be representative of currently marketed products.
2. Testing of selected carpet and underlayment samples to determine physical and thermal characteristics, and
3. Computer simulation of heat transfer in residential and light commercial structures to estimate energy and cost savings resulting from installation of carpets.

Each of these program phases is discussed in detail below.

Carpet Selection

The Carpet and Rug Institute Thermal Subcommittee assumed a major portion of the responsibility for carpet sample selection and provided the samples used for this project. An experimental design was formulated which permitted comparison of the major variables of carpet construction potentially affecting thermal properties, which are as follows:

1. carpet style (or texture)
2. fiber type
3. pile height
4. pile weight
5. tufts per square inch
6. yarn type
7. secondary backing type

The purpose of the selection process was to group carpets in coherent categories which then permitted thermal properties of the carpets to be related to construction properties.

For example, Table 1 shows the selection matrix for carpet style and fiber type. Of primary importance to this selection process was that carpets typical of those found on the current market be selected.

Table 1.

Carpet Style vs. Fiber Type

Fiber Type	Level Loop	Cut Loop (plush)	High-low Loop (tip sheared)	Shag	Saxony
Nylon	X	X	X	X	X
Acrylic	X	X			
Wool		X			
Polyester		X	X		
Polypropylene	X				

Within groups, there was further breakdown with respect to pile height, pile weight and tufts per square inch. Since these latter variables are to some extent interrelated, complete independence of a variable pair such as pile weight versus tufts per square inch was not obtained. Nevertheless, as Table 2 indicates, variations within each variable was permitted by the use of comparison groups which may be identified as follows:

I. Yarn and fiber type, and carpet style constant; vary pile height, weight and tufts per square inch.

II. Yarn type, fiber type, carpet style, pile height, pile weight and tufts per square inch constant; vary secondary backing type.

III. Fiber type and pile weight constant; vary carpet style

IV. Carpet style (and pile weight) constant; vary fiber type

V. Yarn type and pile weight constant; vary tufts per square inch.

For practical reasons, the term constant as it is used above, means of small magnitude relative to other changes. One of the considerations during carpet selection was that all samples be of typical current production inventory rather than special short runs during which production parameters affecting carpet properties may be unstable. Using this criteria, variable values were chosen to be as near the ideal value as possible.

Representative carpet underlayments of five types were selected: prime urethane, slab rubber, waffled sponge rubber, coated combination fiber pad, and bonded urethane. In later testing and simulation, the thermal transmittance of the pads was determined, as were the contribution to heat loss reduction when used with a carpet.

Table 2

Carpet Construction Design Specifications

Sample No.	Comparison Group	Fiber Type	Yarn Type	Style	PH	PW	GA.	SPI	Tufts/In^2 SPI/GA
1	I	Nylon	CF	LL	.125	10	1/10	8.0	80
2	I	Nylon	CF	LL	.109	20	1/8	6.0	48
3	I	Nylon	CF	LL	.192	28	1/8	8.4	67.2
4	I & III	Nylon	CF	LL	.125	24	1/10	8.6	86
5	III	Nylon	S	PLUSH	.250	24	1/8	11.0	88
6	III	Nylon	CF	HLL		24	5/32	8.6	55
7	III	Nylon	CF	SHAG	1.07	24	3/16	5.2	27.7
8	II & V	Acrylic	S	LL	.210	42	1/10	8.0	80
9	II & V	Acrylic	S	LL(FB)	.210	42	1/10	8.0	80
10	V	Polyester	S	PLUSH	.280	42	5/32	8.5	54.4
11	V	Polyester	S	HLL		42	5/32	8.5	54.4
12	V	Nylon	S	Saxony	.552	40	3/16	5.5	29.3
13		Nylon	CF	Shag	1.25	43	3/16	4.2	22.4
14	IV & V	Wool	S	Plush	.487	43	5/32	7.0	44.8
15	IV	Nylon	S	Plush	.812	58	1/8	10.0	80
16	IV	Acrylic	S	Plush	.688	53	5/32	9.0	57.6
17	V	Acrylic	S	Plush	.530	44	3/16	8.25	44
18		Polypropylene	CF	LL		20			

Legend:

PH = Pile height, inches
PW = Pile weight, oz./sq.yd.
GA = Machine guage, inches laternal tuft separation
SPI = Stitches per inch (lengthwise)
LL = Level loop
HLL = High-low loop (tip sheared)
FB = Attached foam back
S = Spun yarn
CF = Continuous filament yarn

Table 2A
Underlayment Constructions

Sample Description	Total Thickness, Inches	Total Weight, oz/sq.yd.
Prime Urethane 3/8" 2.2 Pound Density	0.40	10.3
Slab Rubber	0.23	62.0
48 oz. Waffled Sponge Rubber	0.43	49.2
56 oz. Coated Combination Hair and Jute	0.44	52.6
Bonded Urethane 1/2" 4.0 Pound Density	0.50	

Carpet Testing

In order to establish the physical characteristics of the carpeting samples prior to thermal transmittance testing of carpets, the total height and total weight of the various samples was determined by using lots of 10 specimens taken from regions near the thermal test sample. Then, each lot of 10 specimens was sheared down to the primary backing and a second measurement of height and weight taken. The difference between these measurements represents pile height and weight above the primary backing. Past experience in thermal characteristics of materials indicated to the CRI and Georgia Tech groups that pile height and density variations would have much greater effect on thermal transmittance than the variations found in backings, with the exception of attached foam backings which must be treated separately.

Carpet height measurements were made with a traveling microscope to avoid the problems of pile deformation and measurement repeatability associated with presser foot type instruments. Carpet weight was measured on a laboratory balance.

Thermal transmittance testing was carried out by Dynatech R & D Company, Inc., an independent testing firm, preeminent in the field of thermal conductivity testing and the largest in the world in this field. The test method used was ASTM C518 for determining thermal transmittance. Replication testing of fifteen specimens showed that measurement differences were on the order of 1-2%; thus further samples were evaluated using only one specimen.

The test conditions included a half-inch air gap above the carpet for which the Grashof number (1) indicated negligible convective heat flow. Thus, the measured resistance of the air gap could be subtracted from overall thermal resistance of carpet plus air gap to yield the carpet thermal resistance. By this means, carpet pile deformation was avoided.

The test was configured such that the heat flow direction was downward from a hot plate above the pile to the cold plate below the carpet. The thermal resistance of the air gap was measured to be R = 0.67, which agrees well with past experience at Dynatech for the thermal resistance of air.

Types of Carpet Installations

The benefits resulting from installation of carpet on a floor will vary over a wide range depending on the thermal characteristics of the floor. Factors affecting the magnitude of energy savings due to carpet installation include existing levels of floor insulation, type of furnace and duct work installation, temperature maintained in the structure, outside temperature variation for a geographic location, etc.

1. Wood floor over vented crawl space

   For the case of carpet installed on a wooden floor, the floor was constructed with a plywood subfloor and hardwood flooring supported by wood floor joists over a vented crawl space. See Figure I. Evaluation of this type of floor was made based on the following assumptions:

   a. No floor insulation other than carpet,
   b. The temperature difference between the inside floor surface and the crawl space is approximately 50% of the difference between the temperature maintained inside the structure and the outside air temperature during a heating season, and
   c. The temperature difference between the inside floor surface and the crawl space was assumed to be the equivalent temperature difference listed in the ASHRAE Handbook of Fundamentals, 1972 edition, for residential air conditioning load evaluation, based on the outside design temperature.

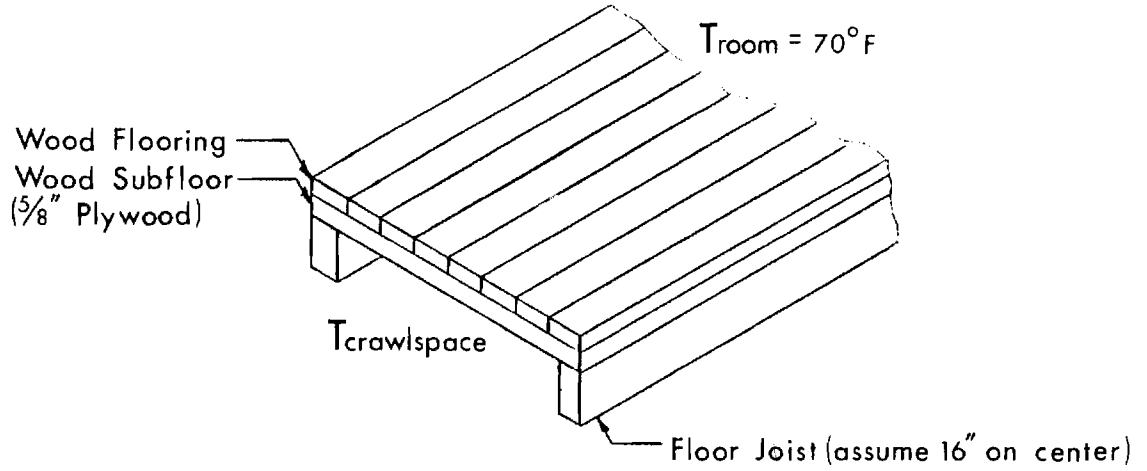
2. Concrete slab on grade

   For the case of carpet installed on a concrete slab, the evaluation was based on the following assumptions:

   a. The perimeter edge of the slab was above finished grade (see Figure I)
   b. The edge of the slab was not insulated,
   c. The heat loss from the slab was proportional to the perimeter of the slab, and
   d. There is negligible heat gain through the slab during a cooling season.

FLOOR TYPES

A. Wood floor over vented crawlspace



B. Slab on grade

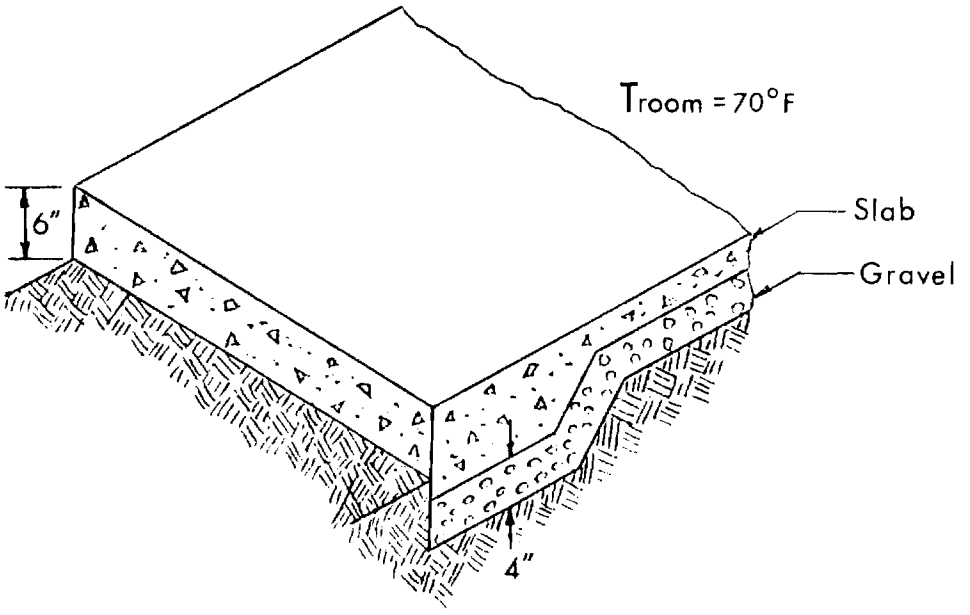


Fig. I

The effects of variations in the thermal characteristics of carpet were accounted for by using a range of carpet thermal resistance values obtained from the thermal tests of the selected samples. The R-values ($hr\text{-}ft^2\text{-}F^o/BTU$) chosen as representative values of the tested samples were 1.0, 2.0, 3.0 and 4.0. The results of the thermal testing of the carpet samples is presented in Section II.

Types of Structures

Two different characteristic structures were chosen to be evaluated with the two floor types discussed above.

1. Residential Structure

   The characteristics of the residential structure evaluated include frame construction, uninsulated walls, insulated attics, infiltration rate equal to one air change per hour, and either concrete slab or wood floors. See Appendix A. The sizes of residential structures chosen to be evaluated were 1000, 1500, 2000, 3000 and 4000 square feet of living area. Four types of floor plans were selected to account for variability of heat loss from the floor due to variations in structural configuration for any one value of floor area. The selected floor plans are:

   a. One-story square - the entire floor area is subject to heat loss.
   b. Two-story square - One half of the floor area is subject to heat loss.
   c. One-story rectangular - Same as one-story square, but perimeter is 6% larger for same floor area.
   d. Ell-shaped - Same as one-story square, but perimeter is 15.5% larger for same floor area.

2. Commercial Structure

   The characteristics of the commercial structures evaluated include concrete block walls with brick veneer, built-up roof with insulation, concrete slab on grade floors, and infiltration equal to one air change per hour. See Appendix A. The sizes of commercial structures chosen for evaluation were 5000, 10,000 and 20,000 square feet of area. The types of floor plans evaluated were two-story square and ell-shaped.

Heating Season Simulation

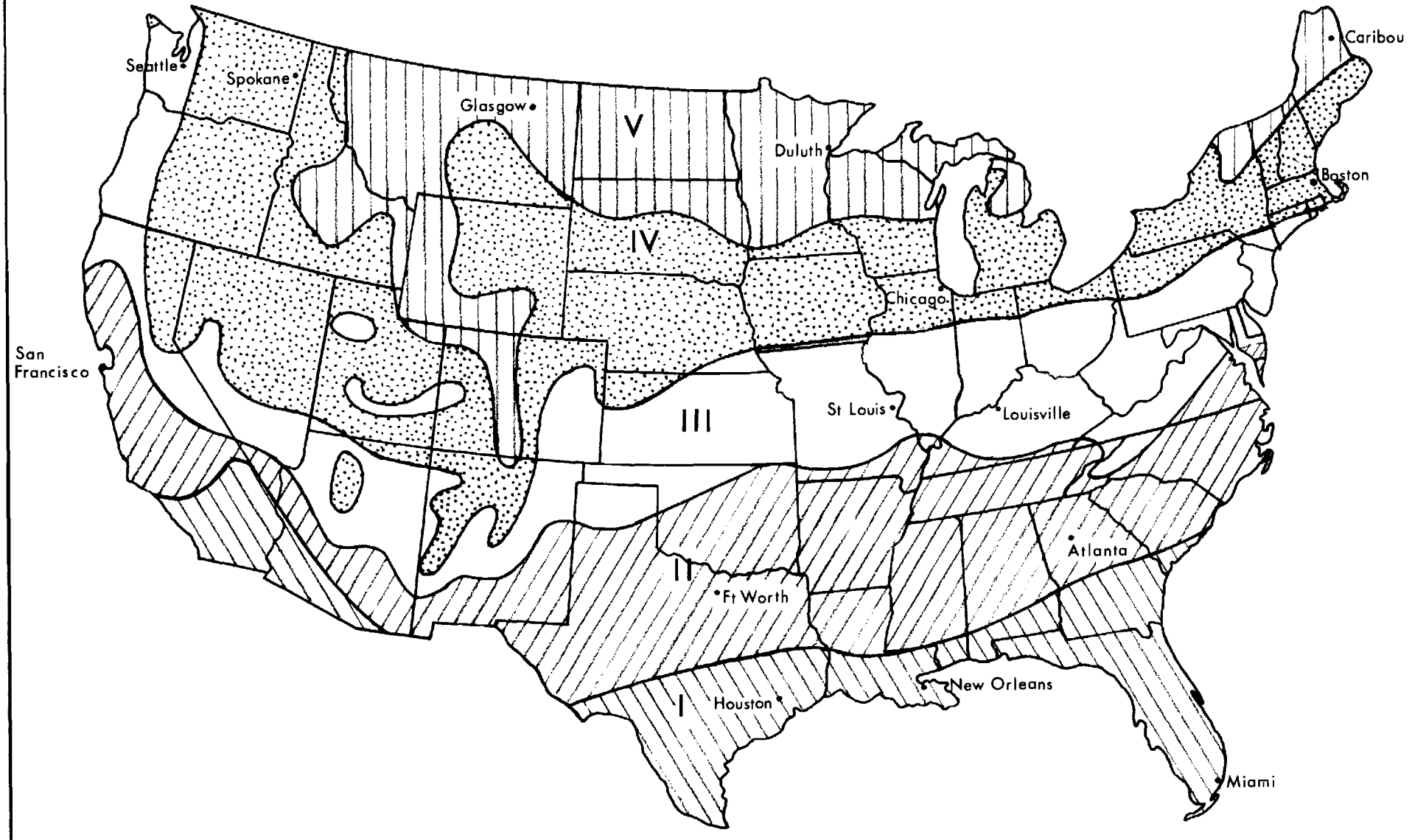
In order to estimate the energy savings over an annual heating season due to installation of carpeting over the two types of floors, several variables which affect energy requirements for heating a structure must be addressed. These variables include:

1. Winter temperatures associated with different geographic locations in the U. S.
2. Size of the structure
3. Configuration of the structure
4. Thermal characteristics of the structure

The method selected to simulate heating season performance for a given structure was the degree-day method outlined in the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) Handbook - 1973 Systems, which estimates energy requirements for heating a structure. This method uses tabulated values of heating degree-days for a given location, where a heating degree-day is a criteria for measuring the temperature variation at the location during a year's time. The formulas used in estimating the fuel or electric requirements for a heating system in a residence or commercial structure are presented in Appendix A.

The variability of heating energy requirements for different geographic locations in the U.S. was taken into account by evaluating three large cities in each of five heating zone divisions which are indicated on Figure II. The heating zones shown on Figure II were designated by the National Bureau of Standards as zones which characteristically determine heating energy requirements for a limited range of temperatures. The variability of heating energy requirements for different types of houses and commercial structures was accounted for by selecting characteristic structures, e.g., one-story rectangular, two-story rectangular, L-shaped, etc., and evaluating different sizes of each characteristic structure .

Thus the evaluation of carpet as thermal insulation addressed various sizes of each type of structure at each of fifteen major cities in the U.S. The results of the evaluation during an annual heating season are presented in the following section.



Zone Map

Source: U.S. Dept. of Commerce, Nat. Bureau of Standards

FIG. II

Cooling Season Evaluation

The method chosen for evaluation of carpet as insulation is the energy estimating method outlined in the ASHRAE Handbook and Product Directory-1973 Systems for residential air conditioning energy requirements for a cooling season. Commercial structures and residences employing slab on grade construction were not evaluated due to the fact that carpet installed on a concrete slab on grade will account for negligible energy reduction during a cooling season.

The energy savings resulting from carpet installation was estimated as a reduction in the heat gained through a wood floor over a vented crawl space. This value was calculated by using the equivalent temperature difference given in the 1972 ASHRAE Handbook of Fundamentals for estimating cooling load contribution of the wood floor, based on the summer design temperature for each city. The thermal characteristics of the wood floor were the same as those assumed in the heating season simulation. Thus, the calculated reduction in the overall heat transfer coefficient for the wood floor resulting from addition of carpet to the floor surface was used to estimate energy savings using the equivalent temperature difference. This energy reduction in air conditioning load was then translated into air conditioning cost savings by using values of seasonal air conditioning operating hours obtained where available, from electric utilities in the fifteen cities indicated in Figure II. The dollar savings were computed based on current electric rates in the cities. The method of calculation is detailed in Appendix A.

IV. PROGRAM RESULTS

Carpet Testing

The results of the carpet sample tests to determine the thermal resistance or R-value of each sample are presented in Tables 3 and 3A. As indicated, the R-values generally range from 1.0 to 4.0 for carpets alone or carpet underlayment combinations. R-values were additive for any combination of samples. For example, a combination of carpet sample 6 (R=1.3) and the prime urethane pad (R=1.6) will yield an overall R-value of 2.9, within a ten percent allowance for error.

The R-value represents a resistance to heat flow. Thus, the higher the R-value of a material, the better the insulation value of the material. Table 4 gives the typical R-value for some common materials, based upon equivalent one inch thick specimens.

Table 4

Thermal Resistance of Some Common Materials

	(R-value(hr-ft^2-°F/BTU)/inch
Copper	0.00037
Concrete	0.10
Plywood	1.25
Carpet	2.4
Fiberglass insulation	3.2

Table 4 indicates that copper is a very poor insulator compared with carpet or fiberglass. Carpet is found to be a good insulator relative to concrete and plywood, which are common flooring materials.

In the carpeting samples tested, there appeared to be a direct proportionality between the total thickness of the test sample and the

Table 3

Carpet Thermal Measurements

Sample No.	Thermal Trasmittance (BTU/hr-ft^2-°F)	R-Value
1	1.46	0.68
2	1.54	0.65
3	1.50	0.67
4	1.81	0.55
5	0.89	1.12
6	0.75	1.33
7	0.66	1.51
8	1.28	0.78
9	0.97	1.03
10	1.06	0.95
11	0.60	1.66
12	0.51	1.96
13	0.41	2.46
14	0.46	2.19
15	0.55	1.83
16	0.53	1.90
17	0.58	1.71
18	1.42	0.70

Table 3A

Underlayment Thermal Measurements

Description	Transmittance(BTU/hr-ft^2-°F)	R-Value
Prime Urethane 3/8" 2.2 Pound Density	0.62	1.61
Slab Rubber	1.63	0.62
48 oz. Waffled Sponge Rubber	1.28	0.78
56 oz. Coated Combination Hair and Jute	0.58	1.71
Bonded Urethane 1/2" 4.0 Pound Density	0.48	2.09

corresponding R-value for that sample. The test results indicate that the contribution of any component of the carpet, i.e., pile or underlayment to the total R-value is more dependent on the thickness of the component, rather than the fiber and/or yarn type.

Heat Transfer Simulation

Due to the large number of variables which affect the evaluation of energy requirements for a composite structure, as many variables as possible were minimized in number. Even so, a total of 208 different combinations of structure types, sizes, floor plans and carpet R-values were evaluated for annual heating season savings in each of the 15 cities. Of these evaluations estimated savings for 104 of the combinations are presented in Tables 5 through 108. Examination of the results of the computer simulation leads to the following conclusions:

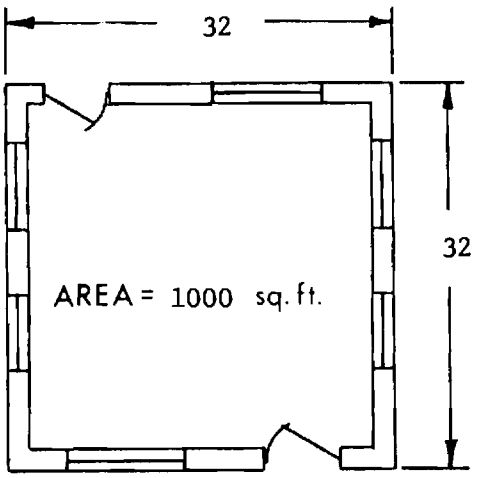
1. Carpet can provide significant savings in the energy required to heat a structure. Again it must be stressed that the estimated savings are "worst case" conditions, due to the fact that the carpeted floors evaluated are otherwise uninsulated. Therefore, the estimated savings should be considered maximum values for the type of structures investigated.
2. Carpet installed on an uninsulated concrete slab will provide greater savings than carpet installed on an insulated wood floor of the same area.

3. Energy savings from carpet will vary substantially, depending on the thermal resistance or R-value of the carpet. For example, a carpet with an R-value of 4.0 provided an estimated energy savings which was greater than two times the savings estimated for carpet with an R-value of 1.0.

The results of the evaluation of the effectiveness of carpet in reducing air conditioning energy requirements during a cooling season are presented in Tables 109 through 112. The cooling season evaluation addressed only the estimated net reduction of heat gained through a wood floor over a vented crawl space. For this reason, the energy savings due to carpet are not expressed as a percentage of total structure energy requirements, but rather as a gross energy savings. The energy savings listed in Tables 109 through 112 are based on electric air conditioning units having a coefficient of performance of 2.5. The estimated energy savings during a cooling season are not as significant as the energy savings estimated for a heating season. This result would be anticipated since the energy required to heat a structure is usually greater than the energy required to cool the same structure.

For both heating and cooling season evaluations, the most significant variable is geographic location, due to the fact

that the geographic location fixes a number of other variables including design temperature for heating and cooling seasons; number of heating season degree days; number of air conditioning system operating hours during a cooling season; and the cost of utilities. These variables are listed for each of the fifteen cities in Appendix A, Table A-II.

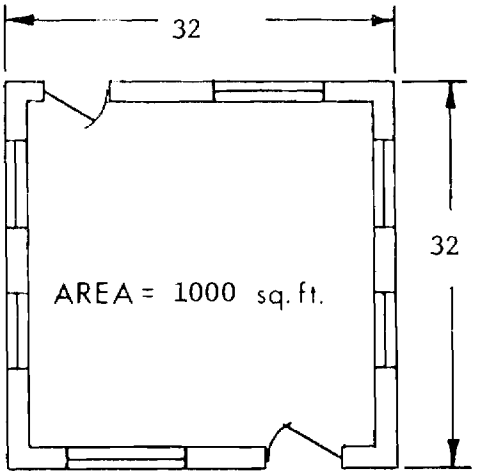


ONE STORY SQUARE
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE = 1.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	3.3 %	$ 0.	$ 1.	$ 0.
	New Orleans Louisiana	3.3	2.	6.	-
	Houston Texas	3.3	0.	5.	-
Zone II	Atlanta Georgia	3.3	4.	8.	7.
	San Francisco California	3.3	4.	11.	-
	Ft Worth Texas	3.3	4.	10.	5.
Zone III	Louisville Kentucky	3.3	5.	12.	11.
	St Louis Missouri	3.3	6.	16.	11.
	Seattle Washington	3.3	7.	7.	10.
Zone IV	Boston Massachusettes	3.6	14.	11.	14.
	Chicago Illinois	3.6	10.	31.	17.
	Spokane Washington	3.6	12.	9.	16.
Zone V	Caribou Maine	3.6	-	24.	23.
	Duluth Minnesota	3.6	17.	31.	21.
	Glasgow Montana	3.6	6.	18.	19.

*Based on utility rates in effect August 1976

TABLE 5

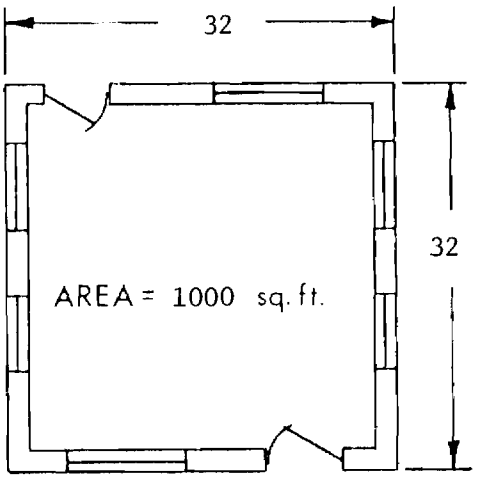


ONE STORY SQUARE
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE = 2.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	5.4	$ 0.	$ 1.	$ 1.
	New Orleans Louisiana	5.4	3.	10.	-
	Houston Texas	5.4	1.	8.	-
Zone II	Atlanta Georgia	5.4	7.	13.	11.
	San Francisco California	5.4	6.	18.	-
	Ft Worth Texas	5.4	7.	17.	8.
Zone III	Louisville Kentucky	5.4	8.	19.	17.
	St Louis Missouri	5.4	10.	26.	18.
	Seattle Washington	5.4	12.	11.	17.
Zone IV	Boston Massachusettes	5.8	22.	18.	22.
	Chicago Illinois	5.8	17.	52.	27.
	Spokane Washington	5.8	19.	15.	27.
Zone V	Caribou Maine	5.8	-	40.	38.
	Duluth Minnesota	5.8	28.	51.	35.
	Glasgow Montana	5.8	10.	29.	30.

*Based on utility rates in effect August 1976

TABLE 6

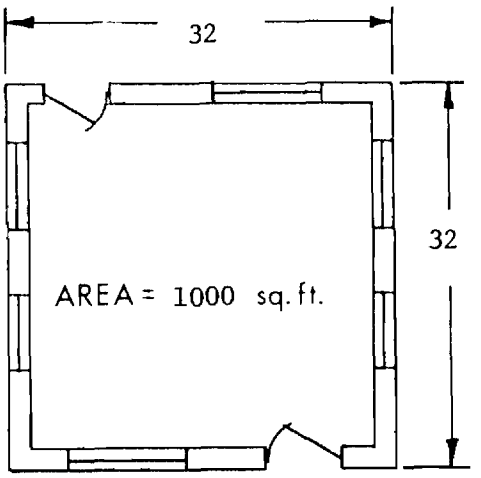


ONE STORY SQUARE
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE = 3.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	6.8 %	$ 0.	$ 2.	$ 1.
	New Orleans Louisiana	6.8	4.	12.	-
	Houston Texas	6.8	1.	10.	-
Zone II	Atlanta Georgia	6.8	8.	16.	14.
	San Francisco California	6.8	7.	23.	-
	Ft Worth Texas	6.8	9.	22.	10.
Zone III	Louisville Kentucky	6.8	11.	24.	22.
	St Louis Missouri	6.8	12.	33.	23.
	Seattle Washington	6.8	15.	14.	21.
Zone IV	Boston Massachusettes	7.4	28.	23.	28.
	Chicago Illinois	7.4	22.	66.	35.
	Spokane Washington	7.4	24.	19.	34.
Zone V	Caribou Maine	7.4	-	51.	48
	Duluth Minnesota	7.4	36.	65.	44.
	Glasgow Montana	7.4	13.	37.	39.

*Based on utility rates in effect August 1976

TABLE 7

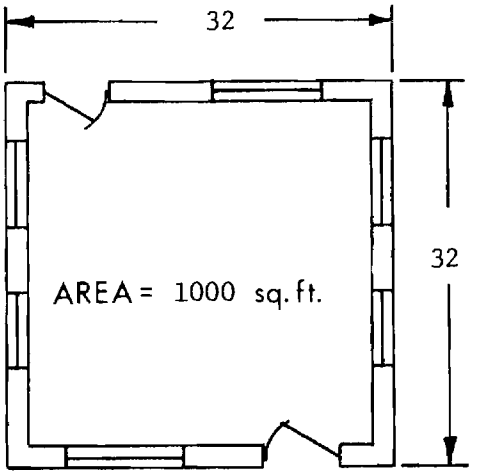


ONE STORY SQUARE
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE = 4.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	7.9 %	$ 0.	$ 2.	$ 1.
	New Orleans Louisiana	7.9	4.	14.	-
	Houston Texas	7.9	1.	11.	-
Zone II	Atlanta Georgia	7.9	10.	19.	16.
	San Francisco California	7.9	9.	27.	-
	Ft Worth Texas	7.9	10.	25.	12.
Zone III	Louisville Kentucky	7.9	12.	28.	26.
	St Louis Missouri	7.9	14.	38.	27.
	Seattle Washington	7.9	18.	16.	25.
Zone IV	Boston Massachusettes	8.6	33.	27.	33.
	Chicago Illinois	8.6	25.	76.	40.
	Spokane Washington	8.6	28.	22.	39.
Zone V	Caribou Maine	8.6	-	59.	55.
	Duluth Minnesota	8.6	41.	75.	51.
	Glasgow Montana	8.6	15.	43.	45.

*Based on utility rates in effect August 1976

TABLE 8

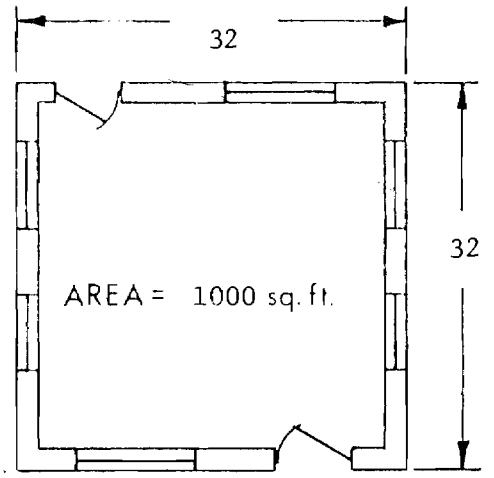


ONE STORY SQUARE
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE = 1.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	6.3%	$ 0.	$ 2.	$ 1.
	New Orleans Louisiana	6.3	3.	11.	-
	Houston Texas	6.3	1.	9.	-
Zone II	Atlanta Georgia	6.2	8.	14.	12.
	San Francisco California	6.3	7.	21.	-
	Ft Worth Texas	6.2	8.	20.	9.
Zone III	Louisville Kentucky	6.2	10.	22.	20.
	St Louis Missouri	6.2	11.	30.	21.
	Seattle Washington	6.2	14.	12.	19.
Zone IV	Boston Massachusettes	6.8	25.	21.	25.
	Chicago Illinois	6.8	19.	58.	31.
	Spokane Washington	6.8	22.	17.	30.
Zone V	Caribou Maine	6.8	-	45.	43.
	Duluth Minnesota	6.8	32.	58.	39.
	Glasgow Montana	6.8	11.	33.	34.

*Based on utility rates in effect August 1976

Table 9

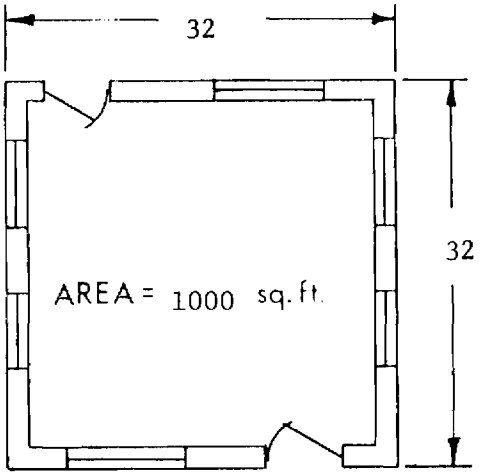


ONE STORY SQUARE
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE = 2.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	9.1 %	$ 0.	$ 2.	$ 1.
	New Orleans Louisiana	8.7	5.	15.	-
	Houston Texas	8.6	1.	12.	-
Zone II	Atlanta Georgia	8.4	10.	19.	17.
	San Francisco California	8.7	9.	29.	-
	Ft Worth Texas	8.4	10.	26.	13.
Zone III	Louisville Kentucky	8.3	13.	29.	26.
	St Louis Missouri	8.3	15.	39.	28.
	Seattle Washington	8.5	19.	17.	26.
Zone IV	Boston Massachusettes	9.0	34.	28.	34.
	Chicago Illinois	9.0	25.	77.	41.
	Spokane Washington	9.0	29.	22.	40.
Zone V	Caribou Maine	8.9	-	59.	56.
	Duluth Minnesota	8.9	42.	76.	52.
	Glasgow Montana	8.8	15.	43.	45.

*Based on utility rates in effect August 1976

TABLE 10

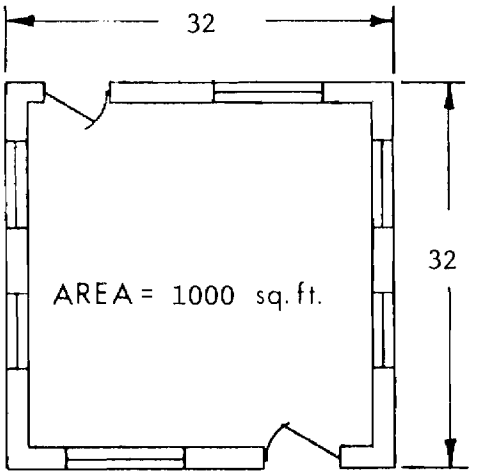


ONE STORY SQUARE
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE = 3.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	12.3 %	$ 0.	$ 3.	$ 1.
	New Orleans Louisiana	11.4	6.	20.	-
	Houston Texas	11.2	1.	16.	-
Zone II	Atlanta Georgia	10.8	13.	25.	22.
	San Francisco California	11.5	12.	39.	-
	Ft Worth Texas	10.8	13.	34.	16.
Zone III	Louisville Kentucky	10.5	16.	37.	34.
	St Louis Missouri	10.5	19.	50.	35.
	Seattle Washington	11.0	24.	22.	33.
Zone IV	Boston Massachusettes	11.5	43.	35.	43.
	Chicago Illinois	11.3	32.	97.	51.
	Spokane Washington	11.3	36.	28.	51.
Zone V	Caribou Maine	11.1	-	74.	70.
	Duluth Minnesota	11.1	52.	95.	65.
	Glasgow Montana	11.0	19.	54.	56.

