BS BUILDING SCIENCE SERIES 108

afety on Stairs

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NBS BUILDING SCIENCE SERIES 108

Safety on Stairs

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ABSTRACT

Stairways are commonplace in U.S. homes. Stairway design and construction standards are based on custom, common sense, and experience. Stairways, however, are hazardous. A large number of stairway accidents have been reported, raising questions about the adequacy of stairway design and construction standards. This study is a first attempt to rationalize stairway standards by applying well established statistical methods to a significant sample of stairways and people using them. A pilot study on a sample of 253 residences in Milwaukee County, Wisconsin, was undertaken. The study included a survey of stairway use and behavior and an inventory of residential stairways. This information was obtained from the total sample. In a subsample of 54 residences, direct field observations and physical measurements of stairways were obtained. The results of the pilot study include a description of existing stairways, inference about interactions that produce accidents, and guidelines which address reasons for accidents (hence should result in a reduction of accidents). The best strategy for making stairways safer, according to the study, is to remove factors that influence accident rates. Specifically, by systematically reducing hazards, careless stairway habits, and frequency of use, patterns of factors responsible for accidents can be broken and accident rates can be reduced.

Key words: Accidents; architectural psychology; consumer products; environmental factors; home safety; occupant behavior; survey technique.

CONVERSION FACTORS TO METRIC (SI) UNITS

Quantity	To convert from	To	Multiply by
Length	inch	m (meter)	2.540×10^{-2}
	foot	m	3.048×10^{-1}
	mile	m	1.609×10^{3}
Area	in^2	m^2	6.452×10^{-4}
	ft^2	m^2	9.290×10^{2}
Volume	in^3	m^3	1.639×10^{5}
	ft^3	m^3	2.832×10^{2}
	gallon	m^3	3.785×10^{3}
Temperature	°F	°C	$t_{°C} = (t_{°F}-32)/1.8$
T. difference	$\Delta t_{°F}$	K	$\Delta T_K=\Delta t_{°F}/1.8$
Mass	pound	kg	4.536×10^{-1}
	ounce	kg	2.835×10^{-2}
Pressure	psi	Pa	6.895×10^{3}
	in H_2O	Pa	2.488×10^{2}
	in Hg	Pa	3.386×10^{3}
	mmHg	Pa	1.333×10^{2}
Energy	Btu	J	1.055×10^{3}
	MBtu	J	1.055×10^{9}
	kWh	J	3.600×10^{6}
	ft·lbf	J	1.356×10^{0}
	kilocalorie	J.	4.184×10^{3}
Power	Btu/h	W	2.931×10^{-1}
	hp	W	7.457×10^{2}
Flow	gal/min	m^3/s	6.309×10^{-5}
	ft^3/min	m^3/s	4.719×10^{-4}
Density	lb/ft^3	kg/m^3	1.602×10^{1}
	lb/gal	kg/m^3	1.198×10^{2}
Heat Capacity	Btu/(lb·°F)	J/(kg·K)	4.187×10^{3}
	Btu/(ft^3·°F)	J/(m^3·K)	6.707×10^{4}

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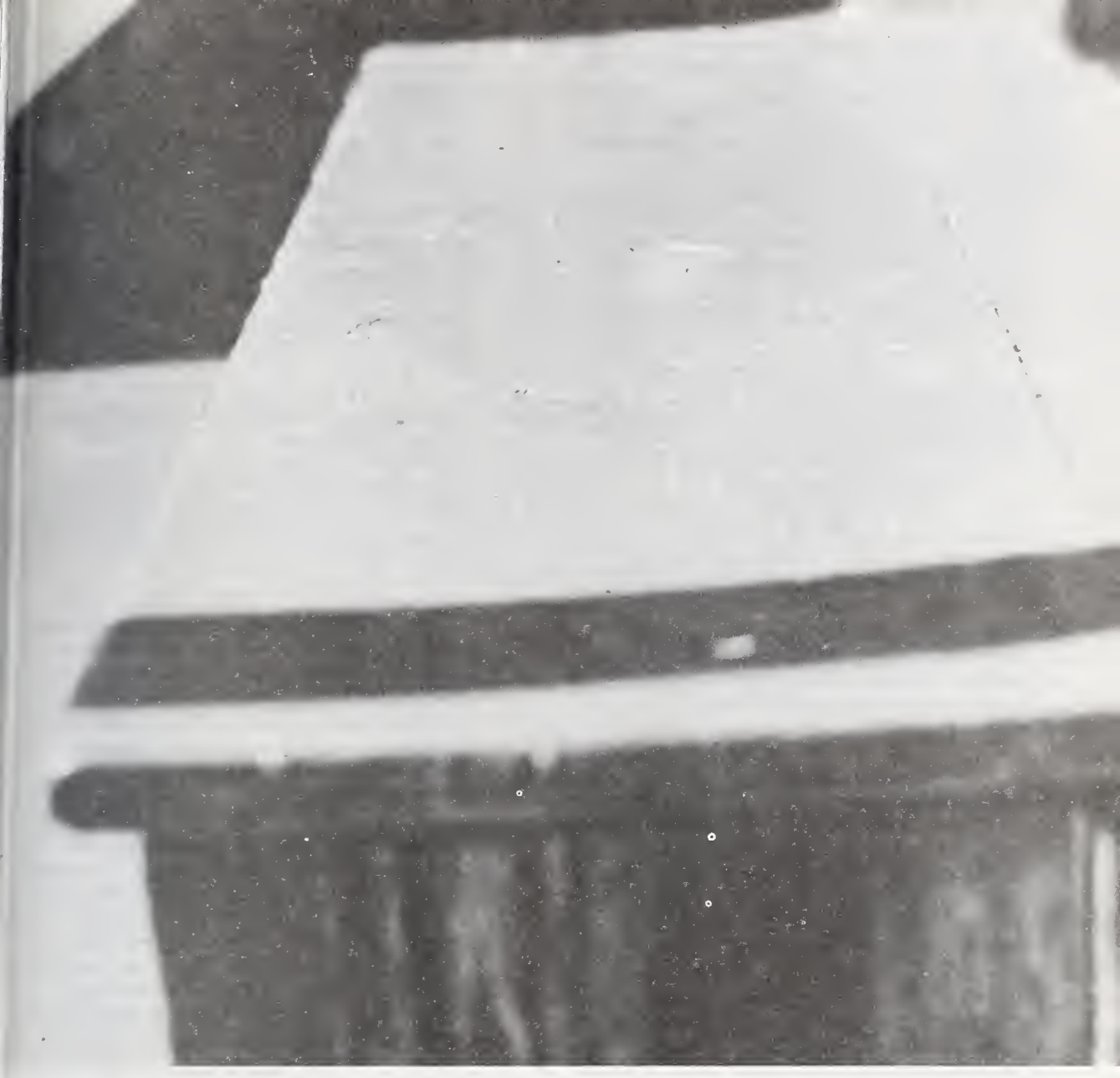
PREFATORY REMARKS

"You see, but you do not observe. The distinction is clear. For example, you have frequently seen the steps which lead up from the hall to this room." "Frequently." "How often?" "Well, some hundreds of times." "Then how many are there?" "How many? I don't know." "Quite so. You have not observed. And yet you have seen. That is just my point. Now, I know that there are seventeen steps, because I have both seen and observed."

Sherlock Holmes in *A Scandal in Bohemia*



1. SUMMARY AND GUIDELINES

1.1 INTRODUCTION

Stairways are commonplace in U.S. homes. Stairway design and construction standards are based on custom, common sense, and experience. Stairways, however, are hazardous. A large number of stairway accidents have been reported, raising questions about the adequacy of stairway design and construction standards. This study is a first attempt to rationalize stairway standards by applying well established statistical methods to a significant sample of stairways and people using them. A pilot study on a sample of 253 residences in Milwaukee County, Wisconsin, was undertaken. The study included a survey of stairway use and behavior and an inventory of residential stairways. This information was obtained from the total sample. In a subsample of 54 residences, direct field observations and physical measurements of stairways were obtained. The results of the pilot study include a description of existing stairways,

inference about interactions that produce accidents, and guidelines which address reasons for accidents (hence should result in a reduction of accidents). The best strategy for making stairways safer, according to the study, is to remove factors that influence accident rates. Specifically, by systematically reducing hazards, careless stairway habits, and frequency of use, patterns of factors responsible for accidents can be broken and accident rates can be reduced.

1.2 BACKGROUND AND SETTING OF THE STUDY

Residential stairways are a fact of life for a large segment of people in the United States; they are commonplace. They are necessary as efficient, economical and practical solutions to space conservation in residential construction. Stairways are also hazardous. From data collected by the National Electronic Injury Surveillance System (NEISS), the Consumer Product Safety Commission has reported that 356,000 stairway injuries are treated annually. This figure includes only those seen in hospital emergency rooms. Many more are seen only by private physicians and still more go unreported.

There are numerous accepted building practices and standards dealing with the features and dimensional characteristics of new or proposed stairways. Yet little is known about existing stairways, including their physical characteristics, their state of repair, alterations their owners have made, the way people use them, and most important, the relationships between stairway accidents and physical and behavioral factors. The need to develop standards for new stairways and for retrofitting old stairways required a study designed to address these very topics.

The preliminary research reported here was aimed at getting data for use in the development of standards, but it also served as a pilot test of procedures and instruments for their usefulness as part of a future full scale study of stairways.

This report draws upon two sources of information: Reports by respondents and direct field measurements by investigators. Respondents described the physical nature of their stairways, how they used them, and any stairway accidents on them. The direct field measurement produced more detailed descriptions of stairways than could be obtained from respondents, and also provided some additional measurement data on stairways.

The pilot test of procedures and instruments compared three data collection methods: Mail survey, phone interview and personal interview. In addition, the more precise field measures and the site visit sample of respondents were used as a way of estimating the accuracy of responses in the larger sample. The detailed discussion comparing procedures is in appendix H at the end of this report.

All residences sampled were in Milwaukee County, Wisconsin. A total sample of 253 residents was obtained, of which 54 were selected for site visits to conduct the direct field measurements. Data were submitted to standard quantitative and statistical procedures.

Limitations on the study imposed by size and characteristics of sample are small. The sample was 1:1400 units. It was taken in Milwaukee County, an area where half the housing was built before 1940 and where basements are almost universal. The sample does not contain innovative new housing or extremes of luxury and dilapidation. Major residential stairways in the sample are full length; split level designs are uncommon. The sample does reflect the high percentage of older housing in the County, which is also common to many other large eastern and midwestern cities. In terms of retrofitting stairways, it was predicted that those that are older would show the ravages of time and use, and as a result be more hazardous, thus requiring more attention than stairways in newer housing.

Even with some qualifications, stairways examined in this study have considerably more generality than might be expected. Stairways are, after all, highly stylized structures. They are restricted in length by conventional ceiling heights and are governed by old, well established building practices. Therefore, number of risers, configuration, structural materials and tread materials fit into a small number of classes. Differences which do appear are created by type of building, age of structure and by residents who both improve and degrade their stairways by a variety of practices.

1.3 SCOPE

Three basic classes of information were gathered from all 253 respondents in the sample: physical measures, use rates and behavior, and accident events. Topics covered under each of these are as follows:

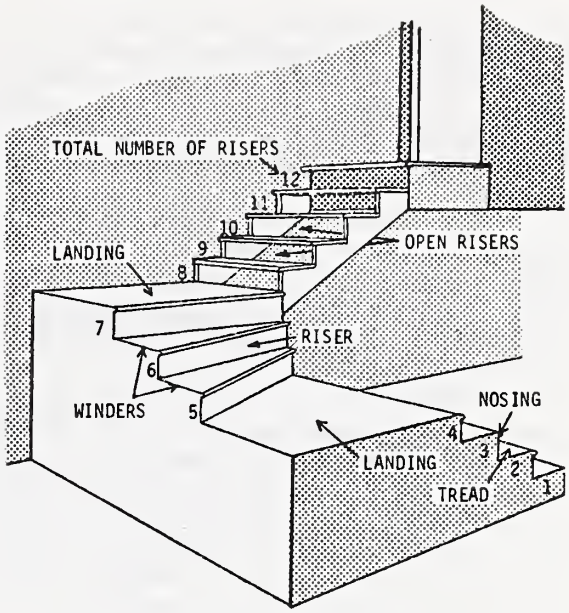
Number and structure of stairways
Configuration
Length of stairways
Tread materials
Riser irregularities
Handrail characteristics
Lighting features
Headroom and orientation edge
Stairway hazards

Reports on needed stairway repairs
Suggestions for improving stairway repairs
Personal habits on stairways
Frequency and rate of stairway use

Stairway accidents and critical incidents

In addition to all of the above measures, the site visits also included measures on the following items: lengths of flights, friction on treads, riser-tread dimensions, handrail dimensions, light levels and gradients, home activities requiring stairway use, housing preferences, and hazard ratings.

Figure 1 is presented to assist in the interpretation of stairway nomenclature used in the section that follows. Other technical terms used in this study are explained in section 2.8.



a RISER is the height of one step
a TREAD is the part you step on
a LANDING is a platform larger than a TREAD
a NOSING is the front overhanging edge
an OPEN RISER is one you can see through
a WINDER is a TREAD, wider on one side than the other
TOTAL NUMBER OF STEPS is TOTAL NUMBER OF RISERS BETWEEN TWO LEVELS

FIGURE 1. *Stairway nomenclature*

Floor of origin or of destination	Floors connected	Abbre-viation
Basement	Basement and first floor	B-1
Second	First and second floor	1-2
Third	Second and third floor	2-3

1.4 SUMMARY OF PHYSICAL INVENTORY

Nearly 1500 changes of level were encountered in a sample of 253 residences in Milwaukee County. About half of them had three or more steps and qualified as stairways. (A *stairway* refers to a series of three or more steps between two floor levels and may include two or more flights with intermediate landings.) They included both private and shared stairways in apartments, duplexes and single family homes.

To designate which indoor stairway in a multistory house is the focus of discussion, stairways are labelled by floor of origin or floor of destination, or by the floors connected.

The average residence had two inside stairways, one of which was a basement (B-1) stairway, and two outside entrances with one or more risers. Ninety-eight percent of the inside stairways were wood. Eighty percent of the outside stairways were concrete, with the remaining 20 percent being painted wood or some combination of wood and concrete. Configuration of basement stairways was divided between straight stairways and those with one landing and a turn. Two-thirds of second floor stairways had some type of turn. Buildings constructed before 1940 and multifamily buildings had more stairways with turns than did newer and single family buildings. Winders were found on thirty percent of the stairways in the sample: virtually all were on inside stairways.

Average length of basement (B-1) stairways was 12 risers and of second floor (1-2) stairways, 14 risers. Average length of outside stairways was considerably shorter: 60 percent had between three and five risers. More single risers and two-riser sets were found on outside stairways than on inside stairways.

Major tread materials on inside stairways followed a distinct pattern: Basement stairways used linoleum with metal nosings as the preferred covering; stairways to the second floor were covered with full or part width carpeting; second to third floor stairways had painted or varnished surfaces. These three classes of materials accounted for nearly 80 percent of all inside stairway surfaces. Because of the frequent use of throw rugs, different materials on landings, and combinations of materials on a single tread, a person could encounter many changes in materials using a single stairways (see sec. 3.3). The average stairway exhibited four different materials from the bottom to the top landings.

Nearly half of all inside stairways measured in the field had some combination of 7-1/2 to 8 in. risers with 10 to 10-1/2 in. treads. Considering the recommended combination of 7 in. risers with 11 in. treads made by Archea, 1975 (citation in footnote, page 27) 70 percent of the sample stairways did not meet this standard. Using this same standard, fewer that 5 percent of outside stairways failed to qualify.

Field measurements showed a minimum of 46 percent of all stairways to have riser or tread irregularities of at least one inch from the average length or height of treads or risers, respectively, of a given stairway. Some stairways had more than one flight, and even within a single flight, 28 percent had such irregularities. Respondents in the site sample noticed only one-third of these measured irregularities.

Full length handrails were reported on 82 percent of second floor stairways. By comparison, outside stairways had fewer full length handrails. Only 36 percent of the front outside stairways had handrails and only 39 percent of back outside stairways had them.

Almost half of all basement (B-1) stairways were reported to need artifical light during daylight hours. With the greater number of windows near second floor (1-2) stairways, only 15 percent were reported in need of daytime lighting. Respondents reported glare on fewer than 5 percent of their stairways, but field measures suggested that the number is closer to 26 percent. About 95 percent of the light levels measured fell below 20 footcandles (fc), the recommended standard for stairways.[1] Differences in light levels on each stairway were recorded. Nearly 25 percent of all stairways had differences of 15 fc from one end to the other. These variations were caused by having only one natural or artificial source available. Still, major stairway features were easy to see after 5 minutes in any residence.

Respondents reported headroom low enough to bump the user on 22 percent of basement and 8 percent of second floor stairways. Using the criterion of 78 in. or less, field measurements added stairways where headroom could be visually distracting to those where the user could actually bump his head. Under this criterion, 67 percent of the basement and 48 percent of the second floor stairways in the site sample had low headroom. Orientation edges, edges which allow the user a view of a room before reaching the bottom step, provide a different kind of distraction. Forty three percent of basement and second floor stairways were reported to have such an orientation edge (50 percent in field measures). Field measures also show that these distracting features occurred together on about 40 percent of all inside stairways. On 20 percent of inside stairways in the field, they occurred at the same step.

1.5 SUMMARY OF USER SURVEY

Twenty-one percent of all 253 respondents (n = 52) reported a total of 87 repairs needed to make their stairways safe. Small repairs accounted for 22 percent and full replacements for 78 percent of the needs. Of the 68 full replacements, structural changes, handrails and tread materials are mentioned most often. The need for improved lighting accounted for only 5 of the 87 intended repairs (6%).

Forty-eight percent of all respondents (n = 121) provided 258 recommendations for improving stairway safety. Most of these dealt with the physical stairway and very few with stairway behavior. Handrails were mentioned most frequently, followed by carpeting. As in the repairs section above, little attention was paid to lighting. Many of the 65 comments on needed changes in

[1]Kaufman, John and Jack Christensen, Editors. (1972) IES lighting handbook. New York: Illuminating Engineering Society, page 9-99.

configuration, style and dimensions of stairways were in substantial agreement with the kinds of recommendations coming from experts in stairways design.

A set of nine user habits was presented to each respondent to obtain information about behavior on stairways potentially related to accidents. The three most frequently reported habits pertain to footwear: wearing slippers or clogs, using stairways with bare feet, and using stairways with stocking feet. Over half of all respondents say these behaviors occur at least a few times a week. Hurrying, failing to use the handrail and leaving objects on stairways were each reported by a substantial group (38%, 39% and 37% respectively). Of the 54 respondents making up the site sample, 70 percent utilized at least one stairway for temporary storage. Site respondents were often unaware of the extent to which they had used stairways for storage until it was called to their attention.

The photographs in figure 2 illustrate the use of stairways for a variety of different household articles. Photographs are explained in the captions.

Respondents were asked to give an overall safety rating of their stairways. Renters rated theirs as less safe than did owners. However, renters' ratings were not consistent with their assessments of the physical quality of their stairways. Owners' safety ratings more directly matched their descriptions of the physical quality of their stairways.

An analysis of self reports giving rates of use over a one-day period shows that highest rates of use occur before 10 AM and that evening use averages less than half the rate of early morning use. Average hourly use for people at home all day is not higher than average hourly use for those away for 8 or 9 hours. [Average hourly use was computed by dividing all reported uses—the absolute number of uses—by the reported hours spent at home (less hours asleep, which was estimated at 8 hours).] However, absolute number of uses, or daily rate, is larger for those who spend more of their day at home.

Most respondents plan many common activites in their homes in ways to reduce stairway use. Access to basements and the usual location of large and fixed appliances determines that certain activities, such as washing and drying clothes, require stairway use to perform.

Given a choice of different types of dwelling units, a large number of respondents in the site sample preferred homes with fewer stairways than they now have, but they did not reject stairways altogether. Eighty percent preferred housing with at least one stairway, and expressed the need to separate activities by stairways.

1.6 SUMMARY OF INFLUENCES ON FREQUENCY OF STAIRWAY USE

Demographic factors of age and type of building and age and sex of users appear to influence frequency of stairway use. To determine these influences, several other important factors were controlled in the analysis, among which were number of stairways, safety ratings, user habits and stairway hazards.

Among physical factors, building type and age do not exert a major influence on hourly rate of stairway use. Whether stairways belong to single family homes, duplexes or apartment units, rate of use is determined far more by the sheer number of stairways than by type and age of building.

Among personal factors, age and sex have a limited effect on rate of stairway use. Whether the adult is old or young, female or male, rate of use is more highly related to sheer number of habits the stairway user has, a kind of stairway style.

In general, residential stairways are used at rates that are necessary to accommodate household activities and are little influenced by various structural features and their state of repair (see chapter 5 for an analysis of hazards).

1.7 SUMMARY OF ACCIDENT ANALYSIS

Distributions of accident events by age in this study are very close to the data produced by NEISS. The four demographic variables of age and type of structures and age and sex of respondents are not individually related to accident events, but their interactions bring out trends. Residents in older single family dwellings have somewhat higher rates, as do females 25-34 years old. The underlying influence for older single family dwellings is the increased hazard rating of their stairways. Higher exposures to residential

FIGURE 2. CAPTIONS FOR PHOTOS OF STAIRWAYS WITH OBJECTS*

*352***
Temporary storage at top and permanent storage at bottom; orderliness permits resident to ignore use (denying storage on stairways); loose throw at top; truncated rails.

313
Crowded flat encourages risky use of stairway for storage (a second refrigerator is stored on a large winder out of picture to right—top of lower flight).

*316***
Summer storage of toy vehicles on landing between 1st and 2nd floor; throw rug is pushed up on baseboard and does not appear to offer any advantage for use.

309
Unobtrusive metal cabinets with sharp edges neatly placed on all landings here; rubber treads are missing from steps 2, 4, 5, and 6; nails are still exposed on some steps.

320
One of numerous cases of shoes stored on stairways, in this case shoes are on an incursion into the stairwell at top step; loose throw on polished and varnished wood; handrails are missing.

331
Careful, planned and decorative use of middle landing; sharp corners on cabinet provide two opportunities to incur a gouging injury.

335
Intensive use of landing (and steps not visible at lower right) for storage of objects used daily by second floor tenant; no handrails; cracked linoleum on top landing can catch shoes.

324
Clothes storage hooks on 2nd to 3rd floor flight used by young children; fall could result in gouging injury; no handrails; boots stored on lower steps of flight.

322
Middle landing from 1st to 2nd floor disappears from intensive use for storage; clothes hooks (out of picture at top) are at shoulder height; bannister on this flight shows large variation in height (forced perspective in picture) of 4½ in; no handrail on lower flight.

These stairways have been selected primarily to show the range of objects that are stored on steps more or less permanently and not merely to be picked up and carried up or down for redistribution. However, they are typical of all the stairways with objects in the sample (61%). Features other than objects that are noted are not unique to these stairways, being present in more than one additional case.

**captions keyed to photos by response numbers on each.*
***accident stairway*


352


313


316


309


320


331


335


324


322

*FIGURE 3. CAPTIONS FOR PHOTOS OF STAIRWAYS WITH ACCIDENT EVENTS**

330 (CR)
Loose runner on lower steps; dark on upper part of flight even with light on; stairwall to right opens at kitchen ceiling, providing an orientation edge at the point of the loose runner and high contrast.

305 (CR, M)
Apartment-townhouse is used to display artwork; header above mezzanine flight (far side of white block in upper right of picture) has a changing display at eye level, distracting the person at the top step.

307 (M)
Fanning of porch risers due to settling; riser heights irregular at all points; concrete steps at sidewalk have recently been put in and contrast with much older porch steps.

331 (CR)
Very unobtrusive riser with incursion, radiator and door; an interesting chair beyond door takes attention away from step.

339 (M)
Lower right stairwall open (orientation edge); low headroom not shown fully in picture; box is easy to step into.

316 (S, M)
Screen door sweeps over entire landing; handrails missing; edges are sharp on treads; warped and worn surfaces; brick landing is an irregular surface.

347 (M)
Prefab home on slab with concrete entry step settled and tilted; the nosing on threshold overhangs step 3½ in, shortening useable tread in descent; riser overgrown and hidden.

322 (S)
Extreme tilt in this long concrete flight is due to settling; handrail was installed after accident; grass at break between steps and top landing is visible in picture.

These stairways having accidents or critical incidents have been selected for their range of types; however, they are not atypical of stairways at the sites visited. These stairways also do not appear particularly unusual or hazardous to the casual user.

**For severity: (S) = severe; (M) = moderate; and (CR) = critical incident.*


330


305


307


331


339


316


322


347

stairways underlie the results for young adult females. (For a summary of all accident data, see table 1).

TABLE 1. SUMMARY OF ACCIDENT DATA

NAME OF VARIABLE	HAS EFFECT ALONE?	SHOWS EFFECT OR TRENO BY INTERACTION WITH*
DWELLING UNIT:		
AGE OF STRUCTURE	NO	TYPE, HAZARDS
TYPE OF STRUCTURE	NO	# STWYS, HAZAROS, AGE STR.
RENTER/OWNER STATUS	NO	PERCENT SAFE
VALUE OF HOME	NO	
MONTHLY RENT	NO	
NUMBER OF STAIRWAYS	YES	HAZAROS, TYPE OF STRUCT.
PERCENT SAFE	YES	HAZARDS, RENTER/OWNER
HAZARD MEASURE	YES	AGE, TYPE, # STWYS, % SAFE
PERSONAL:		
RESPONDENT AGE	NO	SEX, USES/HR, STWY HABITS
RESPONDENT SEX	NO	RESP. AGE
USES PER HOUR	NO	STAIRWAY HABITS, R. AGE
USES PER DAY	YES	
STAIRWAY HABITS	YES	R. AGE, USES PER HOUR
STAIRWAY:		
NUMBER OF RISERS	NO	
RISER-TREAD DIMENSIONS	TREND	
LIGHT LEVEL	NO	LIGHT GRADIENT
LIGHT GRADIENT	NO	LIGHT LEVEL
TREAO MATERIALS/FRICTION	NO	
NUMBER OF MATERIALS	NO	
HANDRAIL PRESENCE	NO	SEVERITY OF ACCIDENT
LOCATION (B-1, 1-2, etc.)	TREND	CONFIG, IRREG, WINDERS
DIMENSIONAL IRREGULARITY	TREND	LOCATION
CONFIGURATION	TREND	LOCATION
PRESENCE OF WINDERS	NO	LOCATION
LOW HEAOROOM	TREND	ORIENTATION EDGE
ORIENTATION EDGE	TREND	LOW HEADROOM

*For completeness, variables are repeated for each interaction.

Of thirteen physical factors considered, none show significant relationships to accident events. However, six of these show trends, and four interactions show definite relationships.

The half dozen showing trends may be summarized as follows: (1) riser-tread dimensions giving steeper stairways are associated with highest accident rates; (2) stairways from first to second floors have highest accident rates; (3) larger dimensional irregularities show more accident events; (4) more turns on stairways are associated with more accident events; both (5) low headroom and (6) orientation edges show increased accident rates. Handrail presence alone does not show a significant relationship to accident events, but having one reduces the severity of the event.

Interaction between low headroom and orientation edge shows that when both are present there is a significant increase in accident events. Location of stairway—basement to first floor (B-1), first to second floor (1-2)—interacts with configuration, dimensional irregularity and presence of winders separately to significantly increase accident events on first to second floor (1-2) stairways. This result is interpreted as an indictment primarily of winders(see fig. 3).

Among behavioral variables, higher hourly rates of use are not related to more accident events, but rate interacts with age of user. The people most prone are those under 45 years of age who average more than two uses per hour. Total daily use is directly related to accident events. It is as though after a certain number of uses, the probability of an event rises sharply, no matter how frequently those uses are made.

Having a larger number of careless or casual habits increases one's accident proneness. Age groups below 45 have more careless habits and also higher rates of use. The need to use stairways and carelessness both contribute to accident events in these groups.

A multiple regression analysis was run separately on physical and behavioral factors to assess the total influence of each set on accidents. Data were limited to respondents' own accident events. Both types of factors contribute significantly when combined this way. No individual factors are singled out. Rather, the pattern of factors is the most important influence on accident rates. This analysis suggests a practical strategy. *By systematically reducing hazards, careless stairway habits, and frequency of use, these patterns can be broken and accident events can be reduced.*

1.8 GENERAL OBSERVATIONS FROM SITE VISITS

Residential stairways in the site sample were ordinary. They were clean and generally free of debris, although objects did abound in neat or somewhat organized arrays. Except for a few isolated instances, they were not dilapidated, loose or broken. But many accidents occur on stairways with no obvious hazards.

People do not spend much time thinking about stairways unless there is an obvious defect in the physical structure, there has been a recent accident of some severity or a household member has a special problem. Small accidents quickly fade into the background. Factors an expert would consider hazardous are sometimes not even noticed by a resident.

Respondents frequently wondered why anyone would spend time and money to study stairways. In due course, they took serious interest and offered

relevant information as the stairway measurements and interview proceeded. Many ultimately asked for an "expert" evaluation of the safety of their stairways and for further advice on how to improve them.

People lack awareness of hazards created by using stairways for temporary and permanent storage. Landings and top or bottom steps are favorite places, but any part of the stairway may be involved. Objects are placed there briefly, as in the case of shoes, laundry or other items to be transported. Stairways are used for longer term storage of items such as bottles, bicycles, cleaning materials and food. Shelves are built and hooks are inserted in stairway walls for storage purposes.

Stairways are such large structural and spatial units that they are included in most redecorating plans. But they are frequently not treated as a unit in those plans. Fashions, appearance and aesthetic considerations predominate over safety factors. Safety becomes important only for minor changes or additions or for single features, and even here, appearance often wins out. Furniture on landings and wall adornments "fill space," conserve space or decorate the stairway. Finishes on walls and tread surfaces are selected to reduce contrast and to camouflage the stairway rather than announce its presence. Loose rugs are used both for protection and decoration. Well intentioned improvements, therefore, often make stairways more hazardous.

Stairway features are unevenly thrust into people's minds. Lighting is one extreme. Unless it is entirely inoperative, few people are conscious of stairway lighting. A substantial number of people have a habit of using stairways in the dark as a regular practice. Basement stairways with no light switch at the bottom are accepted as normal, and sometimes a switch only at the fixture is tolerated. Glare sources, such as bare bulbs on basement stairways, appear in otherwise well appointed homes. Of all stairway features, lighting is probably the last thing that comes to people's minds.

People can identify major problems of stairway structure or configuration. They often mention steepness, narrowness and winders as hazards. But they are generally less aware of subtle hazards such as orientation edges, handrails that are difficult to grasp, or dimensional irregularities. When they do identify a problem, they do not know simple, inexpensive ways to compensate for the defect or to warn users about it.

A small number of people appear to have knowledge about safety features of stairway coverings. But most express their strong preferences for or against an entire class of materials, such as carpeting, linoleum, rubber treads or varnished wood. They fail to see how variations within a class of materials alter stairway dimensions. Further, they overlook the contribution to continuing stairway safety made by proper installation and maintenance, without which a safe material can be rendered hazardous.

Young and middle-aged active adults do not see themselves as potential victims of stairway accidents. They shrug off minor slips or trips. Concern is expressed for people with handicaps or for the very young and the very old. On the other hand, older people stress the care with which they use stairways because they recognize their vulnerability.

Explicit reasons for an accident are not always given. The word "slipped" is a case in point. As a reason, it pops up often, but it serves to conceal more adequate factors, such as catching the foot where friction is actually excessive, or tripping on a nosing, or even missing a step. Tread friction or shoe materials may be singled out while other physical or personal factors go unexamined. These other factors emerge only after some probing. "Slipped" is often shorthand for "an accident happened," and should be the signal for more complete questioning.

1.9 EIGHTEEN GUIDELINES FOR IMPROVED STAIRWAY SAFETY

Stairways are integrated sets of factors; and stairway behavior is a function of all of these factors together. (*Factors* refer to features and hazards of stairways.) This integration provides the primary structure of the guidelines in table 2. Furthermore, the guidelines in table 2 treat important factors separately, insofar as possible. In three cases, guidelines are grouped by a common factor. Guidelines 1, 2, and 3 focus on the physical unity of stairways as used; guidelines 7 and 8 focus on risers and treads; and guidelines 9 and 10 focus on lighting. After each guideline (or set of related guidelines) in table 2, there is a summary of relevant findings from the study.

TABLE 2. EIGHTEEN GUIDELINES FOR IMPROVED STAIRWAY SAFETY

1 EMPHASIZE EACH STAIRWAY AS A UNIT OF INTERACTING FEATURES OR HAZARDS

2 COROLLARY: GIVE FIRST PRIORITY TO STANDARDS FOR FEATURES OF FIRST TO SECOND FLOOR STAIRWAYS

3 RECOMMEND COMPENSATORY MEASURES IN CASES OF INABILITY TO MODIFY STRUCTURES

1-3: First to second floor stairways have higher accident rates than other stairways. Configurations, irregularities and winders interact on these stairways. More fashion and style attention is given first to second floor stairways. People most often degrade them by their intended improvements.

4 CONTROL COMBINATIONS OF FEATURES THAT DIVERT USERS' ATTENTION FROM STAIRWAY

4: Orientation edges and distracting headroom heights significantly increase accident events, especially when they occur together on the same stairway or at the same step.

5 TABULATE AND RECOMMEND DESIGNS ELIMINATING FEATURES THAT DISTRACT THE USER

5: Standard residential stairway construction combines distracting headroom heights and orientation edges on the same stairways 40% of the time, and at the same step of the stairway 20% of the time.

6 INTEGRATE ALL DETAILS OF HANDRAILS TO MAKE THEM FUNCTIONAL UNITS

6: People recognize the need for handrails but are less aware of functional details. Accident events take place equally often on stairways with or without full length handrails. But handrails are necessary to reduce severity of accident events.

7 EMPHASIZE COMBINATIONS OF RISER-TREAD DIMENSIONS THAT HAVE SHALLOWER SLOPES

8 STUDY EFFECTS OF RISER-TREAD COMBINATIONS ON CRITICAL INCIDENTS IN THE FIELD

7-8: Least recommended combinations of riser-tread dimensions show a trend of increased accident rates. Recommended combinations produce stairways with shallower slopes.

9 MAKE STAIRWAY LIGHTING A FUNCTIONAL UNIT BY INTEGRATING ALL ASPECTS

10 STUDY DYNAMIC RELATIONSHIPS OF GRADIENTS AND LEVELS TO CRITICAL INCIDENTS

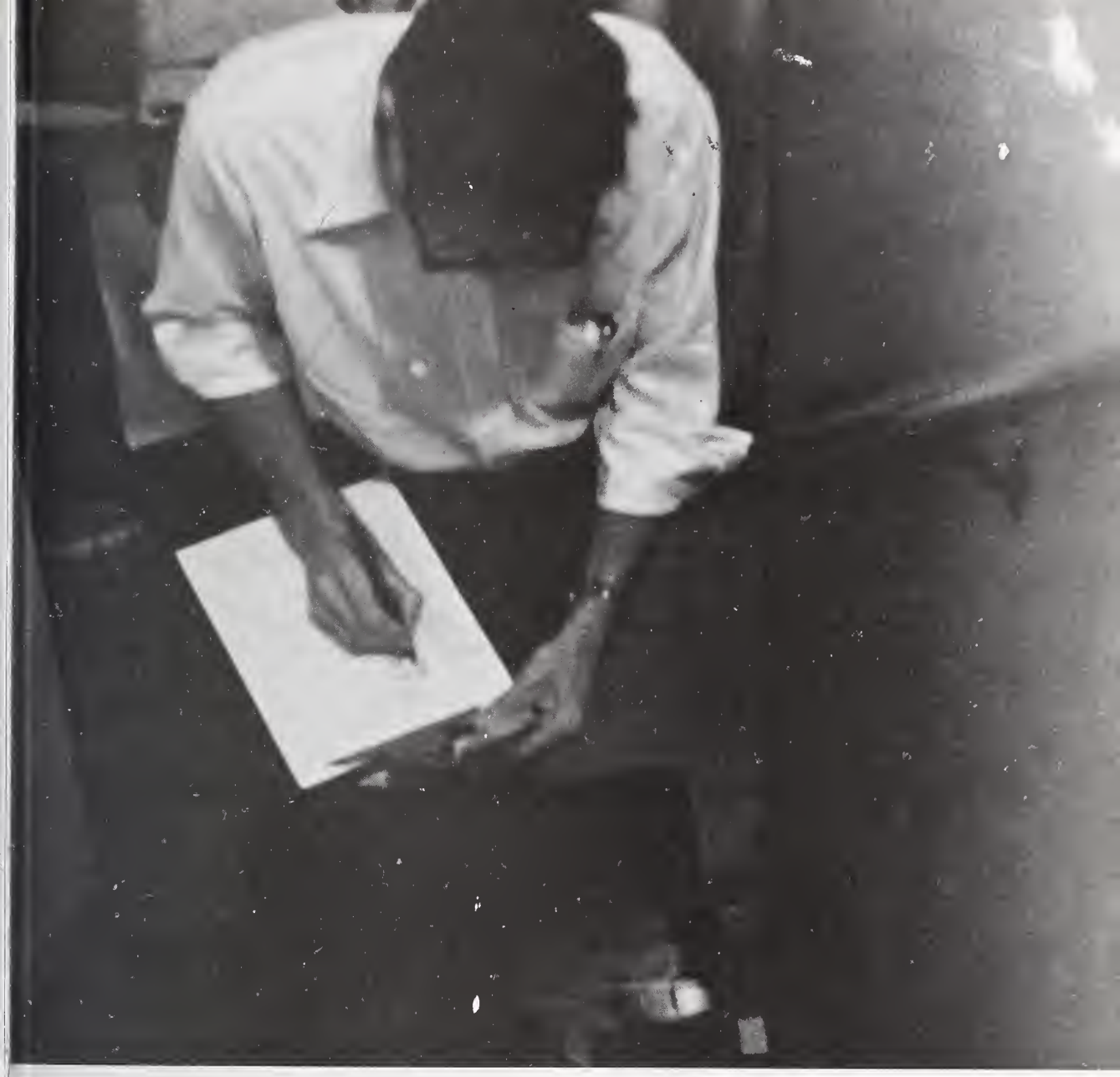
9-10: Stairway lighting gets little attention until it is inoperative. Levels are low and gradients high on most stairways. These conditions show a trend relating to accident events. People do not understand the potential hazards of glare and contrast on their stairways and usually do not control them. Switches are not equally accessible, which may encourage habits of using stairways in the dark.

11 REDUCE NUMBER OF RESIDENTIAL STAIRWAYS; ELIMINATE UNNECESSARY STAIRWAYS

11: Increased number of accident events is associated with increased number of stairways. The probability of hazards increases with an increase in number of stairways. Hazard patterns on different stairways are not the same and may require significant adjustment in use patterns in the same dwelling unit.

TABLE 2. CONTINUED

12	DRAW ATTENTION TO INDOOR PLANNING THAT CAN REDUCE NUMBER OF STAIRWAY USES	12: Increased number of stairway uses is associated with higher accident rates. For younger age groups, rate of use is associated with accident rate. Structure and fixed locations of large appliances can demand increased stairway use. Use is greatest for those at home all day and who work in the home.
13	MAKE YOUNG AND MIDDLE AGED ADULTS AWARE OF THEIR CARELESS STAIRWAY HABITS	13: No single careless stairway habit may be worse than another, but people with more of these habits have more accidents events than those with fewer. Younger age groups have significantly more careless stairway habits than older age groups.
14	DEVELOP AN EASY-TO-USE CHECK LIST TO EVALUATE THE QUALITY OF EACH STAIRWAY	14: If a check list is attractive and clear, residents can and will use it to evaluate their stairways. Evaluations may be used by owners to plan repairs, by renters to inform owners and by builders as a guide.
15	PROVIDE A SET OF PRINCIPLES FOR SELECTION, INSTALLATION AND MAINTENANCE OF STAIRWAY PARTS AND MATERIALS THAT COMBINE SAFETY WITH ATTRACTIVENESS	15: People lack the information to compare and evaluate alternatives. Items aimed to improve wear, utility or appearance often reduce safety. Improper installation of safety features, such as leaving a second handrail loose, add hazards.
16	INFORM PEOPLE OF SIMPLE, INEXPENSIVE METHODS OR DEVICES TO ALTER, REMOVE OR COMPENSATE FOR HAZARDS OR TO WARN USERS OF HAZARDS	16: Renters hold owners responsible for hazards but cannot give the uninformed owner some inexpensive methods. Owners often cannot come up with inexpensive solutions even when they are aware of the hazard. Warning or compensatory measures are either never thought of or add to the hazard. Cost estimates vary widely for the same job.
17	INSTRUCT PEOPLE TO BE AWARE OF CRITICAL INCIDENTS AND LEARN TO ANALYZE THEM	17: After an accident, only curative measures are available. The attitude that critical incidents are minor events causes them to be forgotten rapidly and their information to be lost. Generally inadequate reasons are given for incidents that are recalled. Ability to analyze critical incidents can develop preventive measures.
18	ESTABLISH A STRATEGY OF BREAKING PATTERNS OF HAZARDS, HABITS AND USE	18: Instead of a single prepotent "cause", it is more likely that patterns of physical, personal and situational factors lead to an accident. Breaking up patterns, or at least reducing their probability by trying to modify as many factors as feasible, is more productive than concentrating on a single factor.



2. DESCRIPTION OF STAIRWAY STUDY

2.1 INTRODUCTION

Despite their bland ubiquity, or probably because of it, stairways are the second most hazardous item studied by the Consumer Product Safety Commission. Of the many parts of the residence, stairways are the single most hazardous part. The Commission estimates that each year on stairways there are about 356,000 injuries of sufficient magnitude to be reported to hospital emergency wards or to require some kind of first aid or medical attention.

