LEARNING ARCHITECTURE 
TEACHING ARCHITECTURE

a guide for the perplexed

TOM HEATH
CHAPTER 2

the plan is the generator

www.tomheath.org
What this book is not
This book is not intended to explain how the ‘design elite’, as Larson (1993) calls them, go about designing buildings. There are plenty of books by and about leading architects which seek to do this. However, these books do not seem to be much help to the beginning student facing that dreadful blank screen or sheet of paper. This is not because these eminent people or their biographers are deliberately setting out to mislead anyone. No-one would expect a great musician’s musical biography to pay much attention to chords and finger exercises. Yet chords and finger exercises, or their equivalent, are essential parts of the preparation for any skilled performance, and architecture is a very skilled performance indeed.

What this book is
Sir Henry Wotton (1686), who gave the English-speaking world its most popular architectural cliché, ‘commodity, firmness and delight’, also gave his readers much practical advice. In writing about staircases, he says that what he is providing is a set of ‘vulgar cautions’, that is, advice designed to help people not to make elementary mistakes. This book is a book of ‘vulgar cautions’ for beginning architecture students. The approach taken throughout will be found to differ from those of some other writers, partly because design is a large subject and will look different from different points of view, partly because of its resolutely practical viewpoint, and partly as a consequence of differences in values.

Extract from Chapter 1 Introduction
PROFESSOR TOM HEATH (1931–1998)
A graduate of the University of Sydney (B.Arch 1954), (M.Bld Science 1966), (M.Arch [Research] 1980), Tom Heath joined prominent Sydney firm of McConnel Smith and Johnson where he was a director for 15 years. In 1979, he left the practice to become Dean of the Faculty of Built Environment and Professor and Head of the School of Architecture Interior and Industrial Design at QIT, then QUT in Brisbane until 1990. He then became University Research Professor of Design and Director of the Research Concentration in Design and Construction Studies at QUT. At the same time he was editor of the RAIA journal Architecture Australia from 1980–1990. Heath was highly respected as an architectural theorist and wrote three books and over 200 papers on the theory of design. Method in Architecture (Wiley 1984) and What if Anything is an Architect? (Architecture Media Aust 1991), was followed by Learning Architecture / Teaching Architecture: A Guide for the Perplexed which was completed shortly before his death. His role as editor of Architecture Australia gave him the opportunity to be heard by the profession at large and through his editorials, he was a prominent voice. He was a foundation and active member of the Environmental Design Research Association (USA) and was inducted into the Design Institute of Australia Hall of Fame in 2007. His often perceived eccentric ways of a bow tie wearing academic, concealed an intensely private man who eschewed convention. His contribution to QUT was recognised by the establishment of the Tom Heath Gallery within the QUT Art Museum.

Robert Riddell
Extract from Encyclopedia of Australian Architecture (CUP)

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a guide for the perplexed

TOM HEATH

illustrations by Ray Jones

denarius design books
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ACKNOWLEDGEMENTS

The manuscript of this book was completed by my husband Tom Heath shortly before his death. In the process of producing and publishing the book, I was immensely grateful to receive valuable advice, encouragement and assistance from Tom’s friends and colleagues, and would like to specifically thank Amos Rapoport, Andrew Seidel, Wolfgang Preiser, Gordon Holden, Vesna Popovic, Jill Franz, John Simpson, Ian Close and Harry Nicolson.

I would also like to thank the following individuals and friends whose generosity in providing advice, encouragement and support was greatly appreciated: Derek and Tim Heath, Janet and Bill Conrad, Phillip Follent, Peter Beiers, Izabella Chabrowska and Angelo Kakoulidis.

I express my gratitude for the support given to me by Conrad Gargett Architecture, and by Peter Lavery and Vice-Chancellor Peter Coaldrake, both of Queensland University of Technology.

Special thanks to Ray Jones for his elegant illustrations throughout, and also to Jennifer Marchant, Heather Buchanan, Janelle Fenner, YE Ng and others for their assistance in the production of the book. The illustrations in Chapter 2 are based on original sketches by the late Paula Whitman.

Sipen
foreword
There have been various responses to a sense of dissatisfaction with architecture and architectural education. Some new fields have emerged to suggest solutions (e.g. Environment-Behaviour Studies, Design Methods and Participation). In my own field of Environment-Behaviour Studies, two attitudes can be identified. The majority tries for improvements within the existing paradigm, hoping to improve architecture, the profession and education incrementally – through a greater emphasis on research and users. I am a minority (possibly of one) and argue for a radical change, for a redefinition of architecture (as a science based profession not an art) and hence of the nature of design and education. As a result I rejected the core of architectural education, the studio, and have refused to teach studio or be involved with it for 40 years. Since my 1983 article about the topic I have become even more radical.

What then am I doing writing a foreword for a book on how beginning students in the studio might learn better and be taught more effectively?

What follows is an answer to that question.

I begin by admitting that my position is totally unrealistic (although, I believe, essential). Effectively, I have given up on architecture as it is. Tom Heath was ever the architect, and took a realistic position. While aware of the more radical positions, he believed that through research and incremental change things could be improved. In fact, Tom Heath and I had great debates when we met at conferences and late into the night when I stayed with him during visits to Brisbane and QUT. It was something we both enjoyed.

It was clear that anything Tom said had to be taken seriously – it was always the result of careful thought and thorough knowledge. This applies specially to this book which presents the full development of his ideas about how to improve studio education and bring it and the profession closer – a goal dear to Tom’s heart, reflecting who he was.

After many years as a director of a large Sydney practice (McConnell, Smith and Johnson), i.e. deeply involved professionally, he moved to academia. He became University Research Professor of Design at QUT, and became equally involved in academia. He did research and
not only taught and mentored students but thought deeply about teaching and learning. He also published, both papers and books. One was *Method in Architecture* (1983) in which he dealt with some of the theoretical issues explicitly omitted in this book although as he points out, these inevitably appear in the last chapter addressed to teachers. The second was *What, if anything, is an Architect?* (1991). In the present book he draws on his deep familiarity with both academia and the profession.

Another important thing: as an undergraduate, Tom Heath had been influenced by Andersonian philosophy. As a result he could approach issues intellectually, be analytical and develop a clear, logical argument. At the same time he managed to avoid the jargon, obfuscation and fashionable verbiage that mars many philosophical and architectural writings. In this book the clarity of thought is matched by the crystalline clarity of expression: the use of simple language, a concise and very structured, easy to follow argument. This makes it of great benefit to read it, even if one disagrees with it, or parts of it.

One important aspect of research and scholarship is the extent to which it stimulates thought, questions, reactions and challenges readers (if they disagree) to formulate equally clear, cogent, logical and well-supported counterarguments. Consider two recent quotations from a single issue of the journal *Science* (Vol 326, Issue 5951, 16 October 2009). In the first (p336) a paper is described as ‘one of the most important – not because it is right – I think it is a little wrong – but because it acted as a catalyst to get people thinking’. The second, on pp368-369, reviewing a book says that ‘...fruitfully forces us to think in new ways about…’

*Learning Architecture / Teaching Architecture: A Guide for the Perplexed* does that extremely well, as I will elaborate below.

I think of architecture as dealing with two major questions. The first is what should be done, i.e. what should any given environment be to be supportive of its users, and *why* – providing the research-based evidence for the decision. Then follows the second question – *how* should that environment be given material expression. I regard the first question as more important, but underemphasised, especially in the studio. Heath explicitly addresses only the second
question which of course remains essential (and it is the second question with which studio is currently largely concerned). Since not much is said about the first question, a major point of potential disagreement with my position disappears, because my concern is with how the first question can be made dominant, or at least given more emphasis.

Heath does an outstanding job in dealing with how to improve the way studio deals with the second question. He uses a most unusual and interesting approach by approaching the issue from two directions: first looking at how students best learn (the bulk of the book) using many research findings and, second, how particular ways of teaching could help.

It is a thoughtful, sophisticated, superbly reasoned and clearly expressed account of how architects approach design. It makes explicit what is typically either left implicit or obfuscated. It challenges the reader, student or teacher to think – to think hard, clearly and explicitly about what is being said and advocated, and about the nature of the evidence used. Ultimately that is what education (as opposed to training) is all about. It poses a major challenge for someone to write as good a book about the what and why of architecture as this is about the how, and about how a better job can be done in teaching and learning that aspect of architecture (and how the two can be brought together).

For me, reading is a form of dialogue with the author. Publications that I own (and student work) are much annotated – usually in red ink. As a result, when I retired, my PhD students gave me a red roller-ball pen. I still use it – and it was extensively used on the manuscript of this book.

These annotations showed me how this book has greatly clarified the nature of my position – the points of agreement, of disagreement (and where these are most acute), and my positions vis-a-vis the evidence cited. In effect, Learning Architecture / Teaching Architecture provides guidance, a road-map as it were, of how and where to identify counter-arguments and cite contrary evidence. It challenges one to construct what one hopes would be an equally clear, logical and well-reasoned argument (not an easy task).
From the first paragraph of Chapter 1, Heath clearly states his position, his starting point, his goals; the route followed and the decision points en route become clear as he proceeds point by point, using short, pithy, clear sections. One’s own thinking becomes structured and clear rather than global and inchoate.

In a book on the genetic bases of human behaviour by W.R. Clark and M. Grunstein (*Are we Hard Wired?* p239), it is said about a paper that it can be praised, rejected, welcomed or damned, depending on one’s position, but it cannot be ignored.

Neither can *A Guide for the Perplexed* be ignored, nor must it be. It is to be hoped that readers, whatever their position, will pay due attention and read it as though engaged in a high-level dialogue with someone very special.

Tom Heath died much too early. Personally I wish that he were still with us, and that he and I could continue to debate issues in person. This book, if read creatively and proactively, is the next best thing. We thus owe a debt of gratitude to his wife Sipen for the work she did to make this book available to us.

**Amos Rapoport**
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Tom Heath and the Book
It is an honor, indeed, to frame Tom Heath’s book.

I had the pleasure of meeting Tom first in 1972 in Leuven, Belgium, at a conference organized by the International Association of Empirical Aesthetics. Tom was a serious scholar in that topic area, and he contributed 3 books and over 200 articles to the field of architectural design theory over the span of 40 years. In Australian parlance, Tom was an aristocrat; i.e., a descendant of one of the early arrivals on that continent, and one with a distinguished record, both in architectural practice and academia.

Tom served as editor of *Architecture Australia* and was a founding member of the Environmental Design Research Association in the US. He served as Head of the School of Architecture, Interior and Industrial Design, as well as Dean of the Faculty of Built Environment at the Queensland University of Technology in Brisbane.

During my 11 lecture visits to Australia, I always made it a point to connect with Tom, whose vigorous academic pursuits and exemplary collegiate demeanor made him someone whom one would seek out to collaborate with. Starting in 1979 at the Educational Forum of Australian and New Zealand Schools of Architecture in Brisbane, Australia, I made the pilgrimage to Tom’s academic institution on many occasions, and had the privilege of staying at his Queenslander colonial style home.

The last time I met with Tom was at the 1996 annual conference of the Environmental Design Research Association in Salt Lake City. Were he still with us, he would have been an important contributor to our book *Designing for Designers: Learning from Schools of Architecture*.

I was sad to learn of his untimely death in 1998. It was an honor to have known Tom for so many years. We miss him. The present book is testimony to his serious commitment to scholarship in architectural education and to his critical mind set, which enabled him to separate fact from fiction in the field of architecture.

**Wolfgang F.E. Preiser**  
Professor Emeritus of Architecture, University of Cincinnati
There are so many ways I want to describe Tom. I knew Tom over a period of about five years when I was a Visiting Professor for a part of each year at Queensland University of Technology. Tall, gaunt, always with a warm smile, enjoying a good joke, even a pun, he may have appeared to some as the quintessential patrician completely at home with tea, scones and cricket. Yet, I rarely saw him that way. He was thoroughly the gentleman and always a gentle man. I saw a dedicated teacher and a thorough intellect. He approached ideas, colleagues and students alike with thought, analysis, caring, humor and, I must add, a twinkle.

Tom believed it is now architecture’s turn. Well, so he mentioned to me. I’ll explain.

Today we nearly all think of physicians as a practicing scientist. But they were not always that way. In the 1930s, penicillin underwent one of the first random-trial drug testing protocols, introducing scientific experimentation, external to the daily event seen in a physician’s practice, into the knowledge base of physicians. However, we know that many general practitioners still do not understand the statistics that underpin the vast majority of the healing regimes they prescribe. It has been nearly eighty years and the progress has been very slowly evolutionary. Resistance to change is great. Yet, slowly, the practice of medicine has been changing from a practice-based knowledge to a research- or science-based knowledge. Some might call it glacially evolutionary.

In management education, the 1940s saw a turning point due to many developments occurring during and perhaps because of World War II. Management education was changing from practice-based faculty-member knowledge to research-developed knowledge. While some may lament that the pendulum has swung too far (and perhaps stuck), we nonetheless view management education today as research-based. We daily hear about metrics, research results and demographics in marketing and take them for granted. The seat-of-the-pants management approach is probably very much alive but its credence is severely diminished when confronted by contrary research results.

Tom believed that it is now architecture’s turn to begin the movement from a practice-based profession and discipline to an evidence-, research- and knowledge-based profession and
discipline. It is architecture’s turn to add to its glorification of designer-stars respect for measurable accomplishments and applications. It is architecture’s turn to change faculties from consisting primarily of successful practitioners to faculties consisting of researchers who can bring their research to bear on the practice of making better architecture and on improving the lives of those who inhabit those environments.

Like medicine and management before, Tom Heath believed this slow evolutionary process, even with its potentially significant flaws, had begun and he wanted to be one to leave a lasting contribution to such glacially hasty events. His first three books on method, the profession and aesthetics certainly made a mark.*

Yet, this book may be the most lasting. It will certainly be the most controversial. It was intended to provide entering architecture students with practical and fundamental knowledge that others before them have learned. The idea is that, if these approaches can be passed down, not forcibly rediscovered by every student, then the student’s intellect would be freed to move on to more challenging questions, to attain greater heights. Tom, after all, viewed the world as an intellectual would, trying to make sense of it through a process of both rational and creative thought. Through his career as an architect, a hospital programmer and designer, an editor of professional magazines, and as an academic, he mastered a highly rational approach.

This did not always please everyone, of course. Architects are taught to value, even revere, the grand art of the designer. But Tom knew that art history must be different from architectural history. And art and architecture could not be only examined similarly. After all, no one lives or works in a sculpture. Intellectually Tom knew that architecture can become its own form of art, but just as science was added to the art of medical practice and, with all the research in management, the art of the charismatic leader remains highly elusive to thorough examination, Tom also knew that as projects have become more and more complex and will continue to do so in future, art will remain in architecture but escalating rational abilities will be increasingly required.
I don’t think Tom would have described it as a conflict between the studio method of teaching architecture and the seminar. After all, anything can be done in either setting. His concern was just the growing need within the profession of architecture for increasingly substantive and rigorously developed knowledge for use in practice.

He probably knew that devotees of the studio method might have a problem with this book. Such devotees might argue that nothing should be explained and that the value of the architect was to discover or invent knowledge as appropriate to a project. Tom would disagree. He could not understand how standing on the shoulders of others, unless there was a good reason to ignore precedent and the knowledge of others, could be viewed as anything but positive.

To the student of architecture, use this book. It will save you time and free you to go further. Yet, nothing should be completely unexamined. If you have good reason to circumvent the principals stated here, then you know what to do.

To the practicing architect, you may enjoy this too. It may be a refresher you’d like to have in the office.

To the professor of architectural design, is there a way you could use this book to help your students move more quickly onto the complexity that is, after all, architecture?

To everyone else, enjoy this book. This may give you a clue about the simpler aspects of the problem architects face.

This book is a concluding contribution for Tom due in large part to the efforts of Sipen and a beginning contribution for this continuing discussion.

Tom was right. It is beginning to be architecture’s turn. To paraphrase The New York Times, those few architects who emerge to the level of fashionistas will remain on pedestals. At any given time there are 9-12 such people in the world.
The greatly innovative will realize that there is something in the future of architecture that will combine both the object and services into single packages. Yet, the overwhelmingly vast majority of successful, practicing architects will live fulfilling lives by providing professional services that honestly and directly try to improve the existences of those who utilize the environments they create.

It is to that last group that this book is dedicated.

