a guide for the perplexed

TOM HEATH
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 Riddel
Extract from Encyclopedia of Australian Architecture (CUP)

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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
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 marrs 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
LEARNING
ARCHITECTURE
TEACHING
ARCHITECTURE

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 Follen
Queensland Government Architect
Ministry of Pensions, Helsinki (1952–56)
Alvar Aalto
Introduction

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 (see, for example, Sekler and Curtis 1978; Williams 1989; Silver 1994; Herzberger 1991, 1993). 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 cliche, ‘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. So far as humanly possible, it avoids high or profound theoretical issues. Rather, it seeks to clear the way so that such issues can be better discussed in the studio. Unfortunately, theoretical issues cannot be avoided altogether, and this introduction and the introductions to the succeeding chapters try to set the practical advice offered within a more general framework.

The approach taken in this introduction and, for that matter, throughout the book will be found to differ from those of some other writers, such as Lawson (1980), Rowe (1987) and Mitchell (1990). This is partly because design is a large subject and will look different from different points of view, partly because of our resolutely practical viewpoint, and partly as a consequence of differences in values. Some of
the educational consequences of these differences will be taken up in Chapter 5 and teachers who are reading this book may find it helpful to start there. Here we must begin by looking at some of the difficulties of the task.

**Difficulties**

Wotton’s book was called *The Ground Rules of Architecture*. It, and the many others like it published in the seventeenth and eighteenth centuries, enabled people without any special architectural training to design and build buildings that were solid, practical and handsome. Unfortunately, writing such books has got much harder.

There are two main reasons for this. One is a loss of nerve. Many people no longer believe that there are or even should be any ground rules for architecture. This issue will be taken up in Chapter 5. The other reason is the growth of knowledge. At the end of the nineteenth century, Julien Guadet produced a book designed to do a somewhat similar job to Wotton’s. It ran to five volumes (Banham 1960). Since then, architectural knowledge has really grown. It is no longer possible to do more than give a guide to the ‘ground rules’. Such a guide is needed to stitch together the various parts of a modern architectural education into a more effective whole.

**Modern architectural education**

Most modern architectural education is divided into two complementary parts. There is a theoretical part. The basic knowledge that is needed to design modern buildings, which Guadet attempted to summarise in his five-volume monster, is now given in numerous courses of lectures spread over several years. There is also a practical part, the design studio. Here students learn the process of designing buildings. The method of the studio is in general not theoretical teaching, but learning by doing. Students are expected to apply what they have learned in other courses. In principle this sounds admirable, and it has been suggested that educators in other professions could learn from this example (Schon 1985). However, it poses problems of coordination and synthesis for both the school and the student.
Problems of coordination

The theoretical part of architectural knowledge is usually divided up and taught by a great many specialist teachers. Without going at tiresome length into the administrative absurdities of modern universities, it can be said that the task of coordinating the activities of these teachers is very much like that of trying to run a railway where each driver insists on setting his or her own schedule and destination. It is seldom that a coherent and relevant body of knowledge is presented to the student (Cuff 1996; Gelertner 1988).

There is a further problem in coordinating the entire body of theory with the practical work in the studio. The studio teachers may not have a clear picture of the body of theory that the students are supposed to have mastered. If they do, they may not consider that it is appropriate to what they regard as a properly structured sequence of studio exercises. As a result, it is not uncommon to find studio and theoretical studies proceeding quite independently.

The difficulties are such that some architecture schools have abandoned the traditional structure for what is called problem-based learning, in which theoretical teaching is largely controlled by the demands of the studio (Maitland 1991). Such experiments are still rare, however. Very often, the task of synthesis is left to the student.

The studio situation

It is obvious that the beginning student needs help with this task of synthesis. Of course, studio teachers provide such help. However, the time which teacher and student have together is short, and it often happens that much of it is taken up with the correction of elementary errors that arise from this difficulty of synthesis. The time available for the discussion of broader or deeper issues is accordingly reduced. This can be frustrating and discouraging for both student and teacher (Anthony 1991; Salama 1995). It can be still more frustrating, as Schon (1987) has emphasised, if teacher and student cannot reach common ground, because the student does not know what to ask and the teacher can no longer imagine what it is like not to know.
In this context, this book aims at providing both a guide to students and a reminder to teachers, to assist them in reaching common ground.

**Knowledge and design**

Knowledge is needed to define the goal of design. In order to reach a goal, or solve a problem, we need to know what will count as an answer, or part of an answer. We must have rules or tests that enable us to distinguish answers from non-answers, and steps towards the goal from steps away. Here knowledge that defines the goal and can be used to test progress towards it will be called ‘a constraint’. A constraint is a proposition or statement that enables us to distinguish between solutions (or partial solutions) and non-solutions.