*Based on utility rates in effect August 1976

TABLE 11

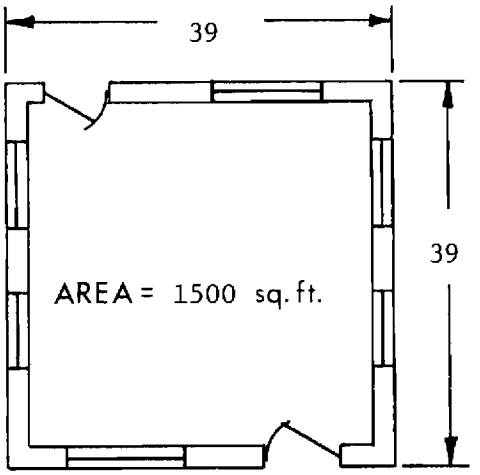


ONE STORY SQUARE
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE = 4.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	15.6 %	$ 1.	$ 4.	$ 2.
	New Orleans Louisiana	14.0	8.	25.	-
	Houston Texas	13.7	1.	19.	-
Zone II	Atlanta Georgia	13.2	16.	30.	26.
	San Francisco California	14.3	15.	48.	-
	Ft Worth Texas	13.3	16.	42.	20.
Zone III	Louisville Kentucky	12.8	20.	44.	41.
	St Louis Missouri	12.7	23.	61.	43.
	Seattle Washington	13.4	29.	27.	41.
Zone IV	Boston Massachusettes	13.9	52.	43.	52.
	Chicago Illinois	13.6	38.	117.	62.
	Spokane Washington	13.6	44.	34.	61.
Zone V	Caribou Maine	13.3	-	89.	84.
	Duluth Minnesota	13.3	62.	113.	77.
	Glasgow Montana	13.2	22.	65.	67.

*Based on utility rates in effect August 1976

TABLE 12

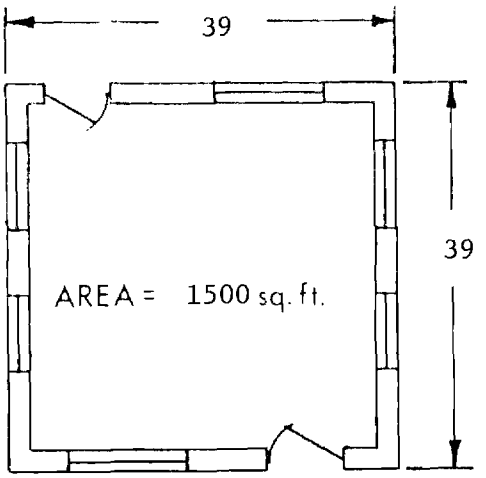


ONE STORY SQUARE
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE = 1.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	3.5 %	$ 0.	$ 1.	$ 1.
	New Orleans Louisiana	3.5	3.	9.	-
	Houston Texas	3.5	0.	7.	-
Zone II	Atlanta Georgia	3.5	6.	12.	10.
	San Francisco California	3.5	5.	17.	-
	Ft Worth Texas	3.5	6.	16.	7.
Zone III	Louisville Kentucky	3.5	8.	17.	16.
	St Louis Missouri	3.5	9.	24.	17.
	Seattle Washington	3.5	11.	10.	15.
Zone IV	Boston Massachusettes	3.8	20.	17.	20.
	Chicago Illinois	3.8	15.	47.	25.
	Spokane Washington	3.8	17.	14.	24.
Zone V	Caribou Maine	3.8	-	36.	34.
	Duluth Minnesota	3.8	26.	47.	32.
	Glasgow Montana	3.8	9.	27.	28.

*Based on utility rates in effect August 1976

TABLE 13

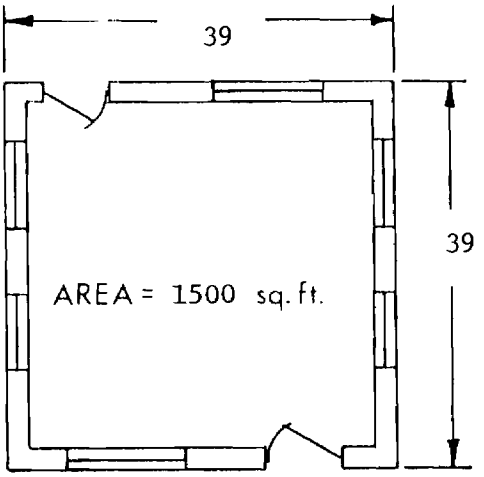


ONE STORY SQUARE
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE = 2.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	5.7 %	$ 0.	$ 2.	$ 1.
	New Orleans Louisiana	5.7	5.	14.	-
	Houston Texas	5.7	1.	12.	-
Zone II	Atlanta Georgia	5.7	10.	19.	16.
	San Francisco California	5.7	9.	28.	-
	Ft Worth Texas	5.7	10.	26.	12.
Zone III	Louisville Kentucky	5.7	13.	29.	26.
	St Louis Missouri	5.7	15.	39.	28.
	Seattle Washington	5.7	18.	16.	25.
Zone IV	Boston Massachusettes	6.2	34.	28.	33.
	Chicago Illinois	6.2	25.	77.	41.
	Spokane Washington	6.2	29.	22.	40.
Zone V	Caribou Maine	6/2	-	60.	56.
	Duluth Minnesota	6.2	42.	77.	52.
	Glasgow Montana	6.2	15.	44.	46.

*Based on utility rates in effect August 1976

TABLE 14

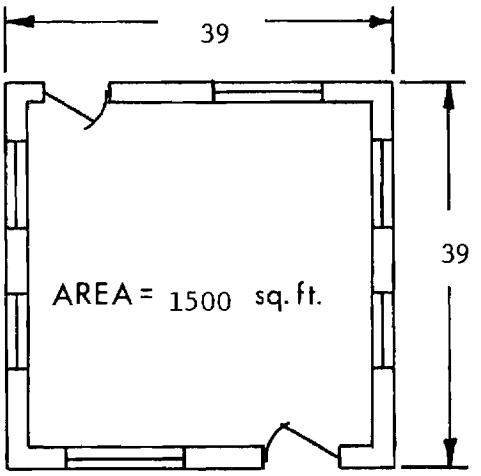


ONE STORY SQUARE
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE = 3.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	7.2 %	$ 0.	$ 3.	$ 1.
	New Orleans Louisiana	7.2	6.	18.	-
	Houston Texas	7.2	1.	15.	-
Zone II	Atlanta Georgia	7.2	13.	24.	21.
	San Francisco California	7.2	11.	35.	-
	Ft Worth Texas	7.2	13.	33.	16.
Zone III	Louisville Kentucky	7.2	16.	36.	33.
	St Louis Missouri	7.2	19.	50.	35.
	Seattle Washington	7.2	23.	21.	32.
Zone IV	Boston Massachusettes	7.9	43.	35.	42.
	Chicago Illinois	7.9	32.	98.	52.
	Spokane Washington	7.9	36.	28.	51.
Zone V	Caribou Maine	7.9	-	76.	72.
	Duluth Minnesota	7.9	54.	97.	66.
	Glasgow Montana	7.9	19.	56.	58.

*Based on utility rates in effect August 1976

TABLE 15

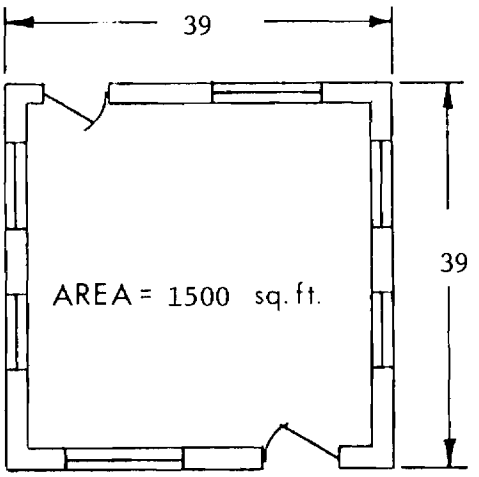


ONE STORY SQUARE
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE = 4.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	8.4 %	$ 0.	$ 3.	$ 1.
	New Orleans Louisiana	8.4	7.	21.	-
	Houston Texas	8.4	1.	17.	-
Zone II	Atlanta Georgia	8.4	15.	28.	24.
	San Francisco Califarnia	8.4	13.	41.	-
	Ft Worth Texas	8.4	15.	38.	18.
Zone III	Louisville Kentucky	8.4	18.	42.	39.
	St Louis Missauri	8.4	21.	57.	41.
	Seattle Washington	8.4	27.	24.	37.
Zone IV	Boston Massachusettes	9.2	49.	41.	49.
	Chicago Illinois	9.2	37.	114.	60.
	Spokane Washington	9.2	42.	33.	59.
Zone V	Caribou Maine	9.2	-	88.	83.
	Duluth Minnesota	9.2	62.	113.	77.
	Glasgow Montana	9.2	22.	65.	67.

*Based on utility rates in effect August 1976

TABLE 16

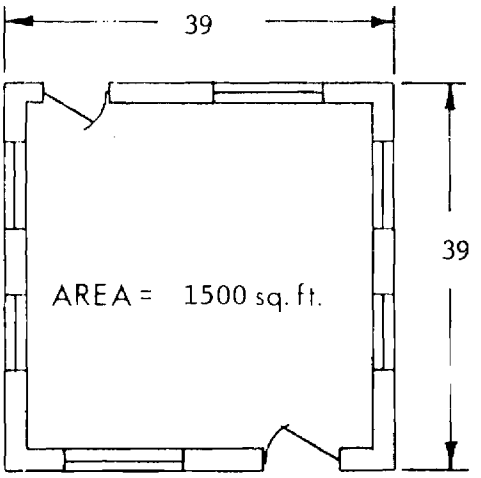


ONE STORY SQUARE
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE = 1.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	6.1 %	$ 0.	$ 2.	$ 1.
	New Orleans Louisiana	6.1	5.	15.	-
	Houston Texas	6.1	1.	12.	-
Zone II	Atlanta Georgia	6.1	10.	20.	17.
	San Francisco California	6.1	9.	28.	-
	Ft Worth Texas	6.1	11.	27.	13.
Zone III	Louisville Kentucky	6.1	13.	30.	27.
	St Louis Missouri	6.1	15.	40.	29.
	Seattle Washington	6.1	19.	17.	26.
Zone IV	Boston Massachusettes	6.7	35.	29.	34.
	Chicago Illinois	6.8	26.	80.	42.
	Spokane Washington	6.8	30.	23.	42.
Zone V	Caribou Maine	6.8	-	62.	59.
	Duluth Minnesota	6.8	44.	80.	54.
	Glasgow Montana	6.8	16.	46.	48.

*Based on utility rates in effect August 1976

TABLE 17

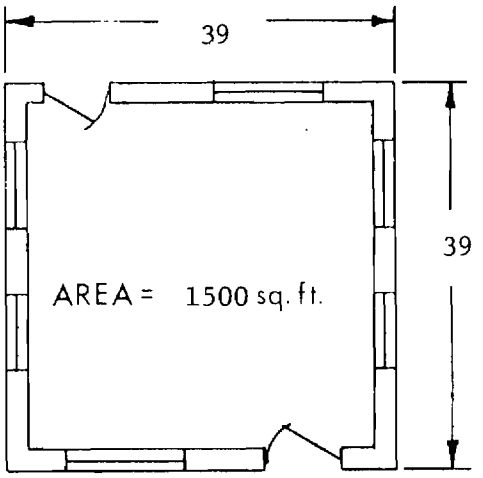


ONE STORY SQUARE
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE = 2.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	8.7 %	$ 0.	$ 3.	$ 1.
	New Orleans Louisiana	8.4	6.	20.	-
	Houston Texas	8.4	1.	16.	-
Zone II	Atlanta Georgia	8.3	14.	27.	23.
	San Francisco California	8.5	13.	39.	-
	Ft Worth Texas	8.3	14.	36.	17.
Zone III	Louisville Kentucky	8.2	17.	40.	36.
	St Louis Missouri	8.2	20.	54.	38.
	Seattle Washington	8.3	25.	23.	35.
Zone IV	Boston Massachusettes	9.0	46.	38.	46.
	Chicago Illinois	9.0	35.	106.	56.
	Spokane Washington	9.0	39.	31.	55.
Zone V	Caribou Maine	8.9	-	82.	77.
	Duluth Minnesota	8.9	58.	105.	71.
	Glasgow Montana	8.9	21.	60.	62.

*Based on utility rates in effect August 1976

TABLE 18

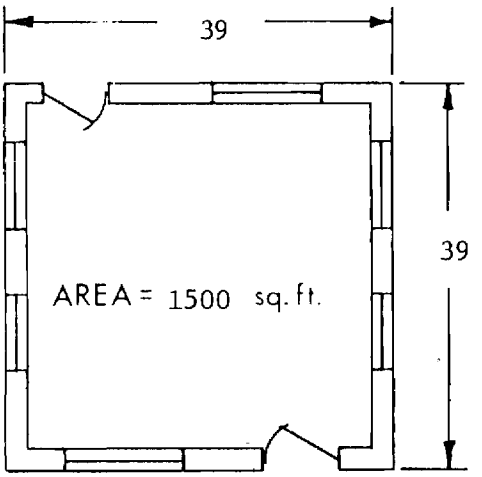


ONE STORY SQUARE
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE = 3.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	11.8 %	$ 1.	$ 4.	$ 2.
	New Orleans Louisiana	11.0	8.	27.	-
	Houston Texas	10.9	1.	21.	-
Zone II	Atlanta Georgia	10.6	18.	34.	29.
	San Francisco California	11.2	17.	52.	-
	Ft Worth Texas	10.7	18.	46.	22.
Zone III	Louisville Kentucky	10.4	22.	50.	46.
	St Louis Missouri	10.4	26.	68.	48.
	Seattle Washington	10.7	33.	29.	45.
Zone IV	Boston Massachusettes	11.4	59.	48.	58.
	Chicago Illinois	11.3	44.	134.	71.
	Spokane Washington	11.3	50.	39.	70.
Zone V	Caribou Maine	11.1	-	102.	97.
	Duluth Minnesota	11.1	72.	131.	89.
	Glasgow Montana	11.1	26.	75.	78.

*Based on utility rates in effect August 1976

TABLE 19

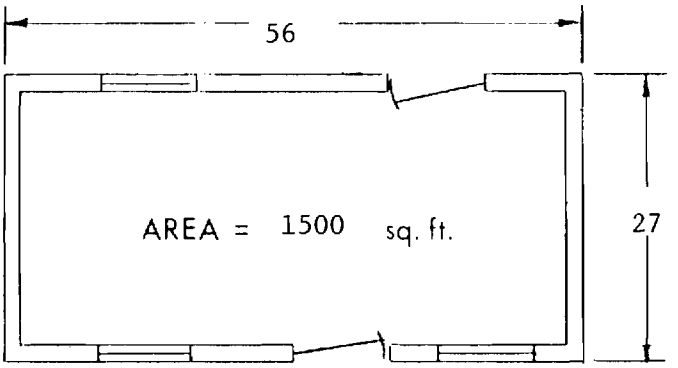


ONE STORY SQUARE
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE = 4.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	14.8 %	$ 1.	$ 5.	$ 2.
	New Orleans Louisiana	13.6	10.	33.	-
	Houston Texas	13.4	2.	26.	-
Zone II	Atlanta Georgia	12.9	22.	42.	36.
	San Francisco California	13.9	21.	64.	-
	Ft Worth Texas	13.0	22.	56.	27.
Zone III	Louisville Kentucky	12.6	27.	61.	56.
	St Louis Missouri	12.6	31.	83.	59.
	Seattle Washington	13.1	40.	36.	55.
Zone IV	Boston Massachusettes	13.8	71.	59.	71.
	Chicago Illinois	13.6	53.	162.	86.
	Spokane Washington	13.6	60.	47.	84.
Zone V	Caribou Maine	13.4	-	123.	166.
	Duluth Minnesota	13.4	87.	157.	107.
	Glasgow Montana	13.3	31.	90.	93.

*Based on utility rates in effect August 1976

TABLE 20

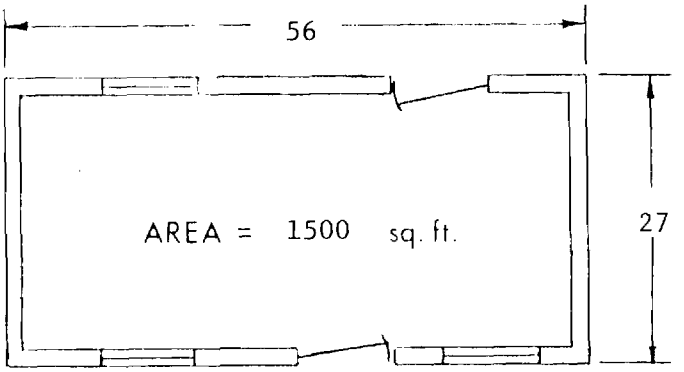


ONE STORY RECTANGULAR
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE 1.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	3.4 %	$ 0.	$ 1.	$ 1.
	New Orleans Louisiana	3.4	3.	9.	-
	Houston Texas	3.4	0.	7.	-
Zone II	Atlanta Georgia	3.4	6.	12.	10.
	San Francisco California	3.4	5.	17.	-
	Ft Worth Texas	3.4	6.	16.	7.
Zone III	Louisville Kentucky	3.4	8.	17.	16.
	St Louis Missouri	3.4	9.	24.	17.
	Seattle Washington	3.4	11.	10.	15.
Zone IV	Boston Massachusettes	3.7	20.	17.	20.
	Chicago Illinois	3.7	15.	47.	25.
	Spokane Washington	3.7	17.	14.	24.
Zone V	Caribou Maine	3.7	-	36.	34.
	Duluth Minnesota	3.7	26.	47.	32.
	Glasgow Montana	3.7	9.	27.	28.

*Based on utility rates in effect August 1976

TABLE 21

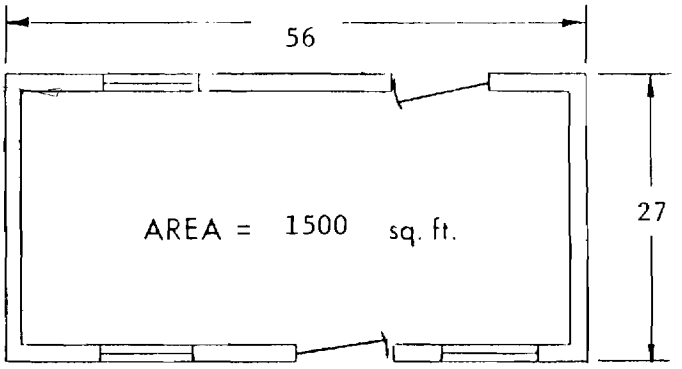


ONE STORY RECTANGULAR
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE 2.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	5.6 %	$ 0.	$ 2.	$ 1.
	New Orleans Louisiana	5.6	5.	14.	-
	Houston Texas	5.6	1.	12.	-
Zone II	Atlanta Georgia	5.6	10.	19.	16.
	San Francisco California	5.6	9.	28.	-
	Ft Worth Texas	5.6	10.	26.	12.
Zone III	Louisville Kentucky	5.6	13.	29.	26.
	St Louis Missouri	5.6	15.	39.	28.
	Seattle Washington	5.6	18.	16.	25.
Zone IV	Boston Massachusettes	6.1	34.	28.	33.
	Chicago Illinois	6.1	25.	77.	41.
	Spokane Washington	6.1	29.	22.	40.
Zone V	Caribou Maine	6.1	-	60.	56.
	Duluth Minnesota	6.1	42.	77.	52.
	Glasgow Montana	6.1	15.	44.	46.

*Based on utility rates in effect August 1976

TABLE 22

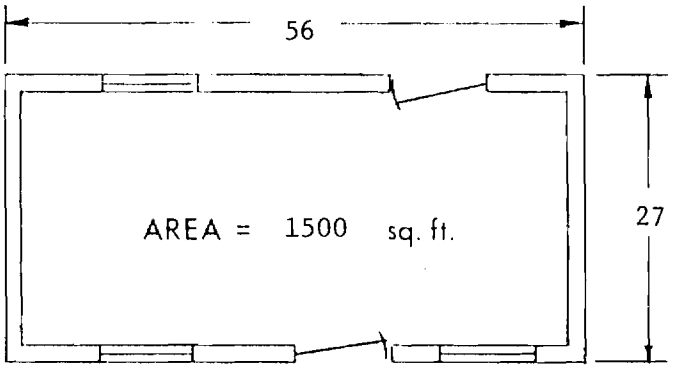


ONE STORY RECTANGULAR
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE 3.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	7.1 %	$ 0.	$ 3.	$ 1.
	New Orleans Louisiana	7.1	6.	18.	-
	Houston Texas	7.1	1.	15.	-
Zone II	Atlanta Georgia	7.1	13.	24.	21.
	San Francisco California	7.1	11.	35.	-
	Ft Worth Texas	7.1	13.	33.	16.
Zone III	Louisville Kentucky	7.1	16.	36.	33.
	St Louis Missouri	7.1	19.	50.	35.
	Seattle Washington	7.1	23.	21.	32.
Zone IV	Boston Massachusettes	7.8	43.	35.	42.
	Chicago Illinois	7.8	32.	98.	52.
	Spokane Washington	7.8	36.	28.	51.
Zone V	Caribou Maine	7.8	-	76.	72.
	Duluth Minnesota	7.8	54.	97.	66.
	Glasgow Montana	7.8	19.	56.	58.

*Based on utility rates in effect August 1976

TABLE 23

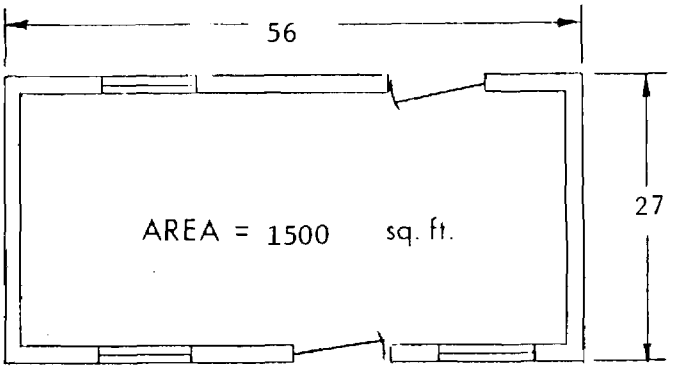


ONE STORY RECTANGULAR
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE 4.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	8.2 %	$ 0.	$ 3.	$ 1.
	New Orleans Louisiana	8.2	7.	21.	-
	Houston Texas	8.2	1.	17.	-
Zone II	Atlanta Georgia	8.2	15.	28.	24.
	San Francisco California	8.2	13.	41.	-
	Ft Worth Texas	8.2	15.	38.	18.
Zone III	Louisville Kentucky	8.2	18.	42.	39.
	St Louis Missouri	8.2	21.	57.	41.
	Seattle Washington	8.2	27.	24.	37.
Zone IV	Boston Massachusettes	9.0	49.	41.	49.
	Chicago Illinois	9.0	37.	114.	60.
	Spokane Washington	9.0	42.	33.	59.
Zone V	Caribou Maine	9.0	-	88.	83.
	Duluth Minnesota	9.0	62.	113.	77.
	Glasgow Montana	9.0	22.	65.	67.

*Based on utility rates in effect August 1976

TABLE 24

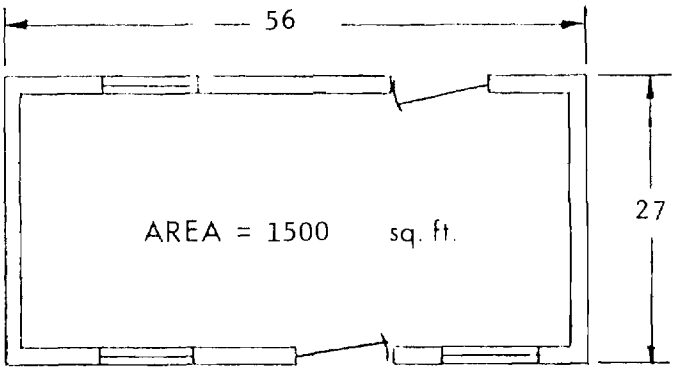


ONE STORY RECTANGULAR
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE = 1.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	6.2	$ 0.	$ 2.	$ 1.
	New Orleans Louisiana	6.2	5.	15.	****
	Houston Texas	6.2	1.	12.	****
Zone II	Atlanta Georgia	6.2	11.	20.	18.
	San Francisco California	6.2	9.	29.	****
	Ft Worth Texas	6.2	11.	27.	13.
Zone III	Louisville Kentucky	6.2	13.	30.	28.
	St Louis Missouri	6.2	16.	42.	29.
	Seattle Washington	6.2	19.	17.	27.
Zone IV	Boston Massachusettes	6.8	36.	29.	36.
	Chicago Illinois	6.8	27.	83.	44.
	Spokane Washington	6.8	31.	24.	43.
Zone V	Caribou Maine	6.8	****	64.	60.
	Duluth Minnesota	6.8	45.	82.	56.
	Glasgow Montana	6.8	16.	47.	49.

*Based on utility rates in effect August 1976

TABLE 25

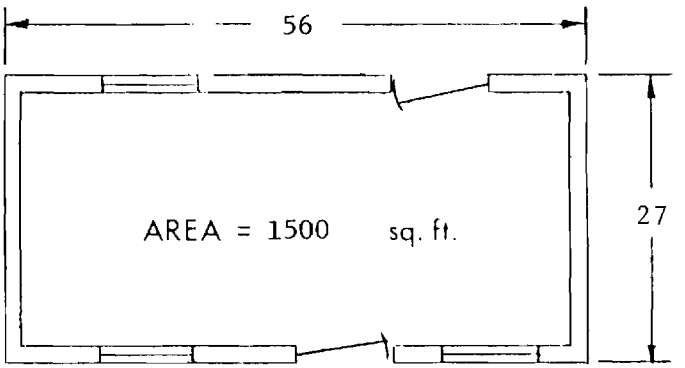


ONE STORY RECTANGULAR
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE= 2.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	8.9%	$ 0.	$ 3.	$ 1.
	New Orleans Louisiana	8.5	7.	21.	****
	Houston Texas	8.5	1.	17.	****
Zone II	Atlanta Georgia	8.4	14.	27.	24.
	San Francisco California	8.6	13.	41.	****
	Ft Worth Texas	8.4	15.	37.	18.
Zone III	Louisville Kentucky	8.3	18.	41.	37.
	St Louis Missouri	8.3	21.	56.	39.
	Seattle Washington	8.4	26.	24.	36.
Zone IV	Boston Massachusettes	9.1	48.	39.	47.
	Chicago Illinois	9.0	36.	109.	58.
	Spokane Washington	9.0	41.	32.	57.
Zone V	Caribou Maine	8.9	****	84.	79.
	Duluth Minnesota	8.9	59.	108.	73.
	Glasgow Montana	8.9	21.	62.	64.

*Based on utility rates in effect August 1976

TABLE 26

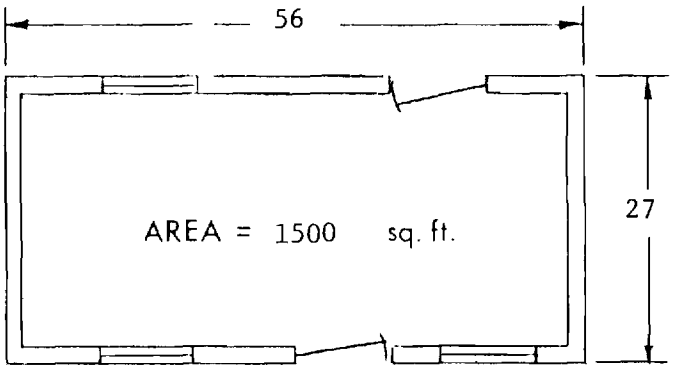


ONE STORY RECTANGULAR
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE= 3.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	12.0%	$ 1.	$ 4.	$ 2.
	New Orleans Louisiana	11.2	9.	28.	****
	Houston Texas	11.0	2.	22.	****
Zone II	Atlanta Georgia	10.7	18.	35.	30.
	San Francisco California	11.3	17.	54.	****
	Ft Worth Texas	10.8	19.	48.	23.
Zone III	Louisville Kentucky	10.5	23.	52.	47.
	St Louis Missouri	10.5	26.	71.	50.
	Seattle Washington	10.8	34.	30.	47.
Zone IV	Boston Massachusettes	11.5	61.	50.	60.
	Chicago Illinois	11.3	45.	138.	73.
	Spokane Washington	11.4	51.	40.	72.
Zone V	Caribou Maine	11.2	****	105.	99.
	Duluth Minnesota	11.2	74.	135.	92.
	Glasgow Montana	11.1	27.	77.	80.

*Based on utility rates in effect August 1976

TABLE 27

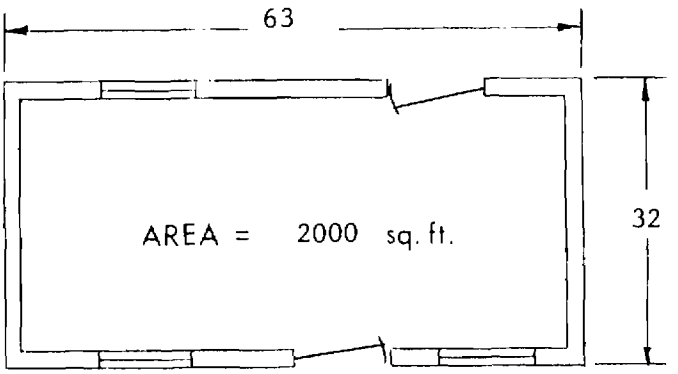


ONE STORY RECTANGULAR
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE= 4.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	15.1%	$ 1.	$ 5.	$ 2.
	New Orleans Louisiana	13.8	11.	34.	****
	Houston Texas	13.6	2.	27.	****
Zone II	Atlanta Georgia	13.1	23.	43.	37.
	San Francisco California	14.1	21	67.	****
	Ft Worth Texas	13.1	23.	58.	28.
Zone III	Louisville Kentucky	12.7	28.	63.	57.
	St Louis Missouri	12.7	32.	86.	60.
	Seattle Washington	13.3	41.	37.	57.
Zone IV	Boston Massachusettes	13.9	73.	60.	73.
	Chicago Illinois	13.7	55.	166.	88.
	Spokane Washington	13.7	62.	48.	86.
Zone V	Caribou Maine	13.4	****	126.	119.
	Duluth Minnesota	13.4	89.	162.	110.
	Glasgow Montana	13.3	32.	92.	96.

*Based on utility rates in effect August 1976

TABLE 28

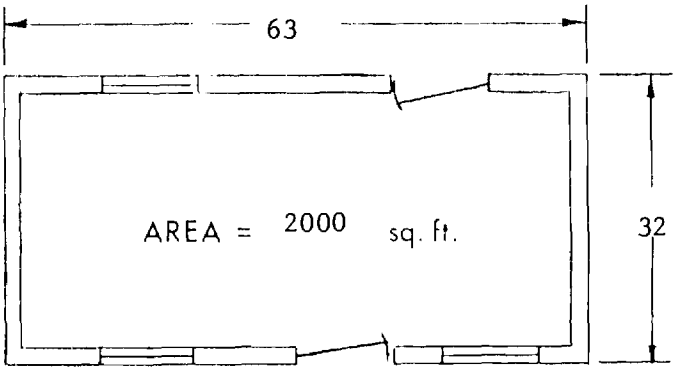


ONE STORY RECTANGULAR
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE 1.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	3.5 %	$ 0.	$ 2.	$ 1.
	New Orleans Louisiana	3.5	4.	12.	-
	Houstan Texas	3.5	1.	9.	-
Zone II	Atlanta Georgia	3.5	8.	15.	13.
	San Francisco California	3.5	7.	23.	-
	Ft Worth Texas	3.5	8.	21.	10.
Zone III	Louisville Kentucky	3.5	10.	23.	21.
	St Louis Missouri	3.5	12.	32.	22.
	Seattle Washington	3.5	15.	13.	20.
Zone IV	Boston Massachusettes	3.9	27.	22.	27.
	Chicago Illinois	3.9	21.	63.	33.
	Spokane Washington	3.9	23.	18.	33.
Zone V	Caribou Maine	3.9	-	49.	46.
	Duluth Minnesota	3.9	34.	62.	42.
	Glasgow Montana	3.9	12.	36.	37.

*Based on utility rates in effect August 1976

TABLE 29

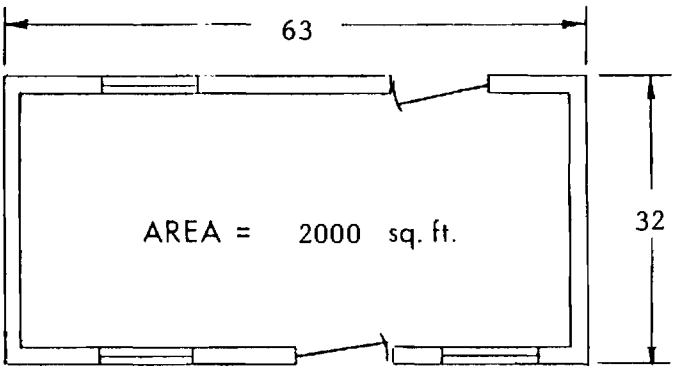


ONE STORY RECTANGULAR
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE 2.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	5.8 %	$ 0.	$ 3.	$ 1.
	New Orleans Louisiana	5.8	6.	19.	-
	Houston Texas	5.8	1.	15.	-
Zone II	Atlanta Georgia	5.8	13.	25.	22.
	San Francisco California	5.8	12.	37.	-
	Ft Worth Texas	5.8	14.	34.	16.
Zone III	Louisville Kentucky	5.8	17.	38.	35.
	St Louis Missouri	5.8	19.	52.	37.
	Seattle Washington	5.8	24.	22.	33.
Zone IV	Boston Massachusettes	6.4	45.	37.	44.
	Chicago Illinois	6.4	34.	103.	55.
	Spokane Washington	6.4	38.	30.	53.
Zone V	Caribou Maine	6.4	-	80.	75.
	Duluth Minnesota	6.4	56.	102.	70.
	Glasgow Montana	6.4	20.	59.	61.

*Based on utility rates in effect August 1976

TABLE 30

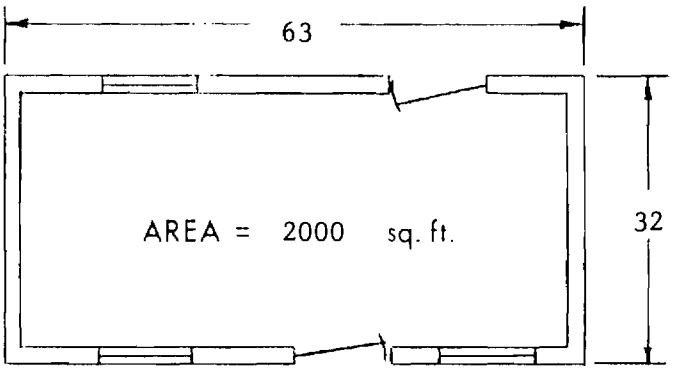


ONE STORY RECTANGULAR
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE = 3.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	7.4 %	$ 1.	$ 3.	$ 2.
	New Orleans Louisiana	7.4	8.	24.	-
	Houston Texas	7.4	1.	20.	-
Zone II	Atlanta Georgia	7.4	17.	32.	28.
	San Francisco California	7.4	15.	47.	-
	Ft Worth Texas	7.4	17.	44.	21.
Zone III	Louisville Kentucky	7.4	21.	48.	44.
	St Louis Missouri	7.4	25.	66.	47.
	Seattle Washington	7.4	31.	28.	42.
Zone IV	Boston Massachusettes	8.1	57.	47.	56.
	Chicago Illinois	8.1	43.	131.	69.
	Spokane Washington	8.1	49.	38.	68.
Zone V	Caribou Maine	8.1	-	101.	96.
	Duluth Minnesota	8.1	72.	130.	89.
	Glasgow Montana	8.1	26.	75.	78.

*Based on utility rates in effect August 1976

TABLE 31

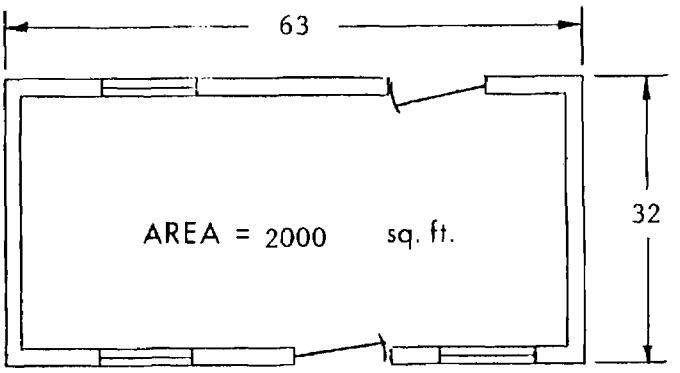


ONE STORY RECTANGULAR
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE = 4.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florido	8.6	$ 1.	$ 4.	$ 2.
	New Orleans Louisiana	8.6	9.	28.	-
	Houston Texas	8.6	2.	23.	-
Zone II	Atlanto Georgia	8.6	20.	37.	32.
	San Francisco Californio	8.6	17.	54.	-
	Ft Worth Texas	8.6	20.	51.	24.
Zone III	Louisville Kentucky	8.6	25.	56.	51.
	St Louis Missouri	8.6	29.	77.	54.
	Seattle Washington	8.6	35.	32.	49.
Zone IV	Boston Massachusettes	9.4	66.	54.	65.
	Chicago Illinois	9.4	50.	152.	80.
	Spokane Washington	9.4	56.	44.	79.
Zone V	Caribou Maine	9.4	-	117.	111.
	Duluth Minnesota	9.4	83.	150.	102.
	Glasgow Montana	9.4	30.	87.	90.

