

## An Evaluation of Stairs and Handrails on Building

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### ABSTRACT

본 연구는 건축에서 발생할 수 있는 미끄럼 사고와 추락 사고에 대한 예방과 계단 및 계단의 손잡이의 설계를 평가하고자 한다. 본 연구를 위하여 두 개의 추수가 다른 계단과 계단의 손잡이를 선택하였고, 계단과 계단 손잡이의 설계에 있어서 인체 측정치를 변수로 선정하였다. 실증을 위하여 설문 분석, 결론을 도출하였다.

### 1. INTRODUCTION

#### 1.1 State of Problem

In the occupational injury and illness statistics for the state of Ohio in 1994, there were 8,479(5.9%) falls from different levels out of a total of 142,865 injuries. The primary causes of falling from stairs and handrails on building are : (1) missing handrails and from misstepping steps or (2) improper dimensions of the stairs and handrails themselves and the state of the surfaces comprising the stairs and handrails.

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Presently, the design of stairs and handrails for the building does not adequately available human factors information take into account. The purpose of this study were to get an idea of magnitude of slipping and falling accidents from building and to investigate the problem in terms of frequency of occurrence and type of injuries. Also, another purpose were to find existing standards and design recommendations and to evaluate typical stair and handrail designs. The final purpose of this study was to propose a set of design guidelines for stairs and handrails on building including high friction coefficient stair and handrail surface and designs.

## 1.2 Review of Accident Statistics

This analysis of accidents was conducted on the basis of the bureau of labor statics from December 1993 through April 1994. The major group of injured workers was from 25 to 34. The most of accidents were occurred by slipping from steps, they lost their balances, they fell down to landing or bottom of stairs, and most of workers fell down from 2 to 4 steps. Also, the most of workers were injured from 2 to 4 foot width of stairs, 7 to 8 inches height of step, and 10 to 12 inches of depth of tread. On handrail, most of workers were fell down from one side of handrail and 9 to 12 steps in the staircase.

## 2. SURVEY OF STAIRS AND HANDRAILS ON BUILDING

To get the general dimensions of stairs and handrails, two places were chosen; Imperial Apartment at Kendall and Library of Miami University, U. S. A.

### 2.1 Imperial Apartment

The Imperial apartment has two story. Riser height was 177.8 mm, depth of tread was 297.4 mm and width was 1219.2 mm. Also, there were tow handrails. The height of the handrails was 1016 mm, the

diameter of the handrail was 6.35 mm for vertical, and 31.75 mm for horizontal.

## 2.2 Library of Miami University

This survey was conducted at the third floor at the library. Riser height was 158.8 mm, the depth of tread was 355.6 mm and width was 2540 mm. Also, there were two handrails, the diameter of the handrail was 114.3 mm for vertical, and 76.2 mm for horizontal, the height of the handrail was 901.7 mm.

## 2.3 Checklist for the Survey

### 1). Stairs / Steps

- Are the stair treads square of abrupt ?
  - \* Are the risers free of square edged nosing ?
  - \* Are the risers 7 inches or less ?
  - \* Are the treads a minimum of 11 inches wide ?
- Do the stairs have continuous handrails 32 ~34 inches high on the both side ?
- Does one handrail extend a minimum of 12 inches beyond the top riser and 12 inches plus width of one tread beyond the bottom riser ?
- Do the handrail extensions intrude into other paths of travel or are turned out of the path of travel as required to accommodate the prescribed extensions dimension ?
- Is there any headroom clearance less than 80 inches ?
- Is there any protective barrier or warning signal for the visually impaired ?

### 2) Handrails and grab bars

- Is the diameter of the gripping surface of the handrail 1-1/4 to 1-1/2 inches ?
- Is the distance between the wall and handrail or grab bar 1-1/2

inches ?

- Are all handrails and grab bars mounted at 32 to 34 inches measured from the floor, surface, or tread nosing to the top of the handrail or grab bar ?

### 3. REVIEW OF SURVEY

The survey for stairs and handrails were conducted at two places: Imperial apartment and library. The height of the first stair from the ground or platform from the survey were 77.8 mm and 158.8 mm, respectively. According to the ISO and SAE, maximum and preferred height were 700 mm and 400 mm respectively. The riser height of the surveys were 177.8 mm and 158.8 mm, respectively. However, the depth of tread of survey were 279.4 mm and 355.6 mm respectively. The surveys were in maximum range, not preferred dimension. The 99% of U. S. college student has 11.4 inches of foot length.

On handrails, the diameter of library was out of standard. Also, according to the standards, the diameter of handrails were preferred round style, the handrails of apartment were rectangular. Also, both handrail height from the ground were in maximum dimensions ( 1016 mm and 901.7 mm - maximum dimension of standard was 1400 mm ). The 99 percent of U. S. people has 2.2 inches of inside grip diameter.

### 4. CONCLUSIONS AND RECOMMENDATION

The dimensions of survey were in maximum ranges of standards. That means the dimensions do not fit for all person. Thus, the stairs and handrails should be designed for all person at apartment and college students at library. So, supplementary handrail for children should be installed at the apartment.

## REFERENCE

- 1). Erikson, T. I. and Rotatori, A. F., *Accessibility to Employment Training for the Physically Handicapped*, 1986, Charles C. Thomas Publishers, Springfield, Illinois.
- 2). Lockhart, T., *Housing Adoptions for Disabled People*, 1981, The Architectural Press, London.
- 3). Mace, R. L., *The Accessible Housing*, 1991, Barrier Free Environments, Inc.
- 4). Robinette, G. O., *Barrier Free Exterior Design*, 1985, Van Nostrand Reinhold Company, New York.
- 5). Rosenbloom, S., *Bus Transit Accessibility for the Handicapped in Urban Area*.
- 6). Sorensen, R. J., *Design for Accessibility*, 1979, McGraw-Hill Book Co.