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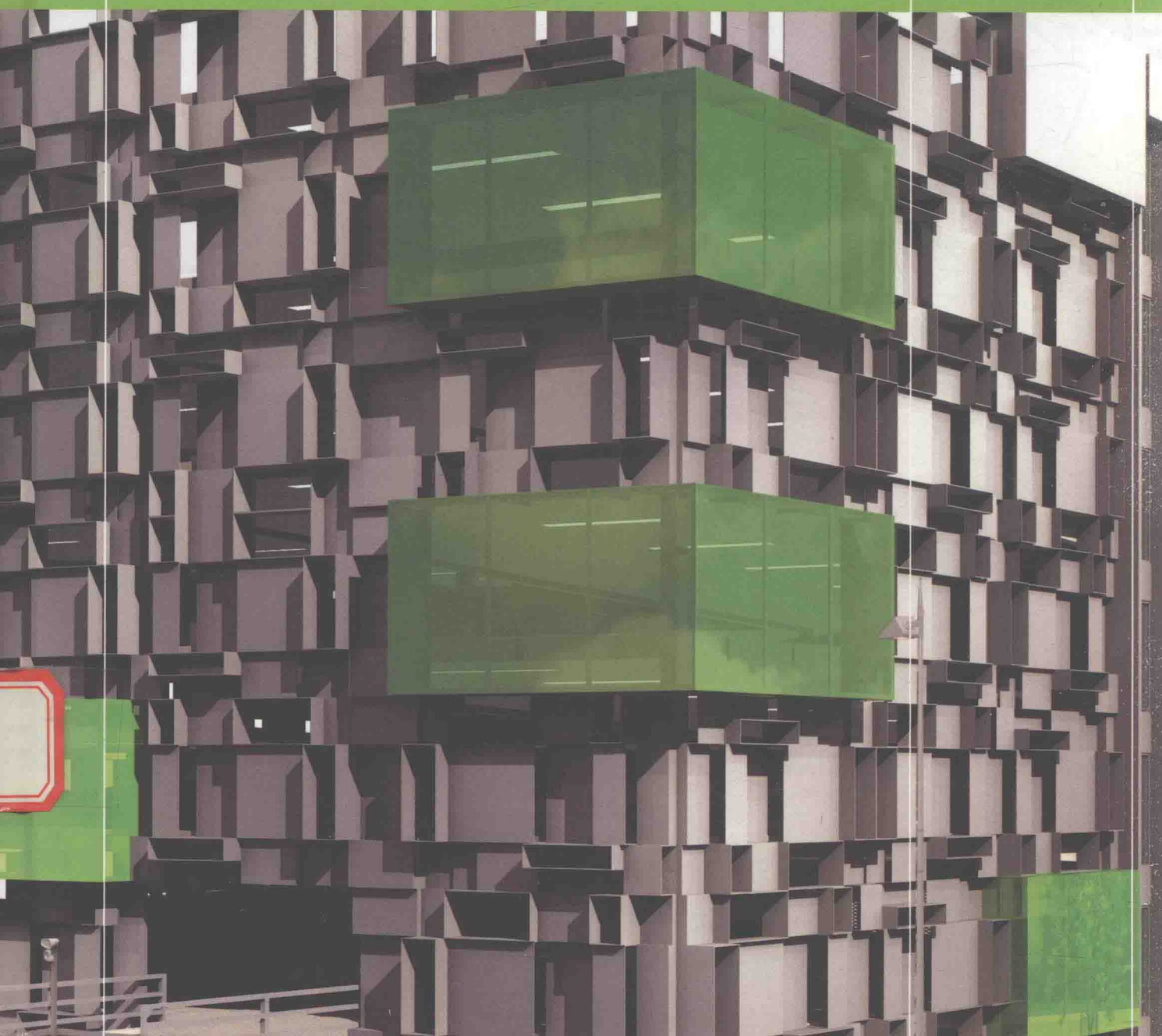
Car Park Designers' Handbook