*Based on utility rates in effect August 1976

TABLE 32

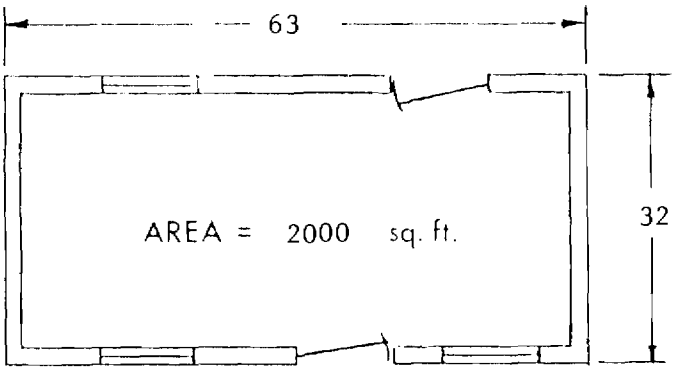


ONE STORY RECTANGULAR
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE=1.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	6.0%	$ 0.	$ 3.	$ 1.
	New Orleans Louisiana	6.1	6.	19.	****
	Houston Texas	6.1	1.	15.	****
Zone II	Atlanta Georgia	6.1	13.	25.	22.
	San Francisco California	6.0	12.	36.	****
	Ft Worth Texas	6.1	14	34.	16.
Zone III	Louisville Kentucky	6.1	17.	38.	35.
	St Louis Missouri	6.1	20.	52.	37.
	Seattle Washington	6.1	24.	22.	33.
Zone IV	Boston Massachusettes	6.8	45.	37.	45.
	Chicago Illinois	6.8	34.	104.	55.
	Spokane Washington	6.8	38.	30.	54.
Zone V	Caribou Maine	6.8	****	81.	76.
	Duluth Minnesata	6.8	57.	103.	70.
	Glasgow Montana	6.8	21.	59.	62.

*Based on utility rates in effect August 1976

TABLE 33

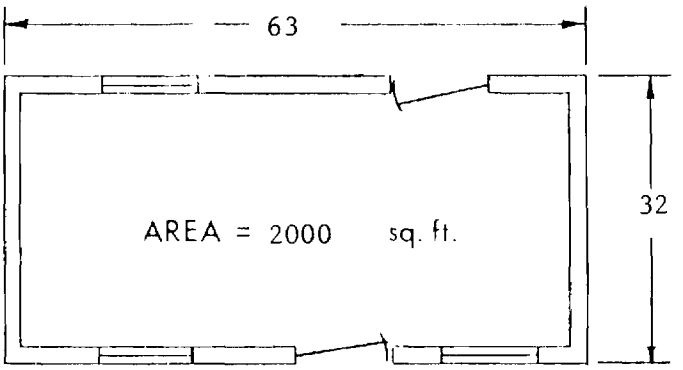


ONE STORY RECTANGULAR
CONCRETE SLAB CONSTRUCTION
CARPETING R - VALUE = 2.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	8.6	$ 1.	$ 4.	$ 2.
	New Orleans Louisiana	8.4	8.	26.	****
	Houston Texas	8.3	1.	21.	****
Zone II	Atlanta Georgia	8.2	18.	34.	30.
	San Francisco California	8.4	16.	51.	****
	Ft Worth Texas	8.3	18.	46.	22.
Zone III	Louisville Kentucky	8.2	22.	51.	47.
	St Louis Missouri	8.2	26.	70.	49.
	Seattle Washington	8.3	32.	29.	45.
Zone IV	Boston Massachusettes	9.0	60.	49.	59.
	Chicago Illinois	9.0	45.	137.	73.
	Spokane Washington	9.0	51.	40.	71.
Zone V	Caribou Maine	8.9	****	106.	100.
	Duluth Minnesota	8.9	75.	136.	93.
	Glasgow Montana	8.9	27.	78.	81.

*Based on utility rates in effect August 1976

TABLE 34

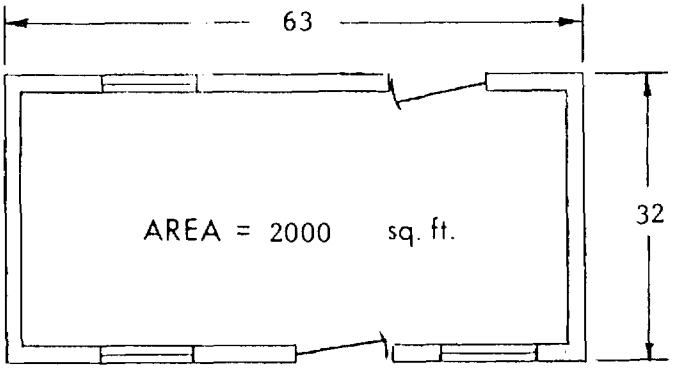


ONE STORY RECTANGULAR
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE= 3.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	11.6%	$ 1.	$ 5.	$ 2.
	New Orleans Louisiana	10.9	11.	34.	****
	Houston Texas	10.8	2.	27.	****
Zone II	Atlanta Georgia	10.6	23.	44.	38.
	San Francisco California	11.1	21.	66.	****
	Ft Worth Texas	10.6	24.	60.	28.
Zone III	Louisville Kentucky	10.4	29.	65.	59.
	St Louis Missouri	10.4	33.	88.	62.
	Seattle Washington	10.7	42.	38.	58.
Zone IV	Boston Massachusettes	11.4	76.	63.	75.
	Chicago Illinois	11.3	57.	173.	92.
	Spokane Washington	11.3	64.	50.	90.
Zone V	Caribou Maine	11.2	****	133.	125.
	Duluth Minnesota	11.2	94.	170.	116.
	Glasgow Montana	11.1	34.	97.	101.

*Based on utility rates in effect August 1976

TABLE 35

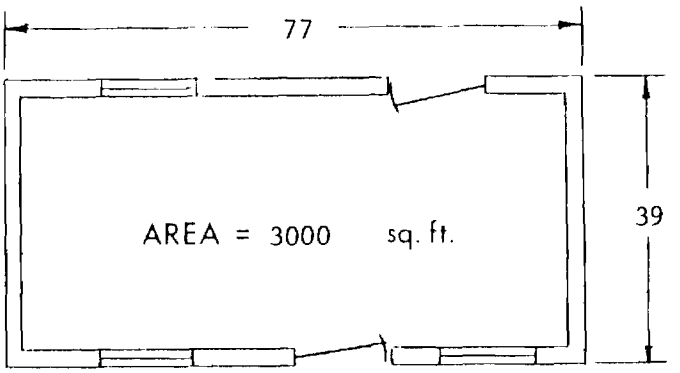


ONE STORY RECTANGULAR
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE=4.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	14.6%	$ 1.	$ 6.	$ 3.
	New Orleans Louisiana	13.5	13.	42.	****
	Houston Texas	13.3	2.	33.	****
Zone II	Atlanta Georgia	12.9	28.	53.	46.
	San Francisco California	13.7	26.	82.	****
	Ft Worth Texas	12.9	29.	73.	35.
Zone III	Louisville Kentucky	12.6	35.	79.	72.
	St Louis Missouri	12.6	40.	107.	76.
	Seattle Washington	13.1	51.	46.	71.
Zone IV	Boston Massachusetts	13.9	92.	76.	91.
	Chicago Illinois	13.6	69.	209.	111.
	Spokane Washington	13.7	78.	61.	109.
Zone V	Caribou Maine	13.4	****	160.	151.
	Duluth Minnesota	13.4	112.	204.	139.
	Glasgow Montana	13.4	40.	117.	121.

*Based on utility rates in effect August 1976

TABLE 36

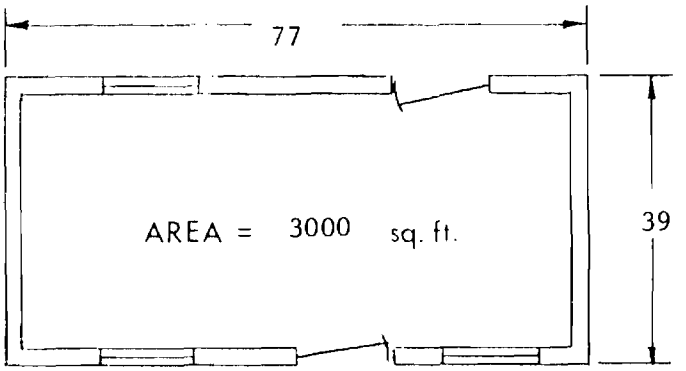


ONE STORY RECTANGULAR
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE 1.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	3.7 %	$ 0.	$ 2.	$ 1.
	New Orleans Louisiana	3.7	5.	18.	-
	Houston Texas	3.7	1.	14.	-
Zone II	Atlanta Georgia	3.7	12.	23.	20.
	San Francisco California	3.7	11.	34.	-
	Ft Worth Texas	3.7	12.	31.	15.
Zone III	Louisville Kentucky	3.7	15.	35.	32.
	St Louis Missouri	3.7	18.	48.	34.
	Seattle Washington	3.7	22.	20.	31.
Zone IV	Boston Massachusettes	4.1	41.	34.	41.
	Chicago Illinois	4.1	31.	94.	50.
	Spokane Washington	4.1	35.	27.	49.
Zone V	Caribou Maine	4.1	-	73.	69.
	Duluth Minnesota	4.1	51.	93.	64.
	Glasgow Montana	4.1	19.	54.	56.

*Based on utility rates in effect August 1976

TABLE 37

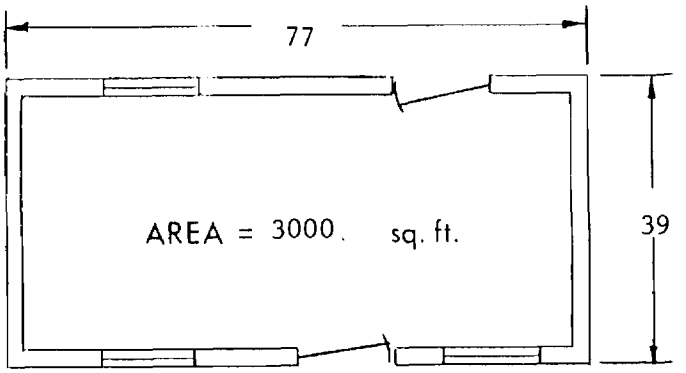


ONE STORY RECTANGULAR
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE 2.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	6.1 %	$ 1.	$ 4.	$ 2.
	New Orleans Louisiana	6.1	9.	29.	-
	Houston Texas	6.1	2.	23.	-
Zone II	Atlanta Geargia	6.1	20.	38.	33.
	San Francisco Califarnia	6.1	18.	55.	-
	Ft Worth Texas	6.1	20.	52.	25.
Zone III	Louisville Kentucky	6.1	25.	57.	52.
	St Louis Missouri	6.1	29.	78.	55.
	Seattle Washington	6.1	36.	33.	50.
Zone IV	Boston Massachusettes	6.7	67.	55.	67.
	Chicago Illinois	6.7	51.	155.	82.
	Spokane Washington	6.7	57.	45.	80.
Zone V	Caribou Maine	6.7	-	120.	113.
	Duluth Minnesota	6.7	84.	153.	104.
	Glasgow Montana	6.7	30.	88.	91.

*Based on utility rates in effect August 1976

TABLE 38

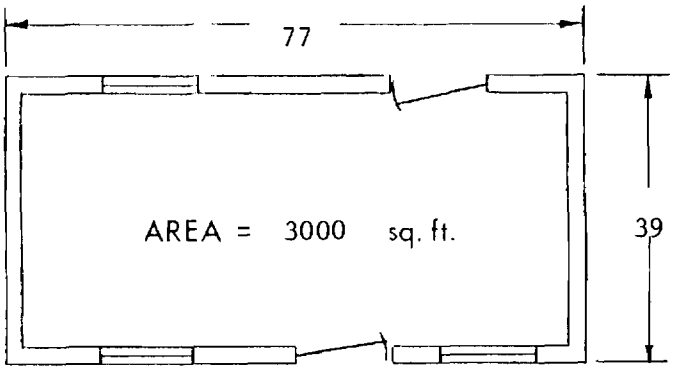


ONE STORY RECTANGULAR
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE 3.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	7.8 %	$ 1.	$ 5.	% 2.
	New Orleans Louisiana	7.8	11.	37.	-
	Houston Texas	7.8	2.	29.	-
Zone II	Atlanta Georgia	7.8	25.	48.	42.
	San Francisco California	7.8	22.	70.	-
	Ft Worth Texas	7.8	26.	66.	31.
Zone III	Louisville Kentucky	7.8	32.	73.	67.
	St Louis Missouri	7.8	37.	99.	70.
	Seattle Washington	7.8	46.	41.	64.
Zone IV	Boston Massachusettes	8.6	85.	70.	85.
	Chicago Illinois	8.6	65.	197.	104.
	Spokane Washington	8.6	73.	57.	102.
Zone V	Caribou Maine	8.6	-	152.	144.
	Duluth Minnesota	8.6	107.	195.	133.
	Glasgow Montana	8.6	39.	112.	116.

*Based on utility rates in effect August 1976

TABLE 39

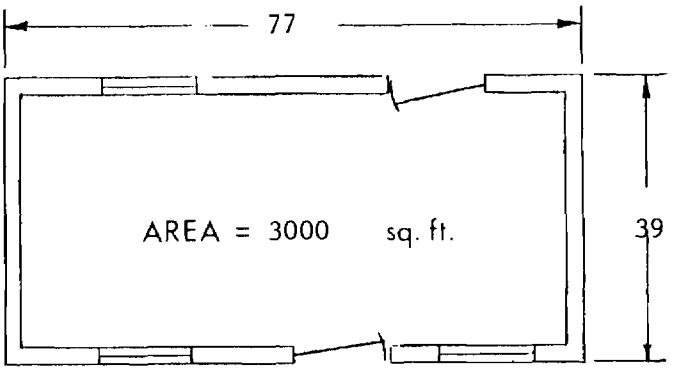


ONE STORY RECTANGULAR
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE 4.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	9.0 %	$ 1.	$ 6.	$ 3.
	New Orleans Louisiana	9.0	13.	42.	-
	Houston Texas	9.0	2.	34.	-
Zone II	Atlanta Georgia	9.0	29.	56.	49.
	San Francisco California	9.0	26.	82.	-
	Ft Worth Texas	9.0	30.	76.	36.
Zone III	Louisville Kentucky	9.0	37.	84.	77.
	St Louis Missouri	9.0	43.	115.	81.
	Seattle Washington	9.0	53.	48.	74.
Zone IV	Boston Massachusetts	9.9	99.	81.	98.
	Chicago Illinois	9.9	75.	227.	121.
	Spokane Washington	9.9	84.	66.	118.
Zone V	Caribou Maine	9.9	-	176.	166.
	Duluth Minnesota	9.9	124.	225.	154.
	Glasgow Montana	9.9	45.	130.	135.

*Based on utility rates in effect August 1976

TABLE 40

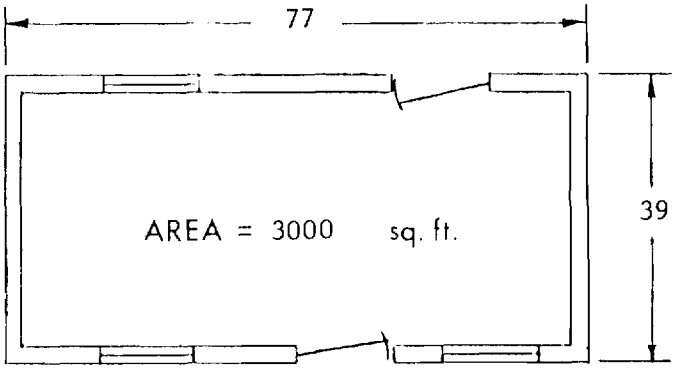


ONE STORY RECTANGULAR
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE = 1.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	5.7%	$ 1.	$ 3.	$ 2.
	New Orleans Louisiana	5.9	8	26.	****
	Houston Texas	5.9	1.	21.	****
Zone II	Atlanta Georgia	6.0	18.	35.	30.
	San Francisco California	5.9	16	49.	****
	Ft Worth Texas	6.0	19.	47.	22.
Zone III	Louisville Kentucky	6.0	23	53.	48.
	St Louis Missouri	6.0	27.	72.	51.
	Seattle Washington	6.0	33	30.	45.
Zone IV	Boston Massachusettes	6.7	62.	51.	62.
	Chicago Illinois	6.7	47.	144.	76.
	Spokane Washington	6.7	53.	41.	74.
Zone V	Caribou Maine	6.8	****	112.	106.
	Duluth Minnesota	6.8	79	143.	98.
	Glasgow Montana	6.8	29	83.	86.

*Based on utility rates in effect August 1976

TABLE 41

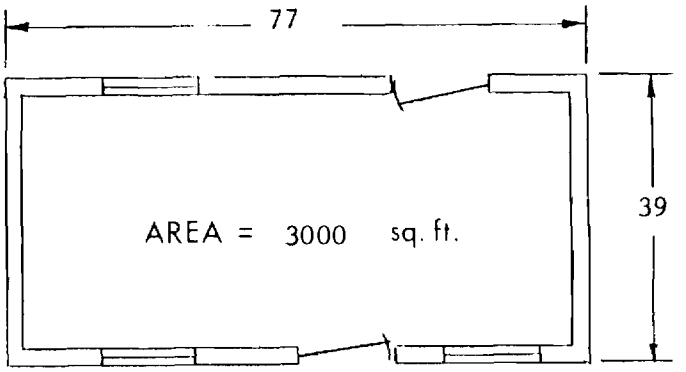


ONE STORY RECTANGULAR
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE= 2.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	8.2%	$ 1.	$ 5.	$ 2.
	New Orleans Louisiana	8.1	11.	36.	****
	Houston Texas	8.1	2.	28.	****
Zone II	Atlanta Georgia	8.1	25.	47.	41.
	San Francisco California	8.1	22.	68.	****
	Ft Worth Texas	8.1	25.	64.	30.
Zone III	Louisville Kentucky	8.1	31.	71.	65.
	St Louis Missouri	8.1	36.	96.	68.
	Seattle Washington	8.1	44.	40.	62.
Zone IV	Boston Massachusettes	8.9	83.	68.	82.
	Chicago Illinois	8.9	63.	191.	101.
	Spokane Washington	8.9	71.	55.	99.
Zone V	Caribou Maine	8.9	****	148.	140.
	Duluth Minnesota	8.9	104.	189.	129.
	Glasgow Montana	8.9	38.	109.	113.

*Based on utility rates in effect August 1976

TABLE 42

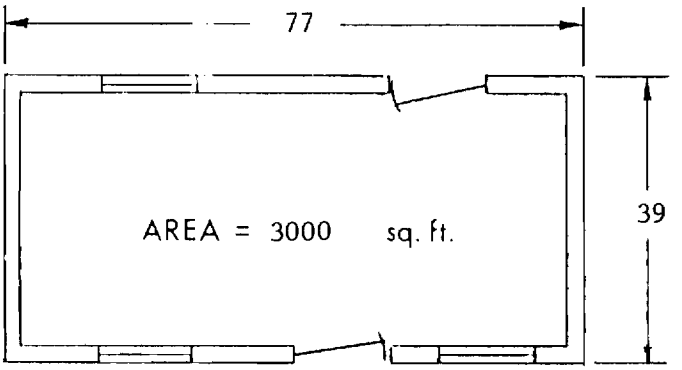


ONE STORY RECTANGULAR
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE = 3.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	11.0%	$ 1.	$ 7.	$ 3.
	New Orleans Louisiana	10.6	15.	46.	****
	Houston Texas	10.5	3.	37.	****
Zone II	Atlanta Georgia	10.3	32.	60.	52.
	San Francisco California	10.7	29.	90	****
	Ft Worth Texas	10.4	32.	82.	39.
Zone III	Louisville Kentucky	10.2	39.	90.	82.
	St Louis Missouri	10.2	46.	122.	86.
	Seattle Washington	10.4	57.	52.	80.
Zone IV	Bostan Massachusettes	11.3	105.	87.	104.
	Chicago Illinois	11.3	79.	241.	128.
	Spokane Washington	11.3	90.	70.	125.
Zone V	Caribou Maine	11.2	****	186.	175.
	Duluth Minnesota	11.2	131.	237.	162.
	Glasgow Montana	11.2	47.	136.	142.

*Based on utility rates in effect August 1976

TABLE 43

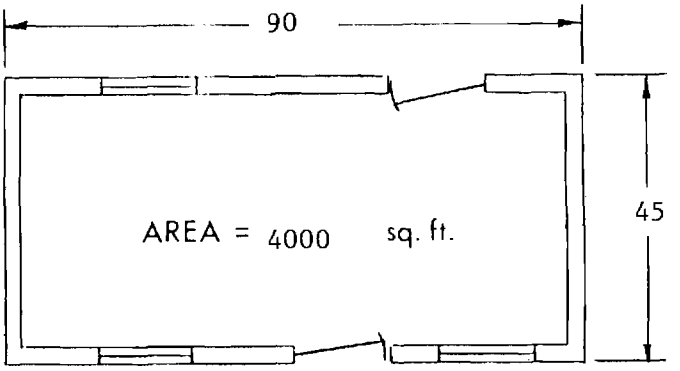


ONE STORY RECTANGULAR
CONCRETE SLAB CONSTRUCTION
CARPETING R - VALUE = 4.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	13.8%	$ 1.	$ 8.	$ 4.
	New Orleans Louisiana	13.1	18.	57.	****
	Houstan Texas	12.9	3.	45.	****
Zone II	Atlanta Georgia	12.6	39.	73.	64.
	San Francisco California	13.2	35.	111.	****
	Ft Worth Texas	12.7	40.	100.	47.
Zone III	Louisville Kentucky	12.4	48.	109.	100.
	St Louis Missouri	12.4	55.	148.	105.
	Seattle Washington	12.7	70	63.	97.
Zone IV	Boston Massachusettes	13.8	128.	105.	127.
	Chicago Illinois	13.6	96.	291.	154.
	Spokane Washington	13.6	108.	84.	151.
Zone V	Caribou Maine	13.5	****	223.	211.
	Duluth Minnesota	13.4	157.	286.	195.
	Glasgow Montana	13.4	57.	164.	170.

*Based on utility rates in effect August 1976

TABLE 44

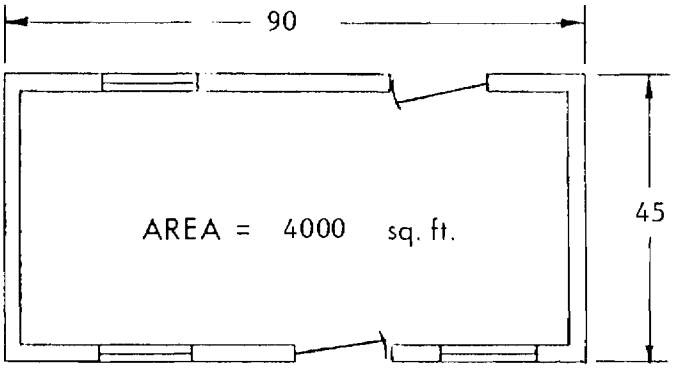


ONE STORY RECTANGULAR
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE=1.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	3.8%	$ 0.	$ 3.	$ 2.
	New Orleans Louisiana	3.8	7.	23.	****
	Houston Texas	3.8	1.	19.	****
Zone II	Atlanta Georgia	3.8	16.	31.	27.
	San Francisco California	3.8	14.	45	****
	Ft Worth Texas	3.8	17.	42.	20.
Zone III	Louisville Kentucky	3.8	20.	46	43.
	St Louis Missouri	3.8	24.	63.	45.
	Seattle Washington	3.8	29.	26.	41.
Zone IV	Boston Massachusettes	4.2	55.	45.	54.
	Chicago Illinois	4.2	41.	126.	67.
	Spokane Washington	4.2	47.	36.	65.
Zone V	Caribou Maine	4.2	****	97.	92.
	Duluth Minnesota	4.2	69.	124.	85.
	Glasgow Montana	4.2	25.	72.	74.

*Based on utility rates in effect August 1976

TABLE 45

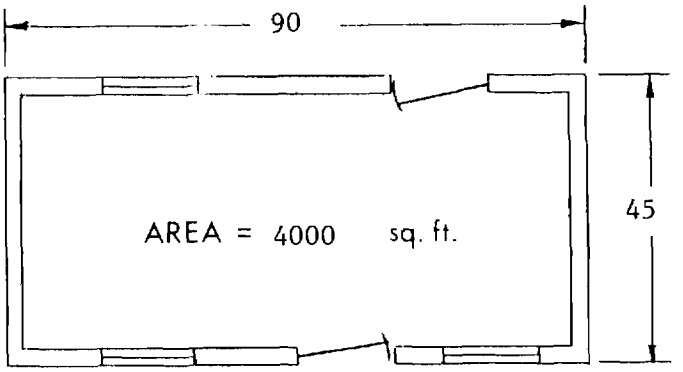


ONE STORY RECTANGULAR
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE=2.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	6.3	$ 1.	$ 5.	$ 2.
	New Orleans Louisiana	6.3	12.	38.	****
	Houston Texas	6.3	2.	31.	****
Zone II	Atlanta Georgia	6.3	27.	51.	44.
	San Francisco California	6.3	24.	74.	****
	Ft Worth Texas	6.3	27.	69.	33.
Zone III	Louisville Kentucky	6.3	34.	76.	70.
	St Louis Missouri	6.3	39.	104.	73.
	Seattle Washington	6.3	48.	43.	67.
Zone IV	Boston Massachusettes	7.0	90.	74.	89.
	Chicago Illinois	7.0	68.	206.	109.
	Spokane Washington	7.0	77.	60.	107.
Zone V	Caribou Maine	7.0	****	160.	151.
	Duluth Minnesota	7.0	112.	204.	139.
	Glasgow Montana	7.0	41.	118.	122.

*Based on utility rates in effect August 1976

TABLE 46

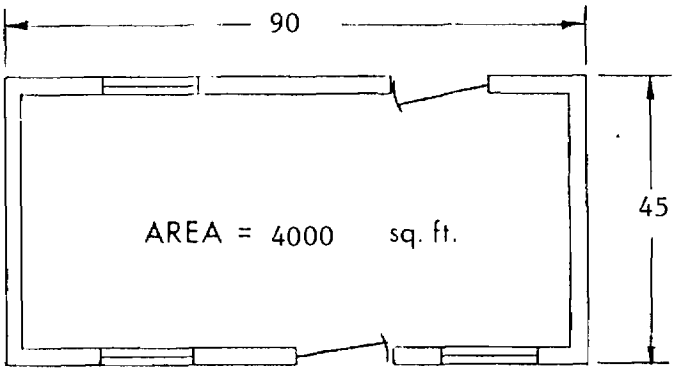


ONE STORY RECTANGULAR
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE = 3.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	8.0	$ 1.	$ 7.	$ 3.
	New Orleans Louisiana	8.0	15.	49.	****
	Houston Texas	8.0	3.	39.	****
Zone II	Atlanta Georgia	8.0	34.	65.	56.
	San Francisco California	8.0	30.	94.	****
	Ft Worth Texas	8.0	35.	87.	42.
Zone III	Louisville Kentucky	8.0	43.	97.	89.
	St Louis Missouri	8.0	49.	132.	93.
	Seattle Washington	8.0	61.	55.	85.
Zone IV	Boston Massachusettes	8.9	114.	94.	113.
	Chicago Illinois	8.9	86.	262.	139.
	Spokane Washington	8.9	97.	76.	136.
Zone V	Caribou Maine	8.9	****	203.	192.
	Duluth Minnesota	8.9	143.	260.	177.
	Glasgow Montana	8.9	52.	150.	155.

*Based on utility rates in effect August 1976

TABLE 47

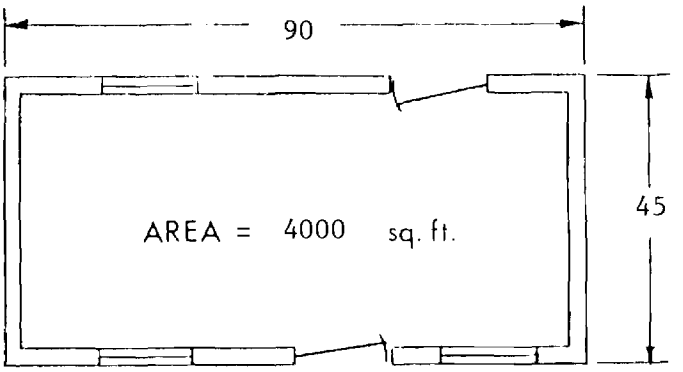


ONE STORY RECTANGULAR
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE = 4.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	9.3	$ 1.	$ 8.	$ 4.
	New Orleans Louisiana	9.3	18.	57.	****
	Houston Texas	9.3	3.	45.	****
Zone II	Atlanta Georgia	9.3	39.	75.	65.
	San Francisco California	9.3	35.	109.	****
	Ft Worth Texas	9.3	40.	101.	48.
Zone III	Louisville Kentucky	9.3	49.	112.	103.
	St Louis Missouri	9.3	57.	153.	108.
	Seattle Washington	9.3	71.	64.	98.
Zone IV	Boston Massachusettes	10.3	132.	108.	131.
	Chicago Illinois	10.3	100.	303.	161.
	Spokane Washington	10.3	113.	88.	157.
Zone V	Caribou Maine	10.3	****	235.	222.
	Duluth Minnesota	10.3	166.	301.	205.
	Glasgow Montana	10.3	60:	173.	179.

*Based on utility rates in effect August 1976

TABLE 48

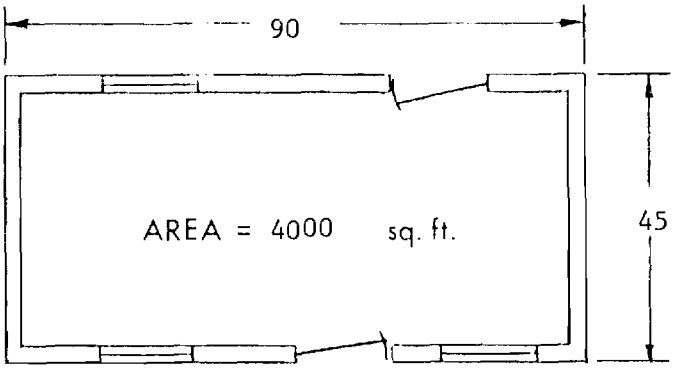


ONE STORY RECTANGULAR
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE = 1.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	5.5%	$ 1.	$ 4.	$ 2.
	New Orleans Louisiana	5.8	10.	32.	****
	Houston Texas	5.8	2.	26.	****
Zone II	Atlanta Georgia	5.9	23.	44.	38.
	San Francisco California	5.7	20.	61.	****
	Ft Worth Texas	5.9	23.	59.	28.
Zone III	Louisville Kentucky	5.9	29.	67.	61.
	St Louis Missouri	6.0	34.	91.	64.
	Seattle Washington	5.9	41.	37.	57.
Zone IV	Boston Massachusettes	6.6	78.	65.	78.
	Chicago Illinois	6.7	60.	182.	96.
	Spokane Washington	6.7	68.	53.	94.
Zone V	Caribou Maine	6.7	****	142.	134.
	Duluth Minnesota	6.7	100	182.	124.
	Glasgow Montana	6.7	36.	105.	109.

*Based on utility rates in effect August 1976

TABLE 49

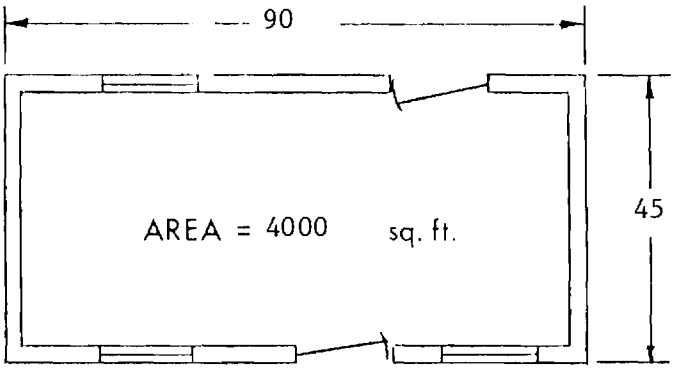


ONE STORY RECTANGULAR
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE = 2.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	7.9%	$ 1.	$ 6.	$ 3.
	New Orleans Louisiana	7.9	14.	44.	****
	Houston Texas	7.9	2.	36.	****
Zone II	Atlanta Georgia	8.0	31.	59.	51.
	San Francisco California	7.9	27.	85.	****
	Ft Worth Texas	8.0	32.	80.	38.
Zone III	Louisville Kentucky	8.0	39.	89.	82.
	St Louis Missouri	8.0	46.	122.	86.
	Seattle Washington	8.0	56.	50.	78.
Zone IV	Boston Massachusettes	8.9	105.	86.	104.
	Chicago Illinois	8.9	79.	242.	128.
	Spokane Washington	8.9	90.	70.	126.
Zone V	Caribou Maine	8.9	****	188.	178.
	Duluth Minnesota	8.9	133.	241.	164.
	Glasgow Montana	8.9	48.	139	144.

*Based on utility rates in effect August 1976

TABLE 50

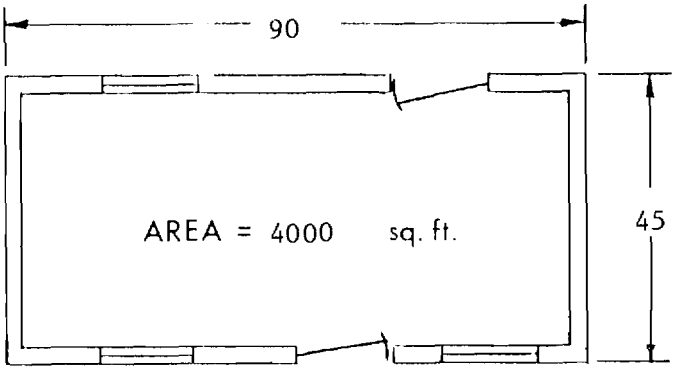


ONE STORY RECTANGULAR
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE= 3.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	10.6%	$ 1.	$ 8.	$ 4.
	New Orleans Louisiana	10.3	18.	58.	****
	Houston Texas	10.3	3.	46.	****
Zone II	Atlanta Georgia	10.2	40.	76.	66.
	San Francisco California	10.4	35.	111.	****
	Ft Worth Texas	10.2	41.	103.	49.
Zone III	Louisville Kentucky	10.1	50.	113.	104.
	St Louis Missouri	10.1	58.	155.	109.
	Seattle Washington	10.2	72.	65.	100.
Zone IV	Boston Massachusettes	11.3	133.	110.	132.
	Chicago Illinois	11.2	100.	306.	162.
	Spokane Washington	11.2	114.	88.	159.
Zone V	Caribou Maine	11.2	****	236.	223.
	Duluth Minnesota	11.2	167.	302.	206.
	Glasgow Montana	11.2	60.	174.	180.

*Based on utility rates in effect August 1976

TABLE 51

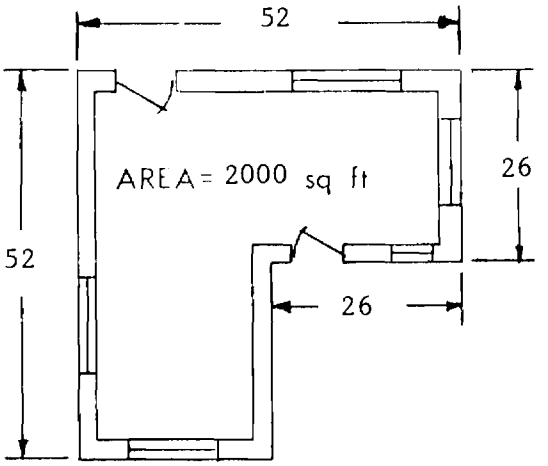


ONE STORY RECTANGULAR
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE = 4.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	13.3%	$ 2.	$ 10.	$ 5.
	New Orleans Louisiana	12.7	22.	71.	****
	Houston Texas	12.6	4.	57.	****
Zone II	Atlanta Georgia	12.4	49.	92.	80.
	San Francisco California	12.8	44.	138.	****
	Ft Worth Texas	12.5	50.	125.	60.
Zone III	Louisville Kentucky	12.3	60.	137.	126.
	St Louis Missouri	12.3	70.	188.	133.
	Seattle Washington	12.5	88.	79.	122.
Zone IV	Boston Massachusettes	13.7	162.	133.	160.
	Chicago Illinois	13.6	121.	370.	196.
	Spokane Washington	13.6	137.	107.	192.
Zone V	Caribou Maine	13.5	****	285.	269.
	Duluth Minnesota	13.5	201.	364.	248.
	Glasgow Montana	13.4	72.	209.	217.

