

PROJECT ADMINISTRATION DATA SHEET

ORIGINAL REVISION NO. _____

Project No. D-48-628 DATE 1/28/82
Project Director: Dr. John A. Templer / *JON SANFORD* School/Lab Architecture
Sponsor: Lapeyre Stair, Inc.; New Orleans, LA

Type Agreement: Research Project Agreement dated 1/20/82
Award Period: From 1/20/82 To 2/17/82 (Performance) _____ (Reports) _____
Sponsor Amount: \$3,672 * 2/7/83 Contracted through: _____
Cost Sharing: N/A GTRI/OST _____
Title: Code and Standard Compliance and the Lapeyre Stair

ADMINISTRATIVE DATA

OCA Contact _____

1) Sponsor Technical Contact:
Dale E. Ordoyne
Lapeyre Stair, Inc.
Box 50699
New Orleans, LA 70150
504-733-6000

2) Sponsor Admin/Contractual Matters:
Dale E. Ordoyne
Lapeyre Stair, Inc.
Box 50699
New Orleans, LA 70150
504-733-6000

Defense Priority Rating: N/A

Security Classification: N/A

RESTRICTIONS

See Attached N/A Supplemental Information Sheet for Additional Requirements.

Travel: Foreign travel must have prior approval - Contact OCA in each case. Domestic travel requires sponsor approval where total will exceed greater of \$500 or 125% of approved proposal budget category.

Equipment: Title vests with none proposed

COMMENTS:

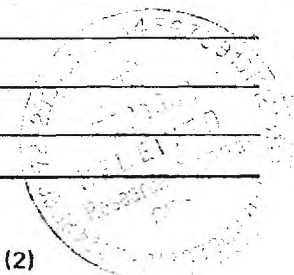
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SPONSORED PROJECT TERMINATION/CLOSEOUT SHEET

58404

Date October 31, 1983

Project No. D-48-628 School/Dept. Architecture

Includes Subproject No.(s) _____

Project Director(s) Dr. John Templar GTRI / ~~ESS~~

Sponsor Lapeyre Stair, Inc.

Title Code and Standard Compliance and the Lapeyre Stair

Effective Completion Date: 2/7/83 (Performance) _____ (Reports)

Grant/Contract Closeout Actions Remaining:

- None
- Final Invoice or Final Fiscal Report
- Closing Documents
- Final Report of Inventions
- Govt. Property Inventory & Related Certificate
- Classified Material Certificate
- Other _____

Continues Project No. _____ Continued by Project No. _____

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OCA-2

GEORGIA INSTITUTE OF TECHNOLOGY
ATLANTA, GEORGIA 30332

COLLEGE OF ARCHITECTURE
RESEARCH PROGRAM
(404) 894-3476

August 19, 1982

Mr. Jay Lapeyre
President
Lapeyre Stair Inc.
P.O. Box 50699
New Orleans, La. 70150

Dear Mr. Lapeyre:

RE: Code and Standard Compliance and the Lapeyre Stair

Contract #D-48-628
Monthly Report July 15 - August 15, 1982

Work began on the latest phase of the Lapeyre Stair research on July 15, 1982.

During this one month period, research activities have focused on these areas:

- 1.) Design and construction of a stair platform to which three stairs will be attached.
- 2.) Analysis of three video tapes supplied by Lapeyre Stair Inc. that show use of the Lapeyre stair at trade shows.
- 3.) Development of a subject inventory for stair testing.

Stair Platform

A wood structure 8 feet tall with a 4'X12' floor area has been erected in the research laboratory. At this time the platform is 85 percent complete with completion due by 8/20.

The platform has been designed to support three stairs simultaneously; two Lapeyre stairs of 68° and 56° and one OSHA code stair of 50°.

Analysis of Video Tapes

Preliminary analysis of three video tapes of people using the Lapeyre stair has shown the tapes to be of limited value. Poor visual quality and lack of a close camera view of the stair make usage of the visual information very difficult.