Stairway accidents causing these injuries are not distributed evenly throughout the population. Female adults incur many more injuries on stairways than male adults. Male children incur more injuries than female children. Injuries treated in emergency wards vary widely in severity and include lesser insults such as sprains, abrasions, contusions and small lacerations along with more

damaging insults such as punctures, large contusions or lacerations, concussions and fractures. Some 2,000 stairway accidents are fatal each year.

Saying accidents that cause the injuries are themselves caused in turn by stairways is not the same thing as saying that the cause of the accident is known. Accident events are almost always a consequence of multiple causes, one of which may be a precipitating factor. The epidemiological model groups causal factors into three broad classes: (1) the physical objects, (2) the user, and (3) the environmental situation. Accident events may have causal factors from one, two, or all three classes.

A substantial amount of formal and informal information exists that describes and analyzes physical features of stairways and the behavior of users. Some of this information explicity deals with stairway safety, but in most cases the relationship is implicit. A surprisingly small amount of information, however, relates the physical performance of stairways, conditions surrounding their use, and human performance on stairways.

In order to address this complex research problem, the Consumer Product Safety Commission has contracted with the National Bureau of Standards to design and implement a study of factors crucial for stairway safety that are instructive for improving stairway performance. Among these factors are physical information on numbers, descriptions and conditions of stairways, behavioral information on the use of stairways by specific subpopulations and relationships between the two.

This report describes the results of a preliminary study organized to collect and analyze data on physical and behavioral variables related to stairway use and stairway accidents. There are three parts to the study:

- A physical inventory of a sample of residential stairways.
- A survey of stairway users' behavior, including a record of frequency of use.
- An analysis of all accidents on stairways in the sample, relating physical and behavioral variables.

The specific aims of the study are:

- ▲To develop and pilot test survey and inventory instruments in the field.
- ▲To collect physical data on structure and condition of stairways relevant to the evaluation of standards.
- ▲To collect behavioral data on stairway use and accidents.

Many commonly held beliefs about stairways and stairway user's behavior may be used to establish causes of stairway accidents, such as poor workmanship, disrepair, "slipperiness," dim lighting, objects or animals on stairways, "dangerous" clothing or footwear, and even the wastebasket categories of carelessness, inattention or poor judgement. These beliefs are sometimes elevated to a mystique that leans too far in one or another direction. In one case, all stairway accidents are due to user carelessness. In another case, a certain building material is a panacea; a different material, anathema. In yet another, stairways are to be avoided at all costs. The overall attitude taken in this study is to consider a number of interacting factors and to attempt to assess their relative importance for stairway safety.

The substantive material of this report is organized into independent chapters. In addition to this chapter, which contains an overview of the study, the overall design, and a glossary of terms and chapter 1, which presents a overall summary of findings and a set of guidelines and recommendations, there are four other chapters. Chapter 3 describes and discusses the physical measures of stairways. Chapter 4 examines the data on stairway behavior and the frequency of stairway use. Chapter 5 discusses the influences of physical and behavioral variables on frequency of use. Chapter 6 presents an analysis of accidents and critical incidents on stairways in the sample.

In the case of chapter 6 dealing with accidents, relevant data are also presented in other chapters, which are referenced as the need arises.

Some supplementary data, raw measures, and other information, including direct quotations from respondents in the sample, are presented in appendixes A through F. Copies of the survey instruments are in appendix G. A critique of the study is presented in appendix H.

In all data tables and often in the text discussing them, the appropriate total numbers and subclass numbers of cases are given. When corresponding numbers do not agree in separate analyses, it is because one or more respondents did not fill in an item.

2.2 SAMPLING PLAN AND OVERALL STUDY DESIGN

The study was limited to Milwaukee County, one of four abutting counties in the Milwaukee Standard Metropolitan Statistical Area (SMSA). Milwaukee County contains 73.7 percent of the population and 77.8 percent of all housing units in the SMSA and reflects all classes of these variables. Its diversity of housing types makes it a suitable area for a pilot study on stairway safety. In fact, national firms test products in Milwaukee because it is considered an "average city" in a number of respects.

The census tract was the primary sampling unit for this study. Five stratifying variables were used to insure that households selected within census tracts came from different levels of variables relevant to stairways and to frequency of their use. The variables were: Owner/renter status, age of structure, type of structure, family income, and age of female population (survey was aimed at adult females). Number of levels were, respectively, 2, 2, 2, 3, and 3, giving a total of 72 strata.[2]

Because of correlations among the stratifying variables, the 274 census tracts in Milwaukee County occupied only 62 of the 72 strata. Ten tracts were then selected randomly, one from each of the 10 strata with the largest number of tracts.

From each of the 72 sample tracts, 7 addresses were selected by systematic random sampling of addresses, using a different sampling fraction based on population in each tract. This procedure yielded a total of 504 households by addresses. Another set of 504 nearest neighbors was selected as the alternative group to the primary sample.

The Wisconsin Bell Telephone System Address Directory was used to obtain addresses. This Directory had been updated one month before its use in this study, and contained 90 percent of all occupied housing units in the County. The remaining 10 percent of the occupied housing units consisted of those without telephones and those with unlisted numbers.

In addition to getting data relevant for the development of standards, this study was designed to compare different methods of collecting data. The total sample of 504 households was divided into two subsamples in a 4:3 ratio yielding samples of 288 and 216, respectively. The larger sample received the mail form and the smaller sample received the phone interview, from which was drawn the site sample. A detailed discussion of this method is presented under Survey Procedures in section 2.5.

Two sample sizes were used to obtain about the same number of responses in mail and phone surveys, predicated on expected response rates with each method. Some alternates were used from nearest neighbors as noted in section 2.5. There were 91 responses to the 288 mail forms (31.6 percent response rate) and 162 responses to the 216 phone contacts, of which 54 were in the site sample (75 percent response rate together). Overall response rate in the study was 253/504 or 50.2 percent. This response rate is acceptable; different methods are compared in appendix H.

2.3 DEMOGRAPHIC COMPARISONS

The actual census tract numbers appear in the cells of table 3 and show how these tracts are distributed according to the original stratifying variables. The tracts selected show a good geographic distribution over Milwaukee County. Table 4 presents a distribution of respondents according to census tract of origin.

TABLE 3. OISTRIBUTION OF CENSUS TRACTS BY ORIGINAL STRATIFICATION
(cell entries are census tract numbers; "45" means census tract #45)

RESPON. AGE			YOUNG			MIOOLE			OLO		
FAM.	INCOME		LOW	MEO	HIGH	LOW	MEO	HIGH	LOW	MEO	HIGH
SFO*	OLO	OWN	45	130	74	161	914	182	189	205	803
		RENT	63 69	183	1003	164 177	188	1004	162	60	61
	NEW	OWN	1501	1601	1203 1301	127	1014	701 901	211	38 203	32 57
		RENT	101	5	1702		28		36	50	190
MFO*	OLO	OWN							171	126	125
		RENT	97 138	133		179 186	1802		111	62 124	802
	NEW	OWN	1803	13	6 1402	212	29	197	206	1018	56
		RENT	77	16	17	21	1009	1	201	24	191

*SFD = single family dwelling; MFD = multiple family dwelling

TABLE 4. OISTRIBUTION OF RESPONOENTS BY CENSUS TRACT OF ORIGIN

RESPON. AGE			YOUNG			MIOOLE			OLO		
FAM.	INCOME		LOW	MEO	HIGH	LOW	MEO	HIGH	LOW	MEO	HIGH
SFO	OLO	OWN		3	6	5	4	4	2	2	3
		RENT	3	2	1	2	3	4	5	4	9
	NEW	OWN	4	4	10	4	5	11	3	4	6
		RENT	1	8	5				3	3	5
MFO	OLO	OWN							4	5	1
		RENT	4	3		8	2		3	3	5
	NEW	OWN	3	2	10	5	4	5	4	4	4
		RENT	3	4	4	4	5	7	2	1	6

[2]Levels: Owner, renter; before 1940, 1940 to present; single family, multifamily; under $10,980, $10,980-$11,338, under 27.0 years, 27.0-33.8 years, over 33.8 years.

Information on each of the stratifying variables was obtained from all respondents. Comparisons between this information and data on Milwaukee County are contained in tables 5a through 5g. Comparisons are made for each of the three methods of data collection as well as for the total sample. The methods are described below.

TABLE 5. COMPARISON OF SURVEY SAMPLE WITH SUBSAMPLES AND WITH UPDATED CENSUS DATA FOR MILWAUKEE COUNTY, 1975

All data are presented as percentages; number of cases at top of column. P values derive from the Kolmogorov-Smirnoff tests of cumulative frequency distributions MAIL/PHONE/SITE compared with SAMPLE and SAMPLE compared with MILWAUKEE COUNTY.

5a. RESP AGE	MAIL +	PHONE +	SITE =	SAMPLE	MILW CO.
N =	90	107	54	251	681,400
20-34	21.1	26.1	44.4	28.4	32.5
35-44	23.4	22.4	18.5	21.9	17.8
45-54	20.0	17.8	16.7	18.3	18.4
55-64	22.2	15.0	11.1	16.7	15.8
65 up	13.3	18.7	9.3	14.7	15.5
P value	--	--	--	--	

5b. INCOME	MAIL +	PHONE +	SITE =	SAMPLE	MILW CO.
N =	82	97	54	233	273,050
under $5000	4.9	11.3	7.4	8.2	10.0
$5000-$9999	23.2	18.5	20.4	20.6	24.9
$10000-$15000	23.1	37.2	38.8	32.6	32.5
over $15000	48.8	33.0	33.4	38.6	32.6
P values	--	--	--	--	

5c. VALUE OF HOME					
N =	68	77	38	183	150,870
under $10000	1.5	-0-	-0-	0.5	3.9
$10000-$19999	5.9	18.2	10.5	12.0	34.1
$20000-$35000	52.9	45.4	50.0	49.2	42.7
over $35000	39.7	36.4	39.5	38.3	19.3
P values	--	--	--	.01	

5d. MONTHLY RENT					
N =	15	24	16	55	159,740
under $100	-0-	-0-	-0-	-0-	24.0
$100-$199	73.4	91.7	75.1	81.9	54.7
$200-$250	10.0	2.7	12.5	7.3	18.9
over $250	16.6	6.2	12.4	10.8	2.4
P values	--	--	--	.01	

5e. TYPE OF UNIT					
N =	91	108	54	253	360,530
Single family	76.9	76.9	63.0	73.9	48.0
Duplex	13.2	18.5	25.9	18.2	27.0
Apartment	9.9	4.6	11.1	7.9	25.0
P values	--	--	--	.01	

5f. YEAR BUILT					
N =	84	104	54	241	360,530
1965-present	11.9	10.5	9.5	10.7	8.6
1940-1964	50.0	40.4	39.6	43.6	42.2
before 1940	38.1	49.1	50.9	45.7	49.2
P values	--	--	--	--	

5g. OCCUPIED BY:					
N =	91	108	54	253	352,150
Owner	83.5	77.8	68.5	77.9	54.4
Renter	16.5	22.2	31.5	22.1	45.6
P values	--	--	--	.01	

The comparison tables treat the five stratifying variables as well as Value of Home and Monthly Rent. The mail, phone and site subsamples did not differ significantly from the total sample on any one of the seven variables.

The total sample differed significantly from the Milwaukee County population on four of the seven variables. The first two are Value of Home and Monthly Rent. In general, the study sample obtained homes that cost more to buy or rent than medians for Milwaukee County. Neither poor nor affluent areas are adequately represented in the study sample because people in those tracts were not responsive. However, neither Value nor Rent show relationships with any stairway use or physical variables for the sample in this study. This result is probably true for stairways and stairway use in general, except for the extremes of dilapidation or specially designed stairways found in inner city or on affluent estates.

The other two variables, Type of Dwelling Unit and Renter/Owner Status, do have relevance. Because of the differences of building structure, stairways are distributed differently among single family, duplex and apartment units. Fewer apartments and more single family dwellings and duplexes turned up in the total sample than the corresponding proportions in Milwaukee County. Results of this study, therefore, are generalizable more to single family and duplex units than to apartments.

Differences in the representation of renters and owners bear primarily on the subject of responsibility for care and maintenance of stairways and to a small degree on stairway use, as discussed in detail in following sections. Data collected in the study, however, are rich enough on both of these aspects that the results may still generalize to both types of tenure.

2.4 DATA COLLECTION METHODS

The most reliable and valid methods for obtaining the data basic to this study are the personal interview, direct observation and field measurement, but they are expensive and time consuming. Only a small number could be treated by these methods, and they form the site sample. Two other methods, the phone interview and the mail survey, were used to extend the data base. They compose the phone and mail samples. Comparing these methods with the more precise site sample data permitted assessing the feasibility of using mail and phone samples for this kind of study.

The mail sample received the basic instrument, the mail survey form, shown in appendix G. In phone interviews and personal interviews of the site sample, some of the questions on the mail form were cast into an interview format but remained substantively the same for all three samples. The phone sample received a short mail survey form to handle questions on physical features of stairways which could not feasibly be collected by phone. Details are given on page 107.

The phone sample was given two additional tasks. At the end of the interview, respondents were asked for suggestions and recommendations for improving stairway safety. They were also asked if they would be willing to keep a record of their own stairway use for 3 days instead of 1 day (cf. pages 108 and 116, sec. K).

The site sample was given everything the phone sample received. In addition, they were asked a short set of questions on household hazards, housing preferences, and home activities requiring the use of stairways. Accidents and critical incidents received additional probing during the interview. Finally, 16 physical measures and several photos were taken on each of their inside and outside stairways (see sec. 2.6).

2.5 SURVEY PROCEDURES

For all subsamples, the responsible female adult was sought as respondent, but allowances were made to include single males, unrelated males or females sharing a residence, and communal living modes. In some cases where the female adult could have been the respondent, the male head of the household chose the respondent role.

The mail sample was sent an introductory letter explaining the study and providing some definitions of stairway terms (pages 111 to 112), the mail survey form (pages 113 to 116) and a stamped, self-addressed envelope for returning the form. A postcard was included that permitted respondents to receive results of the study if they returned it.

If no response was received after one week, a follow-up letter was sent, urging them to complete the form. If there was no response after two weeks, a second letter was sent out. After the third week they were dropped from the study. Alternates were selected in 26 cases where the original survey form was returned by the post office as undeliverable.

The phone sample was sent an introductory letter three to five days prior to the first phone contact (see pages 109 and 110) so that the respondents could become familiar with the purposes of the study and would expect the interview. Up to five attempts were made to contact a household, spaced over times of day and days of the week. After five failures to contact the household, the nearest neighbor alternate was substituted for the original address. This happened in 38 cases. In cases of outright refusal, reasons for refusal were asked, but no alternate was used.

At the very beginning of the study, a preliminary test of the site visit instruments was conducted. It was found that the fairly extensive set of stairway measurements, requiring access to many parts of the home, concerned most of these respondents. Some were fearful, others puzzled, and still others regarded the study as an invasion of privacy. Therefore, in order to obtain access to a sample of homes for purposes of personal interviews and field measurements, all phone respondents were asked to volunteer for this part of the study. This request was delayed until after the interviewer had an opportunity to establish rapport and to explain the basic purposes of the study. Where permission was granted, the phone interview was terminated and the remaining information was gathered in the home. All other phone respondents finished the phone interview questions and were mailed the short mail form (see page 107). By this method, 108 completed phone interviews and 54 site visits were obtained. An additional 47 respondents finished the phone interview but did not return the short mail form. Seven people who were contacted refused to give any information. Alternates were used in 38 cases where five attempts to make a phone contact failed.

2.6 TYPES OF DATA COLLECTED

Three general kinds of data were collected on all subsamples:

2.6.1 Demographic and Background

This included the five stratifying variables of respondent's age, family income, owner/renter status, age of structure and type of building. In addition, background information included value of home or monthly rent, length of residence, occupation of household head and spouse, and ages and sexes of all household members.

2.6.2 Physical Inventory

Data included here were general configuration of all inside and outside stairways, number or risers, structural materials, covering materials, number of floors or levels, descriptions and conditions of specific stairway features, problems, upkeep, wear and intended repairs, when applicable.

2.6.3 Behavioral Survey

This group included information about stairway habits of the respondents, safety ratings of home stairways, accidents of the respondents and others

on their stairways, and a record of the respondent's own use of the home stairways.

Some respondents completed a three-day record of use; the form given them is on page 108. The complete survey form is on pages 113 to 116.

2.6.4 Site Measurements.

In addition to photographs of each inside and outside stairway belonging to the site sample residences, the following were determined for every stairway and, in many cases, for each change of level involving only one or two risers: location, number of risers, closed/open risers, structural materials, type of finish on treads and landings, tread wear, orientation edge, riser, tread, nosing and landing dimensions to the nearest ¼ in., light levels, coefficients of friction on treads, throw rugs on landings, handrail heights, width between handrails, lowest headroom and location of light switches. Further detail on these measures is found in appendixes A, B, and F, where some raw data are given. Summary tables are presented in chapter 3.

2.7 DEFINITIONS AND RESTRICTIONS

The following definitions and restrictions are used in this report. Definitions given as instructions to respondents are displayed on pages 110 and 112 (see also fig. 1).

STAIRWAY refers to a series of three or more steps between two floor levels and may include two or more flights with intermediate landings.

SINGLE refers to one riser between two levels or landings.

DOUBLE refers to two risers between two levels or landings.

FLIGHT refers to one or more steps between two nearest landings and is always all or part of a stairway.

LANDING refers to a platform between flights, at least 24 in. long and the width of the stairway.

TOP LANDING refers to the floor at the top of the stairway.

BOTTOM LANDING refers to the floor at the bottom of the stairway.

LEVEL is used synonymously with floor, referring to commonly understood living levels of a residence. It also refers to a change of level within a floor or outside surface if one or more steps separates two such levels.

THRESHOLD refers to a single step at any entry to a building and always has an associated door.

Stairways studied in this report include only those that belong to the respondent's residence and that are used by the respondent and other members of the household. These include inside and outside stairways and private and shared stairways. These restrictions also apply to singles and doubles, except that curbs at the street are not included in this report.

Certain behavioral questions were limited to the respondent and other questions included all members of the household. One accident question referred to anyone who had an accident on stairways belonging to the residence.

2.8 DEFINITIONS RELATING TO ACCIDENTS

Several definitions and classifications useful in the analysis are described in detail below, along with interview procedures. Limited descriptions of accident events were obtained from the mail subsample. However, more information was obtained from respondents in the phone and site visit groups. These two groups were asked to suggest the cause of the accident and whether physical or personal factors or both were involved. Physical factors include such things as a loose handrail, poor lighting, wetness, or steepness. Personal factors include a handicap such as arthritis, the use of a prosthesis such as braces or bifocal glasses, wearing special shoes or clothing, and special activity such as running or carrying an object. When respondents in the phone and personal interviews attributed cause to "inattention" or "carelessness," more specific causes were sought by probing.

2.8.1 Severity

Three levels of severity of accident events are distinguished in this study:

SERIOUS ACCIDENTS refer to true falls that result in limited activities for at least a day and require medical attention or first aid at home. Accidents falling in this class are comparable to the accidents collected by NEISS.

MODERATE ACCIDENTS refer to falls, bumps or wrenching slips resulting in an injury that did not require medical attention. Respondents in this class reported lacerations, contusions, swollen or twisted limbs or soreness that lasted a week or more, even though activities were not interrupted.

CRITICAL INCIDENTS refer to slips, missteps, abruptly catching oneself in time to avoid serious injury, or falling down steps without injury. Respondents reported that the person was shaken up and may have required a short recovery period before resuming normal activities.

In addition to the location of the accident event by stairways or other steps, three levels of recency of the event are distinguished in the study:

RECENT events occurred less than 30 days before the survey and include the day of the survey.

YEAR refers to events occurring more than 30 days but less than one year before the survey.

OLDER events are those that are more than one year old; most events are less than 5 years old.

Accident events are divided into three different kinds of dependent variables for purposes of analysis; in each case, the total sample of persons, stairways or dwelling units is used:

ACCIDENT PERSON refers to any individual involved in at least one event on any step or steps (see table 44).

ACCIDENT STAIRWAY refers to any step or steps belonging to any dwelling unit where any accident event occurred (see table 45).

ACCIDENT UNIT refers to a dwelling unit where any accident event occurred.

2.9 NOTE ON DATA ANALYSIS AND INFERENCES

The general approach to data analysis is direct and simple for the most part. Descriptions are most often stated in percentages, and in a few cases by mean (m) and standard deviation (SD). Where an inference is based on the comparison of two percentages, a standard test for the difference between independent proportions was used. In most cases of inference, however, the distribution-free Chi square test was employed.

Chi square is particularly appropriate when the data are only frequencies in categories of a nonmetric variable and the shape of the theoretical distribution is not known. It also makes intuitive sense for field data that are usually not distributed equally among all categories of a variable. If the distribution of an effect exhibits a systematic relationship only to the frequencies in the categories of a variable, and not to the categories themselves, the variable is probably not critical in producing the effect. In this case, a Chi square test would not show a significant difference between the two distributions.

In several cases, another nonparametric test was used. This test is the Kolmogorov-Smirnoff cumulative frequency test. Its power is equivalent to Chi square.

Data in only a few cases permitted parametric tests, and when they occurred, the F test (in multiple regression and variance analysis) was used.

3. PHYSICAL INVENTORY OF STAIRWAYS

3.1 NOTE ON TERMINOLOGY

Two distinct types of data are discussed in this chapter. Data gathered from all respondents in the mail, phone and site samples are pooled and are treated as data from the total sample. Data obtained by the investigators from physical measurements are the site measures and are limited to the site sample.

When the two types of measures deal with the same subject matter, they are compared and differences are discussed. However, most of the physical measures extend or elaborate the information given by the respondents, even though they cover the same subject matter. In general, site measures go well beyond anything obtained from the respondents, both in detail and precision, because they use more specific criteria.

Many of the site measurements are presented in appendix A. Lighting measurements taken at the sites are presented in appendix B.

3.2 NUMBER OF STAIRWAYS STUDIED AND THEIR STRUCTURAL MATERIALS

All changes of level that belong to each of the 253 dwelling units and to which household members had access are included in the sample. They total 1469. Of these, 691 have three or more risers, qualifying as a stairway proper, and the rest of the level changes consist of one riser (singles), two risers (doubles), and thresholds. They are distributed in table 6.

TABLE 6. TOTAL SAMPLE OF STAIRWAYS STUDIED

INSIDE LEVEL CHANGES		OUTSIDE LEVEL CHANGES	
3 or more risers:		3 or more risers:	
B-1	249	Front	138
1-2	186	Back	66
2-3	39		
Other inside	13		
One riser	26	One riser	153
Two risers	10	Two risers	99
Thresholds		490	

Taking into account the different kinds of configurations in the sample, such as straight stairways and turning stairways with intermediate landings, there is a minimum of 977 flights among the 691 stairways, making a total of 1755 flights with one or more risers. Clearly, stairways are a fact of life for Milwaukeans.

Among large cities in the nation, Milwaukee ranks high in the proportion of residences with basements; 96.2 percent have them. Not only are basements almost universal in single family buildings, they exist and are ordinarily made available to residents in multifamily buildings. In the present sample, all but four dwellings have an available basement (98%). Of these, one is a prefab metal home on a concrete slab and the other three households have no access to the basements in their buildings.

Only one unit has no thresholds or outside risers; walks are ramplike. Eight other units have thresholds but no outside changes of level of one or more risers. The rest have some change of level accommodated by a stairway, single or double, or some combination of these, and 32 percent have two outside stairways with three risers or more.

Over 98 percent of all inside stairways in the sample are made of wood. The exceptions are: five B-1 stairways combining wood and concrete in separate flights; one B-1 stairway consisting of wood and brick; and one apartment building with three floors having modular steel stairways between all floors. If the sample had included a larger number of multifamily walkup buildings, th proportion of nonwood stairways would have bee higher.

Outside stairways are predominantly exposed concrete with a broom finish (Front: 78% and Bac 74%). Wood is used on 12 percent of the front outside stairways and on 22 percent of the outsid back stairways. The remaining 10 percent of the front and 4 percent of the back are built of wood in combination with concrete and other materials on separate flights.

3.3 TREAD MATERIALS ON INSIDE STAIRWAYS

Data in table 7 are based on the total sample of 473 inside stairways where respondents were able to describe the primary material on the surface of all or most of the treads. The distributic exhibits certain regularities.

Three general classes of materials predominate: *Linoleum or tile, paint or varnish,* and *carpeting*. Underscoring in the table points to another simple relationship. Preferred material on B-1 is linoleum or tile; on 1-2, carpeting; and on 2-3, paint or varnish (see table 7).

TABLE 7. OISTRIBUTION OF TREAD MATERIALS ON INSIDE STAIRWAYS

All data are percentages; number of cases at tops of columns.

	STAIRWAY LOCATION			
MATERIALS N =	B-1 248	1-2 186	2-3 39	TOT 473
Carpet full width of stairway	12.1	40.3	15.4	23.5
Carpet runner down middle	2.4	14.5	-0-	7.0
Painted or varnished wood	23.4	22.6	56.4	25.8
Rubber treads	16.5	5.4	12.8	11.8
Tile or Linoleum w/Metal nosing	42.0	17.2	7.7	29.4
Bare wood	3.2	-0-	7.7	2.3
Concrete (unfin. structure)	0.4	-0-	-0-	0.2

Each of these classes, however, includes a variety of surfaces. For example, carpeting materials themselves fall into at least three major types: Loose pile (shaglike rugs), tight pile, and smooth surfaced carpet, and there are further variations within each type. The simple pattern above quickly proliferates into many different surfaces with different features.

To reduce the many possible types of materials to a common measure, over 3000 friction coefficients were measured on the site visit sample of 112 stairways. The NBS-Brungraber Portable Slip-Resistance Tester was used to measure static coefficient of friction between a representative

material of shoe sole leather and the tread surface.[3] It operates by applying a predetermined, fixed vertical force and simultaneously an increasing horizontal force through a vertical splined shaft with an articulated shaft to the sensor shoe. When this shoe slips on the surface, the ratio between the horizontal and vertical forces is automatically recorded. This is the static coefficient of friction. Tables 8 and 9 summarize these measurements, and they are graphed for eight materials in figure 4. Raw data appear in appendix A.

TABLE 8. FRICTION MEASURES OF MAJOR MATERIALS

	N	MEAN	SD	ANOVA RESULTS
Group I				GROUP I
Linoleum tile	108	.597	.077	F = 1.09
Varnished wood	280	.629	.089	df 3, 1208
Linoleum	528	.641	.094	P > .05
Painted wood	296	.692	.115	
Group II				GROUP II
Pile carpet	352	.768	.104	F = 2.19
Smooth carpet	244	.807	.113	df 3, 1616
Rubber/Vinyl treads	136	.809	.121	P > .05
Concrete	888	.864	.096	
Group III				ALL THREE GROUPS
Fiber top rubber mats	120	.910	.123	F = 11.15
subtotal	2952	(mean).761	(mean).141	df 2, 2949
				P < .001

TABLE 9. FRICTION MEASURES ON MINOR MATERIALS

	N	MEAN
Cork tile with wax	4	.52
Ceramic tile	8	.57
Hemp mat	4	.77
Painted concrete	20	.77
Throw rugs (loose)	40	.77
Asphalt	8	.89
Lannon stone	5	.93
Rug faced brick	12	.97
subtotal	101	

TOTAL N: 3053

The intent of the field measures was to examine the treads under conditions of normal use where more variability is introduced than might be found on comparable materials tested under laboratory conditions. Variable amounts of surface wear, dirt, dust, grease and particulates can be found from one tread to the next, and even on the same tread. The machine is so large that it must be placed on the tread at right angles to the direction of a person's foot in ascent or descent. As a consequence, certain materials critical for using the stairways, notably nosings of metal and other materials, are missed entirely.

The nine major materials found on the stairways are sorted in terms of average friction into three groups and are shown in table 8. The first group has the lowest average friction (overall mean = 0.647, SD = 0.104) and contains tile, varnish, linoleum and paint. The second group has a medium average friction (overall mean = 0.830, SD = 0.109) and consists of pile carpet, smooth carpet, rubber treads and concrete. The third group has the single material of fiber-topped mats with nonskid rubber backing that show the highest average friction (overall mean = 0.910, SD = 0.123).

In a simple randomized analysis of variance design (ANOVA), the four materials in Group I do not show significant differences from one another in their average friction. A separate analysis of the four materials in Group II shows them not to be different from one another. In an overall analysis of variance design, the three groups are shown to be reliably different (see table 8).

Measures taken on the very small number of minor tread materials are summarized in table 9. They cover a wide range of friction, but they are not included in the analysis.

Since "slipperiness" is a term often applied to judge friction, respondents were asked to tell which of their stairways is "sometimes slippery." This gross measure is unreliable when correlated with measures of friction (Point biserial $r = 0.11$, $\Gamma > 0.2301$). Shape of treads and nosings, customary footwear and other factors dilute the usefulness of this simple judgment. Overall, outside stairways are judged "slipperier" than inside stairways (67% vs. 13%). From personal interviews with the site sample, it was determined that weather conditions (wetness, snow, ice) account for virtually all the difference. Dry friction on the majority of outside stairways is of course greater than on inside stairways. "Slipperiness" is therefore associated with factors other than dry friction alone.

Another condition that introduces variability in friction is the large number of different materials encountered on a single stairway as the user proceeds up or down. On the stairways in the site sample there is an average of four different materials from bottom to top, and on some stairways there are nine. In one extreme case where some rubber treads are missing from varnished wood treads (some with nails still protruding), the 17 treads and landings have 13 changes or alternations of materials (see fig. 2 #309). A display of these striking data is presented in appendix F.

A five-point scale of wear was developed for use with the site sample, where one end meant no visible wear and the other end meant extreme wear with damage to surfaces. This scale shows no

[3]Brungraber. Robert J., A New Portable Tester for the Evaluation of the Slip-Resistance of Walking Surfaces. Nat. Bur. of Stand. (U.S.), Tech. Note 953, 51 pages (July 1977).

relationship to friction measures either within or between materials, and is not reliable partly because of variability of judgment and partly because of variable field measurements.

Judgments on an obvious kind of wear, "dishing" (curving) of treads, were obtained for the total sample and are incorporated into the Hazard Measure discussed in chapter 5. No truly dilapidated dwellings appeared in the total sample, so it is understandable that few stairways (8.6%) would be described as having this extreme degree of wear.

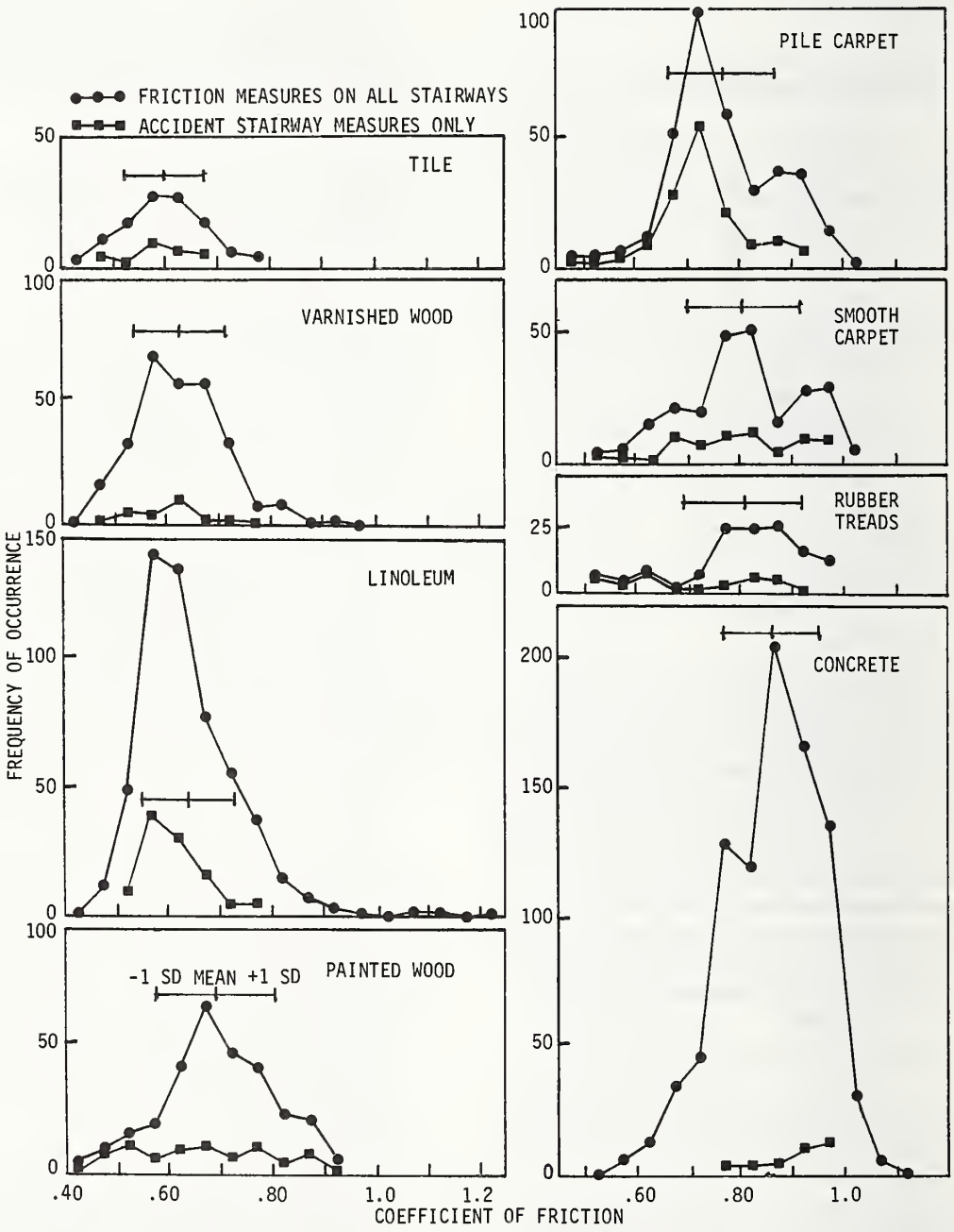


FIGURE 4. *Distributions of friction coefficients on eight tread materials.*

3.4 RISER AND TREAD MEASUREMENTS: IRREGULARITIES AND DIMENSIONS

Dimensions of all risers or all treads in the same stairway or flight are not identical, and the variation will be different in different situations. If the full range of dimensional irregularity is very large within a flight, the user may have to make significant adjustments while using the stairway. If the range is small within a flight, but large between flights, adjustment is less because the intermediate landing allows the user to change gait. Finally, a few winders in an otherwise straight stairway introduce large tread irregularities and map result in large adjustments, depending on where the user choose to step. Winders will be treated under stairway configuration on section 3.9.

For site measurements, three degrees of irregularity are used: Less than 1 in. difference between the shortest and longest riser or trend dimension; about 1 in (±¼ in) difference; and more than 1= difference. Only the last two are classified as true irregularities. The flight is used as the un within which irregularity occurs. When comparing data with responses from the total sample, the unit is the stairway, irrespective of the number of flights.

Both the site visit team and the residents noticed that riser height irregularities of less than one inch are difficult to observe directly. Even after measuring the irregularity on a particular step, the observer often had to view it from a specific angle in order to detect it. Noticed or not, such irregularities cause the user to make adjustments.

Respondents in the total sample were asked which stairways have noticeable irregularities in riser heights. They report that about 15 percent of all inside and outside stairways have irregularities (13% inside and 20% outside). Site measures, using the criteria above on both risers and treads, show 46 percent of the site sample stairways to have irregularities. Even doubling the 15 percent in the total sample to account for tread irregularities, measurements produce 50 percent more than are commonly detected. Irregularity data from the site sample are shown in table 10. About 28 percent of all flights in the site sample have irregularities of 1 in or more.

Recommended riser height is 7 in and tread depth is 11 in.[4] Mean riser height for the site sample is 7.7 in and mean tread depth is 10.3 in. These dimensions are not influenced by different locations of the inside stairway, by building type or by age of structure. Data are summarized in table 11.

TABLE 10. DIMENSIONAL IRREGULARITY ON EITHER RISER OR TREAD

INSIDE FLIGHTS	AMOUNT OF IRREGULARITY under 1"	1"(±¼)	over 1"	TOT	ACC. RATE
8-1	59(12)	10	15(3)	84(15)	17.9%
1-2	45(12)	14(6)	8(5)	67(23)	34.3%
2-3	20(2)	1	1	22(2)	9.1%
N =	124(26)	25(6)	24(8)	173(40)	
ACC. RATE	21.0%	24.0%	33.3%		23.1%

TABLE 11. SUMMARY OF MEAN RISER AND TREAD DIMENSIONS (INCHES)

	LOCATION			BUILDING TYPE			AGE OF STRUCTURE		
	8-1	1-2	2-3	5FD	OUP	APT	65-75	40-64	8, 40
RISERS	7.7	7.8	7.7	7.7	7.5	7.6	8.1	7.8	7.5
TREADS	10.2	10.4	10.3	10.2	10.1	11.1	10.8	10.2	10.2

Steepness of a stairway depends on the particular combination of riser height and tread depth, of which there are many. For inside stairways in the site sample, measurement data in table 12 show that in practice the combinations are concentrated in a narrow range of dimensions. Nearly half (48%) of all inside stairways in the sample are one of the four combinations of 7½ or 8 in risers and 10 or 10½ in treads.

These data may be compared with recommended riser and tread combinations found in the recent literature. Grandjean (1973)[5] recommends design by the equation of twice the riser height plus the tread depth equalling 25 in. A graph of this equation is shown in table 12, as a dashed line, sloping down toward the lower left. Riser-tread combinations recommended by Templer (1974)[6] are all in the upper right quadrant of the table (as indicated by the solid lines).

TABLES 12-14: Numbers of accident cases in parentheses.

TABLE 12. MEAN RISER-TREAD DIMENSIONS (INSIDE; 3 OR MORE RISERS)

RISER HT.	TREAD DEPTH 8	8½	9	9½	10	10½	11	11½	12	12½	13	TOT
6½			1(1)			1				2		4(1)
7			1	1(1)	4	5(2)	2(1)	3			1	17(4)
7½	1		1(1)	7	14(5)	13	7(2)	7(2)	4(2)	1		55(12)
8		1	6(1)	9(2)	30(10)	26(4)	6(2)	3	2			83(19)
8½	1(1)		5(3)	3		3						12(4)
9			1	1								2
N =	2(1)	1	15(6)	21(3)	48(15)	48(6)	15(5)	13(2)	6(2)	3	1	173(40)

(5 missing)

In general, least recommended combinations are in the lower left quadrant, most recommended combinations are in the upper right quadrant, and combinations in the other two quadrants fall between the least and most recommended. These three sets of riser-tread combinations correspond respectively to steeper stairways, shallower stairways, and stairways of intermediate slope.

[4]Archea, John. (Aug. 1975) Summary of Special Stairway Conference, National Bureau of Standards, Gaithersburg, MD.

[5]Grandjean, Etienne. (1973) Ergonomics of the home. New York: John Wiley and Sons.

[6]Templer, John A. (1974) Stair shape and human movement. Unpublished Doctoral Dissertation. New York: Columbia Univ.

If quadrants in table 12 are defined by mean riser and tread dimensions obtained in the site sample (7.7 and 10.3 in), the percentages falling into the above classes are: 33 percent least recommended, 27 percent most recommended, and 40 percent in the intermediate class. Using recommended combinations of 7 in risers and 11 in treads to define the quadrants as shown by the solid lines in table 12 gives percentages of 70 percent least recommended, 5 percent most recommended and 25 percent intermediate. Comparing these two sets of percentages indicates how far the site sample deviates from the recommended dimensions.

Outside stairways in the site sample have riser heights and tread depths more in the recommended direction: Mean riser height is 6.9 in and mean tread depth is 12.3 in (table 13). Combinations are concentrated also, with 33 percent of them using either 7 or 7½ in risers and either 11½ or 12 in treads. Proportions of recommended combinations are: 4 percent least recommended, 58 percent most recommended, and 38 percent intermediate.

TABLE 13. MEAN RISER-TREAD DIMENSIONS (OUTSIDE; 3 OR MORE RISERS)

RISER HT.	TREAD DEPTH 8½	10	10½	11	11½	12	12½	13	14	15	16	17	18	19½	TOT
5							1		1		1	1			4
5½		1								1			1	1(1)	4(1)
6			1	1	1	6(1)		3		1		1	1		15(1)
6½		1		1		5	1	2							10
7		1	1(1)	3	1	13(1)	1								20(2)
7½		2(1)		1	5(1)	8		1							17(2)
8					2	4	2								8
8½				1(1)					1						2(1)
9	1				1	1									3
N =	1	S(1)	2(1)	7(1)	10(1)	37(2)	5	6	2	2	1	2	2	1(1)	83(7)

Data discussed above are for all flights having two or more risers. Table 14 summarizes riser heights for thresholds and singles. Clearly, the single riser is used as an "adjuster" between different levels, and the range of heights is very wide, especially for outside singles. Some of the range of outside singles may be due to settling of porches and steps and of the earth around homes. Given the wide variation in riser heights of both inside and outside singles, they may be considered as irregularities in an otherwise flat surface.

TABLE 14. RISER HEIGHTS OF THRESHOLDS AND SINGLES (SITE SAMPLE)

RISER HT.	SINGLES THR	OUT	IN*	TOT	RISER HT.	SINGLES THR	OUT	IN*	TOT
1½	1	1		2	6½	8	1	1	10
2	1			1	7	8	5	7(1)	20(1)
2½	2	2		4	7½	9	3	1	13
3		1		1	8	17	2	1	20
3½	6	2	1	9	8½	11	1	1	13
4	3	2		5	9	4(1)	3		7(1)
4½	7(1)		1	8(1)	9½	1	2		3
5	4	2		6	10	S(1)	3		8(1)
5½	2	1(1)	2	S(1)	10½		1		1
6	6	1	2(1)	9(1)	11		1		1
(table continued at right)					N =	9S(3)	34(1)	17(2)	146(6)

*10 are isolated singles; 7 are in stairways with other flights.