Second edition

Jim Hill, Glynn Rhodes and Steve Vollar



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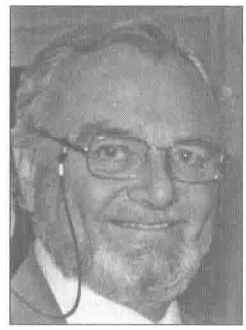
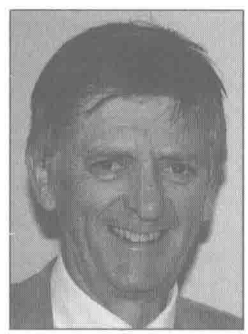


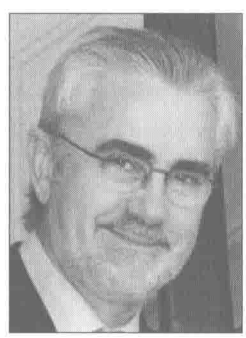
Jim Hill CEng FIStructE (retired)

In 1967, Jim founded the Hill Cannon Partnership with John Cannon and has been involved in car park design since 1969. In 1970, they developed the Tricon structural system and in 1993 Jim patented the Vertical Circulation Module system (VCM). He is a past president of the British Parking Association and a regional chairman of the Concrete Society. As a consultant to the practice, having retired in 1992, he concentrated on the further development of VCM, designing appropriate circulation layouts for many projects and researching this book. He is currently writing a similar handbook on good practice parking in the USA, where he now lives with his American wife Rosie.



Glynn Rhodes BSC (Hons) CEng MICE MIHT

Glynn is Senior Partner of Hill Cannon Consulting LLP and, since 1986, has been involved in the design of 50 multi-storey car parks, two of which have been voted *Best New Car Park* at the annual British Parking Awards. He also received the Ernest Davies Award for the best article published in Parking News, *Current Trends in the Design of Car Parks*. He has provided design advice for large underground car parking facilities in Manila, Kuala Lumpur (Petronas Towers), Zagreb and Dubai. Recent projects include multi-storey car parks at Basildon Hospital, Gatwick Airport, Luton Railway Station, Birmingham International Station, and Nottingham Hub Station, and the one for the Scottish Exhibition and Conference Centre (SECC) in Glasgow.



Steve Vollar EurIng BSc CEng FIStructE MICE

Steve is a Senior Partner of Hill Cannon Consulting LLP and has been actively involved with car park design and parking-related subjects since 1996. He has been responsible for the design of many multi-storey car parks, for inspections, and for the refurbishment of existing structures. His

particular interest is in the inclusion of suitably designed disabled parking facilities, general 'wayfinding', and catering for two-wheeled traffic.

Recent projects include Eastside Birmingham which was voted Best New Car Park at the British Parking Awards 2012, Westgate Railway Station Car Park, Wakefield, Southwater, Telford and a 4000-space facility for the Ministries of Finance Complex in Kuwait.

He was chairman of the Yorkshire Branch of the Institute of Structural Engineers and continues to be a professional interviewer for candidates applying for Chartered status.

Foreword

Before retiring as a Consultant to Hill Cannon Consulting Engineers in 2005, Jim Hill had spent over 35 years in the development of car park design and this experience has given him a unique insight into the reasons why some buildings operate successfully and others, of a similar size and activity, do not. The choice of the correct circulation layout is a subject that he considers to be of prime importance in the creation of an efficient parking building.

Both as a consumer of parking services and a former parking manager, it always intrigues me as to why some parking layouts are easily navigated and yet others test one's patience. As an engineer, I think logically and admire the 'art of parking' created by my fellow colleagues; as a consumer I want to be able to park my car as quickly and as effectively as I can and get on with the business in hand, be it work or play, especially if I have children with me.

My experience has taught me that parking is a means to an end; it is the first and last impression of my destination. This is especially true in the retail and commercial world where, hopefully, my custom is valued. Town and city centres rely on good parking facilities, as do many leisure destinations and major transport hubs like train stations and airports. The parking needs to be good if I'm to contemplate returning there again and again.