However, knowledge also provides the stimulus for imagining ways of achieving the goal. From this point of view, the term ‘constraint’, though in widespread use, has wrong implications. It implies that constraints are negative forces which must somehow be overcome or escaped. In fact, they are more like the winds and currents of the sea to the sailor, sometimes helping, sometimes adverse, but always essential to the voyage. The uses of knowledge as an aid to imagination and as a check on progress interact (Zeisel 1981).

**An example of interaction**

Suppose that the goal is to design a house for a family of four on a steeply sloping site. This statement already gives a number of constraints: the building is to be a house, it has to house four people, the site may present difficulties. The information about the site might lead an architect to a series of what-if thoughts about ways of building on a steep slope. It might be possible to build the house on a level platform, supported on a framework of steel or concrete or timber. The house might be stepped down the slope. Or it might be cantilevered out over the drop. Notice that these what-if thoughts in turn make use of knowledge of solutions to similar problems and also of technical knowledge.

In order to test these ideas, the architect might seek more information
about the site, more constraints. Then, perhaps, it turns out that there is solid rock at the top of the site near the road but the rest is loose, compressible sand. The site is near the sea, and subject to bushfires. Steel or timber supports no longer seem such a good idea, since they are both affected by fire and steel rusts in sea air. It does not sound as if the loose sand will provide good support for a house that steps down the slope. A cantilevered concrete structure, at first rather an unlikely idea, may not be so bad after all.

**Designing as exploration**

The example in 1.8 illustrates the exploratory character of design processes. Design tasks are sometimes called ‘problems’ but they are very different from the kinds of problem to be found in textbooks on mathematics or logic. The constraints on a design, which define the goal, are not necessarily given, certainly not in real life (Heath 1984) and often not in the studio. Many, perhaps all, will have to be discovered. This is a large part of the work of designing. To discover constraints, one has to know where to look. How do we know where to look?

Unfortunately, the answer to this question in practice is, by experience. Experience of similar problems tells the architect what kinds of constraints are likely to apply in a particular case. This is little help to the student, who by definition is not experienced. However, it is worth trying to describe, in a general, abstract way, what it is that the experienced practitioner does. This may make clearer what it is that the student needs to learn. What follows can usefully be read in conjunction with Akins’ (1986) account of the actual processes adopted by architects in tackling a simple problem.

**Maps and searches**

As described in the example given in 1.8, the experienced architect begins by forming a picture of the goal, or, more accurately, a series of possible pictures. We shall call such a picture a *schema*. A schema acts like the map scrawled by the dying prospector to guide the hero to the lost mine. It is not very accurate, but it is better than no map at all. What
the schema does is to guide the search for more knowledge. As the search proceeds and new clues are discovered, the map is redrawn. This process of exploration can be represented thus:

Through this sequence of exploration, discovery and revision, the designer ‘homes in’ on the goal. This process of ‘homing in’ is known as heuristic search.

This model of designing contrasts with a model popular in the 1960s and 1970s known as the analysis–synthesis–evaluation model. The analysis–synthesis–evaluation model assumes that all the relevant information is collected first. It is then synthesised to produce a design, and the design is evaluated to see that it conforms to set criteria. There are many criticisms of this model, of which the most important is that the ‘synthesis’ phase is psychologically impossible (see 1.12). Akin (1986), in his studies of experienced architects working on realistic tasks, found that their procedure was heuristic rather than analytic.

A popular view of designing

This heuristic description of designing differs from the picture of designing that many people have. They think of the architect imagining the building whole, in a single flash of inspiration. Slightly more sophisticated versions allow an initial period of ‘fact gathering’ and ‘incubation’, and perhaps a subsequent period of elaboration. Nevertheless, on this kind of view it is the almost instantaneous formation of a complete ‘concept’ that is central to design. This is very flattering to architects, since it ascribes to them an almost magical power, and it therefore forms part of the ideology of architecture (see 5.1).
**Limits on the imagination**

There are, however, reasons for believing that this kind of thing seldom if ever happens, and that you, the student, would be ill-advised to sit around waiting for it to happen. Research has shown that there are limits on our imagination. These limits are mainly those of our short-term memory, or consciousness. This is quite different from what we ordinarily call ‘memory’, which is technically called the ‘long-term memory’. We cannot think of very many things at once. In fact, most of us cannot think of more than the ‘magical number’ 7 ± 2 (Miller 1956).

You can easily test this for yourself by getting someone to read you a list of random numbers, or trying to picture simultaneously nine different objects: say, a saw, a pen, a table, a car, a cat, a sword, a rock, a traffic light and a fishing rod.

**Escaping our limitations**

Such limitations would seem to make effective designing very difficult if not impossible. As Chapters 2 and 3 of this book show, there are a great many more than nine constraints to be taken into account in designing even simple and common buildings. Since buildings do get designed, it is obvious that these limitations can be escaped, but how?

People who accept these findings but still want to maintain a view of designing as instantaneous inspiration sometimes argue that the work of synthesis takes place in the unconscious. The conscious mind, they admit, is limited, but the capacities of the unconscious are unlimited. This may be so; at present there is no way of knowing. However, as an explanation of designing, it will not do. What is in the unconscious must be brought into consciousness to be used. The ‘gate’ of 7 ± 2 items remains the same size; the holistic solution could not get out.