Andrew D. Seidel
Editor-in-Chief
Journal of Architectural and Planning Research
Toronto

Tom Heath had a very distinguished career in the practice, analysis and teaching of architecture. This unique book is testament to a career long passion for all of the facets and idiosyncrasies of a profession which has been endlessly written about. Most of this writing is about so called architectural ‘heroes’ or ‘signature’ buildings.

This is not one of those books.

This book, perhaps essentially written for students of architecture, will, because of the substance of its message, scope and thoroughness, also appeal to practitioners of architecture. It has the potential to confirm already established philosophies but is capable of, and likely to, I believe, inspire new ones. Tom considered the work of an architect akin to that of a midwife – properly executed it resulted in a wonderful outcome.

I consider myself fortunate, indeed privileged, to have known Tom. He invited me to join the Editorial Panel of Architecture Australia during his term as Editor 1980-1990. We met frequently for very enjoyable and informative sessions in the billiard room of Old Government House at QUT Gardens Point Campus.

This very important building has recently undergone a programme of significant restoration and adaptive-reuse under the skilful direction of Sipen.

I recall very fondly enjoying many lunches with Tom at a favourite restaurant near QUT, during which we had such fun, we must have seemed to others in the restaurant, like naughty schoolboys in need of parental discipline. Although not aware at the time, I later realized that during such occasions, typical of the man, he was testing ideas being explored in the preparation for the book.

Tom was a very private man, seemingly rather shy in company but with a subtle and disarming sense of humour. He was popular with his architectural colleagues, artists and
scientists, all of whom considered him to be one of them. These relationships have informed the book and endowed it with a confidence of intellectual connection to all areas of creative endeavour.

In recognition of his contribution to QUT, The Tom Heath Gallery within The QUT Art Museum is named in his honour.

This is an important and scholarly book. I admire and commend Sipen for her vision and determination to give it life.

John Simpson
The publication of books, articles and conference papers about comprehensive architectural education appears to wax and wane over time. For some time now there seems to have been attention given both to narrow topics on the one hand and overall architectural programme structure and degrees of integration with education for other disciplines on the other – both rarely delving deeply into the detailed scope and curriculum of primary knowledge and skill needed to design buildings. We may be in what can be interpreted as a period of wane in comprehensiveness. So the timing of the release of this book which addresses what Tom Heath considered to be the essentials of architectural education is significant in that it may help fill a gap in current discourse.

This book provides primary knowledge to the student of architecture that directly addresses buildings and their embodied architectural ideas combined with added dimensions of down-to-earth information and advice on how to apply knowledge. Heath writes that the book is ‘for use in the studio, as a practical substitute for experience’. The need for greater attention to primary architectural knowledge has been noted in the past. In a QUT colloquium on the knowledge needs for architectural practice, Jennifer Taylor observed a worrying dominance in architectural debate of secondary knowledge over primary knowledge. She saw secondary knowledge drawn from literature and social theory as easily leading to obfuscation and confusion.

While clearly not targeted at professional architects, the scope of the book is consistent with Heath’s editorials in the profession’s journal *Architecture Australia* during the 1980’s which addressed a very wide range of architectural topics. These editorials and other papers gained a reputation for their wit and seriousness, their rationality and their capacity to pare-down the topic to its essentials. He could capture your thinking in the first paragraph or so with a thoughtfully positioned proposition that you accepted or rejected. If you accepted it, even partially, then the clarity and structure of the rational argument that followed would leave you with little room for a different conclusion. The content of this book is mostly true to Heath’s style. It clearly positions itself at the beginning and it is explicitly structured into obvious chapters each with subheading topics containing clear, rational discussion and
information. But it is different from past works in one important respect. The reader can go into the book at just about any point and gain something valuable from it, without needing to start at the beginning and follow a line of argument. This was clearly intended by Heath, perhaps motivated by his understanding of how students are likely to access knowledge.

Neville Quarry in the foreword to Heath’s *What if Anything is an Architect?* a compilation of editorials, felt that the writings could be grouped under the three headings of: Demolition, Excavation and Construction of architectural beliefs and theories. Accepting Quarry’s groupings, this book squarely sits as a ‘Construction’ although there is also some demolition of what Heath considers to be false beliefs…he couldn’t help himself!

I worked with Tom Heath for nearly twenty years during which I learned much from him about theories of education. I respected his writings and advocacy and I find myself still using some of his aphorisms such as ‘if you are not writing coherently then you are not thinking clearly’. I frequently sought his advice, which he gave generously, and I bounced ideas with him and gave him draft papers that I had written for review. On one occasion he returned a draft with his copious hand written notes all over it, including one part that said ‘bullshit’ followed by a statement of points as to why I needed to re-think the piece. I was pleased with this, because out of deference to a colleague he hadn’t used the stamp marked ‘bullshit’ that he used for student essays, something not politically correct these days. Although there will be different views held from Heath’s about learning and teaching architecture, I think the reader of this book will find that there is no nonsense in it.

Here are Tom Heath’s final thoughts about how to de-mystify architectural education, a cause to which he devoted a considerable part of his life. This is true Heath. I welcome it and recommend it for the perplexed.

It is to the credit of Sipen that this book is now available.

**Gordon Holden**  
Professor & Head, Architecture, Griffith University  
Queensland
On first hearing that Tom Heath had energetically and meticulously penned *Learning Architecture / Teaching Architecture* and being asked to contribute to the book, I felt both privileged and apprehensive. Tom at the end of his life had the deserved reputation of intellectual driver within the School of Architecture at Queensland University of Technology.

A five hundred page manuscript covering the wide gamut of issues embraced by learning and teaching architecture was bound to be a scholarly tome which would be difficult to appraise and honour here.

The manuscript thankfully offers refreshing reassurance from the very first page where Tom talks of ‘what the book is not’ and portrays it as book of ‘vulgar cautions’, and in a very easy-to-navigate format welcomes any teacher, student or those curious about architecture to want to read on.

The contentious and often opposing viewpoints surrounding architecture do not deter the author from either embarking on this ambitious undertaking nor proffering his own interpretations shaped and informed from his teaching experience. He confidently presents the pros and cons of various teaching tools and individual exercises alerting both teachers and students to the pitfalls of seemingly expeditious and easy learning modes.

He presents us with both the understandings and misunderstandings surrounding aesthetics, creativity, and inexpressibility as ideology, and even the ideologies of actually teaching architecture. His viewpoints are presented in bite size prose, well supported by references that allow the student and teacher to explore further. The book thus becomes the first and most important map (with many clues and links) to be scrutinised in the pursuit of a fulfilling architectural education.

Illustrated by Ray Jones, the book is an anthology of elegant, simple sketches akin to the itinerary for a ‘grand tour’ of influential and world renowned architecture. The buildings are thoughtfully chosen, some less well known and obscure but illustrating always the relevant message of adjoining text. They offer much more insight into seminal architectural
endeavour than could be gleaned through a haphazard sweep across the internet in search of short cuts to an architectural appreciation.

The manuscript was conceived almost a decade ago yet treatment of the theme ‘sustainability’ remains as relevant today despite the many changes that rapid technological advances have brought to the tackling of sustainable design. The tried and proven methods of passive design and thoughtful responses to local climatic conditions as well the appreciation of economic and political contexts influencing the processes of building are unequivocally articulated and thus ensure that this document provides a relevant and sound foundation for a student’s understanding of services and building technologies.

The book does not set out to be a curriculum for an architecture course however its thorough coverage of an extensive range of relevant topics along with suggested studio activities cannot help but form a basis for a credible and productive curriculum. If students and teachers did nothing more than to explore the many referenced authors and thereby reached their own conclusions about learning, teaching and aesthetic and creative appreciation they would build self-confidence in architectural discourse and expression that would serve them well in the company of experienced practitioners.

Tom Heath’s manuscript has turned into the most accessible of scholarly texts which dances with great agility from the pragmatic to the poetic and leaves the reader inspired.

I believe this book is destined to shape the lives of many a teacher and student and in turn, through their greater competencies, shape the better built environments of the future.

**Phillip Follent**

Queensland Government Architect
Hadrian’s Villa, Tivoli (c. 118–134), showing contours reshaped for Academy Roccabruna & Canopus
Introduction

The importance of plans

A plan is defined technically as a horizontal section taken so as to show the maximum of void and the minimum of solid. As with so many definitions, this tells us little about what a plan is and nothing about why it is important, so important that one might say ‘no plans, no architects’.

There are three reasons why plans have throughout history been the favourite tool of investigation and communication for architects. The first is that, as Arnheim (1977) has put it, ‘the horizontal is the domain of action’ (p. 54) (Fig. 2.1). The second is that, because plans show the solid parts of the building in relationship to the open ones, they tell us a good deal about the system of load and support. The third is that with experience the plan can give us a feeling for the building as an object and as a sequence of interior spaces.

The domain of action

The plan thus contains information about people’s activities, about technology, and about the way the building is likely to look and feel. This chapter considers only one of these aspects, the plan as representing the domain of action. It is in this sense that Le Corbusier (1923) spoke
of the plan as the generator (p. 44). The connection between action, or activities, and the plan of a building is not a mechanical one. The old notion of ‘functionalism’ involved two mistakes. First, human action was treated as if it were in principle like the action of a machine, the approach satirised by Chaplin in *Modern Times*. Second, it was assumed that there can be only one physical environment that can match a given pattern of activity. Le Corbusier unintentionally fostered these mistakes with his unfortunate and often quoted saying that ‘a house is a machine for living in’ (p. 222). As argued earlier (1.27), any realistic discussion of the generative role of action in planning has to be based on an understanding of values.

**Activities and values**

Human activities are manifestations of values, and the buildings that house them are embodiments of these values (Rapoport 1969). The different built forms that characterise different societies across space and time represent different systems of values. It is not possible to separate the ‘practical’ and the ‘functional’ from the ‘emotional’ and the ‘evaluative’. What is practical and functional in a given setting depends on what people want to do there and how they feel about doing it. The constancy and coherence of these values provides the substance or content of the design. In order to generate a plan, it is first necessary to find out what values are involved and what regularities of expectation or behaviour these values produce. These values provide the constraints that the design must meet if it is to be accepted.

**Categorising values**

Values take a variety of forms (Fig. 2.2). *Feelings* are personal and may be quite vague and difficult to make explicit. *Attitudes* are relatively consistent and readily observable but not necessarily expressed in words. Attitudes may characterise individuals or groups. *Beliefs* are organised, verbalised attitudes. They too may belong to individuals or groups. They are usually easily accessible and may indeed be given even when they are not asked for. *Customs* and *conventions* are the habitual and accepted ways of doing things. They may not be as clearly expressed in words as
beliefs but they also embody values. This comes out very quickly when the attempt is made to alter people’s ways of doing things, even if the change is intended to make them ‘better off’. Finally, laws and regulations express values that have achieved such wide and strong acceptance that they are considered to be enforceable.

Values and reasons
People may or may not have reasons for their values which appear to the architect to be good. The absence of such reasons is by no means an excuse for an architect to disregard values that differ from his or hers. In practice, if the values of significant stakeholders are ignored, things are bound to go badly wrong. However, when differing values lead to contradictory constraints, the absence of apparent reasons for some relevant value may indicate a possible starting point for debate and compromise.

Discovering values
There are two main ways of discovering the relevant values in a particular design task. One way is to seek information directly from the client and the users. The other way is to study existing examples. The study of existing examples, or state of the art review, is a useful preliminary to discussions with clients and users in practice, or to class discussion of design goals in the studio.

State of the art review
There are three main sources of knowledge about the state of the art in relation to the planning of a given building type. First, there is the architectural literature. Second, there is the environment-behaviour literature. And finally, there are actual examples that can be studied in use. Any worthwhile studio project will require state of the art review of the first two kinds. Depending on the educational objectives of the project, the review may be done mainly by the staff or mainly by the students. For a more detailed discussion of these issues, see Anthony (1991), chapter 5.
The architectural literature: books

In trying to understand a particular building type the most useful starting point is a book on that type. For reasons that will become clear later, a book is usually a better starting point than an actual example. Books about most building types are available. They range from illustrated surveys that may deal only with buildings completed in a particular year to thorough studies that trace the history of the building type and discuss in detail the relations between the activities housed, the technology employed, and the building form. Obviously the latter kind of book, if there is one, is the more useful.

There are some other criteria that can help to select books for study. A book would be of little use if it did not have plans that were large enough to read, with the rooms identified and drawn to a clear scale. Sections are a highly desirable addition. Illustrations should be easily relatable to the text. Sample the text itself and see if it is easy to follow and explains the practical issues as well as the aesthetic ones. Books that meet these criteria can provide a solid basis for a studio project. Conversely, if there is no good book on a given building type, that type may not be suited for a studio project for beginning designers.

The architectural literature: monographs

A good general survey can give some understanding of the values that shape a particular building type. This preliminary investigation can then be supplemented by monographs on individual buildings of the type that are recognised as classics. From these classics or exemplars the student can begin to learn the values of the architectural profession. A further guide to current professional values can be obtained by looking for recent examples of the type in journals.

The architectural literature: journals

In many countries there are national architectural journals which publish regular surveys of local architecture. Often such journals are published by the association of architects: examples are Architectural Record, the current journal of the American Institute of Architects, and
Architecture Australia. Because of their local focus, such national or regional journals are likely to contain the most relevant examples. A thorough review, however, requires some study of what is going on outside one’s own country, and there are international journals that provide critical studies of work from around the world. The Architectural Review (UK) has for more than a century been recognised as the leading journal of this kind, but it has many rivals, such as Architecture (USA), Quaderns (Spain) and Architecture d’Aujourd’hui (France). Such journals sometimes produce special issues on a particular building type.

**Interpreting architectural literature**

It is easy to scan a range of architectural books and journals and retain only a few striking images. This in itself is by no means useless. Partial and even wrongly remembered images may be invaluable fuel for the imagination (Goldschmidt 1994). However, a more critical study may be even more useful.

The later sections of this chapter provide a guide to some of the things that one should seek to understand thoroughly in studying examples and exemplars: the rooms, their sizes, shapes and uses; the constraints of the site; the patterns of movement that influence the grouping of rooms; and the organising principles that the architect has adopted (see also 5.3.64). Examples that differ very much from the task in hand in any of these respects are less immediately useful. It can, however, be instructive to think about the reasons for such differences. It is particularly important to bear in mind differences in climate and available technology. Examples from the United States, northern Europe and Japan may be quite misleading for tasks that are set in the tropics or in less developed countries, and vice versa.

Making rough sketches and notes is usually a more effective way of learning from examples than photocopying the article for later analysis (which may never actually take place).

**The environment-behaviour literature**

The environment-behaviour literature is potentially much more useful that the ‘straight’ architectural literature in the understanding of values.
We have to infer the values involved from drawings and pictures of built work, though this may sometimes be assisted by a good critical article or a report of an interview with the architect. Also, the architectural literature is heavily biased towards architects’ values. The environment-behaviour literature, in contrast, focuses on the values of the users.

Unfortunately, using the environment-behaviour literature is not as easy as it should be. Much of it is in specialist journals which may not be readily available. It often takes the form of scientific papers, written in technical jargon and apparently more concerned with methodology than results. The practical implications may not be made clear. It can be difficult to find material that is obviously relevant to the task in hand.

Nevertheless, there are now significant numbers of books written in plain language and with application in mind. Some of them will be referred to as we go along. The proceedings of the annual conferences of the Environmental Design Research Association (EDRA) and the International Association for People–Environment Studies (IAPS) often contain useful material. There are also journals that have a relatively high percentage of applicable material. English language journals include Environment and Behaviour, Journal of Architectural and Planning Research and Journal of Environmental Psychology.

**Studying examples**

If at all possible, a building of the type that one is trying to design should be visited. Such a visit can give a sense of the reality of which the photographs and plans in books and journals are an abstraction. However, there are dangers. It is easy to mistake features that are peculiar to one organisation or one building for general requirements. It is also easy to be overwhelmed by the complexities of the actual situation, and thus fail to grasp what is important and what is not. In education, and even in practice, the understanding obtained by such visits is proportional to the care with which they are planned and carried out.

Therefore, visits to examples, if they are to be made, should happen after a thorough literature review and should make use of systematic methods of investigation. ‘Walk-through’ methods of building evaluation
(Preiser, Rabinowitz and White 1988), the interpretation of meaning and value by the analysis of physical features (Rapoport 1982, 1990) and a variety of specific methods of investigation (e.g. Zeisel 1981; Sanoff 1991) can be used to direct and organise a visit.