Therefore, we expect to have to spend several days prior to the "Small Sample Pretest" described in the proposal using the stairs. This usage will give the investigators a preliminary understanding of how the Lapeyre stair is used and whether any safety precautions need to be added prior to the pre-test and later testing.

Development of a Subject Inventory

The researchers have begun to compile a list of possible subjects. Recruitment will be from groups of industrial workers (union and non-union), members of the Georgia Tech staff, students, and others. Each possible subject is being asked to fill out an information and medical history form (draft attached to this packet) that will be used in selecting the final groups of subjects.

Staff Time Involvement

During the first month July 15 - August 15, 1982 the following staff efforts occurred:

James A. Bostrom, Project Director 25% effort July 15 - August 15

Howard Minsk, Graduate Research Assistant 65% effort

Future Research

At this time we are waiting for the arrival of the first Lapeyre stair. Start of the testing phases will be directly affected by when the two Lapeyre stairs (68° and 56°) are delivered. Since we had expected to conduct the majority of the testing this summer, the delay in receiving the Lapeyre stairs is likely to delay completion of the project. The research will be more difficult to conduct once classes begin September 22. Therefore it is important that we receive the stairs as soon as possible. We expect to have activities "B" and "C" under way within ten days of the arrival of the two stairs.

Time

As of August 15, 1981, the research was nearly on schedule. Two factors; one the poor quality of the video tapes of Lapeyre stair use and the other the delay in receiving the Lapeyre stairs may result in an adjustment in the project schedule. This situation will be discussed further in the September report.

Sincerely,

John A. Templer, Ph.D.
Principal Investigator

JAT/mr

PARTICIPANT INFORMATION

We are conducting a study of three industrial stairs to learn more about their safety. As a participant in this study you would be assisting in the development of knowledge that could result in improved industrial and marine stair safety.

We need some preliminary information to decide if you are eligible for the study.

Name: _____

Address: (Home) _____

(Work) _____

Phone: (Home) _____ (Work) _____

Occupation: _____

Income (list general range per month): _____

Age: ____ Sex: ____ Race: ____ Height: _____

Body Weight (approximate if necessary): _____

Are you in generally good health? _____

Will you be in the Atlanta area during the months of September and October? _____

If you participate in this study, it would involve ascending and descending three sets of stairs for approximately six hours of your time during the course of one day. What days and times are you most likely to be available (days of the week, morning/afternoon?)

Do you have transportation or could you get to a test site at Georgia Tech? _____

PERSONAL MEDICAL HISTORY

Who is your medical doctor? _____

When was your last medical checkup? _____

What operations have you had? _____

Have you been in a hospital for any other reason?

Yes _____ No _____

For what? _____

When? _____

Do you have any drug allergies? _____

What medicines are you presently taking?

Have you had:

High blood pressure	_____
Heart trouble	_____
Irregular heart beat	_____
Pneumonia	_____
Asthma	_____
Diabetes	_____
Arthritis	_____

Has anyone in your family had:

Heart attacks	_____
High blood pressure	_____
Stroke	_____
Early death	_____
Cancer	_____
Diabetes	_____
Epilepsy	_____
Obesity	_____

2-40-82

CODE AND STANDARD COMPLIANCE AND THE LAPEYRE STAIR

a report to
LAPEYRE STAIR INC.
P.O. Box 50699
New Orleans, LA 70150

by
John Templer Ph.D.
The Pedestrian Research Laboratory

College of Architecture
Georgia Institute of Technology
Atlanta, GA 30332

May, 1982

The survey of codes, standards and federal regulations that follows has been undertaken to discover the framework of laws that govern the design, installation and use of stairs and ladders. Only national codes and standards are cited. The four national building codes have been examined --- the **Uniform Building Code (UBC)**, **Southern Building Code (SBC)**, **National Building Code (NBC)**, and the **Building Officials and Code Administrators Code (BOCA)**. The primary Fire Code, the **Life Safety Code** of the National Fire Protection Association (NFPA), has been included as has the Occupational Safety and Health Standards of the Occupational Safety and Health Administration (OSHA), and the American National Standards Institute (ANSI) requirements for fixed industrial stairs, and safety requirements for fixed ladders. We have included the **Minimum Property Standards** of the Department of Housing and Urban Development (HUD) because those standards affect a substantial portion of what is built in this country. Also included are the Department of the Navy's **General Specifications for Ship of the U.S. Navy (GENSPEC)** for ladders and handrails. Other departments and agencies of the Department of Defense, employ **Military Standard 14-72 (MS)** for specifications regarding ladders. These design criteria have been included as well as the **Coast Guard Regulations for Shipping (CG)**.

