

# Designs on your Desktop

*A Comprehensive Guide to Computer-Aided Design*

Harry Atherton



# **DESIGNS ON YOUR DESKTOP**

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*Harry Atherton*

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# Foreword

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It would be hard to exaggerate the potential significance of computer-aided design in most of industry, in engineering, in architecture, and in all other design professions. For those of us who cut our teeth on design software created for use on mainframe computers, the speed at which desktop versions have become able to handle large and complex designs has been bewilderingly fast. One suspects that for those considering computer-aided design for the first time—especially those with little or no computer experience—the choice of the most appropriate hardware and software must seem daunting.

Harry Atherton's coherent and comprehensive book on desktop computer-aided design is absorbingly informative and, in parts, adventurously provocative. A glimpse of the table of contents will illustrate the detailed scope of the book, and its six-part structure will confirm the care with which the author has structured his book.

*Designs on your Desktop* is written in a style which will appeal to a wide audience, from those wishing to 'convert' to computer-aided draughting or design, to those with an overall or functional management responsibility for technical innovation. The book is well illustrated by the author who has produced all his examples on a desktop computer—examples which range from simple two-dimensional illustrations of CAD techniques to three-dimensional drawings originated from 3-D modelling software.

*John Paterson AADipl RIBA  
Emeritus Professor of Construction Management  
University of Reading  
England*

*February 1988*

# Preface

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One of the more surprising discoveries I made whilst researching this book was the large and, so far, uncharted market for CAD, especially for three-dimensional CAD. There is a general inclination to think of CAD in the context of engineering and architecture only, when the reality is that its uses are almost without limit. I have seen proprietary CAD systems used for film set design, playground layout and landscape gardening by people who have no pretensions to being draughts, in the orthodox sense of the word.

There are many who claim no draughting skills, but who are able to express themselves clearly 'on the back of an envelope'. I believe that, as people realise that CAD allows them to convert their freehand sketches into more formal drawings, there will be a substantial growth in its use. As I have claimed in the body of the book, CAD can be a great leveller, because the quality of its output, in terms of 'style', owes little to conventional draughting skills ('style' as distinct from technical competence and composition, that is). In commercial terms, that prospect alone should mean that many small companies will find themselves able to take advantage of the opportunities presented by CAD, particularly in the spheres of presentation drawing.

But, before I lose the good will of experienced designers and draughts who may be considering the adoption of computer-aided systems, I should say immediately that *Designs on your Desktop* is at least as important to *them*. The potential benefits are many, and are not confined simply to productivity. Most significantly, CAD can change both work and career patterns in ways which release designers and draughts from the narrow disciplines imposed by convention. No-one who *might* benefit from CAD can afford to ignore it.

The use of computers in design is not new. Nor is there much difference in principle between word processing and 'line' processing: in both, the computer manipulates simple units of data, whether characters or lines. But, just as dexterity in handling a computer keyboard will not, in itself, make you a great writer, an ability to harness the power of a computer won't necessarily turn you into a world-beating designer. For that, you will need talent or skill or experience or whatever it is that good designers are made of.

You don't need to have a detailed understanding of how computers work to be able to use them, any more than you do a car, a video recorder or a dishwasher, but that is not the same thing as saying that you don't have to make any effort at all. You do. It is not enough just to know the jargon, you have to develop a 'feel' for the scope and potential of desktop computers in general, computer-aided design in particular.

*Designs on your Desktop* assumes that you have little or no knowledge of computers. This may lead you to regard parts of the text as dangerously naive, but, whilst writing

the book, I have tried to keep in mind the utter incomprehensibility I feel when listening to computer buffs using language, quite unaffectedly, which has developed around their industry.

It is rather tritely claimed that only the young can take to computers and, to the extent that the young mind can absorb new information quicker and to more lasting effect than the old, it is obviously true. But such a sentiment is no excuse for the older manager or adviser to evade any responsibility he or she may have for keeping an organisation competitive. Those who ought to invest in CAD, and don't do so very soon, will, at best, fail to prosper. And, sadly, many organisations which would benefit from an ability to display much of their information graphically, do not do so because they remain unaware of its relevance.

To try to prove some kind of point, all the drawings used in the book were done by me. Although you may find their technical quality lacks finesse, they do prove that you don't need to be especially talented or young to make a reasonable fist of things. Any shortcomings or blemishes are down to me.

I make no apology for confining my lexicon of jargon words to their British versions, draughting in particular. I have also adopted the word 'draughter', on what seems to me to be the unanswerable premise that if we don't have designersmen and designerwomen we don't need draughtsmen and draughtswomen.

