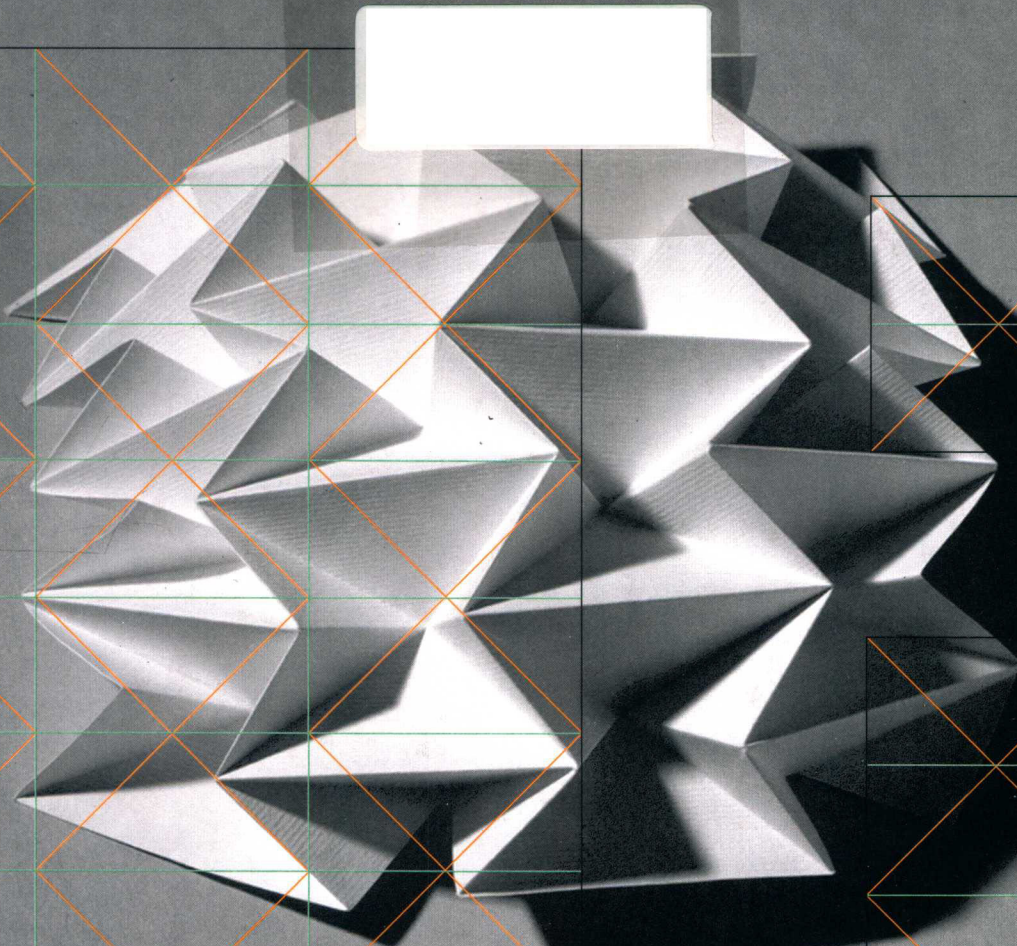


# FOLDING TECHNIQUES FOR DESIGNERS FROM SHEET TO FORM

Paul Jackson

FREE CD —  
CONTAINING ALL  
CREASE PATTERN  
DIAGRAMS



FOLDING  
TECHNIQUES  
FOR Paul Jackson  
DESIGNERS  
FROM SHEET  
TO FORM







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FOR DESIGNERS

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FROM SHEET  
TO FORM

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PAUL JACKSON

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# Preface

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As a teenager, my favourite hobby was origami. Later, as a student of fine art, a steady flow of my original designs was published and I became a very minor player among the small international community of origami creators. Friends who were taking courses in graphic design or industrial design occasionally asked me for origami ideas to help with their projects, and I even did a little teaching.