State, city and local authority codes are far too numerous to be included; however, most of these are based on the national codes. The report does not deal with the codes treatment of ambient environmental conditions, such as lighting, headroom, and the number and location of stairs; and the report does not include material on ramps, helical and circular stairs, winders and guard rails, because these topics are not relevant to the design of the Lapeyre Stair. The appendix to this report sets out in tabular form the limitations that the national codes and standards impose in terms of riser height, tread depth, riser/tread ratios, permissible dimensional tolerances, nosings, open risers, flight limits, surface materials, stair widths; handrail locations, design, heights, and clearances to walls; landing spacing and dimensions, etc.

The purpose of the survey is to delineate the prescriptive requirements of the national codes; to compare them to each other; and to test the Lapeyre Stairs' characteristics to the code requirements. By this means it can be demonstrated whether the Lapeyre Stair does, or can, comply with the codes by definition. Therefore, in the discussion that follows, each type of code requirement is set out and the Lapeyre Stair is compared to the codes; and alternative design solutions to bring the stair into code compliance are discussed. In this report, the requirements for ladders have been kept separate from the discussion on stairs because that is the way that they are treated in the codes.

STAIRS

● Flight Length

BOCA, NBC, NFPA, SBC, and UBC limit the total height to be ascended in one flight to twelve feet. HUD restricts the flight to a maximum of 18 risers which translates to between 11.25 ft. and 12.3 ft., depending on the use to which the stair is to be put. The Lapeyre Stair is not designed to exceed 18 feet before the introduction of a landing. To comply with the extant codes, the Lapeyre Stair would have to be limited to twelve feet for these jurisdictions.

- **Maximum Riser Height**

BOCA limits riser height to 7½" for public interior stairs and 8¼" for private interior stairs. UBC & NFPA limit riser heights to 7½" and 8" for public and private interior stairs, respectively. SBC permits a maximum riser height of 7-3/4" while OSHA and ANSI allows any uniform riser/tread combination if the stairway angle lies between 30° and 50° to the horizontal; depending on the tread depth, risers as high as 9½" are acceptable. NBC restricts riser height to 8" for exterior stairs. HUD specifies a maximum riser height of 7-3/4" for public interior stairs, 7½" for exterior stairs and 6" for exterior stairs not attached to the building.

Riser heights of the Lapeyre Stair range from 7.36" to 9.79". Meeting code requirements will depend on the stairs' use. In those cases which the Lapeyre Stair fails to meet these requirements, provisions must be made to minimize riser height.

- **Minimum Riser Height**

UBC designates 4" as the minimum user height while HUD permits a minimum height of 3". These dimensions are satisfied by the Lapeyre Stair in all cases.

- **Minimum Tread Depth**

HUD, NBC and SBC permit a minimum tread depth of 10" for public interior stairs and 9" for private interior stairs. UBC has a minimum dimension of 10" for all stairs. HUD allows an 11" minimum tread for exterior stairs and 12" for exterior stairs not attached to the building. ANSI and OSHA permit any dimension so long as the angle of the stairway lies between 30° and 50°.

The Lapeyre Stair has tread dimensions ranging from 5.36" to 7.13". These measurements fall below the code requirement minimum. To meet these standards, the tread depth of the Lapeyre Stair must be enlarged to meet all code requirements for interior stairs.