*Based on utility rates in effect August 1976

TABLE 52

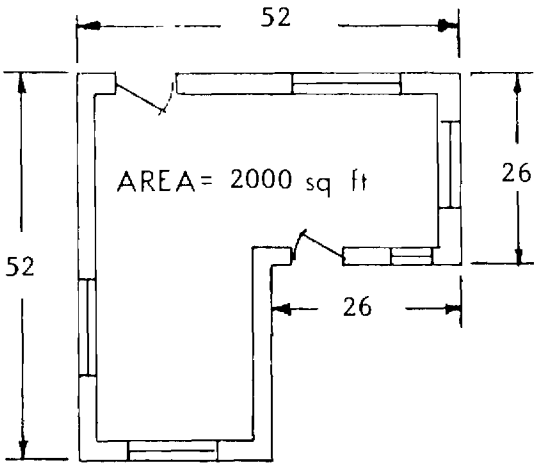


ONE STORY ELL SHAPED
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE = 1

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	3.5%	$ 0.	$ 2.	$ 1.
	New Orleans Louisiana	3.5%	4.	12.	
	Houston Texas	3.5%	1.	9.	
Zone II	Atlanta Georgia	3.5%	8.	15.	13.
	San Francisco California	3.5%	7.	23.	
	Ft Worth Texas	3.5%	8.	21.	10.
Zone III	Louisville Kentucky	3.5%	10.	23.	21.
	St Louis Missouri	3.5%	12.	32.	22.
	Seattle Washington	3.5%	15.	13.	20.
Zone IV	Boston Massachusetts	3.8%	27.	22.	27.
	Chicago Illinois	3.8%	21.	63.	33.
	Spokane Washington	3.8%	23.	18.	33.
Zone V	Caribou Maine	3.8%		49.	46.
	Duluth Minnesota	3.8%	34.	62.	42.
	Glasgow Montana	3.8%	12.	36.	37.

Based on utility rates in effect August 1976

TABLE 53

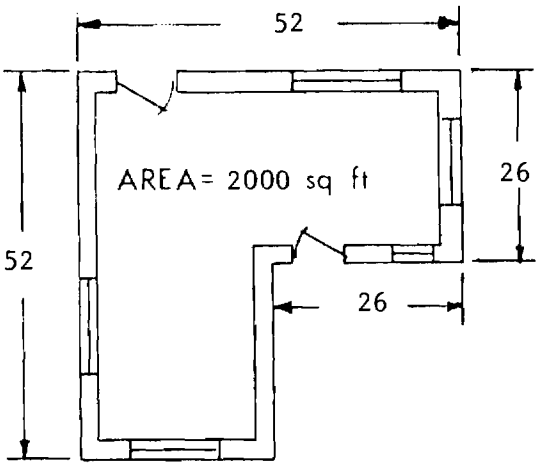


ONE STORY ELL SHAPED
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE = 2

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	5.7%	$ 0.	$ 3.	$ 1.
	New Orleans Louisiana	5.7%	6.	19.	
	Houston Texas	5.7%	1.	15.	
Zone II	Atlanta Georgia	5.7%	13.	25.	22.
	San Francisco California	5.7%	12.	37.	
	Ft Worth Texas	5.7%	14.	34.	16.
Zone III	Louisville Kentucky	5.7%	17.	38.	35.
	St Louis Missouri	5.7%	19.	52.	37.
	Seattle Washington	5.7%	24.	22.	33.
Zone IV	Boston Massachusettes	6.2%	45.	37.	44.
	Chicago Illinois	6.2%	34.	103.	55.
	Spokane Washington	6.2%	38.	30.	53.
Zone V	Caribou Maine	6.2%		80.	75.
	Duluth Minnesota	6.2%	56.	102.	70.
	Glasgow Montana	6.2%	20.	59.	61.

*Based on utility rates in effect August 1976

TABLE 54

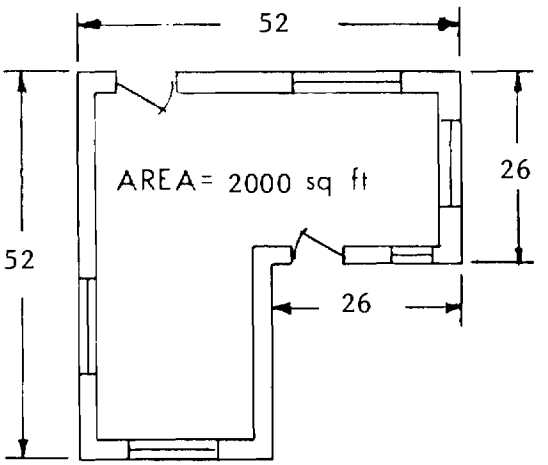


ONE STORY ELL SHAPED
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE = 3

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	7.2%	$ 1.	$ 3.	$ 2.
	New Orleans Louisiana	7.2%	8.	24.	
	Houston Texas	7.2%	1.	20.	
Zone II	Atlanta Georgia	7.2%	17.	32.	28.
	San Francisco California	7.2%	15.	47.	
	Ft Worth Texas	7.2%	17.	44.	21.
Zone III	Louisville Kentucky	7.2%	21.	48.	44.
	St Louis Missouri	7.2%	25.	66.	47.
	Seattle Washington	7.2%	31.	28.	42.
Zone IV	Boston Massachusettes	7.9%	57.	47.	56.
	Chicago Illinois	7.9%	43.	131.	69.
	Spokane Washington	7.9%	49.	38.	68.
Zone V	Caribou Maine	7.9%		101.	96.
	Duluth Minnesota	7.9%	72.	130.	89.
	Glasgow Montana	7.9%	26.	75.	78.

*Based on utility rates in effect August 1976

TABLE 55

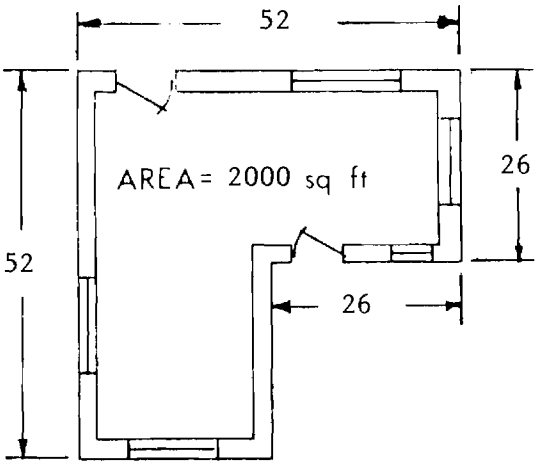


ONE STORY ELL SHAPED
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE = 4

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	8.4%	$ 1.	$ 4.	$ 2.
	New Orleans Louisiana	8.4%	9.	28.	
	Houston Texas	8.4%	2.	23.	
Zone II	Atlanta Georgia	8.4%	20.	37.	32.
	San Francisco California	8.4%	17.	54.	
	Ft Worth Texas	8.4%	20.	51.	24.
Zone III	Louisville Kentucky	8.4%	25.	56.	51.
	St Louis Missouri	8.4%	29.	77.	54.
	Seattle Washington	8.4%	35.	32.	49.
Zone IV	Boston Massachusettes	9.2%	66.	54.	65.
	Chicago Illinois	9.2%	50.	152.	80.
	Spokane Washington	9.2%	56.	44.	79.
Zone V	Caribou Maine	9.2%		117.	111.
	Duluth Minnesota	9.2%	83.	150.	102.
	Glasgow Montana	9.2%	30.	87.	90.

*Based on utility rates in effect August 1976

TABLE 56

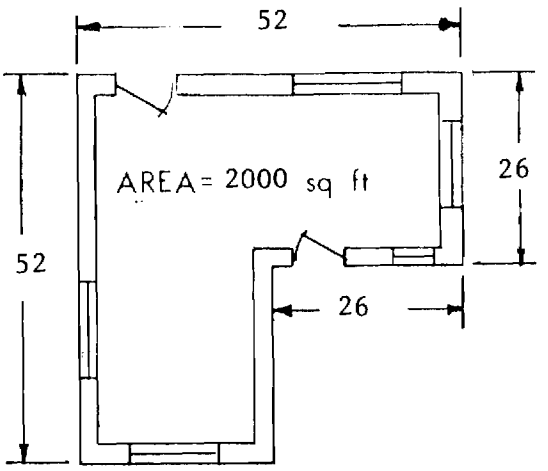


ONE STORY ELL SHAPED
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE = 1

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	6.1%	$ 0.	$ 3.	$ 1.
	New Orleans Louisiana	6.2%	6.	20.	
	Houston Texas	6.2%	1.	16.	
Zone II	Atlanta Georgia	6.2%	14.	26.	23.
	San Francisco California	6.2%	12.	38.	
	Ft Worth Texas	6.2%	14.	36.	17.
Zone III	Louisville Kentucky	6.2%	18.	40.	36.
	St Louis Missouri	6.2%	20.	54.	38.
	Seattle Washington	6.2%	25.	23.	35.
Zone IV	Boston Massachusetts	6.8%	47.	39.	46.
	Chicago Illinois	6.8%	35.	108.	57.
	Spokane Washington	6.8%	40.	31.	56.
Zone V	Caribou Maine	6.8%		84.	79.
	Duluth Minnesota	6.8%	59.	107.	73.
	Glasgow Montana	6.8%	21.	62.	64.

*Based on utility rates in effect August 1976

TABLE 57

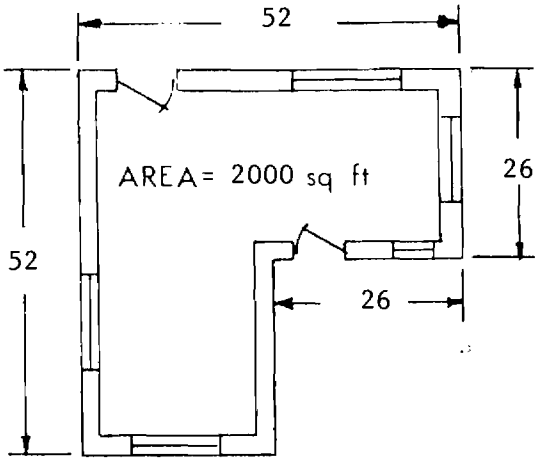


ONE STORY ELL SHAPED
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE = 2

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	8.8%	$ 1.	$ 4.	$ 2.
	New Orleans Louisiana	8.5%	9.	28.	
	Houston Texas	8.5%	2.	22.	
Zone II	Atlanta Georgia	8.3%	19.	36.	31.
	San Francisco California	8.6%	17.	53.	
	Ft Worth Texas	8.4%	19.	49.	23.
Zone III	Louisville Kentucky	8.3%	23.	53.	49.
	St Louis Missouri	8.3%	27.	73.	51.
	Seattle Washington	8.4%	34.	31.	47.
Zone IV	Boston Massachusettes	9.1%	63.	51.	62.
	Chicago Illinois	9.0%	47.	143.	76.
	Spokane Washington	9.0%	53.	41.	74
Zone V	Caribou Maine	9.0%		110.	104.
	Duluth Minnesota	9.0%	78.	141.	96.
	Glasgow Montana	8.9%	28.	81.	84.

*Based on utility rates in effect August 1976

TABLE 58

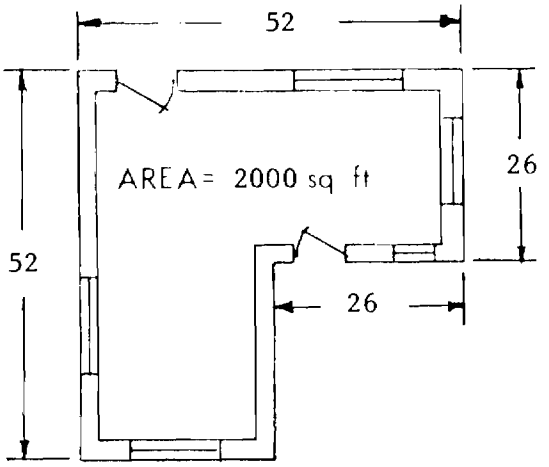


ONE STORY ELL SHAPED
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE = 3

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	11.9%	$ 1.	$ 5.	$ 2.
	New Orleans Louisiana	11.1%	11.	36.	
	Houston Texas	11.0%	2.	28.	
Zone II	Atlanta Georgia	10.7%	24.	46.	40.
	San Francisco California	11.3%	22.	70.	
	Ft Worth Texas	10.7%	25.	62.	30.
Zone III	Louisville Kentucky	10.5%	30.	68.	62.
	St Louis Missouri	10.5%	34.	92.	65.
	Seattle Washington	10.8%	44.	40.	61.
Zone IV	Boston Massachusettes	11.5%	79.	65.	79.
	Chicago Illinois	11.4%	59.	180.	95.
	Spokane Washington	11.4%	67.	52.	94.
Zone V	Caribou Maine	11.2%		138.	130.
	Duluth Minnesota	11.2%	97.	176.	120.
	Glasgow Montana	11.2%	35.	101.	105.

*Based on utility rates in effect August 1976

TABLE 59

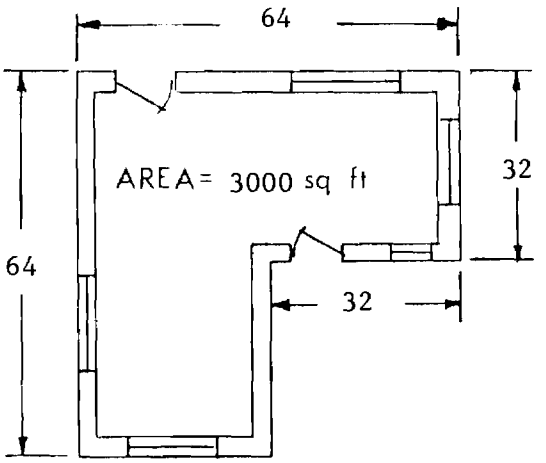


ONE STORY ELL SHAPED
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE = 4

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	15.0%	$ 1.	$ 7.	$ 3.
	New Orleans Louisiana	13.8%	14.	45.	
	Houston Texas	13.5%	2.	35.	
Zone II	Atlanta Georgia	13.0%	29.	56.	48.
	San Francisco California	14.0%	28.	87.	
	Ft Worth Texas	13.1%	30.	76.	36.
Zone III	Louisville Kentucky	12.7%	36.	82.	75.
	St Louis Missouri	12.7%	42.	112.	79.
	Seattle Washington	13.3%	54.	48.	75.
Zone IV	Boston Massachusettes	13.9%	96.	79.	95.
	Chicago Illinois	13.7%	71.	217.	115.
	Spokane Washington	13.7%	81.	63.	113.
Zone V	Caribou Maine	13.5%		165.	156.
	Duluth Minnesota	13.5%	117.	212.	144.
	Glasgow Montana	13.4%	42.	121.	126.

*Based on utility rates in effect August 1976

TABLE 60

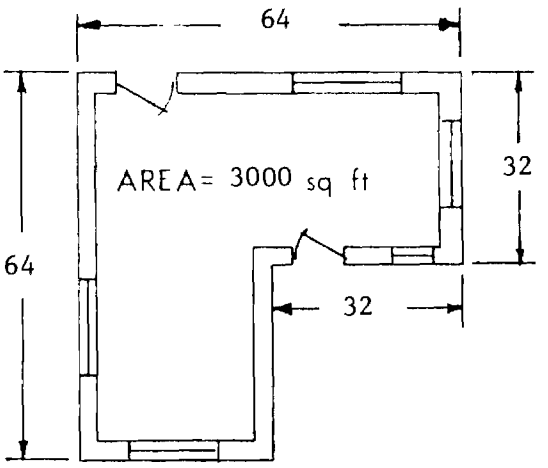


ONE STORY ELL SHAPED
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE = 1

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	3.7%	$ 0.	$ 2.	$ 1.
	New Orleans Louisiana	3.7%	5.	18.	
	Houston Texas	3.7%	1.	14.	
Zone II	Atlanta Georgia	3.7%	12.	23.	20.
	San Francisco California	3.7%	11.	34.	
	Ft Worth Texas	3.7%	12.	31.	15.
Zone III	Louisville Kentucky	3.7%	15.	35.	32.
	St Louis Missouri	3.7%	18.	48.	34.
	Seattle Washington	3.7%	22.	20.	31.
Zone IV	Boston Massachusettes	4.0%	41.	34.	41.
	Chicago Illinois	4.0%	31.	94.	50.
	Spokane Washington	4.0%	35.	27.	49.
Zone V	Caribou Maine	4.0%		73.	69.
	Duluth Minnesota	4.0%	51.	93.	64.
	Glasgow Montana	4.0%	19.	54.	56.

*Based on utility rates in effect August 1976

TABLE 61

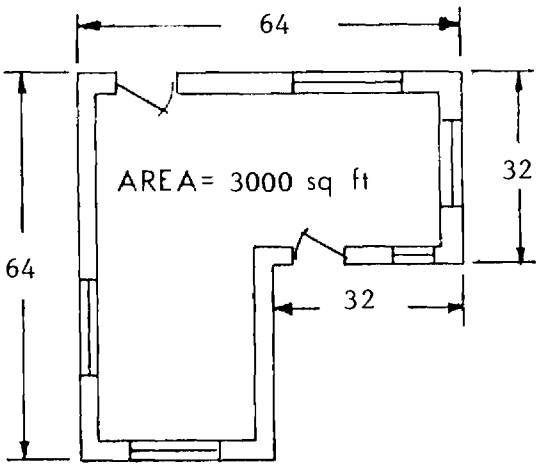


ONE STORY ELL SHAPED
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE = 2

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	6.0%	$ 1.	$ 4.	$ 2.
	New Orleans Louisiana	6.0%	9.	29.	
	Houston Texas	6.0%	2.	23.	
Zone II	Atlanta Georgia	6.0%	20.	38.	33.
	San Francisco California	6.0%	18.	55.	
	Ft Worth Texas	6.0%	20.	52.	25
Zone III	Louisville Kentucky	6.0%	25.	57.	52.
	St Louis Missouri	6.0%	29.	78.	55.
	Seattle Washington	6.0%	36.	33.	50.
Zone IV	Boston Massachusettes	6.6%	67.	55.	67.
	Chicago Illinois	6.6%	51.	155.	82.
	Spokane Washington	6.6%	57.	45.	80.
Zone V	Caribou Maine	6.6%		120.	113.
	Duluth Minnesota	6.6%	84.	153.	104.
	Glasgow Montana	6.6%	30.	88.	91.

*Based on utility rates in effect August 1976

TABLE 62

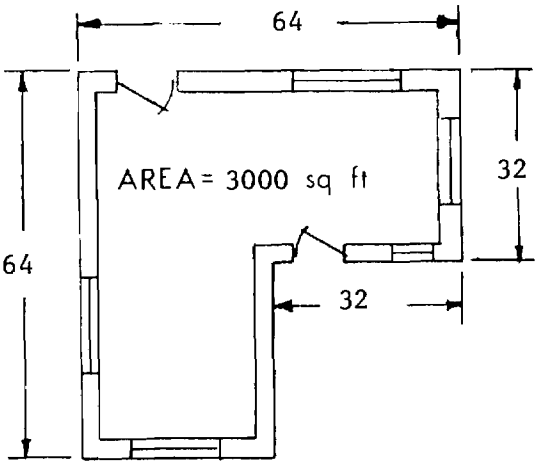


ONE STORY ELL SHAPED
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE = 3

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	7.6%	$ 1.	$ 5.	$ 2.
	New Orleans Louisiana	7.6%	11.	37.	
	Houston Texas	7.6%	2.	29.	
Zone II	Atlanta Georgia	7.6%	25.	48.	42.
	San Francisco California	7.6%	22.	70.	
	Ft Worth Texas	7.6%	26.	66.	31.
Zone III	Louisville Kentucky	7.6%	32.	73.	67.
	St Louis Missouri	7.6%	37.	99.	70.
	Seattle Washington	7.6%	46.	41.	64.
Zone IV	Boston Massachusettes	8.4%	85.	70.	85.
	Chicago Illinois	8.4%	65.	197.	104.
	Spokane Washington	8.4%	73%	57.	102.
Zone V	Caribou Maine	8.4%		152.	144.
	Duluth Minnesota	8.4%	107.	195.	133.
	Glasgow Montana	8.4%	39.	112.	116.

*Based on utility rates in effect August 1976

TABLE 63

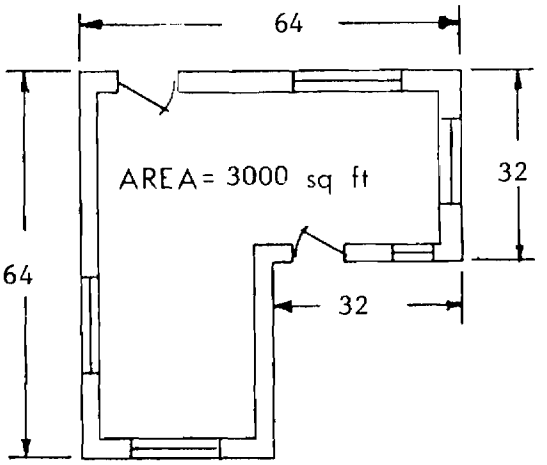


ONE STORY ELL SHAPED
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE = 4

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	8.8%	$ 1.	$ 6.	$ 3.
	New Orleans Louisiana	8.8%	13.	42.	
	Houston Texas	8.8%	2.	34.	
Zone II	Atlanta Georgia	8.8%	29.	56.	49.
	San Francisco California	8.8%	26.	82.	
	Ft Worth Texas	8.8%	30.	76.	36.
Zone III	Louisville Kentucky	8.8%	37.	84.	77.
	St Louis Missouri	8.8%	43.	115.	81.
	Seattle Washington	8.8%	53.	48.	74.
Zone IV	Boston Massachusettes	9.7%	99.	81.	98.
	Chicago Illinois	9.7%	75.	227.	121.
	Spokane Washington	9.7%	84.	66.	118.
Zone V	Caribou Maine	9.7%		176.	166.
	Duluth Minnesota	9.7%	124.	225.	154.
	Glasgow Montana	9.7%	45.	130.	135.

*Based on utility rates in effect August 1976

TABLE 64

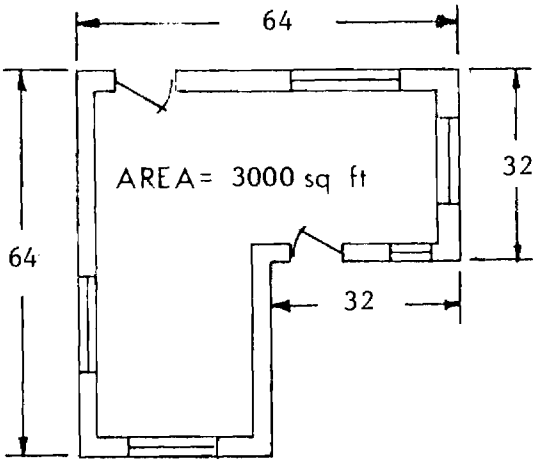


ONE STORY ELL SHAPED
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE = 1

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	5.9%	$ 1.	$ 4.	$ 2.
	New Orleans Louisiana	6.0%	8.	27.	
	Houston Texas	6.0%	1.	22.	
Zone II	Atlanta Georgia	6.1%	19.	36.	31.
	San Francisco California	6.0%	16.	52.	
	Ft Worth Texas	6.0%	19.	49.	23.
Zone III	Louisville Kentucky	6.1%	24.	55.	50.
	St Louis Missouri	6.1%	28.	75.	53.
	Seattle Washington	6.0%	34.	31.	47.
Zone IV	Boston Massachusettes	6.7%	64.	53.	64.
	Chicago Illinois	6.8%	49.	149.	79.
	Spokane Washington	6.8%	55.	43.	77.
Zone V	Caribou Maine	6.8%		116.	109.
	Duluth Minnesota	6.8%	82.	148.	101.
	Glasgow Montana	6.8%	30.	86.	89.

*Based on utility rates in effect August 1976

TABLE 65

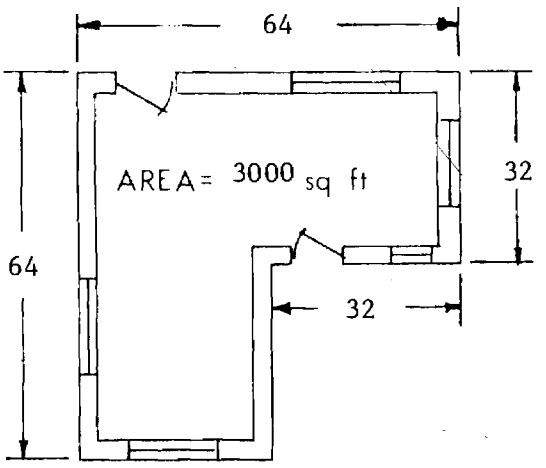


ONE STORY ELL SHAPED
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE= 2

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	8.4%	$ 1.	$ 5.	$ 2.
	New Orleans Louisiana	8.3%	12.	37.	
	Houston Texas	8.2%	2.	30.	
Zone II	Atlanta Georgia	8.2%	26.	49.	42.
	San Francisco California	8.3%	23.	72.	
	Ft Worth Texas	8.2%	26.	66.	32.
Zone III	Louisville Kentucky	8.1%	32.	73.	67.
	St Louis Missouri	8.1%	37.	100.	71.
	Seattle Washington	8.2%	46.	42.	64.
Zone IV	Boston Massachusettes	9.0%	86.	71.	85.
	Chicago Illinois	9.0%	65.	198.	105.
	Spokane Washington	9.0%	73.	57.	103.
Zone V	Caribou Maine	8.9%		153.	144.
	Duluth Minnesota	8.9%	108.	196.	133.
	Glasgow Montana	8.9%	39.	113.	117.

*Based on utility rates in effect August 1976

TABLE 66

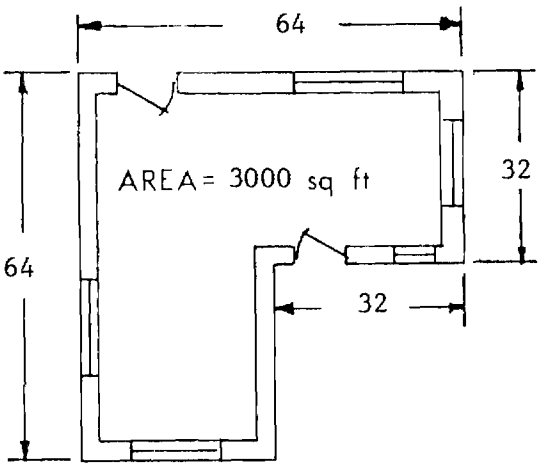


ONE STORY ELL SHAPED
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE = 3

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	11.3%	$ 1.	$ 7.	$ 3.
	New Orleans Louisiana	10.8%	15.	49.	
	Houston Texas	10.7%	3.	39.	
Zone II	Atlanta Georgia	10.5%	33.	63.	54.
	San Francisco California	10.9%	30.	94.	
	Ft Worth Texas	10.5%	34.	85.	41.
Zone III	Louisville Kentucky	10.3%	41.	93.	85.
	St Louis Missouri	10.3%	47.	127.	90.
	Seattle Washington	10.6%	60.	54.	83.
Zone IV	Boston Massachusettes	11.4%	109.	90.	108.
	Chicago Illinois	11.3%	82.	249.	132.
	Spokane Washington	11.3%	93.	72.	130.
Zone V	Caribou Maine	11.2%		192.	181.
	Duluth Minnesota	11.2%	135.	245.	167.
	Glasgow Montana	11.2%	49.	141.	146.

*Based on utility rates in effect August 1976

TABLE 67

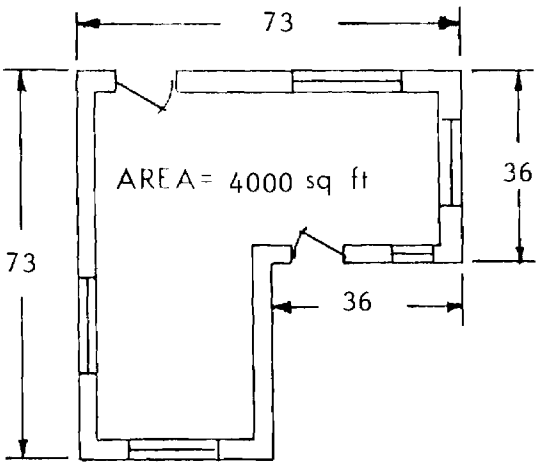


ONE STORY ELL SHAPED
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE = 4

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	14.2%	$ 1.	$ 9.	$ 4.
	New Orleans Louisiana	13.3%	19.	60.	
	Houston Texas	13.1%	3.	47.	
Zone II	Atlanta Georgia	12.8%	40.	76.	66.
	San Francisco California	13.5%	37.	117.	
	Ft Worth Texas	12.8%	41.	104.	49.
Zone III	Louisville Kentucky	12.5%	50.	113.	103.
	St Louis Missouri	12.5%	58.	154.	109.
	Seattle Washington	12.9%	73.	66.	102.
Zone IV	Boston Massachusetts	13.8%	132.	109.	131.
	Chicago Illinois	13.7%	99.	301.	160.
	Spokane Washington	13.7%	112.	87.	156.
Zone V	Caribou Maine	13.5		230.	218.
	Duluth Minnesota	13.5%	162.	295.	201.
	Glasgow Montana	13.4%	58.	169.	175.

*Based on utility rates in effect August 1976

TABLE 68

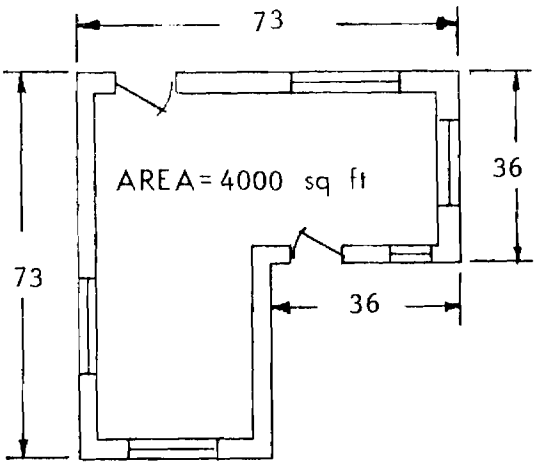


ONE STORY ELL SHAPED
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE = 1

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	3.8%	$ 0.	$ 3.	$ 2.
	New Orleans Louisiana	3.8%	7.	23.	
	Houston Texas	3.8%	1.	19.	
Zone II	Atlanta Georgia	3.8%	16.	31.	27.
	San Francisco California	3.8%	14.	45.	
	Ft Worth Texas	3.8%	17.	42.	20.
Zone III	Louisville Kentucky	3.8%	20.	46.	43.
	St Louis Missouri	3.8%	24.	63.	45.
	Seattle Washington	3.8%	29.	26.	41.
Zone IV	Boston Massachusettes	4.2%	55.	45.	54.
	Chicago Illinois	4.2%	41.	126.	67.
	Spokane Washington	4.2%	47.	36.	65.
Zone V	Caribou Maine	4.2%		97.	92.
	Duluth Minnesota	4.2%	69.	124.	85.
	Glasgow Montana	4.2%	25.	72.	74.

*Based on utility rates in effect August 1976

TABLE 69

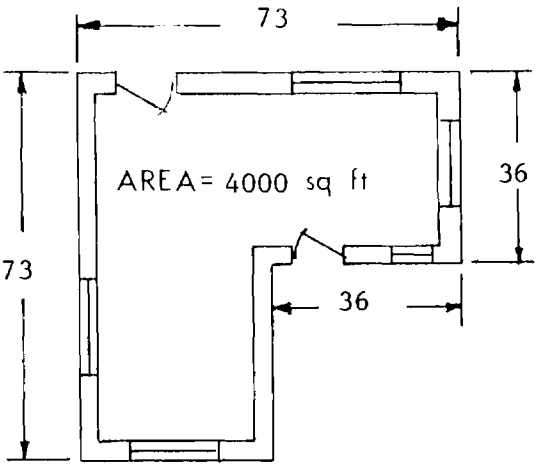


ONE STORY ELL SHAPED
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE = 2

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	6.2%	$ 1.	$ 5.	$ 2.
	New Orleans Louisiana	6.2%	12.	38.	
	Houston Texas	6.2%	2.	31.	
Zone II	Atlanta Georgia	6.2%	27.	51.	44.
	San Francisco California	6.2%	24.	74.	
	Ft Worth Texas	6.2%	27.	69.	33.
Zone III	Louisville Kentucky	6.2%	34.	76.	70.
	St Louis Missouri	6.2%	39.	104.	73.
	Seattle Washington	6.2%	48.	43.	67.
Zone IV	Boston Massachusettes	6.8%	90.	74.	89.
	Chicago Illinois	6.8%	68.	206.	109.
	Spokane Washington	6.8%	77.	60.	107.
Zone V	Caribou Maine	6.8%		160.	151.
	Duluth Minnesota	6.8%	112.	204.	139.
	Glasgow Montana	6.8%	41.	118.	122.

*Based on utility rates in effect August 1976

TABLE 70

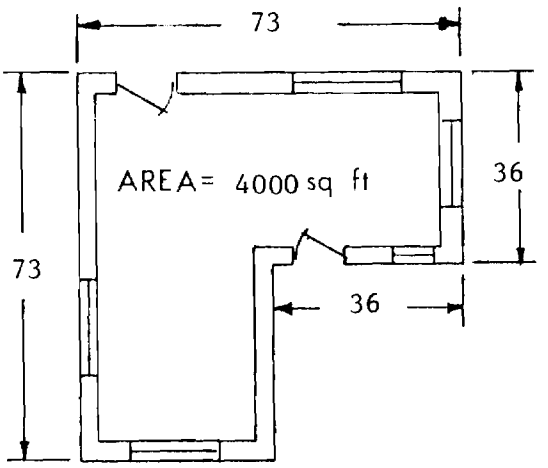


ONE STORY ELL SHAPED
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE = 3

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	7.9%	$ 1.	$ 7.	$ 3.
	New Orleans Louisiana	7.9%	15.	49.	
	Houston Texas	7.9%	3.	39.	
Zone II	Atlanta Georgia	7.9%	34.	65.	56.
	San Francisco California	7.9%	30.	94.	
	Ft Worth Texas	7.9%	35.	87.	42.
Zone III	Louisville Kentucky	7.9%	43.	97.	89.
	St Louis Missouri	7.9%	49.	132.	93.
	Seattle Washington	7.9%	61.	55.	85.
Zone IV	Boston Massachusettes	8.7%	114.	94.	113.
	Chicago Illinois	8.7%	86.	262.	139.
	Spokane Washington	8.7%	97.	76.	136.
Zone V	Caribou Maine	8.7%		203.	192.
	Duluth Minnesota	8.7%	143.	260.	177.
	Glasgow Montana	8.7%	52.	150.	155.

*Based on utility rates in effect August 1976

TABLE 71

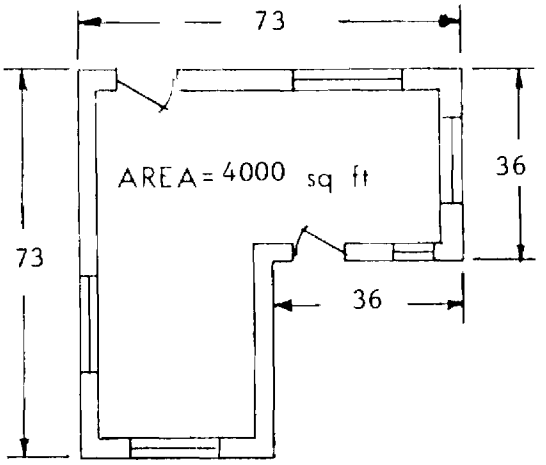


ONE STORY ELL SHAPED
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE = 4

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	9.1%	$ 1.	$ 8.	$ 4.
	New Orleans Louisiana	9.1%	18.	57.	
	Houston Texas	9.1%	3.	45.	
Zone II	Atlanta Georgia	9.1%	39.	75.	65.
	San Francisco California	9.1%	35.	109.	
	Ft Worth Texas	9.1%	40.	101.	48.
Zone III	Louisville Kentucky	9.1%	49.	112.	103.
	St Louis Missouri	9.1%	57.	153.	108.
	Seattle Washington	9.1%	71.	64.	98.
Zone IV	Boston Massachusettes	10.1%	132.	108.	131.
	Chicago Illinois	10.1%	100.	303.	161.
	Spokane Washington	10.1%	113.	88.	157.
Zone V	Caribou Maine	10.1%		235.	222.
	Duluth Minnesota	10.1%	166.	301.	205.
	Glasgow Montana	10.1%	60.	173.	179.

