METAL FORMING

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Tool Profiles and Flow

T. Z. BLAZYNSKI

Dept. of Mechanical Engineering, University of Leeds

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To Pauline

Preface

As the industrial importance of metal-forming processes has grown constantly during the last three decades, so have intensive experimental and theoretical investigations of the basic nature, properties and mechanical parameters of these various manufacturing operations. Although a substantial volume of literature exists in the form of both books and papers, the emphasis in presenting the available information is usually on the overall mechanics of the processes. The study of the patterns of metal flow, their relation to the geometry of the pass and their link with the incidence of faults in the product, appears less prominent.

The present book is designed to redress the balance and, by doing so, to stress the practical importance of a well-informed, rational approach to the problem of assessing the optimum conditions of metal flow. In particular, the book aims to draw attention to the general problem of the effects of the inhomogeneous or redundant deformation, to illustrate its physical and practical significance in a number of basic metal-forming processes, and to show how the choice of the geometry of the pass can alleviate severe working conditions.

The book is intended primarily for engineers and industrial metallurgists concerned with metal forming, and for postgraduate students of engineering and metallurgy. It can also, however, be used profitably for teaching specialised, usually final-year, optional undergraduate courses. To satisfy these requirements, the complex theory of plasticity has been avoided. In fact the mathematical content has been minimised as far as is compatible with clarity, and its standard has generally been maintained at undergraduate level. To cater for the slightly diverse interests of the two main groups of potential readers, the contents are divided into three parts. Part I provides analytical and experimental tools for the study of metal flow, with chapter 2 briefly reviewing the existing range of analytical approaches, and chapter 3 giving the necessary physical means of redundant strain measurements. Part II is concerned in detail with the incidence, pattern and magnitude of redundant effects in the

rotary tube-making, wire, rod and tube-drawing operations, in deep drawing and stretch forming of axisymmetric components, and in the conventional impact and hydrostatic extrusion processes. Part III, comprising chapters 9 and 10, reviews the established rational design concepts for the geometry of metal-working passes, and proposes two new concepts of tool design. The relative advantages of the various design techniques are illustrated in a selection of forming processes.

Many of the graphs, sketches and numerical data tables that illustrate the text have been previously published. The sources of illustrative items are acknowledged in the appropriate figure legends.

My sincere thanks are due to those of my former and present colleagues who, over a period of some twenty years, have contributed in many ways to the gathering of a substantial proportion of the data used in this book. Finally, I gratefully acknowledge my wife's help with the preparation of the manuscript, and her patience during the period of writing.

Leeds, 1976

T. Z. B.

Contents

<i>Preface</i>	vii
PART I GENERAL ANALYSIS	
Chapter 1 Introduction	
1.1 Metal-forming processes	3
1.2 Types and nature of deformations	4
1.3 Friction and inhomogeneity	6
1.4 Effects of redundant shears	7
Chapter 2 Techniques of Analysis	
2.1 Stress and strain redundancy factors	10
2.1.1 General considerations	10
2.1.2 Yield stress, strain hardening and generalised strain	11
2.1.3 Evaluation of the factors of redundancy	14
2.2 Analytical stress determination	18
2.2.1 Introduction	18
2.2.2 The equilibrium method	19
2.2.3 The slip-line analysis	20
2.2.4 Upper-bound technique	24
2.2.5 Visioplasticity	26
Chapter 3 Experimental Determination of Redundant Deformation	
3.1 Introduction	30
3.1.1 Incrementality	30
3.1.2 Grids, inserts and laminates	32
3.1.3 Model materials and prototypes	33
3.2 The use of model materials	33
3.2.1 Model and prototype similitude	33

3.2.2	Materials and their properties	38
3.2.3	Assessment of mean strain rate	46
3.3	The insert and laminate techniques	56
3.3.1	Preparation of specimens	56
3.3.2	Measurement of redundant shears	57
3.3.3	The effect of homogeneous strain	60
3.3.4	Incremental summation of strain	62
3.4	The grid technique	63
3.4.1	Square and circular grids	63
3.4.2	Applicability to viscoplasticity	64
3.4.3	Summation of effects	65