- **Riser/Tread Ratios**

BOCA and SBC require riser and tread proportions to conform to the equation $2 \times \text{Riser} + \text{Tread (excluding nosing)} = 24" - 25"$. NBC has established a standard employing the formula $R \times T \text{ (excluding nosing)} = 70" - 75"$. And as noted earlier ANSI and OSHA control riser/tread ratios by controlling the stair angle limits. The Lapeyre Stair does not meet these criteria. To comply with the existing codes, riser dimensions would have to be decreased and/or tread dimensions increased.

- **Nosing**

SBC requires use of nosings with treads less than 10". NFPA also requires nosings for treads less than 10" for interior stairs and 11" for exterior stairs. Nosing projections of 1" are required for the NFPA, SBC and BOCA codes. HUD requires nosing projections of 1-1/8" for closed risers and 1/2" for open risers. OSHA and ANSI requires a nosing projection of 1/2" to 1" with an 'even' leading edge.

These code requirements are met by the Lapeyre Stair.

- **Surface Materials**

HUD, NBC, NFPA, ANSI, and OSHA require slip-resistant flooring material on treads and/or nosings. The Lapeyre Stair utilizes non-skid strips on their treads as well as a rubber bumper on the face of the spine, and therefore meets code requirements.

- **Permissible Dimensional Tolerances**

OSHA and ANSI require uniform riser heights and tread depths throughout any flight of stairs. BOCA permits a maximum variation of 3/16" in the height of adjoining risers. NFPA and NBC have a similar maximum standard, 3/16" for both the depth of treads and in the height of risers. UBC permits a maximum variation of 3/8" in tread widths and riser heights. The Lapeyre Stair has uniform riser heights and tread widths thus meeting the code requirements.

- **Open Risers**

Restrictions on open risers are employed by several building codes. HUD forbids them in housing for the elderly, SBC permits them on exterior stairs only; NBC forbids them altogether while NFPA allows "skirt type" risers with 1" space on exterior stairs only. ANSI requires stairs having treads less than nine-inches wide to have open risers. Because of the Lapeyre Stairs' design, open risers are evident and, therefore, these restrictions will affect the stair. To meet these requirements, open risers will, in some way, have to be eliminated. Open risers, in fact, may be a necessity of the Lapeyre Stair and, therefore, make it impossible for it to comply with these conditions.

- **Stair Width**

HUD, NBC, NFPA, SBC and UBC require a minimum width of 36" for public stairs with less than 50 building occupants. The same codes require a minimum width of 44" for public stairs in building with greater than 50 occupants. BOCA requires a minimum width of 36" for all public stairs while OSHA and ANSI require a minimum width of 22". Private stair minimum width requirements of HUD are 32" while UBC specifies a width of 20" for those private stairs in buildings with less than 10 occupants. The Coast Guard specifies that the stair 'must have sufficient width for access.'

The width of the Lapeyre Stair, including the handrail, measures 23". With the exception of OSHA and ANSI, this is less than the stair code minimum requirements. To meet these standards, the Lapeyre Stair must be widened substantially from the current width of 23" to (say) 36" (for buildings with less than 50 occupants).

- **Handrail Height**

Handrail heights should measure between 30" and 34" for all public interior stairs according to BOCA, NBC, NFPA, OSHA, SBC, and UBC. HUD requires a handrail height of 36". The latter height is measured vertically from the nosing while the other codes are measured 1" back from the leading edge of the tread to the top of the handrail.

The upper rail height of a 10 foot Lapeyre Stair is 44½". This exceeds the maximum height permitted by the codes. In order to comply with these requirements, the handrail height of the Lapeyre Stair must be lowered to at least 34". This figure would satisfy six of the seven handrail height requirements.

- **Minimum Handrail Locations (For stairs less than 44" wide)**

BOCA and UBC require handrails on both sides of public stairs less than 44" wide. For private stairs of the same dimensions, BOCA requires handrails on at least one side if there are no open edges. UBC requires handrails for private stairs with one or two open edges as does SBC for all stairs. OSHA and ANSI require handrails for stairs with one and two open edges and on one side if no open edges exist. ANSI further specifies that handrails shall be provided on at least one side of closed stairways, preferably on the right side descending. HUD calls for handrails on at least one side of the stair if there are no open edges. NBC and NFPA require handrails on both sides regardless of open edges.