*Based on utility rates in effect August 1976

TABLE 72

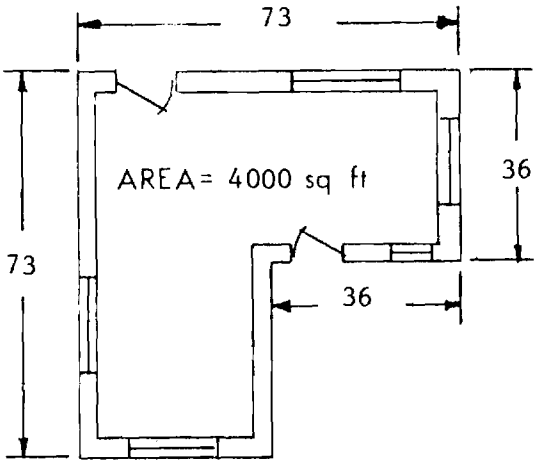


ONE STORY ELL SHAPED
CONCRETE SLAB CONSTRUCTION
CARPETING R - VALUE = 1

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	5.7%	$ 1.	$ 4.	$ 2.
	New Orleans Louisiana	5.9%	11.	34.	
	Houston Texas	5.9%	2.	27.	
Zone II	Atlanta Georgia	6.0%	24.	45.	39.
	San Francisco California	5.8%	20.	64.	
	Ft Worth Texas	5.9%	24.	61.	29.
Zone III	Louisville Kentucky	6.0%	30.	69.	63.
	St Louis Missouri	6.0%	35.	94.	67.
	Seattle Washington	5.9%	43.	39.	59.
Zone IV	Boston Massachusettes	6.7%	81.	67.	81.
	Chicago Illinois	6.7%	62.	188.	100.
	Spokane Washington	6.7%	70.	54.	97.
Zone V	Caribou Maine	6.8%		147.	139.
	Duluth Minnesota	6.8%	103.	188.	128.
	Glasgow Montana	6.8%	37.	108.	112.

*Based on utility rates in effect August 1976

TABLE 73

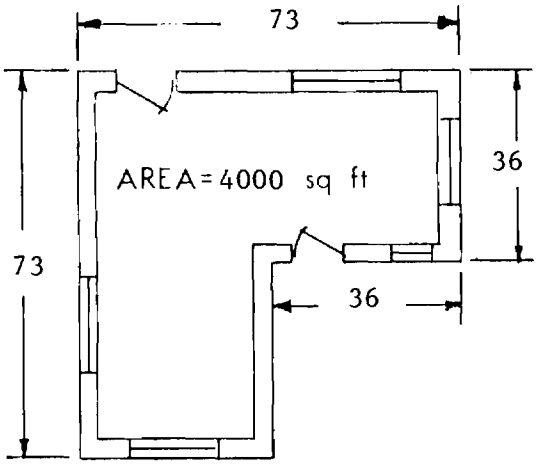


ONE STORY ELL SHAPED
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE = 2

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	8.1%	$ 1.	$ 6.	$ 3.
	New Orleans Louisiana	8.1%	14.	46.	
	Houston Texas	8.1%	3.	37.	
Zone II	Atlanta Georgia	8.0%	32.	61.	53.
	San Francisco California	8.1%	28.	89.	
	Ft Worth Texas	8.0%	33.	83.	40.
Zone III	Louisville Kentucky	8.0%	41.	92.	85.
	St Louis Missouri	8.0%	47.	126.	89.
	Seattle Washington	8.1%	58.	52.	81.
Zone IV	Boston Massachusettes	8.9%	109.	89.	108.
	Chicago Illinois	8.9%	82.	250.	132.
	Spokane Washington	8.9%	93.	72.	130.
Zone V	Caribou Maine	8.9%		194.	183.
	Duluth Minnesota	8.9%	137.	248.	169.
	Glasgow Montana	8.9%	49.	143.	148

*Based on utility rates in effect August 1976

TABLE 74

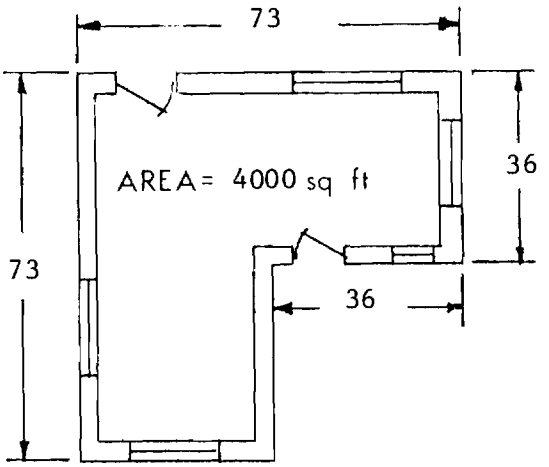


ONE STORY ELL SHAPED
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE = 3

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	10.9%	$ 1.	$ 8.	$ 4.
	New Orleans Louisiana	10.5%	19.	60.	
	Houston Texas	10.4%	3.	48.	
Zone II	Atlanta Georgia	10.3%	41.	79.	68.
	San Francisco California	10.6%	37.	116.	
	Ft Worth Texas	10.3%	42.	107.	51.
Zone III	Louisville Kentucky	10.2%	52.	117.	107.
	St Louis Missouri	10.2%	60.	160.	113.
	Seattle Washington	10.4%	75.	67.	104.
Zone IV	Boston Massachusettes	11.4%	138.	113.	137.
	Chicago Illinois	11.3%	104.	316.	167.
	Spokane Washington	11.3%	117.	91.	164.
Zone V	Caribou Maine	11.2%		243.	230.
	Duluth Minnesota	11.2%	172.	311.	212.
	Glasgow Montana	11.2%	62.	179.	186.

*Based on utility rates in effect August 1976

TABLE 75

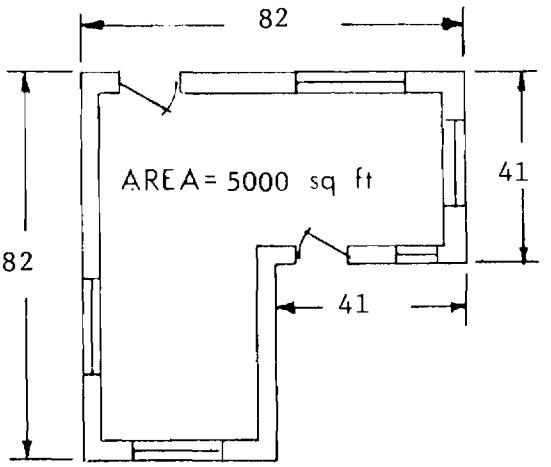


ONE STORY ELL SHAPED
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE = 4

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	13.7%	$ 2.	$ 11.	$ 5.
	New Orleans Louisiana	13.0%	23.	74.	
	Houston Texas	12.8%	4.	59.	
Zone II	Atlanta Georgia	12.6%	50.	96.	83.
	San Francisco California	13.1%	46.	144.	
	Ft Worth Texas	12.6%	52.	130.	62.
Zone III	Louisville Kentucky	12.4%	63.	142.	130.
	St Louis Missouri	12.4%	73.	194.	137.
	Seattle Washington	12.7%	91.	82.	127.
Zone IV	Boston Massachusettes	13.8%	167.	137.	166.
	Chicago Illinois	13.6%	125.	381.	202.
	Spokane Washington	13.6%	142.	110.	198.
Zone V	Caribou Maine	13.5%		293.	276.
	Duluth Minnesota	13.5%	206.	375.	256.
	Glasgow Montana	13.4%	74.	215.	223.

*Based on utility rates in effect August 1976

TABLE 76

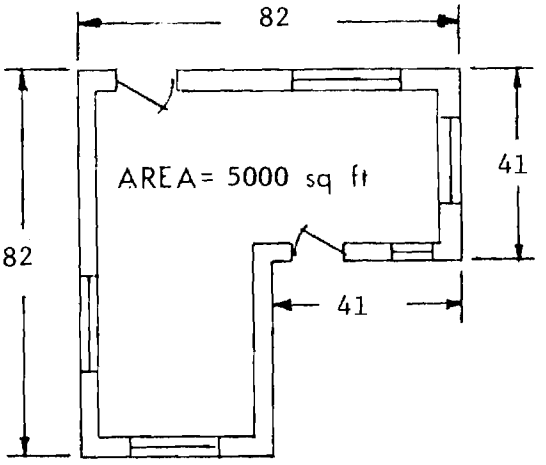


ONE STORY ELL SHAPED
COMMERCIAL CONSTRUCTION
CARPETING R-VALUE = 1

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	5.8%	$ 1.	$ 5.	$ 2.
	New Orleans Louisiana	6.0%	12.	40.	
	Houston Texas	6.1%	2.	32.	
Zone II	Atlanta Georgia	6.2%	29.	54.	47.
	San Francisco California	6.0%	24.	76.	
	Ft Worth Texas	6.2%	29.	73.	35.
Zone III	Louisville Kentucky	6.2%	36.	83.	76.
	St Louis Missouri	6.2%	42.	113.	80.
	Seattle Washington	6.1%	51.	46.	71.
Zone IV	Boston Massachusettes	7.0%	97.	80.	97.
	Chicago Illinois	7.1%	74.	226.	120.
	Spokane Washington	7.1%	84.	65.	117.
Zone V	Caribou Maine	7.1%		177	167.
	Duluth Minnesota	7.1%	125.	226.	154.
	Glasgow Montana	7.1%	45.	131.	136.

*Based on utility rates in effect August 1976

TABLE 77

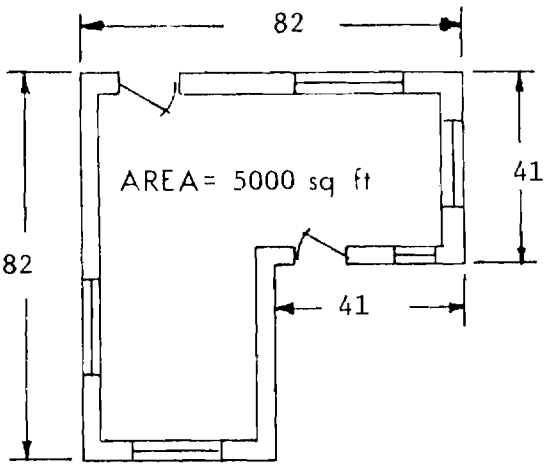


ONE STORY ELL SHAPED
COMMERCIAL CONSTRUCTION
CARPETING R-VALUE = 2

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	8.3%	$ 1.	$ 7.	$ 3.
	New Orleans Louisiana	8.3%	17.	55.	
	Houston Texas	8.3%	3.	44.	
Zone II	Atlanta Georgia	8.4%	39.	73.	64.
	San Francisco California	8.3%	34.	105.	
	Ft Worth Texas	8.3%	39.	99.	47.
Zone III	Louisville Kentucky	8.4%	49.	111.	101.
	St Louis Missouri	8.4%	57.	151.	107.
	Seattle Washington	8.3%	69.	63.	96.
Zone IV	Boston Massachusettes	9.4%	130.	107.	129.
	Chicago Illinois	9.4%	99.	301.	159.
	Spokane Washington	9.4%	112.	87.	156.
Zone V	Caribou Maine	9.4%		234.	221.
	Duluth Minnesota	9.4%	165.	299.	204.
	Glasgow Montana	9.4%	60.	172.	179.

*Based on utility rates in effect August 1976

TABLE 78

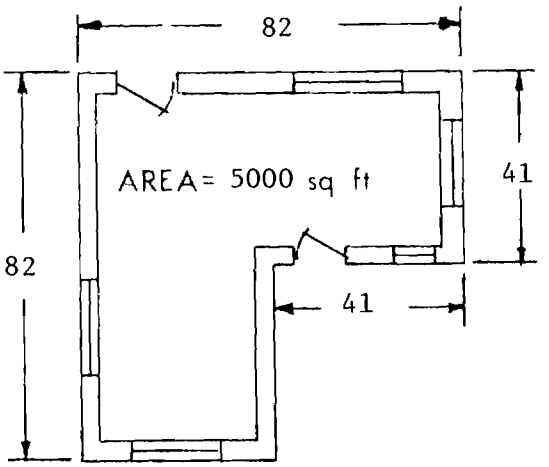


ONE STORY ELL SHAPED
COMMERCIAL CONSTRUCTION
CARPETING R-VALUE = 3

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	11.1%	$ 2.	$ 10.	$ 5.
	New Orleans Louisiana	10.8%	22.	72.	
	Houston Texas	10.8%	4.	57.	
Zone II	Atlanta Georgia	10.7%	49.	94.	81.
	San Francisco California	10.9%	44.	138.	
	Ft Worth Texas	10.7%	51.	127.	61.
Zone III	Louisville Kentucky	10.6%	62.	141.	129.
	St Louis Missouri	10.6%	72.	192.	136.
	Seattle Washington	10.7%	89.	80.	124.
Zone IV	Boston Massachusettes	11.9%	165.	136.	164.
	Chicago Illinois	11.9%	125.	380.	201.
	Spokane Washington	11.9%	141.	110.	197.
Zone V	Caribou Maine	11.8%		294.	277.
	Duluth Minnesota	11.8%	207.	376.	256.
	Glasgow Montana	11.8%	75.	216.	224.

*Based on utility rates in effect August 1976

TABLE 79

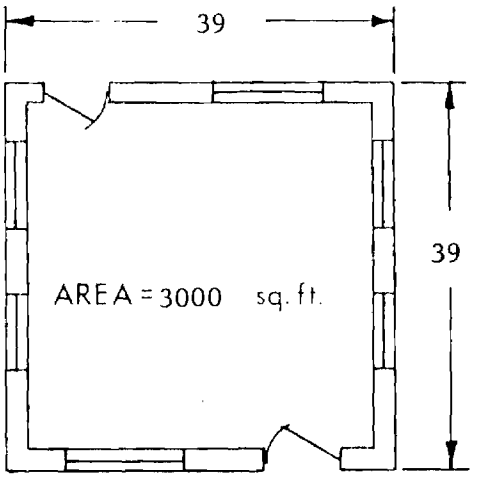


ONE STORY ELL SHAPED
COMMERCIAL CONSTRUCTION
CARPETING R-VALUE = 4

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	13.9%	$ 2.	$ 12.	$ 6.
	New Orleans Louisiana	13.4%	28.	88.	
	Houston Texas	13.2%	5.	70.	
Zone II	Atlanta Georgia	13.0%	60.	115.	99.
	San Francisco California	13.5%	54.	170.	
	Ft Worth Texas	13.1%	62.	155.	74.
Zone III	Louisville Kentucky	12.9%	75.	171.	156.
	St Louis Missouri	12.9%	87.	233.	165.
	Seattle Washington	13.1%	109.	98.	151.
Zone IV	Boston Massachusettes	14.5%	201.	165.	199.
	Chicago Illinois	14.3%	151.	459.	243.
	Spokane Washington	14.4%	171.	133.	238.
Zone V	Caribou Maine	14.2%		354.	334.
	Duluth Minnesota	14.2%	249.	452.	309.
	Glasgow Montana	14.2%	90.	260.	270.

*Based on utility rates in effect August 1976

TABLE 80

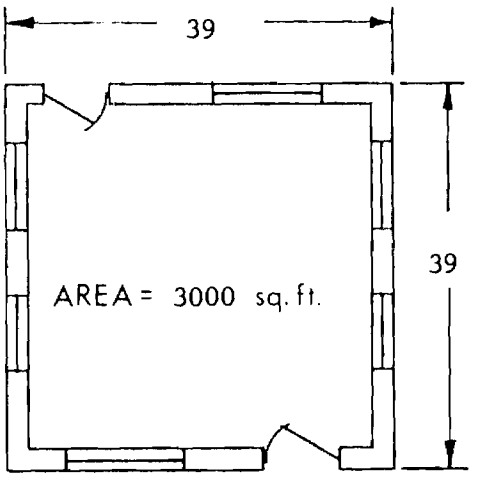


TWO STORY SQUARE
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE = 1.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	2.0%	$ 0.	$ 1.	$ 1.
	New Orleans Louisiana	2.0%	3.	9.	
	Houston Texas	2.0%	0.	7.	
Zone II	Atlanta Georgia	2.0%	6.	12.	10.
	San Francisco California	2.0%	5.	17.	
	Ft Worth Texas	2.0%	6.	16.	7.
Zone III	Louisville Kentucky	2.0%	8.	17.	16.
	St Louis Missouri	2.0%	9.	24.	17.
	Seattle Washington	2.0%	11.	10.	15.
Zone IV	Boston Massachusettes	2.3%	20.	17.	20.
	Chicago Illinois	2.3%	15.	47.	25.
	Spokane Washington	2.3%	17.	14.	24.
Zone V	Caribou Maine	2.3%		36.	34.
	Duluth Minnesota	2.3%	26.	47.	32.
	Glasgow Montana	2.3%	9.	27.	28.

*Based on utility rates in effect August 1976

TABLE 81

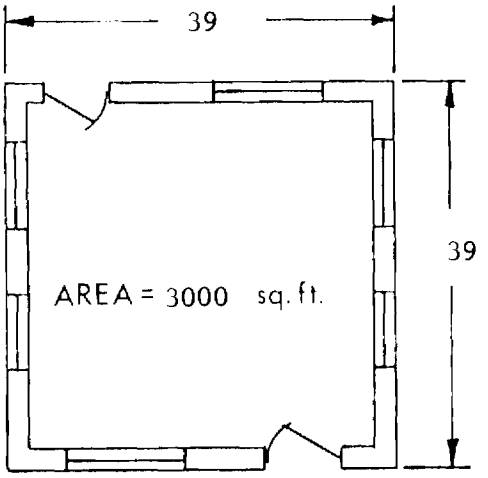


TWO STORY SQUARE
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE = 2.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	3.4%	$ 0.	$ 2.	$ 1.
	New Orleans Louisiana	3.4%	5.	14.	
	Houston Texas	3.4%	1.	12.	
Zone II	Atlanta Georgia	3.4%	10.	19.	16.
	San Francisco California	3.4%	9.	28.	
	Ft Worth Texas	3.4%	10.	26.	12.
Zone III	Louisville Kentucky	3.4%	13.	29.	26.
	St Louis Missouri	3.4%	15.	39.	28.
	Seattle Washington	3.4%	18.	16.	25.
Zone IV	Boston Massachusettes	3.7%	34.	28.	33.
	Chicago Illinois	3.7%	25.	77.	41.
	Spokane Washington	3.7%	29.	22.	40.
Zone V	Caribou Maine	3.7%		60.	56.
	Duluth Minnesota	3.7%	42.	77.	52.
	Glasgow Montana	3.7%	15.	44.	46.

*Based on utility rates in effect August 1976

TABLE 82

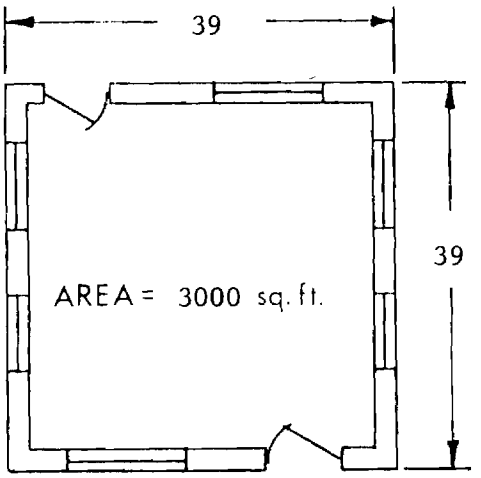


TWO STORY SQUARE
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE = 3.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	4.3%	$ 0.	$ 3.	$ 1.
	New Orleans Louisiana	4.3%	6.	18.	
	Houston Texas	4.3%	1.	15.	
Zone II	Atlanta Georgia	4.3%	13.	24.	21.
	San Francisco California	4.3%	11.	35.	
	Ft Worth Texas	4.3%	13.	33.	16.
Zone III	Louisville Kentucky	4.3%	16.	36.	33.
	St Louis Missouri	4.3%	19.	50.	35.
	Seattle Washington	4.3%	23.	21.	32.
Zone IV	Boston Massachusetts	4.8%	43.	35.	42.
	Chicago Illinois	4.8%	32.	98.	52.
	Spokane Washington	4.8%	36.	28.	51.
Zone V	Caribou Maine	4.8%		76.	72.
	Duluth Minnesota	4.8%	54.	97.	66.
	Glasgow Montana	4.8%	19.	56.	58.

*Based on utility rates in effect August 1976

TABLE 83

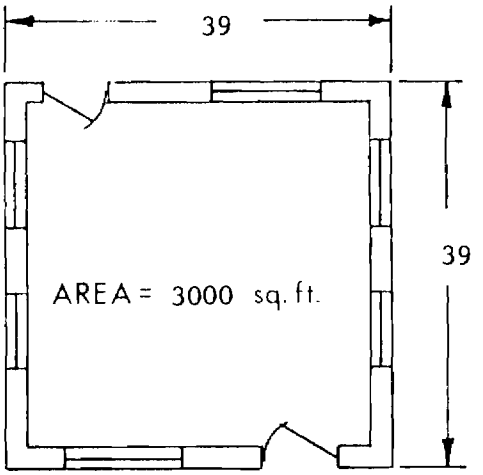


TWO STORY SQUARE
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE = 4.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	4.9%	$ 0.	$ 3.	$ 1.
	New Orleans Louisiana	4.9%	7.	21.	
	Houston Texas	4.9%	1.	17.	
Zone II	Atlanta Georgia	4.9%	15.	28.	24.
	San Francisco California	4.9%	13.	41.	
	Ft Worth Texas	4.9%	15.	38.	18.
Zone III	Louisville Kentucky	4.9%	18.	42.	39.
	St Louis Missouri	4.9%	21.	57.	41.
	Seattle Washington	4.9%	27.	24.	37.
Zone IV	Boston Massachusettes	5.5%	49.	41.	49.
	Chicago Illinois	5.5%	37.	114.	60.
	Spokane Washington	5.5%	42.	33.	59.
Zone V	Caribou Maine	5.5%		88.	83.
	Duluth Minnesota	5.5%	62.	113.	77.
	Glasgow Montana	5.5%	22.	65.	67.

*Based on utility rates in effect August 1976

TABLE 84

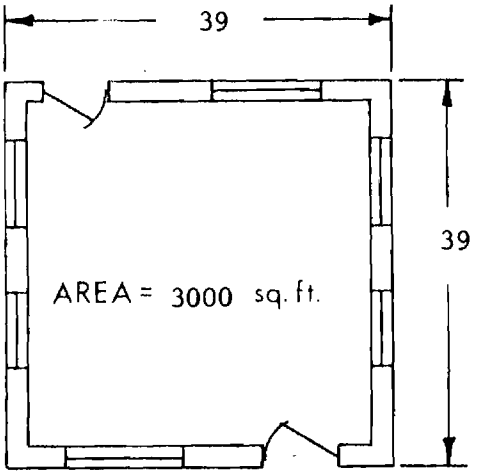


TWO STORY SQUARE
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE = 1.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	3.5%	$ 0.	$ 2.	$ 1.
	New Orleans Louisiana	3.5%	5.	15.	
	Houston Texas	3.5%	1.	12.	
Zone II	Atlanta Georgia	3.6%	10.	20.	17.
	San Francisco California	3.5%	9.	28.	
	Ft Worth Texas	3.6%	11.	27.	13.
Zone III	Louisville Kentucky	3.6%	13.	30.	27.
	St Louis Missouri	3.6%	15.	41.	29.
	Seattle Washington	3.6%	19.	17.	26.
Zone IV	Boston Massachusettes	4.0%	35.	29.	35.
	Chicago Illinois	4.0%	26.	80.	43.
	Spokane Washington	4.0%	30.	23.	42.
Zone V	Caribou Maine	4.0%		62.	59.
	Duluth Minnesota	4.0%	44.	80.	54.
	Glasgow Montana	4.0%	16.	46.	48.

*Based on utility rates in effect August 1976

TABLE 85

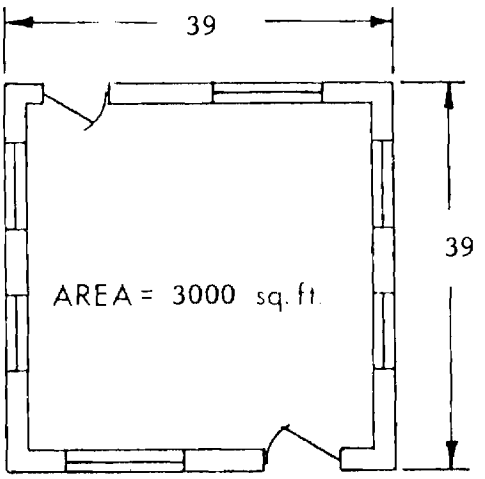


TWO STORY SQUARE
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE = 2.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	5.0%	$ 0.	$ 3.	$ 1.
	New Orleans Louisiana	4.9%	6.	20.	
	Houston Texas	4.9%	1.	16.	
Zone II	Atlanta Georgia	4.8%	14.	27.	23.
	San Francisco California	4.9%	13.	40.	
	Ft Worth Texas	4.8%	14.	36.	17.
Zone III	Louisville Kentucky	4.8%	17.	40.	36.
	St Louis Missouri	4.8%	20.	54.	38.
	Seattle Washington	4.8%	25.	23.	35.
Zone IV	Boston Massachusettes	5.3%	47.	38.	46.
	Chicago Illinois	5.3%	35.	107.	57.
	Spokane Washington	5.3%	40.	31.	55.
Zone V	Caribou Maine	5.3%		82.	78.
	Duluth Minnesota	5.3%	58.	105.	72.
	Glasgow Montana	5.2%	21.	60.	63.

*Based on utility rates in effect August 1976

TABLE 86

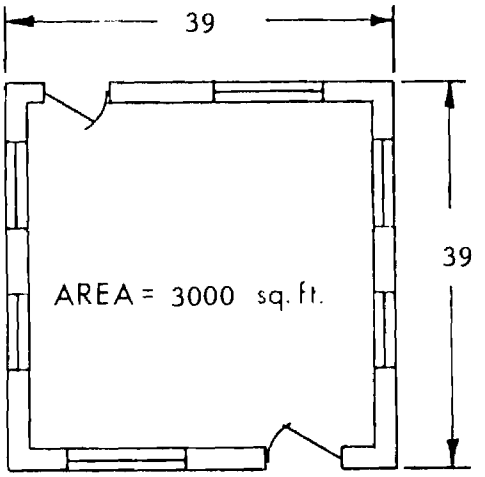


TWO STORY SQUARE
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE = 3.00

	GEOGRAPHIC LOCATION	SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	6.8%	$ 1.	$ 4.	$ 2.
	New Orleans Louisiana	6.4%	8.	27.	
	Houston Texas	6.3%	1.	21.	
Zone II	Atlanta Georgia	6.2%	18.	34.	30.
	San Francisco California	6.5%	17.	52.	
	Ft Worth Texas	6.2%	18.	46.	22.
Zone III	Louisville Kentucky	6.1%	22.	50.	46.
	St Louis Missouri	6.0%	26.	69.	49.
	Seattle Washington	6.2%	33.	29.	45.
Zone IV	Boston Massachusetts	6.7%	59.	49.	59.
	Chicago Illinois	6.7%	44.	134.	71.
	Spokane Washington	6.7%	50.	39.	70.
Zone V	Caribou Maine	6.6%		103.	97.
	Duluth Minnesota	6.6%	72.	132.	90.
	Glasgow Montana	6.6%	26.	75.	78.

*Based on utility rates in effect August 1976

TABLE 87

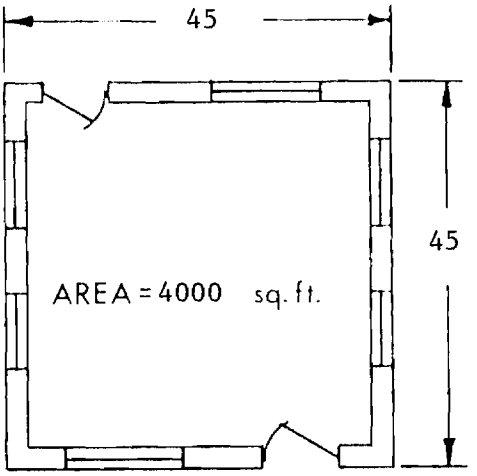


TWO STORY SQUARE
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE = 4.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	8.6%	$ 1.	$ 5.	$ 2.
	New Orleans Louisiana	7.9%	10.	33.	
	Houston Texas	7.8%	2.	26.	
Zone II	Atlanta Georgia	7.5%	22.	42.	36.
	San Francisco California	8.0%	21.	65.	
	Ft Worth Texas	7.6%	22.	57.	27.
Zone III	Louisville Kentucky	7.3%	27.	61.	56.
	St Louis Missouri	7.3%	31.	83.	59.
	Seattle Washington	7.6%	40.	36.	56.
Zone IV	Boston Massachusettes	8.2%	72.	59.	71.
	Chicago Illinois	8.0%	53.	162.	86.
	Spokane Washington	8.1%	60.	47.	84.
Zone V	Caribou Maine	7.9%		124.	117.
	Duluth Minnesota	7.9%	87.	158.	108.
	Glasgow Montana	7.9%	31.	90.	94.

*Based on utility rates in effect August 1976

TABLE 88

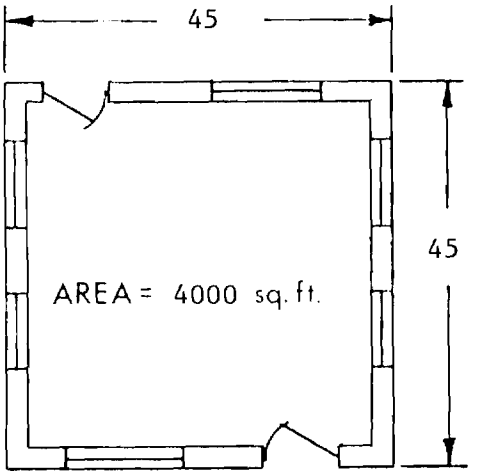


TWO STORY SQUARE
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE = 1.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	2.1%	$ 0.	$ 2.	$ 1.
	New Orleans Louisiana	2.1%	4.	12.	
	Houston Texas	2.1%	1.	9.	
Zone II	Atlanta Georgia	2.1%	8.	15.	13.
	San Francisco California	2.1%	7.	23.	
	Ft Worth Texas	2.1%	8.	21.	10.
Zone III	Louisville Kentucky	2.1%	10.	23.	21.
	St Louis Missouri	2.1%	12.	32.	22.
	Seattle Washington	2.1%	15.	13.	20.
Zone IV	Boston Massachusettes	2.4%	27.	22.	27.
	Chicago Illinois	2.4%	21.	63.	33.
	Spokane Washington	2.4%	23.	18.	33.
Zone V	Caribou Maine	2.4%		49.	46.
	Duluth Minnesota	2.4%	34.	62.	42.
	Glasgow Montana	2.4	12.	36.	37.

*Based on utility rates in effect August 1976

TABLE 89

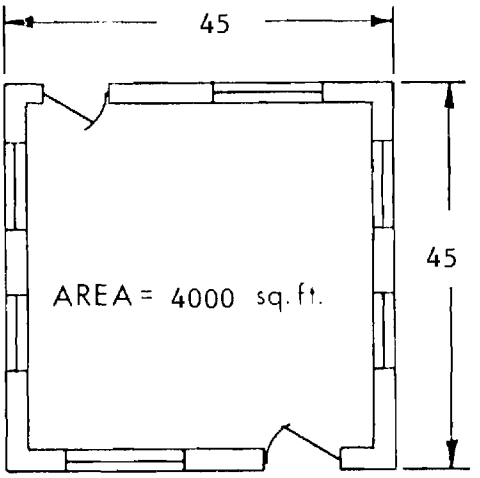


TWO STORY SQUARE
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE = 2.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	3.5%	$ 0.	$ 3.	$ 1.
	New Orleans Louisiana	3.5%	6.	19.	
	Houston Texas	3.5%	1.	15.	
Zone II	Atlanta Georgia	3.5%	13.	25.	22.
	San Francisco California	3.5%	12.	37.	
	Ft Worth Texas	3.5%	14.	34.	16.
Zone III	Louisville Kentucky	3.5%	17.	38.	35.
	St Louis Missouri	3.5%	19.	52.	37.
	Seattle Washington	3.5%	24.	22.	33.
Zone IV	Boston Massachusettes	3.9%	45.	37.	44.
	Chicago Illinois	3.9%	34.	103.	55.
	Spokane Washington	3.9%	38.	30.	53.
Zone V	Caribou Maine	3.9%		80.	75.
	Duluth Minnesota	3.9%	56.	102.	70.
	Glasgow Montana	3.9%	20.	59.	61.

*Based on utility rates in effect August 1976

TABLE 90

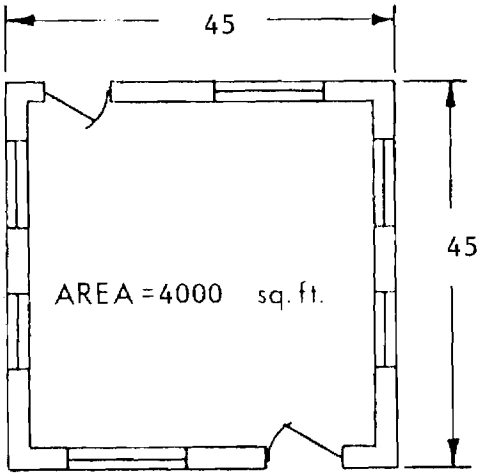


TWO STORY SQUARE
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE = 3.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	4.5%	$ 1.	$ 3.	$ 2.
	New Orleans Louisiana	4.5%	8.	24.	
	Houston Texas	4.5%	1.	20.	
Zone II	Atlanta Georgia	4.5%	17.	32.	28.
	San Francisco California	4.5%	15.	47.	
	Ft Worth Texas	4.5%	17.	44.	21.
Zone III	Louisville Kentucky	4.5%	21.	48.	44.
	St Louis Missouri	4.5%	25.	66.	47.
	Seattle Washington	4.5%	31.	28.	42.
Zone IV	Boston Massachusettes	5.0%	57.	47.	56.
	Chicago Illinois	5.0%	43.	131.	69.
	Spokane Washington	5.0%	49.	38.	68.
Zone V	Caribou Maine	5.0%		101.	96..
	Duluth Minnesota	5.0%	72.	130.	89.
	Glasgow Montana	5.0%	26.	75.	78.

*Based on utility rates in effect August 1976

TABLE 91

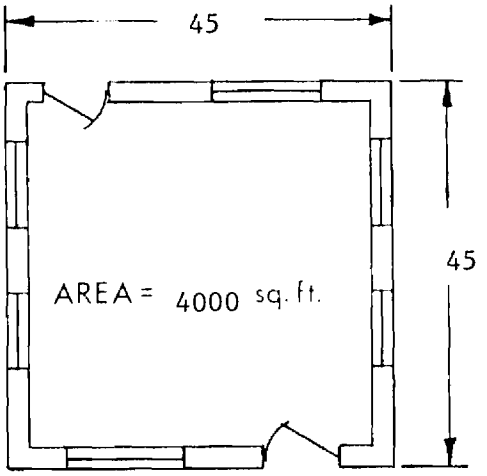


TWO STORY SQUARE
WOOD FLOOR CONSTRUCTION
CARPETING R-VALUE = 4.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	5.2%	$1.	$4.	$2.
	New Orleans Louisiana	5.2%	9.	28.	
	Houston Texas	5.2%	2.	23.	
Zone II	Atlanta Georgia	5.2%	20.	37.	32.
	San Francisco California	5.2%	17.	54.	
	El Paso Texas	5.2%	20.	51.	24.
Zone III	Louisville Kentucky	5.2%	25.	56.	51.
	St Louis Missouri	5.2%	29.	77.	54.
	Seattle Washington	5.2%	35.	32.	49.
Zone IV	Boston Massachusettes	5.8%	66.	54.	65.
	Chicago Illinois	5.8%	50.	152.	80.
	Spokane Washington	5.8%	56.	44.	79.
Zone V	Caribou Maine	5.8%		117.	111.
	Duluth Minnesota	5.8%	83.	150.	102.
	Glasgow Montana	5.8%	30.	87.	90.

