

# Pedestrian facilities

Engineering and geometric design



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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.

# Important note

Selected material in this book in the sections on design guidance and advice includes edited excerpts from governmental and other documents. This editing is aimed at focusing on 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, and there may be differences in those applicable in Northern Ireland, Scotland and Wales.

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# Preface

Engineering the geometric design of pedestrian facilities is the focus of this book. 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, based upon practice in the UK. These are the places where most pedestrian fatalities and injuries due to collisions with motor vehicles occur and, therefore, affect decisions to walk or use some other mode of transport to achieve desired mobility. Also addressed are pedestrian safety and comfort of facilities designed to achieve inclusive mobility, and recent developments in computerised demand and design methods. Design of facilities for other non-motorised users (NMUs) is addressed in terms of joint use with pedestrian facilities, and the book complements other works on the needs of cycle (including on-street and at crossings) and equestrian travel.

Intended for use by practitioners and students involved in civil engineering aspects of design projects for highways and public spaces, the book provides design information intended to assist urban planners, architects and the wide range of people involved with facilities within the public realm in the UK. In addition, because of the numerous instances where factual, evidence-based, analysis and design of pedestrian facilities is unavailable, it is hoped that researchers will find throughout the book a basis for investigating the interaction of pedestrians, infrastructure and motor vehicle traffic. This may help to establish a body of engineering and design knowledge on pedestrian facilities to compare with that available 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 facilities for pedestrians, other non-motorised traffic and vehicular traffic. This book, therefore, complements and augments the many texts and guidance on these subjects and on the public

realm environment and highway engineering, and 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 the locations where pedestrians and motor traffic interact are perceived to be unsafe, the overall route will be judged unsafe and intimidating, and pedestrians will be reluctant to use it. For any pedestrian's journey, only one junction, for example, that is perceived by a pedestrian to be unsafe can render the entire route unacceptable. A basic premise, therefore, is that design of pedestrian facilities and their affected environs should be based upon 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, and in accordance with established codes of conduct.

The geometry of roads (which include pedestrian ways) where pedestrians interact with motorised 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, 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 and 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 which must be left to other works than this one to address.

Pedestrian facilities design information (over 30 individual publications as of the year 2009) used in the UK, published by governmental agencies and by transportation and urban design organisations, provide 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 upon accumulated experience and assumption about how reasonable road users may be expected to behave. Consequently, several of the chapters on physical design described in the book repeat the main dimensional features and elements as shown in guidance documents,

without further comment on the analytical aspects of how such features were derived. Such 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 practiced 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 deciding whether a walking trip is acceptable or, for many disabled or elderly people or children, 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, environmental, community, policy and related issues. Too often, crossings where pedestrians cannot adequately see oncoming vehicles, footways too narrow to adequately pass, refuges too narrow to adequately 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 to 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 the book also assumes that, because design of pedestrian facilities is usually inseparable from that of the adjacent facilities for motorised 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 is not founded on clearly documented evidence. In such cases, further research may be needed to justify or modify current assumptions.

The essential features of the approach adopted are shown in the chart of Figure 1. First, the introduction describes the current framework under which most design of pedestrian facilities is conducted in the UK. It outlines features of the context in which geometric design of pedestrian facilities is undertaken such as highway and street classification, information sources, the analysis and design process, the institutional and legal setting. Importantly, it also indicates some of the areas where design of pedestrian facilities may be made more responsive to the needs of the walking public. The main features of Parts 1 through 4 are outlined below.

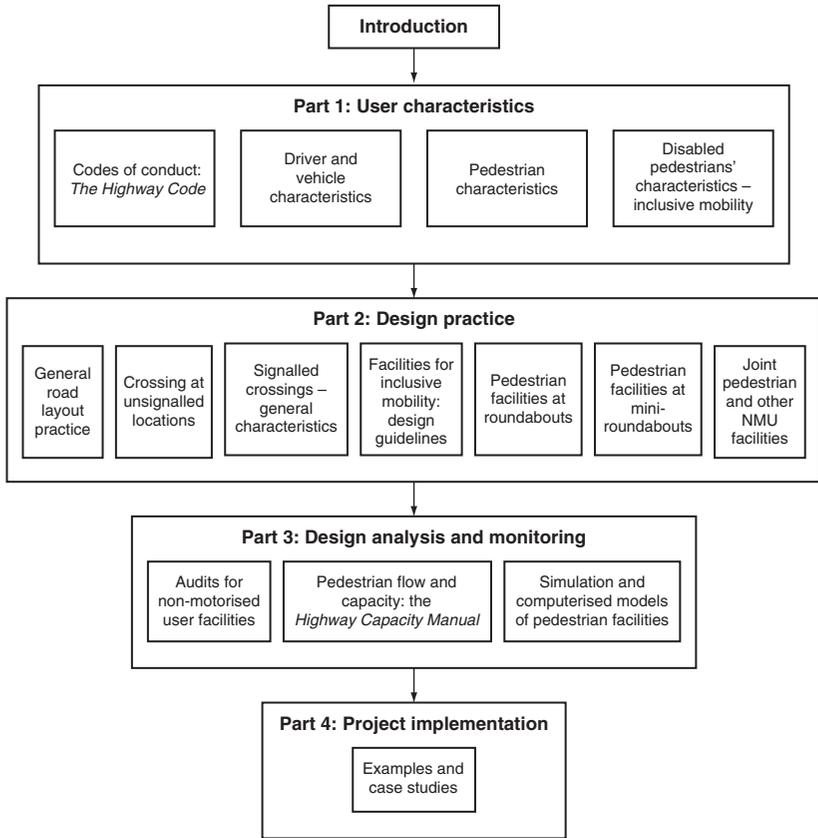


Figure 1 Outline of chapter arrangement

**Part 1: User characteristics** – addresses 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, though not often quoted, descriptor of required road users' conduct, and which physical designs must recognise. The basic characteristics described in this part are also intended to assist research that focuses on improvements to pedestrian facilities which focus on fundamental aspects of all road users' behaviour, mobility needs and associated design parameters.

**Part 2: Design practice** – comprises mostly current practice as described in governmental guidance and advice. General road layout practice (including home zones and shared space and/or surfaces),

at-grade crossings at unsignalled crossings, and an introduction to design practice to ensure inclusive mobility leads to geometric design of the pedestrian elements of signalled junctions, roundabouts and facilities shared with other non-motorised users. Due to the extensive coverage in numerous governmental and institutional publications, the material described is selective and is intended to illustrate key aspects of more detailed engineering design.

**Part 3: Performance analysis and monitoring** – addresses processes and methods of evaluating pedestrian schemes in order to improve and refine specific designs. Auditing, pedestrian facilities capacity estimation and simulation using computerised methods are the main interests here.

**Part 4: Project implementation** – this final part briefly provides a selection of examples and projects – extensively based on pedestrian facilities design projects and incorporating aspects of analysis that assist in key elements of the design and evaluation.

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 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.

There is clearly a need for safe and convenient pedestrian facilities in light of the 3000 pedestrian fatalities and serious injuries experienced on the roads of the UK each year. From a humanitarian and social perspective alone, it would generally be agreed that this statistic represents an unacceptable condition. Furthermore, in light of increasing concerns about the environment and attempts to reduce motor vehicles usage, such a figure 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.

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Regardless of any help or advice, all errors or omissions are mine and I would welcome being told about them, together with suggestions for improvement of future editions.

John Schoon  
March 2010