The Lapeyre Stair has handrails on both sides, thus meeting the criteria for stairs less than 44" wide. No alterations to the stairs design are necessary to achieve compliance with these code requirements.

- **Handrail Design**

OSHA requires a rounded handrail with a diameter of 2" for hardwood rails and 1½" for metal pipe rails. UBC specifies a diameter of 1¼" to 2".

BOCA, HUD, NBC, NFPA, SBC and UBC require that the handrail be continuous the entire length of the flight. BOCA and HUD also require that the handrail extend 18" beyond the top and bottom user; UBC requires a minimum of 6" extension.

The Lapeyre Stair handrail, with a diameter of 1½", satisfies the standards established by OSHA and UBC, and the others by default. The Lapeyre handrail is continuous but does not extend beyond the bottom riser, thereby failing to meet the standards established by BOCA, HUD, and UBC. To meet these standards, the Lapeyre Stair handrail must be extended beyond the bottom riser. This would require an alteration of the stair's handrail design.

- **Wall Clearance**

NBC, NFPA and UBC require a minimum clearance of 1½" between the handrail and wall. OSHA requires a distance of 3". To meet these particular standards, the distance between the stair and wall would have to be at least 3". This requirement could easily be met by the Lapeyre Stair.

- **Landings**

BOCA, NBC and SBC specify landings should have a minimum length and width equivalent to the width of the stairway in the direction of travel. HUD has no requirement for minimum length of the landing while UBC has none for minimum width. They both require a minimum width and length, respectively, of the landing equivalent to the width of the stairway. NFPA requires a 44" minimum length for the landing in the direction of travel. OSHA and ANSI require a minimum 30" length and a minimum width, again, equal to the width of the stairway.

The Lapeyre Stair may employ landing(s) depending on the use to which the stair is to be put. If landings are to be used, they must be designed to meet the requirements of the various code requirements.

LADDERS

● Step Ladders

Ladder requirements, designated by OSHA¹, are more easily met by the Lapeyre Stair. In this case, the stair could be classified as an industrial stepladder. This type of ladder measures between 3 and 20 feet high and used "for heavy duty" such as utilities, contractors and industry.¹

● Inclined Ladders

GENSPEC defines interior inclined ladders as having an angle of 50° to 60° to the horizontal. According to these specifications and those of CG, exterior inclined ladders have an angle of 50°.

GENSPEC requires the top tread of this ladder to be 9 inches wide while all other treads measure 6 inches wide.² Ladders with a pitch greater than 60° should have treads measuring 4 inches wide.²

The length of a single ladder must not exceed 30 feet as specified by OSHA. The rungs of an individually designed ladder shall be so designed that the foot cannot slide off the end. These OSHA requirements are met by the Lapeyre Stair.

MS requires a tread depth of 6.5 inches with a tread rise of 8.5 inches for inclined ladders. Ladders with a pitch of 60° to 69° should have a tread depth and rise of 4.0 inches and 9.5 inches respectively. Those ladders with a pitch of 70° to 75° should have similar measurements of 3.0 inches and 10.5 inches respectively.³

The Coast Guard requires a minimum width of 28 inches for ladders of this type.⁴ For the Lapeyre Stair to meet the ladder requirements of the Navy and military standard, tread depth must be made smaller and riser height must be enlarged. Handrail diameter must be made from 1/8" to 1/4" smaller to meet the military standard specification. The Lapeyre Stair does comply with both standards of employing nonskid, nonmetallic materials for their ladders.

In regard to minimum width of the ladder, the Lapeyre Stair fails to meet the standard set by the Coast Guard but does conform to the military standard.

● Vertical Ladders

GENSPEC requires 12 inch wide ladder rungs with a diameter of 5/8 inches. Semi-circular foot holes may be used in lieu of ladder rungs where practicable. These foot holes should be not less than 5 inches with edges "smooth and rounded."² This standard is met by the Lapeyre Stair.