**Briefs and programs**

Information can be obtained directly from the client in the form of a written document, a ‘brief’ or ‘program’. In practice, such documents are a very valuable basis for investigation and a very poor basis for design or action (Heath 1984, ch. 6). They seldom carry any sense of the political situation, the conflicts of values which always exist in any human activity, even in the mind of an individual. In fact, a brief may deliberately conceal or gloss over such conflicts. Thus there is no way of estimating the reliability of the information given; some of it may be liable to change. Finally, a brief may contain demands which turn out on investigation to be contradictory, and this may not be obvious. Later in this chapter it will be seen how easy it is for demands, reasonable in themselves, to have contradictory consequences.

Thus a brief usually has to be tested and in part re-negotiated. In the studio the program for a particular design task often has to be re-negotiated in this way. There are obvious advantages in treating this process of discovery of contradictions and negotiation of compromises as an explicit theme of the studio (Wade 1977, pp. 49–50).

**Asking and listening**

In practice, the most effective way of discovering the relevant values is to discuss the project with the people involved and listen to what they say. The most common failing of professionals is not listening to their clients.

Listening is not always easy. People often find it simpler to discuss details than broad issues (Wade 1977, p. 103). What they have to say is not always organised or coherent (Cuff 1991, chs 3 and 5). They may say one thing for the record and something quite different unofficially (Heath 1984, ch. 6). They are often reluctant to accept that their demands are, or even can be, contradictory.
For these reasons, discussions with clients and users, like visits to examples, are most productive if they are based on careful preparation. Discussing examples drawn from literature helps to focus and structure the exchange, and to frame the design process as an exploration of possibilities. It encourages clients and users to offer examples from their experience which they see as having features that they want. At the same time, it gives the architect an opportunity to introduce his or her professional values and perhaps introduce the client to ideas and opportunities that have not been considered.

**The client in the studio**

These complex processes of negotiation are difficult to simulate in the studio setting. In many studios, teaching staff enact an uneasy compromise between the roles of client/user, mentor and critic. ‘Live’ clients are sometimes introduced in order to overcome the perceived shortcomings of this mixture of roles. In most cases such initiatives achieve little because the interchange is so limited in time and so formal. One exception is community service projects in which the client is a real client and the outcome a real building. Such projects, however, consume a great deal of time and resources and may involve difficult issues of legal liability.

The educational objective may be able to be achieved in other ways. A ‘gaming’ approach, in which the students themselves enact various roles and trade-off and negotiate the weights to be attached to different demands, is one possibility (Sanoff 1989, 1991, pp. 1, 54–57). Alternatively, members of staff may explicitly take on the roles of clients and users, not in the traditional, ill-defined way but according to a prepared script. Such a script might define the character of the actors, their overt and covert goals, and their characteristic ways of conveying or withholding information.

**From top to bottom**

So far we have looked at ways of discovering the constraints that the plan must meet. These constraints, it has been argued, arise from the values and expectations of the actors, including clients, users and, in the
form of law and regulation, the community at large. A two-stage, ‘top
down’ approach to this initial process of constraint definition has been
proposed. The first stage is state of the art review. The second stage is
interaction with clients and users, or whatever process is substituted for
such interaction in the studio. In this latter stage the output of the state
of the art review is used to focus discussion of the specific task.

The remainder of the chapter offers a ‘bottom-up’ approach to
identifying issues and representing and managing information about
constraints. Three sections deal with important classes of constraint:
rooms and their equipment, site constraints, and the ways in which
patterns of activity influence the arrangement of rooms. The final
section presents some ways of matching and combining these sets of
constraints to generate preliminary layouts.

**Rooms and how to design them**

**Rooms and plans**

The single rooms, which are the most common form of basic shelter
everywhere, serve to protect people and their possessions from the
weather and from dangers real and imagined. They provide a setting for
human activities that is in some ways more comfortable and convenient,
safer and more orderly than the world outside. As communities grow
richer and more civilised, their buildings become more complex. People
no longer carry on all their activities in one big space. They multiply the
basic space or partition it to provide for separation between activities.
They do this because some activities are perceived as interfering with
others. Noisy activities interfere with quiet ones, public with private,
taboo and low-status with high-status and so on.

Even a building like a cathedral (Fig. 2.3) or a church, which is
dominated by a single large space, shows a good deal of differentiation.
There are likely to be a chapel, baptisteries, vestries, toilets, secular halls
and other ancillary places.

Thus we can say that a *plan is an arrangement of rooms and connecting
spaces*. Before we can have an arrangement, we must have something to
arrange. So in general the first step in planning is the understanding of rooms. However, there are some apparent exceptions.

Some exceptions

Spaces for display or exhibition may have few or no dividing partitions. Encouraging exploration is in these cases regarded as more important than creating ideal conditions for any one exhibit. Differentiation may be achieved by means other than solid partitions, such as changes of floor or ceiling level, and the use of lighting. Department stores, trade fairs and some art galleries are examples.

Another apparent exception is space designed for variable subdivision. City office buildings are a very common example. Such space is often spoken of as ‘flexible’, but this is somewhat misleading. The activity to be housed is known in general terms, and assumptions based on experience are made about the kinds and sizes of rooms that will be wanted. The architect then tries to achieve a combination of service distribution, partitioning system and façade system that will give the user a considerable degree of freedom in laying out the space. Planning
the actual subdivision of such spaces still involves knowing what rooms the end user wants.

Because the distribution of services is such an important issue in planning, such cases will be called ‘serviced space’. This should not be confused with the distinction that Louis Kahn described between ‘servant’ and ‘serviced’ spaces. Since the issues involved in the design of ‘serviced space’ are mainly technical and economic, they will be considered in the next chapter.

**Rooms and activities**

One way of understanding rooms is through getting to understand the activities that go on in them. Around two thousand years ago Vitruvius wrote in his chapter on the design of farm buildings: ‘The pressing room itself, if the pressure is executed by means of levers and a beam, and not worked by turning screws, should be not less than forty feet long, which will give the leverman a convenient amount of space. It should be not less than sixteen feet wide, which will give the men who are at work plenty of free space to do the turning more conveniently’ (vol. 6, ch. 6, p. 3).

This is a good description of the design of a room on the basis of the use to which it is to be put. The designer is to take into account the people involved, the leverman and the other ‘men who are at work’, the press itself, and the necessary clearances so that there is ‘plenty of free space’. These things are *constraints* that limit the range of sizes and shapes that the room can take. They are not exact specifications. Dimensions are described as ‘not less than’ so much. Then as now most of these constraints are obvious and commonsense. The difficulty is that there are often very many of them and unless they are dealt with systematically it is easy to overlook some.

**Props**

Because they have direct spatial implications, it is convenient to start with the props, to use the stage term. Props are furniture or equipment that is needed for carrying out a particular activity or playing a particular
social role (Goffman 1959). Walls, doors, windows and other building elements are not counted as props. Props can be divided into the fixed and the non-fixed (Fig. 2.4).

**Fixed Props**

Fixed props are often described as ‘built-in’. Furniture is built in because it is bulky and therefore unlikely to be moved anyway, or to make cleaning easier. These advantages have to be weighed against the loss of adaptability. Equipment is built in for the same reasons, and also because it often requires some service connection such as plumbing or three-phase electric wiring which makes moving it difficult or expensive.

**Non-fixed props**

Non-fixed props include most of what we ordinarily think of as ‘furniture’. However, the term also covers the things that furniture contains or supports, such as food processors or saucepans in kitchen cupboards, books on bookshelves, clothes in wardrobes, and all the other loose paraphernalia of modern life. These smaller props can have significant implications for the size and shape of rooms if large numbers have to be stored (see 2.2.13).

**Openings**

A room without openings is not much use. There must at least be a door to get in and out by, and it must be big enough to admit the people who use the room and all of the props involved. Unless the building is to be air-conditioned, there must be a window for light and ventilation. Even in an air-conditioned building, windows enable people who are doing close work to rest their eye muscles, and an outlook has other psychological benefits. Uninhabited rooms such as store-rooms may not need windows.

The location of openings is constrained by their purpose and their relationship to other fixed or non-fixed features. If a window is to provide an outlook, there are anthropometric constraints (Fig. 2.5); the sill should usually be below the eye level of a small seated woman, the
head above that of a tall standing man. Exceptions may be made where the intention is to frame a view as if it were a painting.

A window for light and ventilation must be big enough to serve these purposes. For temperate climates, 10% of the floor area of the room is a rule of thumb for the glass area. For ventilation, an opening section of about 5% of the floor area is adequate except in hot, humid climates. The opening section may be part of the glassed area or a separate flap or shutter. More accurate calculations can be made later when the room shape is fixed. (See also 3.3.33–39).

**Relationships between props**

This brings up the whole issue of relationships between props. For the successful carrying on of a given activity it is seldom enough just to have the necessary props present. A heap of parts is not a car until the parts are correctly assembled. Similarly, the props that support a particular activity must be properly related to each other. Here we need to consider two main kinds of relationships: sequences and groupings.

**Sequences**

Sequences of fixed props, equipment or furniture occur when an activity involves the movement of people or goods or both from one service point to another in a fixed order. For example, the used instruments coming from an operating theatre go through the following sequence in being sterilised for re-use: receive; soak; drain; clean in ultrasonic cleaner; sterilise in autoclave; sort; pack; dispatch to store (Fig. 2.6). In this case it is literally vital that the sequence be followed exactly. So we can represent the whole thing by means of a ‘knotted string’ diagram,
then find out the dimensions of the individual ‘props’ required, and finally try out arrangements to see how much space is required.

**Groupings**

A sequence is a grouping of props of a special kind. More generally, groupings of props arise because the activity consists of or includes exchanges of people or things or information, and these exchanges do not take place in a fixed order. They may be regular or irregular but more than one sequence is possible.

Take, for example, a group of people sitting together and talking (Fig. 2.7). It would be unusual to find a regular sequence in their exchanges. Their chairs will form a grouping but not a sequence. The dimensions of this grouping will be constrained by the sizes of the chairs, by the people’s need to see each others’ faces and to be heard without raising their voices, by the conventions of interpersonal distance and by other groups or activities, and perhaps by other props such as a coffee table.

**Sizes of groupings**

In general, the space required for a grouping is constrained by three factors. The first is the critical dimensions of the props involved. The second is the space required by the people using them. The third is the space required for other people who need to move through or past the grouping or to carry out cleaning or maintenance, and any equipment that they may have, such as trolleys or polishers. The space required for people must include their ‘personal space’ which cannot be ‘invaded’ without discomfort (Fig. 2.8). This is a cultural variable (Sommer 1969). These things set an approximate lower limit to the space required for an activity. Since, however, they all involve ranges rather than precise values, it is only approximate. Upper limits may be set, as already noted, by the need to see and hear. Other limits are set by consideration of the time and effort involved in moving between two props.

Where this seems likely to be critical, it can be given more precision by systematic observation, as in a work study. In designing an ‘ideal’ kitchen, for example, one might take a sample of recipes and analyse...
the frequency of trips from one prop to another, say between cooktop and sink, and thus estimate how important it is for these pieces of equipment to be close together (Fig. 2.9). Finally, upper limits may be set by the desire not to ‘waste’ space, that is, by economy. Once again, all these limits are in practice elastic. Cooking practices also vary between cultural groups and between individuals.

**Taking a stand**

Because of this characteristic elasticity of constraints, the limitations imposed by a given set of props and their necessary relations can usually be met by a great many different room sizes and shapes. We have ultimately to make a judgement.

Our knowledge of the general space requirements of the activities concerned is one basis for this judgement. In practice, it is also wise to allow for future change; this usually implies allowing more space rather than less. The third basis of judgement is knowledge of sizes and proportions that experience or research has shown to be satisfactory. The passage from Vitruvius quoted in 2.2.3 is exceptional; for most of the room types he discusses he recommends conventional sets of dimensions, and convention is still important today.


2.2.13

**Meaning and scale**

A room is not just a box for storing ‘activities’. Activities have meaning and value and what a room ‘says’ about these things is often more important than any detailed fit between them. Much of this meaning is conveyed through materials and finishes and through semi-fixed and unfixed elements (Rapoport 1982, 1990). Some meaning, however, is communicated by size and more by shape.

An essential skill in this respect and one that cannot be taught by books is an internalised sense of what a room of a certain size and shape will ‘feel’ like. This can only come from experience, but experience can be gained systematically. If you form the habit of measuring rooms that you experience often and rooms that you admire, this will help. Keep a notebook as Le Corbusier did on his famous trip to the east. You can apply the same principle to pictures of rooms in books and magazines. Try to find out their dimensions from the plan or by inference from the size of people or furniture, and keep a record of these dimensions.

As yet another rough rule of thumb, a room that approximates to the minimum area necessary for the activities will be perceived as cramped. One with twice as much space will seem generous and spacious. At three times the minimum area a room may appear grand or silly, depending on whether the activity it houses is regarded as important or unimportant. Above this we enter the realm of the vast, the overpowering and the awe-inspiring.

2.2.14

**Dynamics**

Besides these matters of scale, the proportions and shapes of rooms can produce dynamic effects (Arnheim 1977). Christian churches of the Gothic period had a narrow proportion in plan which produced a strong directional dynamic (Fig. 2.10).

This both enhanced the processional activities that were part of worship and focused attention on the altar. These buildings were also very tall in relation to their width and the resulting vertical dynamics contribute to a sense of spiritual exaltation.

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**Figure 2.10**

Vertical dynamics
Westminster Abbey (c. 1045–)
Rooms with walls that curve outwards seem more spacious for a given area than those with straight walls.

Opening up the corner of a room and extending one of the walls outside links the room to the space beyond more strongly than a framed window (Fig. 2.11). Using such dynamic effects can greatly enhance the meaning of a space.

**Guidelines and conventions**

Research has given us some general guidance on room sizes and shapes. With respect to size, research suggests that a room of about 14 square metres in area will comfortably house a very wide range of activities (Cowan 1964). The ‘next size up’ found by this research was about 18 square metres.

Of course the shape of a room is just as important as its area. Pikusa (1983) found that a square room approximately 3.75 metres x 3.75 metres, that is, roughly Cowan’s 14 square metres, was the most generally useful and adaptable in terms of domestic furniture layouts.

For the proportions of larger rooms, we may fall back on tradition. Palladio (1570) also favoured square rooms. He advises against any room being made longer and thinner than a double square. If a room must be narrower than square, he recommends a proportion of 4:3. As it happens, if we take this latter proportion and Pikusa’s minimum dimension of 3.75 metres we get a room of just under 19 square metres, a little larger than Cowan’s ‘next size up’. On this basis, square or 4:3 rooms with a minimum dimension of 3.75 metres are sensible starting points against which to try our groupings of props.

**Room heights**

The minimum floor to ceiling height of rooms is fixed by regulation in many places. Often these regulations are based on mistaken nineteenth-century beliefs about the minimum volume of air necessary for health. The limited research that has been done suggests that people can tolerate a surprising range of room heights (Savinar 1975). However, a practical minimum distance from floor to any significant projection
from the ceiling (such as a fan or light fitting) is about 2250 mm (7 ft 6 in). This allows a tall person to spring from a chair or to make expansive gestures without risk of injury (Fig. 2.12).

Low ceilings make for lesser quality buildings, by reducing the height of the walls. Higher ceilings may improve thermal comfort in some circumstances, and assist effective natural lighting; these issues will be discussed in Chapter 3. Probably the most important reasons for making ceilings taller than the minimum building code requirements are aesthetic; this aspect is considered in Chapter 4.

**Using guidelines critically**

There is nothing magic about these rules. They are rules of thumb and like all such rules must be applied with commonsense and attention to the particular case. Rooms of these sizes are much too small for a gymnasium or a ballroom and rather too big for a bathroom, unless it is intended to be very luxurious. If minimising area were for some reason very important, it would be possible to start with these sizes and shapes and explore ways of reducing them.

An important consideration in many cases is the ratio of perimeter to area. Mostly the aim is to maximise area and minimise perimeter because walls are expensive and this gives the most space for the least cost. A circle has the most area for a given perimeter. However, circular walls are troublesome to build using modern techniques. Besides, circular rooms do not ‘nest’ well, and they create difficulties in the placing of furniture and equipment, most of which is rectangular for the same reasons. A square is almost as good and avoids these difficulties. However, where there are to be a great many built-in fittings, as in a kitchen, a library or a dressing room, the aim may be just the reverse: as much perimeter as possible for as little area. To achieve this may require the use of proportions even narrower than 2:1.