Respondents in the site sample almost universally omitted thresholds in their data; their commonness escaped notice. When not explicitly noted on the forms, number of thresholds was estimated by the investigators for the total sample from other information given on the survey forms.

3.5 HANDRAIL MEASUREMENTS: HEIGHT, WIDTH, VARIATION AND RIGIDITY

Information on the presence and location of handrails for the total sample of stairways shows that the 1-2 stairway is most likely to have a full length handrail (82%), followed by B-1 (72%), and last by 2-3 (53%). Full length handrails on outside stairways are significantly fewer. Only 36 percent of the front stairways and 39 percent of the back stairways have them. Percentages for the site sample are only slightly different (table 15).

TABLE 15. PERCENTAGE OF HANDRAILS PRESENT AND MISSING (SITE MEAS.)

	INSIDE HANDRAILS 8-1	1-2	2-3	AVG.	OUTSIDE HANDRAILS FRONT	BACK	AVG.
PRESENT	63.1	85.1	63.6	71.7	38.5	23.1	34.6
MISSING	36.9	14.9	36.4	28.3	61.5	76.9	65.4

Coupled with the effect of weather on unprotected outside stairways, the absence of handrails on two-thirds of all outside stairways adds to the hazard and makes special demands on the user.

The general condition of handrails as reported by respondents in the total sample is good. Only about 3 percent report loose, splintered or broken handrails. Because the sample did not contain dilapidated dwellings, this result is expected. However, site visit criteria produced significantly more loose handrails in the site samples ($z = 10.7$, $P < .0001$; table 16). Open handrail supports through which a child can get his body appear on fewer than 7 percent of all handrails in the sample.

TABLE 16. HANDRAIL RIGIDITY (INSIDE STAIRWAYS ONLY; SITE MEAS.)

	RIGID	FIRM	LOOSE	TOTAL	NO HR
8-1	29(6)	6(2)	18(2)	53(10)	31(5)
1-2	27(11)	8(4)	22(5)	57(20)	10(3)
2-3	10(2)	2	2	14(2)	8
TOTAL N	66(19)	16(6)	42(7)	124(32)	49(8)
% TOTAL	53.2%	13.0%	33.8%	100%	

(number of accident cases in parentheses)

Additional information on handrails was obtained from the site visit sample. Measures of handrail height, variations in height, width between handrails and handrail rigidity constitute these additional measures. A summary of accident rates on the site sample is shown in table 19.

Mean inside handrail height is 32 in. (SD = 5.0 in.) and mean width between handrails is 35 in. (SD = 3.1 in.) (see table 17). As a group, stairways in apartment buildings are two SD wider than the rest of the sample, and this difference may be significant, but the number of cases is too small for a meaningful test. Handrails are found equally on the right and left side and 13 flights have handrails on both sides.

Approximately one-third of all handrail heights measured (30%) show a within-flight variation of 2 in. or more (tables 17 and 18). Only six handrails continued across the landing from one flight to the next and these were treated as though they had separate full handrails for each flight. In one case, the variation is over 4 in. from top to bottom and is visible on the picture of the handrail because of the forced perspective (see photo, case #322, in fig. 3).

TABLE 17. HANDRAIL HEIGHTS, WIDTHS, AND VARIATIONS (SITE MEAS.)

INSIDE	HEIGHT IN INCHES									
	21-23	24-26	27-29	30-32	33-35	36-38	39-41	TOT	MEAN	SD
B-1			7	15(1)	12(3)	2(2)		36(6)		
≤2" 1-2			4(4)	16(3)	6(1)	3(1)	2	31(9)		
2-3			2(2)	4	1			7(2)		
N =			13(6)	35(4)	19(4)	5(3)	2	74(17)	31.9"	2.7"
B-1		2(1)	2(1)	8(2)	2	1	2	17(4)		
>2" 1-2	1	2(1)	3(3)	9(4)	8(2)	2(1)	1	26(11)		
2-3	2			2	1	2		7		
N =	3	4(2)	5(4)	19(6)	11(2)	5(1)	3	50(15)	31.5"	4.3"

(number of accident cases in parentheses)

OVERALL INSIDE 124(32) 31.7" 5.0"
MEAN WIDTH OF INSIDE FLIGHTS: 35.3" 3.1"

TABLE 18. HANDRAIL HEIGHTS AND VARIATIONS (SITE MEAS.)

OUTSIDE	HEIGHT IN INCHES								
	21-23	24-26	27-29	30-32	33-35	36-38	39-41	TOT	MEAN
≤2"	1		4(1)	5	3(1)	2		15(2)	31.0"
>2"				2		1(1)		3(1)	33.0"
N =	1		4(1)	7	3(1)	3(1)		18(3)	31.3"

(number of accident cases in parentheses)

TABLE 19. SUMMARY DF ACCIOENT RATES; INSIOE AND DUTSIDE STAIRWAYS (SITE M.)

	INSIOE	RATE	DUTS.	RATE		INSIDE	RATE	DUTS.	RATE
ND HR	49(8)	16.3%	34(2)	5.9%	≤2"	74(15)	23.0%	15(2)	13.3%
HR	124(32)	25.8%	18(3)	16.7%	>2"	5D(17)	3D.0%	3(1)	33.D%
N =	173(40)		52(5)		N =	124(32)		18(3)	

(number of accident cases in parentheses)

A three-point scale of rigidity used categories of loose, firm or rigid. Of all inside handrails tested, 34 percent were found to be loose, 13 percent firm and 53 percent rigid (table 16).

If flights with loose handrails are added to flights with no handrails, 52 percent of the total flights in the site sample present a handrail hazard. Correcting for the overlap in the two distributions, and adding those handrails with more than 2 in. variation in height, 78 percent of the flights in the sample presented one or more hazards.

The most inclusive range of recommended handrail heights sets limits of 30 to 34 in. In addition, a full length railing at 24 in. for children is also recommended. Compared with these standards, site measurements show that 68 percent of the handrails in the sample are adequate for adults but not suitable for children, 20 percent are appropriate for children but are too low for adults, and 12 percent are too high for both adults and children. Therefore, 80 percent are not suited for children and 32 percent are not suited for adults in the site sample.

3.6 STAIRWAY LENGTH: NUMBER OF RISERS BY STAIRWAY AND FLIGHT

Counts of the number of risers were obtained for all stairways in the site sample and for all but 23 stairways in the mail and phone samples. Table 20 summarizes site visit data.

TA8LE 2D. NUMBER OF RISERS BY STAIRWAY AND FLIGHT (SITE MEAS.)

NUMBER RISERS	RISERS PER STAIRWAY			RISERS PER FLIGHT		
	TOTAL	INSIDE	OUTSIDE	TOTAL	INSIDE	OUTSIDE
1	30(3)*	1D(2)	2D(1)	37(3)*	17(2)	2D(1)
2	35(2)	4	31(2)	43(2)	12	31(2)
3	14	1	13	22(1)	6(1)	16
4	8(1)	1	7(1)	22(4)	8(2)	14(2)
5	3		3	21(3)	14(1)	7(2)
6	2(1)	1(1)	1	28(2)	17(2)	11
7	5(2)	3(1)	2(1)	35(5)	32(5)	3
8	2(1)	2(1)		23(8)	23(8)	
9	4(1)		4(1)	6(3)	6(3)	
10	2		2	10(1)	10(1)	
11	9(3)	8(2)	1(1)	7(1)	7(1)	
12	3D(12)	28(12)	2	16(8)	15(7)	1(1)
13	21(3)	20(3)	2	13(3)	13(3)	
14	26(7)	26(7)		9(5)	9(5)	
15	11(5)	11(5)		4(2)	4(2)	
16	7(1)	5	2(1)			
17	3(2)	3(2)				
18						
19	2	2		1	1	
--						
31	1	1		1	1	
TDTALS	215(44)*	126(36)**	89(8)	298(51)*	195(43)**	103(8)
MEANS	9.6	12.3	3.6	6.2	7.9	3.1

*excludes 95 thresholds on which there were 3 accident events
**both flights of seven stairways had accident events
number of accident events in parentheses

Breakdown of the stairways into their constituent flights was possible for the site sample only. Instead of being concentrated into a few classes of length, numbers of risers on inside flights spread over many classes with only a nominal peaking. Outside flights are more concentrated than outside stairways.

Table 21 summarizes data from all respondents. If we compare the three major inside stairways, B-1, 1-2, and 2-3, basement stairways have the lowest mean number of risers and the least variability (m = 11.8, SD = 1.4), 1-2 stairways have the highest mean number of risers (m = 14.0, SD = 2.0) and 2-3 stairways fall in the middle (m = 13.1, SD = 2.0).

TABLE 21. PERCENTAGE OF STAIRWAYS WITH GIVEN NUMBER OF RISERS (RESPONDENT DATA)*

NUMBER RISERS	INSIDE STAIRWAYS 8-1	1-2	2-3	OTH	1's	2's	THR	OUTSIDE STAIRWAYS FRNT	BACK	1's	2's
N =	242	182	39	13	26	10	490	132	60	153	99
3				7.7				26.4	30.0		
4				1S.4				1S.2	31.7		
S				1S.4				1S.2	13.3		
6	0.4			7.7				8.3	10.0		
7	0.8			7.7				8.3	8.3		
8	0.8	1.1	2.6					6.1			
9	0.8			7.7				S.3	3.3		
10	14.0	2.7	12.8	7.7				6.1	1.7		
11	21.5	2.2	S.1					0.8			
12	3S.6	14.9	17.9					S.3	1.7		
13	17.4	14.9	10.3					1.S			
14	6.2	32.4	28.2	7.7							
1S	2.1	1S.S	12.8	23.0							
16		7.1	10.3					1.S			
17		3.8									
18	0.4	1.6									
19		2.2									
20		1.1									
21		0.S									
--											
31				7.7							
MEAN	11.8	14.0	13.1	10.7	1	2	1	6.0	4.7	1	2
SO	1.4	2.0	2.0	7.6	---	---	---	3.1	1.9	---	---

*1's = singles; 2's = doubles; THR = thresholds

Length of each type of stairway is concentrated into a narrow range: about three-quarters of the respective stairways fall into the boxed categories in table 21.

Isolated inside single steps are infrequent (26) and in only two instances are there more than one in a single residence.

Examples of isolated sets of two steps are even more infrequent; eight residences have one such set and one residence has two sets. In no site visit case did these risers receive any special marking. In combination with flights of more than three risers, there are seven singles and eight doubles that are part of the whole stairway in each case.

Ninety-one percent of the dwelling units sampled have the standard two entry arrangement with two thresholds. Some duplexes have one threshold since they are set up so that each residence uses only one of the available entrances. Only four units have more than two thresholds.

Whereas inside stairways usually adjust to fairly standardized ceiling heights, outside riser patterns must adjust to more variable ground levels. There are many outside single and double risers. These are found alone or in combination to form outside stoops or patios. They are also combined with three or more riser stairways to form a variety of sequences. For example, the outside front riser arrangement for case #325 consists of two risers, a 35 ft walk, followed by a three riser stairway, a concrete porch, two risers and a threshold. As a general rule, outside stairways are shorter than inside stairways. About 60 percent of these have between three and five risers.

There is no relationship between age of structure and number of risers on B-1. However, as shown in table 22, there is a small but stable relationship between age of structure and number of risers on 1-2 stairways. Older structures, particularly those built before 1940, probably had higher ceilings above the first floor, but basement ceilings were not correspondingly higher.

TABLE 22. NUMBER OF RISERS BY AGE OF STRUCTURE, FIRST TO SECOND*

AGE OF STRUCTURE	NUMBER OF RISERS 8-12	13-16	17-21	N
1965 to present	25.0%	68.8%	6 3%	16
1940-1964	24.9%	74.9	-0-	52
before 1940	19.4%	66.0%	14.6%	103
	(Chi square = 39.S; P < .0241)			171

*No relationship for basement to first floor stairways.

3.7 LIGHTING LEVELS AND GRADIENTS; LIGHT SWITCH LOCATIONS

Two major aspects of stairway lighting are the total amount of light available and its distribution (or gradient) along the pathway. If enough natural light is not available from windows on or near the stairway, artificial light will be needed during some daylight hours. Two other factors that affect adequacy of stairway lighting are glare on treads and contrast of treads and stairway walls, since they alter either the amount of light or its distribution. Respondents were asked to report on four of these topics: needed light during the day, windows near stairways, relative lightness of walls and treads, and glare on treads. Two topics were measured in the field on the site sample of stairways; incident light in foot candles (fc) and gradient of light along the stairways.

Respondents report that different stairways have different needs for artificial light during the daylight hours. Nearly half of all B-1 stairways (45%), 15 percent of 1-2 stairways, and 21 percent of 2-3 stairways need artificial light during some daylight hours every day. That some of this difference is accounted for by access to natural sources is seen in their report that 17 percent of B-1 stairways, 24 percent of 1-2 stairways and 21 percent of 2-3 stairways have windows directly facing the walker on the stairway. The figures for natural sources do not, of course, include other windows that may be near the stairway, so they underestimate effective natural sources of light on inside stairways.

Respondents report that contrast (relative lightness of walls and tread) occurred on 44 percent of all inside stairways: B-1, 43 percent; 1-2, 48 percent; 2-3, 23 percent. Precise field measurement of

contrast was not made, but judging from observations on the site visits, it is probable that respondents overestimated effective brightness contrast and reported on color differences instead.

Simultaneous glare (a small bright area in the visual field) was reported on under 5 percent of all inside stairways: B-1, 4 percent; 1-2, 4 percent; 2-3, 3 percent. Using a criterion of a 20 fc difference in light levels between treads, field measures indicate glare on at least 17 percent of stairways (another 9 percent have glare between walls and treads). This criterion is twice as much light as measured on 84 percent of the site sample stairways, and is enough to cause marked simultaneous glare in the narrow field of vision that is used on most stairways.[7] Considering negative feelings about glare, it is probable that respondents underestimated glare on their stairways, except for the site sample, who were observed by the investigators (cf. line 3, table 41).

Field measures of incident light in footcandles were taken on each stairway in the site sample. Only tread lighting is reported here (see appendix B for further details). On a single stairway, readings taken on top, middle and bottom treads often showed great variability, and were therefore averaged to obtain a measure of illumination. Of the 112 average light levels, 106, or 95 percent, fell below the recommended 20 fc for stairways (see Note 1, page 4). The gradient of light, or changes in light level, can also influence the dynamic task of using a stairway. Sample gradients both increased and decreased on the same stairway because levels were often higher on middle treads than on either top or bottom treads. To account for this condition, an average gradient was calculated by taking the mean of the two differences without regard to sign. Average differences without regard to sign. Average gradient increased with increasing light levels (r = .98, $P < .001$), however, variability increased for middle levels of illumination more than for high and low levels.

If special effort is needed to find or use a light switch, it is apt not to be used. The consequence is higher incidence of stairway use in the dark. Access differs between stairways from B-1 and 1-2, as shown by the locations of switches or chains in table 23. While the stairways from 1-2 commonly have double-throw switches at both ends of the stairway, stairways from B-1 typically have them at the top only. Data in the table show that there is a significant difference in distribution of location among the three different stairways, and it also remains significant when only stairways B-1 and 1-2 are compared.

TABLE 23. ACCESS TO LIGHT SWITCHES ON INSIOE STAIRWAYS

	LOCATIONS OF SWITCHES OR CHAINS								
	SWITCH			CHAIN			AUTO-	NO	
STAIRWAY	TOP	BOT	BOTH	TOP	BOT	BOTH	MATIC	LIGHT	TOT
B-1	32	1	9	2	1	1*	2	7	55
1-2	2	8	29	1			3	1	44
2-3	2	6	2				1	3	13
N =	36	15	39	3	1	1	6	11	112

(Chi square = 22.56; P < .0001)
*long flat string, top to bottom; light fixture at top.

3.8 LOW HEADROOM AND ORIENTATION EDGES

Sufficiently low headroom offers a bumping hazard, but even if it is not low enough for bumping, it can cause descending users to avert their heads and redirect their attention. Orientation edges are wall and ceiling edges that permit the descending user to get a clear view into a room before reaching the bottom step. The effects of these two variables are greatest on inside stairways because the openness of outside stairways precludes their appearance in most cases.

These variables are treated together because both provide distractions that are potentially hazardous. If they occur together on the same stairway, a frequent occurrence in standard residential stairway construction, they are doubly hazardous. Respondents were asked if either of these conditions appeared on their inside stairways. Their data appear in table 24.

TABLE 24. NUMBER OF STAIRWAYS WITH LOW HEAOROOM, ORIENTATION EOGE, OR BOTH; B-1, 1-2, and 2-3 (RESPONOENT OATA)

	O R I E N T A T I O N E O G E											
LOW	NO			YES			SUBTOTALS			ALL OATA		
HEAO-ROOM	B-1	1-2	2-3	B-1	1-2	2-3	B-1	1-2	2-3	NO	YES	TOT
NO	99	98	27	94	[73	6]*	193	171	33	224	173	397
YES	[34	8]*	3	[22	7]*	3	[56	15]*	6	45	32	77
N =	133	106	30	116	[80	9]*	249	186	39	269	205	474

*pairs of numbers in small boxes are significantly different; P <.05 (difference between independent proportions)

Stable differences between pairs are shown in the small boxes in the table. In general, B-1 stairways present a greater hazard than 1-2 stairways, although the two do not differ with respect to occurrence of orientation edges. The 2-3 stairways have significantly fewer orientation edges than either B-1 or 1-2 stairways, reflecting their use as access to less used spaces (frequently attics), with doors to shut out the view.

[7]Chapanis, A., W. Garner, and C. Morgan. (1948) Applied Experimental Psychology. New York: John Wiley and Sons, pages 107-108.

Rates of occurrence of orientation edges may be assumed to be about right, judging from the correspondence between field measures and by site sample respondents' estimates. Many more stairways, however, have distracting headroom not low enough to bump the user (field criterion) than have headroom that can bump the user (criterion respondents were asked to use). Rates for low headroom are therefore underestimated. Rates for occurrence of the two variables on the same stairway are correspondingly low. Attitudes toward the two variables are not the same. Low headroom is perceived immediately as hazardous, but open stairways that permit views into rooms are perceived as an advantage, even though both distractions can be hazardous.

Data from site measurements alone are presented in table 25 and may be compared with table 24. The data have the same general pattern that shows B-1 more hazardous than 1-2 stairways. However, small numbers of cases do not allow the larger differences to reach significance.

TABLE 25. NUMBER OF STAIRWAYS WITH LOW HEAOROOM, ORIENTATION EDGE, OR BOTH; B-1, 1-2, and 2-3 (SITE MEASURES)*

LOW HEAO-ROOM	ORIENTATION EDGE										
	NO			YES			SUBTOTALS			ALL DATA	
	B-1	1-2	2-3	B-1	1-2	2-3	B-1	1-2	2-3	NO YES TOT	
NO	14	16	3	3	6	1	17	22	4	33	10 43
YES	12	6	3	23	14	5	35	20	8	21	42 63
N =	26	22	6	26	20	6	52	42	12	54	52 106

*no significant differences among corresponding pairs (by a test of difference between independent proportions)

From the standpoint of distracting structures on the stairway, the rates for the site measures are accurate. If the item on low headroom had not asked about bumping, but instead had asked if the ceiling was low enough to reach while standing on one of the lower steps, respondents' data would have more nearly reflected the site measurements, and would be relevant to the specific hazard of distractions.

For site measurements, the field team determined the specific tread up from the bottom of each stairway at which the orientation edge occurred. The measurement of low headroom employed a relaxed standard that included the distracting effects as well as the bumping potentials, Any header lower than 78" directly above a tread was treated as low headroom. Eight cases had headroom lower that 72" and one case had a headroom of 62". Data in table 26, show on which step the variables occur alone and together, counting up from the bottom step.

Low headroom, using the above criterion, and orientation edges occur together on the same stairway 40 percent of the time. Standard residential stairway construction insures that they occur together. Moreover, low headroom and orientation edges occur together on the same step nearly 20 percent of the time in standard construction.

TABLE 26. LOW HEADROOM (LHR) AND ORIENTATION EDGES (OE) AT GIVEN STEP NUMBER (SITE MEASURES ONLY)*

LHR AT STEP NUMBER	OE AT STEP NUMBER: none	1	2	3	4	5	6	7	
none		4	2		3			1	10
1	13	10	7	3					33
2	5	3	5			1			14
3	1	1	1	4		1			8
4	1				2	2	1		6
5	1				1				2
	21	18	15	7	6	4	1	1	73

cases with neither OE nor LHR = 33

N = 106 stairways

*10 cases in upper row have orientation edges only; 21 cases in left column have low headroom only; 21 cases that are underscored have orientation edges and low headroom at the same step; rest have both, but at different steps on stairway.

3.9 STAIRWAY CONFIGURATIONS AS RELATED TO AGE AND TYPE OF STRUCTURE

Four general types of stairway configurations were presented to respondents in the total sample. Drawings of these types are shown on the mail survey form on page 113. Although they do not exhaust all possible configurations of stairways, data from the total sample suggest for all practical purposes they are sufficient to examine the variable of stairway configuration. Only two respondents modified the survey form by noting that they had full winding stairways.

Data in table 27 show the distributions of the four configurations for inside and outside stairways. For each stairway, comparing the percentages in the boxes brings out a simple description: More B-1 stairways are straight and utilitarian than are 1-2 stairways.

TABLE 27. PERCENTAGE OF CONFIGURATIONS BY STAIRWAYS (RESPONOENT OATA)

	INSIOE STAIRWAYS			OUTSIOE STAIRWAYS	
	B-1	1-2	2-3	Front	Back
CONFIGURATION N =	248	184	37	132	60
Straight	53.6	33.2	32.4	92.6	89.8
1 landing, 90° turn	25.4	33.7	16.2	5.8	8.8
1 landing, 180° turn	19.4	25.5	43.2	0.5	0.7
2 landings, 180° turn	1.6	7.6	8.1	0.5	0.7

(Chi square = 22.49; P <.0001)

About half of the B-1 stairways are straight (54%) and the rest (46%) have a turn and landings. But two thirds (67%) of the 1-2 stairways have turns of some kind. The difference is reliable, as shown

by the Chi square. The pattern of 2-3 stairways is like the one for 1-2 stairways.

Data in table 28 show a significant relationship between age of structure and configuration of stairways. In residences built before 1940, more of the B-1 stairways have a turn and a landing than in residences built after 1940. Recent building (since 1965) is similar to older building (before 1940) on 1-2 stairways, and both differ from 1940-1964 housing.

In table 29, the data show a significant relationship between type of structure and configuration. If the residence is a duplex or apartment, there are typically fewer stairways that are straight than in a single family residence. For B-1, the figures are 22 and 28 percent and for 1-2, they are 16 and 21 percent, respectively. Correspondingly, single family residences have 64 percent of the B-1 and 41 percent of the 1-2 stairways without turns.

Apartment buildings favor stairways with 180 degree turns, and about the only place that stairways with two turns can be found is in older duplexes.

Winders make a definite modification of stairway configuration and they do not appear uniformly in all types and ages of dwelling units. Nearly one third of the total sample of stairways had one or more winders (30%). Winders are more likely to appear in buildings built before 1940, in duplexes,

TABLE 28. PERCENTAGE OF CONFIGURATIONS BY AGE OF STRUCTURE (RESP. DATA)

AGE OF STRUCTURE	Straight	90° turn	180° turn	2 turns	N
	CONFIGURATION: BASEMENT TO FIRST				
1965 to present	72.0	8.0	20.0	-0-	25
1940-1964	74.0	17.3	8.7	-0-	104
before 1940	33.3	35.2	28.7	2.8	108
	(Chi square = 42.1; P <.0001)				237
	CONFIGURATION: FIRST TO SECOND				
1965 to present	33.3	33.3	33.3	-0-	15
1940-1964	50.0	31.5	13.0	5.6	54
before 1940	24.3	34.0	31.1	10.7	103
	(Chi square = 14.5; P <.0241)				172

TABLE 29. PERCENTAGE OF CONFIGURATIONS BY TYPE OF STRUCTURE (RESP. DATA)

TYPE OF STRUCTURE	Straight	90° turn	180° turn	2 turns	N
	CONFIGURATION: BASEMENT TO FIRST				
Single family	63.8	22.7	13.0	0.5	185
Duplex	22.2	37.8	33.3	6.7	45
Apartment	27.8	22.2	50.0	-0-	18
	(Chi square = 43.3; P <.0001)				248
	CONFIGURATION: FIRST TO SECOND				
Single family	41.3	34.7	19.8	4.1	121
Duplex	15.9	38.6	27.3	18.2	44
Apartment	21.1	15.8	57.9	5.3	19
	(Chi square = 27.3; P <.0001)				184

and on stairways from 1-2. Sixty-five percent of stairways in old duplexes have winders, and on 1-2 stairways in old duplexes, 88 percent are found with winders.

The following percentages summarize the data on winders: In homes built before 1940, 48 percent; 1940-1964, 19 percent; 1965-1975, 0 percent. In duplexes, 63 percent; apartment buildings, 22 percent; and single family dwellings, 22 percent. On 1-2 stairways, 40 percent; 2-3 stairways, 35 percent; and B-1 stairways, 22 percent.

4. BEHAVIORAL SURVEY OF STAIRWAY USE

4.1 INTENDED STAIRWAY REPAIRS

Respondents were asked what work was needed to improve the safety of their stairways, to estimate the cost of these repairs and to indicate who would pay the bill. Verbatim responses are in appendix D.

Fifty two respondents (21%) suggested 87 different repairs or replacements on their stairways. Small repairs account for 22 percent and full replacements for 78 percent of the needs. Altering, repairing or replacing some part of the stairway structure accounts for 34 percent of the suggestions, covering or refinishing for 40 percent, handrails for 20 percent, and lighting for 6 percent.

Many of the comments pertaining to structure point out obvious needs such as to repair broken concrete, replace missing or broken steps, or even to build a complete stairway replacement. Some

respondents would like to change steep or narrow stairways and shallow winders, but they are neither able to define precisely what needs to be done nor estimate cost.

Concurring with recommendations for improving stairway safety (see sec. 4.2), respondents emphasized the value of handrails. They omitted any reference to handrail quality and design, and only one respondent suggested tightening existing handrails. In contrast, loose handrails were frequently observed in the site sample homes. Little reference (5%) was made to the value of outside handrails where the absence is clearly the greater, and the hazard higher, at least during wet or icy weather.

Respondents expressed an interest in a wide variety of tread materials. In general, obvious wear on treads is the stimulus.

In this section on intended stairway repairs as well as in all other parts of the study, respondents exhibit a lack of concern about lighting on their stairways. In view of the low levels of lighting observed and measured on the site sample, this discrepancy suggests a need for user education.

Respondents' estimates of cost vary widely for what appear to be similar types of repairs. Their variability may be related to such factors as quality of materials, lack of information about the exact nature of the job and about current prices, and whether or not professional labor is utilized. All of these factors may affect the data presented in table 30, but it is clear that low (below $25) or no cost repairs do not appear with high frequency.

TABLE 30. ESTIMATES OF COSTS FOR REPAIRS (RESPONDENT DATA)

No cost	1	$50-$99	7
Below $25	8	$100-$199	3
$25-$49	12	$200 up	11
	Don't know 10		

In all cases, owners said they would bear the cost of repairs and renters referred costs to an owner or manager. Significantly more renters than owners mentioned needed repairs (34% vs. 17%; $P < .005$) and they estimated higher costs. The possiblity suggests itself that renters, in not accepting any responsiblity for repairs, may overlook low or no cost repairs which would reduce hazards. For example, one renter in the site sample (see photo #330, fig. 3) deplored the condition of loose carpeting on her 1-2 stairway but neither she nor her husband considered securing it with nails.

One would expect that older residences would need more repairs and that such repairs might be more extensive. The data are consistent with this expectation. Twenty-seven percent of the respondents in residencies built before 1940 as compared with 17 percent of post-1940 residences mentioned the need for repairs ($P < .05$). There was also a difference in median estimated cost of repairs for these two groups. Median cost for older residences was $75 and for newer residences it was $37.50.

4.2 RESPONDENTS' RECOMMENDATIONS FOR IMPROVING STAIRWAY SAFETY

Respondents to the phone and site interviews were asked for suggestions and recommendations about ways to improve stairway safety. Ninety eight of the 162 respondents answered this question. In addition, there were 6 unsolicited comments from the mail sample and 17 responses drawn from phone interviewees who did not return their short mail form and whose protocols are used for data only here and in the accident analysis.

The 258 different recommendations provided by these 121 respondents appear in a verbatim account in appendix D and are summarized in table 31. They fall into five groups: coverings; location, configuration and style; handrails; maintenance and repair; and behavior. The suggesions cover a wide range of topics within each of the groups.

Handrails are mentioned in 60 comments (23%). Of these, 58 deal with the general importance of having handrails; only 2 are concerned with design features and repair. In sharp contrast, the field measurements found one-third of the homes visited had loose handrails that were potentially hazardous. These results are in agreement with the findings in section 4.1.

There are 48 comments (19%) for or against carpeting as a suitable stairway covering, its installation, maintenance and repair. Respondents differed in their evaluation of carpeting in general and in the relative values of different types of carpeting. With the advent of a large variety of new and inexpensive carpeting in recent years, the difficulty of assessing the characteristics of these fabrics has increased. It is clear that respondents do not possess a common or useful set of guidelines for making a choice.

TABLE 31. SUGGESTIONS AND RECOMMENDATIONS FOR IMPROVING STAIRWAY SAFETY (RESPONDENT DATA)

COMMENTS ON COVERINGS

Things that improve stairway safety

13 Carpeting: General (11), smooth (1), sculptured (1)
10 Treads: Rubber (6), plastic (2), non-skid (2)
3 Skid resistant throw rugs or mats
3 Rough textured paint on outside stairways
1 Double thick carpet on bottom landing
1 Painted or varnished stairways
1 Different colors of linoleum on each tread

Things to be avoided

13 Metal nosings
8 Carpeting: General (2), shag (3), sculptured (1), smooth (1), pile (1)
4 Treads: Rubber (3), plastic (1)
3 Heavy carpet or padding (distorts steps)
3 Loose rugs at top and bottom landings
2 Linoleum
1 Painted or varnished stairways
1 Outside carpeting not protected from becoming wet

COMMENTS ON LOCATION, CONFIGURATION AND STYLE OF STAIRWAYS

Things that improve stairway safety

18 Deeper treads (10) and less steepness (8)
5 Standardized dimensions (risers, treads, stairway widths)
4 Intermediate landings between floors
3 Wider stairways (between handrails or walls)
3 Straight stairways (no intermediate landings or turns)
2 Door with lock on basement stairway (for child's safety)
2 Gate at top or bottom of stairway (for child's safety)
1 Overlarge top and bottom landings
1 Good window design on or near stairways

Things to be avoided

9 Winders
5 Open risers
4 Single steps
2 Low headroom
2 Doors opening into stairway
1 Straight stairways (no intermediate landings or turns)
1 Intermediate landings between floors
1 Irregular riser heights
1 High thresholds

COMMENTS ON HANDRAILS

Things that improve stairway safety

53 Handrails on every stairway (unspecified further)
5 Handrails on both sides of every stairway
1 Detachable handrails (to accomodate moving large objects)

Things to be avoided

1 Open railings with spaces that a child can get through

COMMENTS ON MAINTENANCE AND REPAIR

Things that improve stairway safety

21 Keep in good repair: General (2), uneven or broken steps (7), nosings (2), carpets (7), lighting (1) handrails (1), painting (1)
8 Nail down carpets firmly (so they do not bunch up)
6 Do not wax steps
3 Have good lighting
2 Keep inside stairways dry
2 Keep outside stairways and rails free of ice and water
1 Have stairways professionally covered

COMMENTS ON GENERAL STAIRWAY BEHAVIOR

7 Keep objects off stairways
5 Be careful: General (4), when carrying objects (1)
4 Always walk--don't run
4 Always use available handrail
2 Avoid high heels, slippery shoes (1), platform shoes (1)
1 Supervise children when they are on stairways

SUMMARY OF COMMENTS BY CATEGORIES

67 Comments on coverings
65 Comments on location, configuration and style
60 Comments on handrails
43 Comments on maintenance and repair
23 Comments on stairway behavior
258 Total comments from 121 respondents, or about 2 comments per respondent; 41% of total sample responding.

Respondents reported a high incidence of linoleum and metal nosing coverings, expecially on basement stairways. Thirteen comments pointed out that when the metal nosings loosen, shoes catch on them, with a consequent stairway hazard. Plastic or rubber treads also loosen, posing a safety problem. Ten respondents recommended these types of treads because of their nonskid characteristics, and four criticized them because of their tendency to become loose.

In 65 (25%) comments on location, configuration and style, respondents very effectively covered items often mentioned by experts on stairway safety, although the emphasis given various items is not the same. Nine additional comments dealt with the need to keep the stairway structure in good repair.

Little attention (four comments) was given to stairway lighting as an element of importance to safety.

The small number of comments on behavior as a factor in stairway safety (23) is undoubtedly a result of the emphasis in preceding questions on physical characteristics of stairways. Comments were little more than obvious rules.

Respondents are clearly aware of some of the factors contributing to stairway accidents but their information is, at best, incomplete. Similarly, their knowledge of ways to improve the safety of their stairways is limited and not always accurate. A short, readable document containing principles based on research and standards as well as practical and inexpensive suggestions for improving safety conditions in the home would be of interest and value to many people.

4.3 STAIRWAY HABITS RELATED TO ACCIDENTS

A group of nine habits selected from the literature on stairway safety was described to all respondents. All are considered possible contributors to accidents. The purpose of these items was to get self-reports about habits and to see what relationships exist between them and reported accidents and critical incidents. Respondents were asked to indicate which habits describe their own behavior (see sec. I, page 116).

Table 32 shows that the three most frequently chosen habits pertain to footwear: wearing slippers and clogs, using stairways with bare feet, and using stairways with stocking feet. Each of these items was chosen by at least half of the respondents. The remaining items were chosen in percentages ranging from 39 percent (failing to use handrail) to 20 percent (wearing long clothing which can catch on heels).

TABLE 32. PERCENTAGE OF RESPONDENTS BY AGE CLAIMING GIVEN TYPE OF STAIRWAY HABIT

STAIRWAY HABITS	AGE GROUP OF RESPONDENTS* under 34	35-54	55-64	65 up	TOTAL %YES
Slippers, clogs on stairways	31.6	39.9	14.6	13.9	62.9
Use bare feet on stairways	43.8	38.4	11.0	6.8	58.2
Use stocking feet on stairs	35.8	39.6	14.2	10.4	53.4
Available handrail not used	44.9	37.8	8.2	9.2	39.0
Hurry on stairways	43.2	36.8	14.7	5.3	37.8
Leave objects on stairways	35.9	41.3	13.0	9.8	36.7
Use stairways in the dark	41.2	41.2	11.8	5.9	27.1
Talk on stairways	47.8	35.8	10.4	6.0	26.7
Wear long clothing on stairs	42.9	40.8	12.2	4.1	19.5
N =	71	101	42	37	(251)

*percentages in each row sum to 100%

Site visit respondents contributed information relevant to this set of items. They pointed out that walking on stairways is so routine that they are scarcely aware of their own habits. Even when they tried to remember their behavior, they were not certain about the accuracy of their responses. Respondent #352 looked directly at her basement stairway and did not notice a collection of pop bottles on the top and bottom landings as well as a folding lawn chair on the top landing. They were neatly stacked and had become part of the background. A male respondent said that he never leaves objects on stairs but that his wife makes a practice of storing things on the landings. His young daughter reminded him that at that very moment he had a collection of tools and building supplies on the basement stairs. He dismissed this as something temporary, but he had been building a garage over a period of several months.

Photographs in figure 2 illustrate some typical scenes of objects on stairs. All but #331 contain temporarily placed items as well as some permanent items. Perhaps the most remarkable assortment of objects was found on the stairway of #313. In addition to a large bag of potatoes, hardware, cleaning equipment and materials and other miscellaneous items, a full size refrigerator was stored on the pie shaped landing between two flights of stairs. The carpeting was completely loose from the stairway on one of these flights. Respondent #324 provides another example. In addition to using his step for storage, he places coathooks on the stair wall.

In addition to the nine habits discussed above, respondents were asked about the use of a baby

walker or stroller in the house (5% answered "yes"), and whether children regularly play on the stairways (16% said "yes"). As in other habit questions, this type of activity was difficult for respondents to recall, particularly if children were beyond the toddler stage. More precise data require a monitoring or record keeping procedure.

Table 33 examines the relationship between age and habits. The largest number of habits was chosen by the "under 35" age group and the smallest number by the "over 65" group. Younger respondents chose all but two of the items more frequently than did older respondents. These two exceptions are "wearing slippers or clogs" and "leave objects on stairs," where there was no influence of age.

TABLE 33. PERCENTAGE OF RESPONDENTS BY AGE CLAIMING GIVEN NUMBER OF STAIRWAY HABITS

NUMBER OF HABITS	AGE GROUP OF RESPONDENT* under 35	35-54	55-64	65 up	N
0	9.5	23.8	23.8	42.9	21
1	3.2	51.6	22.6	22.6	31
2	16.2	35.1	32.4	16.2	37
3	22.2	50.0	11.1	16.7	36
4	26.8	43.9	17.1	1.2	41
5	41.9	41.9	9.7	6.5	31
6	47.8	34.8	8.7	8.7	23
7	50.0	43.8	6.3	-0-	16
8	60.0	30.0	10.0	-0-	10
9	100.0	-0-	-0-	-0-	5
N =	71	101	42	37	251

*percentages in each row sum to 100%

4.4 ASSESSMENT OF SAFETY: PERCENT SAFE

Respondents were asked to rate their stairways for safety, using a five point scale from unsafe (0%) to safe (100%). Since respondents are assessing all of their stairways and criteria for judging are not specified, the question provides only a rough measure of their attitudes toward these stairways.

It is interesting to note that almost half (46%) gave their stairways the highest rating, as shown in table 34.

The relationship between the Hazard Measure (see sec. 5.1) and respondents' overall assessment of safety of their stairways (Percent Safe Measure) is shown in table 35. Respondents were divided into Renter/Owner and below and above the mean on number of hazards (called Few and Many Hazards). Safety ratings are divided at 100 percent safe and less than 100 percent safe.

Table 34. RESPONDENTS' ASSESSMENT OF THEIR STAIRWAYS

	UNSAFE -- 0%	25%	50%	75%	100% -- SAFE	
N =	1	4	23	105	115	248
PERCENT	.4	1.6	9.3	42.3	46.4	100%

TABLE 35. HAZARD MEASURE AND PERCENT SAFE MEASURE (PERCENTAGES)

	RENTERS				OWNERS			
		HAZARDS				HAZARDS		
		FEW	MANY	MEANS		FEW	MANY	MEANS
PERCENT SAFE	100%	.39	.28	.33	100%	.66	.29	.51
	0-75%	.61	.72	.67	0-75%	.34	.71	.49
	N =	23	32		N =	117	76	

Two things may be concluded from table 35: First, renters were more prone to rate stairways less safe than owners, and second, they did not appear to take into take into account the physical hazards that they had previously selected. Owners were more realistic in their assessments and were more cognizant of the physical factors on their stairways. Renters agreed closely with owners on low quality stairways, but they were assessing high quality stairways on grounds other than physical factors.

Overall, Percent Safe correlates significantly with Hazards, $r = -0.40$; $P < .0005$, but Percent Safe accounts for only 16 percent of the variation in number of hazards (square of the correlation).

4.5 FREQUENCY OF STAIRWAY USE

The amount of use made of stairways in the home depends on how many waking hours are in the day (week day vs. week end) and how many of those hours are spent in the home (full time at home, part time away, full time job). Of the total sample, 231 respondents recorded the number of stairway uses for one day, from waking to retiring. They also recorded the number of hours they were away from home. A small group maintained a record for three consecutive days but there were not enough of these to use in the analysis, therefore, the descriptions below are limited to a single day of use (see sec. K, page 116).

For purposes of the analysis, a sixteen waking-hour day was assumed, and a measure of uses per hour was calculated. Three groups of stairway users were developed to account for those (a) home all day, (b) away part time, and (c) with full time jobs. In terms of hours at home, these three groups have respectively, 12 to 16, 7 to 12, and under 7 waking hours during which they can use stairways. Data from the analysis are shown below

in figure 5 where the average number of uses per time period throughout the day is plotted for each of the three groups. Differences of the means for each group from the overall mean are plotted in figure 6. The two time periods from 2-6 PM and from 6-10 PM are plotted as two 2-hour periods each by the simple expedient of dividing the total trips in each period in half.

Three things appear in figure 5. First, highest rates of use for all three groups were in the morning, before 10 AM. Second, the group staying at home all day tended to drop off in rate from waking to bedtime, but the other two groups increased their rates of use in the late afternoon and early evening. Third, rate of use for the group at home all day was higher than either of the other groups except in the afternoon and evening when all groups had the same rate of use.

The same data are plotted as deviations from the overall mean rate of use in figure 6. From the indications of the mean ± 1 SD, it is clear that the three groups had different rates only for the two time periods from 10 AM to 2 PM; at all other times their rates were not significantly different. The only thing that differentiates the groups, when they are defined by amount of time at home, is the sheer opportunity to use their stairways at a given time of day. Total use, of course, is a function of total hours at home, and this varied for different groups: housewives, retirees, part-time workers and full-time workers. However, rate of use is a function of time of day.

Two other variables, age and sex, were examined with respect to rate of stairway use. Although rates of stairway use are a function of time of day and the number of hours at home, age is not significantly related to rate of use (table 36). Male and female differences in rate of use are also not significant (data not presented). It might be expected that age and sex would influence time at home and therefore give differential opportunity for stairway use. However, frequency of using stairways was highly variable within age and sex groups. Stairway use is idiosyncratic and depends on many other factors (see sec. 6.6).