Equally important is the need to feel safe and welcome wherever I choose to park. Complex layouts, frustration with queues and conflict with others who are manoeuvring in or out of parking spaces, or sometimes in what seems like a never ending set of twists and turns to get in or out of the car park in the first place, only serve to increase my sense of being uncared for by the owner or operator.

This book describes and illustrates some 60+ variations on the many layout themes: their advantages and disadvantages are discussed, recommendations made for their practical application and suggestions made for other layouts that should also be considered.

More than just discussing layouts, the authors have shown how ramps can be prevented from projecting excessively into traffic aisles, how to assess dynamic capacity and efficiency, and the many other considerations that go to make up the design process. The matters dealt with in chapters 8 to 20, such as the current requirements for people with mobility impairments, pedestrian access, security, ventilation, and so on, have been written by Jim's co-authors, all parking experts in their own right.

In Jim's opinion, effective design is based on common sense, a little crystal ball gazing and experience: it is not a precise art. He suggests that if drivers want to use a car park and clients are willing to pay for it, little else matters. I wouldn't want to disagree with him, but I believe my comments about feeling welcome at any parking facility are the key to its success. If the operator wants to do business, good customer service is vital, and this depends on good design.

This second edition of the book updates and expands on the subjects covered by the first edition in relation to all aspects of car park design, especially the design of circulation layouts, in a practical manner, and can be easily understood by anyone with an interest in the subject. It will help to identify examples of best practice in making our parking facilities more accessible to all. The book is a useful reference for those considering Park Mark® – The Safer Parking Scheme (police-approved safer parking).

Kelvin Reynolds
Director of Policy and Public Affairs at British Parking Association

Preface

Information on the design of vehicle circulation systems in car parks is hard to find: had it not been so this book, probably, would not have been written. To our knowledge, special features and relative efficiencies of car parks have never before been discussed in any great detail. Many designers are unaware of the advantages of using a particular layout system over another and it is a major purpose of this book to redress that imbalance.

No matter how efficient the structural solution and how attractive the architectural appearance, if it is wrapped around a poor choice of circulation layout the result will be another unpopular car park. In many under-used car parks the reason for their unpopularity is not that they have been allowed to become dirty and/or dingy (conditions that by themselves would not normally put off motorists), but rather that they suffered from a poor choice of internal layout. Of the many buildings inspected, the most unpopular have, invariably, incorporated inappropriate circulation designs. Rather than giving these car parks an expensive cosmetic makeover, the money would have been better spent on improving the layout, even at the cost of losing a few parking stalls.

Over the years, as the authors became more experienced, so their awareness of the number of different layouts available increased. Some have been rejected as being impractical or just plain whimsical, but those that are featured in this book are practical and have been constructed somewhere, although not always in the UK. With more than 7000 car parks in the UK, 35 000 in the USA and many thousands more in the rest of the world, it is unlikely that all of the possible variations will have been covered and if any reader is aware of a practical circulation layout substantially different from those featured and lets us know, if it is included in a future edition they will be acknowledged as the source.

The design of underground car parks has also been addressed. In general terms, it follows the recommendations for parking above ground and differs only in the requirements for ventilation. Central points for these layouts can be located either above or below ground. It will be necessary to discuss the proposed surface treatment (large trees and bushes) with the landscape architect before reaching a final decision on the circulation layout and for this reason features above ground have not been shown.

The design of a standard car park is an engineering discipline that requires specialist knowledge in all aspects of car park design, management and operations. Desirable elements in car park design include

- well-laid-out parking bays, aisles and ramps to ensure ease of circulation for both vehicles and pedestrians
- user-friendly environment – with good ventilation, lighting, and open areas to ensure good natural surveillance
- economy in achieving good gross floor area per space ratios
- adequate access and gross control to ensure good dynamic traffic-flow characteristics
- economical structure that is easy to build and is economical while providing long-term durability.

It is the authors' intention that the publication of this handbook will assist the designer in achieving their objectives.