However, it is possible to overcome our limitations. It is not easy; designing is difficult. To do it, we must first of all accept that designing is a step-by-step heuristic process and not a holistic one. Then it is necessary to understand the function of representation and the role of shifting viewpoints in designing.
Zeisel (1981) suggests that designing consists of three elementary activities, imaging, representing and testing. So far, something has been said about imaging and testing. Now it is the turn of representation. The intimate connection between design and representation is clear in the early use of the word to mean both to sketch and to plan. The reason for this connection lies in the limitations of imagination. The schema in the head cannot take us far. It is by representing our schema, and each imagined revision of it, that we can escape the limitations of the imagination. With the image before us, we can apply tests, imagine improvements, and so progressively move the design towards a solution, without exceeding our limitations.

Thus the model of designing given earlier needs to be revised, or redesigned, as follows:

This contains an important lesson. If, when you are working on a design, you are not constantly producing amended or new drawings, the effort you are putting into imagining will largely be wasted. It will also be quite difficult for your teachers to help you, since they cannot see inside your head.
Shifting viewpoints

One objection to such step-by-step procedures is that they are too narrow, too blinkered. They could never produce an integrated whole, only an awkward assembly of partial solutions. This is true if the line of thinking, or viewpoint, remains fixed. However, as Zeisel (1981) points out, designing is characterised by shifts in viewpoint. Three kinds of shift are important here. First, there are shifts from one line of attack to another. Second, there are shifts from one kind of constraint to another. Third, there are shifts from the part to the whole and back.

Lines of attack

The example in 1.8 illustrates shifting lines of attack. The architect’s attention was first caught by the challenge of the site. Several different ways of meeting this challenge were envisaged or imagined. Each of these represents a possible line of attack on this aspect of the problem. To choose between them required more information. Each line was pursued until it encountered some serious difficulty. Then the architect switched to another line, finally selecting the most promising.

Kinds of constraint

In the language of inspiration, it could be said that in that example the architect found inspiration in the site and the constraints arising from the site, and in the technology that might be used to meet these constraints.

Another architect might start quite differently by getting to know as much as possible about the people who are going to live in the house. How do they live now? What do they like about the way they live? What do they dislike? How do they see themselves living in the new house? This is a different group of constraints, concerned with people’s behaviour and their emotional response to the environment.

There is no necessary connection between these two groups of constraints. You cannot deduce much about how people want to live from the shape of a building site, or vice versa. Yet both these sets of constraints have to be discovered and met if the design is to be accepted.
So, at some point our architect is going to shift from thinking about the one group to thinking about the other. In fact, this is unavoidable. Thinking about ways of building in response to the site will raise the question, how big does the building have to be? Thinking about a plan that can support a way of life will raise the question, how can this be fitted to the site? However, it is not wise to wait until a switch to thinking about another kind of constraint is unavoidable. The experienced architect will make such switches constantly.

**Part and whole**

Careful readers may have raised theireyebrows at the mention of switching from the part to the whole. Wasn’t it said earlier that holistic design is impossible? So it was. The switch is from a worm’s eye view to a bird’s eye view, or, as it is sometimes put, from a bottom-up approach to a top-down approach. Whatever the level of view, it is still only possible to think of 7 ± 2 ‘things’, but the scale of the ‘things’ changes. As a result, the ‘big picture’ is simplified and abstracted.

This lack of detail is the weakness of the bird’s eye view. It slips too easily into fantasy. Sometimes the details are critical. Bold political plans often fail for this reason. Architecture that has been thought about mainly at the abstract conceptual level also often fails the test of practice. Nevertheless, the bird’s eye view is necessary.

To continue with the same example, the architect may discover all sorts of detailed requirements for the individual rooms. The furniture fittings and equipment will be specified along with the way they are to be used, and this will constrain the size and shape of each room. In thinking about the layout of the house as a whole, however, these detailed requirements can be temporarily forgotten. Each room can be treated as one thing of a certain approximate size and shape. In this way various approaches to the plan as a whole, or planning lines of attack, can be developed. To test each approach, however, it is necessary to switch levels again and make sure that the detailed constraints on the individual rooms can be met in that arrangement. Once again, the experienced architect will make such switches fairly frequently.
Backtracking

The process of designing, at least as it has been described so far, involves revising one’s schema, or backtracking (Zeisel 1981). From time to time, a particular line of attack will turn out to be blocked by some newly discovered constraint. Then, it is necessary to go back to the point from which that line of speculation started and look for other possibilities.

Backtracking is a normal, if tiresome, aspect of heuristic search processes like designing. There are three things to notice about backtracking. First, you must be emotionally prepared for it. Second, you must be practically prepared for it. Third, you must plan your work so as to minimise it. The first two points can be dealt with immediately. Before considering how to plan the work, some other aspects of design processes need to be brought out.