**Communication spaces**

Communication spaces form the backbone of all but the simplest plans. They include halls and lobbies, corridors and passages, stairs and ramps,
lifts and escalators. Such spaces amount to 20% or more of the area of a public building. The design of these spaces is such an important aspect of architecture today that it could well form the subject of a series of studio projects.

**Halls and lobbies**

Halls and lobbies are transitional areas or zones between the relatively public and the relatively private. The issue of privacy is discussed in more detail later (2.4.29). Such spaces are also often used to make symbolic statements about the importance of the more private areas which they protect, as discussed earlier. Finally, they must provide for some necessary activities: storage of outdoor clothing, orientation, waiting, transit, and in some cases support services.

**Coat hooks and cloakrooms**

In very cold or wet climates, arriving visitors may need to remove, store and later find and put on outdoor clothing. In some buildings, such as art galleries, bags must be checked for security reasons. Provision for these activities range from a few strategically located coat hooks to an elaborate cloakroom with attendants and mechanised racks.

**Orientation**

In almost all buildings open to the public some visitors will need help in finding their destination within the building. Again this can range from a simple directory board and signage system through to elaborate interactive maps to a full-scale staffed reception desk or inquiry counter.

**Waiting**

Waiting is at best boring and is often accompanied by acute anxiety. It is only humane to do everything possible to make it bearable. A space for waiting should be visible but out of the traffic stream. It should have good access to whatever sources of information are available. It should have rather more than enough seats, since in places influenced by European–American cultural values strangers will not willingly sit next to one another (Sommer 1972). If large numbers are involved, a variety of seating groupings may be necessary (Sommer 1972).
Transit

People cross lobbies and halls often in haste and in public buildings often in large numbers. Clear and direct paths between main entrances and exits meet these needs. On the other hand, an indirect path with one or more turns can contribute to privacy or assist in a psychological reorientation (4.5.50–51).

Support services

Besides these major activities, lobbies and halls in large buildings often house or connect directly to a variety of services for visitors. Toilets are the most common of these services. Commercial services, particularly those providing food and entertainment, are also very common. Where long waits may be involved, as in transport interchanges, such facilities are essential.

Corridors and passages

The main activity in corridors and passages is transit. A passage 1 metre (3 ft 4 in) wide will barely allow two people to pass each other without turning sideways. For any public passage with much traffic 1.5 metres (5 ft) is a minimum dimension (Fig. 2.13) and 2 metres (6 ft 8 in) is preferable.

As with halls and lobbies, however, the dimensions of corridors and passages are often based more on symbolic considerations than on anthropometric ones. Also as with halls and lobbies, a most important aspect of corridors and passages is providing visitors with information that can help them to orient themselves and find their destination. These issues will be discussed further in later chapters.

Stairs

Stairs provide greater aesthetic opportunities than any other architectural element. This aspect will be discussed in Chapter 4. Here we want to provide some basic information that will allow the approximate minimum size and shape of stairways to be estimated. The factors that must be considered are the stair width, the length, which in turn
depends on the dimensions of treads and risers and the number and size of the landings, and the overall stair configuration.

**Stair width**

Stairs can be considered as sloping corridors, and the width between handrails should therefore be at least that of a corridor of similar function. However, people move more slowly on stairs than in corridors, and where a stair is expected to carry significant numbers of people it should in fact be wider than any corridor that leads to it. This applies particularly to escape stairs; the width of escape stairs is often fixed by regulation and often on no very clear grounds.

**Treads and risers**

The front-to-back dimension of stair treads and the height of risers are also often fixed by regulation. In many cases these regulations are based on rules devised in the eighteenth century by Francois Blondel, then director of the Royal Academy of Architecture in Paris. These rules were derived from observations of people walking up stairs and for this they work quite well. Unfortunately, more systematic research conducted in the twentieth century has shown that these rules do not work nearly so well for walking down stairs, and, further, that it is in walking down stairs that most accidents happen (Fitch, Templer and Corcoran 1974).

The most important result of this research was to show that the minimum front to back dimension of a stair tread should be 275 mm (11 in). This is significantly greater than the minimum permitted by many codes. The reason is simple. As treads get smaller, a point is reached at which a significant number of people cannot fit their foot on the step without turning it sideways. This produces an unbalanced and unstable gait and greatly increases the risk of missteps. The maximum desirable dimension of the tread was found to be about 350 mm (14 in). The height of the riser can range between 100 mm (4 in) and 175 mm (7 in).

A convenient working rule for preliminary design, derived from this research, is that we should allow a total plan length for the stairs of twice the floor to floor height. To this must be added the landings.
### Landings

It is usual, and often required by regulation, to provide at least one landing between floors, as near as possible halfway up. For stairs that rise more than about 3600 mm (12 ft) a second landing is desirable. The landing is usually thought of as a resting place on the way up, but in straight stairs its most important purpose is to prevent people from falling very far down. To be sure of stopping someone rolling down stairs, a landing should be at least 900 mm (3 ft) wide. Landings that are also changes of direction must be at least the width of the stair, since they are part of the same ‘passage’.

If you want the underside or soffit of your stair to merge neatly with the soffit of the top landing and with landings at changes of direction, and the handrails to flow smoothly without breaks or steps, then you must allow an additional tread at the top of each flight, projecting from the landing and at the same level (Fig. 2.14). The working rule given above allows enough ‘run’ or length of stair for this.

### Stair configurations

Many stair configurations are possible, and a few of the most popular have been illustrated. For a ‘monumental’ stair, that is, one which is of symbolic importance and will be used by large numbers of people, the selection of configuration will be mainly aesthetic. Smaller stairs also are often used for decorative effect. For escape stairs and less used stairs, the so-called ‘dogleg’ stair is the most used, because it is the most compact. (The name comes from the appearance in side elevation.)

There are some quite common stair configurations that should be avoided for reasons of safety. The most common is the stair with ‘winders’ or wedge-shaped treads substituted for a landing or part of a landing at a change of direction (Fig. 2.15). This is quite often done in medium-density housing, to ‘save space’. Since in this arrangement at least half of each such tread will be narrower than the desirable minimum, the danger of a misstep is great. Such houses are often occupied by young families, which may include pregnant women or
young children who have to be carried downstairs, so the use of winders can only be described as seriously irresponsible.

The same arguments apply to two aesthetically appealing stair forms, the ‘spiral’ stair and the ‘geometric’ stair. Anyone who has ever descended a spiral stair will know how dangerous they are. In the case of a geometric stair, it may be possible to design it so that the treads are at least 275 mm at the narrowest point, but the stair would have to be very grand indeed.

Ramps

Ramps were popularised by Le Corbusier, who made brilliant aesthetic use of them in many of his buildings, and by the example of Frank Lloyd Wright’s Guggenheim Museum. Ramps are not particularly dangerous, but they do have some practical limitations. They take up a great deal more space than stairs, and for angles above 8° walking up a ramp takes more energy than walking up stairs (Fitch et al. 1974). There is anecdotal evidence that ramps are not very popular with wheelchair users, who prefer lifts. However, where it is necessary for people to travel considerable distances both horizontally and vertically, as in some transit terminals, ramps of less than an 8° slope are an efficient solution.

Lifts and escalators

The considerations in deciding the size and number of lifts and their arrangement are almost entirely technical. The same applies to the sizing of escalators. A full account of these matters is beyond the scope of this book, but a brief introduction is given in Chapter 3. It seems reasonable to assume that, if a studio project requires students to include lifts or
escalators in their designs, this will be related to previous specific instruction in these technologies. However, some courses are not structured in a way that ensures this. In such cases, either a tutorial on the topic can be included in the studio or staff can act as consultants and lay down a set of parameters for planning.

**Working methodically**

Working methodically saves time in the long run. Working methodically is not the same as working mechanically. Design is not a mechanical process. However, designing both requires and generates a great deal of information, and if it is not kept under control it is likely to overwhelm us. It is useful to have systematic ways of recording and organising information.

Figure 2.16 shows such a system for the preliminary design of rooms, a set of ‘room data sheets’. These data sheets comprise a list of furniture fittings and services, a set of scale drawings of those bits of furniture and equipment which are bulky enough to matter indicating their groupings. Note that a room data sheet is a method of recording information. The example shown is illustrative, not a general checklist. This information may be given to you, or you may have to discover it by observation, research and measurement. If a studio project does not provide this information or require students to obtain it, then the minimum dimensions of the rooms must be stated in the program. Otherwise there will be no basis for comparison of the results.
Preliminary design

Given this information, the next step is to bring it together in a trial layout. This need not be very carefully considered. The purpose is not to determine the final size, shape and layout of the room. In the process of fitting the rooms together to make a plan, the sizes and shapes of the individual rooms will probably have to be adjusted. The point at this stage is to establish a workable size and shape, and to understand the constraints on the process of adjustment.

All we need to do therefore at this stage is ensure a rough match. This can be done by eye. The groupings of props have already been drawn to scale. Draw some likely room sizes and shapes to the same scale, choose one that looks about right and try to place the various bits of equipment in it, not forgetting the doors and windows. If the result is neither cramped nor excessively grand, it will do. You will seldom need more than two trials to reach this stage.

Time savers

Fortunately it is not always necessary to go through this process, simple as it is, for every room in a building in order to be satisfied that a design is a practical one. Some rooms may be repeated several times in the same building, even hundreds of times, as with bedrooms in a hotel.

There are also rooms that occur again and again, with no more than minor variations, in different buildings. Most experienced architects develop standard layouts for such rooms, for example shower rooms. Other such elements are bathrooms and domestic kitchens, public toilets and stairs. Just as it is useful to keep a notebook of room dimensions, it is useful to keep notes of such layouts for easy reference.

Using standards sensibly

There are two important precautions to be observed in using standard layouts. The first is to treat them always as a guide in the preliminary stages of planning, not as monuments cast in concrete. The second is to make sure that conditions are standard before relying on the standard layout. Otherwise it may turn out later that the plan is spoiled and the
work put into it wasted because too little space or space of the wrong shape has been allowed at some critical point.

This applies particularly in using the standard layouts given in many reference books. In fact, there are arguments against using such books, handy as they are, at least while one is a student. Earlier (2.2.13) the importance of developing an internalised sense or instinct for the sizes and shapes of things was emphasised. If you do not measure the sizes and shapes of things yourself, but rely on other people’s measurements entirely, you lose an opportunity for developing this necessary ‘intuition’. A sensible compromise may be to work out your own layouts first and then check them critically against those in textbooks.

**The next stage**

The approach so far has been that of designing from the inside out. There are other approaches which will be considered later (2.5.3). The underlying assumption of this approach is that the building is conceived as an interface between two sets of constraints: those created by the activities within, and those imposed by surrounding conditions, that is, by the site. It is certainly possible to develop an ‘ideal’ layout and then seek a suitable site, but this is unusual in practice and therefore, perhaps, unsuitable in education. In terms of the ‘inside/out’ approach then, a ‘normal’ next stage is to consider the site.

**Marvels and mysteries of the site**

**What is a site?**

From the point of view of architecture the site should not be thought of as simply a piece of land with certain legal boundaries and physical forms. It is more productive to think of it as the complete set of constraints imposed on a proposed building by reason of its being built in a certain place. As with the constraints on the shape of rooms, many of these constraints are not physical features of the land at all, but social and individual expectations. These *values* may limit the design more strictly than awkward physical features, which can often be overcome by the appropriate use of technology.
However, the constraints created by values are not only limits, or negative forces to be resisted or overcome. They are also the main source of stimulus for thoughts about building form and expression. They include opportunities as well as risks. The heading of this section, ‘Marvels and mysteries of the site’, is borrowed from a book by Richard Neutra. Like Frank Lloyd Wright, Neutra emphasised the inspiration that he found in the study of the site.

**The site and the studio**

The architecture schools of the eighteenth and nineteenth centuries paid little attention to the site. In the French Ecole des Beaux Arts in particular the site was conventionally treated as flat and infinite. This was because that school emphasised the quick solution of problems of building organisation under examination conditions. There was no opportunity for site investigation.

Today most schools of architecture base studio projects on real sites and include site investigation as part of the task. Still, such investigations are necessarily incomplete. Neither the time nor the resources are available to do a thorough job. Subsoil investigation, for example, is usually left out. In educational practice, then, some compromise will have to be made between the kind of investigation described here, which is still only an outline, and what is actually considered in the studio. Such compromises are inevitable, but it is important to understand what has been factored out.

**Aspects of the site**

A useful way of organising knowledge about the site is to divide it into four. First, the site is part of a wider environment, a setting that extends beyond its boundaries. Second, it is property; ‘owning’ it carries with it certain legal rights, but also obligations and responsibilities, both legal and, in many cases, moral. Third, it has a surface with a variety of features, some relevant and others not. Fourth, there are conditions and features underground, in the subsoil, which may have a great effect on what can sensibly be done on the surface. The site must be investigated from all four points of view.
The site as environment

Considered as an environment, the site has many features that constrain the ways in which it can be used. The simplest and most basic is its location (2.3.5). Following from that, we have to consider the means of access (2.3.6), the available services (2.3.7), the climate (2.3.8) and the microclimate (2.3.9), the aspect (2.3.10) and the prospect (2.3.11), and last but not least the character of the place (2.3.12). The relative importance of these issues will vary considerably with the nature of the project.

Location

To investigate a site one must know where it is. This may be first of all knowledge of an abstraction, a map reference. However, even this abstract information carries with it some qualitative understanding. We discover whether the site is in the city, the suburbs or green fields. It may be in a familiar place or a remote one. Starting from the location, the rest of the investigation can be planned.

Access

Knowing the location of the site, we can discover the means of getting there. What can be prudently done on a given site is limited by the means of access. A site that can only be reached by helicopter or by four-wheel drive over dirt roads is unsuitable for many kinds of activity, and also for many techniques of construction (see Chapter 3). This illustrates the old real estate maxim that the value of land depends on its accessibility. The more accessible a site is, by road and by public transport of all kinds, the more possibilities it offers. There are exceptions; being too near an airport or a railway line may make the environment unattractive.

Services

Second only to access in its influence on the possibilities of a site is the availability of services. Piped water, public sewers and some form of power supply are assumed in the design of most buildings in developed countries. The issue is not solely a technical one. Where these things are
not available, the character of the building and its relation to the site may be radically affected. If the notion of self-sufficiency or local ‘sustainability’ becomes more widely accepted, this value will impose unfamiliar constraints (see Chapter 3).

**Climate**

Once the location is known, it is possible to consult tables of climatic data. The availability of such data varies from country to country and also considerably within countries. In practice, when official statistics are not available, and the site is not familiar, inquiries must be made on site. In the studio, a typical set of climatic data can be postulated.

Some issues have to be considered in every type of climate. They include mean sunshine hours, cloud cover, irradiation, hourly temperature for typical winter and summer days, average rainfall and peak rainfall intensities, and ‘wind roses’ indicating wind speeds and directions for each month. In colder climates the number of frost days, snowfall data and the wind-chill factor must be added. In places subject to violent winds, maximum gust speeds are also important. In conjunction with the value systems of the society, the owner and the users, each of these factors may affect the overall form of a building as well as its detailed design.

**Microclimate**

The picture given by official statistics on climate is often much modified by local influences. For example, wind speeds are generally lower and temperatures higher in the city than in open country. On the top of a bare hill or at the foot of a skyscraper, wind speeds are greater than the measured averages. Shading by buildings, trees or landforms reduces local temperatures. Large bodies of water reduce temperature variations and increase wind speeds from that direction. Actual measurements for these effects can rarely be obtained and in practice they have to be inferred from a combination of first principles and local inquiry. Discussion during site visits and in the studio can help the student to become sensitive to these issues in interpreting the more easily quantified site data.
Orientation and aspect

Knowledge about climate and microclimate enables us to take advantage of cooling breezes, to minimise the effects of cold or violent winds, and to decide on the relative importance of embracing or excluding sunlight. The application of this knowledge in a particular task depends on knowing the relation of the site to the compass points, or orientation. This in turn may constrain the form of the building and the relationship of the building to the site, or aspect. In a given climate and microclimate and for a given set of values, or way of life, some aspects will be more favourable than others. The determination of favourable aspects has been developed into an art form in the ancient Chinese system of feng shui.