Glossary of terms

Access-way or cross-way	A traffic lane without adjoining stalls, laid flat or to a slope not exceeding 5%; also capable of being used by pedestrians
Aisle	A traffic lane with adjoining stalls on one or more sides
Bin	The dimension across an aisle and its adjacent stalls (a half bin has stalls only on one side)
Circulation efficiency	A comparison (given as a percentage) of the travel distance required to search the stalls, in any particular car park, with the minimum travel distance
Congestion	Applies to traffic that is unable to flow freely
Cross-ramp	An inclined traffic lane connecting the aisles in adjacent bins, laid to a slope greater than 5%
Deck	A single floor that extends over the plan area of a parking building
Des Recs	A shortened form of words describing the *Design Recommendations for Multi-storey and Underground Car Parks, 3rd edition*, published in June 2002 by the Institution of Structural Engineers
Dynamic capacity	A measure of the rate that traffic can pass a given location within a car park (given in vehicles per hour)
Dynamic efficiency	A measure of the ability of a car park to process vehicles under normal operating conditions
Excluded	Applies to an inflow route that is separated from an outflow route
Extended	Applies to any traffic route that is not rapid
Included	A flow route that is located within the circulation pattern of another
Inflow	Applies to the search path for traffic within a car park
Manoeuvring envelope (ME)	The boundaries established by the minimum turning circle when entering a cross-way or ramp, outside of which a vehicle is unable to manoeuvre without reversing
MPV	Acronym for a multi-purpose vehicle
MSCP	Acronym for a multi-storey car park
One-way flow	Traffic flowing in a single direction on an aisle
Outflow	Applies to traffic exiting from a car park
Ramp	Any traffic lane, without adjoining stalls, that provides access to or from parking at different levels
Rapid	Applies to a short route for inflow or outflow traffic
Stall	The parking area allotted to a single vehicle, exclusive of any other adjoining area
Stall pitch	The spacing for stalls, normal to an aisle, for a particular angle of parking
Static capacity	The total number of stalls contained within a designated area or complete car park
Static efficiency	The area of the parking decks divided by the static capacity and given as an area per stall
SUV	Acronym for a sports utility vehicle
Swept path	The width on plan established by a vehicle for any given radius of turn
Two-way flow	Traffic flowing in both directions on an aisle, ramp or cross-way
Vph	Vehicles per hour

Acknowledgements

All photographs featured are from the archives of Hill Cannon Consulting, except

Figure 10.3 courtesy of Falco UK Ltd

Figure 10.4 courtesy of Motoloc Ltd

Figures 19.2, 19.3, 19.4, 19.5 and 19.6 courtesy of Ramboll.

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Chapter 1
Introduction

Rules and regulations are but the paper bastions behind which the inexperienced fight their battles: in the matter of car park design let common sense prevail.

1.1. Historical note

Eugène Freyssinet, 1879–1962, a French structural engineer and the inventor of pre-stressed concrete, is credited with designing the first European multi-storey car park in 1920, a split-level layout (SLD 1 type). In the UK, the first multi-storey car park was built *c.* 1924 and it is conservatively estimated that there are now well over 7000, many of them constructed in the post-war boom years between 1950 and 1975.