Emotional difficulties of backtracking

Students often find it very difficult and frustrating to give up their current line of thinking, even when it is obviously unavoidable. The reason for this seems to be that they commit themselves too deeply to a single line or idea, instead of exploring several lines concurrently. As a result, they waste time and effort trying to save indefensible lines of thinking or defending them from criticism.

It is always annoying to come to a dead end and find that work has been wasted. It helps somewhat if you recognise that this is a necessary part of an exploratory process. If you recognise that design is exploratory, you will be more inclined to make the effort to switch lines of attack, to explore different kinds of constraints, and to move from bottom-up to top-down thinking. This, in turn, will mean that when you have to backtrack you will not have to go back so far.

Be prepared

Since you are going to have to backtrack from time to time, be prepared for it. Never destroy any of your preliminary sketches or draw over them until they become illegible. Number them in order, so it is easy to get
back to the starting point of the blocked line of thinking. This practical issue is discussed further in Chapter 2 (2.5.8).

**1.22**

**Stopping**

From what has been said so far, it is not clear why design should ever stop (Lawson 1980, 1990). Discovering new constraints and revising might go on indefinitely. This is, indeed, the case. In real-life design, processes often stop just because the time or the money have run out. In the studio, it is the time that runs out. Obviously these are not good stopping rules. There is no guarantee that the resulting design will meet all the constraints or even the most important ones. It should be obvious that having a good stopping rule is closely linked to having a good plan on which to work. To get further with this, it is necessary to say some more about the nature of constraints.

**1.23**

**Where do constraints come from?**

So far, constraints have been treated as somehow given. Where do they come from? If they are rules, who makes these rules? These are not simple questions, although attempts have been made to simplify them. Answers have been given in terms of authority, of need, and of values.

**1.24**

**Constraints and authority**

One kind of answer, given by some people both in practice and in the studio, is that constraints are the demands of those in authority. The client, or the teacher, makes the rules by issuing a brief or program. These rules may be complemented by others, for example by building regulations, which are also the demands of a legitimate authority. This answer is true so far as it goes.

However, even if the authority of the brief or program is accepted, such documents are often faulty. They may omit things which the author ‘takes for granted’, and these are not necessarily the things which the architect, or the student, takes for granted. Another common and important flaw is that the various demands or constraints are not *weighted*; that is, there is no way of telling how relatively important they are. This is significant if the demands of the brief or program turn out
to conflict, as they often do (Heath 1984). Finally, taking things on trust, or authority, is always dangerous; a responsible designer will want to know *why* these particular demands were made and not others. Successful designing depends on understanding the system designed for.

**Constraints as needs**

Constraints are also sometimes explained in terms of needs. Those who take this stand often refer to Maslow’s well-known hierarchy of needs (Maslow 1943). At the bottom of this hierarchy are basic physiological needs, such as hunger and thirst. Then in ascending order come the needs for safety and security, affection, esteem and self-actualisation. The needs lower in the hierarchy are supposed to dominate the ‘higher’ needs.

There are criticisms that can be made of this. As a matter of observation, people are quite able to put ‘higher’ needs before ‘lower’ ones, particularly once the basic physiological needs are met. Despite that, as a rough and ready rule it works well enough. However, it is difficult to apply to architecture. The ‘needs’ for which architecture has to provide are safety and security, and the highest level ones of esteem and self-actualisation, which as Sommer (1972) points out can be met in an almost infinite number of different ways. On the other hand, some of the ‘needs’ for which architecture must provide, such as supporting various practical activities (see 2.1.3), don’t seem to fit into Maslow’s hierarchy at all.

**Constraints as facts**

Both the view of constraints as the demands of authority and the view of constraints as needs are attempts to make constraints into something fixed, definite and unalterable, which is somehow given, and can be known once and for all. Such a picture suits people who take what is sometimes called a ‘functionalist’ view of designing, according to which designing is a process of calculation that can be pursued entirely logically or even mechanically.
Unfortunately for such people, the idea of constraints as fixed and definite does not fit well with what happens in practice. In practice, it is very often the case that people are unsure of what they want, they hold conflicting ideas or they change their minds. When clients or users are clear in their minds about what they want, and can specify it exactly, this is usually because there is already a range of examples or exemplars that have helped them to define their values (Wade 1977; Heath 1984). In such cases, for example in the general housing market, there is less demand for architects.

**Constraints as values**

The position taken in this book is different. It is that constraints are demands which arise from people’s values. The different forms that values take in societies are discussed in the next chapter (2.1.4). Values no doubt have some kind of psychophysical process somewhere at their root, but their specific character is almost entirely determined by a particular social setting and way of life. Different individuals and groups have different values and make different and sometimes contradictory demands. Last but not least, values are not all equally strongly held. Some values are more important than others, either to the individual or to the social group.