TABLE 36. RATE OF STAIRWAY USE BY AGE (RESPONOENT DATA)

	AGE GROUPS							
	20-24	25-34	35-44	45-54	55-64	65-74	75 up	MEANS
USES/HR	1.57	2.04	1.27	1.55	1.44	0.79	1.36	1.42
HRS/DAY	10.4	12.6	14.3	12.4	13.4	13.4	13.9	13.6
USES/OAY	16.8	25.8	18.2	19.2	19.3	10.6	18.9	19.3
N =	15	54	43	44	38	28	7	229

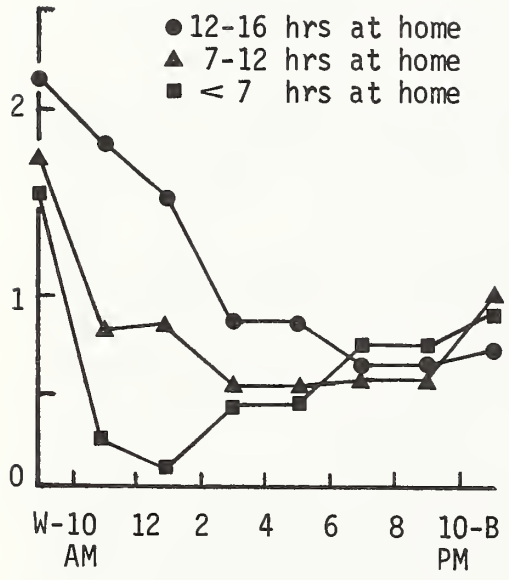


FIGURE 5. *Mean uses/hour from waking to bedtime (respondent data).*

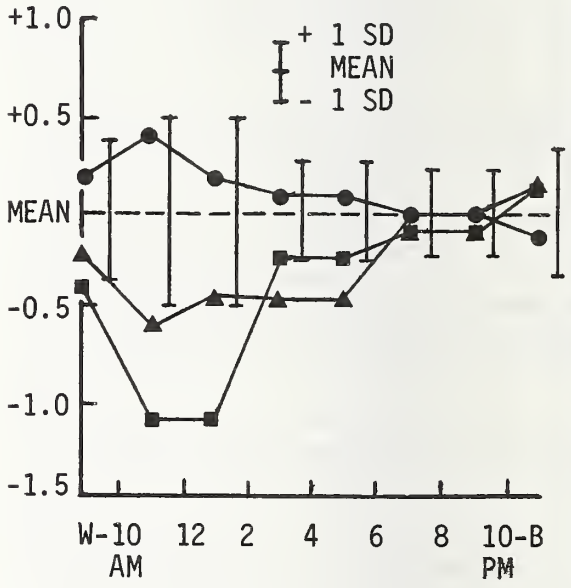


FIGURE 6. *Differences from grand mean in uses/hour (respondent data).*

4.6 HOME ACTIVITIES, HOUSING PREFERENCE AND POTENTIAL SOURCES OF HOME ACCIDENTS

4.6.1 Home Activities.

It might be expected that people will try to locate their activities to minimize overall stairway use. Of course, the structure of the ordinary home and fixed locations of large appliances may require the use of stairways. Trash removal and clothes washing are two activities that may require stairway use because of structure or location. Depending on location or structure, activities such as getting the mail or using the bathroom may or may not require stairway use.

To explore the relationship between home activities and stairway use, part of the site interview presented a selected group of common household activities, and respondents were asked which activities involved the use of stairways in their homes. To provide a common locus from which respondents would start to engage in the activity, the living room was chosen.

Table 37 shows the responses of the respondents in the site sample. As expected, washing clothes and trash removal almost universally required respondents to use stairways to perform these activities. Getting mail is equivocal because some mailboxes are accessible while others are at a distance. For this group of respondents, however, very few required stairways in order to use their bathrooms. Other activities listed are primarily a function of locating them in covenient places. That this is done by respondents is evidenced by the sharp drop in the need to use stairways for these activities.

TABLE 37. COMMON ACTIVITIES REQUIRING THE USE OF STAIRWAYS

IF YOU ARE IN YOUR LIVING ROOM, DO YOU NEED TO USE STEPS TO:	NUMBER OF YESES*	%YES
do the family wash?	52	96%
take out the trash?	51	94%
get the mail?	28	52%
do the ironing?	16	30%
check on children during the day?	11	20%
vacuum the living room?	6	11%
use a bathroom?	5	9%
get linen for this floor?	4	7%
watch TV?	2	3%

*total N = 54

The relationship between these activities and number of stairways around the home was examined. Number of stairways connected to a building is a weak predictor of how many activities require stairway use (r = 0.18). Planning and structure account for the variation.

4.6.2 Housing Preferences.

Respondents in the site sample were asked to give their housing preferences for seven different types of dwelling units presented to them. The preferences expressed by the respondents are presented in table 38.

TABLE 3B. HOUSING PREFERENCES (RESPONDENT OATA)

PRESENT HOUSING TYPE:	PREFERREO* A	B	C	TOT	%
A. House all on one floor		1		1	2%
B. House with two floors	3	7	1	11	22%
C. House with three or more floors	7	7	17	31	62%
O. Split level with short stairways		1		1	2%
E. First floor apartment		2		2	4%
F. Walkup apartment building		1	2	3	6%
G. Elevator building, upper floor			1	1	2%
N =	10	19	21	50	
%	20%	3B%	42%		

*no preferences given for the other housing types

Respondents lived in all seven types but preferred only three: a house all on one floor (A), a house with one floor plus a basement (B), and a house with three or more floors (C).

Forty-eight percent (24) of the respondents preferred their present residential type. At least 42 percent preferred buildings with fewer stairways than their present homes. Residents living in first floor apartments and elevator buildings had fewer stairways than their preferred choice. The remaining 10 percent preferred housing with more stairways than their present homes. This distribution represents a significant shift of the sample toward fewer stairways (Kolmogorov-Smirnoff cumulative frequency test, $P < .001$). Although 20 percent preferred housing with no stairways, the other 80 percent still preferred housing with at least one stairway. Many respondents described the value of separating activities by stairways.

4.6.3 Potential Sources of Home Accidents.

Stairways, doors, tubs and/or showers, and windows have been studied and reported in the literature on home accidents. According to the Consumer Product Safety Commission Age Adjusted Frequency-Severity Index for 1973, the ranking in order of decreasing hazard is: stairs, doors, windows, tubs/showers.[8]

Respondents' opinions on the potential for accidents presented by these four parts of the home were studied. A standard pair comparison

[8]Consumer Product Hazard Index. (1973) Washington, DC. Consumer Product Safety Commission.

technique used the six possible pairs of four items. The respondents ranked them as follows: Stairs and tubs/showers equally hazardous, followed by doors and then windows. The actual scale values are: Stairways, +2.62; tubs/showers, +2.58; doors, -2.06; and windows, -3.14.

Although respondents in the site sample were consistent in their judgments, their rankings are clearly different from those made on the basis of actual accidents by the Consumer Product Safety Commission. This difference between subjective hazard and actual hazard deserves further study.

5. MEASUREMENT AND ANALYSIS OF STAIRWAY HAZARD

5.1 A MEASURE OF STAIRWAY HAZARD

Nineteen statements designed to get respondents' assessments of specific physical aspects of each inside and outside stairway were given to the total sample (see Survey Forms, secs. E and F, pp. 114-115). Several criteria were used in their selection: (1) they represent a broad coverage of stairway features that have some relationship to stairway safety, (2) they can be answered by respondents with reasonable accuracy without recourse to actual measurements, (3) they deal with the same general topics covered by measurements taken in homes of the site sample, and (4) they are easy to understand and no technical knowledge is required for answering.

From the original 19 items, nine were selected for use as an overall measure of stairway hazards. Only data on major inside stairways were used in

the measure. The criterion for selection was a simple measure of consistency: The largest percentage difference among responses from the mail, phone and site samples was tested. If no significant difference could be shown at the .05 level, the item was considered stable and was retained for the Hazard Measure. The nine items are listed in table 39, with responses for each major stairway. The remaining 10 items are listed in table 41. They are treated as individual measures in the appropriate places in the physical inventory. Table 40 reports the number of hazards.

TABLE 39. PERCENTAGE OF STAIRWAYS WITH THE STATED HAZARD

		INSIDE			OUTSIDE	
		8-1	1-2	2-3	FRONT	BACK
HAZARD MEASURES	N =	249	186	39	138	66
Full handrail missing*		28	18	47	64	61
Handrails loose/broken		3	3	**	2	3
Open handrail supports		6	2	**	4	11
Light needed during day		45	15	21		
Low headroom		22	8	16		
Orientation edge		47	43	24		
Stairway has winders		22	40	35	3	6
Steps curved from wear		11	5	8	5	18
Steps loose or broken		5	1	3	12	14

*Reversed for inclusion **Less than ½ of 1%

The response format provided only an indication of presence or absence of the stairway characteristics. Since there is no adequate way to weight relative importance in this study, they were given a weight of 1 and summed across stairways for each dwelling unit. This procedure forces a relationship between the magnitude of the Hazard Measure and the number of stairways (r = .41, $P < .0001$, table 42). Adding stairways increases the probability of more hazards. (Note: The handrail measure was reversed to show absence).

The Hazard Measure is distributed at the bottom of table 40. If all nine hazards had been checked for all stairways in all sample dwelling units, the average of this maximum would have been 17.32 hazards per unit (number of stairways per unit is distributed in table 71, page 55). The

TABLE 40. NUMBER OF HAZARDS (HAZARD MEASURE) BY AGE OF STRUCTURE

AGE OF STRUCTURE	NUMBER OF HAZARDS 0	1	2	3	4	5	6	7	8	9	10	11	TOT
1965 to present	3	6	9	7	1								26
1940-1964	18	31	30	17	6	2	1						105
Before 1940	9	15	16	17	23	12	8	2	4	2	1	1	110
												N =	241
TOTAL FREQUENCY*	32	54	58	45	31	14	9	2	4	2	1	1	253

*12 respondents did not know the age of their structures

maximum in the sample, however, is only 11 hazards per unit, and the mean of this highly skewed distribution is only 2.52 hazards (SD = 1.98). There were 32 units with no stairway hazards at all (13%). This indicates that stairways in the sample were not free of hazards entirely and the hazards were not particularly unusual.

Roughly half of the hazards are related to age of structure, which is also related to number of stairways (see table 42). A partial correlation between hazards and age, computed by holding number of stairways constant, gives a gross check on the validity of the Hazard Measure. The r of 0.42 is reduced to a partial r of 0.32, but it is still significant ($P < .0001$).

Using number of hazards as a measure of stairway quality, two general questions relating to quality may now be considered:

> How is stairway use affected by type of structure and quality of stairways?
>
> How does stairway use vary among different people using stairways of different quality?

In terms of analysis of variance, these questions might be approached by assessing the following 2-way interactions: Use: Type X Quality and Use: Subpopulation X Quality, adding control variables for precision as needed. Field data in this study, however, are not adequately balanced and do not permit an orthogonal statistical design. Another strategy is used to address the questions without directly assessing the interactions. Frequency of use, measured by number of uses per hour, is used as the dependent variable in two multiple regressions, one using physical factors and the other using personal factors as predictors.

The multiple regression approach permits the contribution of each variable alone and all variables combined to be assessed. Each correlation may be tested for statistical significance. In addition, the square of the multiple correlation is the equivalent of a percentage of the variance accounted for by the several independent variables, and therefore may be viewed as a way of assessing the practical significance.

TABLE 41. PERCENTAGE OF STAIRWAYS WITH OTHER PHYSICAL MEASURES

	INSIDE STAIRWAYS						OUTSIDE STAIRWAYS			
	8-1		1-2		2-3		FRONT		BACK	
OTHER MEASURES N*=	197	52	143	43	27	12	113	25	53	13
Covering worn or torn	3	17	4	23	**	**				
Irregular riser heights	5	48	8	26	11	25	11	68	11	46
Lighting causes glare	1	15	**	19	**	8				
Wall lighter than steps	50	17	57	19	30	8				
Window/mirror faces path	10	42	15	51	15	33				
Mud easily tracked in	22	50	19	7	**	**				
Stairway is slippery	8	44	5	21	**	17	46	88	53	80
Rug or furniture near	28	52	21	44	4	33				
Open risers	25	8	21	5	**	8				
Outside protected							41	24	50	46

*N in left column of pair is for mail + phone and N in right column is for site sample.
**Less than ½ of 1%

5.2 STAIRWAY USE RELATED TO PHYSICAL VARIABLES

For the analysis of Use/Type/Quality, building type is supplemented by age of structure to help account for period styles. The correlation matrix used for analysis is in table 42. Number of stairways is used to help account for variations within building type that might reduce the relationship. It is a suppressor variable and when it is partialled out, building type correlates with uses, $r = .17$, which is significantly different from the zero correlation in table 42. As a control variable that correlates with many of the other variables, Percent Safe is added to the analysis.

TABLE 42. CORRELATION MATRIX FOR USE X TYPE X QUALITY ANALYSIS

N = 194	USES/ HOUR	NUMBER OF STAIRWAYS	PERCENT SAFE	HAZARD MEASURE	TYPE OF UNIT
NUMBER OF STAIRWAYS	.35**				
PERCENT SAFE	-.17*	-.17*			
HAZARD MEASURE	.15*	.41**	-.40**		
DWELLING UNIT TYPE	-0-	.38**	-.13	.11	
DWELLING UNIT AGE	.10	.35**	-.20**	.42**	-.08

*P <.05; **P <.01 or better

Number of stairways is related to use more than any of the other variables. Activities requiring the use of stairways are influential for the sample. As a raw variable, building type does not relate to use, but when number of stairways is partialled out, it becomes significantly related. Not so for age of structure. It remains the same even when number of stairways is partialled out.

There is an artifactual relationship between number of hazards and number of stairways. The method of summing hazards insures that having more stairways will increase the probability of having more hazards. Percent Safe is also related to number of hazards, and simply reflects the fact that the judgment shows cognizance of the connection between hazards and safety.

When all five variables are used in the multiple regression with *use* as the dependent variable, they all contribute significantly. The overall result is not large, however, and number of stairways accounts for about 13 percent of stairway use alone. Building type adds about 2 percent and all physical variables together account for only about 17 percent of stairway use. It means that within the limitations of the data in this study, only a very small amount of stairway use is related to the broad classes of physical variables that were measured.

5.3 STAIRWAY USE RELATED TO PERSONAL VARIABLES

For the Use/Subpopulation/Quality analysis, both demographic and behavioral variables are used to relate personal measures to stairway use. The first-order correlations are presented in the matrix shown in table 43.

TABLE 43. CORRELATION MATRIX FOR USE X SUBPOP X QUALITY ANALYSIS

N =204	USES/ HOUR	SEX	AGE	NUMBER OF HABITS	PERCENT SAFE
SEX OF RESPONDENT	-.11				
AGE OF RESPONDENT	-.29**	.18*			
NUMBER OF HABITS	.31**	-.09	-.44**		
PERCENT SAFE	-.18*	-.01	.36**	-.26**	
HAZARD MEASURE	.16*	-.01	-.19**	.23**	-.40**

*P <.05; **P <.01 or better

Number of hazards and Percent Safe are retained as control variables because they are response variables that relate to respondents' ages and behavior. Sex is treated as a continuous variable for convenience of handling (point-biserial r is equivalent to the Pearson Product-Moment r with a dichotomous variable). The assumption of continuity is based on the fact that many variables not measured in the study are related to sex and sex is a shorthand way of lumping them together. In any case, sex is related only to age, a function of sampling covered earlier, and is consistent with the conclusion that users do not differ in rates of use whether they are home all day or away on a full-time job. In fact, age enhances the relationship between sex and use, which goes from -0.11 to -0.06 with age partialled out. Other relationships in table 43 may be taken at face value.

The multiple correlation is quite low, 0.37, with habits accounting for 10 percent of stairway use, age adding only 1 percent and all five variables together totalling 14 percent. Again the result is statistically but not practically significant. It means that within the limitations of the data in this study, only a very small amount of stairway use is related to the broad demographic and behavioral variables that were measured.

5. ANALYSIS OF ACCIDENTS AND CRITICAL INCIDENTS

5.1 NOTE ON ACCIDENT ANALYSIS

There were 170 accident events collected in this study. This large number encouraged a more detailed analysis than would be permitted with fewer data. These events are treated as a dependent variable together with specific physical and behavioral variables as independent variables. The independent variables, however, are themselves survey response variables and their category frequencies will vary. In general, such data connot be submitted to the ideal multivariate statistical design where independent variables are made independent of one another. Nevertheless, the independent variables can be assessed one at a time to determine their effect on accident rates. This strategy is applied to the accident analysis.

Since many of the variables of interest are nonmetric, i.e., they cannot be manipulated arithmetically with ease, and the data are frequencies in the several categories of the variable,

a Chi square test is used here as in earlier sections. If the accident events occur with frequencies that match the frequencies in the categories of a variable on interest, the Chi square test will not be able to distinguish significantly between the two distributions. The conclusion that the variable of interest is not systematically related to the different frequencies of accidents cannot be rejected, since it is possible that merely an increased rate of occurrence will result in the increased accident events.

When two variables acting alone, such as age or sex of user, do not influence the rate of accident events, they may still have an effect when they act together. They are said to interact and their combined effect is called an interaction. It is possible, therefore, to construct what amounts to a new variable from the categories of both original variables and test this new variable (the interaction) again by Chi square. Unless both of the two interacting variables are ineffective alone, the test is not justified. Even when they are both ineffective, some prudence must be used in drawing strong conclusions based on the statistical inferences. But in specific instances, a true but complex interaction effect may be possible to infer.

Knowledge of ages or sexes of users alone, for example, is not sufficient to predict differences in frequencies of accident events. Knowledge of specific age and sex combinations, however, will permit a conclusion based on the statistical significance of their interaction. Male children have significantly more accident events than female children and young adult females have significantly more accident events than young adult males (Chi square = 5.604, $df = 1$, $P < .05$; from recombined data in table 44).

The 170 accident events include repeats by individuals or repeats on stairways or within dwelling units. Although repeats are included in the total sample of accident persons and accident stairways in tables 44 and 45, they are not used in any analysis. There is no adequate way to weight these repeats by the same person or on the same stairway or in the same unit by either recency or severity, and straight counting is not satisfactory for purposes of analysis.

Table 44 classifies accident persons by sex, respondent-nonrespondent, severity of event, recency and age group. See section 2.8 for definitions that relate to accident events. Numbers on the left of the slash count nonrepeated events

TABLE 44.
ACCIDENT PERSONS BY SEX, RESP/NRESP, SEVERITY, RECENCY AND AGE GROUP

FEMALE RESPONDENTS

AGE GROUP	SERIOUS R	SERIOUS Y	SERIOUS O	MODERATE R	MODERATE Y	MODERATE O	CRIT INC. R	CRIT INC. Y	CRIT INC. O	TOTAL
0-4										
5-9										
10-14										
15-19										
20-34		2/		2/1	2/5		5/4	7/9		18/19
35-44		1/	1/			1/	3/1	2/4		8/5
45-54		1/			1/		2/2	2/4		6/6
55-64		1/		/1						1/1
65 up		1/		1/	1/		1/			4/
TOTAL		6/	1/	3/2	4/5	1/	11/7	11/17		37/31

FEMALE NONRESPONDENTS

AGE GROUP	SERIOUS R	SERIOUS Y	SERIOUS O	MODERATE R	MODERATE Y	MODERATE O	CRIT. INC. R	CRIT. INC. Y	CRIT. INC. O	TOTAL
0-4		1/				1/				2/
5-9					2/		1/	1/		4/
10-14						2/1	1/		/2	3/3
15-19		2/			1/	1/				4/
20-34	1/	1/				1/		1/		4/
35-44			1/						2/	3/
45-54		1/	1/					1/	/1	3/1
55-64	1/					1/			1/	3/
65 up		1/								1/
TOTAL	2/	6/	2/		3/	6/1	2/	3/	3/3	27/4

MALE RESPONDENTS

AGE GROUP	SERIOUS R	SERIOUS Y	SERIOUS O	MODERATE R	MODERATE Y	MODERATE O	CRIT. INC. R	CRIT. INC. Y	CRIT. INC. O	TOTAL
0-4										
5-9										
10-14										
15-19										
20-34										
35-44										
45-54								4/6		4/6
55-64								3/7		3/7
65 up							2/	2/4		4/4
TOTAL							2/	9/17		11/17

MALE NONRESPONDENTS

AGE GROUP	SERIOUS R	SERIOUS Y	SERIOUS O	MODERATE R	MODERATE Y	MODERATE O	CRIT. INC. R	CRIT. INC. Y	CRIT. INC. O	TOTAL
0-4		1/	1/		1/	1/	3/	1/	1/	9/
5-9		2/								2/
10-14					1/1		1/			2/1
15-19										
20-34				1/1	1/3			3/2		5/6
35-44					1/		1/			2/
45-54										
55-64										
65 up										
TOTAL		3/	1/	1/1	4/4	1/	5/	4/2	1/	20/7

95/

and numbers on the right of the slash count all repeats. Therefore, there is a maximum of 95 different accident persons on which there are 59 repeat events. Not shown in the table are 8 nonrespondent accident persons whose age is not known by the respondents, and 8 repeats of these nonrespondents, for the total of 170.

Table 45 classifies accident stairways by type, severity and location together with all repeats. Therefore, there is a total of 98 accident stairways on which analysis is possible, including three from the incomplete phone interview group. Accident units total 71 from the sample of 253 dwelling units in the study. The number of cases varies from one analysis to another in the tables that follow either because only a subset is used, such as B-1 and 1-2 or because respondents did not give complete information, such as frequency of use or age. The three cases from the incomplete phone interviews are missing from some analyses. Only respondents' data could be used in the multiple regression cases below and some data are missing for them.

TABLE 45.
ACCIDENT STAIRWAYS, SINGLES AND DOUBLES: INSIDE AND OUTSIDE

ACCIDENT STAIRWAYS					REPEATS ON SAME STAIRWAYS				
INSIDE	S	M	CR	TOT	INSIDE	S	M	CR	TOT
B-1	5*	7	26	38	B-1		5	29	34
1-2	9	5	24	38	1-2	1	6	24	31
2-3		1	1	2	2-3		2	2	4
SINGLES			2	2	SINGLES				
SUBTOT	14	13	53	80	SUBTOT	1	13	55	69
OUTSIDE	S	M	CR	TOT	OUTSIDE	S	M	CR	TOT
FRONT	3	3*	1	7	FRONT			1	1
BACK	2	1*		3	BACK		1		1
SINGLES	1	1		2	SINGLES				
OOUBLES		3		3	OOUBLES		1		1
SUBTOT	6	8	1	15	SUBTOT		2	1	3
THRESH.			3	3	THRESH.				
TOTALS	20	21	57	98	TOTALS	1	15	56	72
					ALL EVENTS	21	36	113	170

NOTES

Tables on the left enumerate the accident stairways, singles and doubles by the defining severity of the event: S = Serious; M = Moderate; CR = Critical Incident.

Tables on the right enumerate additional events occurring on the same stairways, singles and doubles listed on the left.

*Indicates one accident in each case included from the data given by the phone interview subgroup not returning the short mail form; they are used in a limited number of analyses.

Respondents were asked to suggest the cause of the accident, as nearly as they could, and to note whether physical or personal factors or both were involved. When respondents in the phone and personal interviews attributed causes to such things as "inattention" or "carelessness," more specific causes were sought by probing.

Table 1, summarizing the general results of all variables in the study and their effects on accident events, is on page 10.

6.2 COMPARISON WITH NEISS ACCIDENT DATA

Data collected in this study allow several comparisons to be made with data from the National Electronic Information Surveillance System (NEISS) of the Consumer Product Safety Commission. The first analysis compares serious and moderate accident events, broken down by age group, with the NEISS distribution. This is shown in table 46, columns 1 and 2.

There is no significant difference between the distribution of accidents by age collected in this study and the larger sample collected by NEISS. This result supports the use of data in this study for the analysis of relationships between physical and behavioral variables and accident events.

The result holds when repeats of serious and moderate events are used and also when the analysis is made according to accident persons, as table 46 shows (cf. cols. 1 and 3; cf. cols. 1 and 6).

TABLE 46. COMPARISONS OF ACCIDENT EVENTS BY AGE GROUPS (RESPONDENT DATA)

All data are percentages; number of cases at top of column.

AGE GROUP	NEISS SAMPLE	S + M MILW.*	S + M + Sr + Mr*	S + M + CR + Sr + Mr*	TOTAL SAMPLE**	ACCIDENT PERSONS
N =	21,718	44	57	117	154	95
0-4	16	13	10	9	7	12
5-9	6	8	7	5	4	6
10-14	7	11	9	6	6	5
15-19	9	9	7	3	2	4
20-34	27	24	37	35	34	28
35-44	10	11	9	11	12	14
45-54	10	9	7	15	17	14
55-64	7	6	7	7	10	8
65 up	8	9	7	9	8	9
P values***		--	--	.05	.01	--

*S = Serious; M = Moderate; CR = Critical incident; subscript means repeats.
**Minus 8 cases of nonrespondents for which no age was given and 8 repeats.
***P values are from Kolmogorov-Smirnoff test against the NEISS distribution.

On the addition of critical incidents, however, the distribution differs from the NEISS distribution (columns 1 and 4). Despite this difference, all critical incidents are included in the analyses because they point to critical factors.

The second comparison is between accident events on inside and outside steps and stairways in this study and data from NEISS in-depth interviews of a special sample of cases. The comparison is shown in Table 47.

TABLE 47. COMPARISON OF INSIDE AND OUTSIDE STAIRWAY SAMPLES

NEISS IN-DEPTH INTERVIEW SAMPLE		MILWAUKEE SAMPLE		
INSIDE		INSIDE	S + M	S + M + CR
"Inside," hall, kitchen, attic, back inside	130		27	80
Cellar, basement	38			
	168			
OUTSIDE		OUTSIDE		
"Outside," yard, porch, carport	31		14	15
Front (outside, steps, door)	39			
Back, back door, side door	19			
	89			

The number of accident events on inside steps is twice as large as those on outside steps in both sets of data and they are not significantly different (Chi square = 1.52; $P > .2211$). When critical incidents are added, the number of cases on inside steps in this study is five times those on outside steps (Chi square = 18.96; $P < .0001$). This result is probably due to the greater number of handrails on inside stairways and is discussed in section 6.4.5.

The third comparison is illustrated in figure 7. Plotted there are data showing how male children have more accident events than female children and female adults have more than male adults (Kolmogorov-Smirnoff test, $P < .01$; 64 females and 31 males). The sum of these data is not different from the NEISS curve for both sexes shown in the plot.

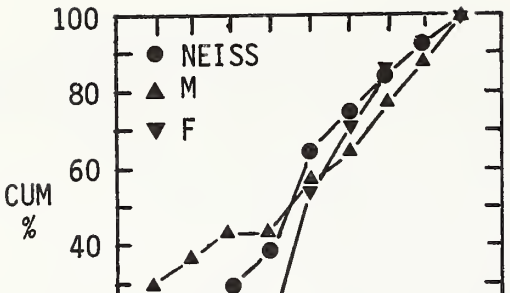


FIGURE 7. *Age and sex differences.*

6.2.1 Comparisons with Other Survey Variables

In keeping with the general strategy outlined above, comparisons between two different distributions are made for each of the several physical and behavioral variables measured in this study.

Cases of accident events (defined by persons, stairways, or dwelling units) are compared with nonaccident cases for each category of the variables in question. The "nonaccident" cases include the remaining people, stairways, or dwelling units on which the variables were measured, and for which no accident was reported by the respondents in this study.

Chi squares were calculated for each of the comparisons. From the probability of finding the differences by chance, an inference was made about the effectiveness of the variable for producing the accident events independent of the unequal occurrences of cases in the variable itself.

In the tables in sections 6.3-6.6, accident cases are indicated by "A" and nonaccident cases by "NA." In some cases where there is insufficient room, "Chi square" is abbreviated "CS."

6.3 ACCIDENTS AND DEMOGRAPHIC VARIABLES

The seven demographic variables used in the selection of the sample for this study were examined in relation to accident events. Three of these: Renter/Owner Status, Value of Home, and Monthly Rent show no trends and are not included in the data presented in table 48. A Chi square analysis of each of the four remaining variables is presented there, however, and briefly discussed. Although none of these variables is significantly related to accident events alone, there are some trends and a significant interaction between age and sex is reported in section 6.1.

TABLE 48. ACCIDENT ANALYSIS OF FOUR DEMOGRAPHIC VARIABLES

BUILD. TYPE	A	NA
SFD	54	133
DUP	11	35
APT	6	14
	71	182
CS = .54		
P = .7654		

AGE OF STRUCT.	A	NA
70-75	2	8
65-69	4	12
50-64	19	60
40-49	8	17
8. 40	36	74
	71	182
CS = 2.36		
P = .6724		

AGE OF RESP.	A	NA
20-24	3	13
25-34	15	40
35-44	8	47
45-54	10	36
55-64	4	38
65 up	8	29
	48	203
CS = 6.33		
P = .2780		

SEX OF RESP.	A	NA
FEM.	37	148
MALE	11	57
	48	205
CS = .52		
P = .4803		

There are more accident units among single family dwellings than in other types of housing. Older units also show more accident events than occur in newer units. Age of structure is related to stairway quality and there are more older SFDs than either of the other two types. The trends may both be accounted for by stairway quality, as measured by hazards.

Females and people in the 25-34 age group show more accident events than other sex and age groups. These two groups show higher rates in the NEISS data also. Young adult females are exposed to residential stairways more systematically than any other group except the children they care for, and this exposure affects accident rates.

The value of demographic variables for stratification of the original sample cannot be based on their specific effects on stairway use, stairway accidents, or stairway hazards. Rather, they enter into interactions with one another and their use insures a balanced representation in the sample.

6.4 ACCIDENTS AND PHYSICAL VARIABLES: FEATURES

Comparisons are made between nonaccident and accident cases for a dozen measured physical variables and three derived physical variables. For most variables, tables are given right along with the text. In some cases, however, where important accident data appear in another section of this report, a reference to those data is given.

Where accident cases are given in those tables, they are presented in parentheses. Since the total number of cases is also given, the nonaccident cases are found by subtracting the numbers in parentheses from the corresponding totals.

6.4.1 Number of Risers

As a deterrent to increased use, which increases exposure to stairways, number of risers is weak. Correlations between number of risers and use/hour is 0.04 for B-1 and 0.10 for 1-2 ($P > .6171$ and 0.2110, respectively; $N = 161$). As shown in table 21, the ranges for numbers of risers on these stairways is not large. For a given ceiling height, adding risers makes a gentler slope and taking them away makes the slope steeper. If an argument is made that having more risers will deter use, an equal case can be made for an increase in stairway use resulting from the gentler slope caused by using more risers, other things being equal.

Rate of accidents, which is in fact related to exposure, is not related to number of risers. Chi square and correlation were used to examine the relationship. The distribution of stairways was divided into three broad classes: One riser, 2-9 risers, and 10 or more risers. These three classes roughly correspond to singles, flights, and full stairways.

For stairways in the site sample, the Chi square was .46 ($P > .9245$), and the correlation between frequencies of accident stairways and the raw frequency of occurrence of different numbers of risers was 0.90 ($P < .001$). If sheer frequency of occurrence of different numbers of risers can account for so much variation in accident events, it is clear that number of risers is not related to accidents, at least within the range of 1-31 risers in the sample.

For economy, only a Chi square test was run on data from the total sample of stairways, still using the three classes. Its small value (1.75, $P > .4294$), again supports the conclusion that number of risers does not affect accident rate.

6.4.2 Riser-Tread Dimensions

Within the range of riser-tread dimensions compiled from site measurements, accident rates are not related significantly to the recommendations for dimensions as determined by the three broad classes defined in section 3.4.

The tests were made on the classes composed by using mean riser and tread dimensions rather than by using recommended dimensions. Although the relationship is not statistically stable, there is a trend in the data (note accident rates) that a larger sample and more refined measurements might prove stable. Data from the site sample for flights are shown in table 49.

TABLE 49.

RECOMMENDED COMBINATIONS OF RISER-TREAD DIMENSIONS

	TYPE OF RECOMMENDATION			
	Least	Inter	Most	TOT
A	17	14	9	40
NA	40	56	37	133
	57	70	46	173
ACC. RATE:	29.8	20.0	19.6	23.1

Chi square = 2.30; P = .3108

The three classes in the table correspond roughly to slope, with the least recommended stairways being the steeper and the most recommended stairways being the shallower. Those having intermediate recommendations fall between the two in slope. None of the riser-tread combinations found in the sample are unusual in any way. They are all reasonably within the recommended limits for riser and tread dimensions.

6.4.3 Stairway Lighting

Stairway lighting was measured in homes of the site sample, taking into account both light levels and light gradients as discussed in section 3.7. Raw measures and relevant accident data are displayed in appendix B. Only accident events that were not explicitly attributed to another feature or personal habit are indicated there. Even though some light levels were very low, and both levels and gradients range over three orders of magnitude, all levels were sufficient to discriminate major stairway features after a short period inside the residence.[9]

Dividing the highly skewed distribution of light levels into two halves at the median also divides the accident events in half. The same procedure applied to gradients also divides accident events in half. However, the interaction between level and gradient shows a trend. Summary data are not presented in this report.

At higher light levels, above 8 footcandles, light level is sufficiently high that gradient has little effect. Accident rate here is about 11 percent (2/19). At lower light levels, below 2 footcandles,

[9]An object in 0.1 fc of light may be discriminated immediately by an average eye adapted to 30 fc: op. cit., footnote 7.

accident rate is doubled, to about 22 percent (15/68). In the intermediate range of light levels, between 2 and 8 footcandles, the range of gradients is very wide and stairways with lower gradients have no accident events. Accident rate for this group is about 32 percent (8/25), or about three times the rate for high light levels.

These differences do not reach significance primarily because of the small number of cases (Chi square = 2.88; $P > .20$). The values used to cut the distribution were quite arbitrary, but the data suggest that it would be fruitful to study both lighting levels and the gradients of lighting in the dynamic field situation with more precise measurement techniques.

6.4.4 Tread Materials, Friction and Sequences

A large number of different tread materials was encountered on stairways in the site sample, but they fell into a few general categories as indicated for the total sample in section 3.3. In addition, the friction measures in the field showed great variability and stairways had varying numbers of different materials in sequence from top to bottom. Finally, the tread materials show different wear. All these factors play roles in the determination of relationships between tread materials and accident rates.

Data in table 50, show that there is no relationship between four broad classes of materials and accident rates. More to the point, however, is a comparison of accident rates with the corresponding average friction measures for these classes of materials displayed to the right in table 50. Over the range of friction measures taken, the

TABLE 50. ANALYSIS OF TREAD MATERIALS AND FRICTION

DATA FROM TOTAL SAMPLE				SITE SAMPLE	
TREAD MATERIAL	A	NA	TOT	ACC. RATE	FRICTION
Linoleum/Tile	17	122	139	.12	.53
Carpeting	24	120	144	.17	.78
Paint/Varnish	24	99	123	.20	.66
Rubber Treads	15	41	56	.27	.81
	80	382	462		

Chi square = 5.79; P = .1755

lower the measure, the lower the accident rate. Clearly this result cannot be explained by relative "slipperiness" of the materials in the sample. In figure 4, the distributions of friction measures on accident stairways show graphically their close relationship to mere frequency of occurrence of all measures, and not to some pattern of materials or value of friction.

Friction of ordinary materials is not a primary factor that determines accident rates. It may operate in the extremes where it is low enough to be like ice or high enough that the shoe is caught, but not in ordinary circumstances.

Supporting this conclusion are data in table 51, which show that varied materials in sequence bear no relationship to accidents. Reference to the list in appendix F shows that many sequences vary widely in friction, sometimes from step to step. It is doubtful that improvement of the measuring techniques to reduce variability of field data would show a relationship except for extreme measures of friction.

TABLE 51. ANALYSIS OF MATERIALS IN SEQUENCE

DATA FROM SITE SAMPLE

	NUMBER OF MATERIALS IN SEQUENCE									
	1	2	3	4	5	6	7	8	9	TOT
A	6	2	4	8	5	4	4	0	1	34
NA	6	7	15	10	18	6	8	5	3	78
	12	9	19	18	23	10	12	5	4	112

Chi square = 8.15; P = .4256

6.4.5 Handrails

Presence of handrails on stairways is the single most frequent recommendation by respondents, and the lack of handrails in the sample is notably high. Experts concur, adding many specifications for shape, height, spacing of supports and strength.

With the indicated awareness of the need for handrails, their absence might be assumed to be related to increased accident rates. It is not. This result is displayed in table 52. The left display shows no relationship. Data there are taken from inside stairways only in the total sample. In the display to the right are data on flights from the smaller site sample. Differences are not significant but the trend is opposite from the expected.

TABLE 52. ANALYSIS OF PRESENCE OF HANORAILS (INSIDE ONLY)

DATA FROM TOTAL SAMPLE				DATA FROM SITE SAMPLE			
HANORAILS:	A	NA	TOT	HANORAILS:	A	NA	TOT
Absent	23	100	123	Absent	8	41	49
Present	62	289	351	Present	32	92	124
	85	389	474		40	133	173
CS = .07; P = .8035				CS = 1.74; P = .1906			

The data in table 53 help clarify the importance of handrails against data above which fly in the face of prudence and practice. Serious and moderate accidents are separated from critical incidents in the analysis. The relationship is significant. Dividing column frequencies by their column marginals shows that critical incidents on stairway

TABLE 53. ANALYSIS OF ACCIDENTS AND CRITICAL INCIDENTS

DATA FROM TOTAL SAMPLE

HANDRAILS:	S,M*	CR**	TOT
Absent	13	10	23
Present	19	43	62
	32	53	85

CS = 4.78; P = .0320

*serious or moderate
**critical incident

with handrails occur four times as often as they occur on stairways without handrails. Accidents on the other hand show very little difference in either case. These data suggest that when handrails are present they reduce severity, or, if they had been present, they would have reduced severity.

With regard to irregularity in handrail height (see table 17) the trend favors regular heights, but the difference is not significant (Chi square = 1.38; P > .25).

6.5 ACCIDENTS AND PHYSICAL VARIABLES: CONFIGURATION

6.5.1 Configuration, Location, Riser-Tread Irregularity and Winders.

This complex set of variables is discussed together because none of the four bear consistently

TABLE 54.

CONFIGURATION, TOTAL SAMPLE

	A	NA	TOT
STRAIGHT	36	158	194
LANO + 90°	14	111	125
LANO + 180°	21	74	95
2 LANOINGS	5	13	18
	76	356	432

CS = 6.28; P = .0990

TABLE 55.

CONFIGURATION X LOCATION, TOT SAM

	B-1			1-2		
	A	NA	TOT	A	NA	TOT
STR	25	108	133	11	50	61
90°	5	58	63	9	53	62
180°	8	40	48	13	34	47
2 L	0	4	4	5	9	14
			248			184

Chi square = 14.07; P = .0394

TABLE 56.

LOCATION, TOTAL SAMPLE

	A	NA	TOT
B-1	38	211	249
1-2	38	148	186
2-3	2	37	39
	78	396	474

CS = 5.31; P = .0760

TABLE 57.

IRREGULARITY, TOTAL SAMPLE

	A	NA	TOT
NO IRR	60	351	411
IRR	18	45	63
	78	396	474

CS = 8.73; P = .0055

TABLE 58.

LOCATION, SITE SAMPLE

	A	NA	TOT
B-1	15	69	84
1-2	23	44	67
2-3	2	20	22
	40	133	173

CS = 8.37; P = .0160

TABLE 59.

IRREGULARITY, SITE SAMPLE

	A	NA	TOT
UNDER 1"	26	98	124
ABOUT 1"	6	19	25
OVER 1"	8	16	24
	40	133	173

CS = 1.75; P = .4294

TABLE 60.

LOCATION X IRREGULARITY, TOTAL

	B-1		1-2		2-3		
	NI	I	N1	1	N1	1	TOT
A	33	5	25	13	2	0	78
NA	181	30	139	9	31	6	396
	214	35	164	22	33	6	474

CS = 33.49; P = .0000

TABLE 61.

LOCATION X IRREGULARITY, SITE

	B-1		1-2		2-3		
	NI	1	N1	1	NI	I	TOT
A	12	3	12	11	2	0	40
NA	47	22	33	11	18	2	133
	59	25	45	22	20	2	173

CS = 13.48; P = .0194

significant relationships to accident events, but interactions of three of them with location are related to accidents on stairways. There are 12 tables and one summary table (tables 54 - 66) displaying the several analyses. They will be referred to by title only. Data are all for inside stairways only.

Which floors a stairway is between—its location—has no influence on accident rates in the total sample. This variable, however, is related to accident rates when flight is the unit of analysis, as shown by the site sample data. Flights from 1-2 are the offenders, as are 1-2 stairways in the trend for the total sample.

6.5.2 Configuration

Configuration for the total sample also has no influence on accident rates, but the trend shows stairways with 180-degree turns to have more accidents than other configurations. When configuration interacts with location, 1-2 stairways with 180-degree turns are more highly associated with accidents than are the others. There is a small increase above chance for straight stairways from B-1.

TABLE 62.

WINOERS: TOTAL SAMPLE

	A	NA	TOT
Absent	51	283	334
Present	27	113	140
	78	396	474

CS = 1.18; P = . 2807

TABLE 63.

WINDERS: SITE SAMPLE

	A	NA	TOT
Absent	20	50	70
Present	13	23	36
	33	73	106

CS = .79; P = .3918

TABLE 64.

LOCATION X WINOERS, TOTAL

	B-1		1-2		2-3		
	NW	W	NW	W	NW	W	TOT
A	31	7	18	20	2	0	78
NA	165	46	96	52	22	15	396
	196	53	114	72	24	15	474

CS = 11.22; P = .0465

TABLE 65.

LOCATION X WINOERS, SITE

	B-1		1-2		2-3		
	NW	W	NW	W	NW	W	TOT
A	13	1	8	10	1	0	33
NA	25	13	15	9	8	3	73
	38	14	23	19	9	3	106

CS = 11.15; P = .0489

TABLE 66.

