The Institution of **StructuralEngineers**

Car park design

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IStructE Guide

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Car park design

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He is vice chair of the IStructE's Safety, Health and Wellbeing Panel, and a member of the Business Practice and Regulatory Control Committee. Since the Hackitt report, Mark has been much involved in providing advice to government on the future of building control, including being a member of Raising The Bar WG6, and the Future of Building Control Working Group.

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He has been responsible for the design and construction of many car parks both in the UK and internationally, and was deeply involved in the development of the patented Vertical Circulation Module (VCM) system. He was a member of three winning teams for the Best New Car Park Award and the Best Refurbishment Award before progressing to the British Parking Award's panel of judges.



Representing the British Parking Association (BPA) Chris worked in association with the Transport Research Laboratory in developing new standards for testing vehicle impact barriers, and with the Building Research Establishment in evaluating fire spread in car parks.

Specialist knowledge of car parks has enabled him to co-author the ICE's *Recommendations for the Inspection, Maintenance and Management of Car Park Structures* (2nd edition), and to sit on several European Technical Committees relating to durability, repair, inspection and maintenance of concrete structures. He is a joint author of the first edition of the *Car Park Designers' Handbook*, and has written and presented several specialist papers to promote the betterment of car parks.

Chris was chairman of the BPA's Parking Structures Group. He was presented the Ernest Davies Award in 2006 for advancing parking knowledge, and ultimately the BPA's Lifetime Achievement Award in 2015, for his outstanding contribution to the sector.

The authors

Peter Guest

Peter has been involved in parking for more than 50 years. Starting in policy research at the GLC in 1972 he was later involved in street parking management. He became involved in parking technology — as a member of, and later chairman of — the British Standards Committee, and the UK's representative on the European committee. He moved to consultancy in 1987 and worked both in the UK and internationally, including World Bank studies in Europe and Asia. He joined a specialist car park design consultancy in 1997 as a partner, working on projects dealing with all aspects of parking. Since 2003 Peter has been self-employed. During this period, he designed and procured the Abu Dhabi Parking programme MAWAQiF, probably the biggest parking project in the world. In 2023 Peter received the BPA's Lifetime Achievement Award. He is now semi-retired but continues to write for *Parking Today*, and is a member of the Temecula Group; a US parking industry think tank.

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Foreword

It has been my pleasure to chair the contributors group for this *Car park design* guidance. As a Building Control Officer (and therefore not a car park expert!) it has been a huge learning experience and I marvel at the depth and breadth of knowledge that The Institution of Structural Engineers can convene.

The brilliant and expert contributors group have produced something which is useful and meaningful to everyone who is involved in the design of car parks.

We have deliberately split the book into 'conceptual' and 'detailed' design so that those who wish to understand the concepts, such as clients, project managers and architects can do so without having to wade through the nitty gritty. We also ensure there is enough nitty gritty for structural engineers, services engineers and those involved in the delivery of projects to get their teeth into.

It is also my fervent wish that students and those starting out in their careers will find this book as illuminating as I have found the process of putting it together to be.

MMu

Mark Pundsack Chair

Foreword

It is my pleasure and privilege to introduce this Car park design guidance.

I have known some of the contributors for several years and they have impressed me with their ability and experience in the world of parking structures. They are leading contributors to the British Parking Association's Parking Structures Group.

Being a civil engineer, I admire the tenacity of my professional colleagues and their peers to design and deliver ever safer parking structures. As a motorist, I simply want to be able to park my car efficiently and effortlessly somewhere I feel intuitively safe and welcome. I want to be able to get to and from my parking spot within the car park easily. Also, I want car parks (especially those contained within buildings) to improve the public realm and not be an eyesore.

It is fitting that The Institution of Structural Engineers has chosen to completely revise, refresh and rename its original publication *Design recommendations for multi-storey and underground car parks*. So much has changed since it was originally published. Simply updating and creating a fifth edition would be to ignore contemporary consumer expectations and the new materials now being used in the construction of vehicles and buildings.

There are important safety and economic implications of the increasing size and weight of the "average vehicle" up from 1.5t in 1974 to almost 2t today. These increased loadings and the changing fire safety requirements are all considerations not just for new car parks but in the thousands which already exist today.

Environmental sustainability means energy-saving lighting, water recycling and air quality monitoring becoming desirable features. Add in greenery from planters and pots through to living walls, and the look and feel of our car parks is transforming. We need to support car sharers and active travel choices with special parking bays, including secure cycle and motorcycle parking and EV charging.

Accessibility and equalities considerations mean special bays for people with disabilities, parents/carers with children, better way-marked pedestrian routes and more.

Crucially, the health and welfare of everyone who uses our parking facilities is paramount, and so out of necessity, sadly, there is also a need to include advice and guidance on managing the risks of people falling from height and the prevention of suicide in car parks.

This guide will be a valuable resource and reference for car park architects, engineers, developers, funders, and those who service and maintain these facilities. It should be of interest to parking operators in the public and private sector, across central and local government. Likewise in retail and leisure; healthcare and higher education; railways and airports — in fact, everyone who needs to understand what is going on in the world of car park design.

To some, it's a matter of creating something which is safe and sound, to others it is a work of art: in combination we have the potential for parking masterpieces.