For example, to go back to the house on the steep site, that particular group may all agree that they want a house which is cheap, has a natural setting and has a view of the sea. Their choice of site meets the two latter constraints but makes the first harder to achieve. Then suppose that the four people concerned are not a nuclear family, but two couples who want to share a weekender. One couple likes to cook and wants a large kitchen. The other couple is quite happy to eat canned food and only wants to pay for minimum cooking facilities. These are contradictory demands expressing different values.

Notice that it does not make sense to say that one couple ‘needs’ a large kitchen or the other a small one. Both couples could probably feed themselves successfully in either. When people talk about ‘needs’ in architecture, they are often trying to privilege their own demands, or
demands of which they approve. If something is a 'need', it is implied that it has absolute, not relative, value and cannot be criticised or discussed. It is being pushed to the top of the hierarchy of values.

Hierarchies of values

Any individual or group has a great many values and some of these will be more important to them than others (see also 1.44 and 2.1.4). Sometimes the most important values are never mentioned: 'everyone knows that' (see also 1.24). Sometimes the majority holds one set of values, but minorities have different values. Sometimes the powerful have values that differ from those of the weak. There are three different kinds of value hierarchy; values can be ranked by individual or group preference, statistically or politically. In real life, deciding which constraints must be met and which will have to take their chance is a complex matter of judgement and negotiation (Cuff 1991). In fact, such negotiation is a central part of design practice.

In the studio there is seldom time to negotiate and renegotiate the ranking of values. Some discussion of rankings may be desirable; this will be taken up in later chapters, and particularly in Chapter 5. Here, we need to look at two paradoxical consequences of the existence of value hierarchies. On the one hand, they contribute to the fact that design tasks are always ill-defined or ill-constrained. On the other hand, they make it possible to establish stopping rules for designing, that is, to arrive at a solution.

Ill-defined goals

The goals of designing are inherently and always ill-defined. This is a dreadful secret, but it has leaked out, and it makes some things about designing clearer (Rittel and Webber 1973, 1984). In fact, it is this that distinguishes design tasks from management tasks (Wade 1977). In a management task the goal is known and what has to be done is to find means to get to it.

What does it mean to say that the goals of designing are ill-defined? First, as has been emphasised, it is seldom possible to know all the
constraints in advance; some at least will have to be discovered. Second, constraints are values, and while some values are rigid, many are rubbery and flexible; values also vary in their importance; they are subject to negotiation. Third, constraints or demands are often not very precise in themselves; for example, ‘a place to hang coats’ may be a row of hooks or a full-scale walk-in closet. All these kinds of imprecision multiply and compound one another.

Designing can thus be seen as a process of defining a goal. In the case of a building, once the goal (that is, the form of the required building) is sufficiently defined for it to be built, designing ceases. In practice, the process of definition continues throughout the production of working drawings, as detailed decisions are made. It is a mistake, as argued in Chapter 3, to think that designing stops when the general form of the building has been decided.

A definition of designing

At this point, it is possible to give a definition of designing which summarises some of the main ideas put forward so far. Designing is a process that enables us to decide what to do under conditions that are too complex for us to visualise all the possibilities, by imagining outcomes or parts of outcomes, representing what has been imagined in some form, and testing these representations in such a way that the risk of things going badly wrong is considerably reduced.

Note that ‘going badly wrong’ here includes all kinds of wrongness: ugliness, environmental destruction and discomfort as well as more obvious kinds of wrongness such as impracticality or collapse.

Satisficing

No doubt you noticed that the definition just given says nothing about the result being the best, or the best possible, or optimising, or anything of that kind. This is because, as a consequence of the vagueness and imprecision inherent in the definition of design goals, there is never any optimum or ‘one right answer’. What designing aims at is not optimising but ‘satisficing’, to use a word invented by H.A. Simon (1970). To
'satisfice' is to produce a design that meets all the discoverable constraints, including aesthetic and other 'qualitative' constraints.

**Stopping**

This notion of satisficing gives the stopping rule for designing. When you have a satisficing design you stop. The 'homing in' process has reached its objective, which Zeisel calls 'the domain of acceptable responses' (Zeisel 1981). This domain is large, perhaps infinite. This is because for each aspect or part of a building there may be many satisficing solutions, and the number of solutions for the whole is not the sum but the product of the number of solutions of the parts. Within this large domain, there are no criteria for 'better' or 'worse' solutions, because all the criteria, all the constraints, have been used up in defining the domain. So once inside, you stop.

The domain is possibly infinite but it is not boundless. There is a much larger number of possible designs which do not meet the constraints. Satisficing is not a low aim. The best practising architects seldom achieve it. There are too many constraints, and there is always too little time; a good design is one that satisfices the important constraints. As a student, with still less time and no experience to draw on, you will seldom achieve even this. This brings us back to students and their immediate problems, which we left at 1.9.