*Based on utility rates in effect August 1976

TABLE 92

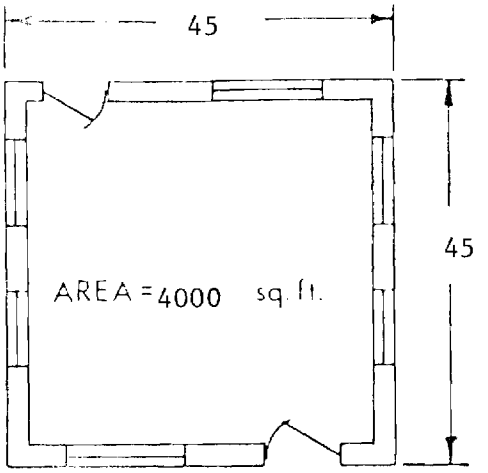


TWO STORY SQUARE
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE = 1.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	3.4%	$ 0.	$ 2.	$ 1.
	New Orleans Louisiana	3.5%	6.	18.	
	Houston Texas	3.5%	1.	15.	
Zone II	Atlanta Georgia	3.5%	13.	25.	21.
	San Francisco California	3.5%	11.	35.	
	Ft Worth Texas	3.5%	13.	33.	16.
Zone III	Louisville Kentucky	3.5%	16.	37.	34.
	St Louis Missouri	3.5%	19.	51.	36.
	Seattle Washington	3.5%	23.	21.	32.
Zone IV	Boston Massachusettes	4.0%	44.	36.	43.
	Chicago Illinois	4.0%	33.	101.	54.
	Spokane Washington	4.0%	38.	29.	52.
Zone V	Caribou Maine	4.0%		79.	74.
	Duluth Minnesota	4.0%	55.	101.	69.
	Glasgow Montana	4.0%	20.	58.	60.

*Based on utility rates in effect August 1976

TABLE 93

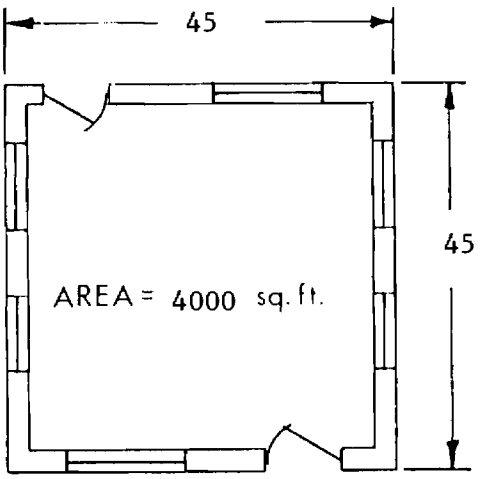


TWO STORY SQUARE
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE = 2.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	4.9%	$ 1.	$ 4.	$ 2.
	New Orleans Louisiana	4.8%	8.	25.	
	Houston Texas	4.8%	1.	20.	
Zone II	Atlanta Georgia	4.7%	17.	33.	29.
	San Francisco California	4.8%	16.	49.	
	Ft Worth Texas	4.8%	18.	45.	21.
Zone III	Louisville Kentucky	4.7%	22.	50.	46.
	St Louis Missouri	4.7%	25.	68.	48.
	Seattle Washington	4.8%	32.	28.	44.
Zone IV	Boston Massachusetts	5.3%	58.	48.	58.
	Chicago Illinois	5.3%	44.	134.	71.
	Spokane Washington	5.3%	50.	39.	70.
Zone V	Caribou Maine	5.3%		104.	98.
	Duluth Minnesota	5.3%	73.	133.	91.
	Glasgow Montana	5.3%	26.	76.	79.

*Based on utility rates in effect August 1976

TABLE 94

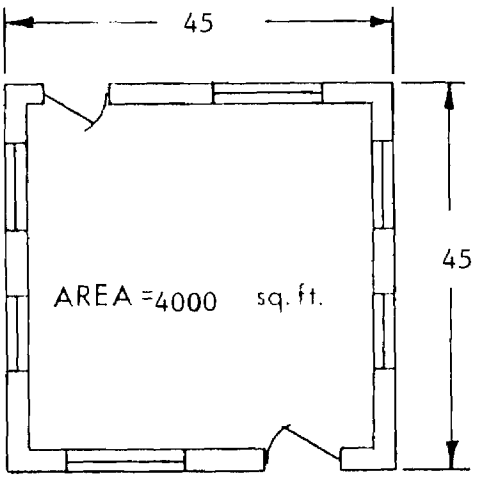


TWO STORY SQUARE
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE = 3.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	6.6%	$ 1.	$ 5.	$ 2.
	New Orleans Louisiana	6.3%	10.	33.	0.
	Houston Texas	6.2%	2.	26.	
Zone II	Atlanta Georgia	6.1%	22.	43.	37.
	San Francisco California	6.3%	20.	64.	
	Ft Worth Texas	6.1%	23.	58.	28.
Zone III	Louisville Kentucky	6.0%	28.	63.	58.
	St Louis Missouri	6.0%	32.	86.	61.
	Seattle Washington	6.1%	41.	37.	56.
Zone IV	Boston Massachusettes	6.7%	74.	61.	74.
	Chicago Illinois	6.7%	56.	169.	90.
	Spokane Washington	6.7%	63.	49.	88.
Zone V	Caribou Maine	6.6%		130.	123.
	Duluth Minnesota	6.6%	92.	166.	113.
	Glasgow Montana	6.6%	33.	95.	99.

*Based on utility rates in effect August 1976

TABLE 95

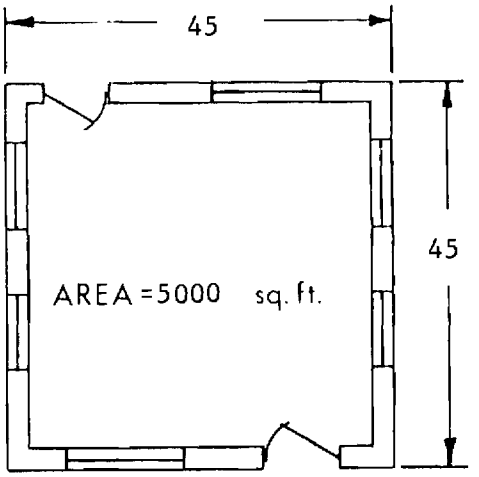


TWO STORY SQUARE
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE = 4.00

	GEOGRAPHIC LOCATION	SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	8.3%	$ 1.	$ 6.	$ 3.
	New Orleans Louisiana	7.7%	13.	41.	
	Houston Texas	7.6%	2.	32.	
Zone II	Atlanta Georgia	7.4%	27.	52.	45.
	San Francisco California	7.8%	25.	80.	
	Ft Worth Texas	7.5%	28.	71.	34.
Zone III	Louisville Kentucky	7.3%	34.	77.	70.
	St Louis Missouri	7.3%	39.	105.	74.
	Seattle Washington	7.5%	50.	45.	69.
Zone IV	Boston Massachusetts	8.2%	90.	74.	89.
	Chicago Illinois	8.1%	67.	204.	108.
	Spokane Washington	8.1%	76.	59.	106.
Zone V	Caribou Maine	7.9%		156.	148.
	Duluth Minnesota	7.9%	110.	200.	136.
	Glasgow Montana	7.9%	40.	115.	119.

*Based on utility rates in effect August 1976

TABLE 96

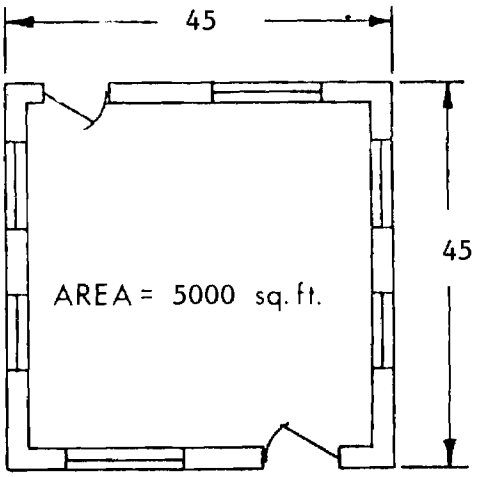


TWO STORY SQUARE
COMMERCIAL CONSTRUCTION
CARPETING R-VALUE = 1.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	3.5%	$ 0.	$ 3.	$ 1.
	New Orleans Louisiana	3.7%	7.	22.	
	Houston Texas	3.7%	1.	18.	
Zone II	Atlanta Georgia	3.7%	15.	29.	25.
	San Francisco California	3.6%	13.	42.	
	Ft Worth Texas	3.7%	16.	40.	19.
Zone III	Louisville Kentucky	3.7%	20.	44.	41.
	St Louis Missouri	3.7%	23.	61.	43.
	Seattle Washington	3.7%	28.	25.	38.
Zone IV	Boston Massachusettes	4.3%	52.	43.	52.
	Chicago Illinois	4.3%	40.	121.	64.
	Spokane Washington	4.3%	45.	35.	63.
Zone V	Caribou Maine	4.3%		94.	89.
	Duluth Minnesota	4.3%	67.	121.	82.
	Glasgow Montana	4.3%	24.	70.	72.

*Based on utility rates in effect August 1976

TABLE 97

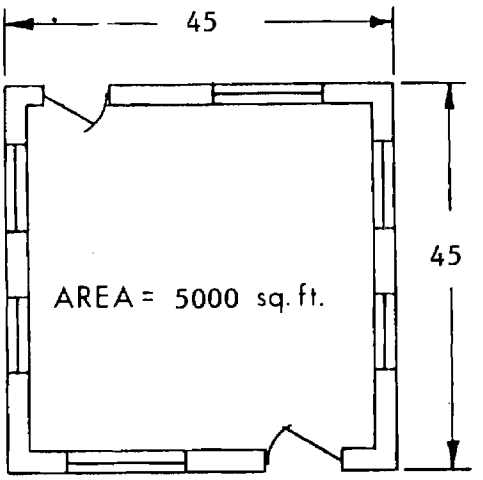


TWO STORY SQUARE
COMMERCIAL CONSTRUCTION
CARPETING R-VALUE = 2.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	5.1%	$ 1.	$ 4.	$ 2.
	New Orleans Louisiana	5.0%	9.	30.	
	Houston Texas	5.0%	2.	24.	
Zone II	Atlanta Georgia	5.0%	21.	40.	34.
	San Francisco California	5.0%	18	58.	
	Ft Worth Texas	5.0%	21.	54.	26.
Zone III	Louisville Kentucky	5.0%	26.	59.	54.
	St Louis Missouri	5.0%	30.	81.	57.
	Seattle Washington	5.0%	38.	34.	52.
Zone IV	Boston Massachusettes	5.7%	70.	57.	69.
	Chicago Illinois	5.7%	53.	161.	85.
	Spokane Washington	5.7%	60.	47.	83.
Zone V	Caribou Maine	5.7%		125.	118.
	Duluth Minnesota	5.7%	88.	159.	109.
	Glasgow Montana	5.7%	32.	92.	95.

*Based on utility rates in effect August 1976

TABLE 98

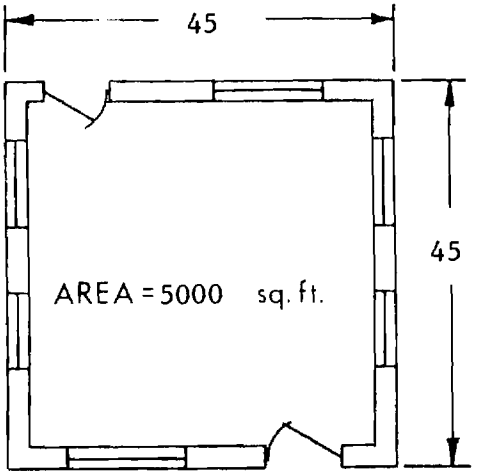


TWO STORY SQUARE
COMMERCIAL CONSTRUCTION
CARPETING R-VALUE = 3.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	6.8%	$ 1.	$ 6.	$ 3.
	New Orleans Louisiana	6.6%	12.	39.	
	Houston Texas	6.5%	2.	31.	
Zone II	Atlanta Georgia	6.4%	27.	51.	44.
	San Francisco California	6.6%	24.	76.	
	Ft Worth Texas	6.4%	27.	69.	33.
Zone III	Louisville Kentucky	6.4%	33.	76.	69.
	St Louis Missouri	6.4%	39.	103.	73.
	Seattle Washington	6.5%	48.	44.	67.
Zone IV	Boston Massachusettes	7.2%	89.	73.	88.
	Chicago Illinois	7.2%	67.	203.	108.
	Spokane Washington	7.2%	75.	59.	105.
Zone V	Caribou Maine	7.1%		156.	148.
	Duluth Minnesota	7.1%	110.	200.	136.
	Glasgow Montana	7.1%	40.	115.	119.

*Based on utility rates in effect August 1976

TABLE 99

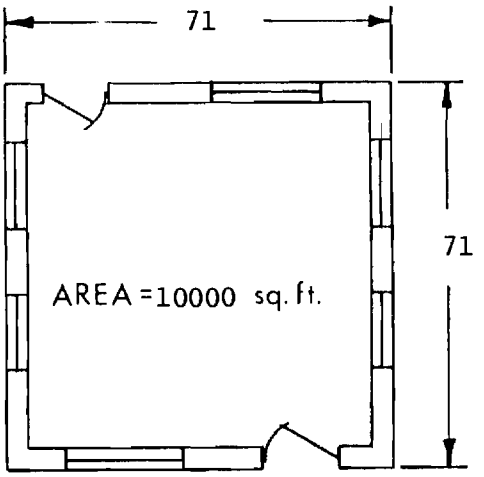


TWO STORY SQUARE
COMMERCIAL CONSTRUCTION
CARPETING R-VALUE = 4.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	8.6%	$ 1.	$ 7.	$ 3.
	New Orleans Louisiana	8.1%	15.	48.	
	Houston Texas	8.0%	3.	38.	
Zone II	Atlanta Georgia	7.8%	33.	62.	54.
	San Francisco California	8.2%	30.	94.	
	Ft Worth Texas	7.9%	33.	84.	40.
Zone III	Louisville Kentucky	7.7%	40.	92.	84.
	St Louis Missouri	7.7%	47.	125.	88.
	Seattle Washington	7.9%	59.	53.	82.
Zone IV	Boston Massachusettes	8.8%	108.	88.	107.
	Chicago Illinois	8.7%	80.	245.	130.
	Spokane Washington	8.7%	91.	71.	127.
Zone V	Caribou Maine	8.6%		188.	177.
	Duluth Minnesota	8.6%	132.	240.	164.
	Glasgow Montana	8.6%	48.	138.	143.

*Based on utility rates in effect August 1976

TABLE 100

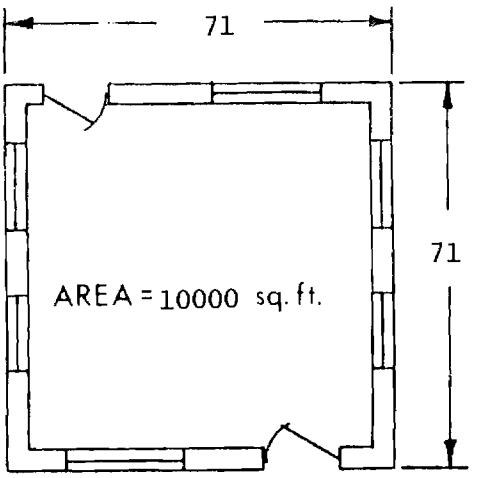


TWO STORY SQUARE
COMMERCIAL CONSTRUCTION
CARPETING R-VALUE = 1.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	3.2%	$ 1.	$ 5.	$ 2.
	New Orleans Louisiana	3.4%	12.	37.	
	Houston Texas	3.5%	2.	30.	
Zone II	Atlanta Georgia	3.5%	27.	51.	45.
	San Francisco California	3.4%	23.	71.	
	Ft Worth Texas	3.5%	27.	69.	33.
Zone III	Louisville Kentucky	3.6%	35.	78.	72.
	St Louis Missouri	3.6%	40.	107.	76.
	Seattle Washington	3.5%	48.	43.	67.
Zone IV	Boston Massachusettes	4.2%	93.	76.	92.
	Chicago Illinois	4.2%	71.	215.	114.
	Spokane Washington	4.2%	80.	62.	111.
Zone V	Caribou Maine	4.2%		169.	159.
	Duluth Minnesota	4.2%	119.	216.	147.
	Glasgow Montana	4.3%	43	125.	129.

*Based on utility rates in effect August 1976

TABLE 101

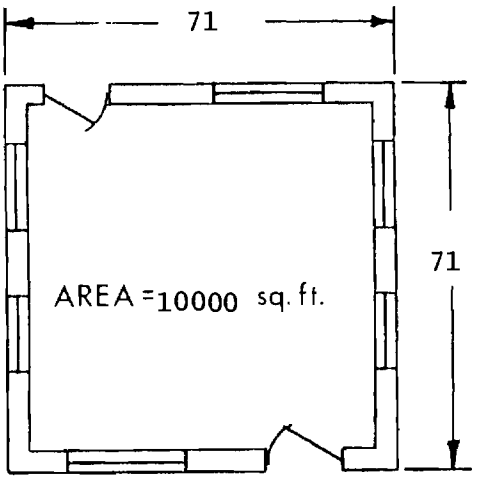


TWO STORY SQUARE
COMMERCIAL CONSTRUCTION
CARPETING R-VALUE = 2.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	4.6%	$ 1.	$ 7.	$ 3.
	New Orleans Louisiana	4.7%	16.	51.	
	Houston Texas	4.7%	3.	42.	
Zone II	Atlanta Georgia	4.8%	36.	69.	60.
	San Francisco California	4.7%	31.	98.	
	Ft Worth Texas	4.8%	37.	94.	45.
Zone III	Louisville Kentucky	4.8%	46.	105.	96.
	St Louis Missouri	4.8%	54.	144.	102.
	Seattle Washington	4.8%	65.	59.	91.
Zone IV	Boston Massachusettes	5.6%	124.	102.	123.
	Chicago Illinois	5.6%	94.	287.	152.
	Spokane Washington	5.6%	106.	83.	149.
Zone V	Caribou Maine	5.6%		223.	211.
	Duluth Minnesota	5.6%	158.	286.	195.
	Glasgow Montana	5.6%	57.	165.	171.

*Based on utility rates in effect August 1976

TABLE 102

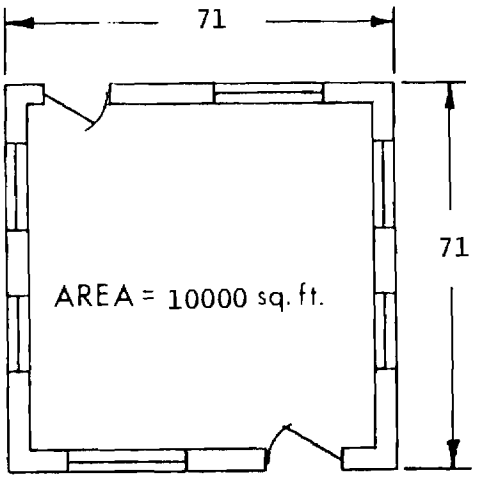


TWO STORY SQUARE
COMMERCIAL CONSTRUCTION
CARPETING R-VALUE = 3.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	6.1%	$ 1.	$ 9.	$ 4.
	New Orleans Louisiana	6.1%	21.	67.	
	Houston Texas	6.1%	4.	54.	
Zone II	Atlanta Georgia	6.1%	47.	89.	77.
	San Francisco California	6.1%	41.	128.	
	Ft Worth Texas	6.1%	48.	120.	57.
Zone III	Louisville Kentucky	6.1%	59.	134.	122.
	St Louis Missouri	6.1%	68.	183.	129.
	Seattle Washington	6.1%	84.	76.	117.
Zone IV	Boston Massachusettes	7.1%	157.	129.	156.
	Chicago Illinois	7.1%	119.	362.	192.
	Spokane Washington	7.1%	135.	105.	188.
Zone V	Caribou Maine	7.1%		281.	265.
	Duluth Minnesota	7.1%	198.	360.	245.
	Glasgow Montana	7.1%	72.	207.	215.

*Based on utility rates in effect August 1976

TABLE 103

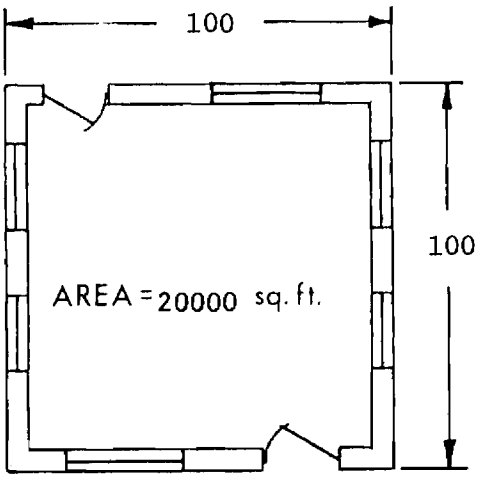


TWO STORY SQUARE
COMMERCIAL CONSTRUCTION
CARPETING R-VALUE = 4.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	7.7%	$ 2.	$11.	$ 5.
	New Orleans Louisiana	7.5%	26.	82.	
	Houston Texas	7.5%	5.	66.	
Zone II	Atlanta Georgia	7.5%	57.	108.	94.
	San Francisco California	7.6%	50.	158.	
	Ft Worth Texas	7.5%	58.	147.	70.
Zone III	Louisville Kentucky	7.4%	71.	162.	149.
	St Louis Missouri	7.4%	83.	222.	156.
	Seattle Washington	7.5%	103.	93.	143.
Zone IV	Boston Massachusettes	8.6%	191.	157.	189.
	Chicago Illinois	8.5%	144.	438.	232.
	Spokane Washington	8.5%	163.	127.	227.
Zone V	Caribou Maine	8.5%		339.	320.
	Duluth Minnesota	8.5%	239.	434.	296.
	Glasgow Montana	8.5%	86.	250.	259.

*Based on utility rates in effect August 1976

TABLE 104

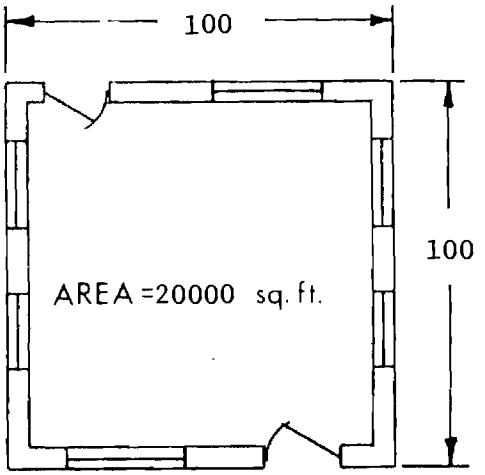


TWO STORY SQUARE
COMMERCIAL CONSTRUCTION
CARPETING R-VALUE = 1.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	2.9%	$ 1.	$ 8.	$ 4.
	New Orleans Louisiana	3.2%	21.	66.	
	Houston Texas	3.3%	4.	54.	
Zone II	Atlanta Georgia	3.4%	48.	92.	80.
	San Francisco California	3.2%	40.	124.	
	Ft Worth Texas	3.4%	49.	124.	59.
Zone III	Louisville Kentucky	3.5%	62.	142.	130.
	St Louis Missouri	3.5%	73.	194.	137.
	Seattle Washington	3.3%	86.	77.	119.
Zone IV	Boston Massachusettes	4.1%	167.	138.	166.
	Chicago Illinois	4.1%	128.	391.	207.
	Spokane Washington	4.1%	145.	113.	202.
Zone V	Caribou Maine	4.2%		308.	291.
	Duluth Minnesota	4.2%	217.	394.	269.
	Glasgow Montana	4.2%	79.	228.	237.

*Based on utility rates in effect August 1976

TABLE 105

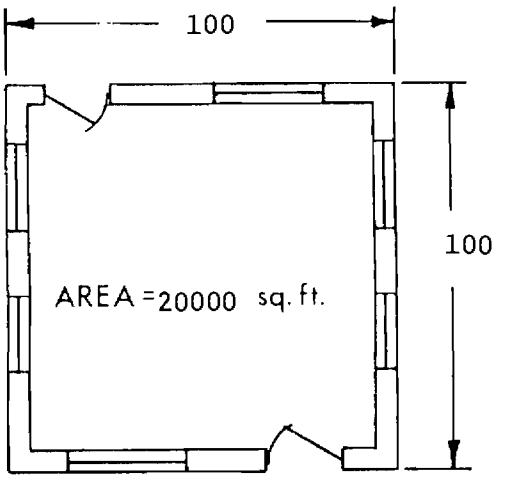


TWO STORY SQUARE
COMMERCIAL CONSTRUCTION
CARPETING R-VALUE = 2.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	4.2%	$ 2.	$11.	$ 5.
	New Orleans Louisiana	4.4%	28.	90.	
	Houston Texas	4.5%	5.	74.	
Zone II	Atlanta Georgia	4.6%	65.	125.	108.
	San Francisco California	4.4%	55.	171.	
	Ft Worth Texas	4.6%	67.	168.	80.
Zone III	Louisville Kentucky	4.6%	84.	190.	174.
	St Louis Missouri	4.7%	97.	260.	184.
	Seattle Washington	4.5%	116.	105.	162.
Zone IV	Boston Massachusettes	5.4%	224.	184.	222.
	Chicago Illinois	5.5%	171.	522.	277.
	Spokane Washington	5.5%	193.	151.	270.
Zone V	Caribou Maine	5.5%		409.	386.
	Duluth Minnesota	5.5%	289.	524.	358.
	Glasgow Montana	5.6%	105.	303.	314.

*Based on utility rates in effect August 1976

TABLE 106

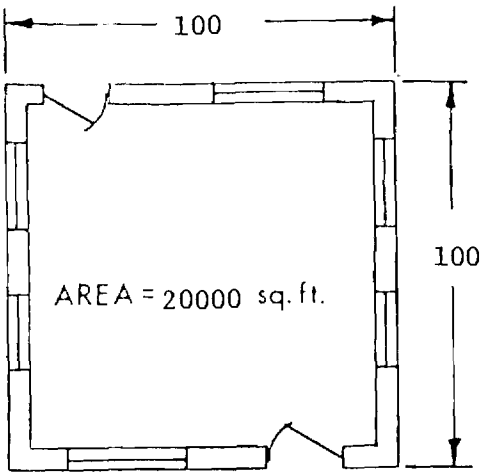


TWO STORY SQUARE
COMMERCIAL CONSTRUCTION
CARPETING R-VALUE = 3.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	5.5%	$ 2.	$ 15.	$ 7.
	New Orleans Louisiana	5.7%	37.	117.	
	Houston Texas	5.8%	7.	95.	
Zone II	Atlanta Georgia	5.9%	84.	159.	138.
	San Francisco California	5.7%	71.	223.	
	Ft Worth Texas	5.8%	85.	215.	102.
Zone III	Louisville Kentucky	5.9%	106.	242.	222.
	St Louis Missouri	5.9%	124.	331.	234.
	Seattle Washington	5.8%	149.	135.	208.
Zone IV	Boston Massachusettes	6.9%	285.	234.	283.
	Chicago Illinois	6.9%	217.	661.	350.
	Spokane Washington	6.9%	245.	191.	342.
Zone V	Caribou Maine	7.0%		516.	487.
	Duluth Minnesota	7.0%	364.	661.	451.
	Glasgow Montana	7.0%	132.	382.	396.

*Based on utility rates in effect August 1976

TABLE 107



TWO STORY SQUARE
CONCRETE SLAB CONSTRUCTION
CARPETING R-VALUE = 4.00

	GEOGRAPHIC LOCATION	% SAVINGS FROM CARPET DURING ANNUAL HEATING	ANNUAL SAVINGS W/ NATURAL GAS*	ANNUAL SAVINGS W/ RESISTANCE HEAT*	ANNUAL SAVINGS W/ FUEL OIL*
Zone I	Miami Florida	6.9%	$ 3.	$ 19.	$ 9.
	New Orleans Louisiana	7.0%	45.	144.	
	Houston Texas	7.1%	8.	116.	
Zone II	Atlanta Georgia	7.1%	102.	194.	168.
	San Francisco California	7.0%	87.	275.	
	Ft Worth Texas	7.1%	104.	262.	125.
Zone III	Louisville Kentucky	7.2%	129.	293.	269.
	St Louis Missouri	7.2%	150.	401.	284.
	Seattle Washington	7.1%	182.	165.	254.
Zone IV	Boston Massachusettes	8.4%	346.	284.	343.
	Chicago Illinois	8.4%	263.	800.	424.
	Spokane Washington	8.4%	297.	231.	415.
Zone V	Caribou Maine	8.4%		623.	589.
	Duluth Minnesota	8.4%	440.	798.	544.
	Glasgow Montana	8.4%	159.	460.	478.

*Based on utility rates in effect August 1976

TABLE 108

TABLE 109
COOLING SEASON SAVINGS
CARPETING R-VALUE = 1.0

FIRST FLOOR AREA		1000 FT^2		1500 FT^2		2000 FT^2		3000 FT^2	
CITY	$/KWH *	KWH	COST	KWH	COST	KWH	COST	KWH	COST
NEW ORLEANS	0.034	112	$4	168	$6	224	$8	336	$11
HOUSTON	0.027	155	$4	233	$6	310	$8	465	$13
ATLANTA	0.021	81	$2	121	$3	162	$3	242	$5
FORT WORTH	0.035	213	$7	319	$11	426	$15	638	$22
ST. LOUIS	0.026	97	$3	145	$4	194	$5	290	$8
BOSTON	0.042	35	$1	53	$	70	$3	106	$4
CHICAGO	0.038	49	$2	73	$3	98	$4	146	$6
DULUTH	0.025	16	0	24	$1	32	$1	48	$1
GLASGOW	0.016	46	$1	68	$1	91	$1	137	$2

* Based on electric rates in effect August, 1976.

TABLE 110
COOLING SEASON SAVINGS
CARPETING R-VALUE = 2.0

FIRST FLOOR AREA		1000 FT^2		1500 FT^2		2000 FT^2		3000 FT^2	
CITY	$/KWH*	KWH	COST	KWH	COST	KWH	COST	KWH	COST
NEW ORLEANS	0.034	184	$6	276	$9	368	$13	552	$19
HOUSTON	0.027	254	$7	382	$10	509	$13	763	$21
ATLANTA	0.021	133	$3	199	$4	266	$6	398	$8
FORT WORTH	0.035	350	$12	524	$18	699	$24	1049	$37
ST. LOUIS	0.026	159	$4	239	$6	318	$8	478	$12
BOSTON	0.042	58	$2	88	$4	117	$5	175	$7
CHICAGO	0.038	79	$3	119	$5	158	$6	238	$9
DULUTH	0.025	26	$1	40	$1	53	$1	79	$2
GLASGOW	0.016	75	$1	113	$2	150	$2	226	$4

* Based on electric rates in effect August, 1976.

TABLE III
COOLING SEASON SAVINGS
CARPETING R-VALUE = 3.0

FIRST FLOOR AREA		1000 FT^2		1500 FT^2		2000 FT^2		3000 FT^2	
CITY	$/KWH *	KWH	COST	KWH	COST	KWH	COST	KWH	COST
NEW ORLEANS	0.034	234	$8	350	$12	467	$16	701	$24
HOUSTON	0.027	323	$9	485	$13	646	$17	970	$26
ATLANTA	0.021	169	$4	253	$5	338	$7	506	$11
FORT WORTH	0.035	445	$16	667	$23	890	$31	1334	$47
ST. LOUIS	0.026	202	$5	304	$8	405	$11	607	$16
BOSTON	0.042	74	$3	112	$5	149	$6	223	$9
CHICAGO	0.038	101	$4	151	$6	202	$8	302	$11
DULUTH	0.025	34	$1	50	$1	67	$2	101	$3
GLASGOW	0.016	95	$2	143	$2	190	$3	286	$5

* Based on electric rates in effect August, 1976.

TABLE 112
COOLING SEASON SAVINGS
CARPETING R-VALUE = 4.0

FIRST FLOOR AREA		1000 FT^2		1500 FT^2		2000 FT^2		3000 FT^2	
CITY	$/KWH*	KWH	COST	KWH	COST	KWH	COST	KWH	COST
NEW ORLEANS	0.034	270	$9	405	$14	541	$18	811	$28
HOUSTON	0.027	374	$10	561	$15	749	$20	123	$30
ATLANTA	0.021	195	$4	292	$6	390	$8	585	$12
FORT WORTH	0.035	515	$18	772	$27	1029	$36	1544	$54
ST. LOUIS	0.026	234	$6	351	$9	468	$12	702	$18
BOSTON	0.042	86	$4	129	$5	172	$7	257	$11
CHICAGO	0.038	117	$4	175	$7	234	$9	351	$13
DULUTH	0.025	39	$1	58	$1	78	$2	117	$3
GLASGOW	0.016	110	$2	165	$3	220	$4	331	$5

* Based on electric rates in effect August, 1976.

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3. H. D. Bareither, A. N. Fleming, and B. E. Albertg, "Temperature and Heat Loss Characteristics of Concrete Floors Laid on the Ground," University of Illinois, Small Homes Council Technical Report.

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APPENDIX A

METHODS OF EVALUATION

APPENDIX A

I. Heating Season Simulation

A. Energy Requirements

For Natural Gas Heating:

$$F = G\ Q_d\ D\ C_f$$

Where F = fuel used in therms (1 therm = 100,000 BTU)

G = unit fuel per degree day per BTU/hour design heat loss

G = 4.9×10^{-6} therms/degree day - BTU/hour

(Assuming 70% efficiency of heating system)

Q_d = design heat loss for structure, BTU/hour

D = number of degree days for period of interest (degree days are a measure of outside temperature variation based on $65^{\circ}F$ base. The number of degrees which the outside mean temperature is below $65^{\circ}F$ represents the number of heating degree-days for that day)

C_f = temperature correction factor for outside design temperature (See Chapter 43, Table 3 ASHRAE Handbook and Product Directory - 1973 Systems)

For Fuel Oil Heating:

$$F = O\ Q_d\ D\ C_f$$

Where F = fuel used in gallons of No. 2 fuel oil

(1 gallon = 141,000 BTU)

O = unit fuel per degree day per BTU/hour design heat loss,

O = 3.47×10^{-6} gallons/degree day - BTU/hour

Q_d = design heat loss, BTU/hour

D = number of heating degree days in period of interest

C_f = temperature correction factor for outside design temperature

For Electric Resistance Heating:

$$KWH = \frac{Q_d\ D\ C}{(3415\ \frac{BTU}{KW})\ (\Delta\ T_d)}$$

Where Q_d = design heat loss, BTU/hour

D = number of degree days in period of interest

C = constant (C = 18.5 for simulation)

ΔT_d = difference between indoor and outdoor design temperatures

B. Design Heat Loss

General quation:

$$Q_d = U A \Delta T_d$$

where Q_d = design heat loss in BTU/hour

U = overall heat transfer coefficient
BTU/hr-ft^2 - °F

A = surface area, ft^2

ΔT_d = difference between inside and outside design temperatures, °F

Table A-I gives the U values used for the various structural components of the buildings simulated:

TABLE A-I

OVERALL HEAT TRANSFER COEFFICIENTS, BTU/hr-ft^2-°F

STRUCTURAL COMPONENT	RESIDENTIAL STRUCTURE	COMMERCIAL STRUCTURE
Exterior Walls	U = 0.22	U = 0.17
Windows	Zones 1-3: U = 1.13 Zones 4 & 5: U = 0.65	Zones 1-3: = 1.13 Zones 4 & 5: U = 0.65
Ceiling-Roof	U = 0.061	U = 0.12
Wood Floors	U = 0.28	N/A

The Q_d value for the entire structure was estimated by summing the calculated heat loss for each structural component of the residence, including exterior walls, windows, cold ceilings and floors, and the heat loss due to infiltration of outside air. This procedure was followed for each of the four types of characteristic structures for a range of structure sizes based on floor area. A total of 64 strûctures was evaluated for each of the fifteen cities in order to present a thorough evaluation of a range of structures throughout the United States.

The heat loss through each structural component was estimated based on the following assumptions:

Exterior Walls: Residential--Frame construction with wood siding, sheathing, 2 x 4 studs, 16 inches on center, no insulation and interior wallboard.
Commercial--Concrete block wall with brick facing, wood furring and interior wallboard.

Windows: Zones 1-3: Single glazing, metal frame
Zones 4-5: Double glazing or storm windows, metal frame

Ceiling-Roof: Residential--Naturally ventilated pitched roof with asphalt shingles, building paper, plywood decking, roof trusses 16-inches on center, R-13 insulation and interior wallboard.
Commercial--Built-up roofing, R-5 insulation, metal decking, airspace, metal lath and plaster.

Floors: Residential--Concrete slab on grade with no edge insulation, or wooden floor over vented crawl space with no insulation. (see Figure I)
Commercial--Concrete slab on grade with no insulation.

Heat flux was assumed one-dimensional except in concrete slab on grade. For slab on grade, the heat loss from the floor slab was estimated assuming no insulation of the exposed slab edge. References 3 and 6 present experimental results which indicate the major factor is slab heat loss is the heat loss from the edge of the slab exposed to the atmosphere above grade. Therefore, in order to evaluate the insulating effect of carpet on the horizontal surface, which is perpendicular to the vertical edge surface through which the heat is transmitted, a two-dimensional model for determining temperature distribution in the slab was needed. An iteration technique was used to determine the temperature distribution in the slab on grade floor. The computer program used for this iteration technique is presented in Appendix B. The slab temperature model was then calibrated using experimental data presented in Reference 3.