ANSI requires 12 inch wide ladder rungs with a diameter of at least 3/4 inch regardless of the material used. The minimum clear width of step-surface for steps and rungs shall be 16 inches. For ladders subject to unusually corrosive atmospheric exposures, one inch rungs are required. For through ladder extensions, the clearance between side rails should fall between 24 and 30 inches.⁵

Vertical ladders are not considered acceptable by the Coast Guard and may be used in extreme circumstances only as a secondary exit. The Navy's General Specifications require that these ladders not interfere with the opening and closing of doors or covers.

The Lapeyre Stair, with an angle of 70° to the horizontal, may not be considered a "vertical ladder". Therefore, these standards are not applicable.

- **Pitch**

OSHA and ANSI "prefer" a fixed ladder having a pitch which falls in the range of 75 to 90 degrees to the horizontal.¹ A ladder falling in the range of 60 to 75 degrees is classified as "substandard pitch" and should be avoided if possible.¹ The Lapeyre Stair, having a pitch of 70° , would fall in this latter range.

MS requires ladders be used when the desired rise from the horizontal is 75° to 90° . Stairways should be used when the desired rise from the horizontal is 50° or less. Stair ladders, from 50° to 75° , may be used if access cannot be provided by other feasible means.³ Again, the Lapeyre Stair would fall into this final category.

REFERENCES

1. Occupational Safety and Health Standards, Subpart D-Walking-Working Surfaces, Code of Federal Regulations, Title 29, Chapter XVII, Part 1910, 1981.
2. Department of the Navy, Naval Sea Systems Command, General Specifications for Ships of the U.S. Navy, Section 622, 1981.
3. Department of Defense, Human Engineering Design Criteria for Military Systems, Equipment and Facilities, Military Standard 14-72 (9104-1816), 1968.
4. Coast Guard Regulations for Shipping, Code of Federal Regulations, Title 46, Subpart 92.10, 1981.
5. American National Standards Institute, Safety Requirements for Fixed Ladders, ANSI A14.3-1974, 1974.

The following tables represent a compilation of eight National Codes with respect to their requirements for stairs and ramps.

The codes cited include:

- *The BOCA Basic Building Code, 1978, Building Officials and Code Administrators International, Inc., Chicago, Illinois.
- *Minimum Property Standards for Multi-Family Housing, 1976 (latest revision) U. S. Department of Housing and Urban Development, Federal Housing Administration, Washington, D. C.
- National Building Code, 1976, American Insurance.
- **Code for Safety to Life from Fire in Buildings and Structures, NFPA, 101, 1976, National Fire Protection Association.
- ***Occupational Safety and Health Standards, Subpart D - Walking-Working Surfaces, Code of Federal Regulations, Title 29, Chapter XVII, Part 1910, 1978 (latest revision).
- ****Southern Building Code, 1976, Southern Building Code Congress International, Inc., Birmingham, Alabama.
- Uniform Building Code, 1979, International Conference of Building Officials.
- USA Standard - Requirements for Fixed Industrial Stairs, American National Standards Institute, Inc., New York, New York, 1968.

The tables have been broken down into three major categories: Stairs, Ramps, and illumination. Within each heading are several smaller headings and specifications for each. Every code is represented in every category. If the code is not listed, or a blank appears next to the code, no specification was made for that category.

- * - with 1979 revisions
- ** - with 1978 revisions
- *** - with 1981 revisions
- **** - with 1980 revisions

STAIRS

Risers and Treads (Straight Flights)