Prospect

To be able to see a wide expanse of country, or merely the immediately surrounding area, without being seen is a very widespread desire, perhaps an instinct. This is supported by recent experimental testing of Appleton’s prospect-refuge theory (Appleton 1975; Conrad 1993). An outlook is a valuable asset and exploiting any available outlook is a common aim of architectural design. This is still more the case if there is something worth looking at, a view. The opportunities for outlook and view that a site offers are known as the prospect.

Character

The character of an environment is made up of all those features that lead people to judge it pleasant or unpleasant, ugly or beautiful. Here the first thing to come to mind may be the landforms, vegetation and buildings, the things that can be seen. However, other, invisible things, such as sounds or smells, also affect the character of a site. The sound of birdsong or of aircraft taking off and the smell of a pine forest or a gasometer make a difference in people’s judgements.

Some environments may have a character that would be worth retaining or enhancing but they are already in the grip of change forces that make this pointless, as when a residential district is being transformed into a commercial one, by changes in accessibility. Other environments,
especially in modern cities, may have such a mixture of building scale, type, style and material that it is not possible either to harmonise or contrast with them. The whole issue of character and designing for context will be discussed at greater length in Chapter 4.

**The site as property**

The site as property is a legal fiction. Because they are human inventions, legal constraints on the site are more precise than any others. Like all constraints, such legal rights and duties are based on social values and are therefore in principle subject to change by negotiation. However, laws usually represent strongly and widely held values. Attempts to modify laws and regulations therefore usually meet with much difficulty and opposition. As a result, legal constraints are in practice quite inflexible. Some common kinds of legal constraint are the site ‘boundaries’ (2.3.14), building lines and plot ratios (2.3.15), and easements and rights of way (2.3.16).

**Boundaries**

Because they are fictions, boundaries are in theory like the lines of mathematics: they have length and position but no thickness. They are the most precise characteristics of the site as property. In reality, this precision is often compromised by the rough and ready processes of setting out buildings. Sometimes one encounters sites whose boundaries cannot be related to a first-order survey or may be fixed only by old-fashioned physical markers or even written descriptions; in such cases the boundaries may be quite vague.

Under most legal systems, site boundaries set a limit to the horizontal extent of building. However, they do not always limit the rights and obligations of the owner. Neighbours may have rights of way or rights of light or the right to an unobstructed view. The site owner may be responsible for nuisances or dangers caused, for example, by water running off the site onto neighbouring land.

The extent of the site in the vertical dimension is often less well defined. It may be regarded as extending to the centre of the earth and upwards
to infinity. But this, like the usable area of the site, is subject to all kinds of rules and regulations, which greatly constrain building.

**Building lines and floor space ratios**

Local governments often try to limit the amount of building that can be put on a given site. One common kind of limitation is the fixing of ‘building lines’, as they are sometimes called (Fig. 2.17). Buildings cannot be taken up to the boundary but only to another imaginary line set a specified distance within it. Sometimes the building line varies according to the number of storeys in the proposed building: taller buildings are set back further. A variant of this idea produced the stepped skyscrapers built in New York in the early part of the twentieth century (Fig. 2.18). This was supposed to allow light and air to reach the streets.

In addition to the fixing of a building line or lines, the maximum height of buildings in a street or district may be fixed. Often this is done to maintain the prominence of some landmark. Washington and the old

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**Figure 2.17**

‘Building lines’
Minimum set-backs are commonly determined by local governments

**Figure 2.18**

Stepped skyscrapers in New York in early part of 20th century
centre of Paris have restrictions of this kind. At one time the height of buildings was also often fixed in relation to the technical constraints of fire-fighting and means of escape, but thanks to improved technology such regulations have become less common.

Finally, local governments adopt development controls to limit the maximum floor area that may be constructed on a given site. Some controls are expressed as a ratio between the site area and the combined area of all levels of the building, known as the floor space ratios.

**Easements and rights of way**

‘Easement’ is a technical term for another kind of legal restriction on the use of sites. Public services, underground like main sewers, at or near ground level like power lines, or far above like microwave relays, may pass through the site. In such cases it may be forbidden to obstruct them or even build near them.

A ‘right of way’ gives the general public the right to cross private land, usually by a fixed path. The owner of the land is not allowed to fence off or otherwise prevent public access to such paths. The height of buildings along aircraft flight paths is often restricted by law; this is somewhere between an easement and a right of way.

**The site as surface**

The surface of the site includes the contours or landform (2.3.18), the soil and surface water (2.3.19), existing structures (2.3.20), vegetation (2.3.21) and perhaps resident animals (2.3.22). All of these may constrain building form.

**Contours and landform**

Sites can be level or sloping, flat or richly curved, smooth or marked by cliffs, gullies or outcroppings. Even in ancient times architects often overcame site constraints by reshaping the contours or by supporting buildings clear of the natural ground. Hadrian’s Villa at Tivoli provides striking examples (Fig. 2.19). Modern technology has made this kind of thing easier. Equally often, however, architects have chosen to adapt
their buildings to the form of the site. Each approach makes a statement about the relationship of human conceptions and powers to the world in which we live. Few architectural decisions are more heavily loaded with symbolic meaning or more potentially controversial. This issue will be discussed further in Chapter 4. Here it should be noted that respecting the form of the site is often easier and therefore cheaper.

Soil and surface water

Where there is land to spare, landscaping can do more to create a pleasant environment than most buildings. Soil can be imported, but skilful use of the natural soil and rocks is more likely to produce a setting that is durable and in harmony with the surrounding environment. If the areas of soil are deep enough to grow trees or rich enough to support a variety of garden plants, preserving these areas for landscaping should be considered in site planning. A stream or a lake is a bonus; water is one of the most loved of landscape features.
However, if there is water about, it is wise to investigate the risk and frequency of flooding and the flood levels. A known flood line is an important limitation on buildable site area.

**Existing structures**

Existing structures on the site may have to be retained because they are useful, or picturesque, or historically interesting. In the case of historic or ‘heritage’ structures, demolition may be forbidden by law.

Retaining existing structures may generate spatial, aesthetic and technical constraints. The retained structure itself obviously limits the space available for new building. In addition, it is often necessary to leave some space around the retained structure to enable it to be seen or to prevent damage during the construction of the new work. The other aesthetic constraints created by existing buildings on the site are similar to those already discussed under the heading of ‘character’ (2.3.12). The technical issues involved in upholding and preserving existing buildings are too specialised for this book. Some brief discussion of problems of excavation near old buildings is given in Chapter 3.

**Vegetation**

Existing plants provide the best basis for landscaping. They have proved that they can survive on the site. In particular it is often sensible to try to preserve any existing trees, as trees take a long time to grow. Mature trees can sometimes be bought but they are not cheap. However, existing vegetation may not survive if the building changes the environment too much, for example by changing the water table or shading areas that were sunny. Disturbing the root systems of trees and large shrubs is very likely to kill them. Since the root systems of trees in most cases extend to the edge of the canopy, this can be a major constraint. Regulations often require the preservation of trees.

**Animals**

A ‘green fields’ site will certainly be the home of a variety of animals. The presence of rare species may prevent building altogether. Visible activity
by destructive insects such as termites may suggest special precautions in building. However, with the growth of ecological knowledge and values the habitats of quite ordinary creatures are more and more regarded as worth preserving, even apart from the pleasure that the presence of song-birds or friendly animals such as the Australian possum can give. Since animals do not pay much attention to legal boundaries, what is done on one site may have to be considered in relation to adjoining sites. Once again this objective may, directly or indirectly, limit the areas of a site that can be built upon.

**Subsoil: geology**

Realms of mystery traditionally lie underground. Their denizens, too, are often antisocial. In architecture, the subsoil is all too frequently a source of nasty surprises. Think of the leaning tower of Pisa. Prudent architects will wish to found their buildings on the best material available, preferably bedrock, but failing that shale or well-compacted gravel or sand. Compressible material such as loam or dune sand can be unsuitable for larger buildings: it is difficult to be sure how far they will sink. Clays, which expand and contract with changes in moisture content, are dangerously unpredictable unless we can be sure of carrying the footings below the water table. Filled ground, composed of mixtures of unknown and possibly toxic material, and perhaps containing car-sized cavities, is worst of all. Underground streams can frustrate attempts to construct normal footings.

A suitable pattern of test bores will reveal at least some of these potential dangers. Once a problem has been identified, technical solutions are usually available. However, boreholes are expensive, and drilling is therefore often deferred until some thought has been given to building location on the basis of other constraints. Then, if difficulties are found, the trouble and expense of a more elaborate technical solution has to be weighed against the limitations on the use of the site necessary to avoid bad ground. In addition, the technology necessary to solve foundation problems often constrains the building form, for example by limiting the height of the building or requiring the inclusion of movement
joints. Geological aspects of sites should perhaps be considered in the studio more often than they are.

**Subsoil: underground structures**

The longer and more intensively an area has been settled, the more likely is it that the subsoil will contain the remains of structures or parts of structures, and active services. According to legend, there are areas of Manhattan where it is impossible to drive so much as a knitting needle into the ground without striking some active service. Old footings, abandoned walls and cellars, and buried tanks are seldom shown on any maps. Mine shafts, train tunnels and sewers will usually appear on surveys but are seldom to be found exactly where they are supposed to be. A major archaeological find, like the ancient walls revealed in the course of I.M. Pei’s work on the Louvre in Paris, can create immense difficulty and delay or even force the abandonment of a project.

**Getting to know the site**

So far, some of the issues that arise in designing for a specific site have been reviewed. However, it must be emphasised once again that the site constraints are a source of inspiration as well as limitation. This inspiration rarely comes from plans alone. One of the many unsatisfactory features of architectural competitions is the reduction of a site to plans and photographs. Getting to know a site is like getting to know a person. Repeated visits at different times of the day and the year and if possible under different weather conditions are needed. This is not always possible in practice and cannot be simulated in the studio project. Thus it may be the teacher’s responsibility to provide such information. Nevertheless, even within the limits of the studio project, much can be achieved if the right attitude is taken.

**Exploring systematically**

The more time spent on site in the early stages of design, the better the chance that the design will respond to the opportunities that the site affords and the limits that it suggests. Time, however, is always in short supply. To make good use of site time, it is necessary to explore systematically. The earlier parts of this section provide some guidance as
to what to look for. On site, the relevant information has to be recorded quickly and clearly. In addition to the use of standard surveying techniques, the site should be thoroughly photographed. If time permits, sketching is a valuable complement to photography. It helps in getting a qualitative ‘feel’ for the site.

**The uses of site information**

In collecting site information, or any other information for that matter, it helps to bear in mind the uses to which the information will be put. The main purpose is to discover constraints on building form and character. In practice, site survey material may also be used to instruct surveyors and other specialists to obtain more detailed and precise information, and as a basis for discussion with consultants and clients. In the studio project, material from the site survey can be used to make drawings or models of a scheme more realistic and convincing.

**Recording the visit**

To avoid confusion and make analysis easier, it is best to record different groups of site data on different plans. Data about the general environment can often be most clearly recorded on the location plan. More detailed information about access, aspect, prospect and surface features should be recorded on the largest scale site plan that can be easily handled. The point from which photographs and sketches were made and the direction of the view can be shown on another plan.

**Modelling dynamic features**

Some important characteristics of sites are dynamic and cannot be captured in a visit or a series of visits. Examples are shading by geographic features or adjoining buildings, and wind effects. If a model of the site to a suitable scale can be built, then these effects can be studied mechanically in a solarscope and a wind tunnel. If not, computer programs are available that will carry out these analyses. The need for such studies can be estimated during the site visit. They are particularly likely to be necessary in central city areas where there are tall buildings.
Site analysis

Once all this information is obtained, it has to be organised so that it can provide a guide for design decisions. Much of it will be used somewhat later in the design process in making decisions about layout planning and technology. In the initial planning stage, however, it is the constraints on building area and volume that are most critical. An easy and effective way of organising site information for this purpose is overlay mapping.

Overlay mapping

The features of the site as environment, property, surface and subsoil are plotted on four separate site plans to the same scale. More maps can be used if, for example, the mapping of the vegetation hides the contours. The maps are drawn on transparent film. On each map the areas that are unsuitable for building and those that have special advantages are hatched, using different hatching patterns. Overlaying the maps then produces a gradient of tones from the most suitable for building to the least suitable.

If a suitable computer program is available it can be used to do the overlaying. Excellent site analysis packages which will do this and much more have been developed by landscape architects.

Deciding on siting

It may turn out that just one part of a site is ideally suitable for building. More often, different constraints will point in more or less contradictory directions and a judgement will have to be made. In practice, the architect has to advise the client and give reasons for the advice. In the studio, students should be able to explain their decisions.

The scope for decision will vary with the nature of the site. On inner-urban sites the size and shape of the building envelope may be almost entirely fixed by the economic pressure to develop an expensive site to the full and the regulatory pressure that limits what may be built. As the value of the site in relation to the proposed building decreases, and the area in relation to the proposed building area grows, the number of options usually increases.
2.3.33

The minimum number of storeys

The minimum number of storeys for a given project on a given site is the ratio of the building area to the buildable area.

The building area can be estimated by adding up the approximate room areas from the room data sheets and adding 20% to 25% for walls and circulation space.

The maximum buildable area is defined by the site area less setbacks and easements. Other constraints, represented by the output of the overlay mapping process described in 2.3.31, may suggest the adoption of a smaller buildable area. Region-specific planning guidelines may also constrain the outcome.

Implications of area ratios

If the ratio of building area to buildable area is greater than 1, it is obvious that the building must be of two or more storeys.

If the ratio is between 1 and 0.5, either the shape and orientation will be largely fixed by that of the buildable area or it must be of two or more storeys.

As the ratio decreases from 0.5 towards 0.25, the designer’s freedom, in terms of being able to choose the number of storeys, the building shape and the building orientation, increases. Under 0.25, site constraints will be insignificant unless the buildable area is a very odd shape.

2.3.34

Other reasons for building tall

In most cases, if the buildable area is sufficient, the cheapest thing to do is to build on one level. However, clients’ and users’ values in relation to the site often override simple considerations of cost.

Height can convey direct benefits. A site may have been selected because of a view or a cool breeze which can only be enjoyed to the full by building more than one storey. A steeply sloping site may in effect have two or more ‘ground levels’, so that it is cheaper to build split levels or
two or three storeys. The client may value additional ground area for landscaping or other uses above the likely additional building cost.

Height also has symbolic value. A two-storey house may seem more impressive than a bungalow. Symbolic value often translates directly into economic return. The tallest building in the world can charge premium rents, and so quite often can buildings that are merely tall in relation to those around them. Higher floors rent for more than lower ones.

The next step

Where there is any significant choice, the final decision on building height and location can seldom be made sensibly on the basis of site data alone. The results of the site analysis have to be brought together with trial plans. The internal constraints have to be matched with the external constraints. The external constraints are the demands of the site. The internal constraints are the demands of the activities to be housed, expressed as a set of rooms or spaces and their possible arrangements. The attempt to bring these two sets of demands together guides both building form and building location and involves the principles of arrangement.

Arrangement

Principles of arrangement

A plan is an arrangement of rooms or spaces and connecting areas. Calling it *an arrangement* implies that it is not arbitrary. It is governed by *principles*. Like the differentiation of single, simple spaces into many specialised rooms, the principles of arrangement arise from people’s perceptions of the proper relationships between different activities. These perceptions are different for different groups and change over time. They are often based on habit and convention rather than careful investigation of what actually happens. Nevertheless, six principles or values can be identified that are both common and important in modern planning. They are convenience (2.4.2), comfort and enjoyment (2.4.22), intelligibility (2.4.23), privacy (2.4.26) and security (2.4.28), safety (2.4.30), and economy (2.4.33).
These principles are not necessarily consistent with one another. Attention will be drawn to some likely conflicts. Situations in which values do not conflict are the exception rather than the rule in design. Such conflicts cannot be settled \textit{a priori}. There is no pre-established hierarchy among values, the same for all people and all occasions. Conflicts when they arise have to be settled by specific processes of judgement and decision.

\textbf{Planning for convenience}

By 'convenience' we mean \textit{easy and quick access between related activities}. Convenience is the most salient value in the literature on planning of the last fifty years or so. It was not always so. Before the eighteenth century rooms in major buildings such as palaces were seldom much differentiated and their arrangement was determined largely by aesthetic considerations. The change is linked with new notions of comfort and economy. Convenience is often seen as leading to efficiency and thus to economy of operation. Convenience and economy are the values of what is still, even today, called 'functionalism'. Both appeal to bureaucrats, and clients for large buildings are now mostly bureaucrats.