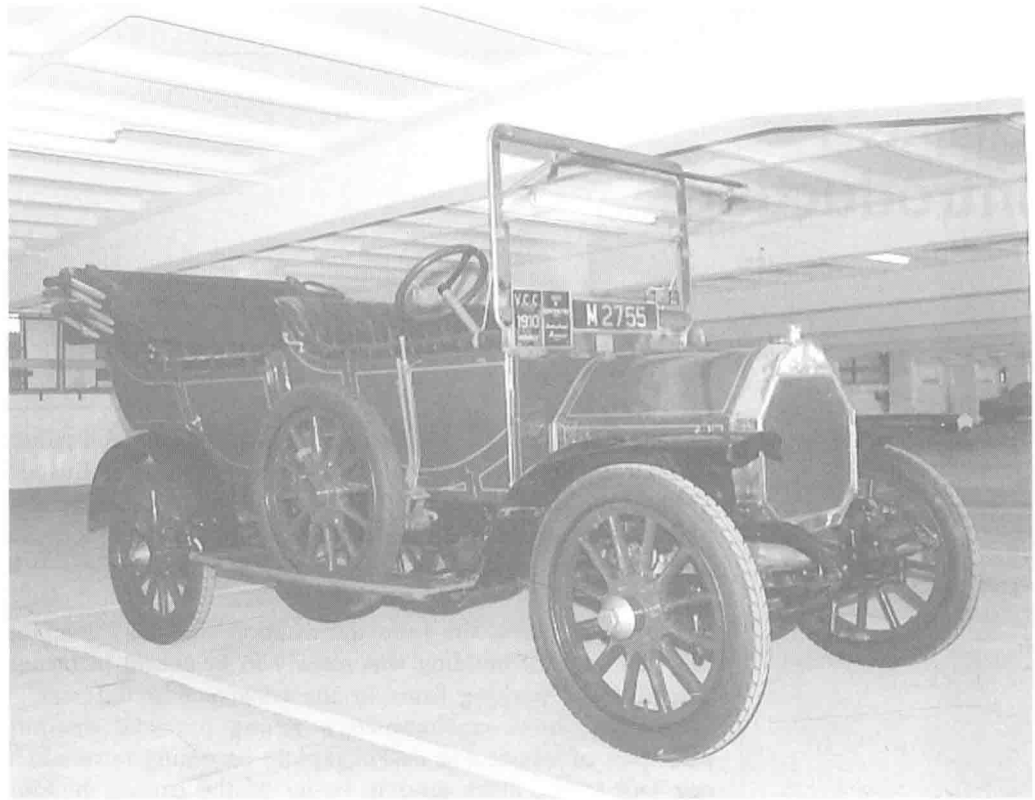
In the early years, the little information that was available concerning the design of this new type of building was mainly to be found in technical literature distributed by specialist car parking firms in the construction industry. The manoeuvring geometry of vehicles, however, imposed a strong practical discipline resulting in the general principles of layout and design rapidly becoming rationalised, with split-level decks and one-way traffic flows used in many of the earliest buildings designed specifically for parking cars.

Independent information gradually became more available, especially after the publication in 1969 of the *AJ Metric Handbook* and in 1970 of *BPA Technical Note 1. Metric dimensions for car parks – 90° parking*. In 1973, at a Joint Conference on Multi-storey and Underground Car Parks, organised by The Institution of Structural Engineers and The Institution of Highway Engineers, a paper by BR Osbourne and WP Winston was presented containing most of the relevant information available at that time relating to parking geometry. The 'Des Recs' (Design recommendations for multi-storey and underground car parks) were published in 1976: the first attempt to create a national standard work on car park design. It contained much of the information presented at the Joint Conference, together with relevant parts of *Report LR 221* by the Road Research Laboratory, *Parking: Dynamic Capacities of Car Parks*, published in 1969. The report was omitted from subsequent editions.

Historically, MSCPs in the UK have suffered an unenviable reputation for poor layout design and quality of parking. The problem has always been in balancing the motorist's desire for ample room in which to park with the client's desire to build as economically as possible, but in a highly competitive market designers sometimes went too far in the direction of pure economy, and cost-conscious clients were insufficiently critical about poor design features. This resulted in car parks that were lacking in essential dimensions. Many were poorly constructed, badly lit, inadequately waterproofed, awkward to park in, and insecure: mostly, however, they had the merit of being cheap to build.

Modern social trends recognise that parking quality plays a major role in the choice of destination for motorists and their families. Car parks provide, quite often, the first and last impression that people experience when visiting an urban location or commercial enterprise, and have a significant influence on any decision they may make to return. Over the years there has been little change in the manoeuvring envelope of cars licensed to drive on the public highway. Figure 1.1 shows that even in 1910 car-manoeuvring envelopes were similar to those of today's vehicles and that a well designed modern car park can be used by vehicles of all ages.