Category	Public/ Private	Interior	Exterior	Exterior not attached to building	Code	
Riser* Maximum	Public	7-1/2"			BOCA	
	Private	8-1/4"				
	Public	7-3/4"	7-1/2"	6" (Minimum 3")	HUD	
	Private	8-1/4"				
	Housing/ Elderly	7-1/2"				
				8"	8"	NBC
	Class A Class B	7-1/2" 8"				NFPA
	Stairway at angle to horizontal of 30°-50°. Any uniform riser/tread combination acceptable if flight results between these angles.				OSHA ANSI	
		7-3/4"			SBC	
	Public	7-1/2" (min. 4")			UBC	
Tread * Minimum (excluding nosing)	Public	10"			BOCA	
	Private	9"				
	Public	9"	11"	12"	HUD	
	Private	9"				
			9"			NBC
	Class A Class B	10" 9"				NFPA
		(See Riser Maximum Specifications) treads 9" requires open riser				OSHA ANSI
			9"			SBC
		10"			UBC	

* Minimum riser and tread maximum dimensions must comply with riser/tread proportion formulas. BOCA, NBS, SBC

Risers and Treads (continued)

Category	No Variation	Tolerance within 3/16"	Tolerance within 3/8"	Code
Continuity Requirements Acceptable variation in tread depth or riser height		X		BOCA
	X			HUD
			X	NBC
			X	NFPA
	X			OSHA ANSI
	X			SBC
			X ¹	UBC
Riser/Tread Proportions	2R + T (excl. nosing) = 24" - 25"			BOCA
	R + T (excl. nosing) = 70" - 75"			NBC
	2R + T (excl. nosing) = 24" - 25"			SBC
	R + T (excl. nosing) = 17-1/2"			ANSI
Nosings	Closed/ Open Risers	Required Use of Nosings	Required Width of Nosings	Code
	Closed		1-1/8"	HUD
	Open		1/2"	
		Treads less than 10" (interior); 11" (exterior)	1"	NFPA
			1/2" - 1" with even leading edge	OSHA ANSI
	Open (straight flight)		1"	SBC
	Closed	Treads less than 10"	1"	
			1"	BOCA

Risers and Treads (continued)

Open Risers	Locations Restrictions	Code
	Not in housing for elderly.	HUD
	None on interior or exterior stairs.	NBC
	Skirt Type risers with 1" space for drainage permitted on exterior stairs.	NFPA
	Permitted on exterior stairs.	SBC

Length of Flights	Maximum vertical height	Maximum number of risers/flight	Minimum number of risers/flight	Code
	12'			BOCA
		18	3	HUD
	12' ²		3	NBC
	12'		3	NFPA
		avoid long flights		
	12'			SBC
	12'			UBC

Stair Flooring Material: The following codes specified slip-resistant flooring material on treads and/or nosings: HUD, NBC, NFPA, OSHA, ANSI.

Landings

Minimum Width in Direction of Travel	Minimum Length in Direction of Travel	Flooring Material	Code
Width of Stairway	Width of Stairway		BOCA
Width of Stairway			HUD
Width of Stairway	Width of Stairway	Slip-Resistant	NBC
	44"		NFPA
Width of Stairway	30"		OSHA ANSI
Width of Stairway	Width of Stairway ⁴		SBC
	Width of Stairway ⁴		UBC

Handrail Requirements

A. Handrail Height

Public/Private	For Stairs	For Ramps	Code
	30" - 34"		BOCA
	36" ⁵		HUD
All Public Interior	36"	36"	
	30" - 34" ⁵	30" - 34"	NBC
	30" - 34" ⁵	30" - 34"	NFPA
	30" - 34" ⁵		OSHA
	30" - 34" ⁵	30" - 34"	SBC
	30" - 34" ⁶	30" - 34" (where required)	UBC

B. Minimum Handrail Location Requirements for Stairs

1. Stairs less than 44" Wide

Public/ Private	At One Open Edge	At 2 Open Edges	On at least one side (usually on Right Side de- scending) if no Open Edges	On both Sides (Regardless of Open Edges)	Code
Public Private			X	X	BOCA
			X		HUD
				X	NBC
				X ⁷	NFPA
	X	X	X		OSHA ⁷ ANSI
	X	X			SBC
Public Private	X	X		X	UBC

Minimum Handrail Location Requires for Stairs (continued)