'Functionalism' became unpopular largely because of this narrow view of function. Nevertheless, convenience is important in planning, especially in planning workplaces, and most places today are workplaces to some degree. So we need ways of understanding and representing the constraints imposed by convenience.

\textbf{Tools for describing room relationships}

The prolonged high level of interest in planning for convenience has led to the invention of a number of tools or techniques for representing relationships between activities. Not all of these tools can be discussed here. Comprehensive overviews have been provided by Palmer (1987) and Sanoff (1992). Here, four simple and widely used tools are described: adjacency matrices (2.4.4), flow diagrams (2.4.10), bubble diagrams (2.4.15) and interaction nets (2.4.17).
There are cases in which it is not necessary to use these tools. Small groups of rooms can be dealt with in simpler ways. For example, it is possible to plan a group of three rooms ‘by exhaustion’, that is, working out all the possible combinations and seeing which is best. As the number of rooms and the number of connections increase, the difficulty increases exponentially and it becomes more and more necessary to use formal tools to help in planning.

Even so, experienced architects do not always use such tools even for complex buildings. There are two probable main reasons for this. One is that they have, through much experience of a particular building type, developed an internal ‘model’ arrangement which works in most cases. Frank Lloyd Wright seems to have had such a model for houses, which appears in superficially very different designs (March and Steadman 1971, pp. 27–28). The other reason is that some architects develop an intuitive skill in breaking planning tasks up into manageable parts; this is discussed further in 2.5. Students by definition do not possess either of these abilities, so it is useful for them to learn to use formal planning tools, even if later on they can learn to do without them.

**Adjacency matrices**

An adjacency matrix is a simple, useful device for thinking about room relationships. In form it consists of a grid with an equal number of horizontal and vertical divisions, or rows and columns. It is easy to construct one on graph paper. The number of horizontal and vertical divisions is the number of rooms whose relationships are being investigated. Starting from one corner, usually the top left, called the origin, each row and each column is labelled with a room name in the same order. Each cell of the matrix then represents the interaction of two rooms. The diagonal from the origin represents the interaction of each room with itself, and remains empty. Since the two halves of the matrix about this diagonal are the same, it is only really necessary to draw one, triangular, section.

**Strength of relationships**

Having constructed the matrix, the next step is to indicate in each cell
the strength of the connection between those two rooms. Every room in a plan is obviously somewhat connected to every other, but what we must decide is how strongly they are connected.

This is a matter of judgement, and depends ultimately on the values of the actors. Identifying the issues involved and considering them separately can make the task of reaching a decision easier. There are three main issues: the number of trips involved (2.4.6), the urgency of the trip (2.4.7), and the risks and nuisances that the trip may involve (2.4.8).

**Counting trips**

If there are many trips between two rooms, as between kitchen and dining room, it is obviously an advantage to keep them as short as possible. Where trips are made by employees, the time taken for the trip has a cost, and this is known as the distance-cost. Because they are fairly easy to measure and yield numbers that are easily compared, trip numbers and distance-costs are often treated as more important than they are. They are not really important economically unless one can demonstrate an opportunity cost; that is, that fewer staff can be used or that staff could be doing something else more useful.

**Urgency**

The time involved in getting from one room to another can be important in other ways. Delay may be disruptive or even dangerous. If getting out of bed in the middle of the night to go to the bathroom, we want to keep the trip short to avoid waking up fully. As a more dramatic example, the emergency trolley in an intensive-care ward in a hospital is not used very often, but when it is no delay in getting it to the patient can be tolerated. Even when the number of trips is small, urgency may demand that rooms be close together.

**Risks and nuisances**

All kinds of risks and nuisances increase as trip length increases. Things that are carried may be dropped or spilled. Going down the corridor to the bathroom in one’s own house may involve putting on a dressing
gown; in a public hospital it almost certainly does, and in addition also involves exposing one’s bedraggled appearance to strangers. Keeping trips short can be important for such reasons, quite apart from the time taken.

**Measurement**

In deciding the relative strength of the association between rooms, we have to place them on some sort of scale and record the result in the appropriate cell of the matrix. It would be possible to use numbers to represent infinitely subtle graduations of relationships. There are two arguments against this. The first is that the issues are not as precise nor our judgements as accurate as such a system would imply. The second reason is that we need to keep in mind that these are not actual, precise numbers which can be added, subtracted, multiplied and so on.

For these reasons it is best to use a qualitative scale with a small number of categories, technically known as a Likert scale. A suitable set of categories for room associations might be: next door; close; some connection; indifferent; separate; as far apart as possible. The categories can be entered in the matrix using letters or other easily identified symbols rather than numbers.

**Flow diagrams**

An adjacency matrix represents groupings of rooms. As we saw in considering the relationships of props within rooms, groupings are not the only kind of arrangements. Activities are also connected in sequences. This applies equally to the arrangement of rooms. People and goods enter buildings and move or are moved between rooms and out of the building again. Wastes are generated and have to be removed. Some of these patterns of movement are recurrent sequences. Such sequences or flows can be represented in flow diagrams. These are more elaborate versions of the ‘knotted string’ which was discussed earlier.

**Flows of people**

As an example, let us consider a visit to a formal restaurant (if you don’t approve of formal restaurants, make up your own example on the same
People arrive in groups or sometimes singly. They are greeted. Their reservations are confirmed. They check their coats, briefcases and the like. They may go to the bar, if there is one, to wait for friends, or they may go direct to their table. From either the bar or the table they may go to the toilet and return. After their meal is finished, they collect their coats and leave. All this can be shown in a flow diagram.

Along the way our diners encounter other people, the receptionist, the cloakroom clerk, the barman, the head waiter, the table waiter, perhaps the sommelier. If it is a restaurant dedicated to the art of cookery, the chef may visit their table. Each of these people has to arrive, perhaps change into working clothes, and reach their station. From time to time they too visit the toilet, usually one reserved for the staff. Each of these sequences can be shown as a branch on the ‘diners’ flow diagram.

The kitchen workers behind the scenes link with the waiters to provide the food served, so their flow diagram can be shown as a branch on the waiters’ flow diagram. Earlier in the day the restaurant will have been cleaned and the cleaners will have their own separate sequence.

**Flows of goods**

The food that our diners eat and the drinks that they consume also reach them as a result of sequences of operations. These are flows of goods. Food and drink are delivered to the restaurant at a loading dock. Meat goes to a cold room, vegetables and dairy products to a cool room, groceries to a dry store, alcoholic drinks to a security store or wine cellar. From these stores the drinks go to the bar, to holding racks or refrigerators, or direct to the table. Food goes through a complex sequence of operations in the kitchen and is served. Just as the flow of people constrains the way in which a restaurant can conveniently be laid out, so does the flow of goods.

**Flows of wastes**

At almost every stage in the flow of goods, wastes are generated. Empty bottles and packets of bar nuts, squeezed lemons and corks come from the bar, empty bottles and unconsumed food from the diners’ tables,
scrap and trimmings from the kitchen, packing cases from the storerooms, and paper from almost everywhere. This rubbish has to be collected at or near the source. It may have to be sorted for recycling purposes. The food wastes may be wrapped to control vermin. It is removed and placed in bins, probably of industrial size and probably near the loading dock, for removal. This set of flows joins with the other flows to make up the complete flow diagram for a given set of activities.

**Symbolism**

All of these flows are important from the point of view of convenience of the plan. However, they are likely to have very different degrees of symbolic importance. Flows of goods and wastes are of little symbolic importance in most situations, unless they have the negative symbolism of the taboo. As a rough general rule, flows of people who are outsiders, members of the public, clients or guests have the greatest symbolic importance. In the example of the restaurant, the sequence followed by the diners would have this kind of importance. Because of their critical influence on later stages of design, such symbolically important routes should be identified at this stage of the investigation and marked on the flow diagram. Low-status or taboo flows that must not be allowed to intersect the high-status, symbolically important ones should also be identified.

**Bubble diagrams**

Bubble diagrams are a long-established planning tool. One is shown in figure 214 of Le Corbusier’s *Precisions*, first published in 1930. The idea is very simple. Each room is represented by a freely drawn circle of about the right area, to scale. These are the ‘bubbles’. Each bubble is labelled with the appropriate room name.

Lines are drawn connecting the bubbles in accordance with the adjacency matrix. Heavier lines can be used to show stronger connections. More sophisticated bubble diagrams incorporate ‘sausages’ as well as bubbles. ‘Sausages’ represent circulation space, passages and halls.
If the diagram is drawn thoughtfully, starting with those rooms that have many strong connections with other rooms, it usually takes only a few rearrangements to achieve a grouping that meets the adjacency requirements as well as they can be met. Rearrangements are necessary to get rid of connections that cross other rooms and to free rooms that are entirely surrounded by other rooms and their connections. A quick way to draw rearrangements is to use tracing paper overlays.

**Dangers of bubble diagrams**

The bubble diagram is very popular because of its simplicity, and its use is very widely taught. However, it has some serious dangers. The worst of these is that, because a bubble diagram somewhat resembles a plan, students are tempted to make it into one directly by simply pushing the ‘bubbles’ together.

Even if the bubbles have been arranged so that all habitable rooms have an outside wall, and this is often overlooked, the result is usually a very bad plan. The fact that the shape of the rooms is important as well as their area is disregarded. This is inherent in bubble diagrams. Besides, the requirements of comfort, privacy and intelligibility are met, if at all, only by chance. A technique that does the same job as the bubble diagram in respect of the constraints of convenience, and which avoids some of the disadvantages, is the interaction net.

**Interaction nets**

Interaction nets are not quite as simple as bubble diagrams, but they are more powerful. The first step in constructing the net is to draw a circle, and to represent the rooms by points spaced roughly equally around its circumference. Each room is identified by a number or a letter. If you have used letters in your interaction matrix, don’t use the same letters here, or confusion will result. The circle can be drawn quite sketchily, but it is important that it be a circle and not some other shape. Other shapes make the later steps much more difficult.

After setting up the circle, the connections required by the adjacency matrix are represented by lines connecting the points that stand for the rooms. For this purpose we need only represent two kinds of
relationship: close, and some connection. Pairs of rooms that must be next door to each other can be treated as one. ‘Close’ can be represented by a thicker line than ‘some connection’.

**Unfolding the net**

The next step is to ‘unfold’ the net. The object is to rearrange the points so that no lines cross. With a little practice, it is very easy to do this by eye.

A simple rule for beginners is to start by treating all rooms that have three or more connections as fixed. Then move all those with one or two connections outside the circle. As the net becomes simpler, it becomes easier to see what remains as a group of overlapping larger figures, quadrilaterals and even pentagrams, which can be unfolded in their turn. Alternatively, Jones (1970) suggests that we may start by considering only the strong or close connections and then add the weaker ones.

Once again, an easy way to produce the successive stages of unfolding is to use overlays of tracing paper. If you still find the visualisation of the unfolding too hard, it may help to build a physical analogue with curtain rings for the rooms and strings for the connections.

**Contradictions**

With luck, the net will unfold into a figure in which lines meet only at rooms. Often, however, there will be crossed connections that cannot be uncrossed by any rearrangement. There will also be cases in which a room or even several rooms may be entirely surrounded by other rooms and their connections and cannot be extracted. These two cases are actually equivalent. In such cases, some of the connection requirements will have to be given up. This is discussed further in 2.5.

**Limitations of interaction nets**

Very large nets are tiresome to construct, and they cannot be readily unfolded by eye. However, it is rare to find a task that cannot be solved by introducing a hierarchy. Starting from the interaction matrix, the
rooms are divided into groups that have many strong internal connections and few strong external connections. The interaction nets for each group and the group of groups are then developed. Such large tasks may require the use of a computer program to sort the groups and/or to do the unfolding.

Advantages of interaction nets

The interaction net has two important advantages as compared with the bubble diagram. First, since the rooms are treated as points, there is no temptation to transform it prematurely into a plan. Second, as we will see, other objectives of planning can readily be mapped onto the interaction net. It then becomes a powerful and abstract ‘spatial organisation of thoughts ... about function’, as Arnheim (1977) has put it (p. 272). Because it is abstract it can form the basis of many different trial layouts.

Planning for comfort and enjoyment

In this context, ‘comfort’ is narrowly defined as thermal and acoustic comfort. ‘Enjoyment’ is equally narrowly defined as the enjoyment of the pleasant sights and sounds that a site has to offer. Planning can contribute to these objectives through the overall form and orientation of the plan. These issues are discussed at greater length in Chapter 3.

Correct orientation of rooms in the plan can also contribute to the achievement of these objectives. The desired orientation or orientations for each room can be noted, first on the room data sheet and then on the interaction net. As with representing desired adjacencies, this has to be done with commonsense. It may be possible to face every room towards a single most favourable aspect, but even if the site and other constraints permit this, the constraints of convenience probably will not. More often than not, various considerations of comfort and convenience will be found to be opposed. It is then necessary to rank the values attached to the different issues. In practice, it is wise to do this in consultation with the client and the users. In the studio, a class discussion can be a good way to establish agreed rankings.
Planning for intelligibility

By intelligibility we mean the ease with which people find their way about in a building. This is important in most public buildings. There are exceptions. The plan form of the Pentagon, Washington, is said to have been chosen expressly because of its confusing qualities; it discourages spying. Further back in history fortresses and even cities were sometimes designed as mazes, to disorient intruders (Passini 1992, pp. 14–17).

Intelligibility is not equally important in all buildings. A building to which people go to stroll about and enjoy themselves, such as a shopping centre or an art gallery, may not need to be so easily and immediately understood as a building to which people go on urgent business. In private houses and other buildings that strangers seldom enter without a guide, this issue is less important.

Nevertheless, in democratic and egalitarian societies in which public buildings are freely open to all, a major responsibility of the architect must be to ensure that people do not get lost. Being lost is very unpleasant to most people. Besides, it wastes time and in emergencies it can be dangerous. Since the plan form is the most important feature in way-finding in buildings (Weisman 1981), this is an important issue.

Failures of intelligibility

It might seem that any competent architect would produce intelligible plans. Unfortunately, this is not so. A comparative study of a group of university buildings by Weisman (1981) showed that 9% of users reported becoming lost in these buildings often or almost always. In one building, 40% of users reported becoming quite or totally lost. Similarly, Moeser (1988) reported on a hospital building that was so difficult to understand and learn that nurses who had worked there for two years could neither find their own way with confidence nor give directions.

The characteristics that make the plans of these buildings difficult to understand are also to be found in a great many other plans of the last thirty years or so. They result from concentrating on convenience, or
What makes plans intelligible?

There are four characteristics of plans which, research suggests, help in making them intelligible. First, the pattern of the corridors should be simple (Weisman 1981). This is consistent with the general finding of the Gestalt school of psychology that people invariably organise what they see and what they imagine into the simplest possible form. As far as patterns of corridors are concerned, this means that people expect them to be symmetrical. The importance of simplicity, as compared with other aids to way-finding such as signs, has been confirmed by O’Neill (1991). Note particularly that it is the pattern of the corridors, not the shape of the surrounding building, that must be simple.

Second, arrangements that allow the user to move in a circle confuse many people, especially if they cannot see outside to orient themselves. Third, people have a strong expectation that turns will be right angles, or else complete reversals of direction (Sadalia and Montello 1989). Note that the Pentagon both allows people to move in a circle and has obtuse angle turns. Finally, work on way-finding in streets suggests that decision points, where more than one direction can be taken, should be given distinctive shapes, so that they can be easily told apart (Kaplan and Kaplan 1982, p. 47). There is some evidence that women make more use of such ‘landmarks’ in way-finding generally, while men make more use of ‘cognitive maps’ or conceptions of the overall layout (Kimura 1992). Similar results have been found for buildings (May 1997). However, when women were provided with maps they grasped the overall layout much better. The performance of men was not improved by maps.

Since intelligibility is a characteristic of the actual shape of the corridor system, it cannot be represented in an abstract system of relationships such as an interaction net.
Planning for privacy

Privacy has been defined by Altman (1975) as *control of access to oneself or group*.