Figure 1.1 A 1910 Ford in a 1990 car park



1.2. Advice and guidance

Multi-storey car parks are utilitarian constructions. Their design is not a finite art: it is a compromise, a balancing act between motorists' spatial desires and the practical need to achieve economy of construction and effective use of the site area. Stall dimensions, aisle, ramp, and access-way widths, ramp slopes, headroom and circulation layouts can all vary: the critical criterion is general acceptance by the motorist. The purpose of this handbook is to provide advice and guidance on the features that will enable car parks to perform their function efficiently and economically and to be, at the same time, 'user friendly'.

1.3. Scope

The contents of this handbook cover the practical aspects of design for self-parking facilities. Block parking and valet parking, where attendants park cars, have been excluded. Also excluded are mechanically operated car parks and matters concerning architecture, except where they are affected by practical considerations.

1.4. Design flexibility

A multi-storey car park, whether above or below the ground, is costly to construct. Consideration should be given to possible changes of parking function during its working life. Initially, it might seem sensible and economical to provide minimum dimensions and standards to suit a particular purpose. Within time, however, its parking category may change, and unless the interior layout is sufficiently flexible to cope with these changes, the facility could become redundant.

Example 1 is a multi-storey car park serving a town centre bus station, which was relocated. The site was sold for retail development and the car park was offered as part of the deal. The layout with warped decks, although adequate for its original purpose, was not suitable for shoppers and so a 500-space building in good order had to be demolished.

Example 2 is a large factory, located on the edge of town, which closed down and was sold for retail development. The car park for the workforce, designed to minimum standards, was unsuitable for use by the general public. It too, had to be demolished.

In the early 1970s, it was rarely considered that car parks could be bought and sold, and that the role for which they were originally designed might alter. Nowadays, however, they are being bought and sold in increasing numbers, either individually or collectively. Market values depend not so much on their architectural merits but on their popularity with the parking public and as such they should be designed, within reason, to be as flexible as possible.

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Chapter 2
Design brief

2.1. The client

Not all clients have an expert knowledge about car parks. They are conscious of the need to provide a certain number of parking spaces at a given location, but they are not, necessarily, aware of the information that is required in order to produce the most efficient and cost-effective building.

Designers should present their clients with a questionnaire in order to obtain the maximum amount of relevant information as early as possible. It is unlikely that it will all be available at the preliminary stage, but it does no harm to ask the questions and, at least, it establishes the designer's expertise in the subject.

2.2. The brief

Apart from items such as a ground investigation report and an accurate site and level survey, both of which may require an unacceptable financial outlay by the client at an early stage, the brief should include as much of the following information as possible.

- The maximum and minimum number of spaces required.
- A plan of the proposed site to a known scale, showing the building lines and the surrounding access roads.
- Site levels, even if they are only approximate.
- Proposals for future development that might have an effect on the setting out, shape and function of the building.
- The presence and if possible, the location of electric cables, gas pipes, drains and sewers that might be under the site, especially those that must not be moved or built over without special precautions being taken.
- The maximum number of parking levels and height of building required by the client or allowed by the local planning authority.
- The proposed use, whether it is to be a long-, medium- or short-stay facility, together with the anticipated vehicle entry and exit traffic flow figures.
- The category of parking required, bearing in mind the possibility that it could be sold at some future date for another purpose category.
- The proposed method of payment to be adopted for financial control, whether it is to be a 'payment on exit', 'payment on foot', or 'pay and display' system, or even no payment at all.
- The client's preference, if any, for a particular type of construction.
- The accommodation required for staff and the general public (offices, rest rooms and toilets, etc.).
- The capacity and preferred location for lifts and/or escalators. This is an especially important item when in conjunction with retail shopping.
- The requirements for water-protection over the top parking deck, either with asphalt or an elastomeric membrane, or leaving the top deck untreated, or even roofing over the complete building.
- The need to provide heating to exposed ramps.
- Whether or not a mechanical means of ventilation is acceptable: an important issue when the building is close to adjacent site boundaries.
- The client's preference, if any, for standards of finish in lift lobbies, escape stairs, on parking floors and on exposed parts of the internal structure
- The levels of interior lighting to be adopted (if it varies from British Standards) and any other instructions regarding painting of the interior that could affect the lighting design.