**Knowing how**

In 1.9 the student’s main problem was identified as lack of experience. The student beginning a design is in the position of someone asked to make an omelette for the first time. They may have seen and eaten omelettes, but they have never seen one cooked. They are given a set of ingredients, that is the brief or program. This set of ingredients may or may not be complete; ‘obvious’ things like salt or even eggs may have been omitted. They are not given a recipe or directions as to how to do it. Under these conditions, an edible omelette or an acceptable design are unlikely outcomes.

This book aims to produce not only a guide to ingredients that may be
useful but also some basic recipes or ‘procedural knowledge’. This is a highly controversial thing to attempt. Many teachers consider that offering anything in the way of procedural knowledge is likely to stifle the creativity of the student and foster conservatism. This issue is taken up again in 5.1. Here it is assumed that, on the contrary, many students desperately need a little help. The next part of this section considers what kinds of help it is possible to give and explains how this book sets about it.

The constraint model of designing

Much of this section has been devoted to introducing the ‘constraint model’ of designing. This is not the ‘one right model’. There are many other ways to look at designing, some of them overlapping with this model and some opposed to it. See, for example, Alexander (1964), Broadbent (1973), Wade (1977), Rowe (1987) and Mitchell (1990). However, the constraint model is the one around which this book is structured, because it makes it relatively easy to explain some useful heuristics or search methods.

Heuristics and their limitations

Just as there is no ‘one right answer’, so there is no ‘one right way’ or ideal set of steps for reaching an answer. Different kinds of buildings, for different kinds of clients, follow different patterns (Heath 1984). Even for one particular building, the maze of decisions can be traced in many different, equally efficient and successful ways. Therefore, procedural knowledge for architecture is not like having a recipe or even a book of recipes or a library of cookbooks.

There are, however, commonsense ways of attacking the problem. These ‘heuristics’ are not 100% reliable. They are rules of thumb, a term used often throughout this book. If a particular heuristic doesn’t seem to be working, try to figure out why and then try something else. This reflection on the situation, and switching from one approach to another, is characteristic of all professional practice (Schon 1983). This does not mean that any old method of working is as good as any other. On the whole, but not every time, those who use well-tried heuristics in a
commonsense way will get on faster and produce better results than those who don’t. We will now outline a generally useful way of approaching architectural designing: a large-scale map into which the more detailed maps of the later chapters can be fitted.

**Search plans**

A good search plan is obviously very desirable. How can such a thing be discovered? In designing, the best way to discover a good search plan is to study the *structure of the problem*. Look for the structure (that is, the inherent organisation) of the system to be designed.

What is the structure of a system? A system’s structure is defined by the parts that it must have and the necessary connections between them. The system structure can therefore be found by discovering the *main constraints* on the system; constraints are either the things that the design must have, for example ‘four large bedrooms’, or the relations between those things: ‘three of these bedrooms must be grouped and one must be as far away from the others as possible’. Usually, these main constraints will be the largest or most obvious features and their relationships.

**State of the art review**

As a first step in discovering the system structure for a particular architectural task, it is often useful to find some examples or exemplars. An *example* is a building that solves some more or less closely similar problem. An *exemplar* is an example that is in some way or other outstanding or worthy of emulation. Buildings that have found a place in the history books, or won awards, or that appear in the architectural journals, are often taken as exemplars. You should not, however, accept their exemplary status uncritically. Some teachers will begin a studio task with a critical discussion of examples and exemplars, and this can be very useful. If this is not the approach taken in your studio, you can still find and study examples and exemplars for yourself. Design problems are always partly novel, but they are seldom so novel that no models or exemplars can be found (see also 4.4).
1.38

**Analysing examples**

Students often approach examples or exemplars simply as images for imitation. While this is very natural, it is often counterproductive. The image, however seductive, may not be appropriate to your particular task. To understand the image, and thus to know whether it is relevant or not, you need to analyse the plan, identifying the rooms and their relations, and also the technology with which the building is realised, and see how each relates to the final appearance of the building. Which direction are the photographs taken from? To which rooms do the visible windows belong and what are the relationships between inside and outside? Try to draw the structural system. Is the building likely to be energy-efficient? What is it built of? How is it organised visually? What messages does it convey? In looking for answers to these and many other similar questions, you come to understand the underlying system of constraints and the ways in which it contributes to, or perhaps takes away from, the visible image. Chapters 2, 3 and 4 of this book are guides to critical analysis and the evaluation of examples and exemplars as well as guides to your own efforts.

1.39

**Solving the parts**

Having identified the parts of the problem, explore them individually and develop trial solutions for each. This is an easier task because each part is necessarily less complex than the whole. There are three basic strategies for solving parts: recognition, generate-and-test and heuristic search. Heuristic search will be used only for complex parts; it involves repeating, at the small scale, the overall processes that have been described: analyse the structure of the part, and try to solve its parts.

1.40

**Recognition**

Recognition involves knowing the answer, or knowing how to work it out. For example, in Chapter 2 it is suggested that for certain planning problems, such as laying out a small bathroom or a service stair, the number of solutions is limited. After a while, you get to know the possible answers and can solve these problems by recognition. Similarly, if you are exploring the need for shading devices and their visual effect
on a façade, and you have access to and can use a suitable computer program, you can work out an answer or a range of possible answers. Again the problem is solved by recognition.