SUMMARY TABLE OF P-VALUES FROM TESTS

	LOCATION	CONFIGURATION	BOTH
TABLES 56, 54, 55:	.0760	.0990	.0394
	LOCATION	IRREGULARITY	BOTH
TABLES 56, 57, 60:	.0760	.0055	.0001
TABLES 58, 59, 61:	.0160	.4294	.0194
	LOCATION	WINOERS	BOTH
TABLES 56, 62, 64:	.0760	.2807	.0465
TABLES 58, 63, 65:	.0160	.3918	.0489

6.5.3 Riser-Tread Irregularity

Riser-tread irregularity does show a relationship to increased accident rates in the total sample, but the more precise data taken on the site sample does not bear out the relationship. When irregularity interacts with location, relationships are significant for both site and total samples, and again, the 1-2 stairways are offenders by showing more accident events than expected by chance.

6.5.4 Winders

Winders alone consistently show no relationships to accidents in either set of data. Again, when winders interact with location, the interaction shows the relationship for both samples. Winders more frequently appear on 1-2 stairways in the total sample, and it is the 1-2 stairway that shows a greater accident rate in the Winder X Location interaction.

With a larger sample, configuration, location, and irregularity—but not winders—might exhibit significant relationships to accident rates since they are so close with the present sample sizes. However, it is clear that winders contribute directly to increased turns and to tread irregularities. Moreover, they appear more often on 1-2 stairways. The data do not permit more complete analysis and individually each analysis makes a small point. Together, they marshal considerable force of argument to implicate winders as contributors to hazards that may lead to increased stairway accidents.

6.5.5 Low Headroom and Orientation Edge

These two variables are discussed together because each can distract the user while using the stairway and increase the probability of accidents. Therefore, stairways having one or the other should also have more accident events than stairways without either one. When both are present, the stairways should show an even higher incidence of accident events.

Data in tables 67 and 69 relate low headroom and orientation edge to accident events. Number of accident events is in parenthesis in both table 67 and 69. Table 67 displays the data from the total sample using the respondents' criteria for both variables. The comparison test, in table 68, shows no significant relationship, but together the variables have twice the effect than either alone.

TABLE 67.

RESPONDENT CRITERIA FROM TOTAL SAMPLE

ORIENTATION EOGE ON:

LHR ON:	NONE	8-1	1-2	2-3	TOT
NONE		94(12)	73(16)	6(1)	173(29)
8-1	4(5)	22(7)			56(12)
1-2	8(1)		7(2)		15(3)
2-3	3			3(1)	6(1)
TOT	45(6)	116(19)	80(18)	9(2)	250(45)
				NEITHER:	224(33)
				TOTAL STAIRWAYS:	474(78)

TABLE 68.

COMPARISON TEST	A	NA
NEITHER	33	191
LHR ONLY	6	39
OE ONLY	29	144
TOGETHER	10	22
	78	396

CS = 5.91
P = .1211

TABLE 69.

INVESTIGATOR CRITERIA FROM SITE MEASUREMENTS

ORIENTATION EOGE AT STEP NUMBER:

LHR AT:	NONE	1	2	3	4	5	6	7	TOT
NONE		4(2)	2(1)		3(2)			1(1)	10(6)
1	13(2)	10(4)	7	3(2)					33(8)
2	5	3(2)	5(3)			1(1)			14(6)
3	1(1)	1	1	4(2)		1(1)			8(4)
4	1				2(2)	2	1(1)		6(3)
5	1(1)				1				2(1)
TOT	21(4)	18(8)	15(4)	7(4)	6(4)	4(2)	1(1)	1(1)	73(28)
								NEITHER:	33(6)
								TOTAL STAIRWAYS:	106(34)

The detailed data in table 69, using investigator criteria, are taken from the site measurements. Low headroom uses a standard that includes the distracting effect of headers not low enough to bump peoples' heads. In addition, the step at which each variable appears was determined. The test of these data is in table 70.

TABLE 70.

	COMPARISON TEST: NO OE OR LHR	LHR ONLY	OE ONLY	BOTH	SAME STEP	TOT
A	6	4	6	7	11	34
NA	27	17	4	14	10	72
	33	21	10	21	21	106

Chi square = 12.15; P = .0170

There are clear effects of the variables, and when they occur at the same step, hazard is increased. The same standard for low headroom used with respondents probably would increase the occurrence alone and in conjunction with orientation edge.

Headroom low enough to bump heads is immediately recognized as hazardous by most people. But the distracting effects of low headroom that is not low enough to bump heads, and of orientation edges that permit a full view of a room before the user reaches the bottom are not universally seen as hazardous. In fact open views into a room are often considered an advantage by many people. That under certain conditions they can become hazardous is important to know.

6.5.6 Number of Stairways

Increasing the number of stairways in a dwelling unit will increase the probability of stairway accidents (using percentages based on data in table 71). This finding makes intuitive sense, but it doesn't explain why stairways are hazardous. More specific information is needed and is partly supplied by the measure of quality below.

6.5.7 Hazard Measure

Increased accident rates are associated with increased stairway hazards. Percentages calculated from data in table 72 show this increase. The measure is a sum of hazards, so a higher score means lower stairway quality. Since it is a combination of nine potential hazards it is a more stable measure than some of the single variables measured in this study. It also has an imposed metric property that makes it useful in analysis. It is a relatively quick way to assess residential stairways, particularly since it shows a close relationship to accident rate.

TABLE 71.

NUMBER STAIRWAYS	A	NA
0	1	1
1	13	49
2	41	106
3	11	26
4	5	0
	71	182

CS = 16.57
P = .0043

TABLE 72.

HAZARD MEASURE	A	NA
0-1	16	70
2-3	28	75
4-5	17	28
6-7	6	5
8-9	3	3
10-11	1	1
	71	182

CS = 11.68
P = .0221

TABLE 73.

PERCENT SAFE	A	NA
0%	0	1
25%	2	2
50%	11	12
75%	36	69
100%	22	93
	71	177

CS = 12.20
P = .0167

The addition of more hazards to the scale, along with some modification of existing hazards, would improve it. Using the forced choice mode would make responses less equivocal. Its discrimination would be improved by applying the scale to individual stairways instead of all stairways in a unit.

6.5.8 Percent Safe

This measure is quite subjective and combines not only a collection of feelings about stairways and their specific features, but also all stairways that belong to the unit. In this respect it is deficient. The measure was shown to interact with Renter/ Owner Status to produce an inconsistency of response for renters (table 35). If a choice has to be made, the Hazard Measure is the one recommended. Percent Safe, however, does not measure the same thing as the Hazard Measure, as their intercorrelation of 0.40 demonstrates. Applied to individual stairways of the dwelling unit, its directness and simplicity recommend it. More important it is related to accident rate and is probably a function of whether the respondent has had (or has seen) accidents on home stairways.

6.6 ACCIDENTS AND BEHAVIORAL VARIABLES

6.6.1 Number of Uses Per Hour

Special activities, style of life, and sheer opportunity all influence hourly rate of use of home stairways. One of the two respondents with highest hourly rates held a meeting at home the day the record was taken and used stairways 90 times in 13 hours. The other, whose special activity was redecorating an old house, counted 82 uses during 14 hours at home (see table 74).

Less rare in the sample were several respondents who regularly use their stairways 35-45 times each day (2.2 to 2.8 uses per hour). Such a person would make between 5000 and 6000 round trips on home stairways per year on weekdays alone (table 75).

Being at home all day or having more than the average number of stairways are both associated with somewhat higher hourly rates of stairway use. The average, however, is about 1.4 uses per hour for respondents in the total sample. The range is from 0.125 uses per hour to 6.545 uses per hour, a factor of 52.

Although there is a fairly wide range in the hourly rate of use, there is only a faint trend relating accident rates to uses per hour, and the relationship is not significant. Table 74 presents the data on uses per hour.

When age is controlled, as shown by the classification in table 77, the trend is significant. The interaction selects out only the lower age groups having high uses rates as those with more accident events than expected by chance.

6.6.2 Number of Uses Per Day

Daily rate may be treated as a total frequency of use because diurnal periods do not really represent continuous rates in the same way as hourly rates can. They are separated by periods of sleep.

TABLE 74

USES/HOUR	A	NA
0-.9	17	89
1-1.9	14	60
2-2.9	9	23
3-3.9	2	9
4 up	3	5
	45	186

CS = 4.01
P = .4144

TABLE 75.

USES/DAY	A	NA
0-8	5	33
8-15	15	72
16-23	15	31
24-31	2	26
32 up	8	24
	45	186

CS = 9.62
P = .0482

TABLE 76.

TOTAL HABITS	A	NA
0-1	5	49
2-3	10	63
4-5	21	51
6-7	5	34
8-9	4	11
	45	208

CS = 11.36
P = .0343

TABLE 77. AGE OF RESPONDENT X USES PER HOUR

	0-45 years		45 and up		TOT
	0-1.9	2 up	0-1.9	2 up	
A	13	13	18	1	45
NA	66	20	81	17	184
	79	33	99	18	229

Chi square = 11.06; P = .0111

Counting all uses made during the day, regardless of how many hours the person is at home, shows a significant increase in accident events as daily use increases; see table 75. Together with results on hourly rate, these results suggest that accident events for a particular individual take place after some particular *number of uses* is made, rather than how rapidly those uses are made, assuming normal conditions.

This interpretation fits with the behavioral information about use in general. Hourly rate is a function of time of day and not a function of whether the person is home all day or away at work full time.

Accident data were not collected in this study in a way that allowed them to be distributed by time of day. Therefore, use is made of some data found in Esmay (1961).[10] Replotting those data by two-hour periods shows the accident events to be distributed almost equally throughout the day. There are two nominal peaks, one in mid-morning and the other in the late afternoon. These periods are when hourly rate is next to highest and next to lowest, respectively (fig. 5, page 40). When hourly rates are ebbing and at their lowest, from 2 PM to 8 PM, Esmay's data show a high incidence of accident events. Hourly rates alone are not clearly related to accident rates.

6.6.3 Stairway Habits

The way people use and treat home stairways bears a relationship to accident rates on those stairways. Many things determine stairway habits, including how often stairways must be used, frequent demands of special situations, features of specific stairways, the person's accident history and generalized attitudes toward stairways. A sample of imprudent habits considered to contribute to accidents were given to respondents in the total sample; see section I, page 116. They were ranked by the total number of habits they checked. The scale was then used to relate total habits to accident events.

Data on total habits for the accident and non-accident groups are shown in table 76. There is a significant relationship; people with fewer habits in general have fewer accident events than people with more habits. The average number of habits for the total sample is 3.6, with an average of 3.4 for the nonaccident group and 4.3 for the accident group.

Respondents under 45 years have both higher rates of use and a larger number of careless habits. There were not enough data to run a meaningful multivariate analysis with three variables, but looking at the Habit X Use interaction strongly suggests that people in the younger age groups have more accidents as a result of greater demands for stairway use combined with careless stairway habits (see table 77).

6.7 ACCIDENT ANALYSIS BY MULTIPLE REGRESSIONS

Parallel to the approach used in chapter 4, the analysis here addresses a pair of questions: How are accident rates affected by (1) physical variables and (2) personal variables? Regression analysis is used here to get a rough idea of the total effect of several variables on accident rates, used independently, with the limited data on hand. There is a degree of control, but it is not as complete as in analysis of variance.

Because age and type of structure are not as important as configuration in assessing accident rates, the set of physical variables substitutes configuration (B-1 and 1-2) in the analysis. They were metricized by imposing a ranking based on the number of turns in the stairway, since each turn involves a change in gait (sec. C, page 113).

Data in table 78 show the multiple regressions for physical and personal variables separately, listed in order of their importance. The Multiple R^2 term may be treated as a percentage of variability accounted for, and is used to measure importance.

Only respondents who themselves had accidents on their own stairways were used in this analysis.

[10] Esmay, Merle L. (1961) Home stairway safety research results. Unpublished manuscript, Michigan State University, 16 pp. mimeo.

The Multiple R^2 for each set of variables (24.5 percent for physical variables and 23.0 percent for personal variables) shows that their aggregate ability of these sets of variables to predict accidents is substantial. The aggregate pattern is important, not the individual factors.

TABLE 78. SUMMARY OF MULTIPLE REGRESSIONS

Dependent Variable: Accident Events		
Physical Variables:	Multiple R	N = 32
Percent Safe	.370	
Configuration, 1-2	.432	
Configuration, B-1	.458	
Number of stairways	.476	
Uses per hour	.488	
Hazard Measure	.495	
Personal Variables:	Multiple R	N = 41
Uses per hour	.297	
Sex of respondent	.401	
Age of respondent	.441	
Number of habits	.469	
Hazard Measure	.477	
Percent Safe	.480	

The results imply that with more data and a precise analysis patterns would emerge that emphasize the crucial factors. These patterns must include physical hazards, habits and use factors, and exigencies and special conditions surrounding the accident events. The interpretation is that no one factor is crucial until the pattern of factors thrusts it into a causal relationship with an accident event. The conclusion is to lower the probability of that event by eliminating as many factors as feasible, both physical and behavioral, to break up the patterns or at least reduce their probability of occurrence.

APPENDIX A

DATA FROM SITE VISIT SAMPLE OF 54 HOUSEHOLDS IN MILWAUKEE COUNTY

Overall order of the table is by stairways: B-1, 1-2, 2-3, Front outside, Back outside, Miscellaneous. Housing type is shown within each stairway type: apartments first, duplexes second, and single family houses third. Read across on epair of facing pages for physical measurement data on a given stairway. Each stairway is numbered by a SUBJECT CODE, which is a serial listing of the 54 households.

COLUMN HEADINGS AND CODING

SUBJECT CODES — com = common stairway; pri = private stairway; all unlabelled inside stairways are private.

NUMBER RISERS — Total number of risers from bottom to top landings of of specific flight; lower flight first; op = open risers.

STEP DIMENSIONS RS TR NO IR — Average RiSer, TRead, and NOsing measures in inches; IRregularity: 0 = under 1 in, 1 = 1 in, 2 = over 1 in.

HANDRAIL MEASURES R/L R/F/L HT/ IR — Right/Left side; Rigid/Firm/Loose; Average HeighT in inches; IRregularity; 0 = under 2 in, 1 = 2 in or more.

ORIENT/ HEADRM — Number of risers from bottom landing to tread where either orientation edge or lowest headroom occurs.

MAJOR MATTER — Material on largest number of trends. Letter in ( ): materials different from major material under FRICTION.

cnc: concrete(c)
cpt: smooth carpet(s)
pil: pile carpet—nap(n)
mat: rubber/fiber mat(m)
vtr: vinyl plastic treads
rtr: rubber treads(r)
wd: bare wood(w)
pnt: painted wood(p)
var: varnished wood(v)
lin: linoleum alone(l)
l/m: linoleum/metal nosings(l)
t/m: tile/metal nosings(t)
throw rug(o); ceramic tile(ct); hemp mat(h); cork(ck); asphalt (a)

NUMBER MATER — Total number of materials, including bottom and top landings, for all flights between given floor levels.

WEAR — 1 = No visible wear; 2 = Some wear; 3 = Moderate wear; 4 = Much wear; 5 = Extreme wear, usually with damage.

NUM SEV — Number of occurences and severity of accidents and critical incidents on specific flight indicated.

FRICTION (LOCATION) — Coefficients of friction (x 100) measured on landing or tread indicated, using the NBS-Brungraber Portable Slip-Resistance Tester.[11] Measures are given for the major material abbreviated under MAJOR MATER(IAL). Measures for minor materials are underlined and a 1- or 2-letter abbreviation is used. In cases of two flights, friction on TOP LANDING of a lower flight applies to BOT(TOM) LANDING of the upper flight.

[11]Brungraber, Robert J. A New Portable Tester for the Evaluation of the Slip-Resistance of Walking Surfaces. Nat. Bur. of Stand. (U.S.), Tech. Note 953, 51 pages (July 1977).

BASEMENT TO FIRST FLOOR

SUBJECT CODES	NUMBER RISERS	STEP DIMENSIONS RS	TR	NO	IR	HANDRAIL MEASURES R/L	R/F/L	HT.	IR	ORIENT/ HEADRM	MAJOR MATER	NUMBR MATER	WEAR
APARTMENTS													
301 com	5	8	10½	1½	0	L	L	30	0		l/m	5	4
	6	8	10½	1½	0	L	L	30	0				
302 com	8	8	10	1	0	L	F	28	0		l/m	6	3
	5	8	10½	1½	0	L	L	29	0		l/m		
303 com	6	8	10½	1½	0	R	R	32	0	1/1	l/m	7	2
	6	7½	10½	1½	0	R	R	32	0				
304 pri*	7	7½	11½	1½	0	L	R	30	0	2/1	pil	2	1
com	7op	7½	11½	1½	0	R+L	R/R	30/30	0/0		pil	1	1
	7op	7½	11½	1½	0	R+L	R/R	30/30	0/0				
305 com	6	7½	11	1½	0	R	R	28	0		vtr	5	1
	7	7½	11	1½	0	R	R	28	0				
306 com	7op	8	12	2	1	R+L	R/R	34/33	0/0		vtr	5	1
	7op	8	12	2	1	R+L	R/R	33/33	0/1				
DUPLEXES													
307 com	6	7½	10	1½	0	none				1/-	l/m	5	4
	6	7½	10	1½	1	none							
308	10	7	10	1½	1	L	R	29	0	-/1	pnt	8	5
	3	8	9½	1½	0	none							
309	10	8	10½	1½	0	R	R	30	1	-/2	l/m	7	1
	4	7	10½	1½	0	R	R	30	1				
310	none												
311	6	9	9	1½	0	none				-/1	lin	5	5
	5	8	10½	1½	0	none							
312	8	7½	10½	1½	0	none					pnt	3	5
313 com	11	8½	9	1	1	L	L	28	0	2/2	lin	3	5
314 com	7	8	9½	1½	0	none					lin	8	4
	5	7	10½	1½	0	none					l/m		
315	8	7½	9½	1½	0	none				3/3	rtr	9	5
	4	7	10½	1½	0	none					l/m		
316 com	8	7	10	1½	2	L	L	30	0	3/3	l/m	7	5
	5	7½	10	1	0	L	L	24	1				
317 com	13	8	10½	1	1	L	R	35	0	-/4	l/m	6	1
318 com	10	8	10½	1	1	R	F	31	0		l/m	6	1
	2	7½	10½	1	0	none							
319 com	8	8	9½	1½	2	R	F	27	1	1/2	l/m	6	3
	5	7	10	1½	0	none							
320 com	11	7½	10½	1½	2	none					t/m	9	3
	2	7½	10½	1½	2	none							

*Short split-level flight inside apartment.

BASEMENT TO FIRST FLOOR

NUM SEV	FRICTION BOT LANDING	FRICTION BOTTOM STEP	FRICTION MIDDLE STEP	FRICTION TOP STEP	FRICTION TOP LANDING	SUBJ. CODES
						APARTMENTS
		63 65 72 68				301
			73 71 68 72	61 62 74 67		
		62 65 68 65				302
			58 59 60 66	53 59 60 64		
		48 58 50 52		49 62 51 59	52 58 56 54v	303
		54 68 58 56	61 64 62 64	58 62 59 61		
	55 40 60 65	57 54 60 57		41 40 46 47	65 58 56 74v	304
		54 56 59 47				
				65 68 62 65		
	68 77 69 74t	72 89 78 86	72 89 79 85			305
			71 86 83 81	73 84 78 79		
	94 109 104 99c	76 98 84 86		76 79 99 86	96 108 102 94c	306
		86 78 89 84		75 96 79 84		
						DUPLEXES
		59 79 63 68				307
			76 73 54 58		64 69 61 54	
		67 79 68 74	69 72 71 69	69 75 72 71	78 82 79 81o	308
		60 71 65 67		59 68 70 59		
	82 72 83 79o		69 64 59 65			309
	84 89 87 88s					
					none	310
	62 64 64 66c	76 71 71 70	76 78 78 80	76 74 74 70	78 76 78 77n	311
		77 79 72 76	76 76 67 72		63 64 72 69v	
		79 69 57 63		69 65 63 68		312
	92 98 95 94c	48 59 52 51	50 56 49 58	52 54 49 57		313
	73 84 79 81o	51 57 62 61		71 58 61 65		314
		53 54 58 62	56 58 62 65	74 52 59 63		
		87 76 84 79	78 68 75 71		66 69 68 68w	315
M			78 77 79 78			
	78 84 89 81c		58 63 59 61			316
				59 61 58 64		
	76 83 78 81o	58 64 59 61	59 72 62 66		89 99 91 94s	317
		61 60 55 60				318
			65 66 66 67		83 84 82 83s	
L	86 84 92 94c	47 56 61 62	61 61 58 56			319
			92 94 96 88		86 92 96 91	
	103 102 92 98m		62 67 64 58		89 97 102 92m	320
			65 74 59 61		100 98 92 97m	

BASEMENT TO FIRST FLOOR

SUBJECT CODES	NUMBER RISERS	STEP DIMENSIONS RS	TR	NO	IR	HANDRAIL MEASURES R/L	R/F/L	HT.	IR	ORIENT/ HEADRM	MAJOR MATER	NUMBR MATER	WEAR
SINGLE FAMILY													
321	7	7½	8	1½	2	R	R	33	1	-/2	var	7	5
	5	7½	11	1½	0	none					t/m		4
322	8	8	10½	1½	0	none				-/2	l/m	7	2
	4	8	11½	1½	0	none							
323	8	8	11½	1½	2	L	R	32	1	-/1	l/m	5	1
	4	7	11	1	0	L	R	32	1				
324	8	8	10½	2	0	L	R	38	0	1/1	l/m	6	3
	4	7	11½	2	0	L	R	35	0				
325	8	8	10	1½	0	none				-/1	l/m	7	1
	4	7½	10	1½	0	none							
326	9	8	9	1	0	R	L	40	1	-/2	l/m	6	1
	3	8	9	1	0	R	L	40	1				
327	7	8	9½	1	2	none				-/2	pnt	7	4
	5	8	10	1	2	none					l/m		3
328	2	7½	9½	1½	0	none					lin	7	3
	12	7½	9½	1½	0	L	L	34	0		var		
329	11	9	9½	0½	2	L	L	35	0	2/-	l/m	5	3
330	11op	8	10	2	0	L	F	37	1	-/1	pnt	4	3
331	12	7½	12½	1½	0	L	R	31	0	3/3	cpt	8	1
	2	7	13	2	0	none					t/m		
332	12	8	10	1½	0	none				1/1	l/m	3	2
333	13	8	11	1½	2	L	R	28	1	3/1	l/m	4	1
334	11	6½	9	1½	2	none				1/1	pnt	4	3
rear*	3	8	9	1	0	none					l/m	4	5
335	7	8	10	1½	0	none					l/m	5	2
	5	7½	9½	1½	0	none							
336	5	8	11	0	2	none					cnc	5	4
	6	7	10	1	2	R	R	33	1		l/m		
337	12	8½	9	1½	0	R	R	30	1	2/2	rtr	4	2
338	10	7½	10½	1½	2	L	R	34	0	2/3	l/m	9	1
	3	7½	10½	1½	0	none							
339	12	8	10	1	0	R	L	32	0	3/3	rtr	4	3
340	12	8	9½	1	0	L	L	28	0		t/m	4	1
341	14	7½	10	1½	0	R	L	30	0	-/1	t/m	3	2
342	10op	7½	9	0	0	L	R	26	1	2/-	pnt	7	3
	2	7½	10	1½	0	none					l/m		
343	12	8	10½	1½	2	R	F	31	1		rtr	5	2

*Flight down to connected garage.

BASEMENT TO FIRST FLOOR

NUM SEV	FRICTION BOT LANDING	FRICTION BOTTOM STEP	FRICTION MIDDLE STEP	FRICTION TOP STEP	FRICTION TOP LANDING	SUBJ. CODES
						SINGLE FAMILY
		45 61 48 59 54 62 60 56	55 58 46 59 61 60 58 55	60 49 61 52 59 54 62 60		321
		49 63 55 58	50 54 61 52	58 49 61 57	89 102 92 94m 98 100 99 98m	322
		110 105 92 120	79 85 91 71 80 95 82 71	65 75 78 59 85 77 87 92		323
L		57 63 58 65 59 57 57 58		61 54 55 56 61 55 51 57		324
L L	85 81 82 78s	65 62 66 59 66 62 59 61		56 60 66 61 58 61 61 65	79 68 69 72s	325
		59 54 56 55 56 55 50 55		58 59 67 72	68 68 67 69o	326
		68 73 69 71 50 62 54 61	74 69 71 72 55 58 62 51	69 82 74 79 59 51 62 58		327
	69 58 74 67	58 74 63 65	71 69 74 66	68 82 68 74		328
		86 92 89 90	55 68 58 64	60 64 55 56	59 58 64 65	329
	82 77 76 77c	65 55 63 60		66 45 58 55	52 65 60 59l	330
	52 50 54 52ct	79 77 82 78 53 48 50 60	88 85 80 83 57 46 49 52	60 60 70 62 48 58 52 54	63 64 63 61o	331
		62 65 68 65	65 71 72 68	74 74 79 77		332
	85 83 85 83s	55 58 58 57	52 53 63 64	52 54 60 54		333
5M	65 68 68 59l 75 82 65 78c	72 64 78 74 62 67 66 53w	53 41 70 48 68 74 62 68	60 67 63 50	48 52 50 42l 68 72 72 60s	334 rear
	67 69 64 65c	65 62 59 59 63 61 60 65		62 61 60 69 59 71 64 60		335
L,M		78 86 79 84 58 67 59 66	82 81 86 78 60 61 59 64	84 79 81 82 62 64 58 59		336
M	64 61 62 61c	60 55 53 52	63 60 59 62	69 70 75 62	72 76 70 74l	337
		54 68 61 63	57 67 58 60	55 72 56 59		338
L	66 78 90 86c	90 82 80 75	86 83 83 89	84 86 84 81	55 64 64 58v	339
		55 68 59 64	59 68 64 60	64 61 63 63		340
		62 50 56 56	58 59 59 69	52 64 36 56	75 62 63 68	341
L	71 76 74 75n	48 56 49 54	50 48 55 53 53 62 55 60	49 56 54 51 61 64 62 58	65 99 68 83o	342
		92 98 96 96	96 94 95 96	94 93 95 98	56 65 59 61l	343

BASEMENT TO FIRST FLOOR

SUBJECT CODES	NUMBER RISERS	STEP DIMENSIONS RS	TR	NO	IR	HANDRAIL MEASURES R/L	R/F/L	HT.	IR	ORIENT/ HEADRM	MAJOR MATER	NUMBR MATER	WEAR
SINGLE FAMILY, cont.													
344	12	8	10	1½	0	L	R	34	0	1/2	cpt	4	1
345	12	8	9½	1½	0	L	L	33	0	2/1	l/m	3	1
346	12	8	10½	2	0	L	F	32	1	3/1	rtr	5	1
347	none												
348	13	8	10½	1	1	R/L	L/L	31/32	1/0	1/2	l/m	5	1
349	12	8	10	1½	0	L	L	33	0	2/2	l/m	4	2
350	12	8	10	1½	0	R	R	36	0	3/1	t/m	4	1
351	7*	7½	9½	1	1	L	L	34	0	5/4	cpt	2	1
rear	4**	7½	9½	1	1	R	L	32	0		t/m	3	1
352	12	7½	10	1½	0	R/L	R/R	33/33	0/0	2/2	var	6	3
353	12	8	10½	1½	0	R	R	32	0	2/1	cpt	3	1
354	11	8½	10½	1½	0	L	R	32	1		wd	4	1
FIRST TO SECOND FLOOR													
APARTMENTS													
301 com	8	8	10½	1½	0	R	F	30	0		l/m	5	3
	7	8	10½	1½	0	R	F	30	0				
302	8	8	10	1½	0	R	L	30	0		t/m	7	3
	9	7	9½	1½	0	R	L	28	0				
303 com	7	8	10½	1½	0	R	R	32	0		cpt	9	2
	7	8	10½	1½	0	R/L	R/R	32/38	0/1				
304	none												
305 com	7	7½	11½	1½	0	L	L	28	0		cpt	1	1
	7	7½	11½	1½	0	L	R	28	0				
306 com	7	7½	12	2	1	R/L	R/R	29/34	0/0		vtr	5	1
	7	7½	12	2	1	R/L	R/R	32/34	0/0				
DUPLEXES													
307 com	8	7½	10½	1½	0	R	L	32	0	1/-	l/m	5	3
	8	7½	10½	1½	0	R	L	32	0				
308	31***	8½	9½	1½	0	none					pnt	2	3
309	10	8	10½	1½	1	R	R	30	1	1/-	l/m	5	2
	6	8	10½	1½	0	R	R	30	1				
310	12	7½	10½	1½	0	R	R	30	1		cpt	3	3
	5	7½	11	1	0	R	R	30	1				
311	none												
312	19	7½	10½	1½	1	L	L	41	1		pnt	5	4

*Split-level to living room. **Split-level to patio. ***Flight direct to 3rd floor.

BASEMENT TO FIRST FLOOR

NUM SEV	FRICTION BOT LANDING	FRICTION BOTTOM STEP	FRICTION MIDDLE STEP	FRICTION TOP STEP	FRICTION TOP LANDING	SUBJ. CODES
					SINGLE FAMILY,	cont.
M, 2L	84 83 86 83		83 84 83 82		78 76 75 75	344
	72 77 73 65	87 84 86 87	77 76 76 66	78 72 79 73	82 72 71 76	345
M	67 68 66 67o	58 51 54 53	55 52 50 51	53 57 60 58	68 64 64 64n	346
					none	347
	58 62 59 60t	62 74 65 70	74 63 71 69	67 73 72 63	57 65 63 58n	348
L		62 66 68 64	60 66 58 60	53 63 65 59		349
5L	65 65 67 71	58 64 60 65	63 69 73 68	61 76 68 66	50 60 61 53	350
	61 64 58 61	65 70 60 65 55 58 52 48	70 75 64 71 58 54 52 56	72 75 76 65 48 62 54 56	62 68 62 56n	351 rear
L		58 71 59 65	60 64 68 65	72 58 64 69		352
	84 83 80 78l		78 78 76 79	79 81 78 80		353
	95 97 99 88c	78 82 81 74	65 78 73 79	67 72 79 81	61 64 72 67l	354
					FIRST TO SECOND FLOOR	
					APARTMENTS	
		68 86 83 79				301
			67 81 73 75	71 76 68 73		
L		65 68 73 74				302
S			51 53 60 61	54 59 65 71		
	78 86 79 84m	62 78 68 74		60 81 69 76	56 64 58 60v	303
	64 76 66 72t	68 84 68 72		70 82 76 78		
					none	304
L	74 82 76 77	80 81 76 68				305
L			81 69 75 77	72 79 68 69	69 73 80 78	
	108 97 96 99c	82 87 79 94 82 80 95 78		76 83 89 91 94 91 79 80	95 104 96 101c	306
					DUPLEXES	
	54 69 59 60				55 72 65 59	307
		60 61 64 55		59 64 59 67		
	57 73 58 64v		61 64 62 63		64 69 65 67	308
						309
		98 94 102 98 98 95 97 98		97 95 98 98 94 87 91 96		310
					none	311
		68 69 66 74		70 70 68 72		312

FIRST TO SECOND FLOOR

SUBJECT CODES	NUMBER RISERS	STEP DIMENSIONS RS	TR	NO	IR	HANDRAIL MEASURES R/L	R/F/L	HT.	IR	ORIENT/ HEADRM	MAJOR MATER	NUMBR MATER	WEAR
DUPLEXES, cont.													
313	8	8	10	1½	2	R	L	35	1		rtr	8	5
	6	8	10	1½	0	R	L	33	1		cpt		
314 frnt	15*	8	10	2	1	R	R	26	1		pil	5	1
rear	8	8	9	1½	0	none					var	5	3
	7	8	9½	1½	0	none							
315	9	7½	10	1½	0	none				4/-	var	4	3
	6	7½	10	1½	0	none							
316	7	8	10	1	0	L	L	32	0		l/m	7	3
	7	8	10	1½	0	L	L	32	0				
317	13	8	11½	1½	0	L	R	35	1		cpt	5	2
318	none												
319 (3	9+1	8	9½	1½	1	L	R	30	1	1/-	l/m	7	3
flgts)	5	8	10	1½	0	R/L	F/F	28/31	1/1				
320	10	8	10	1½	0	R	L	35	1	4/-	var	7	2
	2	8	10½	1½	0	R	L	40	0				
SINGLE FAMILY													
321	6	8	10	1	2	none				-/1	l/m	2	4
	8	8½	9	1½	2	none					var		5
322	8	7½	10	1½	1	none				4/4	l/m	7	2
	6	7½	10	1	0	R	R	35	1		var		3
323	15	8	10	2	2	R	R	27	1	5/2	pil	3	3
324	14	7½	11	2	1	R	F	31	1	-/5	pil	5	4
	3	7	11	1½	0	R	F	31	0				
325	9	8	10½	1½	1	L	R	31	0	5/3	pil	1	1
	6	8	11	1½	1	L	R	30	1				
326	12	8	10	1½	1	R/L	F/L	39/37	0/0	2/1	pil	2	2
327	7	8	10	1	2	L	R	32	1	1/1	cpt	2	2
	7	8	10	1½	2	L	R	26	1				
328	14	7½	11½	1½	0	L	L	30	0	4/5	pil	3	1
	3	7½	11½	1½	0	L	L	36	0				
329	none												
330	13	8	10	1½	0	L	R	36	1	-/3	cpt	4	5
331	11	6½	12½	1½	0	L	R	32	0	16/-	pil	1	2
	8	6½	12½	1½	0	L	R	39	0				
332	13	8½	9½	1½	1	R	L	22	1	2/1	pil	1	3
333	15	7½	11	2	0	L	F	29	1	6/4	pil	1	2
334	14	7	10½	1½	2	L	R	34	1	4/4	pnt	4	1

*Unit has two stairways; front stairway has private entrance; rear has two flights.

FIRST TO SECOND FLOOR

NUM SEV	FRICTION BOT LANDING	FRICTION BOTTOM STEP	FRICTION MIDDLE STEP	FRICTION TOP STEP	FRICTION TOP LANDING	SUBJ. CODES
					DUPLEXES, cont.	
	65 79 73 74m	84 88 85 85 78 92 80 86	92 81 82 90 84 86 91 79	79 89 79 84 91 79 86 87	85 88 86 87	313
	89 96 91 94	88 89 94 91	94 92 92 90	91 88 96 94	95 95 96 89 f	314
M	72 71 61 68l	48 53 57 52			r	
			57 52 61 54	59 83 72 64	106 108 99 110m	
		68 76 69 71				315
			66 66 64 64	63 68 64 65		
		54 58 59 56				316
			54 63 59 61	58 68 55 64		
		79 84 79 83	89 93 89 94	90 91 89 93	91 92 88 94	317
					none	318
L		62 58 61 60				319
			64 63 57 56	51 54 57 55		
	104 95 103 97m		62 67 75 71 61 69 70 65		66 74 59 68o 52 59 61 64o	320
					SINGLE FAMILY	
		51 65 63 58	60 64 52 51	59 51 65 63		321
S		47 58 49 54	50 57 56 49	56 47 53 51		
M,L	55 59 58 56	55 57 58 56		57 58 59 59	94 99 97 96m	322
		48 62 51 58	50 54 59 48	59 62 49 61		
S	85 88 82 85	87 90 91 80	83 85 86 78	86 86 84 88	90 92 90 88	323
2L	72 75 76 74	72 72 74 69		69 72 71 71	91 87 91 81	324
L			72 74 71 71			
L	78 75 75 79	78 79 79 72			74 71 72 73	325
L			76 70 68 69	72 73 74 74		
	70 72 70 72		76 74 75 75		72 70 73 69	326
L		91 98 96 94				327
L			94 96 92 98	96 98 97 94		
	86 86 86 89s	72 72 73 71		72 72 78 66		328
			86 89 84 91			
					none	329
2M, 2L		53 53 54 56	72 70 71 71	69 69 69 69		330
	70 72 75 72			78 73 71 78		331
			78 72 76 72			
	77 76 74 77		69 74 64 72		72 69 71 72	332
2L	72 73 72 71		77 72 76 71		84 82 82 84	333
5M	68 72 72 60n	48 40 51 53	48 43 51 50	55 54 47 64	73 60 82 77n	334

FIRST TO SECOND FLOOR

SUBJECT CODES	NUMBER RISERS	STEP DIMENSIONS RS	TR	NO	IR	HANDRAIL MEASURES R/L	R/F/L	HT.	IR	ORIENT/ HEADRM	MAJOR MATER	NUMBR MATER	WEAR
SINGLE FAMILY, cont.													
335	7	8	8½	1½	0	none				2/2	var	3	4
	7	8	9½	1	0	none							
336	14	8½	8	1½	1	R	L	29	1	1/1	l/m	4	3
337	13	8½	9	1½	0	R	R	38	0		var	3	2
338	10	8½	10½	1½	0	L	R	34	0		l/m	5	1
	4	6½	10½	1½	0	R/L	R/R	32/31	1/1				
339	13	8	11	1½	2	L	L	34	1		cpt	3	4
340	13	8	10½	1½	0	R/L	L/L	28/30	0/0	4/-	pil	2	2
341	15	8	11	2	1	R	R	30	0	5/4	pil	1	2
342	13	8	10½	2	0	L	L	31	0	-/1	pil	1	2
343	13	8	10½	1½	0	R	L	30	0	-/1	var	3	3
344	none												
345	13	8½	9½	1½	0	R	L	34	0	2/1	pil	3	2
346	none												
347	none												
348	none												
349	14	8	10	1½	0	R	F	33	0	1/1	pil	4	3
350	none												
351	8	7½	10	1½	0	L	R	33	1		pil	1	1
352	14	7½	10	1½	0	L	F	33	0	4/-	var	3	2
353	none												
354	none												
SECOND TO THIRD FLOOR													
APARTMENTS													
301	5	8	10	1½	0	L	F	36	1	-/1	var	3	4
	9	8	10	1½	0	R	F	36	1				
302	8	7½	10½	1½	0	R	L	30	0		pnt	3	3
	8	7½	10½	1½	0	L	L	30	0				
305 mezz	7*	7½	11		0	R	R	27	0	7/-	pil	1	1
3rd	6	8	11	1½	0	R/L	R/R	27/32	0/0				
306 com	7op	7½	12	2	0	R/L	R/R	32/33	0/0		vtr	5	1
	7op	7½	12	2	0	R/L	R/R	33/34	0/1				
pri	2**	7	11½	1	0	none					pil	1	1

*Apartment has two floors and mezzanine. **Dining room to sunken living room.