The heat flux through the floor in the vertical direction for the perimeter of the slab was estimated as a function of distance from the outside edge. This estimate was made by taking the slab surface temperature which was approximated by the computer and, assuming a constant room temperature and an estimated slab to air convection coefficient of h=1.35 BTU/hr.-ft^2-°F (7.67 W/M^2-°C), using the equation q= H A (T Room--T Slab) for each finite interval used in the relaxation program and summing the q's for each interval within 3 feet of the outside slab edge.

The heat loss from the interior area of the slab was estimated by assuming the slab surface reaches an equilibrium temperature at a distance of 3 feet from the exposed edge [1] and again using the convection heat loss formula for the entire interior area.

q = h A int (T Room - T Equil.)

where Q int = heat loss from interior area

h = 1.35 BTU/hr - ft.^{2}-°F

A int = interior slab area

T Room = 70°F

T Equil = slab equilibrium temperature

The heat loss due to infiltration was estimated by assuming an air change rate of one complete air change per hour and using the formula.

q_{Inf} (Pair) (A) (h) (cp) (ΔTd)

where q_{Inf} Heat loss due to infiltration, BTU/hr.

Pair = 0.075 lbm/ft.^{3}

A - Living area of house, ft.^{2}

h = Ceiling height of living space = 8 feet

Cp = 0.24 BTU/lbm-°F

ΔTd = Design temperature difference

II. Cooling Season Evaluation

The equivalent temperature difference used for evaluating heat gained through a wood floor over a crawlspace was taken from ASHRAE Handbook of Fundamentals. The equivalent temperature difference for values of outside design temperature other than those listed is derived by extrapolating between the values tabulated:

$$\Delta Teq = Td-80°$$

Heat gain was then calculated by:

$$qc = UA\ \Delta Teq$$

where qc = heat gained through the floor at design conditions

U = overall heat transfer coefficient of wood floor, BTU/hr--ft.^{2}--°F

A = floor area, ft.^{2}

ΔTeq = design equivalent temperature difference.

Using the estimated design heat gain through the floor, the cooling energy requirement for the floor over a cooling season was estimated by assuming a coefficient of performance (COP) of the residential air conditioning unit of 2.5 and using

$$KWH = \frac{(qc)\ (\text{Operating hours})}{2.5\ (3415)}$$

where KWH = energy required during a cooling season

qc = design heat gain through floor

Operating hours = total estimated hours of operation of residential air conditioning unit, based on utility records

The energy savings due to carpet insulation on the floor is estimated by applying the reduction in qc due to a lower overall heat transfer coefficient of the floor with the carpet installed. These energy savings are then converted to cost savings using residential electric rates for each city. These utility rates and other data are presented for each of the selected cities in Table A-II.

TABLE A-II

CITIES	WINTER DESIGN TEMP.	HEATING DEGREE DAYS	SUMMER DESIGN TEMP.	A/C SEASONAL OPERATING HRS.	NATURAL GAS $/THERM	FUEL OIL $/GAL	ELECTRIC $/KWH
Miami, Fla.	44 F	214	92 F	Not Available	$0.104	$0.45	$0.030
New Orleans, La.	32 F	1385	93 F	1600	$0.192	Not Available	$0.034
Houston, Tex.	28 F	1396	96 F	1800	$0.302	Not Available	$0.027
Atlanta, Ga.	18 F	2961	95 F	1000	$0.176	$0.41	$0.021
San Francisco, Cal.	35 F	3015	83 F	Not Available	$0.180	Not Available	$0.030
Ft. Worth, Tex.	20 F	2405	102 F	1800	$0.224	$0.38	$0.035
Louisville, Ky.	8 F	4660	96 F	Not Available	$0.136	$0.40	$0.020
St. Louis, Mo.	7 F	4900	98 F	1000	$0.150	$0.40	$0.026
Seattle, Wash.	23 F	4424	81 F	Not Available	$0.219	$0.43	$0.012
Boston, Mass.	6 F	5634	91 F	600	$0.300	$0.42	$0.042
Chicago, Ill.	-4 F	6639	95 F	600	$0.193	$0.44	$0.038
Spokane, Wash.	-2 F	6655	93 F	Not Available	$0.218	$0.43	$0.011
Caribou, Maine	-18 F	9767	85 F	Not Available	Not Available	$0.43	$0.020
Duluth, Minn.	-19 F	10000	85 F	600	$0.223	$0.39	$0.025
Glasgow, Mont.	-25 F	8996	96 F	530	$0.092	$0.39	$0.016

APPENDIX B

SIMULATION PROGRAMS

Relaxation Program, Two Dimensional Flow Through in a Slab

The relaxation program for two dimensional heat flow through a slab is based upon steady state equilibrium of heat transfer to every point in the slab, i.e., the sum of heats from above, below and either side of any point in the slab is zero. The iteration procedure works upon a matrix of points within the slab and, if present, a carpet above the slab. The procedure then finds the termperature at each point that sets the net head flow at that point to zero. By repeating this several hundreds of times for the entire matrix of points, a state is reached in which the measured net heat flow into the room undergoes negligible changes.

This entire procedure is repeated for a range of outside temperatures and one carpet conductivities, each repeat providing one data point for edge heat loss per foot of perimeter and one data point for heat loss in the central area of the room three feet or more from any wall. This data was curve fit to a parabola, one curve for each carpet thermal resistance value for use in the main simulation program.

The validity of the procedure, including internal and ground temperature profiles, was checked by comparing calculated isotherms with those found in the literature. These check points were available for a few specific outside temperatures for rooms without carpeting. Thus, the relaxation program provided the mechanism for including carpeting and obtaining data for a wide range of outside temperatures.

The program is written in standard FORTRAN IV with a few non-ANSI usages which are available in the Control Data Corporation FTN compiler.

```
      PROGRAM HEAT(INPUT,OUTPUT,TAPE6=OUTPUT)
      DIMENSION AREA(10),QC(10),PERIM(10),TEMP(10),Q(10),TOTHT(10,10)
      DIMENSION GGUESS(10),EDGEHT(10,10),CALCHT(10,10)
      DATA AREA/1000.,1250.,1500.,1750.,2000.,3000.,4000.,5000.,10000.,
     120000./
      LOCK=0
      DO 4 NHOUSE=1,4
      CARPET=1.28
      Y=0.35
      SUMX=SUMX2=SUMX3=SUMX4=SUMXY=SUMX2Y=SUMY=0.
      DO 1 I=1,9
      IF(NHOUSE.NE.1)GOTO6
      AI=I-1
      T0=-30.+(10.*AI)
      SUMX=SUMX+T0
      SUMX2=SUMX2+T0**2
      SUMX3=SUMX3+T0**3
      SUMX4=SUMX4+T0**4
      TEMP(I)=T0
      CALL RELAX(LOCK,Y,CARPET,T0,HTFLOW,CENTER)
      SUMXY=SUMXY+HTFLOW*T0
      IF(I.EQ.1)WRITE(6,105)CENTER,T0
      IF(I.NE.1)WRITE(6,110)CENTER,T0
      SUMX2Y=SUMX2Y+HTFLOW*T0**2
      SUMY=SUMY+HTFLOW
      Q(I)=HTFLOW
      QC(I)=CENTER
C     ALPHA IS  W / L  RATIO FOR RECTANGULAR HOUSE
      ALPHA=.5
    6 DO 2 J=1,10
      IF(NHOUSE.EQ.1)PERIM(J)=4.*SQRT(AREA(J))
      IF(NHOUSE.EQ.2)PERIM(J)=8./3.*SQRT(3.*AREA(J))
      IF(NHOUSE.EQ.3)PERIM(J)=2.*SQRT(2.*AREA(J))
      IF(NHOUSE.EQ.4)PERIM(J)=2.*(1.+1./ALPHA)*SQRT(ALPHA*AREA(J))
      EDGEHT(I,J)=Q(I)*(PERIM(J)-12.)
      AREADN=3.*PERIM(J)-36.
      IF(NHOUSE.EQ.2)AREADN=AREADN-9.
      AREAUP=AREA(J)-AREADN
      HTCENT=2.*AREAUP
      HTCEN2=QC(I)*AREAUP
      CALCHT(I,J)=EDGEHT(I,J)+HTCEN2
    2 TOTHT(I,J)=EDGEHT(I,J)+HTCENT
    1 CONTINUE
      IF(NHOUSE.NE.1)GOTO7
      DET=9.*SUMX2*SUMX4+2.*SUMX*SUMX3*SUMX2
      DET=DET-SUMX4*SUMX**2-9.*SUMX3**2
      A2=9.*(SUMX2*SUMX2Y-SUMX3*SUMXY)
     1-SUMX*(SUMX*SUMX2Y-SUMX2*SUMXY)
     2+SUMY*(SUMX*SUMX3-SUMX2**2)
      A2=A2/DET
      AM=SUMXY-A2*SUMX3
      AN=SUMY-A2*SUMX2
      A1=(AN*SUMX-9.*AM)/(SUMX**2-9.*SUMX2)
      A0=(AN-A1*SUMX)/9.
      DO 3 I=1,9
    3 GGUESS(I)=A0+A1*TEMP(I)+A2*TEMP(I)**2
    7 IF(NHOUSE.EQ.1)WRITE(6,106)
```

```
      IF(NHOUSE.EQ.2)WRITE(6,108)
      IF(NHOUSE.EQ.3)WRITE(6,107)
60    IF(NHOUSE.EQ.4)WRITE(6,100)
      WRITE(6,101)(AREA(I),I=1,10),(PERIM(I),I=1,10)
      WRITE(6,102)((TEMP(J),(EDGEHT(J,I),I=1,10),(TOTHT(J,I),I=1,10)
     1,(CALCHT(J,I),I=1,10),J=1,9))
      IF(NHOUSE.NE.1)GOTO4
65    IF(NHOUSE.EQ.1)WRITE(6,109)
      WRITE(6,103)A0,A1,A2
      WRITE(6,104)(TEMP(J),Q(J),QGUESS(J),J=1,9)
    4 CONTINUE
  100 FORMAT(*1*/////10X*SOLUTION OF HEAT FLOW THROUGH*
70     1* A SLAB*//10X*RECTANGULAR HOUSE WITH CARPET # 40*)
  101 FORMAT(///15X*AREA*10(2X,F8.1)/10X*PERIMETER*10(2X,F8.1))
  102 FORMAT(/1X*TEMP.(OUTSIDE)*9(/3X,F6.1,4X*Q-EDGE*10(2X,F8.1)/
     18X,4X*Q-TOTAL*10(2X,F8.1)/12X*Q-TCALC*10(2X,F8.1)/))
  103 FORMAT(///10X"COEFFICIENTS OF   Y = A0 + A1 * X  + A2 * X**2  :"
75     1//10X*A0 = *F10.3/10X*A1 = *,F10.3/10X*A2 = *F10.3)
  104 FORMAT(///20X*TRIAL SOLUTIONS :*//
     110X*TEMP.(OUTSIDE)*5X*Q/FT.(RELAXATION)*5X*Q/FT.(SOLVING*
     2* POLYNOMIAL)*/9(12X,F8.1,10X,F8.3,14X,F8.3/))
  105 FORMAT(/////15X,*Q-TOTAL IS BASED UPON EDGE LOSSES PLUS*
80     1* CENTER LOSSES AT AN ASHRAE BASED RATE OF 2.0*
     2* BTU/FT.2*/15X,*Q-TCALC IS A TOTAL HEAT LOSS*
     3* BASED UPON CENTER LOSSES CALCULATED BY RELAXATION*/
     415X,*THE LOSS RATE CALCULATED IS *,F8.3,* BTU/FT.2*
     55X,F6.1)
85  106 FORMAT(*1*/////10X*SOLUTION OF HEAT FLOW THROUGH*
     1* A SLAB*//10X*SQUARE HOUSE WITH CARPET # 40*)
  107 FORMAT(*1*/////10X*SOLUTION OF HEAT FLOW THROUGH*
     1* A SLAB*//10X*TWO STORY HOUSE WITH CARPET # 40*)
  108 FORMAT(*1*/////10X*SOLUTION OF HEAT FLOW THROUGH*
90     1* A SLAB*//10X*ELL SHAPED HOUSE WITH CARPET # 40*)
  109 FORMAT(*1*/////10X*SOLUTION OF HEAT FLOW THROUGH*
     1* A SLAB*//10X*ANY OF THE HOUSE SHAPES WITH CARPET # 40*)
  110 FORMAT(43X,F8.3,14X,F6.1)
      END
```

```
      SUBROUTINE RELAX(LOCK,Y,CARPET,T0,HTFLOW,CENTER)
      DIMENSION T(60,242,2)
       REAL K1,K2
      TG=64.5
C     CARPET IS U VALUE OF THE CARPET, Y IS THICKNESS (INCHES)
      IF(Y.NE.0.)K2=CARPET*Y/12.
C     NOTE:  THE ABOVE VALUE OF CARPET MUST BE FOR ONE FT**2
      IF(Y.EQ.0.)K2=0.
C     K2 TAKEN AS U VALUE NORMALIZED FOR ONE FT. THICKNESS
      X=6.
      K1=1.
C     X AND K1 DEFINE CONCRETE SLAB THICKNESS AND CONDUCTIVITY
      TINF=70.
      X=X/12.$Y=Y/12.
      H=1.35
      STEPX=36./38.
      STEPY=12./80.
      DLX=STEPX/12.
      DLY=STEPY/12.
      MSY=IFIX(1./(2.*DLY))
      HHOC=H*DLX/K1
      IF(K2.NE.0)HHC=H*DLX/K2
      SUMK=K1+K2
      IY=(IFIX(Y/DLY*10.+.5))/10
      NI=MSY+IY+1
      NJ=IFIX(3.*(1./DLX)+2.)
C     PRINT*,"    NI,NJ = ",NI," , ",NJ
      A24=DLX/DLY
      A13=DLY/DLX
      ASUMA=A13+A24
C     INITIALIZE ALL TEMPS TO LINEAR CALC. VALUE
      IF(LOCK.NE.0)GOTO669
      DO 1 I=1,NI$DO 1 J=1,NJ$DO 1 K=1,2
    1 T(I,J,K)=((TINF-TG)*FLOAT(I)/FLOAT(NI)+TG)
     1*FLOAT(J)/FLOAT(NJ)+T0*FLOAT(NJ-J)/FLOAT(NJ)
  669 CONTINUE
C     SET BOUNDARY GROUND TEMPS TO TG EXCEPT EXPON TO TEMP0 AT EDGE
C     ROOM AIR TEMP IS TINF
      DO 2 J=1,NJ$DO 2 K=1,2
      AJ=J-1
      IF(J.LE.IFIX((1./DLX+1.)/4.))TGG=T0+(40.+T0/4.-5./4.)*AJ*DLX*4.
      IF(J.GE.IFIX((1./DLX+2.)/4.))TGG=40.+T0/4.-5./4.+((TG+T0/10.)-(40.
     1+T0/4.-5./4.))*(AJ*DLX-0.25)/1.75
      IF(J.GE.IFIX(2./DLX+2.))TGG=TG+T0/10.
      T(1,J,K)=TGG
    2 T(NI,J,K)=TINF
C       PRINT*,"   G R O U N D   T E M P E R A T U R E  -- 1,",NJ
C     WRITE(6,66)(T(1,J,1),J=1,NJ)
C       PRINT*,"   G R O U N D   T E M P E R A T U R E  -- 1,",NJ
C     TEMP OF OUTER SLAB EDGE
      DO 3 I=1,NI$DO 3 K=1,2
      T(I,1,K)=T0
      IF(I.GT.MSY)T(I,1,K)=T0+(TINF-T0)*FLOAT(I-MSY)/FLOAT(NI-MSY)
    3 CONTINUE
C     SLAB TEMP BY RELAXATION
      NSTEPS=1
   76 ERROR=.001
```

```
                HTOL=0.
             77 CONTINUE
60              ILIM=NI-1$JLIM=NJ-1
          C     NOTE: I VARIES MOST RAPIDLY TO OPTIMIZE CYCLE TIME
              6 DO 5 ICOUNT=1,200
                DO 5 KOPP=1,2$K=3-KOPP
                DO 4 J=2,JLIM$DO 4 I=2,ILIM
65              T4=T(I-1,J,KOPP)
                T3=T(I,J+1,KOPP)
                T2=T(I+1,J,KOPP)
                T1=T(I,J-1,KOPP)
                T(I,J,K)=(A13*(T1+T3)+A24*(T2+T4))/(2.*ASUMA)
70              IF((I.EQ.MSY).AND.(Y.EQ.0.))T(I,J,K)=(A13*(T1+T3)
               1+2.*A24*T4+2.*HNOC*T2)/(2.*(ASUMA+HNOC))
                IF((I.EQ.MSY).AND.(Y.NE.0.))T(I,J,K)=(SUMK*A13*(T1+T3)
               1+2.*A24*(K1*T4+K2*T2))/(2.*SUMK*ASUMA)
                IF((I.EQ.ILIM).AND.(Y.NE.0.))T(I,J,K)=(A13*(T1+T3)
75             1+2.*A24*T4+2.*HNC*T2)/(2.*(ASUMA+HNC))
                JJ=J+1
                IF(J.EQ.(NJ-1))T(I,JJ,K)=T(I,J,K)
                T(I,J,KOPP)=T(I,J,K)=T(I,J,K)+(T(I,J,K)-T(I,J,KOPP))*.75
              4 CONTINUE
80            5 CONTINUE
                HTNW=0.
                NNJ=NJ-1
                DO 671 J=2,NNJ,4
            671 HTNW=HTNW+(T(NI,J,2)-T(NI-1,J,2))*H*DLX
85        C     PRINT*,"   HTNW = ",HTNW
                IF(ABS(HTNW-HTOL).LT.ABS(ERROR*HTNW))12,7
              7 CONTINUE
                HTOL=HTNW
                GO TO 6
90            12 CONTINUE
                IF(LOCK.EQ.0)WRITE(6,65)
              65 FORMAT(*1*///)
                 IF(LOCK.EQ.0)PRINT*,"    H (CONVECTIVE) = ",H
                IF(LOCK.EQ.0)PRINT*,"    K1 (SLAB CONDUCTIVITY) = ",K1
95              IF(LOCK.EQ.0)PRINT*,"   U CARPET = ",CARPET,"  1/U=R = ",1./CARPET
                IF(LOCK.EQ.0)PRINT*,"    K2 (CARPET CONDUCTIVITY) = ",K2
                IF(LOCK.EQ.0)PRINT*,"        (FOR THICKNESS = ",Y," )"
                IF(LOCK.EQ.0)PRINT*,"    Y STEP SIZE (INCHES) = ",STEPY
                IF(LOCK.EQ.0)PRINT*,"    X STEP SIZE (INCHES) = ",STEPX
100             IF(LOCK.EQ.0)PRINT*," "
          C     DO 666 JMIN=1,NJ,20
          C     JMAX=JMIN+19
          C     IF(JMAX.GT.NJ)JMAX=NJ
          C     WRITE(6,66)((T(NI+1-I,J,2),J=JMIN,JMAX),I=1,NI)
105       C 666 WRITE(6,13)
              66 FORMAT(60(3X,20(F6.2)/))
              13 FORMAT(/////)
          C     WRITE(6,13)
          C      HEAT FLOW PER FT. SLAB PERIMETER PER 3 FT. DEPTH
110             Q=0.
                CENTER=(T(NI-IY-1,NJ,2)-T(1,NJ,2))*K1*2.
                NNJ=NJ-1
                DO 22 J=2,NNJ
             22 Q=Q+(T(NI,J,2)-T(NI-1,J,2))*H*DLX
```

```
115           C     PRINT*,"   **********HEAT FLOW PER INCREMENT ***********"
              C     JMAX=3./DLX
              C     WRITE(6,66)((T(NI,J,2)-T(NI-1,J,2))*H*DLX,J=1,JMAX)
              C     PRINT*,"   **********HEAT FLOW PER INCREMENT ***********"
              C     WRITE(6,13)
120           C     PRINT*,"  ***** HEAT FLOW ACROSS SLAB/INCREMT IF 1 DIMENS.*****"
              C     WRITE(6,66)((T(40,J,2)-T(1,J,2))*2.*K1*DLX,J=1,JMAX)
              C     PRINT*,"  ***** HEAT FLOW ACROSS SLAB/INCREMT IF 1 DIMENS.*****"
              C     WRITE(6,13)
                    HTFLOW=Q
125           C     PRINT*,"   HTFLOW = ",HTFLOW
              C     PRINT*,"   CENTER = ",CENTER
              C     ABOVE ACCOUNTS FOR HEAT FLOW THROUGH SLAB
                    Y=Y*12.
                    LOCK=1
130                 RETURN
                    END
```

Simulation Program, Design Heat Load

The main simulation program consists of a main program and a series of subroutines. The subroutines divide a residential or light commercial building heat load into elements, e.g., wall, roof, floor, etc., and are called as required with the input data provided by the main program.

The program is written in standard FORTRAN IV with a few non-ANSI usages which are available in the Control Data Corporation FTN compiler.

```
      PROGRAM HTMAIN(INPUT,OUTPUT,TAPE6=OUTPUT)
      DIMENSION NOTE(15)
      DIMENSION PERIM(8),AREA(8),CITY(15),DESGNT(15),DEGDAY(15)
      DIMENSION HEATHR(15,2),HEATYR(15,2),THERM(15,2),GALLON(15,2)
      DIMENSION EKWH(15,2),COSGAS(15,2),COSOIL(15,2),COSELC(15,2)
      DIMENSION DOLGAS(15),DOLOIL(15),DOLELC(15),FLOOR(3),NUM(15)
      DIMENSION SAVGAS(15),SAVOIL(15),SAVELC(15),PLAN(4),PCT(15)
      DATA FLOOR/10HWOOD FLOR,10HSLAB ON GR,10HCOMMERCIAL/
      DATA NUM/10,11,8,1,12,6,9,15,13,2,4,14,3,5,7/
      DATA COLGAS/.176,.3,999999.,.193,.223,.224,.092,.032,
     1.136,.104,.192,.18,.219,.218,.150/
      DATA DOLELC/.021,.016,.02,.038,.025,.035,.016,.027,
     1.02,.03,.034,.03,.012,.011,.026/
      DATA DOLOIL/.41,.42,.43,.44,.39,.38,.39,999999.,
     1.40,.45,999999.,999999.,.43,.43,.4/
      DATA CITY/7HATLANTA,6HBOSTON,7HCARIBOU,7HCHICAGO,6HDULUTH,
     110HFORT WORTH,7HGLASGOW,7HHOUSTON,10HLOUISVILLE,
     25HMIAMI,10HNEWORLEANS,10HSANFRANSCO,7HSEATTLE,7HSPOKANE,
     38HST LOUIS/
      DATA DEGDAY/2961.,5634.,9767.,6639.,10000.,2405.,8996.,1396.,
     14660.,214.,1385.,3015.,4424.,6630.,4900./
      DATA DESGNT/18.,6.,-18.,-4.,-19.,20.,-25.,28.,8.,
     144.,32.,35.,23.,-2.,7./
      DATA AREA/1000.,1500.,2000.,3000.,4000.,5000.,10000.,20000./
      DATA PLAN/7H SQUARE,9HRECTANGLE,9HELL SHAPE,9HTWO STORY/
C     INDEX ASSIGNMENT:
C     I = FLOOR PLAN :  1 = SQ.   2 = RECT.   3 = ELL   4= 2-STORY
C     J = TOTAL AREA :  (SEE DATA AREA)
C     K = R VALUE :     R = K-1  FOR K=1,5
C     L = CITY NO.:     (SEE DATA CITY)
C     M = FLOOR TYPE:   1 = WOOD OVER CRAWL SPACE
C                       2 = SLAB ON GRADE
C     N = REF. NO.:      N=1 IS NO CARPET   N=2 IS WITH CARPET
C     ALPHA IS W/L RATIO FOR THE RECT. FLOOR PLAN
      ALPHA=0.5
      DO 1 II=1,15
    1 NOTE(II)=10H
      NOTE(5)=10HNOTE :
      NOTE(7)=10H****  =
      NOTE(8)=10HNO DATA
      NOTE(9)=10HAVAILABLE
      DO 103 I=1,4
      STORYS=1.
      IF(I.EQ.4)STORYS=2.
      DO 102 J=1,8
      IF(I.EQ.1)PERIM(J)=4.*SQRT(AREA(J))
      IF(I.EQ.2)PERIM(J)=2.*(1.+1./ALPHA)*SQRT(ALPHA*AREA(J))
      IF(I.EQ.3)PERIM(J)=8./3.*SQRT(3.*AREA(J))
      IF(I.EQ.4)PERIM(J)=2.*SQRT(2.*AREA(J))
      DO 101 M=1,2
      IF((AREA(J).GE.5000.).AND.(M.EQ.1))GO TO 99
      MM=M
      IF(AREA(J).GE.5000.)MM=3
      DO 98 K=1,5
      R=K-1
      N=2
      IF(K.GT.1)CARPET=1./R
```

```
      IF(K.EQ.1)CARPET=0.
      IF(K.EQ.1)N=1
      DO 100 L=1,15
      CFACT=1.02553+.01536*DESGNT(L)+.0000924*DESGNT(L)**2
      FACGAS=.0000049*CFACT
      FACOIL=.00000347*CFACT
      FACELC=18.5/3415./(70.-DESGNT(L))
      CALL WALL(AREA(J),0.,PERIM(J),DESGNT(L),STORYS,HTFLOW)
      HEATHR(L,N)=HTFLOW
      CALL ROOF(AREA(J),STORYS,DESGNT(L),HTFLOW)
      HEATHR(L,N)=HEATHR(L,N)+HTFLOW
      CALL INFILT(AREA(J),STORYS,DESGNT(L),HTFLOW)
      HEATHR(L,N)=HEATHR(L,N)+HTFLOW
      CALL WINDOW(AREA(J),DESGNT(L),DEGDAY(L),HTFLOW)
      HEATHR(L,N)=HEATHR(L,N)+HTFLOW
      IF(MM.EQ.1)CALL WOFLOR(CARPET,AREA(J),STORYS,DESGNT(L),HTFLOW)
      IF(MM.GE.2)CALL SLABHT(CARPET,STORYS,AREA(J),PERIM(J)
     1,DESGNT(L),HTFLOW)
      HEATHR(L,N)=HEATHR(L,N)+HTFLOW
      HEATHR(L,N)=HEATHR(L,N)+.25*(HEATHR(L,1)-HEATHR(L,N))
      HEATYR(L,N)=HEATHR(L,N)*DEGDAY(L)
      THERM(L,N)=HEATYR(L,N)*FACGAS
      IF(K.NE.1)PCT(L)=(HEATHR(L,1)-HEATHR(L,N))/HEATHR(L,1)
      PCT(L)=PCT(L)*100.
      GALLON(L,N)=HEATYR(L,N)*FACOIL
      EKWH(L,N)=HEATYR(L,N)*FACELC
      COSGAS(L,N)=THERM(L,N)*DOLGAS(L)
      COSOIL(L,N)=GALLON(L,N)*DOLOIL(L)
      COSELC(L,N)=EKWH(L,N)*DOLELC(L)
      SAVGAS(L)=COSGAS(L,1)-COSGAS(L,N)
      SAVOIL(L)=COSOIL(L,1)-COSOIL(L,N)
      SAVELC(L)=COSELC(L,1)-COSELC(L,N)
  100 CONTINUE
      IF((K.EQ.1).OR.(K.EQ.3))WRITE(6,110)
      IF(K.EQ.5)WRITE(6,110)
      IF(K.NE.1)WRITE(6,104)R,CARPET
      IF(K.EQ.1)WRITE(6,105)
      WRITE(6,106)PLAN(I),AREA(J),FLOOR(MM)
      IF((K.GT.1))WRITE(6,107)
      IF(K.EQ.1)WRITE(6,111)
      IF(K.EQ.1)WRITE(6,108)(CITY(NUM(LL)),HEATHR(NUM(LL),N),
     1HEATYR(NUM(LL),N),THERM(NUM(LL),N),COSGAS(NUM(LL),N),GALLON(
     2NUM(LL),N),COSOIL(NUM(LL),N),EKWH(NUM(LL),N),COSELC(NUM(LL),N)
     3,NOTE(LL),LL=1,15)
      IF(K.NE.1)WRITE(6,109)(CITY(NUM(LL)),HEATHR(NUM(LL),N),HEATYR
     1(NUM(LL),N),THERM(NUM(LL),N),COSGAS(NUM(LL),N),GALLON(NUM(LL),N),
     2COSOIL(NUM(LL),N),EKWH(NUM(LL),N),COSELC(NUM(LL),N),PCT(NUM(LL)),
     3SAVGAS(NUM(LL)),SAVOIL(NUM(LL)),SAVELC(NUM(LL)),LL=1,15)
   98 CONTINUE
   99 CONTINUE
  101 CONTINUE
  102 CONTINUE
  103 CONTINUE
      WRITE(6,110)
      STOP
  104 FORMAT(/////8X*DATA FOR CARPETING THERMAL RESISTANCE*
     1* = *F4.2*  (TRANSMITTANCE = *F4.2* )*)
```

```
      105 FORMAT(/////8X*BASE DATA   (NO CARPETING)*)
      106 FORMAT(8X*FOR *A10* FLOOR PLAN OF AREA = *F6.0
     1* SQ.FT.,  USING *A10* CONSTRUCTION*//)
      107 FORMAT(T5*CITY*T15*HEATING/*T26*ANNUAL*T42*NATURAL GAS*
     1T61*FUEL OIL*T77*ELECTRICITY*T101*SAVINGS DUE TO CARPETING*
     2/T15*DES-HR*T26*HEATING*T41*THERMS/ COST*T58*GALLONS*
     3*/ COST*T78*KWH  / COST*T96*PCT*T104*GAS*T113*OIL*T122*ELEC*)
      108 FORMAT(15(2X,A10,2X,F7.0,2X,F11.0,2X,3(2X,F7.0* /$*F6.0),12X,A10/)
     1)
      109 FORMAT(15(2X,A10,2X,F7.0,2X,F11.0,2X,3(2X,F7.0* /$*F6.0),
     14X,F4.1*%*3(3X*$*F5.0)/))
      110 FORMAT(*1*)
      111 FORMAT(T5*CITY*T15*HEATING/*T26*ANNUAL*T42*NATURAL GAS*
     1T61*FUEL OIL*T77*ELECTRICITY*
     2/T15*DES-HR*T26*HEATING*T41*THERMS/ COST*T58*GALLONS*
     3*/ COST*T78*KWH  / COST*)
      END
```

```
      SUBROUTINE WALL(AREA,WALINS,PERIM,DESGNT,STORYS,HTFLOW)
      U=.082
      IF(WALINS.EQ.0.)U=.22
      IF(AREA.GE.5000.)U=0.17
C     AT 5000 SQ FT AND ABOVE USE CONCRETE BLOCK
C     W/ BRICK VENEER  (U=0.17)
      HTFLOW=U*PERIM*8.*(70.-DESGNT)*STORYS
C     WALINS IS 0.0 IF NO INSULATION USED IN WALLS
C      (1.0 IS TO BE USED TO INDICATE USE OF STD INSUL.)
C     8. FT. STANDARD WALL HEIGHT HAS BEEN ASSUMED
      RETURN
      END
```

```
      SUBROUTINE ROCF(AREA,STORYS,DESGNT,HTFLOW)
      AROOF=AREA/STORYS
      UROOF=0.061
      IF(AREA.GE.5000.)U=0.12
C     FOR COMMERCIAL STRUCTURES (5000 SQ FT OR LARGER)
C     USE MASONRY ROOF WITH LIGHT INSULATION (U=0.12)
      HTFLOW=UROOF*AROOF*(70.-DESGNT)
C     UROOF DEPENDS ON ATTIC INSULATION
C     R OF INSULATION                    UROOF (BTU/HR-°F-FT**2)
C     ---------------                    -----------------------
C       R-0                                0.276
C       R-7                                0.095
C       R-8.75                             0.081
C       R-13                               0.061
C       R-19                               0.046
C
      RETURN
      END
```

```
1                SUBROUTINE INFILT(AREA,STORYS,DESGNT,HTFLOW)
                 ALIVNG=AREA
                 HTFLOW=ALIVNG*8.*.075*.24*(70.-DESGNT)
           C     ASSUMES ONE AIR CHANGE PER HR. IN STRUCTURE
5          C     AIR DENSITY IS .075 LBM/FT**3
           C     SP. HEAT AIR IS .24 BTU/LBM-°F
                 RETURN
                 END
```

```
      SUBROUTINE WINDOW(AREA,DESGNT,DEGDAY,HTFLOW)
C      AREA WINDOW TAKEN AT 12% OF FLOOR AREA
C      (FHA STANDARDS REQUIRE 10%)
      AWIND=0.12*AREA
C
C
C      FOR ZONES 1 - 3  U=1.13
C      FOR ZONES 4 & 5  U=0.65
C      THIS ACCOUNTS FOR THE PREDOMINANCE OF DOUBLE
C      PANE WINDOWS IN NORTHERN REGIONS
      U=1.13
      ZONE=1.
C     FOR SINGLE PANE GLASS IN BTU/HR-°F-FT**2
C
      IF(DEGDAY.GT.5600.)ZONE=4
      IF((ZONE.EQ.4.).OR.(ZONE.EQ.5.))U=0.65
C      DOUBLE PANE
      HTFLOW=U*AWIND*(70.-DESGNT)
C     AWIND IS AREA OF WINDOWS,FT**2
C     DESGNT IS DESIGN TEMP. FM. ASHRAE
C     720 IS NO. OF HRS. PER MO.
      RETURN
      END
```

```
      SUBROUTINE WDFLOR(CARPET,AREA,STORYS,DESGNT,HTFLOW)
      UFLOOR=.28
      AFLOOR=AREA/STORYS
      IF(CARPET.NE.0.)UFLOOR=1./(1./UFLOOR+1./CARPET)
C     TUNHTED=(DESGNT*3.*PERIM*.9+70.*AFLOOR*UFLOOR)
C     TUNHTED=TUNHTED/(3.*PERIM*.9+AFLOOR*UFLOOR)
C      ABOVE TWO EQNS. ARE FOR REFERENCE ONLY
C     TUNHTED IS TEMP OF UNHEATED CRAWL SPACE OR BASEMENT
C     IN ACCORDANCE WITH ASHRAE DESIGN GUIDELINES
C      FOR UNVENTILATED CRAWL SPACES
C
C
C     FOR VENTILATED CRAWL SPACES THE FOLLOWING APPLIES :
      TUNHTED=0.50*(70.)+0.50*(DESGNT)
      HTFLOW=UFLOOR*AFLOOR*(70.-TUNHTED)
C     U OF WOOD FLOOR IS 0.28 BTU/HR.-FT**2-°F
      RETURN
      END
```

```
      SUBROUTINE SLAEHT(CARPET,STORYS,AREA,PERIM,DESGNT,HTFLOW)
      DIMENSION QA0(10),QA1(10),CA0(10),CA1(10),RVAL(10)
C      DATA STATEMENTS ARE BASED ON SEPARATE PROGRAM (RELAX)
      DATA RVAL/.613497,.781250,.927868,1.333333,2.439024,5*0./
      DATA CA0/3.123,2.627,2.321,2.079,1.274,4.25,4*0./
      DATA CA1/-.059,-.05,-.045,-.041,-.027,-.079,4*0./
      DATA QA0/38.149,32.389,28.870,26.218,17.461,51.901,4*0./
      DATA QA1/-.475,-.403,-.359,-.326,-.271,-.647,4*0./
      RCARPT=0.
      IF(CARPET.NE.0.)RCARPT=1./CARPET
      NFLORS=STORYS
      AREASB=AREA/STORYS
      N=6
      IF(RCARPT.NE.0.)GOTO1
      QEDGE=QA0(N)+QA1(N)*DESGNT
      QCENT=CA0(N)+CA1(N)*DESGNT
      GOTO3
    1 J=1
      NMIN=N-2
      DO 2 I=2,NMIN
    2 IF(RCARPT.GE.RVAL(I))J=I
      JJ=J+1
      QHIGH=QA0(J)+QA1(J)*DESGNT
      QLOW=QA0(JJ)+QA1(JJ)*DESGNT
      QCHIGH=CA0(J)+CA1(J)*DESGNT
      QCLOW=CA0(JJ)+CA1(JJ)*DESGNT
      FRACT=(RCARPT-RVAL(J))/(RVAL(JJ)-RVAL(J))
      QEDGE=FRACT*(QLOW-QHIGH)+QHIGH
      QCENT=FRACT*(QCLOW-QCHIGH)+QCHIGH
    3 QEDGE=QEDGE*(PERIM-12.)
      FACTOR=36.
      IF(NFLORS.EQ.2)FACTOR=45.
      QCENT=QCENT*(AREASB+FACTOR-3.*PERIM)
      HTFLOW=QEDGE+QCENT
      RETURN
      END
```

BASE DATA (NO CARPETING)
FOR SQUARE FLOOR PLAN OF AREA = 2000. SQ.FT., USING WOOD FLOOR CONSTRUCTION

CITY	HEATING/ DES-HR	ANNUAL HEATING	NATURAL GAS THERMS/	COST	FUEL OIL GALLONS/	COST	ELECTRICITY KWH /	COST
MIAMI	33177.	7099877.	65.	/$ 7.	46.	/$ 21.	1479.	/$ 44.
NEWORLEANS	42489.	67157899.	530.	/$ 102.	376.	/$******	9574.	/$ 326.
HOUSTON	53594.	74816682.	560.	/$ 18.	397.	/$******	9650.	/$ 261.
ATLANTA	66354.	196474180.	1282.	/$ 226.	908.	/$ 372.	20468.	/$ 430.
SANFRANSCO	44661.	134653949.	1106.	/$ 199.	783.	/$******	20842.	/$ 625.
FORT WORTH	63802.	153443614.	1030.	/$ 231.	729.	/$ 277.	16625.	/$ 582.
LOUISVILLE	79114.	368673006.	2085.	/$ 284.	1477.	/$ 591.	32213.	/$ 644.
ST LOUIS	80390.	393913045.	2196.	/$ 329.	1555.	/$ 622.	33872.	/$ 881.
SEATTLE	59974.	265324106.	1856.	/$ 406.	1314.	/$ 565.	30582.	/$ 367.
BOSTON	74294.	418570457.	2299.	/$ 690.	1628.	/$ 684.	35430.	/$ 567.
CHICAGO	85902.	570303640.	2698.	/$ 521.	1911.	/$ 941.	41750.	/$ 1586.
SPOKANE	83580.	554137805.	2702.	/$ 589.	1914.	/$ 823.	41693.	/$ 459.
CARIBOU	102154.	997735937.	3808.	/$******	2697.	/$ 1160.	61421.	/$ 1228.
DULUTH	103315.	1033146150.	3883.	/$ 866.	2750.	/$ 1072.	62886.	/$ 1572.
GLASGOW	110230.	992075689.	3399.	/$ 313.	2407.	/$ 939.	56572.	/$ 905.