While some conception of privacy seems to be almost universal, the specific rules differ widely between different cultural groups. However, Lawrence (1987) has argued convincingly for two quite general architectural approaches to providing privacy. One is the use of *transition zones*. A transition zone marks the division between a less private area and a more private area. Porches, entrance halls, reception rooms and outer offices are all examples of transition zones. The other is the *privacy gradient*. Zones regarded as more private are located further from the entrance. Lawrence’s discussion relates to dwellings, but the principles seem to be generally applicable.

Other means of controlling access

Access to particular rooms can be controlled by armed guards or receptionist secretaries. Access can also be effectively controlled in many cases by visual cues, such as marked changes in the level of lighting, the amount and character of the decoration, and so on. This will be discussed further in Chapter 4.

Planning for security

Security is a strong form of privacy. A secure room or building excludes people who intend to intrude where they are not wanted or to eavesdrop. Such intrusions need not be criminal. Backstage areas at theatres have to be kept secure against over-enthusiastic fans.

Planning can help to make buildings more secure in three ways. First, the fewer entrances there are, the easier it is to control access to a building or space. Second, the harder it is to get to openings that could be used for unauthorised entry, the less the risk of a break-in. This is one of the reasons why Italian Renaissance palaces have their main rooms on the first floor or ‘piano nobile’; ground floor openings are few and heavily barred (Fig. 2.20) or open onto internal courtyards. Third, entrances and publicly accessible spaces can be arranged so that
people who loiter in them are exposed to the view of people within the building and of passers-by.

Figure 2.20
Ground-floor openings are few and heavily barred in Italian Renaissance palaces

2.4.29

Representing issues of privacy and security

As with issues of convenience, issues of privacy and security can be ranked using a simple qualitative scale, for example secure; restricted access; unrestricted access; general public access. The level of access for each room can be recorded on the room data sheet. Using suitable symbols, it can be shown on the interaction net.

Planning for safety

A safe plan is primarily one in which escape in emergencies is easy and quick. Fire is the commonest type of emergency. Modern cities have fire regulations which mostly require ‘alternative means of escape’. This
means that there must be exits to the outside or to a protected space, arranged so that it is impossible for people to be trapped by a fire between them and the exit. The maximum distance between exits is also regulated. The existence of these regulations indicates the high value that modern societies place on safety.

**Behaviour in emergencies**

Unfortunately, existing fire regulations are based on mistaken assumptions about people’s behaviour. In emergencies, people do not panic or behave irrationally. However, their reasoning is different from that on which most regulations are based. They do not risk getting lost by venturing into unknown areas. They choose the most visible exit, not necessarily the closest (Horiuchi 1980). They use the exits they know. Since fire exits and other escape routes are usually ‘backstage’ in ‘private’ areas, only people familiar with the building use them. Other people try to go out the way they came in. If lost, they follow someone who seems to know where they are going, but not into a backstage area, since such a choice indicates that their *guide* is lost.

**Additional precautions**

On the basis of these findings about behaviour in emergencies, Sime (1985) argues that conventional rules about means of escape are not enough. He suggests that in public buildings people should be encouraged to enter by one route and leave by another. This would create greater awareness of both as potential escape routes. Like most measures that one can take to increase safety, this conflicts with security.

The more intelligible a plan is, the safer it is. People’s choices of means of escape are more likely to be correct in an intelligible plan. Like intelligibility, then, safety is a feature of the actual layout and not an abstract relationship.

**Planning for economy**

A plan is often regarded as economical if room areas have been kept small in relation to normal expectations, if its perimeter has been kept
to a minimum, and if there is little circulation space. 10°, 4 or less of usable floor area devoted to circulation is a common rule of thumb for 'economy'. The reasoning behind these rules is that the smaller the volume and surface area of the building, the less the amount of material used. Rough estimates are often made on the basis of so much per square metre or foot, so saving space looks like saving money. Because these criteria are easy to calculate, they have often been included in computer programs for layout planning.

**False economies**

As a general rule, saving space does save money. However, there are other factors in economy that are just as important if not more important, such as choice of materials and speed and ease of construction. Strict application of such rules will result in plans that are nearly square and very tightly packed, which are not necessarily the easiest to build. The interaction of these technical factors with planning in achieving real economy is considered further in Chapter 3.

Money value may also conflict with use value. Making every room and hallway as small as tolerable is likely to produce a building which feels mean. Cramming the rooms together to fit them into a near square and cutting down on the circulation space is likely to reduce intelligibility and safety, even if convenience is maintained.

Buildings designed to minimise volume are often inflexible. Tight rooms will not accommodate new props or allow old ones to be rearranged to suit changed activities. Expensive alterations may be required. The building may even have to be scrapped. This has happened with many buildings built to minimum standards in Australia during the depression of the 1930s and during the Second World War. Buildings built earlier, on more generous lines, have lasted better.

Despite these criticisms, economy in this narrow sense is a constraint that may influence choices between trial layouts. As with intelligibility and safety, the issues involved cannot be represented in an interaction net.
From the abstract to the concrete
The theme of this section has been planning objectives. These have turned out to be divided into relationships between parts, which can be represented in an abstract diagram such as the interaction net, and features of the emergent whole. The next section considers ways of bringing the internal constraints (that is, the rooms and the planning objectives) and the external constraints of the site together in generating trial layouts.

Putting it together

Trial layouts
This section is about ways of generating arrangements of rooms such that the rooms are of approximately the required sizes and shapes, they are arranged in the desired way, and the resulting arrangement can be fitted onto the buildable area of the site. The output of this operation is called ‘trial layouts’ to distinguish them from ‘sketch plans’, in which technical and aesthetic constraints should also be considered.

Satisficing
As discussed in 1.31, layout tasks seldom have ‘one right answer’. There is no ‘best’ or ‘optimum’ solution. Rather, there are likely to be many layouts that meet the constraints equally well. Given that constraints may conflict, there is often no layout that can meet the constraints without compromise. H.A. Simon (1970) coined the word ‘satisficing’ to describe what architects are trying to do in such cases. The word means ‘conforming to a set of constraints’.

Two basic approaches
There are two fundamentally different ways of doing layout planning. One is to decide the shape of the building first and then fit the required rooms into it. The other is to develop a layout based on the constraints on arrangement and then adapt it as necessary to suit the other constraints. Here, these two approaches will be called outside in and inside out. Some architects prefer to fix the plan shape or even the
volume of their buildings as an organising principle. There may also be purely technical reasons for fixing the shape. This chapter considers only those cases in which the plan shape is fixed by site constraints.

2.5.4

The organisation of this section

This section starts by explaining some working methods that apply to layout planning in general. Then it describes a method of planning from the inside out for single-storey buildings. After that, the additional constraints imposed on plans by building on more than one level are discussed. Lastly, a method of planning from the outside in is suggested, with particular reference to buildings of more than one floor.

2.5.5

The need to work efficiently

At this stage the objective should be to generate as many satisficing trial layouts as possible. This is because a satisficing trial layout is not necessarily a good plan. A good plan has to meet other kinds of constraints, technical and aesthetic, as well. It is often necessary to generate a considerable number of satisficing layouts before one is found that can be successfully matched to these other constraints. Since time is always limited, it is necessary to work quickly and efficiently.

2.5.6

Assembling the information

It helps to have the necessary information to hand in an easily scanned form. To work on layout planning, you will need the information about the rooms, about the site, and about arrangement. Start by drawing each type of room that you have to lay out to scale. If you have been given room data sheets or prepared them yourself, use the approximate size and shape from the data sheets. If you have only been given room areas, you can use the rules in 2.2.15 to estimate the dimensions. Rooms with the same requirements, like bedrooms in a hotel, need only be drawn once. For ease of reference, it is best to draw the rooms to a small scale: 1:200 or 1:500 is usually suitable. At such scales you should be able to get all the rooms for any project you are likely to have to tackle onto one or at the most two A4 or quarto sheets.
Draw the site to the same scale on another sheet. Mark the buildable area clearly. Indicate the compass points and the desirable aspect(s) and prospect(s).

Draw the interaction net in its unfolded form on another A4 or quarto sheet. If you have not already done so, map onto it the most important flows. Identify the symbolically important ones. Also identify rooms or groups of rooms that are private. Note the desired orientation, if any, against each room.

Keep all this information by you as you work.

**Sketching to scale**

When producing trial layouts and partial layouts, draw freehand. There are two reasons for this. It is quicker, given a little practice, and it does not create so much commitment. The more effort you put into a drawing, the more committed you will be to that arrangement. When the objective is to explore by producing many trials, it is important not to commit yourself to any one.

Draw to scale, tracing the rooms as described. If you do not draw to scale, you can deceive yourself completely and waste time. The small scales recommended in 2.5.6 save time in drawing and help in avoiding getting bogged down in detail.

**Overlays**

Once again, the quickest way of revising, developing or varying a final layout is to trace over it. Never throw a trial layout away and never draw over or rub out parts of it. You may find that the new idea does not work as well as the old. Besides, rubbing out is wasted work. Overlaying saves setting things up to scale all over again.

Keep a stack of small pieces of tracing paper by you for overlaying. If you number them in sequence as you use them, it is easier to find the latest version (or the earliest) amid the inevitable clutter.
Messages from the network

At this point, a study of the interaction net can give clues as to how to proceed. It can indicate contradictions that must be resolved before a layout can be generated. It can help in deciding whether to try to work on the whole network or to break it up into parts. Finally, it is one potential source of patterns of organisation.

Finding contradictions

As noted in 2.4.19, some patterns in the unfolded network indicate that the constraints are contradictory. If the net has the form of a closed polygon (that is, anything from a triangle to a decagon and beyond), and it has internal connections that cross, or it has one or more internal nodes connected to two or more non-adjacent nodes in the perimeter, then it cannot be turned into a layout by the method to be described shortly. One or more of the connections will have to be given up.

If a contradiction can be resolved by breaking one weak connection, then it is obvious what to do. If there is a choice between a weak connection and a strong one, it is still simple. But if, as often happens, there is a choice between weak connections or a choice between strong connections, then judgement is required. First of all it is wise to go back to the adjacency matrix and think again about the relative strengths of the different connections (see 2.4.4 to 2.4.9). If that does not give a clear answer, then the different layouts that result from giving up different connections should be explored. This is one way of generating variant layouts that can be matched to the technical and aesthetic constraints.

When to break up the net

As discussed in 2.4.3, nets of only three or four rooms may be able to be solved ‘by exhaustion’, that is, by drawing all the possible arrangements. Small nets, up to say nine or ten rooms, can be converted into layouts directly. Large nets should be broken up if possible. It is too easy to make mistakes in converting large nets into layouts. Also, if we work with a few large chunks it is easier to think about the intelligibility of the overall layout than if we are struggling with a great many small ones. Therefore, we need to consider how to break up a net.
The part and the whole

Breaking up a task and solving the parts is often necessary but it always has risks. There is no guarantee that good solutions to the parts can be fitted together again into a working whole (see 1.43).

Constraint hierarchies

In Chapter I the general principle of constraint hierarchies was explained. What we have to do in breaking up the net is to apply this principle. We look for those parts of the task that are most constrained, solve them first, and then let them constrain the other parts. In this way we can be sure that we do not end up trying to squeeze hopelessly rigid pieces into impossibly shaped holes, to use a jigsaw metaphor. There will probably still be some contradictions in the process of reassembly that will have to be resolved by giving something up. However, if the breaking up has been done carefully, they should not be critical.

Finding the parts

If the net has been unfolded carefully and drawn clearly, the most constrained parts should be easy to identify by eye. Let us call such parts clusters. A cluster consists of a group of three or more rooms connected to each other in a radial or ring pattern or some combination of these patterns. A cluster by definition cannot have more than one connection to any other cluster. A well-defined cluster will have only one or two connections to the rest of the net. The more rooms and the more connections a cluster contains, the higher it is likely to be on the constraint hierarchy.

Patterns in layouts

Organising principles can also be derived from the net by eye if one knows what to look for. By studying actual plan forms, Ching (1979) identified five types of organisation: centralised, linear, radial, clustered and gridded. However, at the more abstract level of the net, radial and centralised layouts are identical. Clustered organisations turn out to be reducible to either radial or linear forms. Gridded organisations in plan may be based on either technical or formal considerations, but they
cannot be derived from considerations of arrangement. They will be
discussed further in the next two chapters. We are then left with only
two categories: radial, and linear, which includes closed linear patterns
or rings. One approach to making a plan intelligible is to identify and
strengthen its inherent form of organisation. It may help to redraw the
net to emphasise this.

The existence of strongly defined clusters weakly connected to each
other may suggest an overall organisation of the building into pavilions
or wings, particularly in the case of a single-storey building on a
relatively unrestricted site. Alternatively, if a multi-storey building is a
possible solution, clusters may be positioned vertically, on different
floors or groups of floors.

Net into layout

The next step is to convert the net, or the chosen parts, into layouts or
partial layouts. Start by drawing a straight line on a sheet of tracing
paper. This represents a communication space. It does not yet represent
a real space. If it ever becomes a real space, it may not be straight or even
linear. For this reason, and as a reminder that it is a space and not just
a line, it may be best to draw a thick line in, say, coloured marker pen.
This is the guide line.

Now find the room in the net or cluster that has the largest number of
connections with other rooms. If there are two or more with equally
large numbers, choose one of them at random. Locate this room on
your sheet of rooms drawn to scale, and trace it with one side joining the
guide line. If the room data sheet requires the entrance to be in a
particular side, put that side next to the guide line. If not, put the larger
side against the guide line, so that one long side faces ‘outwards’.

Working in the same way, place the rooms that have strong connections
with this room on either side or opposite to it, in relation to the guide
line. Since the guide line represents a communication space, opposite
may work out to be closer than next door in terms of travel distance.
Recall that rooms that must be interconnecting have been treated as one
(2.4.17).
When there is a choice as to which room to place next, again choose the one with the most connections to other rooms. Continue in this way until all the rooms have been placed.

**Variant layouts**

There are several ways of generating variant layouts:

- Use different guide lines. Particularly if the pattern of the net seems to be radial rather than linear, try a cross or a T-shape.
- Instead of starting with the most constrained room, as the constraint hierarchy principle would suggest, start with the entrance.
- Start at the end of the guide line, or the end of one of the arms of the cross of the T rather than at the centre.
- Use variants of the net generated by relaxing different constraints to resolve contradictions (see 2.5.10).
- Where there is a choice, vary the order in which you add rooms to the trial layout.

Using different guide lines is likely to produce the most radically different variants.

**Building up**

If the net has been broken up, generating the trial layouts is a two-stage process. The clusters are converted into partial layouts. What happens then depends on the number of clusters. If there are only a few, it may be possible to tackle the second stage of assembling them into a whole ‘by exhaustion’, developing all possible variants. In a large or complex scheme with more than four or five clusters, it will be necessary to treat them as rooms in a second round of the process described in 2.5.16.

**Layout and site**

The selection of trial layouts for further development, even in cases in which site constraints are not dominant, may be guided by the appropriateness of the building shape in relation to land form and contours, aspect, prospect, and perhaps the shape of the buildable area. It is not always possible to bend or otherwise adapt a layout to the site constraints. A quick check can be made by overlaying the layout on the site plan.
2.5.20

The limits of layout planning

Working in the way described, it should be possible to generate at least three significantly different trial layouts in a reasonably short time. Final selection of a layout must, however, still be put off. Some layouts will be easier to build than others and some will suggest more satisfying organisations than others. Methods of investigating these aspects are discussed in the next two chapters. Here we must leave planning of a single storey and consider buildings of more than one storey.

2.5.21

Issues in multi-storey planning

There are some issues that arise in the design of almost every multi-storey building. The continuity of load and support, the continuity of vertical communication and the continuity of service systems must be considered whether a building is of two storeys or a hundred. Load and support is largely a technical issue and will therefore be considered in the next chapter. Service systems (2.5.22) and vertical transport (2.5.23), however, are so strongly related to layout that they must be discussed here, at least in a preliminary way.

2.5.22

Service systems

The basic principles of distribution of common services are discussed in Chapter 3. Here, the constraints that they impose can be summarised very simply and crudely. First and generally, it is desirable that all vertical service runs should be continuous throughout the building. Since in buildings of more than two storeys services are usually run in ducts for easy access, this also implies that the ducts will be continuous. The taller the building, the more desirable it is to maintain continuity.

The second set of constraints arises specifically from the requirements of plumbing and drainage. It is highly desirable that the stacks or vertical pipes that remove soil from toilets and waste water from baths, showers, basins, sinks and so on should in fact be vertical, and they must run right through the building from a vent above the roof to the drains below ground.