In 1981, I finished my postgraduate studies in London. Out in the real world and needing a job, I had an idea: maybe courses in art and design in the London area would welcome a short course on origami? I had nothing to lose except the cost of the postage, so I sent a proposal to more than a hundred courses, unsure of the response I would receive.

A few days later the phone started to ring. And ring. Within weeks I was teaching students of fashion design, textile design, graphic design and jewellery design, pleased to be working.

But there was one problem: I had no idea what to teach! Certainly I was skilled at origami, and I had excellent experience in higher education, but my subject had been fine art and I didn't understand what I should teach to students of design. I was entirely ignorant of what design students learnt. Also, my hobbyist's knowledge of origami was confined to models – that is, representations of flora, fauna, objects and geometric forms. The one thing I did know was that students of art and design didn't need to learn how to make an origami giraffe.

I have always admitted that my first attempts at teaching students of design were terrible. In those early days I did little more than use selections from a list of favourite models. Slowly, though, I began to understand something that now seems very obvious to me, but which at the time required a quantum leap of my imagination – namely, that I shouldn't be teaching the students how to make origami models, but instead, should teach them how to fold. It had never previously occurred to me that folding paper was anything other than model making. To understand that origami could be as much about folding as about models seemed a radical departure. In time, I came to realize that it wasn't radical at all, but a consequence of being unwittingly blinkered – brainwashed, even – by 15 years of origami practice.

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The crucial educational difference was that a model was simply a model – perhaps fun to learn, but it didn't teach the students much that they could apply creatively to their design work. By contrast, if folding techniques were taught, they could be used with any number of different materials and adapted to any number of design applications. And when I looked around, I could find examples of folding throughout both the natural and the designed worlds.

That revelation was the genesis of this book.

In the few years following that epiphany, I evolved a series of self-contained mini workshops that introduced a diversity of folding techniques – pleating, crumpling, one crease and so on. I would shuffle the choice and content of the workshops to best suit each course. The workshops were usually followed by quick 'hit and run' creative projects.

As word spread, I began to be employed as a consultant by a number of multinational companies, to give workshops on the theory and practice of folding. I also gave workshops to a variety of design practices and to architects, structural engineers and professional bodies. These experiences fed back into my teaching, which in turn fed back into my professional experiences.

By the late 1980s, the final form of my teaching had more or less evolved. I have taught what I came to call 'Sheet to Form' workshops and projects to students of fashion, textiles (surface, print, knit and weave), ceramics, embroidery, product design, industrial design, engineering, architecture, jewellery, graphic design, interior design, environmental design, model-making, packaging, theatre design, fine art, printmaking, foundation courses – and probably other courses now forgotten – at all educational levels, from my local community college in north London, to the Royal College of Art and colleges in Germany, the US, Israel, Belgium and Canada. To date, I've taught on more than 150 courses in design in 54 colleges, some regularly for a decade or more, others for just a day.

Wherever I've taught, I've always been asked the same question: "Is this in a book?" My answer was always "No!" and, frankly, the lack of follow-up material, or any substantial documentation, was an embarrassment to me. Although there are hundreds of origami books, they are all about model-making, of limited use to a design student or professional. My best advice was always to keep carefully the samples made in the workshop and refer to them when working on a project.

So, finally ... finally! ... I have the opportunity to present in print the most useful of my Sheet to Form workshops. Deciding what to include or exclude, or to emphasize or skim over, has been difficult and time-consuming, and I hope I have made the right choices. I have written more than 30 books about origami and paper crafts, but this is the one I have most wanted to write.

Perhaps, though, it was proper that the book was not written until now. In recent years there has been an upsurge of interest in origami, not only by designers of all disciplines, but also by mathematicians, scientists, educators and others. 'Origami' and 'folding' are very much words of our time, and though the focus will doubtless diminish, the interest and respect will remain. This book, then, is being published at the right time.