NOTE :

**** = NO DATA AVAILABLE

DATA FOR CARPETING THERMAL RESISTANCE = 1.00 (TRANSMITTANCE = 1.00)
FOR SQUARE FLOOR PLAN OF AREA = 2000. SQ.FT., USING WOOD FLOOR CONSTRUCTION

CITY	HEATING/ DES-HR	ANNUAL HEATING	NATURAL GAS THERMS/	COST	FUEL OIL GALLONS/	COST	ELECTRICITY KWH /	COST	SAVINGS DUE TO CARPETING PCT	GAS	OIL	ELEC
MIAMI	31983.	6844781.	63.	/$ 7.	45.	/$ 20.	1426.	/$ 41.	3.6%	$ 0.	$ 1.	$ 2.
NEWORLEANS	40744.	64740709.	511.	/$ 98.	363.	/$******	9229.	/$ 314.	3.6%	$ 4.	$*****	$ 12.
HOUSTON	51664.	72133274.	540.	/$ 17.	382.	/$******	9303.	/$ 251.	3.6%	$ 1.	$*****	$ 9.
ATLANTA	63965.	189401091.	1236.	/$ 218.	875.	/$ 359.	19732.	/$ 414.	3.6%	$ 8.	$ 13.	$ 15.
SANFRANSCO	43054.	129806394.	1066.	/$ 192.	755.	/$******	20091.	/$ 603.	3.6%	$ 7.	$*****	$ 23.
FORT WORTH	61505.	147919630.	993.	/$ 222.	703.	/$ 267.	16026.	/$ 561.	3.6%	$ 8.	$ 10.	$ 21.
LOUISVILLE	76266.	355400744.	2010.	/$ 273.	1424.	/$ 569.	31053.	/$ 621.	3.6%	$ 10.	$ 21.	$ 23.
ST LOUIS	77496.	379732139.	2117.	/$ 318.	1499.	/$ 600.	32653.	/$ 849.	3.6%	$ 12.	$ 22.	$ 32.
SEATTLE	57815.	255772414.	1789.	/$ 392.	1267.	/$ 545.	29481.	/$ 354.	3.6%	$ 15.	$ 20.	$ 13.
BOSTON	71354.	402006497.	2208.	/$ 662.	1564.	/$ 657.	34028.	/$ 544.	4.0%	$ 27.	$ 27.	$ 22.
CHICAGO	82503.	547735189.	2591.	/$ 500.	1835.	/$ 807.	40098.	/$ 1524.	4.0%	$ 21.	$ 33.	$ 63.
SPOKANE	80273.	532209080.	2595.	/$ 566.	1838.	/$ 790.	40043.	/$ 440.	4.0%	$ 23.	$ 33.	$ 18.
CARIBOU	98111.	958252839.	3658.	/$******	2590.	/$ 1114.	58990.	/$ 1180.	4.0%	$*****	$ 46.	$ 49.
DULUTH	99226.	992261775.	3729.	/$ 832.	2641.	/$ 1030.	60397.	/$ 1510.	4.0%	$ 34.	$ 42.	$ 62.
GLASGOW	105916.	952816583.	3265.	/$ 300.	2312.	/$ 902.	54333.	/$ 869.	4.0%	$ 12.	$ 37.	$ 36.

DATA FOR CARPETING THERMAL RESISTANCE = 2.00 (TRANSMITTANCE = .50)
FOR SQUARE FLOOR PLAN OF AREA = 2000. SQ.FT., USING WOOD FLOOR CONSTRUCTION

CITY	HEATING/ DES-HR	ANNUAL HEATING	NATURAL GAS THERMS/ COST	FUEL OIL GALLONS/ COST	ELECTRICITY KWH / COST	PCT	SAVINGS DUE TO CARPETING GAS	OIL	ELEC
MIAMI	31217.	6680437.	62. /$ 6.	44. /$ 20.	1392. /$ 42.	5.9%	$ 0.	$ 1.	$ 3.
NEWORLEANS	45625.	63190407.	499. /$ 96.	353. /$******	9008. /$ 306.	5.9%	$ 6.	$*****	$ 19.
HOUSTON	50427.	70396731.	527. /$ 17.	373. /$******	9080. /$ 245.	5.9%	$ 1.	$*****	$ 15.
ATLANTA	62434.	184867060.	1207. /$ 212.	854. /$ 350.	19259. /$ 404.	5.9%	$ 13.	$ 22.	$ 25.
SANFRANSCO	42023.	126698988.	1041. /$ 187.	737. /$******	19610. /$ 588.	5.9%	$ 12.	$*****	$ 37.
FORT WORTH	60033.	144378614.	969. /$ 217.	686. /$ 261.	15643. /$ 547.	5.9%	$ 14.	$ 16.	$ 34.
LOUISVILLE	74441.	346892883.	1962. /$ 267.	1389. /$ 556.	30310. /$ 606.	5.9%	$ 17.	$ 35.	$ 38.
ST LOUIS	75641.	370641814.	2066. /$ 310.	1463. /$ 585.	31871. /$ 829.	5.9%	$ 19.	$ 37.	$ 52.
SEATTLE	56431.	249649534.	1746. /$ 382.	1237. /$ 532.	28775. /$ 345.	5.9%	$ 24.	$ 33.	$ 22.
BOSTON	69469.	391388873.	2150. /$ 645.	1522. /$ 619.	33129. /$ 530.	6.5%	$ 45.	$ 44.	$ 37.
CHICAGO	80324.	533208234.	2525. /$ 487.	1787. /$ 786.	39039. /$ 1483.	6.5%	$ 34.	$ 55.	$ 103.
SPOKANE	78153.	518152205.	2527. /$ 551.	1789. /$ 769.	38986. /$ 429.	6.5%	$ 38.	$ 53.	$ 30.
CARIBOU	99570.	932944101.	3561. /$******	2522. /$ 1084.	57432. /$ 1149.	6.5%	$*****	$ 75.	$ 80.
CULUTH	96606.	966053843.	3451. /$ 810.	2571. /$ 1003.	58802. /$ 1470.	6.5%	$ 56.	$ 70.	$ 102.
GLASGOW	103118.	927650489.	3179. /$ 292.	2251. /$ 878.	52898. /$ 846.	6.5%	$ 20.	$ 61.	$ 59.

DATA FOR CARPETING THERMAL RESISTANCE = 3.00 (TRANSMITTANCE = .33)
FOR SQUARE FLOOR PLAN OF AREA = 2000. SQ.FT., USING WOOD FLOOR CONSTRUCTION

CITY	HEATING/ DES-HR	ANNUAL HEATING	NATURAL GAS THERMS/ COST	FUEL OIL GALLONS/ COST	ELECTRICITY KWH / COST	PCT	SAVINGS DUE TO CARPETING GAS	OIL	ELEC
MIAMI	30634.	6566459.	60. /$ 6.	43. /$ 19.	1368. /$ 41.	7.5%	$ 1.	$ 2.	$ 3.
NEWORLEANS	44846.	62112284.	491. /$ 94.	347. /$******	8855. /$ 301.	7.5%	$ 8.	$*****	$ 24.
HOUSTON	49567.	69195057.	518. /$ 17.	367. /$******	8925. /$ 241.	7.5%	$ 1.	$*****	$ 20.
ATLANTA	61369.	181712951.	1186. /$ 209.	840. /$ 344.	18931. /$ 398.	7.5%	$ 17.	$ 28.	$ 32.
SANFRANSCO	41306.	124537313.	1023. /$ 184.	724. /$******	19276. /$ 578.	7.5%	$ 15.	$*****	$ 47.
FORT WORTH	59008.	141915299.	952. /$ 213.	674. /$ 256.	15376. /$ 538.	7.5%	$ 17.	$ 21.	$ 44.
LOUISVILLE	73170.	340974371.	1929. /$ 262.	1366. /$ 546.	29793. /$ 596.	7.5%	$ 21.	$ 44.	$ 48.
ST LOUIS	74351.	364318110.	2031. /$ 305.	1438. /$ 575.	31327. /$ 815.	7.5%	$ 25.	$ 47.	$ 66.
SEATTLE	55468.	245390139.	1717. /$ 376.	1216. /$ 523.	28284. /$ 339.	7.5%	$ 31.	$ 42.	$ 28.
BOSTON	68158.	384002192.	2109. /$ 633.	1494. /$ 627.	32504. /$ 520.	8.3%	$ 57.	$ 56.	$ 47.
CHICAGO	78808.	523204265.	2475. /$ 478.	1753. /$ 771.	38302. /$ 1455.	8.3%	$ 43.	$ 69.	$ 131.
SPOKANE	76678.	508373509.	2479. /$ 540.	1756. /$ 755.	38250. /$ 421.	8.3%	$ 49.	$ 68.	$ 38.
CARIBOU	93717.	915336429.	3494. /$******	2474. /$ 1064.	56348. /$ 1127.	8.3%	$*****	$ 96.	$ 101.
CULUTH	94782.	947822237.	3562. /$ 794.	2523. /$ 984.	57692. /$ 1442.	8.3%	$ 72.	$ 89.	$ 130.
GLASGOW	101172.	910143641.	3119. /$ 287.	2208. /$ 861.	51900. /$ 830.	8.3%	$ 26.	$ 78.	$ 75.

DATA FOR CARPETING THERMAL RESISTANCE = 4.00 (TRANSMITTANCE = .25)
FOR SQUARE FLOOR PLAN OF AREA = 2000. SQ.FT., USING WOOD FLOOR CONSTRUCTION

CITY	HEATING/ DES-HR	ANNUAL HEATING	NATURAL GAS THERMS/	COST	FUEL OIL GALLONS/	COST	ELECTRICITY KWH /	COST	PCT	SAVINGS DUE TO CARPETING GAS	OIL	ELEC
MIAMI	30292.	6482588.	60.	$ 6.	42.	$ 19.	1351.	$ 41.	8.7%	$ 1.	$ 2.	$ 4.
NEWORLEANS	44274.	61318949.	484.	$ 93.	343.	$******	8742.	$ 297.	8.7%	$ 9.	$*****	$ 28.
HOUSTON	48934.	68311849.	511.	$ 16.	362.	$******	8811.	$ 238.	8.7%	$ 2.	$*****	$ 23.
ATLANTA	60585.	179392003.	1171.	$ 206.	829.	$ 340.	18089.	$ 392.	8.7%	$ 20.	$ 32.	$ 37.
SANFRANSCO	40778.	122946647.	1010.	$ 182.	715.	$******	19030.	$ 571.	8.7%	$ 17.	$*****	$ 54.
FORT WORTH	58255.	140102671.	940.	$ 211.	666.	$ 253.	15179.	$ 531.	8.7%	$ 20.	$ 24.	$ 51.
LOUISVILLE	72236.	336619240.	1904.	$ 259.	1348.	$ 539.	29412.	$ 588.	8.7%	$ 25.	$ 51.	$ 56.
ST LOUIS	73401.	359664819.	2005.	$ 301.	1420.	$ 568.	30327.	$ 804.	8.7%	$ 29.	$ 54.	$ 77.
SEATTLE	54754.	242755868.	1695.	$ 371.	1200.	$ 516.	27923.	$ 335.	8.7%	$ 35.	$ 49.	$ 32.
BOSTON	67143.	378566931.	2079.	$ 624.	1473.	$ 618.	32044.	$ 513.	9.6%	$ 66.	$ 65.	$ 54.
CHICAGO	77642.	515798703.	2440.	$ 471.	1728.	$ 700.	37760.	$ 1435.	9.6%	$ 50.	$ 80.	$ 152.
SPOKANE	75592.	501177865.	2444.	$ 535.	1731.	$ 744.	37709.	$ 415.	9.6%	$ 56.	$ 79.	$ 44.
CARIBOU	92341.	902380531.	3444.	$******	2439.	$ 1049.	55551.	$ 1111.	9.6%	$*****	$ 111.	$ 117.
DLUUTH	93441.	934406528.	3512.	$ 785.	2487.	$ 970.	56876.	$ 1422.	9.6%	$ 83.	$ 102.	$ 150.
GLASGOW	89740.	897261244.	3074.	$ 283.	2177.	$ 849.	51165.	$ 819.	9.6%	$ 30.	$ 90.	$ 87.

The complete computer output will be available through:

Mr. Barry Torrence
Director of Technical Services
Carpet and Rug Institute
Dalton, Georgia 30720
(404) 278-3176

APPENDIX C

Physical Testing

Physical Testing

Carpet samples evaluated in this program for thermal transmittance were further evaluated for pile height and weight above the primary backing. In the course of these measurements, the total height and weight were also determined. This data and data on carpet construction parameters is related to the thermal transmittance on R-value of the carpets in the following disucssion.

For reference, the carpets were assigned to comparison groups according to their design speicifcations in Table 2 as follows:

I.) Yarn and fiber type, and carpet style constant; vary pile height, weight and density

II.) Only secondary backing type varies

III.) Fiber type and pile weight constant; vary carpet style

IV.) Carpet style and pile weight constant; vary fiber type

V.) Yarn type and pile weight constant; vary stitch density.

The assignment of carpet samples to these groups is shown in Table C-1.

Table C - 1

Comparison Group Assignment

Group	Sample Numbers Included
I	1,2,3,4
II	8,9
III	4,5,6,7
IV	14,15,16
V	8,10,11,12,13,14,17

In addition to the data given in Table 2, Table C - 2 gives the results of pile height and weight measurements with carpet R-values from Table 3 included for reference. The pile measurements recorded differ from the design specifications because this work purposely did not include any of the pile inbedded in the primary backing. This decision was taken with the assumption that the backing layer of a carpet is relatively thin (excepting attached foam back carpets) and consistent from one carpet to the next, whereas most of the design variability which could influence thermal transmittance exits with the pile.

Table C - 2

Physical Test Results

Sample No.	Total Height(in.)	Pile Height(in.)	Total Weight(oz/sq.yd.)	Pile Weight*	R-value
1	0.25	0.19	48.9	5.6	0.68
2	0.20	0.18	59.5	9.7	0.65
3	0.25	0.23	62.2	17.0	0.67
4	0.20	0.15	67.7	15.1	0.55
5	0.45	0.38	61.8	16.6	1.12
6	0.55	0.48	66.6	14.7	1.33
7	0.44	0.39	62.9	21.8	1.51
8	0.33	0.21	80.1	26.5	0.78
9	0.45	0.21	99.1	26.0	1.03
10	0.43	0.37	82.9	26.0	0.95
11	0.72	0.65	79.3	29.8	1.66
12	0.76	0.70	74.2	30.6	1.96
13	1.14	1.06	90.2	33.0	2.46
14	0.70	0.60	78.6	32.6	2.19
15	0.82	0.77	96.3	51.7	1.83
16	0.72	0.67	88.4	46.4	1.90
17	0.70	0.63	78.6	33.4	1.71
18	0.29	0.14	67.2	13.9	0.70

*NOTE: This measurement is pile weight above the back.

In group V, an attempt was made to fix pile weight and vary stitch density. To do this pile height was variable, also. Thus, an analysis was undertaken with respect to several of the variables in this group by finding the regression coefficient for a linear regression curve fit to the data. This coefficient was used as a measure of the dependency of R-value on each variable when the variable is taken as an independent variable. This analysis is shown in Table C - 3. Note that the regression coefficient may range from 0.0 - 1.0, with 0.0 implying no fit and 1.0 implying a perfect fit.

Table C - 3

	Independent Variable	Regression Coefficient
1.)	(Tufts per square inch)$^{-1}$ = GA./$_{SPI}$	0.80
2.)	Pile height above back	0.91
3.)	The product of 1. (and 2.) above	0.75
4.)	Total height	0.92
5.)	Pile weight above back	0.89
6.)	Total weight	0.18

The inferences which may be drawn from Table C - 3 are that carpet total height or pile height above the back strongly influences the R-value of carpet. Similarly, pile weight above the back strongly influences R-value, but total weight, as an independent measure, does not indicate what R-value will be obtained from the carpet. Since total height, pile height and pile weight are physically interrelated,

any one may be taken as a guide number for a first estimate of R-value in a form such as:

R-value = 2.6 x Total Height (inches)

The group IV results are largely voided by the changes in pile weight and height which occured within this group. The point of this grouping was to isolate a change in fiber type. Samples 11,12, and 17 are similar in pile height, but differ in fiber type and certainly do not show any strong changes other than that expected from the pile height differences.

Similar comments apply to the group III carpets where carpet style changes occurred, regretably along with pile height changes. For example, no strong, unexplainable changes in R-value occurred between samples 11 and 17, where style changed markedly, but pile height varied only a small amount. The R-values shown in Table C - 2 for these two samples are 1.66 and 1.71, respectively.

Group II results showed that the attached foam backing on sample 9, which was otherwise the same carpet at sample 8, led to an increase in R-value of the same magnitude as would have been found with an increased pile height equivalent to the thickness of the attached foam back, restated, the foam has approximately the same R-value as carpet pile for equal thickness.

Group I results follow the trends indicated in discussion of group V, i.e., pile height and pile weight are the first order factors influencing carpet thermal resistance.

Trapped air is the best, least expensive insulator available, and physically the trapped air in a carpet pile accounts for the unexpectedly good performance of carpets as insulators. This comment has been applied frequently to fiber glass insulation, and can be seen as an explanation of the difference in thermal resistance between the prime urethane (a low density foam) underlayment (R=1.6, many cells of trapped air) and the slab rubber (a high density foam) (R=0.6). Thus, the results discussed in this appendix are well in line with what may have been expected.

The following pages are the cover letter and report to Georgia Tech on thermal testing conducted by Dynatech R & D Co.

DYNATECH R/D COMPANY TEL. 617-868-8050
99 ERIE STREET • CAMBRIDGE, MA 02139 • USA

DYNATECH
THERMATEST DEPT.

October 6, 1976

Dr. L. Howard Olson, Associate Professor
Georgia Institute of Technology
School of Textile Engineering
Atlanta, Georgia 30332

Your Reference: P.O. No. E 27-643-77-61400
Our Reference: GIT-2

Dear Dr. Olson:

Enclosed you will find two copies of our report on the thermal transmittance of the thirty-one carpet materials. We have received the second set of samples and will begin testing the week of October 11.

One measurement which we performed which is not included in the enclosed data is the test with no air gap on specimen 22-1. With no air gap we measured a thermal conductance of 0.51 Btu $h^{-1}ft^{-2}degF^{-1}$. With the air gap we measured a thermal transmittance of 0.38. The air film thermal conductance was calculated from

$$\frac{1}{F_a} = \frac{1}{C_t} - \frac{1}{C_c}$$

Where F_a = the thermal conductance of a 1/2 inch air film

C_t = measured thermal transmittance with air gap

C_c = measured thermalconductance with no air gap

$$\frac{1}{F_a} = \frac{1}{0.38} - \frac{1}{0.51}$$

$$F_a = 1.5$$

The value of 1.5 is consistent with published values and suggests that running carpet materials in the heat flow meter instrument with an air gap is a viable technique.

If you have any questions, please do not hesitate to call.

Sincerely,

Stewart C. Spinney, Manager
Measurements Laboratory
Thermatest Department

SCS:pn

Enclosures

DYNATECH

Report on

THE THERMAL TRANSMITTANCE OF THIRTY-ONE CARPET MATERIALS

For: Georgia Institute of Technology
School of Textile Engineering
Atlanta, Georgia 30332

Thirty-one carpet materials were submitted for analysis of the thermal transmittance.

Experimental Procedure

The sample was tested in accordance with ASTM C518-70, "Test for Thermal Conductivity by Heat Flow Meter." The sample was placed between 300 mm square aluminum plates with blackened surfaces leaving an air gap of 12.7 mm between the top of carpet and the upper plate or hot plate. The upper plate contained a heater while the lower plate consisted of cooling chamber, a subsidiary heater and a multi-junction thermopile calibrated heat meter. At equilibirum conditions, the temperature of both hot and cold faces was evaluated from thermocouples embedded in the plates and the heat flux through the specimen was derived from the output of the heat meter.

The thermal transmittance was calculated from

$$C = (q/A)\left(\frac{1}{\Delta T}\right)$$

where C = thermal transmittance

q/A = heat flux

ΔT = temperature difference between hot plate 12.7 mm above top of sample and cold plate at the bottom of the sample.

The results for the samples tested are shown in the following tables.

Reference: GIT-2 October, 1976

DYNATECH

Table

THE THERMAL TRANSMITTANCE OF THIRTY-ONE CARPET MATERIALS

Sample	Description	Composite Density kg m^{-3}	Thickness[1] mm	Thermal Transmittance W m^{-2} $degK^{-1}$ 1st	2nd
20	Blood Red Plain Carpet	190	11.4	3.15	3.2
22	White/Lt. Blue Patterned Carpet	130	19.6	2.15	2.1
23	Rust Colored Plain Carpet	140	18.0	2.0	2.0
30	Orange/Brown Industrial Carpet	260	6.6	4.2	4.2
33	Off-white Plain Carpet	160	18.0	2.4	2.4
35	Red/rust/green/purple textured C.	110	16.0	2.8	2.8
37	Tan/gold/charcoal "striped" C.	260	10.9	3.5	3.6
40	Green/brown Industrial Carpet	320	8.9	3.9	3.9
41	Gold/Rust/Green Plain Carpet	110	29.0	[illegible]	[illegible]
42	Foam-backed Gold/Brown Carpet	300	10.4	[illegible]	[illegible]
[illegible]	Lime Green Textured Carpet	160	18.5	[illegible]	2.4
[illegible] 376	Green/Grey Textured Carpet	160	14.0	[illegible]	2.95
Green Waffle	Slightly textered Rubber Mat	350	5.8	4.4	[illegible]
Yellow Waffle	Extremely Waffled Rubber Mat	160	10.9	3.9	3.85
Yellow Foam	Flexible Urethane, Plain	32	10.2	2.5	2.5
37 and Yellow Foam	Stacked Carpet and Underlay	-	21.1	1.8	[illegible]

NOTE (1) The test was performed with an additional 12.7 mm air gap.

Reference: GIT-2

October, 1976

DYNATECH

Table

THE THERMAL TRANSMITTANCE
OF THIRTY-ONE CARPET MATERIALS

Sample	Description	Composite Density $lbs\ ft^{-3}$	Thickness inches	Thermal Transmittance[1] $Btu\ h^{-1} ft^{-2} degF^{-1}$ 1st	2nd
20	Blood Red Plain Carpet	12	0.45	0.56	0.57
22	White/Lt.Blue Patterned Carpet	8	0.77	0.38	0.37
23	Rust Colored Plain Carpet	9	0.71	0.35	0.35
30	Orange/Brown Industrial Carpet	16	0.26	0.74	0.74
33	Off-White Plain Carpet	10	0.71	0.42	0.42
35	Red/Rust/Green/Purple Textured C	7	0.6[illegible]	0.49	0.49
37	Tan/Gold/Charcoal "Striped" Carpet	16	0.[illegible]3	0.62	0.63
40	Green/Brown Industrial harpet	20	0.35	0.[illegible]	0.69
41	Gold/Rust/Green Plain Carpet	7	1.14	0.32	0.32
42	Foam Backed Gold/Brown Carpet	19	0.41	0.59	0.58
48	Lime Green Textured Carpet	10	0.73	0.43	0.42
[illegible]OR 576	Green/Grey Textured Carpet	10	0.55	0.50	0.52
[illegible]reen Waffle	Slightly Textured Rubber Mat	22	0.23	0.78	0.78
Yellow Waffle	Extremely Waffled Rubber Mat	10	0.43	0.69	0.68
Yellow Foam	Flexible Urethane, Plain	2	0.40	0.44	0.44
37 and Yellow Foam	Stacked Carpet and Underlay	-	0.83	0.32	-

NOTE (1) The test was performed with an additional 0.50 inch air gap.

Reference: GIT-2

October, 1976

DYNATECH

Report on

THE THERMAL TRANSMITTANCE OF FOURTEEN CARPET MATERIALS

For: Georgia Insitute of Technology
School of Textile Engineering
Atlanta, Georgia 30332

Fourteen carpet materials were submitted for analysis of the thermal transmittance.

Experimental Procedure

The sample was tested in accordance with ASTM C518-70, "Test for Thermal Conductivity by Heat Flow Meter." The sample was placed between 300 mm square aluminum plates with blackened surfaces leaving an air gap of 12.7 mm between the top of carpet and the upper plate or hot plate. The upper plate contained a heater while the lower plate consisted of cooling chamber, a subsidiary heater and a multi-junction thermopile calibrated heat meter. At equilibrium conditions, the temperature of both hot and cold faces was evaluated from thermocouples embedded in the plates and the heat flux through the specimen was derived from the output of the heat meter.

The thermal transmittance was calculated from

$$C = (q/A)\left(\frac{1}{\Delta T}\right)$$

where C = thermal transmittance
q/A = heat flux
ΔT = temperature difference between hot plate 12.7 mm above top of sample and cold plate at the bottom of the sample.

The results for the samples tested are shown in the following tables.

Reference: GIT-3 November, 1976

DYNATECH

Table

THE THERMAL TRANSMITTANCE OF
FOURTEEN CARPET MATERIALS

Sample	Description	Composite Density kg m^{-3}	Thickness[1] mm	Thermal Transmittance W m^{-2} $degK^{-1}$
49523-3	Tan Deep Pile Carpet	160	18.3	2.2
49523-2(50)	Gold Deep Pile Carpet	160	20.8	2.25
378	Gold/Brown/Black Carpet	310	6.6	4.3
#4(9909 78298-A)	Gold/Orange Carpet	440	5.1	4.65
137	Green/Blue/Black Carpet	410	5.3	4.25
Sample 7	Navy Blue Carpet	190	11.2	2.6
Hair Mat	Hair Mat Underlay	150	11.2	2.4
18	Blue/Green Carpet	-	7.4	4.15
49523-3 and Hair Mat		-	29.5	1.35
49523-2(50) and Hair Mat		-	32.0	1.4
378 and Hair Mat		-	17.8	1.95
#4(9909 78298-A) and Hair Mat		-	16.3	2.05
137 and Hair Mat		-	16.5	1.85
Sample 7 and Hair Mat		-	22.4	1.45

NOTE[1] The test was performed with an additional 12.7 mm air gap.

Reference: GIT-3

November, 1976

DYNATECH

Table

THE THERMAL TRANSMITTANCE OF
FOURTEEN CARPET MATERIALS

Sample	Description	Composite Density $lbs\ ft^{-3}$	Thickness[1] inches	Thermal Transmittance $Btu\ h^{-1} ft^{-2} degF^{-1}$
9523-3	Tan Deep Pile Carpet	10	0.72	0.39
9523-2(50)	Gold Deep Pile Carpet	10	0.82	0.40
78	Gold/Brown/Black Carpet	19	0.26	0.76
4(9909 78298-A)	Gold/Orange Carpet	28	0.20	0.82
.37	Green/Blue/Black Carpet	26	0.21	0.75
ample 7	Navy Blue Carpet	12	0.44	0.46
lair Mat	Hair Mat Underlay	10	0.44	0.42
.8	Blue/Green Carpet	18	0.29	0.73
9523-3 and Hair Mat		-	1.16	0.24
9523-2(50) and Hair Mat		-	1.26	0.25
78 and Hair Mat		-	0.70	0.34
4(9909 78298-A) and Hair Mat		-	0.64	0.36
37 and Hair Mat		-	0.65	0.33
ample 7 and Hair Mat		-	0.88	0.26

NOTE[1] The test was performed with an additional 0.50 inch air gap.

Reference: GIT-3

November, 1976

DYNATECH

Report on

THE THERMAL TRANSMITTANCE OF A CARPET MATERIAL

For: Georgia Institute of Technology
School of Textile Engineering
Atlanta, Georgia 30332

A carpet material was submitted for analysis of the thermal transmittance.

Experimental Procedure

The sample was tested in accordance wtih ASTM C518-70, "Test for Thermal Conductivity by Heat Flow Meter." The sample was placed between 300 mm square aluminum plates with blackened surfaces leaving an air gap of 12.7 mm between the top of carpet and the upper plate or hot plate. The upper plate contained a heater while the lower plate consisted of cooling chamber, a subsidiary heater and a multi-junction thermopile calibrated heat meter. At equilibrium conditions, the temperature of both hot and cold faces was evaluated from thermocouples embedded in the plates and the heat flux through the specimen was derived from the output of the heat meter.

The thermal transmittance was calculated from

$$C = (q/A)\left(\frac{1}{\Delta T}\right)$$

where C = thermal transmittance
q/A = heat flux
ΔT = temperature difference between hot plate 12.7 mm above top of sample and cold plate at the bottom of the sample.

The results for the sample tested are shown in the following table.

Reference: GIT-4 January, 1977

DYNATECH

Table

THE THERMAL TRANSMITTANCE
OF A CARPET MATERIAL

Sample	Composite Density $kg\ m^{-3}$	Thickness (1) mm	Thermal Transmittance $W\ m^{-2} degK^{-1}$
#1 Bonded Urethane	70	11.9	2.05
#2 Bonded Urethane	66	12.7	2.05

NOTE (1) The test was performed with an additional 12.7 mm air gap.

Sample	Density $lbs\ ft^{-3}$	Thickness (1) Inches	Thermal Transmittance $Btu\ in\ h^{-1} ft^{-2} degF^{-1}$
#1 Bonded Urethane	4.4	0.47	0.36
#2 Bonded Urthane	4.2	0.50	0.36

NOTE (1) The test was performed with an additional 0.50 inch air gap.

DYNATECH

Table

THE THERMAL TRANSMITTANCE
OF A CARPET MATERIAL

Sample	Composite Density $kg\ m^{-3}$	Thickness (1) mm	Thermal Transmittance $W\ m^{-2} degK^{-1}$
#1 Bonded Urethane	70	11.9	2.05
#2 Bonded Urethane	66	12.7	2.05

NOTE (1) The test was performed with an additional 12.7 mm air gap.

Sample	Density $lbs\ ft^{-3}$	Thickness (1) Inches	Thermal Transmittance $Btu\ in\ h^{-1} ft^{-2} degF^{-1}$
#1 Bonded Urethane	4.4	0.47	0.36
#2 Bonded Urthane	4.2	0.50	0.36

NOTE (1) The test was performed with an additional 0.50 inch air gap.

DYNATECH

Report on

THE THERMAL TRANSMITTANCE OF A CARPET MATERIAL

For: Georgia Institute of Technology
School of Textile Engineering
Atlanta, Georgia 30332

A carpet material was submitted for analysis of the thermal transmittance.

Experimental Procedure

The sample was tested in accordance wtih ASTM C518-70, "Test for Thermal Conductivity by Heat Flow Meter." The sample was placed between 300 mm square aluminum plates with blackened surfaces leaving an air gap of 12.7 mm between the top of carpet and the upper plate or hot plate. The upper plate contained a heater while the lower plate consisted of cooling chamber, a subsidiary heater and a multi-junction thermopile calibrated heat meter. At equilibrium conditions, the temperature of both hot and cold faces was evaluated from thermocouples embedded in the plates and the heat flux through the specimen was derived from the output of the heat meter.

The thermal transmittance was calculated from

$$C = (q/A)\left(\frac{1}{\Delta T}\right)$$

where C = thermal transmittance
q/A = heat flux
ΔT = temperature difference between hot plate 12.7 mm above top of sample and cold plate at the bottom of the sample.

The results for the sample tested are shown in the following table.

Reference: GIT-4 January, 1977

R-values of carpet and underlay combinations were checked for the combinations shown in Table C-4. The underlays used were the coated combination hair pad and the prime urethane foam pad, designated in Table C-4 as hair and foam pad types, respectively.

Table C-4

R-Value of Carpet-Underlay Combinations

Carpet Sample No.	Pad Type	Sum of Individual R-values	Combination R-value
10	Foam	2.56	2.46
2	Hair	2.36	2.27
3	Hair	2.38	2.36
4	Hair	2.26	2.11
7	Hair	3.22	3.18
15	Hair	3.54	3.33
16	Hair	3.61	3.50

Table C-4 indicates that the R-values of carpet and underlay combinations are additive within ten percent. This result is in close agreement with theory which states that under ideal conditions, e.g. perfect interfacial contact, the R-values of combined objects is additive.

Appendix D

Sample Calculation

SAMPLE CALCULATION

In order to obtain a number representative of the cost benefit of carpeting in a particular structure, the following factors need to be established:

1. Geographic location
2. Type of floor plan (square one-story, rectangular one-story, etc.)
3. Area of living space in square feet
4. Type of heating system (natural gas, fuel oil or electric)
5. Type of floor in the ground floor of the house (concrete slab on grade or wood floor over vented crawl space)

With these factors established, consult Tables 5 through 108 and find the type structure most representative of the structure being considered. It is obviously not possible to account for a great number of different structures due to the attendant volume of tables generated. However, basic structure types were chosen to address a general class of structures which exist in the U.S. today. EXAMPLE: The savings due to carpeting installed in a 3,000 square foot, rectangular house, with uninsulated concrete slab floor and electric resistance heating, located in St. Louis, will range from $72/year to $148/year for carpeting R-value ranging from 1 to 4, as indicated in Tables 41 through 44.

The zone map in the report (Figure 2) is useful in determining in which zone a city not found among those listed in the table is located. The best approximation to percentage savings in heating would be to use that figure given for the nearest city found in the table of the same zone. Since dollar savings depends upon local utility rates, the percentage savings is the useful number for cities not listed (and for the citites listed if a utility rate change should occur).

For floor areas between those given, a savings can be calculated by interpolating between values given in tables. For example, 3500 sq. ft. is half way between 3000 sq. ft. and 4000 sq. ft. Thus, by interpolation, the savings for a 3500 sq. ft. house is approximately equal to the savings at 3000 sq. ft. plus one half the difference between the savings at 4000 sq. ft. and 3000 sq. ft. In the rectangular house given in the previous example, but for 3500 sq. ft., for percentage savings for carpeting with R-value of 2 would be:

$$(8.1\%)_{3000} + 1/2 \left[(8.0)_{4000} - (8.1\%)_{3000} \right] = 8.05\%$$

In the review, the sample calculation followed this order:

Determine:

1. city or zone in which calculation is to be made.
2. house shape.
3. floor area in square feet.
4. type of heating system.
5. type of floor construction.
6. carpeting R-value.

Find:

1. group of tables covering the particular floor plan being considered.
2. tables of same floor area and construction.
3. select one of the four tables most closely approximating the carpeting R-value.
4. percentage or dollar savings for the city or zone needed.

Interpolation of the results can be used where needed to correct for values of floor area, R-value, or city location and utility rates different from those found in the tables to improve the estimate of savings.

The dollar savings are valid for utility rates in the specific cities listed in each talbe, using rates in effect August, 1976. The percentage savings are not influenced by a change in utility rates, and thus are useful for a longer period of time.

The influence of a building construction technique which greatly improved wall, ceiling and window thermal resistance will increase the percentage savings over the values shown, whereas improvements in floor construction which increase thermal resistance will decrease the percentage savings. Obviously, with the wide variety of construction techniques in use across the country, and even within a geographic region, the numbers for savings will be more or less accurate in each particular application. The constructions used are typical for housing completed over the past twenty years, except that recent housing should have improved floor insulation relative to older structures.