Pedestrian Facilities

Pedestrian Facilities

Geometric design for safety and mobility

Second edition

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Dedication

This book is dedicated to George and Jenny, my parents, whose walks in the Pentland Hills brought them happy days, and to Marion my wife, for her limitless encouragement and cheerfulness.

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Preface

Engineering the geometric design of facilities to improve the safety and mobility of pedestrians and other road users is the focus of this book. Based on practice in the UK, the emphasis is on numerical, functional aspects of designing footways, uncontrolled and controlled crossings along roads and at junctions, roundabouts and driveways where pedestrian and vehicular traffic interact. These are the places where most pedestrian fatalities and injuries due to collisions with motor vehicles occur. They are the places where people are most concerned about how safe walking is and, therefore, about whether to walk or use some other mode of transport for their desired mobility – or, significantly for many, whether to travel at all, with resulting adverse social, health and economic implications.

Also addressed are pedestrian safety and the comfort of facilities designed to achieve inclusive mobility – embodied in the Equality Act 2010 – and recent developments in computerised demand and design methods. The design of facilities for other non-motorised users is addressed in terms of joint use with pedestrian facilities, and the book complements other works on the needs of bicycle and equestrian travel.

Numerous books and research papers on the geometric design of highways focus on planning and design to ensure collision avoidance and reduction of travel time for

Outline of chapter arrangement

vehicular traffic. This book does the same for pedestrians. Approximately 5000 pedestrians are killed or seriously injured annually in the UK, with a further 20 000 ‘slightly’ injured – and these are casualties which occurred to people who walked. Several million more are reluctant to walk at all because of the perceived, and actual, danger – with adverse effects on health, welfare and social, environmental and economic impacts.

Intended primarily for practitioners and students of civil engineering and design for highways and public spaces, the book is also intended to assist urban planners, architects and the wide range of people who plan and design the public realm in the UK. Inconsistencies in design procedures related to user characteristics, operational procedure and advice are addressed and, because evidence-based analysis and design of pedestrian facilities is often unavailable, it is hoped that the book will assist investigations into the interaction of pedestrians, infrastructure and vehicles. Hopefully, this will help to establish a body of engineering and design knowledge on pedestrian facilities that is comparable to that for vehicular transport.

Engineering and geometric design, which determine the layout and dimensions of the visible elements of the footways and crossings, are integral parts of the aesthetic, social and community aspects of providing for pedestrians, other non-motorised traffic and vehicular traffic. This book, therefore, complements and augments the many texts and guidance documents on these subjects and on the public realm environment and highway engineering. It draws together material from many, often overlapping, sources.

The concentration throughout is on the detailed, numerical, engineering analysis and design of individual elements of a pedestrian’s route. This focus recognises that, no matter how well the overall route and its environs are planned and executed, or how attractive aesthetically the route may be, if only one junction is perceived by a pedestrian to be unsafe, the entire route can be rendered unacceptable. A basic premise, therefore, is that the design of pedestrian facilities and their environs should be based on the *pedestrian’s* perspective of functionality and safety. Consequently, design procedures should, wherever possible, incorporate evidence-based physical and movement characteristics of people who use the facility, in accordance with established codes of conduct.

In this second edition, developments in cycle facilities and shared use are also addressed – albeit as they relate to pedestrian traffic and rather briefly – in recognition of their own extensive and often complex needs. Cyclist characteristics, flow and capacity, auditing and the combined use of facilities are included. A consideration of shared space and related concepts includes examples from the UK and continental Europe. This aspect of the pedestrian’s environment is recognised as contributing to the desirability of walking and ‘sojourning’ as a part of the social experience. However, in most traditional inner suburbs and rural areas, the emphasis has historically been on design for vehicular traffic, often at the expense of pedestrians’ safety and convenience. In such locations, as well as in new developments, improved geometric design will continue to be of value.

The geometry of roads (which include pedestrian ways) where pedestrians interact with vehicles is responsive to and determined by a wide variety of physical, operational and human factors. Physical factors include the carriageway and footway dimensions and horizontal and vertical alignments, the proximity of obstructions, and property lines. Operational features include vehicle speeds and stopping distances, road markings, signs

and signals, substantially as described in the *Highway Code* and related publications. Human factors include cultural, physical and mental abilities, reaction times, walking speeds, visual ability and the extent of pedestrians' disabilities or encumbrances. Overlaying these direct variables on the design process are the policy, educational, enforcement and cost factors affecting all road users and responsible authorities – matters that must be left to works other than this one to address.

A wide variety of government agencies and transportation and urban design organisations act as a source of references for guidance during the design process. Often, the bases for such guidance are expressed in qualitative, rather than numerical, terms, and the associated features and dimensions are based on accumulated experience and assumptions about how reasonable road users might behave. Consequently, several of the chapters in this book repeat the main dimensional features and elements given in guidance documents, without further comment on the analytical aspects of how such features were derived. These documents may include dimensions, such as space requirements of pedestrians (especially disabled people and their space needs). They therefore provide a guide to pedestrian facilities design as practised by local, regional and national authorities.