2. Stairs between 44" and 88" Wide

Public/ Private	At One Open Edge	At 2 Open Edges	On at least one side (usually on Right Side de- scending) if no Open Edges	On both Sides (Regardless of Open Edges)	Code
				X	BOCA
Public Interior			X		HUD
			X		NBC
			X ⁸		NFPA
			X		OSHA
				X	SBC
			X		UBC

3. Stairs Wider than 88" Wide

The following codes specified the need to provide evenly spaced intermediate handrails for public stairs wider than 88":

Maximum Width Between Handrails	Code
88"	BOCA
88"	NBC
88"	NFPA
88"	SBC
88"	UBC

C. Continuity of Handrails

The following codes required that the handrail be continuous the entire length of the flight: BOCA, HUD, NBC, NFPA, SBC, UBC. BOCA and HUD codes require that the handrail extend 18" beyond the top and bottom riser; UBC requires a minimum of 6" extension.

Handrail Requirements (continued)

D. Design of Handrail

<u>Handrail Rounded</u>	<u>Diameter of Handrail</u>	<u>Code</u>
X	2" if hardwood 1 1/2" if metal pipe	OSHA
	1 1/4" - 2"	UBC

E. Minimum Clearance Between Handrail and Wall, Partition, Etc.

<u>Dimension</u>	<u>Code</u>
1-1/2"	NBC
1-1/2"	NFPA
3"	OSHA
1-1/2"	UBC

Other General Stair Requirements

1. Required Headroom

Minimum Height	Measuring Specifications	Code
6'8"	Measured vertically from tread nosing.	BOCA
7'6"	Ceiling height.	HUD
6'8"	From lowest hanging projection.	
7'6"	Ceiling height.	NBC
6'8"	From lowest hanging projection.	
6'8"	Vertical clearance above each tread and landing.	
7'6"	Ceiling height.	NFPA
6'8"	From lowest hanging projection.	
7'	Measured from leading edge of tread.	OSHA ANSI
6'6"	Measured vertically from leading edge of tread of soffit.	UBC

2. Width of Stair

Public/ Private	Number of Occupants	Minimum Width	Permissible Projection of Handrail into stair	Code
Public		36" ³	3-1/2" 3-1/2"	BOCA
Public	Less than 50	36"	3-1/2" on each side	HUD
Private	More than 50	44"	3-1/2" on each side	
		32"	Clear of handrail	
Public	Less than 50	36"	3-1/2" on each side	NBC
	More than 50	44"	3-1/2" on each side	
Class A & B	Less than 50	36" ³	3-1/2" on each side	NFPA
	More than 50	44"		
Public		22"	3-1/2" on each side	OSHA ANSI
Public	Less than 50	36" ³		SBC
	More than 50	44" ³		
Public	Less than 50	36"	3-1/2" on each side	UBC
	More than 50	44"	3-1/2" on each side	
Private	Less than 10	30"	3-1/2" on each side	

ENDNOTES

1. Exterior Stairs: if bottom riser adjoins sloping public way, walk or drive, variation of 3" per 3' of stairway width is permitted.
2. Maximum vertical height between landings for stairs used as an exit from a place of assembly is 9'0".
3. Stairway width should not decrease in the direction of exit travel.
4. Length of landing in direction of travel need not exceed 4'0" if stairway has a straight run.
5. Handrail height measured 1" back from leading edge of tread to the top of the handrail or guardrail.
6. Handrail height measured vertically from nosing.
7. For winders: a handrail (or guardrail) should be provided wherever tread are less than 6" to prevent walking in these areas.
8. Required for new stairs.
9. Gradient should be the same between landings.
10. Landing width should be the same as width of ramp.
11. Exception: theaters may be reduced during performance to 1/5 foot candle (BOCA allows reduction to only 1 f.c.).
12. Emergency illumination required for: 13.

Places of Assembly	(Occupancy over 300)	300
Institutional	(Occupancy over 150)	ALL
Residential	(Occupancy over 100)	100
Eductational	(Occupancy over 300)	300
Business	(Occupancy over 150)	150
Mercantile		150