FIRST TO SECOND FLOOR

NUM SEV	FRICTION BOT LANDING	FRICTION BOTTOM STEP	FRICTION MIDDLE STEP	FRICTION TOP STEP	FRICTION TOP LANDING	SUBJ. CODES
					SINGLE FAMILY, cont.	
		52 56 54 57	51 49 58 55			335
				58 57 56 54	57 62 61 64l	
L,M	47 58 49 55		59 55 48 52		58 59 62 61	336
M,S		71 60 62 63	66 63 54 61	67 60 61 64		337
	56 63 58 61					338
			53 62 57 60	67 59 60 66		
	86 88 84 83n	64 67 60 62v	79 75 76 74	84 85 84 84	82 78 80 85	339
L	65 72 66 70	68 71 65 72	68 72 71 69		71 65 63 70	340
	64 66 65 65		69 74 70 71		80 77 80 79	341
	85 92 89 90		90 86 87 91		97 92 85 88	342
	65 79 68 74n	50 59 53 55	58 57 51 59		59 52 55 57	343
					none	344
	82 82 78 68s	101 98 97 96	95 92 93 88	93 98 95 94	98 97 97 94	345
					none	346
					none	347
					none	348
	84 76 79 77		66 73 70 69		77 76 75 78	349
					none	350
S	54 56 58 48	62 63 65 58	62 59 65 62	62 64 60 62	65 70 60 65	351
L		55 65 58 63	63 55 64 59	58 59 65 56		352
					none	353
					none	354
					SECOND TO THIRD FLOOR	
					APARTMENTS	
		66 67 63 64				301
			61 65 71 67	72 59 58 63		
		41 48 53 62	51 60 62 67			302
				59 64 65 68		
3L	69 78 72 76	68 74 76 71	72 79 76 71	69 69 70 73	68 72 74 69 m	305
3M	70 71 69 78	68 75 72 76	71 72 73 69	76 69 69 70	69 68 73 71 3	
	94 109 96 98c	84 79 92 94		79 83 86 99	101 97 99 104c	306
		94 76 94 91		90 80 87 89	101 102 95 94c	
	71 86 76 79		72 74 81 85		71 76 82 86	

SECOND TO THIRD FLOOR

SUBJECT CODES	NUMBER RISERS	STEP DIMENSIONS RS	TR	NO	IR	HANDRAIL MEASURES R/L	R/F/L	HT.	IR	ORIENT/ HEADRM	MAJOR MATER	NUMBR MATER	WEAR
DUPLEXES													
307	8	8	10½	1	0	none							
	7	8½	10½	1½	0	none				1/3	var	3	4
309	10	7	11½	1½	2	R	R	32	1				
	6	7	10½	1	0	R	R	32	1		rtr	6	4
314 (3	7	8½	9	1	0	none							
flgts)	5+2	7	9	1	0	none				-/1	var	5	3
315	8	8	10	1½	0	none							
	6	8	10	1½	0	none					var	4	3
316	7	7½	9½	1	0	L	R	23	1				
	7	8	9	1	0	L	R	23	1		pnt	4	4
SINGLE FAMILY													
324	13	8	10	1½	0	none				1/1	var	2	3
328	14	8	9	1½	0	L	R	31	0	1/1	var	2	3
341	15	7½	10	1½	1	L	R	31	0	2/1	pil	1	2
FRONT OUTSIDE (3 or more risers only)													
DUPLEXES													
307	4	7	12	0	0	none					cnc	1	2
	5	7	10½	1	2	L	F	28	0		pnt	2	4
308	4	7	12	0	2	none					cnc	1	4
	6	7	10	1	0	R	L	32	0		pnt	2	4
309	5	6	11	0	2	none					cnc	1	2
	4	6	13	0	0	none					cnc	2	2
311	5	6½	11	0½	1	R	L	32	1		pnt	2	4
313	6	7½	12	0	0	none					cnc	1	3
	6	7½	11½	1	2	R/L	L/L	29/29	0/0		pnt	2	5
314	6	6½	12	0	2	L	R	31	1		cnc	1	3
	6	7½	11½	1½	2	R/L	L/L	32/32	0/0		pnt	2	2
315	3	6½	12	0	2	none					cnc	1	3
	4	8½	11	1	0	R/L	R/R	34/34	0/0		pnt	2	3
318	3	7½	12	0	0	none					cnc	1	1
319	3	6	12	0	0	L	R	21	0		cnc	1	3
SINGLE FAMILY													
321	6	6	12	0	0	none					cnc	1	3
	5	7½	10	0	0	none					cnc	1	3
322	12	7	12	0	2	L	R	36	1		cnc	1	3
	4	8	11½	2½	2	none					pnt	2	3
323	5	7	12	1	2	none					pnt	2	4

SECOND TO THIRD FLOOR

NUM SEV	FRICTION BOT LANDING	FRICTION BOTTOM STEP	FRICTION MIDDLE STEP	FRICTION TOP STEP	FRICTION TOP LANDING	SUBJ. CODES
						DUPLEXES
		68 89 79 83				307
				84 69 81 75		
					none taken	309
		59 65 71 72				314
			68 65 64 68	73 71 68 65		
		64 69 65 67	63 71 67 69			315
				68 72 66 70		
		69 74 63 70		61 67 63 62		316
			63 72 61 64			
						SINGLE FAMILY
	87 83 82 82n	59 52 55 53	52 59 55 62	70 67 63 54	52 57 62 64p	324
		58 59 69 62	69 58 71 66	54 57 59 58		328
					none taken	341
						FRONT OUTSIDE
						DUPLEXES
	98 86 89 94		91 86 92 96		97 91 89 87	307
M		87 76 79 84	79 83 86 77		86 76 81 79	
	89 94 91 90		90 89 93 91		92 91 88 89	308
		72 84 79 81	67 79 69 76	59 76 60 69		
	101 84 93 86		78 85 89 72			309
			83 76 79 87	74 76 76 74		
		62 62 68 66	64 59 64 68		80 64 66 69	311
	78 98 79 86		88 97 79 84		89 96 86 79	313
	88 92 89 91c	59 68 61 64	61 59 67 66		64 68 59 61	
	78 92 77 86	79 91 84 86	84 86 79 91	78 84 86 90	81 92 91 79	314
		69 73 79 81	73 76 84 86	76 71 84 81	81 69 73 86	
	80 82 87 83	84 87 86 86	82 81 87 83	83 87 86 74	87 75 82 81	315
M		88 87 92 89	88 86 78 84		62 56 61 61	
	75 81 88 80		88 79 97 91		88 88 92 88	318
	88 89 92 94		86 88 94 66		91 94 93 97	319
						SINGLE FAMILY
	94 101 99 96		99 100 100 100			321
S,L			96 101 97 98	66 76 68 69p	68 94 79 89m	
S	92 98 94 95		96 97 97 92		94 92 97 98	322
		69 84 72 76	73 78 83 72	79 69 83 74	88 112 94 98m	
		105 103 103 109	85 89 91 75	90 93 91 86	75 65 83 781	323

FRONT OUTSIDE

SUBJECT CODES	NUMBER RISERS	STEP DIMENSIONS RS	TR	NO	IR	HANDRAIL MEASURES R/L	R/F/L	HT.	IR	ORIENT/ HEADRM	MAJOR MATER	NUMBR MATER	WEAR
SINGLE FAMILY, cont.													
324	5	7	12	0	0	none					cnc	1	3
	4	7½	12	0	2	none					cnc	1	3
325	3	6½	13	0	0	R/L	R/R	35/35	0/0		cnc	1	2
326	4	6½	13	0	0	none					cnc	1	1
328	7	6	13	0	2	R	F	36	0		cnc	1	3
	6	6	13	0	0	none					cnc	1	3
	3	6	15	0	1	none					cnc	1	3
329	3	7	12½	0	1	none					cnc	1	3
330	3	8	12	0	2	none					cnc	1	3
	6	7	11	1	0	L	R	34	0		pnt		2
331	3	5	17	1	1	none					brick	2	1
332	6	6	12	0	1	none					cnc	1	3
	4	8	12½	1	1	none					cpt	2	3
335	4	7½	11½	1	1	none					pnt	2	1
336	7	7	12	0	0	none					cnc	1	3
	6	6½	12½	0½	1	none					pnt	2	5
340	3	6	10½	0	2	none					cnc	1	2
341	4	7½	12	0	0	R/L	F/F	28/28	0/0		cnc	1	3
343	3	6½	12	0	2	none					cnc	1	3
BACK OUTSIDE (3 or more risers only)													
DUPLEXES and SINGLE FAMILY													
307	5	7½	10	0	2	R/L	R/R	28/28	0/0		cnc	1	3
	3	6½	12	0	1	R	L	36	0		cnc	1	3
316	4	7½	11½	2	2	none					pnt	3	5
317	3	6½	12	0	2	none					cnc	1	2
323	4	8	11	1½	1	none					pnt	2	4
324	3	9	8½	2	2	none					pnt	2	1
328	6	7	11½	1½	2	R	F	30	0		pnt	2	3
332	4	7	12	0	0	none					cnc	1	3
336	7	8½	14	0	0	L	R	30	0		cnc	1	5
340	3	6½	10	0	0	none					cnc	1	4
341	4	7	11	0	2	none					cnc	1	2
343	3	7½	11	0	1	none					cnc	1	3
349	3	7	12	0	1	L	F	31	0		cnc	1	2

FRONT OUTSIDE

NUM SEV	FRICTION BOT LANDING	FRICTION BOTTOM STEP	FRICTION MIDDLE STEP	FRICTION TOP STEP	FRICTION TOP LANDING	SUBJ. CODES
					SINGLE FAMILY, cont.	
	66 79 83 92 62 63 72 65		69 73 57 87 71 64 76 65		86 74 82 78 57 54 58 70	324
	92 82 87 80		81 83 87 92	86 89 86 74		325
	87 86 92 91	82 82 75 81		65 87 82 82	82 85 89 72	326
		64 94 64 74				328
			64 77 88 75			
				94 76 74 84		
	89 96 91 93		94 99 97 96	88 102 92 96	71 88 78 82	329
					(covered with a wild grape vine)	330
	100 98 97 99m	67 67 63 67	78 78 75 77	69 87 72 82	75 76 78 75	
	94 99 94 98		102 99 97 98		98 94 97 97	331
		85 87 92 88 88 94 91 91	92 92 89 91	71 84 96 84 95 93 95 93	83 91 87 87 88 89 90 87	332
	78 79 84 72c	78 85 69 73	66 68 72 64	65 69 69 72	64 72 63 71m	335
	86 95 88 94	88 93 91 87 65 82 73 79		78 85 81 80 75 78 68 80	79 65 68 78	336
	95 104 99 96		99 97 101 98	102 95 97 98	61 85 78 82m	340
	90 83 89 86		93 88 95 92		94 92 92 94	341
	87 99 98 89		99 93 89 91	96 97 97 97	69 89 72 78m	343
					BACK OUTSIDE	
					DUPLEXES and SINGLE FAMILY	
	79 86 81 84		92 92 96 98		87 102 89 97	307
	91 97 94 98		86 87 89 92		101 84 96 99	314
S,M		77 68 69 75	61 69 64 66		74 71 72 72	316
	79 89 82 87		82 86 79 89	80 79 84 86	89 90 94 94m	317
					none taken	323
		68 62 74 59		74 62 61 48		324
					none taken	328
	90 94 90 92		83 75 82 80	87 81 85 83		332
	92 90 91 86	78 86 79 85		74 89 78 86	79 89 83 85	336
	72 92 78 84		80 89 76 74		90 91 79 83	340
	90 87 90 89		84 89 88 87	75 79 74 76		341
	87 96 89 94	94 96 95 95		87 89 93 96		343
	72 70 82 84			95 87 87 91	78 69 74 80	349

ISOLATED SINGLES AND DOUBLES, OUTSIDE AND INSIDE; MISCELLANEOUS

SUBJECT CODES	LOCA-TION	STEP DIMENSIONS RS	TR	NO	IR	COMMENTS	MAJOR MATER	NUMBR MATER	WEAR
OUTSIDE SINGLES									
304	F	6				Threshold	cnc	3	1
305	F	8				At sidewalk, 90' from bldg.	cnc	1	1
305	balcony	8				Sill of door on 2nd floor	pil	3	1
311	F	7				At sidewalk, 25' from bldg.	cnc	1	4
311	S	8½				Basement landing door	cnc	3	5
317	F	8½				Entrance landing	cnc	3	2
317	F	9				Alternate entrance	cnc	3	2
317	S	7				Basement landing door	cnc	4	2
319	S	5½				Walk to garage	cnc	1	4
320	S	10				Side entrance landing	cnc	3	5
322	S	7½				Basement landing door	cnc	3	3
324	B	10				Threshold	cnc	3	3
325	B	8½				Threshold	cnc	3	2
327	F	2½				Porch step	cnc	3	1
329	S	7½				Back landing	cnc	4	3
333	F	8				Entrance landing	cnc	3	2
333	B	5				Threshold	cnc	3	2
339	F	7				At sidewalk, 20' from bldg.	cnc	1	3
342	F	10½				Entrance landing	cnc	2	3
342	B	4				Basement landing door	cnc	3	2
344	F	7½				Entrance landing	cnc	3	1
344	B	4½				Threshold	cnc	3	1
345	B	4½				Threshold to garage	cnc	3	2
346	B	10				Pie-shaped back landing	cnc	2	1
348	F	9½				Entrance landing	cnc	3	1
348	B	1½				Back landing	cnc	3	1
349	F	5				Entrance landing	cnc	3	1
350	F	9				At sidewalk, 40' from bldg.	lannon	1	2
352	F	7				Entrance landing	cnc	1	3
352	B	4				Back landing	cnc	1	2
OUTSIDE DOUBLES									
303	F	7	12	0	2	Entrance landing	cnc	1	3
303	B	8	12	0	2	Entrance landing (back)	cnc	1	3
308	B	7	11	0	0	Back porch	pnt	3	4
316	B	6	12	0	2	Severe spalling	cnc	1	5
325	F	5½	18	0	0	At sidewalk, 35' from bldg.	cnc	1	2
325	F	5	14	0	0	Entrance landing steps	cnc	2	2
326	B	5½	19½	0	2	Basement landing door	cnc	4	3
327	S	5	12½	0	2	Porch steps	cnc	3	1
330	B	5½	10	0	0	Back landing	cnc	1	4
331	F	6	12	0	0	At sidewalk, 50' from bldg.	cnc	1	3
331	B	5½	15	1½	2	Back porch	pnt	4	4
334	F	6	11½	0	1	At sidewalk, 40' from bldg.	cnc	1	3
337	F	9	12	0	2	Entrance landing	cnc	2	3
337	B	9	11½	0	0	Back porch	cnc	3	2
338	F	7½	12	0	0	Entrance landing	cnc	2	3
338	B	7½	11½	0	0	Entrance landing	cnc	2	3

ISOLATED OUTSIDE AND INSIDE; MISCELLANEOUS

NUM SEV	FRICTION BOT LANDING	FRICTION BOTTOM STEP	FRICTION MIDDLE STEP	FRICTION TOP STEP	FRICTION TOP LANDING	SUBJ. CODES
					OUTSIDE SINGLES	
	90 94 83 87				65 82 58 75n	304
	87 96 89 90				98 99 97 94	305
	72 86 79 82n					305
	63 78 78 75				69 68 75 67	311
	79 72 92 74					311
	87 94 89 92				104 110 94 105m	317
	89 96 94 92				89 99 94 96	317
	97 99 102 94a			88 94 92 89	87 102 91 98m	317
M					74 79 84 79	319
	95 85 76 72				92 84 86 88	320
	89 98 89 96				112 101 99 103m	322
	68 68 76 65					324
	82 84 76 86					325
	92 96 97 87				93 99 90 94m	327
	96 102 97 99a			86 94 89 90	84 104 91 99m	329
	92 87 84 89				78 78 75 77h	333
	75 87 78 62				65 58 62 63	333
	69 80 86 82				85 82 82 79	339
	87 97 90 93					342
	93 104 97 102					342
	84 86 82 92				89 93 84 86	344
	97 100 97 98					344
	92 82 84 78					345
					97 97 87 84	346
	89 95 99 91			84 97 89 91	98 105 99 101m	348
	99 98 94 96				82 94 89 92	348
	82 78 87 76				68 63 68 62	349
62	87 96 105 120					350
	72 96 78 86					352
	72 79 96 84					352
					OUTSIDE DOUBLES	
	82 94 88 92				88 96 99 94	303
	92 99 97 96	91 95 95 91				303
		74 83 76 81			72 79 74 76	308
	78 92 89 84				91 93 82 79	316
	84 85 86 79	91 87 89 92			97 89 89 95	325
	89 89 88 78	88 76 67 78			64 66 62 59ct	325
2M	77 77 88 88					326
	92 99 97 94	88 97 89 93			91 89 89 90	327
	76 92 90 86				95 88 84 89	330
	88 92 79 81	74 72 78 80			79 83 78 92	331
		98 88 102 96m				331
	70 85 74 82	70 75 81 67			78 88 91 75	334
	76 82 88 82	72 88 78 79			71 73 88 78	337
	84 84 87 85m	79 72 75 75			79 72 75 74n	337
	86 88 87 86	92 99 94 98			87 97 89 94	338
	72 89 78 84	92 104 101 93			86 94 87 90	338

ISOLATED SINGLES AND DOUBLES, OUTSIDE AND INSIDE; MISCELLANEOUS

SUBJECT CODES	LOCA-TION	STEP DIMENSIONS RS	TR	NO	IR	COMMENTS	MAJOR MATER	NUMBR MATER	WEAR
OUTSIDE DOUBLES, cont.									
339	F	8	12	0	2	Entrance landing	cnc	2	3
339	B	8	12	0	0	Entrance landing	cnc	2	3
341	F	7	12	0	0	Porch to open patio	cnc	1	3
345	F	6	17	0	2	Entrance landing	cnc	2	3
346	F	8	12½	0	2	Top of sloping walk	cnc	1	1
346	F	7	12	0	0	Right angles to above (346)	cnc	1	1
347	F	6	12	0	2	Settled, tilted step	cnc	3	5
350	F	7	12	0	0	Entrance landing	cnc	1	2
350	B	7½	12	0	0	Back landing	cnc	1	2
351	F	7	12	0	0	Entrance landing	cnc	2	2
351	S	7½	13	0	1	Kitchen to driveway	cnc	2	2
353	F	7½	12	0	0	Entrance landing	cnc	1	2
353	B	7½	12	0	0	Back landing	cnc	1	2
354	F	5	16	0	0	Entrance landing	cnc	1	1
354	B	6	18	0	0	Step 1: Wood slat on gravel	cnc	5	1
INSIDE SINGLES									
323	F	7		1½		LR to screen porch	var	2	4
331	hall	6		1'		Incursion, door, radiator	pil	1	1
331	hall	5½		1		Complex hall system	l/m	2	1
345	B	7		1		Kitchen door threshold	cpt	3	1
INSIDE DOUBLES									
324	LR	5	12	1½	0	LR to sunporch	var	2	1
334	F	7	12	0	0	LR to sunporch	pnt	4	5
348	S	8½	16	0	2	Hall to garage	mat	4	1
MISCELLANEOUS									
305	F	8				Threshold	cnc	4	1
321	F	10				Threshold	pnt	3	4
339	inside					Top landing, 1-2	cpt	1	1
345	F	7½				Threshold	cnc	3	2

NOTE: Other isolated singles and doubles, thresholds and miscellaneous steps having no friction measures or accidents appear only in summary tables.

ISOLATED OUTSIDE AND INSIDE; MISCELLANEOUS

NUM SEV	FRICTION BOT LANDING	FRICTION BOTTOM STEP	FRICTION MIDDLE STEP	FRICTION TOP STEP	FRICTION TOP LANDING	SUBJ. CODES
					OUTSIDE DOUBLES, cont.	
	95 88 88 96	72 84 79 79			84 79 77 76	339
	69 75 77 84	78 78 68 67		67 59 68 58	82 66 67 66m	339
	84 88 92 88	89 91 97 91			93 93 94 96	341
	98 95 97 102	75 72 67 66			87 77 74 78	345
		88 88 88 88				346
	88 87 75 82				76 79 75 78	346
M					none taken	347
	99 96 94 95	96 93 89 88			94 96 88 94	350
	76 77 82 82	69 75 76 80			77 82 78 84	350
	105 110 94 102	95 84 105 99			100 102 94 104	351
	75 82 76 71				75 72 68 79	351
	89 87 92 95	88 82 88 82			75 86 82 86	353
	81 81 77 82	85 84 74 79			87 84 78 68	353
	93 96 99 89	87 89 95 98			102 104 94 96	354
			93 97 84 86		108 110 99 97	354
					INSIDE SINGLES	
					70 72 80 98	323
L	53 48 50 60				65 63 64 64	331
	58 54 43 53				51 57 43 49	331
L	95 92 93 94				68 74 70 72l	345
					INSIDE DOUBLES	
	50 52 50 54ck	47 50 52 45			52 48 40 56	324
	57 60 59 62	60 43 74 63l			73 71 75 73n	334
	95 102 97 100	95 99 96 96			92 97 95 96n	348
					MISCELLANEOUS	
L	86 92 91 88				79 87 82 81m	305
L					none taken	321
					86 82 82 89	339
L					none taken	345

APPENDIX B LIGHTING MEASURES (Explanatory notes at end of table)

	B-1			1-2			OTHER		
	R	T	L	R	T	L	R	T	L
301								2-3	
	-	-	4	3	-	-	-	-	-
	1	-	-	-	-	-	-	-	-
	-	1	-	-	-	8	2	-	1
302								2-3	
	-	-	-	-	-	3	-	-	-
	-	-	-	-	-■	-	-	-	-
	-	-	-	-	-	-	-	-	-
303									
	5	22	4	4	12	5			
	1	-	-	2	1	4			
	-	-	-	8	20	15			
304								B-1(pri)	
	-	-	-				2	-	4
	-	-	-				1	-	3
	-	-	-				-	-	2
305								2-3(pri)	
	-	-	-	1	-	1	-	-■	-
	-	-	-	4	-■	1	-	-	-
	-	-	-	2	1	1	2	-■	-
306								2-3	
	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-
307								2-3	
	-	2	2	2	5	9	1	40	35
	-	-	-	72	-	12	-	-	-
	-	1	1	5	2	5	-	-	-
308								1-3	
	-	1	-				12	17	28
	1	27	13				30	10	20
	3	12	7				1	-	1
309								2-3	
	9	47	7	-	-	-	-	-	-
	5	+	24	30	8	12	13	5	20
	80	51	65	2	3	9	-	4	6
310									
				-	-	2			
				15	2	10			
				2	3	1			
311									
	-	-	-						
	2	5	4						
	-	-	-						

	B-1			1-2			OTHER		
	R	T	L	R	T	L	R	T	L
312									
	-	-	-	35	3	18			
	-	-	-	-	-	-			
	-	-	-	-	-	-			
313									
	1	-	-	1	-	1			
	-	-	-	5	1	4			
	-	-	-	1	-	-			
314								2-3	
	20	2	12	1	4	3	32	40	35
	52	5	10	-	-■	-	-	-	-
	6	5	9	20	42	3	1	4	3
315								2-3	
	-	1	2	2	3	12	-	1	4
	10	2■	3	-	-	-	-	-	-
	-	19	-	-	-	-	-	-	-
316								2-3	
	-	-	-	34	+	14	75	35	4
	5	-	1	30	6	12	-	1	4
	10	32	1	1	11	4	-	-	4
317									
	44	42	11	21	29	8			
	2	47	3	5	3	5			
	2	3	5	16	15	20			
318									
	50	62	15	not taken					
	22	2	12						
	-	1	5						
319									
	6	15	16	7	2	4			
	12	40■	33	1	-■	1			
	-	-	-	5	5	4			
320									
	9	2	5	8	1	10			
	2	2	1	1	-	1			
	-	-	-	4	5	8			
321									
	1	16	2	48	15	6			
	22	53	4	-	-■	2			
	6	6	15	-	-	-			
322									
	4	1	1	-	-	-			
	-	-	2	-	-■	-			
	3	1	-	1	16	3			

	B-1			1-2			OTHER		
	R	T	L	R	T	L	R	T	L
323							single		
	-	-	-	-	-	-	-	3	1
	3	-	-	-	-	-	single		
	-	-	-	-	-	-	8	10	10
324								2-3	
	1	-	1	-	-	-	4	7	3
	-	-■	-	-	-■	-	-	-	-
	-	-	-	-	-	-	-	-	-
325	1	1	2	1	2	2			
	5	-	7	1	-■	3			
	-	-	-	1	1	3			
326	11	5	13	10	5	10			
	2	-	2	6	2	9			
	-	-	-	-	-	-			
327	-	-	-	-	-	-			
	15	8	46	-	-	-			
	11	7	18	-	-	4			
328								2-3	
	-	-	1	4	12	6	-	-	-
	-	-	-	0	1	4	-	-	-
	2	1	3	0	0	0	-	-	-
329	-	-	-						
	-	-	-						
	-	-	-						
330	-	-	-	2	-	2			
	-	1	2	-	-■	-			
	1	1	9	-	-	-			
331							fr.	hall	
	-	-	-	-	-	2	2	2	5
	3	-	9	16	2	1	b.	hall	
	-	-	-	1	-	1	-	-	-
332	+	8	9	9	9	9			
	8	-	4	2	-	1			
	-	-	2	-	1	3			
333	6	1	2	-	-	-			
	-	-	-	-	-	1			
	-	-	-	4	2	3			

	B-1			1-2			OTHER		
	R	T	L	R	T	L	R	T	L
334							den-gar.		
	-	-	-	5	2	5	-	-	-
	-	-■	-	4	-■	3	-	-	-
	2	1	-	2	4	2	-	-	-
335	5	4	8	-	-	-			
	80	80	24	15	1	4			
	13	6	6	1	-	1			
336	4	6	4	3	12	32			
	14	12	■15	-	-■	1			
	2	-	5	-	-	-			
337	-	-	-	-	-	-			
		-■	-	-	-■	-			
	-	-	-	1	-	16			
338	1	-	1	8	27	9			
	15	17	5	16	9	76			
	3	2	3	2	-	1			
339	1	-	-	2	-	1			
	-	-■	-	-	-	-			
	2	-	1	-	-	-			
340	-	-	-	5	2	3			
	-	2	-	-	-	-			
	30	20	19	-	-	-			
341									2-3
	3	-	6	-	-	-	10	1	4
	-	-	-	-	-	-	1	-	1
	1	-	-	-	-	-	-	-	-
342	4	2	5	5	5	9			
	1	-■	1	1	-	1			
	2	1	2	-	-	-			
343	19	37	18	+	11	11			
	4	1	2	22	34	12			
	1	-	2	8	1	4			
344	3	2	3						
	-	-■	-						
	1	-	-						

	B-1			1-2			OTHER		
	R	T	L	R	T	L	R	T	L
							kit-den		
345	-	-	-	3	1	1	14	1	2
	-	-	-	1	-	1			
	-	-	-	-	-	-			
346	-	-	1						
	-	-	-						
	15	2	15						
347	No inside stairways. Light levels on thresholds were all higher than 100 fc.								
							hall-gar.		
348	17	7	6				12	2	2
	1	1	3				-	-	-
	2	1	5				-	-	-
349	-	-	2	1	1	4			
	-	-■	-	-	-	-			
	-	-	-	-	-	-			

	B-1			1-2			OTHER		
	R	T	L	R	T	L	R	T	L
350	7	3	20						
	12	3	10						
	4	1	3						
							back	B-1	
351	1	1	5	2	-	1	50	12	40
	-	-	-	3	1■	9	41	6	20
	-	-	-	4	9	10	30	2	10
352	-	-	-	1	1	4			
	-	-	-	-	-	-			
	-	-	1	-	-	-			
353	6	1	16						
	1	-	1						
	1	-	-						
354	12	5	7						
	2	-	2						
	-	-	-						

EXPLANATORY NOTES

1. All measures are in footcandles of incident light.
2. - = less than 1 footcandle; + = greater than 100 footcandles.
3. Patterns in table are locations of measures as follows:
   (wall = eye level on right or left stairway wall; if no wall, at eye level above handrail)

RIGHT	MIDDLE	LEFT	
wall	landing	wall	TOP
wall	tread/ landing	wall	MIDDLE
wall	tread	wall	BOTTOM

4. ■ = stairway where accident may be a result of lighting.
5. OTHER = 2nd to 3rd; Inside single or double; Miscellaneous.
6. All measures were taken with a direct reading, cosine-corrected light meter with limits of 0-100 footcandles (Weston Model 703-60, type 7).

APPENDIX C

ACCIDENT DESCRIPTIONS AND RELATED INFORMATION

NOTES: In addition to a brief description of the accident or critical incident, selected physical features of the stairway and conditions surrounding the event are noted. Where relevant, personal data such as handicaps or prostheses are presented along with the age and sex of the victim.

These descriptions are essentially clinical notes, providing observations not clearly discernible from the tabular data and statistical analysis. Because of this format, categories of information are not uniformly present in each case.

MAIL SAMPLE

- 4 Respondent, a 61 year old female, fell on B-1 and broke her wrist. She fell from step 2 downward and has no idea of the cause. Medical treatment was required. This is a single family detached home built between 1950-64. The 12 steps are covered with tile/metal nosing.

- 6 Respondent's 25 year old daughter was visiting home and fell on B-1, injuring her arm. Medical treatment was required and daughter lost over a week of work. This straight stairway has 11 steps covered with tile/metal nosing. The house was built between 1950-64.

- 15 Respondent, 55 year old male, says someone in his house trips or falls at least once every two weeks. "Coming down stairs (1-2) you have to reach down to open the door. You lean forward and it throws you off balance." The bottom landing to the door is very short (3¼ in from door to riser). Both B-1 and 1-2 have irregular riser heights. On B-1, the top riser is 4 in and others range from 7½ to 9 in. There is an orientation edge on B-1. Covering on B-1 is linoleum/metal nosing, and on 1-2, varnish. Respondent does not think the stairways need any repairs. He rates them as 75 percent safe. House built between 1950-64.

- 58 Respondent, 35 year old female, has had two recent falls which she believes are due to the narrow steps with winders on 1-2. She lives in a duplex, built before 1940. The 13 steps are covered with linoleum/metal nosing.

- 81 Respondent, 27 year old female, reports that an 18 year old girl in the home caught her foot in a worn rug on 1-2 and fell down part of a stairway with 16 steps. This is a single family home built before 1940. The rug has been changed since then.

  (All other accident events reported on the mail survey forms appear only in the summary tables and in the overall analysis. These descriptions were limited to number of events, flight locations, times and whether accident event involved the respondent or another person.)

TELEPHONE SAMPLE

- 105 Female respondent, age 27, fell when she was pregnant, hit hard on the wall of B-1, and saved herself from falling all the way down. Because she was pregnant, she went to the doctor to make sure she was all right. She was wearing cork platform shoes. In an older accident she fell on the front concrete steps (2 steps + landing) and had multiple scratches and bruises. She did not see her doctor, although she was pregnant this time also. Respondent thinks that pregnancy affects her balance because she has had no other problems with falling. She rates her stairways as 50 percent safe. In reporting her stairway use, she had made 40-50 trips on the day she kept her diary record.

  Comments: The B-1 stairway is enclosed but has no handrails. Covering is rubber treads and varnish. There are winders. The house was built before 1940.

- 122 This 30 year old female recently slipped on her B-1 stairway. Her heel caught on her pants cuff. She caught herself on the handrail and avoided a fall. She was not injured. Her 5 year old boy fell on the front stoop, injured his face and eyes and required emergency medical care. He was running up the step, not paying attention. Respondent said it was a stupid accident, not due to steps.

  Comments: The B-1 stairway is fully carpeted. There is only one step in the outside front of this new town house.

- 132 The respondent, 27 year old female, fell on her front outside wooden steps. She reports that she fell at night. Stairway was slippery and had

no handrail at the time of the accident. Injuries were light.

Comments: Duplex was built before 1940; the inside steps are described as loose, broken and patched. Stairway has six open risers; treads are worn.

- 134 Respondent, female age 40, reports that she has seen two other persons in her family fall on B-1. There were no injuries. Information is incomplete.

- 145 Female respondent, age 26, reports that she slipped on the top ledge of the basement steps. The end of her sandal got caught on the nosing. The top steps are loose and the rubber treads are also loose. This rental house was built in 1950-64.

- 146 Respondent, female age 38, lives in a HUD sponsored, low income attached town house. Within the past year there have been two accidents. Both occurred on 1-2. There is a handrail there but one of the girls, age 15 broke it when she fell down the stairs. She needed medical attention. Another girl, age 18, fell on the same stairway and required first aid. Respondent thinks straight steps with no landing are dangerous even though her stairway is not "slippery."

  Comments: Respondent in this 1965-70 house emphasizes HUD rules about not putting any covering on her varnished stairways. She thinks carpeting would make the stairways safer.

- 149 Female, 37, living in a pre-1940 single family detached home, reports that her son running up the stairway 1-2, missed a step and slipped down several steps. His injuries were light and respondent thinks the accident was probably his fault.

  Comments: The stairs are curved from wear and very dark. There is an orientation edge. There are no hand rails.

- 153 Respondent, female 32, lives in a 1950-64 age town house. Her 3½ year old son fell on stairway 1-2 and required medical attention. She thinks the cause was his inexperience with steps. He was probably hurrying. The stairway is fully carpeted.

- 155 Male respondent, age 25, lives in a pre-1940 single family detached home. His wife, 22, slipped as she was descending from 2 to 1. She wore slipper sox which respondent thinks might have caused the accident. Injuries were light. Accident occurred during the daytime.

  Comments: Stairway has orientation edge. Covering is varnish with carpeting in the middle. Stairway has a landing and a turn, and some irregular riser heights.

- 176 Female respondent, age 75, got to the top of her B-1 shared stairway and fell down most of the 11 steps. She was sore and bruised and went to her doctor for assurance that she hadn't broken anything. She thinks her stairway was not at fault. She gets dizzy spells and she had one when she fell. Apartment was built in 1950-59 period.

  Comments: This stairway has no handrail.

- 186 Female respondent, age 65, reports that her sister fell on the outside front steps (three woode steps) and required first aid. The sister has a history of falling. Respondent feels the steps are clearly marked and lighted, but that sister was inattentive.

- 188 Male respondent, age 32, described accident which happened to a 30 year old female. She stepped on her long pants and fell on stairway 1-2. This is a pre-1940 single family dwelling. The architect-respondent says the house has very steep risers and runs. Injury light.

  Comments: There are winders and 13 steps between 1 and 2. Stairway is fully carpeted.

SITE VISIT SAMPLE

- 302 A resident in the respondent's home, male, age 43, missed 2 steps, lost his balance but was able to keep himself from a full fall. He was carrying a large glass display case at the time. The incident happened on the lower flight of stairway 1-2 as he was descending. He has a severe case of osteomyelitis and uses a cane. Respondent said his behavior was foolhardy for he was balancing the case and waving his cane at the same time. He had been drinking and was "feeling no pain." The accident occurred in the middle of the afternoon.

  A female visitor, age 36, tripped on the top step of 1-2. Her thin high heel shoe caught on the metal nosing. She fell into the window at the

bottom of the upper flight of 1-2. Lacerations required first aid. Her elbow cracked the glass pane. Although she was cut up, everyone in the house was grateful that she was not seriously injured.

Respondent, age 42, describes herself as clumsy and regularly trips both on stairs and "on the flat." She adjusts by walking down stairs with great care. She is not as careful when she walks up the stairs and consequently she often trips on her way up. Respondent, whose family has lived in the house for over 100 years, considers the stairways to be safe (except for the above mentioned window). (Not included in analysis.)

Comment: This old house has been cut up into 4 apartments so respondent does not have full use of all of the stairways in the house. She does not have a history of the stairway accidents but she knows that her immediate family has not had any severe accidents. Lighting on 1-2 while adequate for vision to the dark adapted eye, did not register on the light meter when it was placed on the treads. Only one reading on the wall, at eye level, registered as much as 3 fc.

- 305 Twenty five year old female respondent has had problems with the steps between the top floor and mezzanine of her apartment. Once she pulled a muscle when she lost her balance and fell down part of this flight. She was carrying clothes and feels this contributed to the fall. A second time she went down the whole flight, falling into a large picture which covers the mezzanine wall. The picture was dented, the respondent bruised. On the third occasion, she fell down part of the same stairway, again hitting the picture, this time she hurt her hand. Part of her problem is that she watches TV in the evening, and sleepily walks down to the bedroom or bathroom without turning on the light. She has tripped many other times on various stairways in the building but these are the ones where she was hurt.

  Respondent's 28 year old husband has fallen twice on the flight between the mezannine and living room. He characteristically rushes down and up these stairs, taken two steps at a time. Each time he was shaken up but required no treatment. Both falls were while descending. While carrying a case of beer into the building, he fell at the threshold to the front entrance. The door is heavy and he was trying to balance the beer, with a resulting fall.

  A male visitor, approx. age 32, fell from the mezzanine to main floor of the apartment. He was looking at a new picture displayed on the wall of the living room. He was shaken, no injuries.

  Respondent's female friend, no age given, tripped on the inside apt. stairway (shared apt. stairs) but was not hurt.

  Respondent's husband saw a four year old boy catch himself as he was falling through the open handrails of the same inside shared stairway, 1-2. Child was frightened but not hurt.

  Comments: In addition to living in a home requiring heavy use of stairs for normal household activities (three levels inside apartment and two shared stairways), other features may be relevant. All floors and stairs inside the apartment are covered with a light colored sculptured rug, making the stairs not particularly distinguishable. The lighting doesn't hit the stairway so that the edges of the steps stand out. Respondent's husband is an art director. The apartment looks like a gallery, displaying many large, striking pieces of art. These are attractive but very distracting.

- 307 As he was leaving for work, respondent's husband, age 29, slipped on the outside front wooden steps. It was early in the morning and the day was cold and wet. He was shaken and bruised but required no treatment. He felt that the steps were slippery because they were wet.

  Comments: The five steps on the accident flight have settled, producing many irregularities. Between the first and second steps, there is a 2½ in difference in riser heights. On a single step of this flight, there is as much as a 1 in difference in riser height from the left to the right side. The appearance of these steps is fan-like.

  Respondent considers stairways 100 percent safe, although the steps have irregularities, considerable wear, missing handrails, low head room and other negative features. Moreover, there are four small children living in the home. She can't recall any stairway accidents or even near accidents for them.

- 315 Respondent, age 40, lost her balance and fell down four wooden steps on the front outdoor flight. It was dark, the steps were icy and she was holding a bowling ball. After this fall, she had the porch resurfaced with a sand paint

finish. Since respondent has osteomyelitis, she thinks the fall caused her more pain and inconvenience than might have happened to a healthy person. She usually walks very carefully because she knows she is vulnerable.

Respondent's 15 year old daughter fell down kitchen to back hall landing. The fall involved only a couple of steps but she sprained her ankle. Accident was in the daytime. Respondent is not sure of the cause, but suggests daughter may have been hurrying. There are no handrails on this flight and this may also have contributed.

Comments: Husband is in the process of redecorating and repairing. There are no handrails. Linoleum and metal nosings are worn and it is easy to catch your shoe in the nosing. Despite the fact that there is a door with a window in it, daytime readings on treads did not measure more than 2 fc with the door closed.

- 316 Respondent's neighbor, a 60 year old female who lives in the lower part of this duplex, fell on the back outside stairs, requiring medical care (several treatments). Exact injuries are not known but they lasted several months. Victim normally wears a leg brace, making an added complication both in walking and extent of injury. Accident in descent.

Respondent's 5 year old daughter slipped and hurt her leg, requiring first aid. Daughter has slipped on these steps many times but this one time she got hurt. She is frightened of this stairway because she feels that she might fall when she stands at the top of the stairs. Respondent has told daughter to use another exit. Accident was during descent.

Respondent's mother (now deceased) fell off this same stairway 3 years ago, with only a minor injury. This is not included in the accident summary because of insufficient information.

Respondent feels that a good handrail would solve the problem of this stairway.

Comments: The steps described above not only lack a handrail, but they are warped, have exceedingly sharp edges, and have riser heights varying from 6½ to 8½ in. When the screen door is opened, it sweeps over the whole landing so that a person going up the stairs has to back down them when opening the door. The respondent does not worry about any other stairway they use although they have a variety of problems. The two front concrete steps to the entrance are broken and cracked. One has a 4½ in riser and the other a 7 in riser. The steps in the building have irregular riser heights within a single flight. Lighting levels vary widely on single flights. A string which goes from the rear door to the first landing is used to turn on the hall and basement light. Two bicycles as well as many other objects are stored on both the steps and landings of the stairways. This is not a dilapidated building, rather, it is old and in need of repairs.

- 319 Respondent, female 26, has had three falls. On the middle step of the lower flight of B-1, she caught the toes of her shoes on the metal nosing. She was descending. She was able to balance herself and did not have a complete fall. She was merely shaken.

On 1-2, lower flight, respondent also tripped on metal nosing. This time she caught herself on the handrail and avoided an injury. Again it occurred during descent.

Respondent fell flat on outside single step leading to garage. Abrasions on hand and arm but no serious injury. She wasn't sure why she fell.

Comments: The outside garage step riser is 5 in. on one side and 6 in. on the other to accommodate a walk (cracked because of heaving) which slopes down toward the step.

Respondent claims that she catches her shoes on all of the steps, but the accidents described above occur as she steps off the middle landing and turns to descend on the lower flight (i.e., there is a directional change). On 1-2, the middle landing is broken up into two parts by a single step, so adding to directional change is a change in the vertical height imposed by the single riser. Respondent says most of the incidents of shoes caught in nosing occur during ascent, but the ones described above occurred during descent.

- 321 Respondent, 51 year old female, reported an old accident (at age 46) when she slipped on a stone on the top landing of the stairway leading from the front porch to the sidewalk. She fell down five concrete steps to the middle concrete landing. She required first aid and still has a scar above her ankle. Another time she fell on part of this same stairway but can't remember any details (not included in sample).

Respondent remembers still another incident when she missed a step on the same flight and fell down to the middle landing. She thinks this could have been avoided had there been a handrail. She may have been hurrying. She was shaken but not really hurt.

Respondent put her foot in a box at the top of the stairway between 1 and 2. She fell from 2 to landing. Some factors of interest are: She was not wearing glasses, there was no handrail. She had some soreness and abrasions requiring first aid but no medical care. She felt the effects for a couple of weeks.

Respondent's friend, female, age 54, fell on the deep threshold step at the front entrance. She tripped, hit the rubber mat on the porch at the edge of the step, twisted her ankle, but does not consider injury to be of any consequence. Other people have had trouble with this step.

Comments: The 1-2 stairway is relatively steep and the upper straight section without winders has shallow treads (9 to 9½ in.) and moderate risers (7½ to 9 in.). Light levels vary from 0 to 15 fc so it's very dark walking down into the stairway. The large amount of light at the top is misleading.

On the outside front steps, the lower and upper flights have different aggregates.

Threshold step has 10 in riser and ½ in nosing.

- 322 Respondent, female age 67, described an old accident on her front concrete stairway. When age 40 she fell the complete length (12 steps) of the stairway. She slipped on grass which grew between the concrete sections of the upper landing and fell into a soft spongy area. Respondent was hurrying to get to a friend waiting in a car. She was wearing high heels, it was raining, there was no handrail. She was bruised and felt the effects for a couple of weeks but never consulted a doctor. There is now a very rigid, substantial pipe handrail on one side of the stairway. Note: actual fall was to concrete step, she then rolled to bottom.

  Respondent recently tripped and "partly fell" down winders on lower flight of 1-2, spraining her ankle. This happened during the daytime and respondent doesn't really know how it happened.

  Respondent's 18 month old grandson dropped off near the bottom of winders in the same lower flight of 1-2. She feels the child should have been supervised; it was a case of adult negligence. No injury noted.

  Comments: Orientation edge and low head room are at steps 4-5 of this flight. There are no handrails. Outside concrete steps are now visibly settled to one side so that they tilt. This may help drainage of the steps but it appears to be a dangerous slope for walking up and down the steps. The foot never hits a horizontal plane.

- 323 Respondent's small male child, age 2, cut his head open as a result of stairway accident betwen 1 and 2. He was wearing pajamas with feet when he slipped and fell on a winder four steps from the bottom. He hit a hinge which had previously been used for a gate. Respondent commented on the slipperiness of the sculptured rug covering on the stairway. He as well as others in the family have slipped on this stairway also. The padding under the carpet contributes. The steps are rounded and one's foot tends to slip downward as you descend these steps.

  Comments: The rounded nosing has a large radius of curvature so the descending person's foot actually does not hit a flat surface but, rather, hits a surface sloping slightly downward.

- 324 Respondent, age 26, can remember falling or slipping three times since they moved into their home 3 months prior to interview. She thinks she may be accident prone on stairways as a result of never having lived in a house with many steps. She is always slipping, barely avoiding a major fall. The carpet between 1 and 2 is "slippery" and worn, and it is on this stairway where she usually trips. In each of two falls on this stairway, she was descending. One occurred near the top of the stairway, the other, as she turned on the landing and planned to descend the lower flight of 1-2. In both cases, she slipped a few steps, caught herself on the handrail and avoided a complete fall. She fell on B-1 also, this time close to the bottom of the stairway.

  Respondent's 4 year old son has also taken a few spills since they moved into the house. The worst one occurred on 1-2. The boy tumbled down the lower flight, hit his head but had no noticeable injury.