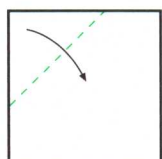
I hope that while using this book you will come to share my enthusiasm and love for a subject that I have come to regard simply as a Wholly Good Thing. I feel very privileged that it has not only made me a living, but given me an absorbing and fulfilling life and introduced me to many wonderful people, worldwide.

**Paul Jackson**

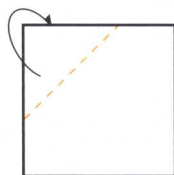
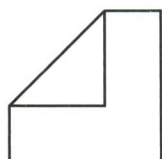


# 00. Symbols

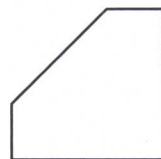
The few symbols shown here recur throughout the book. Some of them occur on almost every drawing. Please take a little time to familiarize yourself with them, so that you can fold fluently and accurately.



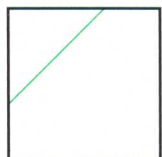
1. Valley fold



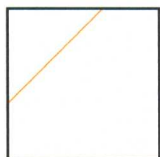
2. Mountain fold



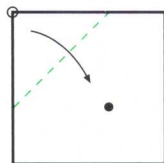
3. Turn over



4. Unfolded valley fold



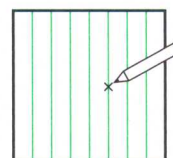
5. Unfolded mountain fold



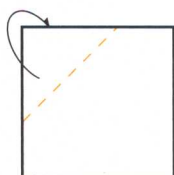
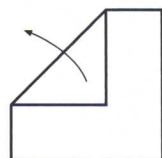
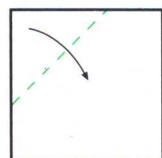
6. Bring these points together



7. Glue here



8. Mark this fold



9. Universal fold



# Introduction

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All designers fold.

That is, all designers crease, pleat, bend, hem, gather, knot, hinge, corrugate, drape, twist, curl, crumple, collapse, wrinkle, facet, curve or wrap two-dimensional sheets of material, and by these processes of folding, create three-dimensional objects. These objects will perhaps not be origami-like in appearance, or the folding may only be a detail, but most will nevertheless have been folded – wholly or in part – in some way. Since almost all objects are made from sheet materials (such as fabric, plastic, sheet metal or cardboard), or are fabricated from components used to make sheet forms (such as bricks – a brick wall is a sheet form), folding can be considered one of the most common of all design techniques.

And yet, despite being so ubiquitous, folding as a design topic is rarely studied. Perhaps this is because the folded content in a designed object is often unrecognized, or merely incidental, or because folding is synonymous with origami, with brightly coloured squares and children's hobbycrafts (an image of origami now several decades out of date). Folding is rarely an inspiration for designers.

At least, that is how it used to be. In recent years, more and more designers of all disciplines have turned to folding to create a wide range of handmade and manufactured objects, both functional and decorative. A little time spent looking through design and style magazines will reveal a significant number of folded products, from apparel to lighting and from architecture to jewellery. Origami is one of the most vibrant buzzwords in contemporary design.

*Folding Techniques for Designers* is the first book to present this essential topic specifically to designers. For almost 30 years, I have specialized in teaching folding techniques to design students and to design

professionals of all disciplines, perhaps the only such specialist teacher since the days of the Bauhaus, when Josef Albers taught paper folding as a basic topic of design.

Chapter by chapter this book presents those techniques which, from my experience, have proven to be the most inspirational and the most versatile. It comprehensively describes the basics, including such diverse techniques as pleating, crumpling and box making, presenting concepts variously as step-by-step drawing sequences, crease pattern diagrams and photographs. The techniques are presented in paper, but the reader is encouraged to adapt them freely, using other sheet materials. This book is not primarily a book about paper or paper folding, but a book about folding.

