

FUNDAMENTALS OF METAL FORMING

Metal Forming

- Large group of manufacturing processes in which plastic deformation is used to change the shape of metal workpieces
- The tool, usually called a **die**, applies stresses that exceed yield strength of metal
- The metal takes a shape determined by the geometry of the die

Stresses in Metal Forming

- Stresses to plastically deform the metal are usually **compressive**
Examples: forging, rolling, extrusion
- However, some forming processes:
 Stretch the metal (**tensile** stresses)
 Others bend the metal (tensile and compressive)
 Still others apply **shear** stresses

*Tensile - capable of being stretched or extended; ductile.

*Shear stress - exists when two parts of a material tend to slide across each other in any typical plane of shear upon application of force parallel to that plane.

Material Properties in Metal Forming

Desirable material properties:

- **Low yield strength and high ductility**

*Yield strength refers to an indication of maximum stress that can be developed in a material without causing plastic deformation.

These properties are affected by temperature:

Ductility increases and yield strength decreases
when work temperature is raised

Other factors:

Strain rate and friction

Bulk Deformation Processes

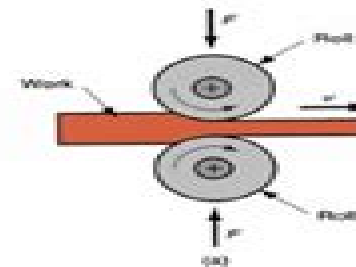
- Characterized by significant deformations and massive shape changes
- "Bulk" refers to workparts with relatively low surface area-to-volume ratios
- Starting work shapes include cylindrical billets and rectangular bars

BASIC PROCESSES

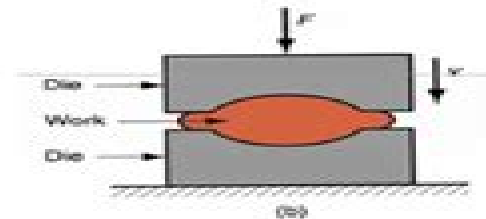
BULK

DEFORMATION

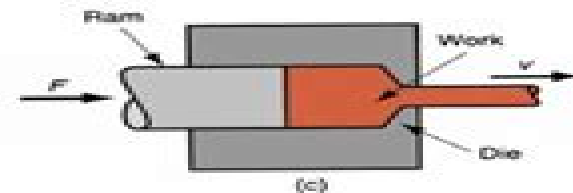
A. Rolling



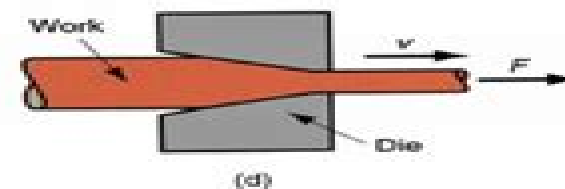
B. Forging



C. Extrusion



D. Drawing



Fundamentals Of Metal Forming

Robert H. Wagoner, Jean-Loup Chenot



Fundamentals Of Metal Forming:

Sheet Metal Forming Taylan Altan,A. Erman Tekkaya,2012 This practical and comprehensive reference gives the latest developments on the design of sheet forming operations equipment tooling and process modeling Individual chapters cover all major sheet forming processes such as blanking bending deep drawing and more Process modeling using finite element analysis is described in one chapter and discussed in all appropriate chapters Other chapters cover sensors and die materials which are critical for practical sheet forming applications Other topics include relatively new technologies such as warm forming of magnesium and aluminum alloys forming of advanced high strength steels AHSS and hot stamping Chapters also address special sheet forming operations like spinning incremental forming and mechanical joining and processes related to sheet forming such as sheet and tube hydroforming roll forming and high velocity forming **Metal Forming** Taylan

Altan,Soo-Ik Oh,H. L. Gegel,1983 Briefly reviews the basic principles of metal forming but major emphasis is on the latest developments in the design of metal forming operations and tooling Discusses the position of metal forming in manufacturing and considers a metal forming process as a system consisting of several interacting variables Includes an overall review and classification of all metal forming processes The fundamentals of plastic deformation metal flow flow stress of metals and yield criteria are discussed as are significant practical variables of metal forming processes such as friction temperatures and forming machines and their characteristics Examines approximate methods of analyzing simple forming operations then looks at massive forming processes such as closed die forging hot extrusion cold forging extrusion rolling and drawing discussion includes the prediction of stresses and load in each process and applications of computer aided techniques Recent developments in metal forming technology including CAD CAM for die design and manufacture are discussed and a review of the latest trends in metal flow analysis and simulations **Fundamentals Of Metal Forming Processes** B. L. Juneja,2007

Fundamentals Of Metal Forming Processes, 2/e B. L. Juneja,2010 **Metal Forming Processes** Zainul Huda,2024-04-29 This unique textbook features fundamentals and analyses of metal forming processes supported by 200 worked numerical examples It provides rigorous detail on the three all important groups of metal forming processes bulk metal forming sheet metal forming and sheet bulk metal forming Theory of metal forming is presented by discussing deformation behavior plasticity and formability with a thorough mathematical analyses and calculations The mechanics of sheet metal forming is also covered by including principal strain increments in uniaxial loading as well as plane stress deformation There are 125 diagrammatic illustrations real life photographs that have been labelled properly to enhance the understanding of readers Among the salient features of the book is the inclusion of industrially oriented projects covering both technological and business considerations The key solutions connected to these projects are presented with the aid of mathematical analysis and process flow diagrams The book includes 100 multiple choice questions MCQs with their answers and those for selected problems facilitating self directed learning **Metal Forming Analysis** R. H. Wagoner,J.-L.