  Comments: This household consists of two young families who recently moved into the

house. They have been doing extensive renovations and much equipment is visible. Respondent, when home, spends much time going up and down stairs as part of the activities related to remodeling. Light level measures 0 fc on all measures of both B-1 and 1-2. The 1-2 covering is moderately dark with low contrast, which may prevent edges of steps from being seen easily. There is no hand rail on the lower flight of B-1 and there are winders. Moreover, orientation edge and low head room occur on step 1 of this flight.

- 325 Respondent, age 28, was able to remember four separate occasions, two within the last 30 days, when she fell or tripped on her stairs. When she comes home from work, she puts on Scholl's sandals and this may be why she has tripped (her conjecture). Each time she slipped on a different place on the stairway. Two were on the B-1 and two on the 1-2 stairway. She has been shaken, bruised, but considers injuries to be trivial.

  Comments: Stairway between 1 and 2 has an awkward handrail to grab because of the way the newell and rail come together. Stairway has walls on B-1 but there is no handrail. On both stairways, light levels were low (no tread measured over 2 fc) but contrast appears to be adequate. Respondent plans to continue to wear the Scholl sandals.

- 327 Respondent's children, two girls ages 6 and 10, occupy a second floor bedroom as do the other two children in the family. The parents sleep on the first floor. Children describe the congestion on the stairways, especially when they rush downstairs in the morning. It is not unusual for them to bump each other. One week prior to the interview the older child bumped into the younger one's head. They both fell down several steps and had "sore" heads. No serious injury.

  Comments: Stairway has winders from step three through eight, with orientation edge and low head room at step 1. Light levels are very low (0 fc on all treads) but contrast appears sufficient.

- 330 Respondent's son, age 12, fell twice in the nine months they have lived in the house. The carpet between 1 and 2 is completely detached in the middle of the flight, and it moves as you walk on the remaining steps. The first time he tumbled down and hit his head. The second time he skinned his leg. First aid was needed but no medical attention was necessary.

  Respondent has slipped twice on these steps within the past 9 months. Again the problem is related to the loose carpeting.

  Comments: This is a 100-year old house scheduled for demolition. The stairway has apparently been remodeled several times. An opening in the stairwall, looking into the kitchen area, is one such change. Respondent is embarrassed by the condition of the house and assured interviewer that it was not the usual level of housing to which she was accustomed. It is interesting, however, that in nine months, neither she nor her husband made any effort to nail down the stairway carpeting. It was completely detached from several middle steps and was an obvious hazard. The treads all measured 0 fc on the inside stairways and contrast was also relatively low. As a result of the remodeling, there was a 5 in difference in handrail height from top to bottom of the stairway. There was a pair of shoes and a loose throw rug at the bottom of the flight.

- 333 Respondent's 2-year old son fell five steps from the bottom of front inside stairway, 1-2. He cut his head but this was superficial. She feels it was his inexperience with steps and that the stairway is very safe. She was close to him at the time of the incident.

  Respondent slipped on steps between 1-2 recently. There was no injury.

  Comments: Except for low light levels (maximum of 2 fc) there are no features which appear hazardous.

- 334 This 28-year old female respondent was able to enumerate 10 separate accidents on their home stairways—all within the past year. The basic problem reported by the respondent is low head room on B-1 and 1-2, with headroom of 60 in and 62 in on steps 1 and 4 respectively. Although the details of these accidents were not completely spelled out, they follow a pattern. The respondent or her husband hurry up or down the stairs (usually descent is related to accidents) and, forgetting the low ceiling, hit their heads on the overhang. Respondent talked about "sore heads." None of these accidents have required medical attention but "One of these days we're going to get hurt bad." Accidents happen "day or night, lighted or not lighted."

Comments: This is a small house to which a den and garage were added. Nothing seems to fit. Every stairway is awkward, except 1-2. There is no handrail on B-1, the handrail on 1-2 varies in height by 4 in., and riser heights are low (6-7 in. on 1-2). There is a high variability in friction caused by debris on the steps. B-1 and 1-2 steps are painted black with white walls. The step between the den and garage has a partly missing tread and loose riser.

- 336 Respondent, female age 23, has had no recent accidents nor has her husband and child. She recalls four accidents, two on B-1 and two on 1-2. She can't recall the details of these accidents but there were lacerations on two of the occasions. She feels that she probably was running and not watching where she was going. She says the nosing of her 1-2 steps is slippery and a potential hazard. The front porch and steps are so dilapidated that they are blocked off to prevent their use.

  Comments: These two stairways have some irregularities in riser heights. Risers are higher than treads are deep, making a very steep stairway, the steepest encountered in this study (over 45°). B-1 also has no handrail. The house will probably be torn down in the next few years.

- 337 Respondent, female age 53, has never had an accident in her home but recalls that each of her daughters have fallen on their 1-2 stairway. One, age 22, required first aid after falling down the upper part of the stairs. She was hurrying in stocking feet. It was a daytime accident. The second daughter fell at age 12, fell on the lower half of the stairway, hurt herself but there was no serious injury. She was probably hurrying. There is a low headroom point on steps 2 and 3 of B-1. An assessor, not familiar with the house, hit his head on the overhang, something which never happens to respondent or her husband because they are familiar with this. She rates her stairways as 100% safe.

  Comments: Light levels on both stairways is low (0 fc on all treads measured). On B-1, orientation edge and low head room both occur on step 2.

- 339 Respondent, female, age 53, recalls some falls when her children were small but none stand out in her mind. The week prior to the interview she stumbled going up the basement steps. She thinks it was due to wearing slippery soles. She was shaken. She says that "everyone stumbles" on B-1, usually towards the bottom of this straight stairway.

  Comments: Orientation edge occurs at step 2. Low light levels are found on both stairways (0 fc on all treads measured).

- 340 Respondent, age 47, female, described an old accident. She was carrying a sheet down 1-2, stumbled, caught herself and fell again on the last four steps. It was about 4 PM. She was not injured, but was shaken by the experience. She attributes the accident to the sheet which interfered with her view of the stairway. Respondent thinks her stairway is very steep and wishes something could be done about it.

  Comments: Orientation edge is at step 4. There are two handrails, one on either side. A person might look around to see handrails and be distracted. A bannister, part length on one side, ends at a vertical orientation edge. The stairway is not among the steepest encountered in this study. The light level is between 0 and 2 fc for the stairway, but contrast is adequate.

- 342 Respondent, 44-year old female, feels the stairways are very safe but her husband plans to rebuild B-1. The steps are getting wet and rotting as a consequence of water from a shower located at the foot of the basement steps. She has tripped on these steps but caught herself in time. This was a misstep because her hands were full of clothing. She feels it was due to personal carelessness. Slipped on lower flight, B-1.

  Comments: One side of lower flight, B-1, is without a handrail. The shower curtain hanging there is deceptively solid-looking.

- 344 Respondents's 2-year old niece fell down whole flight of B-1. It was evening and the light was not on. The child was not watched. Child was frightened. She hit her head but there was no evidence of any lasting injury. The kitchen step which leads to the upper landing of the B-1 stairway is a problem because visitors don't know it's there. Respondent, age 26, female, has tripped on this step because she makes a habit of jumping from the kitchen to the unused bedroom across the landing (over 2 single steps). The family dog likes to lie on the landing and sometimes they have tripped over it. Respondent's husband has also tripped on this same step but was not injured.

Comments: The top riser of B-1 is awkward. The otherwise straight stairway has one extra riser at the top landing so that a person descending the stairway from the kitchen or the unused bedroom must step down one step, turn 90 degrees and continue down the remaining 11 steps. The landing often has a dog or cat on it. It is level with the back door threshold and that door swings inward over the entire landing, below the kitchen floor level or the bedroom floor opposite. When the door was open, light level at the top jumped off the scale. With the door closed, light levels drop to between 0 and 2 fc.

- 345 Respondent has not fallen but is very careful on stairs because he has a severe arthritis which has partially crippled him. He finds that walking on stairs of any kind is a problem to him. His grandchildren who visit very often have both fallen on stairs. The younger one, 2-year old male, recently tripped on the step between the breezeway and garage. He was bumped and shaken but no lasting injury occurred. The six year old grandaughter has very poor vision and he has observed her falling on all of the stairways as well as on the flat. The one he remembers specifically is a fall from the kitchen to the breezeway.

- 346 When respondent's son was less than a year, he fell about three steps to the bottom of stairway B-1. He acquired first aid but no medical care (laceration on thigh). Respondent, female age 27, has not had an accident on these stairs but she has had her heel stuck on the nosing between steps 3 and 4.

  Comments: Steps 3 and 4 have loose nosing which they plan to fix. There is low head room on step 1 and an orientation edge on step 3. There is no handrail on this flight but there is a partial wall half way up.

- 347 Respondent, female 26, has tripped on her front threshold plus single step a number of times. One month prior to the interview she was holding her four month old baby, fell but managed to hold on to the baby and save herself from injury, although she turned her ankle. Respondent attributes some of the problem to the step itself which is not level. She suggests that since there are no inside steps, she often forgets the steps at the front and back entrances.

  The prefabricated home did not have this step originally. It has separated from the house and is tilted. Vines are growing around it so that it is hard to see. The back riser is high (10").

- 349 A male adult visitor slipped on the middle steps of B-1 but was not hurt. Cause is unknown.

  Comments: There is low head room on step 2 from the bottom of B-1. The middle part of the handrail is loose. Light readings on tread levels are all 0 fc. There is a throw rug and folding door at the top of the stairway. This stairway also has an orientation edge at step 2.

- 350 Respondent, female age 30, has slipped or fallen about five times between basement and first floor over the past year. No medical care or first aid was required.

  Comments: Light level is somewhat low (between 1 and 3 fc on treads). Orientation edge is on step 3 and low head room on step 1.

- 351 Within the past year, respondent, female age 22, fell on 1-2, going up the stairs. She was wearing platform shoes, tried to turn around and change direction and fell. She hurt her knee but didn't see a doctor. Accident is attributed to wearing platform shoes.

  Comments: The padding on the 1-2 stairway is very thick and the pile of the rug is thick, tending to round the nosing. Handrail on this stairway is not even height (2 inch difference in height from top to bottom).

- 352 Respondent, female age 53, occasionally misses the top step and trips. Two times she actually fell, once from B-1 and once from 1-2. She was walking downstairs on both occasions. She attributes these accidents to the wearing of bifocals.

  Comments: Light levels are 0-1 fc on these stairs. There are no other obvious hazards.

APPENDIX D

RESPONDENTS' SUGGESTIONS AND RECOMMENDATIONS FOR IMPROVING STAIRWAY SAFETY

DIRECT QUOTATIONS FROM MAIL SAMPLE

#75 25F SFD OWNER 1940-49[12]
We keep heavy double thickness of carpet at the foot of the basement stairs. I do appreciate the railing around here and would hope to see them all over. I avoid high heels like the plague.

#81 39M SFD OWNER Bef. 1940
No worn carpeting. Keep surfaces dry. Handrails are important.

#84 57F SFD OWNER Bef. 1940
No fences or walls at bottom of stairs. We are going to court about a neighbor putting a fence at the bottom of the outside stairway.

#85 54F SFD OWNER Bef. 1940
Should not have narrow or winding stairways with platform. Should have wide enough tread to accommodate a large foot. No metal strip on stairs. No high wax. Handrailing inside and out. No holes in concrete steps.

#87 67F SFD OWNER 1940-49
If stairs are built wide enough, there shouldn't be any trouble because then they're not so steep looking, especially when coming down. They should not have open steps without a backing.

#88 41F SFD OWNER
What about lighting? You asked the questions about stairways in the dark and I thought about my folks' house that has a light only at the bottom of the stairs. I think this is very dangerous. I think that curving stairs (winding) are always more dangerous than straight ones because they are more unequal in width and it makes them more difficult.

[12]Lists respondent's age, sex; unit type (single family detached or attached: SFD, SFA; duplex: DUP; apartment: APT); tenure; when built.

DIRECT QUOTATIONS FROM TELEPHONE SAMPLE

#111 53F SFD OWNER 1965-70
Just to not keep a loose rug at the top of the steps or keep the floor waxed at the top of the steps.

#112 45F SFD OWNER Bef. 1940
We did something that might sound odd, but it works. We put a different color linoleum on each step leading to the basement, that way every step was very noticeable. I never wax my steps either.

#115 40F SFD OWNER 1950-64
We always use a gate that collapses and pulls open on our basement door so our children don't fall downstairs.

#118 68F DUP OWNER 1950-64
Carpeting is not as safe as rubber mats. Rug at bottom of stairs should be skid resistent.

#119 69M DUP OWNER 1940-49
Handrails are important.

#120 67M SFD OWNER 1950-64
Many people have standard treads and risers on their stairs but then they put on heavy carpeting and padding which cause bunching or lumping. I think this is quite dangerous, especially for elder people. They can stumble and fall very easily.

#123 65F SFD OWNER Bef. 1940
Winders on stairways should be banned. People not familiar with them can very easily step on the narrow part and fall.

#101 41F SFA OWNER 1971-74
We looked at many apartments and town houses that had open risers and while we don't have any small children, consider this type very bad. The openings are large enough for a child to fall through.

#103 48F SFD OWNER 1950-64
I think stairs should be made a proper height and slope. My mother had to have 10 steps replaced outside. It was done by a professional but he made the steps the wrong height and also sloped them so much it's a wonder no one got hurt on them. You know we are all used to lifting our feet a certain height on the stairs and

this was all wrong. The little strips of metal that are put on some of the basement steps are a nuisance and very very dangerous and very easy for a person to catch their heels on them.

#104 39M SFD OWNER 1965-70
I wish they would come up with a standard riser and tread height. Being in the construction business, I see this every day because of decor or some such thing, they change the height of the riser. I find this to be very dangerous, especially for older people cause they are usually used to one height. It's hard for them to not fall when the stair is of a different height.

#107 42F SFD OWNER 1950-64
I think the metal strips some people have on their stairs are dangerous because if they become loose, they can cause you to trip.

#108 31F SFD RENTER 1950-64
I would say that there should always be a handrail at least on one side of the stairwell if not both. I've been places when there was no rail and I thought it was very dangerous. In this house, we now have treads on the basement stairs to improve safety.

#110 41F SFD OWNER 1950-64
Keep the stairs clear of objects that don't belong there. I'm guilty of putting clothes etc. on the stairs until my next trip and know this is bad. We could so easily trip over them.

#126 62M DUP OWNER Bef. 1940
Waxed linoleum is bad. Metal edging is bad. All stairways should be carpeted completely.

#127 52F SFD OWNER 1950-64
I do think that handrails are so important and (also) keep the stairs clear of things.

#128 33F SFD OWNER Bef. 1940
Worn carpeting (should be) removed or replaced. Handrails are important and loose metal strips are dangerous.

#129 54M SFD OWNER Bef. 1940
Width of stairways should be uniform. (They should) be wide enough so both hands could reach either side. Handrails are important. Carpeting should be installed so it won't pull out.

#131 29M SFD OWNER Bef. 1940
Iron railings outside. Handrailings over at least 3 or 4 steps. Replace covering if worn or torn.

#132 27F DUPLEX RENTER Bef. 1940
Handrails are important.

#133 62F DUPLEX OWNER Bef. 1940
Have standard tread. Flat carpeting, no shag. All stairs should have handrails. No linoleum, no metal edging.

#134 40F SFD OWNER 1940-49
I try to tell my children 'walk' instead of 'run' for safety, and to remove anything that might be on steps even if they didn't put it there.

#135 23M SFD RENTER Bef. 1940
Just a little tighter on things that the landlord promises. They should be made to do things that they promise, like he told us he would put up a handrail when we moved in, and he hasn't.

#136 71F DUPLEX OWNER Bef. 1940
Handrailings are important.

#137 57F DUPLEX RENTER Bef. 1940
Should have handrails inside and out.

#138 75F DUPLEX RENTER 1940-49
Handrailings are important.

#139 48M APT RENTER Bef. 1940
Get the landlords to fix the steps but they don't do it unless forced to do it (wood is rotten, steps are crooked).

#140 78F SFD OWNER Bef. 1940
Everybody should have handrails and not too much carpeting on the steps and not worn so you can't catch your heel in it.

#141 50F SFD OWNER Bef. 1940
I do think there should be a railing on all stairways inside and outside.

#142 66M SFD OWNER Bef. 1940
Handrailings are important. Carpeting if it's tacked down good. Rubber treads are good.

143 53F SFD OWNER Bef. 1940
Handrail on both sides (resp. had stroke 2 years ago and is very cautious on stairs).

144 65F SFD OWNER Bef. 1940
No curved stairways. Straight stairways and landings. Need railings on all stairways. Painted stairs are slippery, should have carpeting or rubber treads.

145 26M DUP RENTER 1950-64
Entire stair should be covered with a non-skid tread. Handrails should be on both sides.

146 38F SFA RENTER 1965-70
I think stairs should definitely have landings. They shouldn't have so many straight stairways, just all stairs. They should sort of have them broken up into landings between stairs to break a fall or prevent accidents. I also don't think they should have stairs that come to a point. I love winding stairs but they should be much wider than what they usually are, like if you are going up while someone is coming down, there isn't much room on the step for two, or if you're carrying something, it's hard to not miss the step.

147 58M SFD OWNER Bef. 1940
(Suggest) putting more handrails on stairs. Permanent carpet is better than rubber mats. Mats tear and are dangerous.

149 37F SFD OWNER Bef. 1940
No metal edge—can catch heel. Handrails are important. Uniform width is important. Paint on outside that wouldn't be slippery when wet (is important). All carpeting (should be) tacked down securely or glued.

152 50F SFD OWNER 1950-64
I'm all against carpeted stairs, toward the basement especially. I think they're slippery.

153 32F SFA OWNER 1950-64
Just hang on to the guardrail and walk, don't run.

154 53F SFD OWNER Bef. 1940
Should have same size step (uniform risers).

#157 21F DUPLEX RENTER 1965-70
Handrails important, especially for older people.

#158 41F SFD OWNER Bef. 1940
Mine going to the basement have crooked stairs. The second one from the bottom is straight across and the bottom one is sort of peaky or pointy and then I also have a peaky or pointy one in the center of the stairway. I think instead of the peaky ones, I should have all straight ones, not peaky winding stairs, sort of. I think the steps should be wider—like with the fellows—they have like a size 10 shoe (and) it don't fit on the stairway. Like with mine, it's a size 5 shoe, but some of my son's friends have larger shoes and they don't fit on the step. The tread should be wider (deeper).

#159 25F DUPLEX RENTER 1950-64
Rubber treads (are) bad.

#160 27F DUPLEX OWNER Bef. 1940
I think all stairs should have a handrail. Most old houses don't and I know of friends who have had bad falls because of this. Most old houses (also) have steps that are too narrow.

#161 47F SFD OWNER Bef. 1940
Outside railing on steps can be slippery in winter. Landings on inside steps are easier than straight steps. Rubber stair treads can be bad, and would rather have paint or varnish. Handrails are important at least on one side. Steps should be wide and not too steep. Landings are important. Steps, if ripped can be dangerous.

#162 68F SFD OWNER Bef. 1940
Have railings! Removable railings would be nice for movings. Rubber treads are unsafe. Have steps wide enough and not too steep. Stairs should have a landing, some way.

#164 63F SFD OWNER Bef. 1940
The only thing I can think of is with carpeted stairways. The carpeting around the stair on the edge gets slippery. I don't know if it's because of the type of carpeting I have. It's a smooth nylon with no relief in it. Perhaps a sculptured carpet would be different.

#165 40F APT RENTER Bef. 1940
Stairways should not be too narrow or steep.

#167 55F SFD OWNER Bef. 1940
I just like railings on stairways. Some places don't have any at all.

#170 42F SFD OWNER Bef. 1940
The only thing (is that) handrails are important.

#171 75M SFD OWNER 1950-64
I think everyone should put carpeting on their steps from the first to second floor and cover the entire stairs, not only part of it, so they don't fall. They should also have a handrail on the side.

#173 25M SFD (converted duplex) OWNER Bef. 1940
I've been fixing up the place since we got it and have all kinds of inspectors here and was told it's a law that any place that has 3 steps or more, you gotta have a railing, but yet I can go around here and show you ten places that don't have any. I had to put my railing up in the middle of winter. I'd like to know why do they press the point with only one person and not on ten others? (these were fixed as of 10/15/75)

#174 56F SFA RENTER 1940-49
Carpets are sometimes nailed to the steps too shallow. When they run the carpeting from one step to the next, they don't nail them back far enough and then the steps are too narrow and todays young people have bigger feet. They tend to overbalance and fall.

#176 75F APT RENTER 1950-64
I think all stairways should have railings and also a nice wide platform before you go up the stairs and at the top of the stairs.

#181 72F SFD RENTER AGE: ?
A handrail is so important. I have seen it prevent accidents. It's so easy to slip or stumble and have a bad fall if one isn't using the handrail.

#184 40F SFD RENTER 1950-64
Being in real estate, I'm up and down a lot of stairs and steps. I showed two homes today and the one place the sale of the home did not materialize (was) because th steps were too steep and narrow. The other home had the basement entrance going from the living room. They had bui in shelves for the wall right next to the door that extended out into the stairway. thought, if you were nine months pregnant, why you couldn't even get dow the stairway. Many older people have live in their homes for 20 years or more and say they are selling for health reasons. I feel most of the time their poor health is because of the stairways they have in the home.

#185 85F SFD OWNER Bef. 1940
All stairs should have railings.

#186 65F SFD OWNER Bef. 1940
I really think lighting is a big factor. I live in an older house and I would make the risers shorter and treads wider from fron to back.

#188 32M SFD OWNER Bef. 1940
A lot of the older homes such as this have very steep risers and runs—that should b changed. I don't know how but it should be changed although the new regulations on risers and runs is better. One thing that should not be allowed—this house does not have a handrail on the stairways going to the basement. I think a handrail should be required all over. I don't think the metal nosing strips are too good. It's too easy to catch your foot or heel on them.

#190 41F SFD OWNER 1950-64
I think carpeting on stairs is a must. Being padded, if one should fall, it would be a softer landing.

#193 77F SFD OWNER Bef. 1940
Make sure all stairways have a handrail and check often to make sure the metal strip on the stair isn't raised. Yesterday I caught the toe of my sandal on a part of the strip on the basement stairs and very nearly had a nasty fall. I checked all the rest of the steps, believe me.

#194 28F SFD OWNER Bef. 1940
A lot of people don't have handrails. I know if you sell a home under FHA

regulations that you have to install brand new handrails if they're the least bit rickety—if you want to sell the house. I think the FHA regulations are pretty strict, which is a good thing.

#195 66M SFD OWNER 1950-64
Just that all stairs should have a handrail. The stairs should be wide enough and they should be straight if possible.

#196 35F SFD OWNER 1950-64
Wider stairways and deeper. The tread could be, say, instead of 9 in. they could be like 11 in. Handrails on both sides of the stairway rather than only one.

#197 65M SFD OWNER 1950-64
Risers not too high, windows designed correctly, handrails on both sides of stairs, although residential stairs are usually too narrow for this.

#199 32F SFD OWNER 1971-74
Do away with scatter rugs. I nearly fell when I tripped over one at the basement of my mother's staircase. We have shag carpeting and this isn't good. When we wear those plastic scuffs, they tend to be very slippery on the shag carpeting.

#200 42F SFD OWNER 1950-64
I think one of the biggest things is people leaving junk on them. A stairway is a permanent thing. It's the person using it that makes the hazard and he should exercise the care.

#201 48F SFD OWNER Bef. 1940
Families should have a hook on the basement door and keep it locked as well as closed when there are children around.

#202 76F DUP RENTER 1940-49
Handrailings are important. No linoleum with metal strips. Rugs at bottom of stairs are dangerous.

#205 44F SFD OWNER 1950-64
Perhaps these winding stairs. Some folks have them where they're wide on one side and narrow on the other. I think that could be dangerous.

#206 24F DUP RENTER 1950-64
I think shag carpeting is dangerous on steps because it sticks out and can't tell the end of the steps, especially for children.

DIRECT QUOTATIONS FROM SITE VISIT SAMPLE

#303 72F APT RENTER 1950-64
Older people must walk very carefully, especially on steps. They should not build doors that open into the stairway like we have here.

#305 25F APT RENTER 1965-70
Pile rugs should not be put on stairways. Open railings where children can fall through are bad, so are open risers. Single steps like from a patio door are a hazard.

#307 29F DUP RENTER Bef. 1940
Use rough (textured) paint on porch steps to avoid slipping. Fix broken and loose steps which you find in a lot of old houses.

#308 62F APT RENTER Bef. 1940
Repair steps that are not on firm. Use rubber treads for safety.

#309 61F DUP OWNER Bef. 1940
Narrow stairs are dangerous. In our last house I fell, hit my spine and had a concussion from a fall down the stairs which were winding and very narrow. Also, don't carry large things, like laundry, on winding and turning stairways.

#313 24F DUP RENTER Bef. 1940
Keep carpets on stairways hammered down. Keep lighting fixed so that it always works.

#314 29F DUP OWNER Bef. 1940
I keep a lot of things on my stairways and I suppose I shouldn't do this. The front steps (1-2) are hardly ever used so I store a lot of things on them. Keep stairs in good shape and repair when needed.

#315 40F DUP OWNER Bef. 1940
Put sand in paint for outside porch steps. I walk carefully on steps because I have osteomyelitis and it would be bad for me to fall.

#316 35F DUP RENTER Bef. 1940
Handrails are very important.

#319 26F DUP RENTER 1940-49
Don't use metal strips on stairs, they get loose and people trip on them. Handrails should be on all stairways.

#321 51F SFD OWNER Bef. 1940
Handrails, especially for older people. Deep single steps like at our front door are bad. In some older houses like this, they made them very deep and it's easy to trip on them.

#323 34M SFD OWNER Bef. 1940
Avoid carpeting, especially sculptured rugs. Carpeting is slippery and rubber treads are preferable. Have good lighting on stairways.

#324 26F SFD OWNER Bef. 1940
Replace slippery and worn carpeting. Fix handrails and install when necessary. I have to learn to be careful on stairways because this is the first house we've lived in where there are a lot of stairs.

#326 75M SFD OWNER Bef. 1940
Watch out for ice on outdoor steps. Walk carefully and use the handrails.

#330 44F SFD RENTER Bef. 1940
Fix loose carpeting. Repair all loose steps. Stairways that turn are not as good as straight stairways. Narrow and uneven stairs such as you find in very old (100-year old) houses are a problem.

#331 31F SFD OWNER Bef. 1940
Avoid single steps. Use handrails. Tell children not to run.

#332 59F SFD OWNER Bef. 1940
Keep stairways painted, use handrails.

#334 28F SFD OWNER Bef. 1940
Don't build stairways with a low overhang. Don't put wax on steps. Fix broken and missing steps.

#335 62F SFD OWNER Bef. 1940
This house doesn't have handrails and it is very important to have them. You can't sell a house without them.

#336 23F SFD RENTER Bef. 1940
Watch out for slippery metal nosings. Fix dilapidated steps.

#337 53F SFD OWNER 1950-64
Make ceilings above stairways high enough so people don't bump heads.

#338 48F SFD OWNER 1950-64
Lots of people fix their own stairways, put carpeting on, metal nosings and other things. Stairways should be done by professionals. On my own house and on other properties I own, I keep up repairs and get things done right.

#339 53F SFD OWNER 1950-64
Keep steps dry. Kids come in from the pool in the back yard and get the kitchen floor and the basement steps wet.

#340 47F SFD OWNER 1950-64
Steep stairways are dangerous. Handrails are important and so are throw rugs that don't slide.

#344 26F SFD OWNER 1950-64
Doors opening into stairwells and one or two steps that people don't know are there, can cause accidents.

#346 27F SFD OWNER 1950-64
Repair steps as necessary. Rubber treads are good.

#349 57F SFD OWNER 1940-49
Handrails.

#350 30F SFD OWNER 1950-64
Narrow steps in older houses, no handrails.

#352 53F SFA RENTER 1950-64 (est.)
I'm not allowed to put anything on the stairs, no covering, but would like to carpet the stairs from 1-2 and put rubber-treads on B-1. Still, I don't have any problems on my stairways.

ADDITIONAL TELEPHONE RESPONSES (UNCODED: MAIL FORM NOT RETURNED)

23F DUP RENTER Bef. 1940
Have handrails to hold onto all stairways. Having carpeting, I think, would cut down on slipping and falling on stairs.

32F SFD OWNER Bef. 1940
Stress handrails. I have a thing about going down steps. I have to hang on to a rail and when I have to go down where there is none, I am very uncomfortable. I hate to see steps where there are no risers. They always look to me like they are flimsy and could collapse.

8F SFA OWNER AGE: ?
Have a lock on the basement door high enough that the kids have to use a chair to reach it, to keep them from falling downstairs. Never wax the steps, that makes them too slippery.

7F SFA RENTAL AGE: ?
I do not think they should have open stairs with no wood at the back of the step. They should have some kind of treads on them. Mine that I got here are sort of a plastic tread on the first to second floor, but they are glued down and they keep coming loose all the time from when I scrub them. Water gets under them. They may not be nailed down or taken off, the landlord said, so I have to glue them all the time.

9F DUP OWNER Bef. 1940
They should never have sharp turns and not so high in between steps. Steps should be carpeted. Handrail on all stairways.

5F SFD OWNER Bef. 1940 (Architect's wife)
As long as there are human beings, there is no such thing as safety. People are careless.

9F SFD OWNER 1940-49
Carpeting is best because linoleum is slippery. Keep toys off stairs.

F DUP OWNER Bef. 1940
Old carpeting and carpeting not being tacked down is dangerous. Loose treads are dangerous and leaving objects on stairs are dangerous. Metal strips are bad. Should have railings on all stairs.

5F SFD OWNER Bef. 1940
Be sure there is a handrail. Never have worn carpeting on them.

75F SFD OWNER 1940-49
Handrails are important.

37F SFD OWNER Bef. 1940
Handrails are important.

Retired F SFD RENTER Bef. 1940
All stairs (should) have handrails. Carpeting on outside stairs isn't too good if there is no roof over it. It rains and becomes slippery.

50F SFD OWNER Bef. 1940
I do not like the metal trips on the basement stairs. They tend to loosen although ours are real tight. I have been other places where they have been loose. I would rather have none at all.

75F SFD OWNER Bef. 1940
I think stairway safety whether for outside or inside stairs should be stressed for small children, whether it's in their house or someone elses. Not to run up or down stairs. They are not toys and can be just as dangerous as playground equipment at playgrounds where they have no supervisor.

63M SFD OWNER 1950-64
Have wide treads on the stairs that are wide enough for an adult's foot. Some are so narrow you just about get half of the foot in them.

59F DUP RENTER Bef. 1940
Handrailings are important.

62M SFD OWNER Bef. 1940
I just think that everyone should have a railing on stairways. Some places don't and that's dangerous.

50F SFD OWNER Bef. 1940
Turning stairway is good with a landing. Carpeting is best.

APPENDIX E
INTENDED STAIRWAY REPAIRS

"YES" RESPONSES TO SECTION G: DO YOU THINK THE STAIRWAYS AROUND YOUR BUILDING NEED WORK, OTHER THAN CLEANING, TO MAKE THEM SAFER? IF SO, WHAT NEEDS TO BE DONE? PLEASE ESTIMATE HOW MUCH THIS WORK MIGHT COST.

Add, Fix or Repair Coverings

9 SFD 1950-64 OWNER[13]
Indoor-outdoor carpeting on exterior steps and stoop. Back stoop too high because of settling concrete adjacent to it. Est. cost: $25 for carpeting; ? for back stoop

7 DUP Bef. 1940 RENTER
Carpeting or rubber tile or linoleum. Est. cost: $200

9 SFD Bef. 1940 OWNER
Stair treads or coverings needed. Est. cost: $100-199

9 SFD 1950-64 OWNER
Handrails, treads. Est. cost: $25-50

5 SFD 1940-49 OWNER
Rubber treads. Est. cost: under $25

0 APT Age? RENTER
Metal strips are loose, steps are narrow. Est. cost: $200 or more

08 SFD 1950-64 RENTER
The stairway to the basement should have treads on them. I've never fallen, but our baby sitter went down a couple of them. Est. cost: $25

26 DUP Bef. 1940 OWNER
New coverings. Old ones are getting worn. Est. cost: $200-299

31 SFD Bef. 1940 OWNER
Stairs need new covering. Est. cost: $25-49

139 APT Bef. 1940 RENTER
They should be rebuilt in the back outside. The wood is rotten and they're crooked. Also steps should be checked to basement. Est. cost: $200 or more

145 DUP 1950-64 RENTER
Basement needs rubber treads fixed (loose treads). Stairs on top are loose. Est. cost: $100-199

146 SFA 1965-70 RENTER
On the stairway from the first to second floor it's all straight steps but very dangerous. I would like to put something on them but this is a HUD house and you are restricted with what you can put on it. We can't nail anything down. We're not allowed to put carpeting down. It's not slippery but it's very dangerous. Someone in the household would pay for it, but we have to get permission. Est. cost: $25-49

147 SFD Bef. 1940 OWNER
I'm in the process of pouring more concrete steps to front walk which need repair. I'm doing it myself. Est. cost: $25-49

160 DUP Bef. 1940 OWNER
My husband is going to replace our outside stairs to the second floor during his vacation. They are old and need too much repair so he is going to build new ones. There is no handrail between the second and third floor, and he will do this too. Est. cost: under $100

168 DUP Bef. 1940 OWNER
A new step (stairway) on the front that I'm going to get next year. Est. cost: $200

188 SFD Bef. 1940 OWNER
Outside rear steps—some of the boards are loose. They could be replaced or nailed down. Actually, I think the whole thing will have to be rebuilt one of these years. Est. cost: $50-99 to replace loose boards; $100-199 to rebuild.

197 SFD 1950-64 OWNER
Safety nosings on the basement stairs for more safety. Est. cost: $50

301 APT Bef. 1940 RENTER
Paint steps, fix lighting. Est. cost: $200 or more

[13]Lists unit type; when built; tenure. See Note 12, page 91

307 DUP Bef. 1940 RENTER
Paint outside steps with rough textured paint. Est. cost: Below $25

313 DUP Bef. 1940 RENTER
Pound down loose carpets; fix lighting. Est. cost: about $30

323 SFD Bef. 1940 OWNER
Recarpet stairway from 1-2. Est. cost: $25-50

324 SFD Bef. 1949 OWNER
Recarpet front stairs, 1-2, install handrails, patch outside cement steps. Est. cost: $200 or more

330 SFD Bef. 1949 RENTER
Recover 1-2, resurface from basement to first floor, put handrail on 1-2. Est. cost: ?

333 SFD Bef. 1949 OWNER
Ice control (how to keep ice off front stoop, especially), Est. cost: ?

336 SFD Bef. 1940 OWNER
Front porch needs to be completely redone, including the steps. The inside steps, 1-2, have slippery edges so you slide down if your foot hits it. Should be fixed. Est. cost: $200 or more

335 SFD Bef. 1940 OWNER
Put sand in paint for wooden porch and steps. Put handrails all over inside and outside steps. Don't think it can be sold unless this is done. (Respondent lives alone and would like to sell her house) Est. cost: ?

334 SFD Bef. 1940 OWNER
Back inside step is mostly missing and riser is loose. Est. cost: $25 or under

340 SFD 1950-64 OWNER
The stairway from 1-2 is too steep but maybe nothing can be done about it. If there was a way, it should be fixed. Est. cost: ?

342 SFD 1940-49 OWNER
Repair worn and rotten stairs between basement and first floor. Husband is handy and would put in whole new set of stairs. Est. cost: $50-99

346 SFD 1950-64 OWNER
Add new rubber treads, fix single B-1 step with loose nosing. Est. cost: $50

347 SFD 1940-49 OWNER
Replace front outside step. Est. cost: under $25

REPAIR OR REPLACE STEPS

15 SFD 1950-64 OWNER
Coming down stairs, from 2-1, you have to reach down to open the door and have to lean forward—throws you off balance. Bottom landing to door is very short, 3¼ inches from door to riser. Est. cost: ?

28 DUP 1971-74 RENTER
Eliminate winder where inner steps are too narrow. Est. cost: ?

30 DUP 1950-64 RENTER
Change height of some of the basement steps. Est. cost: ?

38 SFD Bef. 1940 OWNER
Turn step over. Est. cost: $50-99

42 SFD 1950-64 OWNER
Front bricks need straightening, but we use back entrance most of the time. Est. cost: $25-49

47 SFD 1950-64 OWNER
Back outside needs to be redone and protection from weather added. Est. cost: $50-99

50 SFD 1950-64 OWNER
Handrails and treads are needed. Est. cost: $25-49

58 DUP Bef. 1940 RENTER
Steps are narrow on inside (winders). Est. cost: $200 or more

63 APT Age ? RENTER
Basement steps need repair. Broken step between 2-3. Est. cost: $50-99

70 SFD 1950-64 OWNER
Mudjacking or redoing concrete steps. Est. cost: $200 or more

85 SFD Bef. 1940 OWNER
Cellar steps need to be repaired. Son is taking down a house now and will use the lumber. Est. cost: $25 or less

90 SFA 1971-74 OWNER
A gutter to keep water off steps when snow melts. Would cost about $25-50

132 DUP Bef. 1940 RENTER
Handrail needed on outside stairway. Est. cost: $25 or less

194 SFD Bef. 1940 OWNER
A handrail from the back entrance to the back yard. We are planning on putting on an addition to the house, so anything we do now would have to be torn out.

302 APT Bef. 1940 OWNER
Tighten handrails. No cost

314 DUP Bef. 1940 RENTER
Intend to put railings down to the basement. Est. cost: ?

316 DUP Bef. 1940 RENTER
Install handrails outside. Est. cost: ?

349 SFD 1940-49 OWNER
Handrail needed on back steps. Est. cost: $25 or less

LIGHTING

57 SFD Bef. 1940 OWNER
Lighting needed from basement to first floor. Est. cost: $25 or less

310 APT Bef. 1940 RENTER
Lighting and painting. Est. cost: $200 or more

APPENDIX F

MATERIALS ENCOUNTERED SERIALLY FROM BOTTOM TO TOP OF EACH INSIDE STAIRWAY

301 B-1: concrete, linoleum/metal, linoleum, linoleum/metal, linoleum
1-2: linoleum, linoleum/metal, linoleum, linoleum/metal, linoleum
2-3: linoleum, varnish, carpet/plastic sheet

302 B-1: concrete, rubber mat, linoleum/metal, linoleum, tile/metal, tile
1-2: tile, tile/metal, tile, tile/metal, tile, pile carpet, tile
2-3: tile, pile carpet, paint

303 B-1: concrete, linoleum/metal, varnished nosing, linoleum, linoleum/metal, linoleum, rubber mat
1-2: rubber mat, smooth mat, carpet/varnish, varnished nosing, linoleum, carpet/varnish, varnished nosing, throw, linoleum

304 B-1: pile carpet, parquet wood/varnish (inside apt.)
B-1: pile carpet (inside shared stairs)

305 B-1: concrete, vinyl tile, vinyl treads, smooth carpet
1-2: smooth carpet (inside shared stairs)
2-3: pile carpet (inside apt.)