The aim of the book is to establish folding as a primary design tool and, by doing so, to reintroduce it as an essential topic in design education and design practice.

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## How to Use the Book

The book presents generic folding concepts from which ideas for designed products can be derived. It is not a book of models to copy, or of formulaic design solutions. This book is useful – or should be – because it presents practical concepts of folding that can be adapted infinitely by any designer from any design discipline, using any sheet material.

It presents the basic ways in which a sheet of 100gsm paper can be manipulated into three-dimensional forms or relief surfaces. It does not show how those concepts can be adapted to thousands of other sheet materials which are thicker, thinner, softer, harder, larger or smaller, which are stitched, glued or self-supporting, which are one-piece or multi-piece, which are hand-made or machine-made, which are rigid or flexible, pervious or impervious, tough and hard-wearing or delicate and decorative ...and so on and so on, without end. These are decisions that you must make as a designer.

As you work through the book and look at the diagrams and photographs, you will hopefully remark time and again “That’s obvious”. But you would be wrong! Generic concepts are necessarily ‘obvious’, but usually only so after they have been seen. Each chapter is devoted to a technical theme and the many illustrated variations – some of them apparently almost identical – have been carefully selected to show the different ways in which a technique can be employed. Only when you make and play with them will these differences become apparent.

The key word in that last sentence is ‘play’. In fact, it is the key word to using the book successfully. Do not just make an example, look at it briefly, then turn the page to make something different. Instead, play with it. Bend it this way and that; press together the folds along one edge, then along another edge, then press two edges together at the same time; invert it (that is, ‘pop’ it inside out); squeeze the middle; try to make the opposite corners touch and turn it around and around in your two hands to look at it from all angles. Many of the examples in the book, although apparently rigid when seen in a photograph, have the flexibility of an Olympic gymnast. It is your choice whether what you design is flexible or rigid.

Do not be seduced into making only the more complex examples. Also make the simpler, less showy ones because they will offer you more creative possibilities in a greater choice of materials. When folding, as in all matters of design, less is often more (more or less). The Basic Concepts chapter is extremely important. The concepts it introduces can be freely adapted to anything described in any subsequent chapter. Pick an example at random from any chapter and imagine how it would change if it were adapted to any or all of the concepts in the Basic Concepts chapter. But do not just imagine

what they would look like – make as many as you can. If you cannot understand how to make something you thought of, try anyway. You may not make it exactly, but you may well make something different and better, which you did not (or could not) conceive of when you began.

Of course, not everything extrapolated from the examples in the book will be immediately successful. Much of what you create initially will probably be technically or aesthetically weak. However, some pieces will be more satisfactory, while others will become successful after a process of much refinement. In this sense, folding paper is no different to any other design process. It is not a ‘quick fix’ substitute for perseverance and hard work.

In truth, there is absolutely no substitute for folding, folding, folding. Thinking too much, analyzing too much and trying to understand in your head what something will look like will inevitably lead you to poor design work. Paper is readily available, quick and easy to work with, and very inexpensive. Use it – and use this book – as extensively as time permits before perhaps adapting your ideas for use with other materials.

## How to Make the Examples

There are four ways to make the examples you see in the book. Which method you use for which example depends on personal taste and on the characteristics of the example being made.

Like developing ideas in a sketchbook, the key to developing good designs in folded paper is to work fluently and quickly. Your folding does not always need to be technically perfect (yes, really!). A great deal of time can be saved by working somewhat roughly, then remaking something with care when you feel you have an idea worth developing. Do not allow yourself to become bogged down in unnecessarily precise folding, when all you need is a quickly made folded sketch. Working too slowly is typical of a beginner. With experience, your speed and spontaneity with paper will increase.