PART II INCIDENCE, PATTERN AND MAGNITUDE OF REDUNDANT DEFORMATION

Chapter 4 Classification of Processes

4.1	Introduction	69
4.2	Stress system classification	69
4.3	Some basic industrial processes	71
4.3.1	Rotary operations	71
4.3.2	Drawing operations	80
4.3.3	Extrusion	83

Chapter 5 Redundancy in Rotary Operations

5.1	Tube-making processes	88
5.1.1	Introduction	88
5.1.2	Incidence and type of redundant shears	89
5.1.3	Redundancy factors	90
5.1.4	Geometry of the processes	93
5.1.5	Mechanics of the processes	101
5.2	Piercing	115
5.2.1	2 and 3-roll systems	115
5.2.2	Influence of process parameters	123
5.2.3	Cavitation	128
5.3	High-ratio tube-elongating processes	133
5.3.1	Assel elongating	133
5.3.2	Secondary piercing	137
5.3.3	Combined piercing-elongating	143
5.4	Triangulation in tube making	149
5.4.1	The origin, effect and measurement of triangulation	149
5.4.2	Incidence of triangulation in individual processes	152

Chapter 6 Wire, Rod and Tube Drawing

6.1	Introduction	156

6.2	Rod and wire drawing	158
6.2.1	Flow through conical dies	158
6.2.2	Methods of analysis	162
6.2.3	Pass geometry, material properties and redundancy	170
6.2.4	Redundancy and mode of flow	180
6.3	Tube drawing	184
6.3.1	Introduction	184
6.3.2	Analytical treatment	185
6.3.3	Drawing systems and redundancy	200
 Chapter 7 Deep Drawing and Stretch Forming		
7.1	Characteristic features	222
7.1.1	Introduction	222
7.1.2	Drawing of cylindrical cups	223
7.1.3	Stretch forming	225
7.2	Redundant deformation	227
7.2.1	Introductory remarks	227
7.2.2	Flange wrinkling	228
7.2.3	Bending and unbending	228
7.2.4	Ironing	229
7.3	Analytical considerations	230
7.3.1	Introduction	230
7.3.2	Deep drawing of cylindrical cups	231
7.3.3	Conventional stretch forming	239
7.3.4	Dynamic stretch forming	241
7.4	Process parameters and metal flow	246
7.4.1	Deep drawing of cups	246
7.4.2	Conventional stretch forming	252
7.4.3	Dynamic stretch forming	254
 Chapter 8 Extrusion		
8.1	Introduction	262
8.2	Analytical considerations	264
8.2.1	Homogeneous and redundant strains	264
8.2.2	Conventional extrusion	265
8.2.3	Impact extrusion	270
8.2.4	Hydrostatic extrusion	276
8.3	Flow and redundancy	280
8.3.1	General comments	280
8.3.2	Conventional extrusion of rod	280
8.3.3	Characteristic features of impact extrusion	287
8.3.4	Hydrostatic extrusion	294
8.3.5	Drawing-augmented hydrostatic extrusion of bar	297
8.3.6	Conventional and hydrostatic extrusion of bimetallic rod	299

PART III TOOL DESIGN**Chapter 9 Concepts of Tool Design**

9.1	Introduction	309
9.2	Some specific design solutions	313
9.2.1	Rotary operations	313
9.2.2	Extrusion and drawing	321
9.3	Theoretical design concepts	328
9.3.1	Deformation and strain-rate concepts	328
9.3.2	Application to rotary processes	329
9.3.3	Application to drawing and extrusion	334
9.3.4	Computer-aided design	339

Chapter 10 Tools and Redundancy

10.1	Introduction	342
10.2	Rotary processes	342
10.2.1	Primary tube-piercing	342
10.2.2	Assel elongating	347
10.2.3	Secondary tube-piercing	349
10.2.4	Combined piercing–elongating	356
10.3	Extrusion	361
10.3.1	Extrusion of rod	361
10.3.2	Tube extrusion	362
10.3.3	Drawing-augmented hydrostatic extrusion of bar	366
10.4	Concluding remarks	368

<i>Author Index</i>	371

<i>Subject Index</i>	374