306 B-1: broom concrete, steel/plastic treads, broom concrete, steel/plastic treads, broom concrete
1-2: same as above
2-3: same as above
two steps inside apartment: shag rug

307 B-1: concrete, linoleum/metal, linoleum, linoleum/metal, linoleum
1-2: linoleum, linoleum/metal, linoleum, linoleum/metal, linoleum
2-3: linoleum, linoleum/metal, varnish

308 B-1: linoleum, throw, bare wood, paint, linoleum, varnish, smooth carpet, varnish
1-3: varnish, paint (no access to second level)

309 B-1: concrete, throw, linoleum/metal, linoleum, linoleum/metal, throw, linoleum
1-2: linoleum, linoleum/metal, linoleum, throw, linoleum
2-3: linoleum, rubber treads/varnish, linoleum/metal, linoleum, rubber treads/varnish, bare wood

310 1-2: ceramic tile, throw, smooth carpet/varnish

311 B-1: concrete, linoleum, throw, linoleum, bare wood

312 B-1: concrete, painted linoleum, rubber mat
1-2: painted linoleum, rubber mat, painted linoleum, smooth throw, bare wood

313 B-1: painted concrete, linoleum, paint
1-2: paint, plastic mat, rubber treads, paint, throw, smooth carpet/paint, varnish

314 B-1: concrete, rubber mat, linoleum/metal, linoleum, smooth throw, linoleum, linoleum/metal, linoleum

314 1-2: pile carpet, pile carpet/varnish, varnish throw, pile carpet (front stairway)
1-2: linoleum, smooth throw, varnish, linoleum/metal, linoleum (back)
2-3: linoleum, linoleum/metal, varnish, throw, varnish

315 B-1: concrete, throw, rubber treads/paint, paint, rubber treads/paint, throw, linoleum/metal, throw, linoleum
1-2: linoleum, varnish, smooth throw, linoleum
2-3: linoleum, throw, varnish, bare wood

316 B-1: brick, concrete, linoleum/metal on wood, linoleum, throw, linoleum/metal, linoleum
1-2: linoleum, throw, linoleum/metal, linoleum, throw, linoleum/metal, linoleum
2-3: linoleum, throw, varnish, bare wood

317 B-1: concrete, pile carpet, rubber mat, linoleum/metal, throw, linoleum
1-2: linoleum, throw, throw, smooth carpet, linoleum

318 B-1: concrete, tile/metal, smooth carpet, tile/metal, varnished nosing, smooth carpet

319 B-1: concrete, throw, linoleum/metal, linoleum, throw, smooth carpet
1-2: smooth carpet, linoleum/metal, linoleum,

linoleum/metal, linoleum, linoleum/metal, linoleum

320 B-1: concrete, throw, tile/metal, tile, throw, tile/metal, varnish, throw, tile
1-2: tile, throw, varnish, throw, varnish, throw, varnish

321 B-1: linoleum, tile, varnish, tile/metal, tile, tile/metal, tile
1-2: linoleum, varnish

322 B-1: painted concrete, rubber mat, linoleum/metal, linoleum, rubber mat, linoleum/metal, linoleum
1-2: linoleum, throw, linoleum/metal, varnish, throw, varnish, linoleum

323 B-1: concrete, linoleum/metal, linoleum, linoleum/metal linoleum
1-2: smooth carpet, pile carpet, shag rug,
Hall to back porch: smooth carpet, varnish, paint
Living room to front porch: varnish, linoleum

324 B-1: concrete, throw, linoleum/metal, linoleum, linoleum/metal, linoleum
1-2: pile carpet, pile carpet/varnish, pile carpet, pile carpet/varnish, pile carpet
2-3: pile carpet, painted wood,
living room-sun room: cork tile, varnish

325 B-1: concrete, pile throw, linoleum/metal, linoleum, smooth throw, linoleum/metal, linoleum
1-2: pile carpet

326 B-1: concrete, throw, linoleum/metal, linoleum, linoleum/metal, linoleum
1-2: throw, smooth carpet/paint

327 B-1: concrete, paint, linoleum/metal, linoleum, shag throw, linoleum/metal, tile
1-2: tile, smooth carpet

328 B-1: smooth carpet, varnish, linoleum/metal, linoleum, varnish, linoleum/metal, linoleum
1-2: smooth carpet, shag carpet, smooth carpet
2-3: shag carpet, varnish

329 B-1: painted concrete, linoleum/metal, tile, smooth throw, tile

330 B-1: concrete, painted wood, throw, linoleum
1-2: tile, throw, smooth carpet/paint, smooth carpet

331 B-1: ceramic tile, throw, smooth carpet, tile, tile/metal, throw, tile, pile carpet
1-2: pile carpet
front-back hall: pile carpet
back hall-kitchen: linoleum, linoleum/metal, linoleum

332 B-1: concrete, linoleum/metal, linoleum
1-2: pile carpet

333 B-1: smooth carpet, linoleum/metal, linoleum, smooth carpet
1-2: pile carpet

334 B-1: concrete, paint, paint/metal, linoleum
1-2: pile carpet, throw, paint, smooth carpet,
den-garage: concrete, wood, linoleum, smooth carpet
porch-entry: painted wood, linoleum, bare wood, smooth carpet

335 B-1: painted concrete, linoleum/metal, linoleum, linoleum/metal, linoleum
1-2: linoleum, varnish, linoleum

336 B-1: concrete, plastic mat, concrete, linoleum/metal, linoleum
1-2: linoleum, throw, linoleum/metal, tile

337 B-1: linoleum, throw, varnish/rubber treads, smooth carpet
1-2: pile carpet, varnish, pile carpet

338 B-1: concrete, smooth carpet, linoleum/metal, linoleum, throw, linoleum, linoleum/metal, throw, linoleum
1-2: linoleum, linoleum/metal, linoleum, linoleum/metal, linoleum

339 B-1: concrete, rubber treads/varnish, varnish, smooth throw
1-2: pile carpet, varnish, smooth carpet/varnish

340 B-1: tile, linoleum, pile, plastic mat
1-2: pile throw, pile carpet

341 B-1: tile, tile/metal, tile
1-2: pile carpet
2-3: pile carpet

342 B-1: concrete, stained wood, linoleum/metal, linoleum, smooth carpet, linoleum/metal, linoleum

1-2: pile carpet, varnish (to storage area), pile carpet (to sleeping area)

343 B-1: painted concrete, loose linoleum, rubber treads/varnish, linoleum/metal, linoleum
1-2: pile carpet, varnish, smooth carpet

344 B-1: tile, smooth carpet, varnished edge, linoleum

345 B-1: linoleum, linoleum/metal, linoleum
1-2: linoleum, pile carpet/varnish, pile carpet
kitchen-den: smooth carpet, linoleum

346 B-1: concrete, throw, rubber treads/varnish, pile throw, linoleum

348 B-1: tile, throw, linoleum/metal, smooth carpet/plastic sheet
hall-garage: concrete, fiber mat, rubber mat, throw, linoleum

349 B-1: concrete, linoleum/metal, throw, tile
1-2: varnish, throw, pile carpet/varnish, pile carpet

350 B-1: tile, tile/metal, tile, throw

351 B-1: smooth carpet, pile carpet (front)
B-1: smooth carpet, tile/metal, tile (back)
1-2: pile carpet

352 B-1: concrete, throw, varnish, linoleum, throw, linoleum
1-2: throw, varnish, smooth carpet

353 B-1: smooth carpet, tile/metal, smooth carpet

354 B-1: smooth concrete, bare wood, linoleum/metal, linoleum

EXPLANATORY NOTES

The following abbreviated uses are made:

linoleum/metal = linoleum treads with metal nosings.
carpet/plastic sheet = carpet covered with protective plastic sheet.
tile/metal = asphalt tile treads with metal nosings.
carpet/varnish = varnished wood stairway with carpet down the middle.
throw = loose throw rug; sometimes smooth, sometimes knitted.
rubber treads/varnish = varnished wood stairway with rubber treads nailed to the wood; in middle only.

APPENDIX G

SAMPLE SURVEY FORMS AND LETTERS

Three-day record of stairway use (NBS 1031 C)
Introductory letter to phone interview group
Introductory letter to mail survey group
Long mail survey form (NBS 1031 A)

XPLANATORY NOTES

1. The long mail survey form (NBS 1031 A) is the comprehensive form, lacking only the three-day record of stairway use (NBS 1031 C).

2. The long form was divided into two parts to facilitate data collection for the phone interview group:

   The interview schedule (NBS 1031 F), not included here, was composed of the following sections of the long mail form in this order:

   B, A, D (last half), G (Q1 - Q4), I, J and H.

   The short mail form (NBS 1031 B), not included here, contained the following sections of the long mail form in this order:

   F, C, D (first half), E, G (Q5) and the three-day record.

   The phone interview schedule also included a request for any comments and recommendations on stairway safety.

3. In addition to the questions on the long mail form, the site visit group was asked for their housing preferences, asked to compare four hazards (stairways, tubs and showers, doors and windows), and asked to note activities requiring the use of stairways in their household. They filled out the three-day record of stairway use and physical measures were taken on all stairways of their building. These items are described and summarized elsewhere in this report. Physical measures were recorded on a single sheet at the site (NBS 1031 B).

NBS 1031 C
(6-75)

O.M.B. No. 41-S75044
Approval Expires: March 1976

A 3-Day Record of Your Own Use of Stairways

For the next 3 days, *keep a record of how many times you go up and down your stairways.*
Please follow the instructions below so everyone will count in the same way:

1. Count only the number of times you use stairways that are part of your house or apartment building.
2. Count each time you walk up one floor or level as one use. Going down counts as another use. For example, if you go from the first floor to the second floor and come right back down again, you have used stairways twice.

Day 1

DATE_____

FREQUENCY OF USE

Waking to 10 a.m. _____
10 a.m. to noon _____
Noon to 2 p.m. _____
2 p.m. to 6 p.m. _____
6 p.m. to 10 p.m. _____
10 p.m. to bedtime _____
*Hours away from home this day*_____

Did you *slip or fall at any time?* ☐ Yes ☐ No
Did you see anyone else *slip or fall?* ☐ Yes ☐ No
If yes, *tell what happened and where it happened:*

_____
_____
_____
_____
_____
_____

Day 2

DATE_____

FREQUENCY OF USE

Waking to 10 a.m. _____
10 a.m. to noon _____
Noon to 2 p.m. _____
2 p.m. to 6 p.m. _____
6 p.m. to 10 p.m. _____
10 p.m. to bedtime _____
*Hours away from home this day*_____

Did you *slip or fall at any time?* ☐ Yes ☐ No
Did you see anyone else *slip or fall?* ☐ Yes ☐ No
If yes, *tell what happened and where it happened:*

_____
_____
_____
_____
_____
_____

Day 3

DATE_____

FREQUENCY OF USE

Waking to 10 a.m. _____
10 a.m. to noon _____
Noon to 2 p.m. _____
2 p.m. to 6 p.m. _____
6 p.m. to 10 p.m. _____
10 p.m. to bedtime _____
*Hours away from home this day*_____

Did you *slip or fall at any time?* ☐ Yes ☐ No
Did you see anyone else *slip or fall?* ☐ Yes ☐ No
If yes, *tell what happened and where it happened:*

_____
_____
_____
_____
_____
_____

THANK YOU FOR YOUR COOPERATION—PLEASE MAIL IN THE STAMPED ENVELOPE.

Safety On Stairs

A SURVEY AND INVENTORY CONDUCTED BY CARSON CONSULTANTS, INC., FOR THE U.S. DEPARTMENT OF COMMERCE, NATIONAL BUREAU OF STANDARDS.

This letter is about a survey and inventory of stairways in the Milwaukee area conducted under the auspices of the National Bureau of Standards. The purpose of the study is to help the Bureau establish standards to improve stairway safety. Before they can write standards, they need to know about existing stairways and how people use them.

Most of us do not realize that the stairway is the most unsafe place in our homes. Last year alone, there were about 365,000 injuries requiring treatment in hospital emergency rooms because of stairways, ramps and landings. And this number does not include the many injuries on stairways that were treated in a doctor's office or at home. This report comes from the U.S. Consumer Product Safety Commission, a Federal agency whose purpose it is to make sure our consumer products are safe for us to use.

Our study has several different parts and includes interviews, mail and phone surveys and record keeping of stairway uses. We would like to ask you to participate in a phone interview. In a week or so, an interviewer will be contacting your household. She will ask to speak to a person in the house who is most familiar with activities in your home. She will ask for descriptions of your stairways and their use. A short written form will be sent following the call. It asks for additional stairway information which is more economically collected by mail. The interviewer is a trained person with much experience doing surveys for non-commercial organizations in Milwaukee.

The information that will be asked of you is not of a highly personal kind. In any case, please be assured that your name and the specific information you supply will be held in strict confidence. Nobody outside the study will see any of your answers. The Bureau will use only summary information,

You may want to know how we got your name. The study used a standard selection method and information from the U.S. Census publications and the Milwaukee Street Address Telephone Directory. We have gotten a cross-section of homes to represent the population of Milwaukee County. Since the sample has been carefully chosen, your response is important.

We would like to emphasize that there is no sales or marketing purpose behind this study. We are conducting a purely scientific and engineering study for a branch of the Federal government to help improve stairway safety.

You may keep this sheet for your records. It has our Post Office Box number and telephone number in case you wish to contact us regarding the study.

Thank you for your cooperation.

Florence E. Carson

Florence E. Carson, Pres.

PLEASE TURN OVER

CARSON CONSULTANTS, INC., POST OFFICE BOX 18474, MILWAUKEE, WI 53218, TEL. 354-3080

WHO SHOULD FILL OUT THE SURVEY FORM? We would like the person who knows most about the everyday activities in your home to answer the questions. This will usually be the woman of the house, but another adult who lives in the home may wish to do it.

You can answer all of the main survey questions right now. The last section on p. 4 asks you to keep a record of your actual stairway uses for one full day. As soon as you finish both parts, send the 4-page survey form back to us in the enclosed stamped envelope. NO POSTAGE IS NECESSARY. Keep this letter for your files.

* * * * * * * * * * * * * *

SOME BRIEF INSTRUCTIONS

In answering the questions:

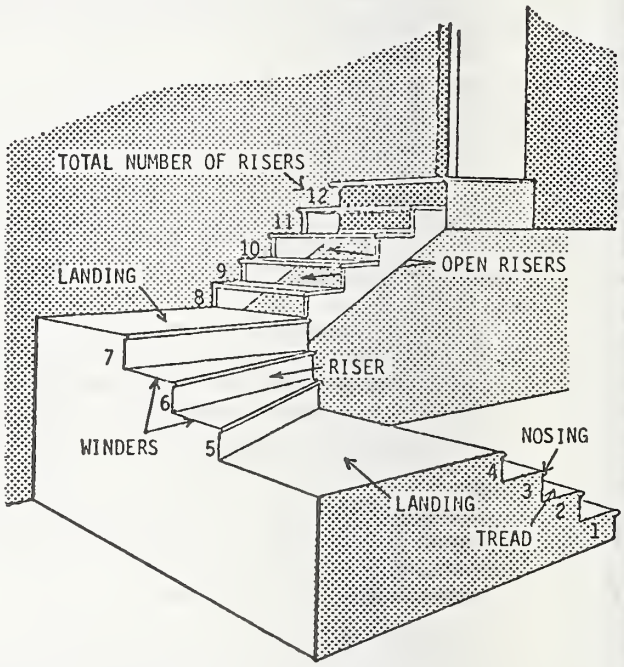
Please note that we use the words "stairs" and "stairway" to mean a set of 3 or more steps in a row.

Include private stairs, such as in a house, and shared stairs, such as in an apartment building.

Include inside stairs and outside stairs, as long as they are a part of the building where you live.

SPECIAL NOTE: If you live in a split level house or another less common house design, consider the stairs between different levels the same as stairs between floors that are found in a conventional house.

PLEASE STUDY THE PICTURE ON THE RIGHT FOR DEFINITIONS OF WORDS AND FOR THE WAY TO COUNT STEPS.



a RISER is the height of one step
a TREAD is the part you step on
a LANDING is a platform larger than a TREAD
a NOSING is the front overhanging edge
an OPEN RISER is one you can see through
a WINDER is a TREAD, wider on one side than the other
TOTAL NUMBER OF STEPS is TOTAL NUMBER OF RISERS BETWEEN TWO LEVELS

* * * * * * * * * * * * * *

Most questions can be answered with one or more check marks (✓). If your answer does not fit into any of the printed choices, use the space marked OTHER to write in your answer. The remaining few questions ask for a number or a word or two only.

Safety On Stairs

A SURVEY AND INVENTORY CONDUCTED BY CARSON CONSULTANTS, INC., FOR THE U.S. DEPARTMENT OF COMMERCE, NATIONAL BUREAU OF STANDARDS.

The enclosed survey form is part of a study for the National Bureau of Standards. The Bureau is trying to establish standards to improve stairway safety. Before they can write standards, they need to know about existing stairways in the United States and how people use them.

Most of us do not realize that the stairway is the most unsafe place in our home. Last year alone, there were about 365,000 injuries requiring treatment in hospital emergency rooms because of stairways, ramps and landings. And this number does not include the many injuries on stairways that were treated in a doctor's office or at home. This report comes from the U.S. Consumer Product Safety Commission, a Federal agency whose purpose it is to make sure that the things we use as consumers are safe.

Milwaukee has been selected for the initial study of stairway safety because it has a wide variety of housing types and a varied population. We used a standard selection method and information from the U.S. Census publications and the Milwaukee City Directory. This has given us a cross section of homes to represent the population in the Milwaukee area. Since the sample has been very carefully chosen, your response is important.

The study you are a part of has several aspects. Much of the information will come from people like you who complete the survey form and return it. A small number of people will be phoned to get other details about stairways. Finally, some people will keep a special record of their own stairway use for a few days.

Please be assured that your name and the specific information you supply will be held in strict confidence. Nobody outside the study will see any of your answers, and the Bureau will use only the summary information.

Please keep this sheet. It has our address in case you wish to contact us about the study. Return only the survey form. No stamps are needed. On the back of this letter are some instructions that will help you answer the questions quickly.

Thank you for your cooperation.

Florence E. Carson

Florence E. Carson, Pres.

PLEASE TURN OVER

CARSON CONSULTANTS, INC., POST OFFICE BOX 18474, MILWAUKEE, WI 53218, TEL. 354-3080

SOME BRIEF NOTES ABOUT STAIRWAYS

The phone interview will be easier and faster if you take a few minutes to study the picture and statements below. You might also take a look at your own stairways to check on their location, design, coverings and state of repair. In answering the questions over the phone, please note:

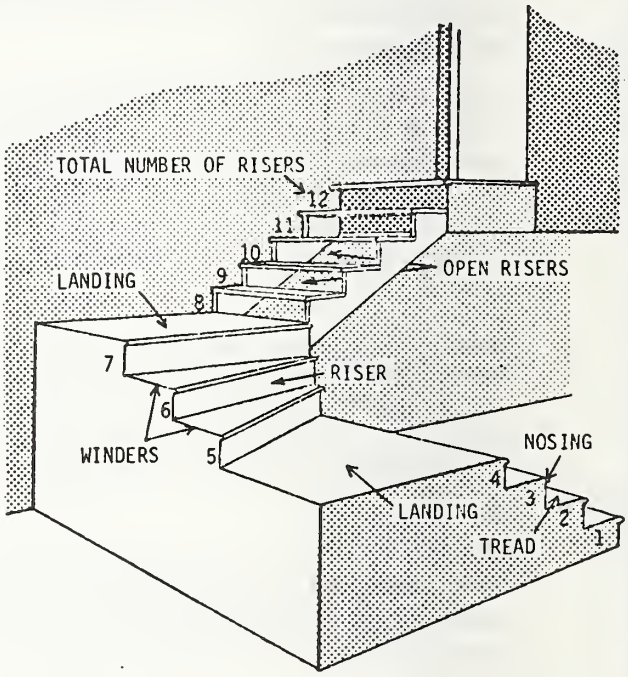
We use the words "stairs" and "stairway" to mean any set of 3 or more steps in a row.

We include private stairs, such as inside a house, and shared stairs, such as in an apartment building.

We include inside stairs and outside stairs, as long as they are part of the building where you live.

In counting steps, you can count risers, as shown in the picture. You can also simply count the number of steps you must take in order to go from one floor to the next floor.

If you live in a split level house or another less common house design, consider the stairs between different levels the same as stairs between floors that are found in a conventional house.



a RISER is the height of one step
a TREAD is the part you step on
a LANDING is a platform larger than a TREAD
a NOSING is the front overhanging edge
an OPEN RISER is one you can see through
a WINDER is a TREAD, wider on one side than the other
TOTAL NUMBER OF STEPS is TOTAL NUMBER OF RISERS BETWEEN TWO LEVELS

NBS 1031 A
(6-75)

O.M.B. No. 41-S75044
Approval Expires: March 1976

Safety On Stairs

A SURVEY AND INVENTORY CONDUCTED BY CARSON CONSULTANTS, INC., FOR THE U.S. DEPARTMENT OF COMMERCE, NATIONAL BUREAU OF STANDARDS.

•Today's Date_____

•Time You Began_____

The information supplied by you on this form will be held in strict confidence. It will be used only for the purposes of this study.

SECTION A

1. *How would you describe the place where you are now living?*
   ☐ Single-family detached house
   ☐ Single-family attached house (like a row or town house)
   ☐ Apartment building (different families on different floors)
   ☐ *Other* (describe)_____

2. *When was it built?*
   ☐ 1971-1974 ☐ 1965-1970 ☐ 1950-1964 ☐ 1940-1949 ☐ Before 1940 ☐ Don't know

3. *Have you lived in your present place* less than 6 months? ☐ Yes ☐ No

4. *Is your place:* ☐ Rented? ☐ Owned or being bought by you?

Answer these questions only if you live in a single-family house (attached or detached).

5. *Check* each *floor that is in your house:*
   ☐ Basement ☐ 1st ☐ 2nd ☐ 3rd
   ☐ *Other*_____

6. *Is your house divided into two or more separate apartments?* ☐ Yes ☐ No
   *If it is, which floors are used by you and members of your household?*_____

Answer these questions only if you live in an apartment building.

7. Total *number of floors in your building* (include basement)_____

8. *Which floor do you live on?* ☐ Basement ☐ 1st ☐ 2nd ☐ 3rd ☐ 4th or above

9. *Is there an elevator?* ☐ Yes ☐ No
   Do you use the elevator regularly? ☐ Yes ☐ No

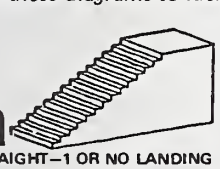
SECTION B

Please give the following information about **people now living in your household:**

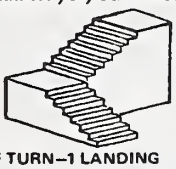
1. **Head of household:** ☐ Self ☐ *Other* (Relationship to you_____)
2. **Yourself:** Sex_____ Age_____ Occupation_____
3. **Husband or Wife:** Age_____ Occupation_____ ☐ Not applicable
4. **All Other People,** *whether related or not related.* (Give sexes and ages only.)
   (AGE / SEX) ___/___ ___/___ ___/___ ___/___ ___/___ ___/___ ___/___ ___/___

SECTION C

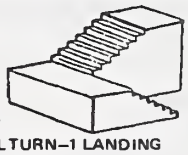
Use these diagrams to identify stairways you have. Only the **style** *is important.*



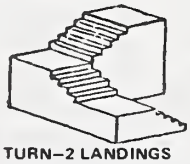
a STRAIGHT—1 OR NO LANDING



b HALF TURN—1 LANDING



c FULL TURN—1 LANDING



d FULL TURN—2 LANDINGS

e NO STAIRWAY

Which of the above diagrams is **closest to the style** *of the stairway you have between the:* (Please circle the appropriate letter.)

1. basement and the first floor? a b c d e
2. first floor and second floor? a b c d e
3. second floor and third floor? a b c d e
4. front door and sidewalk? a b c d e
5. back door and ground level? a b c d e
6. *Other floors*_____ a b c d

PLEASE GO ON TO THE NEXT PAGE

SECTION D

Carefully **count** *the number of steps in each stairway of your house or apartment building that you and members of your household use. Starting on one floor, count the actual number of steps you would take to get to the next floor. Count a landing between floors as only one step, as shown on the instruction sheet. For no steps, write in "none."*

	NUMBER OF STEPS:		NUMBER OF STEPS:
1. Basement to the first floor		4. Front door to sidewalk	
2. First floor to second floor		5. Back door to ground level	
3. Second floor to third floor		6. *Other floors*	

If there are any places with **only one or two steps**, *please give their locations in your house or apartment building:*

_____

_____

Residential stairways may be made of wood, concrete, brick or other materials. Please write in what each stairway of your building is made of. If more than one material is used, write in all materials used.

1. Basement to the first floor		4. Front door to sidewalk	
2. First floor to second floor		5. Back door to ground level	
3. Second floor to third floor		6. *Other floors*	

Please check all materials on the steps of the following inside stairways:

	CARPET FULL WIDTH OF STEP	CARPET DOWN MIDDLE ONLY	PAINT OR VARNISH	RUBBER TREADS	OTHER MATERIALS (*Write in*):
1. Basement to the first floor	☐	☐	☐	☐	
2. First floor to second floor	☐	☐	☐	☐	
3. Second floor to third floor	☐	☐	☐	☐	

SECTION E

Please check **each** *stairway for which the statement is* **true**:

1. *Stairway has a handrail or bannister along the* **full length.**
   ☐ Basement–1st ☐ 1st–2nd ☐ 2nd–3rd ☐ Front outside ☐ Back outside
2. *Some or all steps have* **open risers.**
   ☐ Basement–1st ☐ 1st–2nd ☐ 2nd–3rd ☐ Front outside ☐ Back outside
3. *On these stairs, a person can* **bump into** *a ceiling or projection.*
   ☐ Basement–1st ☐ 1st–2nd ☐ 2nd–3rd ☐ Front outside ☐ Back outside
4. *A child's body can get through the handrailing or bannister.*
   ☐ Basement–1st ☐ 1st–2nd ☐ 2nd–3rd ☐ Front outside ☐ Back outside
5. *You can notice that one or more steps have* **irregular riser heights.**
   ☐ Basement–1st ☐ 1st–2nd ☐ 2nd–3rd ☐ Front outside ☐ Back outside
6. *Going down, you can get a clear view of a room before reaching the bottom step.*
   ☐ Basement–1st ☐ 1st–2nd ☐ 2nd–3rd
7. *Mud, snow or water from the outside is easily tracked on these steps.*
   ☐ Basement–1st ☐ 1st–2nd ☐ 2nd–3rd
8. *The color or shade of this stairway wall is* **much lighter** *than the steps.*
   ☐ Basement–1st ☐ 1st–2nd ☐ 2nd–3rd
9. *This stairway is protected from the weather by a roof, awning or other protection.*
   ☐ Front outside ☐ Back outside
10. *This stairway has one or more* **winders.**
    ☐ Basement–1st ☐ 1st–2nd ☐ 2nd–3rd ☐ Front outside ☐ Back outside

PLEASE GO ON TO THE NEXT PAGE

SECTION F

Please check **each** *stairway for which the statement is* **true**:

1. *Some or most steps are curved from wear.*
   ☐ Basement–1st ☐ 1st–2nd ☐ 2nd–3rd ☐ Front outside ☐ Back outside
2. *Some steps are loose, broken or badly patched.*
   ☐ Basement–1st ☐ 1st–2nd ☐ 2nd–3rd ☐ Front outside ☐ Back outside
3. *Covering on steps is loose, torn or worn.*
   ☐ Basement–1st ☐ 1st–2nd ☐ 2nd–3rd
4. *Handrail is loose, splintered or broken.*
   ☐ Basement–1st ☐ 1st–2nd ☐ 2nd–3rd ☐ Front outside ☐ Back outside
5. *Steps are sometimes slippery.*
   ☐ Basement–1st ☐ 1st–2nd ☐ 2nd–3rd ☐ Front outside ☐ Back outside
6. *Electric light is needed on the stairway during some daylight hours every day.*
   ☐ Basement–1st ☐ 1st–2nd ☐ 2nd–3rd
7. *You face a large mirror or window as you go up or down the stairway.*
   ☐ Basement–1st ☐ 1st–2nd ☐ 2nd–3rd
8. *Lighting on the stairway causes glare on the steps.*
   ☐ Basement–1st ☐ 1st–2nd ☐ 2nd–3rd
9. *A throw rug or piece of furniture is within 3 feet of the stairway.*
   ☐ Basement–1st ☐ 1st–2nd ☐ 2nd–3rd

SECTION G

1. *Do you think the stairways around your building need work, other than cleaning, to make them safer?*
   ☐ Yes ☐ No
   If so, what needs to be done? _____
2. *Who would have to pay for it?* _____
3. *Please estimate how much this work might cost:*
   ☐ Below $25 ☐ $25–$49 ☐ $50–$99 ☐ $100–$199 ☐ $200 or more
4. *Who is responsible for cleaning and clearing your outside stairways?*
   ☐ Someone in your household ☐ Manager or Owner ☐ Homeowners' Group ☐ Paid help
5. *Given the present condition of stairways around your building, rate them for safety:*

☐	☐	☐	☐	☐
Very Unsafe – 0%	25%	50%	75%	100% – **Very Safe**

SECTION H

1. *About what was your* **total family income before taxes** *in 1974?*
   ☐ Under $5,000 ☐ $5,000–$7,499 ☐ $7,500–$9,999 ☐ $10,000–$14,999
   ☐ $15,000–$19,999 ☐ $20,000–$29,999 ☐ $30,000 and above
2. **Owners:** *If you sold your house today, how much do you think you could get for it?*
   ☐ Under $10,000 ☐ $10,000–$19,999 ☐ $20,000–$34,999 ☐ $35,000 and above
3. **Renters:** *What is your monthly rent?*
   ☐ Under $100 ☐ $100–$199 ☐ $200–$299 ☐ $300–$399 ☐ $400 and above
   Which of these is included in your rent? ☐ Water ☐ Gas or Oil ☐ Electricity ☐ None

PLEASE GO ON TO THE NEXT PAGE

SECTION I

Please check **each** *item you do* **a few times each week** *at your house or apartment building:*

1. ☐ Hurry or run on stairways
2. ☐ Use stairways in the dark
3. ☐ Fail to use an available handrail
4. ☐ Stop to talk while on stairways
5. ☐ Leave object on or near stairways
6. ☐ Walk on stairways with bare feet
7. ☐ Walk on stairways in stocking feet
8. ☐ Wear slippers, clogs, high heels or platform shoes
9. ☐ Wear clothing that is long enough to catch on your heels

10. *Do children regularly play on stairways at your house or apartment building?* ☐ Yes ☐ No
11. *Do you use a baby walker or stroller inside your house or apartment building?* ☐ Yes ☐ No

SECTION J

All of us have had minor slips or **near-accidents** *on stairways without actually falling. Some of us have had more serious falls or* **accidents** *on stairways. Try to remember if any of these things happened* **today** *on the stairways of* **your house or apartment building:**

1. *Did* **you** *slip, have to grab a handrail, lose balance, stumble or actually fall on your stairways* **today?** ☐ Yes ☐ No
2. *About how many times did any of these things happen to you?* _____
3. *Were you hurt by any of these events?* ☐ Yes ☐ No
4. *Which stairways were involved?* _____
5. *Did* **you see any other member of your household** *slip, have to grab a handrail, lose balance, stumble or actually fall on your stairways* **today?** ☐ Yes ☐ No
6. *About how many times did you* **see** *these things happen?* _____
7. *Was anyone hurt by any of these events?* ☐ Yes ☐ No ☐ Don't know
8. *Which stairways were involved?* _____

9. *Were there any stairway accidents during the* **past year** *at your present residence that were serious enough to require first aid or medical care?* ☐ Yes ☐ No

   If there were, please give age and sex of each person and the stairways involved:

•Time You Finished_____

SECTION K: One-Day Record of Your Own Use of Stairways

Tomorrow *keep a record of how many times you go up and down your stairways. Please follow the instructions below so everyone will count in the same way:*

1. Count only the number of times you use stairways that are part of your house or apartment building.
2. Count each time you walk up one floor or level as **one use. Going down counts as another use.** For example, if you go from the first floor to the second floor and come right back down again, you have used stairways twice.

DATE_____

FREQUENCY OF USE	
Waking to 10 a.m.	_____
10 a.m. to noon	_____
Noon to 2 p.m.	_____
2 p.m. to 6 p.m.	_____
10 p.m. to bedtime	_____
Hours away from home this day	_____

Did **you** *slip or fall at any time?* ☐ Yes ☐ No

Did you **see anyone else** *slip or fall?* ☐ Yes ☐ No

If **yes,** *tell what happened and where it happened:*

_____
_____
_____
_____
_____
_____

THANK YOU FOR YOUR COOPERATION—PLEASE MAIL IN THE STAMPED ENVELOPE.

APPENDIX H

COMPARISON OF METHODS OF DATA COLLECTION

The study was designed to obtain physical data and respondent information directly from a site visit and to enlarge the data base by mail and phone surveys. This elaborate design was required by the second purpose of the pilot study, which was to compare the efficacy of each data collection method for the study of stairway safety. Where important differences between the methods occur, they are discussed below. This is followed by an overall evaluation of the various parts of the survey and recommendations for its use in any future studies.

Demographic Differences. Some relationships among the three subsamples, the total sample and the Milwaukee County population have already been discussed in section 2.3 of this report. The following demographic differences are important in understanding variations obtained by the three methods:

The site sample has a larger proportion of duplexes and apartments, renters, and respondents in the 20-34 age group.

The mail sample has a larger proportion of high incomes.

The site sample contained more younger people because they were less fearful about allowing the investigators into their homes. There are also more renters in this younger group and they came largely from the duplexes and apartments.

The mail survey required a fairly high literacy level and, since education and income are correlated in the general population, it is expected that this relationship held for this subsample as well.

Response Rate. The mail survey response rate of 32 percent was in keeping with the generally expected low rate of returns for mail surveys. Two additional features contributed to the low responses. The subject of stairway safety does not have a high interest value and the survey form itself requires competence in reading and following directions. The falling off in tract representation occurred in tracts with the lowest educational and economic levels.

The phone interview had the best response rate of the three methods. Because the additional short mail survey was needed to obtain the complete information, there was a loss of 47 cases (completed phone interview but no return of the mail form). These can be considered lost cases although some use of the data is made in the verbatim accounts of respondents in appendix C. Professional interviewers under supervision of an experienced interview supervisor aided greatly in this phase of the study.

The interviewing staff put a great deal of effort into allaying any fears and persuading respondents to allow a site visit. In addition, they made a list of "on the fence" phone respondents and the principal investigators contacted these people in order to reassure them of the value and legitimacy of the study. These efforts, coupled with the introductory letter made it possible to obtain 54 site visits. Two additional cases were obtained when owners of duplexes introduced the investigators to their tenants.

The site visit represented a considerable invasion of privacy in that all portions of the home were entered—basements, attics and sometimes bedrooms—places where people don't even invite their best friends. In addition, respondents were questioned about their stairways and their habits. For these reasons, all physical measures and site interviews were conducted by the principal investigators. Most of the interviews lasted at least an hour and some extended well beyond this time. Many of the respondents had allowed the visit because they did not realize the extensiveness of the measurements. It required stamina, persistence and persuasion in order to keep them in the study.

The paragraphs below discuss the major differences in responses of the three subsamples to the various physical and behavioral measures in the survey.

Configuration. The site subsample had fewer straight stairways and more stairways with a full turn on B-1 and 1-2. The larger representation of duplexes plus apartments accounts for this difference. When configuration is controlled for building type, differences between methods decrease sharply. Some part of the difference may also be due to difficulties in discriminating between configuration styles which have landings, winders and turns. Site respondents were motivated to check their stairways and produced accurate responses.

Number of risers. As in the case of configuration, the larger proportion of apartments and duplexes in the site sample contributed to a small increase in

number of risers reported by this group. When number of risers is controlled for building type, differences between the methods decrease.

Coverings. Site respondents reported more B-1 stairways covered with linoleum and metal nosings, and fewer with rubber treads and paint/varnish. The linoleum/metal nosing response is not one of the printed alternatives, which means that the answer had to be written in the "other" space. Whenever a write in item is used instead of a multiple choice item, response rate to that item is reduced.

Nineteen physical measures. Nine measures out of this group (Mail Survey Form on pp. 114-115) were used in the Hazard Measure for the very reason that the data were stable across the three subsamples. Out of the 11 remaining items, 9 show some differences, particularly between the site sample and the phone and mail groups. Respondents in the site group gave more critical reports on the condition and description of their stairways: more worn/torn, more irregularity, more glare, more mirrors, windows, throw rugs, furniture on or near stairways, mud easier to track in, and fewer open risers and cases where walls are lighter than steps. The last two items were misunderstood by many respondents. The site interview gave an opportunity to clarify them, but they need editing for inclusion in a mail survey.

Habits. More site respondents reported that they hurry on stairways, leave objects, fail to use handrail and overall, check more habits. In general, the site respondents were probably more motivated than the phone and mail groups, because the site visit forced them to take time out and both think and look at the whole subject of stairways. In addition, the site subsample has more younger respondents, and it has already been noted that age and number of habits chosen are correlated.

Frequency of Use. The same reasoning as employed in *Habits* above applies to frequency of use. Age and trips/hour are correlated and the site visit prompted more attention to the diary keeping. Since respondents gave all other responses during the site visit it was necessary to leave the form for trips/hour and get the information later by phone. Mean number of trips/hour were 2.8 for the mail group, 3.2 for the phone group and 3.3 for the site group.

Accidents and Critical Incidents. More accidents and critical incidents came out of the site sample than from either of the other groups. This was due to the probing done during the site visit which elicited greater recall of accidents. It was not unusual for respondents to report at first that they never had any accidents, only to correct this later in the interview. Unless a serious or at least a clear cut injury results from an accident, people have difficulty remembering the accident.

Rationale for combining data of the three subsamples. Site respondents were interested or at least concerned with having someone examine and measure their stairways. As a result, they gave more responses and were more critical of their stairways than were the other two groups. Only a small number of respondents had information about their stairways immediately available to them. More typically, they had to stop and look at their stairways before answering questions about configuration, number of risers, covering and the like. Similarly, on the behavioral measures, they often had to stop and reflect before they could provide an answer. Much of stairway behavior occurs with little conscious awareness of the details.

Despite the greater responsiveness on the part of the site respondents, there was remarkable consistency in the data of all groups that justifies combining them for analysis. Compared to the investigators' more precise site observations and measurements, it is safe to say that the respondent data, no matter what method was used, must be considered as understated, both for the physical and behavioral parts of the survey, but is never contradictory.

General recommendations.

- Reasonable remuneration to residents would be the most effective way to get physical site measurements needed for an inventory.
- The overall number of physical measures gathered from any one residence should be reduced.
- A monitoring approach would be the preferred method for getting an accurate record of stairway use and data on critical incidents and small accidents.
- The greater responsiveness of the site sample does not necessarily suggest that much of the data is best gathered by this method. Alterations and clarifications of individual items would increase their effectiveness so that they could be compiled by either phone or mail methods.

- This pilot study aimed at getting broad coverage of information about stairways and stairway behavior. Reduction in survey scope and greater precision on specific topics would increase response rate and maintain accuracy.

- The mail survey allows respondents more time to think and check answers, hence tends to be more accurate than the phone survey. It is not as cost effective as the phone survey. Average interview cost of the phone survey was 60 percent of the cost of the mail survey.

DETAILED ANALYSIS OF THE MAIL SURVEY FORM

The recommendations presented below are organized by section, and item number within section, as they appear on the mail survey form (pages 113 to 116). Sections for which no changes are recommended are left out of the alphabetical sequence entirely. In some cases, an item from one section is recommended to be connected more closely with an item from another section. In these cases, both items are discussed under the first listed item.

General modifications. An instruction page with nomenclature and definitions should be attached to the survey form so the respondents do not have to refer to a separate sheet.

A space should be provided at the end of the survey form to allow respondents to offer recommendations and suggestions about improving stairway safety. The instruction to this item should suggest broad classes of physical and behavioral variables to the respondent, e.g., structure, sizes, covering materials, lighting, etc., and users' habits, frequency of use, repairs, etc.

Section B. Items B-2 and B-3, pertaining to AGE of respondent and spouse should show categories rather than ask for an exact figure. The following categories are recommended: under 20/20-24/25-29/30-34/35-44/45-54/55-64/65-75/above 75.

Section D. In addition to the present four explicit categories, and the two following categories: "Linoleum or tile," and "Metal nosings."

Section E. Remove item E-1 to a section by itself and reword as follows for each stairway, B-1, 1-2, 2-3, Front and Back outside: "The (basement to first floor) stairway has:

- ☐ a handrail or bannister along the *full length*
- ☐ a handrail or bannister only on the *upper part*
- ☐ a handrail or bannister only on the *lower part*
- ☐ a part or full length handrail on *both sides*
- ☐ no handrail or bannister at all."

Delete items E-2 and E-7 entirely.

Reword item E-3 to read: "On these stairways, the ceiling is low enough for an adult to reach it while standing on one of the lower steps." (B-1, 1-2, 2-3, Front and Back outside)

Add the following item: "On these stairways, the user can *bump into* a projection." (B-1, 1-2, 2-3, Front and Back outside)

Combine items E-8 (contrast) and F-8 (glare) into a separate section by themselves and reword as follows: "Some parts of a stairway may be very bright compared with other parts of the same stairway. This bright spot may be caused by an unshaded light bulb, a window, or very shiny steps, for example, and it is called "glare" when it gets uncomfortably bright. Check which stairways have *glare* in your house:" (B-1, 1-2, 2-3). "Sometimes the stairwalls and the steps have different colors that contrast very much with one another and one returns much more light then the other. Check which stairways have stairwalls that are *much lighter* than the steps:" (B-1, 1-2, 2-3).

Section F. For items F-2, F-3, and F-4, make two items from each present item by separating out "loose" from the other faults, e.g., (F-2) "Some steps are loose on this stairway." and "Some steps are broken or badly patched on this stairway." Retain the same categories of stairways for checking as in present items.

Delete item F-5 entirely.

Section G. For item G-1, provide a checklist of 5-7 potential hazards, and several blanks with "Other (specify)." Retain the present wording. Add a column titled "Approximate cost," e.g.:

"1. Do you . . . safer? If so, what needs to be done?

	Approximate cost:
Handrails _____	$ _____
Coverings _____	$ _____
. . .	
Other (specify) _____	$ _____"

Delete items G-2 and G-3 entirely.

Retain the wording of item G-5, but provide space so the rating may be made for stairways: B-1, 1-2, 2-3, Front and Back outside, separately.

Section I. Provide all items I-1 through I-9 with spaces so number of times per week can be approximated, e.g.: "Please check approximately *how many times each week* you do each of the following things at your house or apartment building:
"1. Hurry or run on stairways ☐ none ☐ 1-2 ☐ 3-5 ☐ over 5."

Section J. For items J-1 and J-5, replace the ☐ No" with "☐ slipped ☐ grabbed the handrail ☐ lost balance ☐ stumbled ☐ actually fell ☐ none of these," to get more specific kinds of information if possible.

Precede item J-9 with two new items of the same form, but dealing with "during the *last week*," and "during the *last month*." These two new items would become items J-9 and J-10. J-9 becomes J-11.

Add a new section for respondents to give their housing preferences. Use the seven categories shown table 38, and word the item as follows: "Ideally, I would like my family to live in a."

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Stairways are commonplace in U.S. homes. Stairway design and construction standards are based on custom, common sense, and experience. Stairways, however, are hazardous. A large number of stairway accidents have been reported, raising questions about the adequacy of stairway design and construction standards. This study is a first attempt to rationalize stairway standards by applying well established statistical methods to a significant sample of stairways and people using them. A pilot study on a sample of 253 residences in Milwaukee County, Wisconsin, was undertaken. The study included a survey of stairway use and behavior and an inventory of residential stairways. This information was obtained from the total sample. In a subsample of 54 residences, direct field observations and physical measurements of stairways were obtained. The results of the pilot study include a description of existing stairways, inferences about interactions that produce accidents, and guidelines which address reasons for accidents (hence should result in a reduction of accidents). The best strategy for making stairways safer, according to the study, is to remove factors that influence accident rates. Specifically, by systematically reducing hazards, careless stairway habits, and frequency of use, patterns of factors responsible for accidents can be broken and accident rates can be reduced.

KEY WORDS *(six to twelve entries; alphabetical order; capitalize only the first letter of the first key word unless a proper name; separated by semicolons)*
Accidents; architectural psychology; consumer products; environmental factors; home safety; occupant behavior; survey technique.

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NOTE: At present the principal publication outlet for these data is the Journal of Physical and Chemical Reference Data (JPCRD) published quarterly for NBS by the American Chemical Society (ACS) and the American Institute of Physics (AIP). Subscriptions, reprints, and supplements available from ACS, 1155 Sixteenth St. N.W., Wash., D.C. 20056.

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