There seems to be everything you need to know in this publication, which is a world leader in its advice, advocacy, and approach and which should be the 'go to' reference for everyone with an interest in new and existing car parks. I commend it to you all.

Keli- Rugues

Kelvin Reynolds, I.Eng., FIHE, FRSA, FBPA, DipHTE (Middx). Chief Technical Services and Governance Officer British Parking Association



Lifetime Achievement Award.

Definitions and acronyms

Accessway: carriageway not adjoining bays and used solely for the movement of vehicles.

Aisle: an accessway serving adjoining bays.

Angled parking: where parking bays are at an angle less than 90° to drive aisle.

ANPR: automatic number plate recognition.

Bay: parking area, exclusive of aisle or other adjoining area, allocated to one vehicle.

Bay turnover: number of times a parking bay is occupied within a 24-hour period.

Benchmark inspection: post-construction assessment of a car park's durability — entailing the comparison of as-built structural records and survey results, with the original designs and specifications in the handover information pack (HIP) — enabling future inspection and maintenance programmes to be defined.

Bin: two rows of bays with the access aisle running between them. A half-bin is one row of bays and the aisle serving them.

CE mark: a form of product identification that:

- Indicates that the manufacturer has checked the product meets EU safety, health or environmental requirements
- Is an indicator of a product's compliance with EU legislation
- Allows the free movement of products within the European market

Note: from 1 January 2025 the CE mark is expected to be replaced by the UK conformity assessed (UKCA) mark, in England, Scotland and Wales.

Clearway ramp: a ramp system that does not include an aisle in its circulation and which provides unencumbered access between the parking floors and an entrance or exit.

Churn: see Bay turnover.

Condition survey: visual examination of all accessible areas and associated fabric/elements, and measurement of evidence of deterioration, including any structural investigation.

Cross aisles: aisles which interconnect the main drive aisles (generally at 90°).

Daily surveillance: visual observation and reporting of equipment breakdown, obvious deterioration and damage to the structure, cladding and edge protection, and vandalism/general misuse of the facility.

Deck: Slab or floor at any level.

Design service life: intended working life of the structure, as set out in the design brief, on which recommended values for parameters such as concrete class and minimum cover for durability have been chosen to give a low-risk of reinforcement becoming excessively corroded and requiring significant repair.

Dynamic capacity: applicable to individual parts of a car park or to the building as a whole. It is the maximum flow per hour of vehicles (or where appropriate, people) that can be accommodated.

Dynamic efficiency: measure of the ability of a car park to process vehicles under standard operating conditions.

Echelon parking: see Angled parking.

Gross vehicle mass/weight: mass/weight of vehicle plus passengers and luggage.

Ground clearance: shortest distance between lower part of vehicle body/chassis and road when vehicle is unladen.

Inclusive design: the design of mainstream products and/or services that are accessible to, and usable by, as many people as reasonably possible without the need for special adaptation or specialised design.

Inspector: person competent by virtue of a combination of qualification, experience and training to undertake **condition surveys**. May be employed by the same or a different organisation from the engineer. Will usually be an experienced (Chartered) civil or structural engineer.

Lean design: avoiding overdesign and achieving greater utilisation ratios of structural elements, including foundations.

Life-care plan: long-term plan for the implementation of an inspection maintenance strategy.

Lighting efficacy: measure of how well a light source produces visible light.

Local planning authority (LPA): local government body empowered by law to exercise urban planning functions for a particular area.

MSCP: multi-storey car park.

Oblique parking: see Angled parking.

PARCS: parking access and revenue control systems.

Parking angle: angle between the length of a bay and the aisle from which it is served.

Parking ramp: inclined section of deck that forms part of a ramping system and has a gradient shallower than 1:20.

Pedestrian ramp: inclined surface for use by pedestrians to access a change in level.

Ramp: accessway (or less commonly aisle) connecting parking areas at different levels.

Reservoir: accessway where cars may queue without obstructing movements in other parts of a car park or the external highway system. May also be described as a 'vehicle reservoir'.

Routine inspection: regularly scheduled visual inspection of a car park structure, cladding, edge protection and any other defined aspects of the facility.

Routine maintenance: periodic activity intended to prevent or correct the effects of minor deterioration, degradation or mechanical wear of the structure or its components.

Standard design vehicle (SDV): any vehicle that falls within a set of dimensions applicable to 95% of vehicles currently in use in the UK.

Static capacity: total number of bays.

Structural appraisal: evaluation of the structural adequacy of a car park structure, cladding and/or edge protection taking into account its environment, likely usage, extent of deterioration and anticipated **design service life**.

Switchroom: area containing an assembly of electrical equipment for control and protection of electrical circuits.

Turning circle: diameter of the swept path by outermost part of vehicle when on maximum steering angle.

Vehicle ramp: inclined surface for use by vehicles to access parking decks at different levels, that has a gradient steeper than 1:20.

Vertical circulation module (VCM): module comprising two parallel internal longitudinal parking ramps interconnected by a transverse vehicle ramp.

Wearing screed: structural concrete applied *in situ* to concrete or precast units to act compositely with them and to form the finished flooring, as defined in BS 8204. Formerly known as a 'structural topping'.

Wheelchair accessible vehicle (WAV): vehicle that has been specially adapted to enable a wheelchair user to travel safely and comfortably while seated in their wheelchair.