None of the software I used whilst writing the book has been mentioned by name. I reviewed a number of systems costing between £100 and £2500 and, as one would expect, the higher the cost, the wider the range of facilities. All the systems I have used, even the cheapest, provide potential for productivity gains and produce both acceptable screen images and hard-copy output. If you want to get the feel of CAD, or just want a simple stand-by system, by all means buy one of the low-cost versions which can be written off without hurting. But if your intention is to move into serious computer-aided design, you are unlikely to build on a solid foundation if you choose anything other than one of the higher-priced systems which provide full software support, have a verifiable track record, and can demonstrate 'comprehensiveness'.

Nor have I mentioned costs in the book. As I write, you can set up a full CAD three-dimensional modelling system for under £5000—including an A3 flat-bed 8-pen plotter, colour monitor with EGA card, IBM PC/XT-compatible computer with 20Mb hard disk drive, mouse and full software. If money isn't the overriding criterion, you can spend double or more: this will provide you with a faster computer, higher screen resolution, and more software. For £15000, or less, you can buy a stand-alone workstation designed specifically for computer-aided design. If you move from an A3 to an A0 plotter, you may have to add £5000 or so to your total cost.

My thanks are due to Abtex (Pertmaster Advance), Autodesk (AutoCAD), Robocom (RoboCAD-PC), Ecotech Design (Scribe Modeller), Pink Software (TurboCAD), Mountford & Laxon (MLD2), Imtec Group (Ormus PC), Redland Construction (Zeta 2000), Timatic Systems (Microdraft) and Trilex (Doodle) for allowing me to borrow

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# ***Introduction***

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One of the paradoxes of using a computer for draughting or design is the effect it can have on one's perception of time. When first used, responses seem unbelievably fast: no sooner is a key pressed than the screen image is transformed. But, in no time at all, waiting for a screen transformation can seem like intimations of infinity. The importance of time perception in getting to grips with desktop computer-aided draughting or design needs to be anticipated and recognised for what it is: something which is relative to your prevailing mood. Nothing (except, perhaps, waiting for hidden lines to be removed or the regeneration of a large or complicated drawing) really takes very long, but even thirty seconds glued to an unresponsive screen can seem interminable.

What this means in practice is that you need a well constructed operating discipline. Put the computer in its place from the start; it's not there to monopolise your affections, and it is certainly not there to take charge of your life. It is really just a large calculator with a screen and a memory; and it should be used as such. It is a slumbering giant of a calculator just waiting for you to nudge it into life: the potential for quite startling productivity gains is there if you can discard any prejudices or preconceptions you may have.

## **The Power and Scope of the Computer in Design**

CAD systems have the power to provide the designer with much more time to think and to plan and to organise. However, sitting in front of a screen for hour after hour just using the system as an electronic substitute for a drawing board is not the way to exploit it. Quite apart from the sterility of such an exercise, it can be unbearably fatiguing: imagine sitting half a metre away from your domestic TV screen for eight hours or so at a stretch.

It is so often claimed that, because the act of drawing consumes only a small proportion of a draughter's time that, ergo, productivity gains from CAD can never be significant. That the controlling factor in the evolution of any drawing is the speed at which a designer can resolve problems, is hard to dispute. But isn't the speed of decision making very much influenced by the intractability of conventional draughting techniques, and the overwhelming need to re-invent the wheel? It is at an altogether subtler level that real productivity gains manifest themselves; but, even at the most basic level, you will very quickly discover that you can do things with desktop CAD that would be unimaginable to the conventional draughter.

When you start to look at both hardware and CAD application software, you will find that no one system has everything. In reviewing good CAD software, one finds that there is a core of facilities which, although sometimes idiosyncratically different at the margin, is present in them all. For general draughting, you would probably be happy using any of them. It is likely that your selection will be based on less immediately

obvious factors than simple draughting technique: you would be strongly advised to make the most pertinacious examination of the claims made by suppliers. If in doubt, insist on having your worries removed by a demonstration on details of your choice. It probably isn't a very good idea simply to ask for one of your drawings to be copied, as it may not test the computer or the software to the limit. Try to assemble a drawing which includes as many different, and taxing, features as possible. And don't just buy on what seems to be a 'colourful shop window'; although an extensive range of goodies may add up to something worthwhile, it could just be padded with tinsel and diamond dust. Try to match the facilities available with what you perceive to be your need. CAD software houses enhance their systems at about six-monthly intervals, and you may catch different suppliers a little out of step with each other: none of the better ones gets far out of line for long. It is rather like interest rates and insurance premiums!

Some of the more expensive CAD software is complemented by 'bargain' versions which, though lacking the overall versatility of the flagship software can, nonetheless, provide a worthwhile entry into computer-aided design. But, to quote the popular aphorism, you get what you pay for. The high cost of top-of-the-range CAD software reflects not only a large investment in user research and software writing; it also indicates a commitment to long-term development and support for the user. A problem for CAD software houses is that they have to adapt continuously to new hardware developments, as well as enlarging the scope of their design and draughting software.