**Generate-and-test**

Generate-and-test solution involves selecting a solution from a range of possibilities. Some examples are selecting furniture from a manufacturer’s catalogue or selecting a roof form for a rectangular building (see 3.5). For this to work, the range of possibilities must be limited and there must also be a limited range of known criteria on which to make the selection. Thus, in the case of the chairs, suppose that what is wanted is a dining chair: there are twenty different types currently available and the criteria are price, durability, comfort, general appearance and colour range. By using these criteria as a series of ‘sieves’, it is possible to arrive at a decision quite quickly.

Recognition and generate-and-test overlap. The example of the sunshading given in 1.40 might be seen as a case in which a number of different possible arrangements are generated, using the computer program, and then tested on other criteria such as appearance or ease of construction. Because of the large number of constraints that even simple architectural elements must meet, pure recognition is seldom found above the level of technical detail.

Generate-and-test methods and heuristic methods also overlap. The difference is that heuristic methods are used where either the range of possibilities or the criteria, or both, are not well defined. Heuristic search uses a search plan to reduce the number of ideas generated and tested.

**Buy it or break it**

John Wade (1977) has called the heuristic strategy we have been describing ‘buy it or break it’. If you can’t *buy* an answer, that is, solve it by recognition or generate-and-test, you have to *break* it: find the structure, identify the parts, attempt to solve the parts. If you can’t *buy* the answer to a part, you have to break it down still further, and so on.
Now the question arises as to how to fit the solved parts back together again. There is no law of nature that says that a satisficing solution to one part is going to be compatible with other parts when they are put together in their required relationships. If you were to make the parts of a jigsaw individually, without regard to the whole, it would be very surprising if they fitted together.

This difficulty cannot be overcome by breaking up the system in such a clever way that the parts do not constrain each other. Christopher Alexander (1964, 1974) at one time argued that this was possible but he later admitted that it is not.

The building-up process, if it is to work, must be essentially one of matching parts with parts and assemblies of parts with other assemblies. To make sure the pieces match, some part solutions must be allowed to constrain other part solutions. The order in which the parts are investigated is important.

Earlier the hierarchy of values was introduced (see 1.28). How does this relate to the hierarchy of parts and the order of solution? It is one element but not the only element in finding the solution hierarchy. There are four heuristic rules which indicate that a part of the task deserves early attention: the pervasiveness rule, the salience rule, the Gordian knot rule, and the rigidity rule.

Things that are going to affect many different aspects of the design should be considered early, and the more aspects something affects, the earlier it should be considered. This is the pervasiveness rule. For example, legal constraints on the use of a site are difficult to change, and they may in some cases turn out to fix the form of the building envelope. The decision to use or not to use air-conditioning is another pervasive decision.
**The salience rule**

Parts of the building that are *identified* as important are high up on the value hierarchy. They may not in fact be the most constrained parts, but if specific requirements for these salient parts are not met there will be trouble. This is the *salience* rule.

**The Gordian knot rule**

The Gordian knot was a puzzle made of many interlocked strands which were impossible to disentangle unless you knew the code. Here it is used as a symbol for parts that are made up of many sub-parts, all strongly tied to each other. This kind of situation is often found in the technical departments of large complexes, such as kitchens in hotels or laboratories in a hospital. Gordian knots should be detected and solved early, and then adapted or altered as little as possible. Cutting the Gordian knot may have worked for Alexander the Great, but architectural Gordian knots must be kept intact.

**The rigidity rule**

Parts that are exactly specified or specified in great detail, such as a squash court or a fire stair, have to be allowed to constrain other parts. As these two examples illustrate, rigid requirements are particularly likely to come from rules or regulations. Fire stairs are governed by fire regulations, squash courts by the rules of the game. However, the installation of standardised pieces of equipment may also impose rigid constraints.

**Interactions**

Combinations of the four rules are possible. The more of these rules that apply to a part, the higher in the constraint hierarchy it is, and the sooner its solution should be undertaken. The application of the rules requires judgement. The rules are aids to exploration, like the ‘keep turning left’ rule for solving mazes. Like it, they will not work in every case.
1.50

About computers

The pattern of decisions in a design is not a flat ‘tree’ but a three-dimensional net. The ideal way of representing this for the guidance of students would be by means of an interactive computer program (Heath et al. 1994). However, such a program has proved very difficult to construct, and progress has been slow, though parts of the desirable computer environment have been realised. Even when the problem is solved, there will still be the usual ongoing difficulties of distribution, access and maintenance. For these reasons, what you have here is a book, not a computer program.