Appropriate detailed geometric design of the facilities along a pedestrian's route is an essential element in a person's deciding whether a walking trip is acceptable or, for many disabled or older people or children (nearly 20% of the population, depending on the precise definition), even possible. Safety – the underlying requirement for acceptable design, as presented here – is regarded as an essential prerequisite for mobility. Of course, safety, mobility and accessibility must exist alongside other key factors, such as urban design, aesthetics, and environmental, community, policy and related issues. Too often, crossings where pedestrians cannot adequately see oncoming vehicles, footways that are too narrow to adequately pass, refuges that are too narrow to accommodate an adult with small children, crossings at junctions with large radii and signals that do not offer sufficient time to cross can intimidate pedestrians and reduce the number of walking trips. The contrast with the comfort and perceived safety of an equivalent trip by car could not be greater. The results of such a contrast are excessive dependence on car use, decreased health, decreased access to essential services and, often, a feeling of exclusion for the large portion of people who must depend on walking as a means of attaining independence and social interaction.

The approach adopted in this book also assumes that, because design of pedestrian facilities is usually inseparable from that of adjacent facilities for vehicular traffic, a basic knowledge of highway engineering is essential. Elements may also assist forensic engineering in that reference is sometimes made to underlying principles where assumptions about UK design practice are not founded on documented evidence. Furthermore, in the light of increasing concerns about the environment and attempts to reduce motor vehicle usage, such evidence may well underlie the reluctance of people to walk rather than drive for many short trips. The author hopes that this book will help to address many of these concerns, thereby improving the safety and attractiveness of walking and, in doing so, improve the sustainability of our increasingly vulnerable environment.

The main features of the approach adopted here are shown in the figure. First, an introduction section describes the current framework for most design of pedestrian facilities in the UK. It outlines features of the context in which geometric design of pedestrian facilities is undertaken; these include highway and street classification,

information sources, the analysis and design process and the institutional and legal setting. Importantly, the introduction also indicates some areas where design may be made more responsive to pedestrians' needs. The main features of the book are outlined next.

Chapters 1 to 4: User characteristics

These chapters address the underlying theory and available parameters associated with driver and pedestrian behaviour and design rationale, including material documented in British publications on which the UK's design guidance is based. A brief description of the *Highway Code* is included as an important, although not often quoted, descriptor of required road users' conduct, which physical designs must recognise. The characteristics described in this part also mention shortcomings in current design analysis. This is intended to assist research focusing on improvements to pedestrian facilities as they affect all users' behaviour, mobility needs and associated design parameters.

Chapters 5 to 11: Design practice

This part of the book mostly covers current practice, as described in governmental guidance and advice. Chapters on general road layout practice (including home zones and shared spaces or surfaces), at-grade crossings at unsignalled crossings and an introduction to design practice to ensure inclusive mobility lead to chapters on the geometric design of the pedestrian elements of signalled junctions, roundabouts and facilities shared with other non-motorised users. Owing to extensive coverage in numerous governmental and institutional publications, the material presented is selective and is intended to address key aspects as a guide to more detailed engineering design.

Chapters 12 to 14: Design analysis and monitoring

Processes and methods of evaluating pedestrian schemes in order to improve and refine specific designs are described here. Auditing of pedestrian facilities, capacity estimation and simulation using computerised methods are the main interests.

Chapter 15: Project implementation

This final chapter briefly provides a selection of examples and projects – extensively based on pedestrian facilities – incorporating aspects of analysis that assist in key elements of design and evaluation.

Summary – the way ahead

Provision of adequate pedestrian facilities affects and is affected by many, often conflicting, factors, from the skill of workers repairing a broken paving slab to a national government's transport policy. The focus in this book is on one essential element of the spectrum of factors, i.e. detailed geometric design. This focus is deliberate, perhaps to the excessive exclusion of the other elements. It is hoped that readers will understand the intent of this approach.

About the author

John G Schoon MSCE PhD CEng MICE MASCE FITE PE is a visiting fellow with the Transportation Research Group, University of Southampton, and Emeritus Professor of Civil Engineering, Northeastern University, Boston. His consulting experience of multimodal transportation planning, highway engineering and community involvement brings a wide perspective on transportation engineering and planning. Other experience includes forensic engineering in traffic accident reconstruction, project management and consulting in several countries for governmental agencies and the United Nations. He is the author of numerous project reports and technical papers and several books.

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The subject of pedestrian safety and mobility varies widely; opinions between policy makers, users and the professional community often differ. Hopefully, the approach adopted in this book reflects an objective introduction to these differences, so enabling analysis, design and planning to respond effectively to specific cases. Of course, any errors or omissions in the book are mine and I would appreciate being told about them, together with suggestions for possible improvements.

Conversion of units

$$\begin{aligned}1 \text{ in} &= 25.4 \text{ mm} \\1 \text{ ft} &= 0.305 \text{ m} \\1 \text{ ft}^2 &= 0.093 \text{ m}^2\end{aligned}$$

$$\begin{aligned}1 \text{ mm} &= 0.034 \text{ in} \\1 \text{ m} &= 3.281 \text{ ft} \\1 \text{ m}^2 &= 10.76 \text{ ft}^2\end{aligned}$$

Cautionary note

This book, particularly the sections on design guidance and advice, includes edited excerpts from government and other documents. This edition focuses on the geometric design of pedestrian facilities, often embedded in other aspects of analysis and design. The descriptions in this book should be read, and professional experience and judgement employed, in the knowledge that relevant, updated and additional source documents, including those not mentioned in this book, must be consulted and appropriate advice sought in any application and actual design task and its context. In general, the design guidance and advice sources described apply to cases in England; there may be differences in those applicable in Northern Ireland, Scotland and Wales.