Surrounded as we seem to be by such an array of ever-changing sophisticated electronic wizardry, the bugaboo of the market place is that it doesn't stand still long enough for us to make a purchasing decision. It is a safe bet that whatever you buy will have been superseded by something faster, or more powerful, or cheaper within two years. The only comfort is that it is unlikely to be any worse than that and, as with any car you buy, your computer and the software may become less efficient, look a bit dated and need rather more maintenance than when you bought it, but it still gets you there! There is never an ideal time to buy. For the newcomer to CAD at least, a desktop system is the best initial investment. It is sometimes claimed that you may have to reinvest after two or three years if you buy a desktop system. You may have to do so, but there is no guarantee that larger systems will not become obsolete within the same period, either.

When moving into computer-aided design for the first time, it is very important that you think about other computer applications, too. The multi-purpose stand-alone **workstation** is now a most attractive and cost-sensible proposition: embracing CAD, **spreadsheets**, **databases**, **word processing**, costing, scheduling and accounting systems. Moving from one application to another is simple and quick; and linking two or more applications to make them interactive is becoming increasingly easy.

## The Flair to Use CAD

Computer-aided design makes it possible for everyone with creative flair but with no draughting experience, to set their ideas down on paper. Trained, or intuitive, designers can quickly reconstruct in their minds a two-dimensional assembly of lines and curves on a drawing into a recognisable three-dimensional object. Many CAD software

systems now make it easy for us to view, print or plot the drawings in three dimensions (the way we actually see things) without our having such training or intuition. No attempt has been made in this book to review or evaluate by name the many different CAD systems or computer hardware available to you. In making your decision, much will depend on what you expect of the system and what you can afford to spend. Think carefully about future needs before committing yourself.

Unless the author's experience is exceptional, very few draughters particularly enjoy the act of draughting (otherwise why do they continually badger for moves into jobs that don't call for much drawing?). As in so many other spheres of life, it is the joy of creation and invention which provides the stimulus to action. Computer-aided design uniquely provides the medium through which designers and draughters can exploit broader skills than simply cobbling drawings together. The act of draughting should be just one component of a wider, and more fulfilling, role in whatever context draughters find themselves. The more that pre-validated data are instantly available from databases (standard library components, for example) the less is the draughter's work. Where those databases allow interactivity, the design solutions are quicker and more reliable; and the drawings will be more readable than most of those produced conventionally.

It is salutary to remind ourselves frequently that a drawing is only a medium of communication and record: it is one of the very few paper-based ways we have of explaining our thoughts to others. If we could do without drawings, we would do so, and there are many very clever people now working on ways of sending design information direct from the computer to the machine without any hard-copy intervention. This doesn't pose any immediate threat to the draughter, but it should reinforce the argument that the role of the draughter has to change. In the context of this book, that change should be in the direction of removing 'drawing offices', as such, replacing them with 'design groups' which regard the act of draughting as something which is only part of a much more absorbing and rewarding responsibility. In part, it should exploit CAD's power to achieve design objectives faster by programmed trial and error techniques. Mistakes are free. And, if modelling software is used, you can go a very long way down the design road, interactively proving or disproving fitness for designed purpose before you need to manufacture or assemble anything tangible.

## **The Administration of CAD**

Speed of response is a part of this overall brief to designers and draughters, and should not be overlooked. In a highly competitive environment, an ability to give customers (and suppliers) fast, polished, reliable answers can often make the difference between success and failure, but only if you cocoon both **hardware** and **software** in a protective layer of efficient administration. No matter how good a CAD system may be as an alternative way of producing drawings, judgements should not be made on this factor alone. Indeed, it is arguable that one should not judge a CAD system by its effect on the economics of design alone. The really worthwhile benefits are from the macro-economics of the organisation in which CAD is to be positioned; not the least benefit of which is an improvement in the product itself.

Almost before you do anything else, you should assemble an operating framework within which you will use your CAD system. The aim should be to reduce the face-to-screen periods to a minimum by thoroughly planning your work before you even switch on the computer. Whilst this is rather easier to achieve when draughting than when **modelling**, a great deal of time in front of the screen can be avoided in either case if you work within sound design disciplines. The greatest gain of all is from a full understanding of how the system works and a cultivated flair for exploiting the techniques available to you. Knowing how to use the library of standard components effectively is a particularly fruitful talent.

It isn't just the obvious things which make the difference. Fatigue is the great bogey and nothing is better calculated to accelerate its onset than irritation. This brings us back again to the perception of time. As you read through the book, you will quickly appreciate that as drawings or **models** grow in complexity in the computer's **memory**, they are slower to respond to commands which force the computer to recalculate the data and, although there are a few tricks one can use to speed things up, there will be periods when you will find time dragging. The way to avoid irritation is to deflect your attention during these pauses onto something else: read a magazine or work on a report, anything to avoid a 'watched pot'. You will be surprised how quickly the **screen transformations** are effected when you have to leave another task, especially one you are enjoying. There are very few screen operations which take more than 90 seconds to accomplish. Compare that with the time it takes to scratch out and redraw one line manually, say. The only difference is that one method keeps your mind and body active; the other doesn't.

