

This PDF includes a chapter from the following book:

The Staircase

Studies of Hazards, Falls, and Safer Design

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PREFACE

*A poor devil has ended his cares
At the foot of your rotten-runged rat-riddled
stairs?*

—Robert Browning

The stair is a delightful element of architectural theater. But it also has another face—one that witnesses millions of injurious, crippling, and often fatal accidents every year. This is a cruel face because much of the suffering is unnecessary. It reflects the ignorance, carelessness, or indifference of the building industry and, ultimately, our society. Stairs are known to be dangerous and potentially injurious, but little attention or research has been devoted to improving their safety record.

It might be interesting to compare the magnitude of the financial resources expended on investigating the causes of injuries and deaths that occur as a result of air accidents, vehicle accidents, and stair accidents every year. That automobile and air travel has become demonstrably safer over the years cannot be argued. That the stair has become safer as a result of similar endeavors cannot be argued because no one has studied the question. This is not to say that there has been no research on stair safety. There has been some, but no conscientious, continuing process of analysis, diagnosis, refinement, reanalysis, and so on. It is as if society had invested in a

dozen small studies of automobile safety over the past century—studies that were so small in scope as to be quite unrepresentative of traffic accidents and were so underfunded that the results and recommendations were never evaluated. With this record of research, the automobile would still be the perilous machine it was at the turn of this century. The stair still is.

Automobile and airplane safety have improved by a continuous process of monitoring, analysis, and feedback leading to progressive improvements. This has occurred because of actions of the industry, spurred on by pressure and assistance from the federal government and the undoubted influence of personal injury litigation. There is no such community of interests in the building industry. There is no federal agency with a continuing mission to reduce building accidents, and the industry seems to be too fragmented to undertake such a task. The building codes suffer from the same limitations. Without the evidence of research, their provisions represent a consensus based on the well-intentioned ideas and experience of industry and code officials.

This, then, is the climate within which this volume is written. Nevertheless, on the basis of the studies that have been made, we know that there are ways to make stairs much safer. There are two synergistic approaches to stair safety: accident prevention and injury reduction. The former has been the focus of almost all the reported studies to date. Much of this book discusses the state of our knowledge of the factors that cause accidents. Using this information, there are ways to design stairs where the probability of falls is smaller.

The science of injury reduction recognizes that accidents will still occur even on the safest stair, but that the resulting injuries need not be serious or fatal. To discuss stair injury reduction is easy from one point of view. To date, there are only six published articles (Templer 1984, 1985; Templer and Hyde 1988; Templer et al. 1989; Boulet et al. 1989; Hanagud et al. 1989), and all are part of one research project. However, some of the theory and experience of injury reduction measures in automobiles is transferable to stair accidents. Accidents that injure automobile passengers are very different from those that occur during a fall on stairs, so the comparison must be limited. Nevertheless, the last part of chapter 7 discusses ways of reducing injuries. The discussion is based on reasonable premises, bearing in mind the limited research.

Stair safety is a complex subject, encompassing many disciplines. We must consider the epidemiology of stair accidents: the biomechanics of human gait, reaction time, and responses; work physiology and the energy demands in walking on stairs; etiology (the causes of accidents); kinematics (the influence of mass and force that occur during a fall); perceptual and cognitive aspects of behavior on stairs; traffic engineering and pedestrian flow and the capacity of stairs to cope with crowds; materials engineering; and the many facets of human factors engineering that relate to illumination, field and ground identification, and accident reconstruction.

Chapter 1 of this book describes the magnitude of the problem and identifies those groups of people most at risk. It also sets out to examine why people fall and what causes injuries. Much of the remain-

der of the book discusses ways to reduce stair falls and injuries. Chapter 2 deals with the ancient debate on how big risers and treads should be for safety and comfort. Chapter 3 examines the role of slip resistance and its implications for stairs and ramps. Chapter 4 is concerned with the dimensions of flights of stairs and other factors that may render them inadequate for large crowds of people.

Chapter 5 reviews the behavioral ramifications of stair use—how people see, understand, and behave on stairs and may be misled by dangerous designs; what causes human errors; and what is the difference among risk, hazard, and danger and how these are recognized. Chapter 6 deals with handrails, balustrades, and guardrails. Chapter 7 shows how to avoid the main causes of stair falls and discusses some of the ways to reduce the likelihood of injuries caused by the parts of the stair. Chapter 8 introduces some of the legal duties owed by building designers, owners, and builders. Finally, the appendix sets out a process for making sure that a stair is to be relatively safe, comfortable to use, and properly constructed.

The story of the stair is fascinating and complex. The history of the main phases of stair design and the concepts that governed these developments are treated in the companion volume, *The Staircase: History and Theories*.