1.51

The structure of this book

So far as possible, this book has been structured on the basis outlined in 1.43–1.49. There are difficulties in doing this. The network structure of design decisions arises because of the need, discussed in 1.15–1.18, to shift between lines of attack, kinds of constraint, and bottom-up and top-down viewpoints. A book is essentially linear; it is not an ideal medium in which to represent a network. This has been overcome to some extent by the selection of chapter content, the order of the chapters, and the use of cross-references.

1.52

Chapter content

Each chapter deals with a group of constraints. Four main groups or divisions have been used: activity, site, technology and aesthetics (see also 5.3.10). The constraints within each of these groups tend to have more connection with each other than the constraints in the other groups. Activity and site are addressed in Chapter 2, technology in Chapter 3 and aesthetics in Chapter 4. These three chapters bear an obvious resemblance to Wotton’s commodity, firmness and delight.

Rather than use Wotton’s words as chapter headings, however, reference has been made to some aphorisms of master architects of the early twentieth century. These references should not be understood as endorsements. Neither are they intended ironically. Much of the professional ideology of architecture consists of such aphorisms, and
they should neither be dismissed nor accepted uncritically, but confronted critically. That is the intention here.

This first chapter is an overview from the point of view of theory and Chapter 5 is an overview from the point of view of teaching.

**The order of the chapters**

The order in which the chapters are placed is often, but by no means always, a sensible one in which to tackle an architectural task. Activities and site restrictions tend these days to impose more and more powerful constraints than technology or aesthetics. In some situations technical issues cannot be subordinated to aesthetic ones.

However, as already pointed out, because of the network structure of design decisions it is usually possible to start with any one of the major constraint groups. In the example given in 1.8, the architect started from technology, not in this case the most plausible place to start. In 1.17 it was pointed out that another architect might have started with the people concerned and their activities. Equally, another architect might have started by thinking about aesthetic issues such as the symbolism that the house would hold for this group of people, its visual relationship to the setting, and so on.

In practice, judgement and commonsense, and what Schon (1983) calls ‘listening to the back talk of the situation’, are required in deciding which area of investigation to pursue first. In the studio also, the student may be faced with tasks framed so as to focus on one or other of the main constraint groups. You should not assume any routine order of work.

**Cross-references**

Within the three middle chapters, the sections represent sub-groups of constraints. Once again, the order in which these sections are arranged is a plausible but not a necessary one. Each section in turn discusses a considerable number of particular constraints and their application to some common situations. To help in maintaining or switching lines of
attack and in moving between constraint groups when necessary, numerous cross-references have been provided. These cross-references mark some important nodes of the decision network. However, in this as in many other things, there is no substitute for self-discipline. It is always easier to pursue one narrow line. Training yourself to switch viewpoints regularly is hard, but it is essential if you are to progress as a designer. The precedence diagrams illustrated in figures 5.4 and 5.5 illustrate the process of switching between constraint groups. Detailed references to earlier parts of the book are also given in these diagrams. In order to understand these diagrams fully, you will need to read 5.3.15 to 5.3.28.

**Disclosures of interest**

The authors of educational books have a particular duty to disclose at least the major beliefs and prejudices that underlie their work. Here, we outline our attitude to designing, to professional responsibility, to the social role of architecture, and to education. Some of these issues will be explored further in Chapter 5.

**A functionalist tract?**

This book takes serious account of behavioural and technical issues in designing. This may lead some people to suspect it of being a functionalist tract. It is not. We do not believe that the form and arrangement of a building can be extracted from any set of facts by any mechanical procedure. It follows that our view of computers is that they are extremely useful devices for doing boring calculations or organising information. However, if it is agreed that attitudes to architecture range from the romantic to the pragmatic, our attitudes are somewhat closer to the pragmatic end of the scale.

**Professionals and laypeople**

Professionals may see themselves as experts who know what’s best. This is an authoritarian attitude. Our attitude is democratic in the specific management sense, which involves listening to the voices of the actors and especially the users and the innocent bystanders.
Architecture in the social setting

Architects may see themselves primarily as providers of symbols to embody great ideals or as revolutionary leaders reshaping society through its environment. This may be called the ‘heroic’ view of architecture. Another view is that the architect’s role is that of a facilitator of people’s aspirations towards more humane buildings and cities. This may be called the ‘humanistic’ view of architecture. Our inclination is toward the humanistic view.

Teachers and learners

Our view of teaching is that it cannot be a wholly democratic process, even in the sense discussed in 1.58. A book for beginners must often take what Schon (1987) calls the ‘follow me’ approach. The teacher assumes a certain authority and must take responsibility for it. For this reason, we have not hesitated to use the direct imperative, ‘do this’, from time to time. We have also at various points introduced higher levels of reflection and teaching. This issue is taken further in Chapter 5.

Warning

This book is not a manual of practice. It is intended for beginning students, for use in the studio, as a practical substitute for experience, a professional library and the advice of expert consultants. Sizes of areas and quantities suggested in this book are for general guidance. Relevant building codes will dictate specific requirements and constraints. For a professional in practice, who should have all these things, to rely on this book in any way would be irresponsible.
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