Further, regulations often require that any fitting that has to be
connected to such a stack be no more than a certain maximum distance away from it, usually about 2 metres (6 ft). For this reason, and to avoid the nuisance and expense of additional stacks and the ducts to contain them, plumbing fittings are usually grouped together in plan and placed above each other in section as far as possible.

**Vertical transport**

Under ‘architects’ in Flaubert’s *Dictionary of Received Ideas* we find ‘All idiots; they always forget to put staircases in houses’. In fact, forgetting the stairs, and forgetting that they are pre-eminently three-dimensional objects that extend vertically as well as horizontally, is a typical mistake of the amateur and sometimes of the beginning student. Stairs *must* be in the same place on each of any two floors that they connect. For intelligibility, it is best if they are in the same position on *every* floor. The same is true of escalators. In the case of lifts, there are technical issues as well, which will be discussed in Chapter 3.

The main stair, or the lift lobby or the bank of escalators, is often the main destination of people arriving on the entry level of a multi-storey building. It is always the point from which a visit to an upper floor must begin. Its location is therefore a critical planning decision. To use the technical term introduced earlier, it is at or near the top of the constraint hierarchy. In very tall buildings this decision is severely constrained by technical considerations, but in buildings of lesser heights it is usually the issues of arrangement that dominate. Very tall buildings are not likely to be selected as studio projects in the first two or three years of design.

**Kinds of vertical organisation**

Le Corbusier is reported to have said: ‘For Ledoux it was easy – no pipes’. As the number of building services has grown, and the demand for convenient availability of services, and particularly plumbing services, has increased, the architect’s task has grown more difficult. At the same time, various type-solutions to the constraints imposed by services have been invented. Plans can be categorised according to which of these type-solutions has been adopted. In the studio, a discussion of this
aspect can usefully form part of the state of the art review (see 2.1.6 to 2.1.12).

The type-solutions differ mainly in the degree to which services and areas requiring plumbing services in particular are concentrated spatially. Here, the three main type-solutions are called the service grid (2.5.25), the service core (2.5.26) and the repetitive plan (2.5.27).

2.5.25

**Service grid**

In buildings in which activities demanding plumbing and drainage and other supply and waste services are widely diffused and/or subject to change, such as hospitals and laboratories (Fig. 2.21), the only solution may be to provide a grid of service ducts, as closely spaced as economically possible. While such technically complex buildings will not usually make suitable studio projects, some discussion of the issues is provided in Chapter 3 as part of the general treatment of service distribution.
Service core

The other extreme approach is to concentrate all the vertical services, along with the means of vertical transportation, in a *service core*. This approach was invented for office buildings, in which the demand for plumbing is relatively low, and false ceilings are provided for horizontal distribution of other services from the core.

However, the principle of the service core has been applied in buildings of other types. Frank Lloyd Wright’s Guggenheim Museum has a miniature service core containing a small lift and toilets.

Repetitive plan

Between these two extremes are plans in which rooms that require water and drainage are distributed horizontally according to the constraints of arrangement but stacked one above the other vertically. This approach is most suited to buildings in which the same plan can be repeated on every floor, as in blocks of flats and the bedroom wings of hotels. Often some effort is made to reduce the number of ducts and stacks by grouping bathrooms with other bathrooms or with kitchens, and so on. Hotel rooms, for example, may be ‘handed’ so that two bathrooms share one stack (Fig. 2.22).

Figure 2.22
Hotel rooms with ‘handed’ bathrooms,
The Portman, San Francisco (1987)
John Portman
A variant of this approach is often found in two-storey houses, in which the first floor can seldom be identical with the ground-floor plan. An attempt is still made to group wet areas vertically: for example, an upstairs bathroom may be located over the kitchen or a downstairs toilet. Failing this, stacks and other plumbing are often concealed in low-status areas such as closets or garages.

**Some planning processes**

Where the vertical organisation is simple repetition, layout planning can generally be done in the way described for single-storey plans. Some modifications to this approach are necessary in the case of the single-occupancy low- to medium-rise building, in which one set of interrelated activities must be distributed over several floors. In such buildings a main part of the task is to match the specific layout requirements of the various floors with the requirements of vertical circulation and of the vertical distribution of services, which are often diffused.

**Single-occupancy low-rise**

Planning for a set of related activities to be carried on over a number of storeys imposes additional constraints on layout, primarily because of what can be called the *barrier effect* (2.5.30). This constrains the way in which we break up the network and share out the activities and their space requirements over the various levels. Issues of privacy, access and status arise in deciding what to put on which level. All of this has to be taken into account in deciding whether the various floors are to be of the same size and shape or of different shapes and sizes. Finally, since the plans of the various floors constrain each other through the system of vertical organisation, it is important to start in the right place.

**The barrier effect**

A change of floor level discourages communication. Going up or down stairs or a ramp is a physical effort. Lifts keep one waiting. Escalators offer the least resistance but they are expensive and take up a lot of space; therefore they are normally used only where very large numbers of people have to move between different levels.
In addition to these obvious physical effects, a change of floors is a significant psychological barrier. Even where the actual time taken for the trip is the same, going to another floor requires a decision, whereas a horizontal trip will be taken without hesitation. Because of this barrier effect, closely connected activities should not be placed on different floors. Therefore, a useful first step in planning on more than one floor is to break up the net into clusters, as described in 2.5.14. The clusters can then be shared out among the floors.

**Sharing out the space**

In order to share the space out among the floors, it is necessary to know the number of floors, the area of each floor, and the areas of the clusters or groups of clusters that are to be assigned to the floors.

The approximate number of floors can be decided either on the basis of direct benefits (2.3.35) or by calculating the ratio of building area to buildable area (2.3.34). In either case, the area of each floor can be assumed initially to be the building area divided by the number of floors.

The area of each cluster can be calculated in the same way as the total building area, by adding up the approximate room areas and adding 20% to 25% for walls and circulation space.

**What goes on which level?**

Because of the barrier effect, stairs and other means of vertical transport make a useful contribution to privacy. In cultures in which bedrooms are private parts of houses they are often placed upstairs. The more stairs, the more privacy; each floor above ground is more private than the one below.

Above the first floor, however, floors decline in *status*. The work of going upstairs makes the higher levels less attractive. When there were servants and attics, servants were housed in the attic.

These principles do not apply where lifts are provided. All floors serviced by a lift are at the same ‘psychic distance’ from each other. Therefore,
the symbolism of height has free reign, and going up leads to the boardroom or the penthouse.

Carrying heavy goods or refuse up and down stairs is not a popular activity. Even if a goods lift can be afforded or must be provided for other reasons, it is best to keep rooms that have many deliveries of goods or generate a lot of refuse on the ground floor.

For obvious reasons rooms that must be visited by large numbers of the public on a regular basis are also best located on the ground floor. The requirements for escape from rooms that house large numbers of people at once, such as cinemas, restaurants and nightclubs, become harder to satisfy the higher up they are placed.

**Equal or unequal**

A sensible subdivision of the activities may not fit into floors of equal sizes. In a two-storey building this hardly matters, although making the floors of different sizes may impose some constraints on the selection of technology.

It is also technically feasible to build tall buildings with floors of different sizes and shapes. There are economic and technical arguments both for and against this, which will be briefly discussed in Chapter 3.

There is a strong argument against designing large public buildings housing complex activities with floors of very different sizes and shapes. Such an arrangement is contrary to people’s expectations and makes the plan hard to understand and learn (Moeser 1988). However, as previously noted (2.4.25), some variation in the shape of floors will not affect intelligibility so long as the pattern of corridors is intelligible and remains constant on each floor.

**Selecting a starting point**

It might seem that the planning of buildings of more than one storey should begin with the ground floor but this is not always the case. As we have seen, the location of vertical transportation and also of certain services, particularly plumbing and drainage, constrains the floors
through which they must pass. If a particular floor is tightly constrained in its layout and the position of these features in the building generally is not related to the needs of that floor, then an irreconcilable contradiction is likely.

Therefore, it is wise to consider the most constrained floor, whichever it may be, first. After exploring the possible layouts, including the location of stairs, lifts, wet areas and so on for that floor, identify the next most constrained floor, and try to lay it out on the assumption that the vertical elements are in the positions best suited to the most constrained floor. By proceeding in this way, the mutual constraint exercised by the different levels on each other through the continuous vertical elements can be allowed for.

If the floors are to be of equal size and the same shape, then only the most constrained floor can be planned by the ‘inside out’ method. The rest will have to be done by the ‘outside in’ method described later.

**Multiple-occupancy serviced space**

So far the discussion has focused on multi-storey planning for single occupancy with diffused services. It has been assumed that at least the shape of the most constrained floor can be determined by considerations of arrangement alone. That is, we have assumed planning from the inside out. This is the most difficult but not the most commonly encountered case.

For the majority of medium- and high-rise multi-storey buildings, the size and shape of the upper floors is restricted or fixed by a combination of site, economic and technical constraints. A large fraction of these buildings are apartments or rental office buildings. Most office buildings consist essentially of a service core and a surrounding area of ‘serviced space’ (see 2.2.2). Since the planning techniques in use for other multi-storey building types are, historically speaking, largely derived from the office building, the focus here will be on methods of laying out office buildings, and other applications will be mentioned as we go along.
2.5.36

**Elements of the office building**

In the initial planning of the multi-storey office building, three sets of constraints have to be matched. They are the site constraints and especially the legal constraints (discussed earlier), the constraints of horizontal service distribution, which influence the selection of a planning grid (discussed in 3.4), and the constraints on the location of the service core, which follow. These three elements then constrain the layout planning.

The principles of core location, to be discussed, can also be applied to locating the main vertical circulation in other buildings with repetitive vertical organisation, such as blocks of apartments or the bedroom wings of hotels, and in buildings with grids of vertical service ducts.

2.5.37

**Service cores**

Most multi-storey serviced space buildings are planned with a core consisting of a lift lobby or lobbies, lifts, escape stairs, and wet areas, that is, kitchens and toilets. The size of the core is usually largely fixed by regulations governing the number of toilets and the number and size of escape stairs, and by technical considerations that tightly constrain the number and size of lifts and their grouping into lobbies. Since the number of elements that make up a core is small and their sizes and shapes are tightly constrained, it is usually possible to plan the core itself by exhaustion. The next question is the location of the core within the building. This is also often tightly constrained by technical issues, but it is also influenced by matters of arrangement, particularly with regard to the rationing of windows and to circulation.

2.5.38

**Core and perimeter**

Putting the core in the centre of a deep plan (see 2.5.43) helps to fill up the less valuable internal space and to conserve the window space on the perimeter (Fig. 2.23). In the case of a building that is to be built up against other buildings on one or more sides, the core is often moved away from the centre towards the point furthest from any window (Fig. 2.24). In buildings with relatively shallow plans, the core is often placed
in the middle of whichever long side is less attractive in terms of aspect and prospect. This minimises escape distances.

Core and circulation

Since the core is primarily an element of vertical circulation, its relation to the general pattern of circulation has to be considered in deciding its position. There are three main issues here. The core has to be related to the entrance on the entrance floor. Economy of circulation on upper
floors is usually also an objective. Finally, most designers aim at minimising the number of escape stairs while maintaining safety.

2.5.40

Core and entrance

If the position of the entrance is fixed in relation to the plan shape, by regulation or some other consideration, this can strongly influence the location of the core. As pointed out in 2.2.23, a clear and direct path from entrance to central circulation is often desirable.

2.5.41

Economy of circulation

On upper floors, a ring of corridor surrounding a central core is a very economical way of providing the basic circulation for a plan that is approximately square or circular. It is a poor arrangement from the point of view of intelligibility, but some orientation is usually provided by the lift lobby. In rectangular or other elongated plans, a central corridor running the length of the plan is more economical.

2.5.42

Core and escape

With a central core in a deep plan, it is generally possible to provide alternative means of escape by having entrances to a fire stair or stairs from opposite sides of the core, connected by a ring corridor of the kind described above.

However, a central core also has disadvantages from the point of view of escape. People have to get out of the building safely at the bottom. This may require a fire-isolated passage at ground-floor level or on one of the low-rise floors where fire stairs can be offset. A passage is obtrusive and may break up the space in an unsatisfactory way. For some building types, escape is thus better served in some ways by stairs on the perimeter.

2.5.43

Deep plans

For purposes of layout planning, plans can be divided into shallow plans and deep plans. A deep plan is one in which a substantial portion of the plan area is too far from an unobstructed external wall to receive
useful amounts of natural light or ventilation. As a very rough working rule, the critical distance is about 6 metres or 20 feet. The rule is more than usually rough because of the number of factors that have to be taken into account; these factors are discussed in Chapter 3.

A deep plan may be chosen for technical reasons. More often it is a consequence of site and economic constraints. The building may have to be built up against one or more existing buildings, as often happens in older cities. Or the buildable area may be inherently compact, approximately to a square or a circle and also large. Square or circular plans of small areas are not deep plans. Frank Lloyd Wright’s laboratory tower for the Johnson Wax Factory is square, with rounded corners (Fig. 2.25), but the distance from the outside wall to the centre is so small that the building is naturally lit and could probably have been naturally ventilated, though in fact it is air-conditioned.

Figure 2.25
S.C. Johnson & Son Inc., administration building & research laboratory tower, Wisconsin (1936–50)
Frank Lloyd Wright
2.5.44

**Implications of deep plans**

By definition, multi-storey buildings with deep plans are dependent on air-conditioning and artificial lighting. They often, but by no means always, consist of ‘serviced space’ (see 2.2.2). Conversely, many but not all ‘serviced space’ buildings have deep plans.

A deep plan imposes additional constraints on layout because perimeter walls with access to outlook or natural light are limited. Since outlook or prospect is valued, and access to natural light is essential for some tasks, the perimeter then has to be rationed, and this will constrain the position of some rooms.

2.5.45

**Serviced space and planning grids**

If you are preparing a layout plan for a floor or floors of a building that consists of ‘serviced space’, the planning grid will be a critical constraint. Draw the planning grid onto the floor plan before beginning the layout. Room sizes and shapes should be adjusted to the planning grid as you go.

You will notice that planning with a grid in this way increases the overall area used. It is only by chance that the minimum acceptable dimension of a room is also a grid dimension. Most rooms will therefore be slightly oversized.

2.5.46

**Layouts in shallow plans of fixed shape**

In the case of a multi-storey shallow plan building the main corridor can be treated as the guide line for layout planning, using the method described in 2.5.16. This is so whether the plan shape is compact, with a ring corridor around a central core, or elongated, with a core on one side and a central corridor running the length of the building. In the latter case, however, rather than starting with the most constrained room or cluster it may be better to start from the core, treating it as the entrance as discussed in 2.5.17.

The taller the building, the more value is likely to be placed on prospect. Therefore, rooms that have special claim to the most favourable prospect should be located as early as possible in the process.
**Layouts in deep plans**

Layout in a deep plan is a little more complex. Here, as previously noted, the perimeter has to be rationed. The layout then has to be conceived in terms of two zones, the perimeter zone and the inner zone. If the whole space is to be occupied by one set of activities, start by locating those rooms that have the strongest claim to perimeter space on the perimeter. As before, locate the most constrained room or cluster first, and then place the others in relation to it, treating the perimeter as the guideline. Go on in this way until all the perimeter is used up.

Having achieved a rough layout for the perimeter zone, locate the remaining rooms in the inner zone in relation to the perimeter rooms, keeping as close to the constraints of the net as possible.

The layout of the circulation will follow; it must be designed to connect the perimeter and intermediate zone to the core in an intelligible way.

Where several unrelated or weakly related activities are to be housed in one space, as often happens in deep plan buildings, it may be more efficient to do a separate trial layout for each activity first. Having formed some idea of the importance of each activity and the size and shape of the space required for it, assign the activities to parts of the available area. Then plan each part, starting with the perimeter zone. Finally, adjust the boundaries between the areas devoted to the different activities as necessary to conform to the service grid and to improve the shapes of the rooms and the clarity of circulation.

**Looking forwards and backwards**

This is as far as the development of a plan can sensibly be taken on the basis of considerations of arrangement and site constraints alone. To go further without considering technical issues is not impossible but it is risky. An experienced architect would have had technical issues in mind throughout, but the student by definition is not an experienced architect. The last section of Chapter 3 shows how some of the technical decisions which have been omitted for clarity are linked to the layout planning process.
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