### 1. Folding by hand

Folding by hand is as low-tech as any making activity can be. You are making something directly with your body (your hands) without the intervention of a third-party tool such as a pencil, mouse or needle. It is an almost unique making experience and perhaps unfamiliarly primal. This very basic, hands-on activity – especially in today’s high-tech design studio environments – can be a very powerful and rewarding experience for both the rawest student and the most seasoned professional, and should not be underestimated or regarded as unsophisticated or inadequate. You can think of folding by hand as an alternative to designing by computer (which means that aside



from the design benefits, folding by hand is of itself an excellent educational experience).

Many of the examples in the book are made from paper divided into 8, 16 or 32. These divisions are quick and easy to make by hand (see pages 16–18 of the Basic Concepts chapter), and learning how to make them will save you a great deal of time measuring with a ruler.

Think of folding by hand as the norm, and resort to using the other methods described below only when necessary.

## 2. Using geometry equipment to draw the folds

Simple geometry equipment such as a scalpel or craft knife, ruler, pair of compasses, 360° protractor and a hard, sharp pencil is sometimes necessary to help construct unusual shapes of paper, precise angles, incremental divisions etc. However, be careful that using them does not become habitual, so that you find yourself using them when folding something by hand would be quicker and easier.

To make a fold using a scalpel or craft knife, turn the blade over and make the crease line by running the back of the blade against the side of a ruler. Never try to cut through some of the thickness of the paper to create a fold; just compress it with the back of the blade.

## 3. Using a computer to draw the folds

These days, most of us would prefer to draw folding patterns on a computer rather than draw them on paper with geometry equipment. We seem to be losing the hands-on habit. However, drawing on a computer does have its advantages: scaling is easy, as is symmetrical repetition, or skewing and stretching, and drawings can be kept and copied endlessly.

The biggest drawback is having to print out your drawing. If the drawing is bigger than the size of your printer, you may have to collage sections together, which can be messy and imprecise. The alternative is to use a plotter. If you do not have ready access to one, many walk-in print and copy shops have a plotter and can make inexpensive black-and-white copies a metre or so wide.

## 4. A combination of the above methods

Being pragmatic and switching between the three methods described above is probably the way that most people will make most of the examples, most of the time. Each has its advantages and disadvantages, and experience will tell you which method to use, and when.

# How to Work from the Drawings, Photographs and the Text

## The Drawings

Unless stated in the text, the exact lengths and angles used in a drawing are unimportant. As long as what you make looks something like the drawing, it will be accurate enough. Where an element of the construction is critical, this will be stated and you should follow the instructions exactly. If a shape is clearly a circle (or whatever), this may not be stated, so do the obvious and make what your eyes can see. Think of the drawings as suggestions rather than as models to copy.

However, rather than 'eyeball' a drawing and draw it freehand without references, it may be helpful to first use a ruler and measure the major lines of a drawing. This will give you a rough sense of its proportion, and then it can be scaled up to the appropriate size.

One tip when making something for the first time is not to make it very small. Samples that are small can look trivial and be creatively inhibiting, and you can feel that your time has been wasted. Similarly, if you make things too big they can look clumsy and weak. As a rough guide, try to make samples that can fit on to an A4 sheet. Later, when you know the scale you want and the sheet material you want to work with, you can make them at the correct scale, larger or smaller.

## The Photographs

Although the photographs were taken to make the examples look interesting and attractive (of course), their primary function is to give descriptive information about how the different planes, edges and folds lie in relation to each other, so that you have a better sense of how something should look when made. In that sense, the photographs should be regarded as diagrams, not simply as pleasing pictures that beautify the book.

Paper is a living, breathing material. It distorts under the heat of studio lights, reacts to humidity and can bend out of symmetry, depending on the direction of the grain (the parallel fibres that lie within the paper). For these reasons, some of the folded examples may look a little misshapen. The alternative to seeing an occasional wobble was to make everything from thick card that would not distort. However, this was considered a rather soulless material for the book. The idiosyncrasies of paper are hopefully more appealing, giving the folded forms a little personality.

## The Text

In three words – please read it!