## Buying CAD Systems

The one way you can mitigate the time problem is to buy the fastest hardware you can afford. Consider three aspects: the computer **clock speed**, the **chip** on which the computer is based, and the speed of the **hard disk**. All three are important; none should be ignored. And make sure that you marry your hardware to the software house's demands: if it calls for a **maths co-processor**, make sure one is fitted.

You should also buy as much computer memory and **disk space** as your money will run to: hard-disk space, **random access memory (RAM)** and, if you will be using one or more **floppy-disk drives**, the capacity of the disks themselves. The bigger your hard-disk drive (in **megabytes** of memory, that is) the bigger your instantly-available library of drawings and standard components can be. The larger the RAM (effectively the computer memory available to you when working on your current drawing) the larger the drawing you can work on. The greater the capacity of the floppy disks you will use, the larger the drawings you can **file** on them, either as back-up to your main library on the hard disk or as libraries of standard components you can call on as you need them. Each of these factors is dealt with more comprehensively in later chapters.

You should also think carefully about the collection of hardware you assemble. You will probably find that you can get down to the lowest level of initial capital cost by buying your computer and its peripherals from different manufacturers. Indeed, you will almost certainly optimise capacity, speed, and cost that way. But you must consider after-sales service, too, making sure that you are assuredly and affordably covered.



Lastly, and at least as importantly, you should compare those of the available CAD software systems that seem able to do what you expect of them. Compare not only the end result, but the ways by which that result is achieved. In the author's experience, the best systems make it possible for you to use them constructively within a week, and profitably within a month or less. They ease you in with a shoehorn, as it were. Other systems can seem altogether too protected by labyrinthine commands which can intimidate the newcomer to computers.

## **The Future of CAD**

In less than twenty years, early **mainframe computer** power (and more) has become available in desktop computers, and there seems to be no reason to expect such rates of change to slow down. What is now available to CAD users on **super-minicomputers** will become run-of-the-mill stuff for the desktop user. The most predictable changes will be massively more affordable computer memory, **storage capacity**, and speed. This will transform the quite ordinary routines of CAD and render them more available to, and usable by, less design-skilled operators. Advanced interactive modelling will become a commonplace, allowing free-form surfaces to be represented, something designers from Giotto di Bordonne to Sir Alec Issigonis have found extremely difficult to cope with conventionally. In the past, such shapes have had to be set down on paper as sections derived from solid moulds. There are many **solid** and **surface modelling** software packages already available: their translation to desktop computers cannot be far away. It is important, too, that designers themselves learn to use computers: employing specialised CAD operators is not the way to get the best out of CAD.

Whether or not computers can take over the whole design process from us humans is an esotericism which will be left for others to contemplate. But the advances made in **artificial intelligence (AI)** and **expert systems (ES)** seem certain to automate much of the design process, if only because of their enormous capacity to store and retrieve validated information. This suggests a greatly accelerated use of computers in all design processes; earlier rather than later.

Even though the use of computers is already widespread in most of our industrial, commercial, educational and private lives, there seems to be a surprisingly large number of people who 'don't understand' computers. More worrying, many of them either don't want to understand them or are afraid to attempt an understanding. Simply 'joining the club' is as good a reason as any for switching to CAD: recognising that, in not doing so, the enterprise is the more likely to fail.

Nevertheless, 'joining the club' is an absolute waste of time, effort and money if there isn't a corresponding philosophical shift in the thinking about the way that enterprise is run. If you are charged with responsibility for others who will use computer-aided design, they will need enthusiastic support and, more importantly, an understanding of what CAD can do. Above all, those charged with the move from conventional draughting to computer-aided design need to feel not only secure in the immediate future, but motivated to believe that it has the potential successfully to change their job fulfilment and career expectations for the good. It is propitious to be reminded

that whenever you hand tasks over to a computer, you invest a great deal of trust until results justify your confidence. If you delegate everything to others, you are also yielding power: especially in the field of computer-aided design, where the designer ought not to hand everything over to an 'operator'.

It has been estimated that in 1985 there were no more than 100,000 CAD workstations in use throughout the world. This is thought to represent only one thousandth part of the potential world market. Even if the figures are wrong, the horses are in the chariot and going at full speed. Jump on.

Finally, two words of advice. First, if you come across a jargon word that seems unfamiliar, turn to the Glossary (you will find most jargon words emboldened the first time they appear in the book text). Second, the ordinary tools of conventional draughting and design are becoming antiques: start collecting!