Chenot,2001-05-07 The introduction of numerical methods particularly finite element FE analysis represents a significant advance in metal forming operations Numerical methods are used increasingly to optimize product design and deal with problems in metal forging rolling and extrusion processes Metal Forming Analysis first published in 2001 describes the most important numerical techniques for simulating metal forming operations The first part of the book describes principles and procedures and includes numerous examples and worked problems The remaining chapters focus on applications of numerical analysis to specific forming operations Most of these results are drawn from the authors research in the areas of metal testing sheet metal forming forging extrusion and similar operations Sufficient information is presented so that readers can understand the nonlinear finite element method as applied to forming problems without a prior background in structural finite element analysis Graduate students researchers and practising engineers will welcome this thorough reference to state of the art numerical methods used in metal forming analysis **Metal Forming** Taylan Altan,Soo-Ik Oh,Harold L.

Gegel,1963 **Metal Forming and the Finite-Element Method** the late Shiro Kobayashi,Soo-Ik Oh,Taylan Altan,1989-03-09 The application of computer aided design and manufacturing techniques is becoming essential in modern metal forming technology Thus process modeling for the determination of deformation mechanics has been a major concern in research In light of these developments the finite element method a technique by which an object is decomposed into pieces and treated as isolated interacting sections has steadily assumed increased importance This volume addresses advances in modern metal forming technology computer aided design and engineering and the finite element method

Metal Forming Handbook Schuler,1998 This chinese edition of the Metal Forming Handbook presents the fundamentals of metal forming processes and press design As a textbook and reference work in one it provides an in depth study of the major metal forming technologies sheet metal forming cutting hydroforming and solid forming Written by qualified practically oriented experts for practical implementation supplemented by sample calculations and illustrated throughout by clearly presented color figures and diagrams this book provides fundamental information on the state of the art in the field of metal forming technology *Fundamentals of Metal Forming* Robert H. Wagoner,Jean-Loup Chenot,1996-04-26 Designed as a textbook for courses on metal forming elasticity plasticity or continuum mechanics this work incorporates finite element methods and operations analysis Emphasis is placed on physical intuition and numerous exercises are used throughout

Sheet Metal Forming Processes and Die Design Vukota Boljanovic,2004 This book is a complete modern guide to sheet metal forming processes and die design still the most commonly used methodology for the mass production manufacture of aircraft automobiles and complex high precision parts It illustrates several different approaches to this intricate field by taking the reader through the hows and whys of product analysis as well as the techniques for blanking punching bending deep drawing stretching material economy strip design movement of metal during stamping and tooling

Grundlagen der Umformtechnik - Stand und Entwicklungstrends Kurt Lange, **Sheet Metal Forming:**

Fundamentals Taylan Altan,2012 **Metal Shaping Processes** Vukota Boljanovic,2009 As the only comprehensive text focusing on metal shaping processes which are still the most widely used processes in the manufacture of products and structures Metal Shaping Processes carefully presents the fundamentals of metal shaping processes with their relevant applications The treatment of the subject matter is adequately descriptive for those unfamiliar with the various processes and yet is sufficiently analytical for an introductory academic course in manufacturing The text as well as the numerous formulas and illustrations in each chapter clearly show that shaping processes as a part of manufacturing engineering are a complex and interdisciplinary subject The topics are organized and presented in such a manner that they motivate and challenge students to present technically and economically viable solutions to a wide variety of questions and problems including product design It is the perfect textbook for students in mechanical industrial and manufacturing engineering programs at both the Associate Degree and Bachelor Degree programs as well a valuable reference for manufacturing engineers those who design execute and maintain the equipment and tools process engineers those who plan and engineer the manufacturing steps equipment and tooling needed in production manufacturing managers and supervisors product design engineers and maintenance and reliability managers and technicians Features Each chapter begins with a brief highlighted outline of the topics to be described Carefully presents the fundamentals of the particular metal shaping process with its relevant applications within each chapter so that the student and teacher can clearly assess the capabilities limitation and potentials of the process and its competitive aspects Features sections on product design considerations which present guidelines on design for manufacturing in many of the chapters Offers practical understandable explanations even for complex processes Includes text entries that are coded as in an outline with these numerical designations carried over the 320 related illustrations for easy cross referencing Provides a dual ISO and USA unit system Contains end of chapter Review Questions Includes a chapter on sheet metalworking covering cutting processes bending process tubes and pipe bending deep drawing processes other sheet metal forming process stretch forming spinning rubber forming and superplastic forming and diffusion bonding Provides a useful die classification with 15 illustrations and description presses for sheet metalworking and high energy rate forming processes A chapter on nontraditional manufacturing process discusses such important processes as mechanical energy processes ultrasonic machining water jet cutting electrochemical machining processes electrochemical machining electrochemical grinding thermal energy processes electric discharge processes laser beam machining electron beam machining and chemical processes chemical milling **Fundamentals of Metal Forming Analysis** Robert H. Wagoner,Jean-Loup Chenot,1996 **Manufacturing** Beno Benhabib,2003-07-03 From concept development to final production this comprehensive text thoroughly examines the design prototyping and fabrication of engineering products and emphasizes modern developments in system modeling analysis and automatic control This reference details various management strategies design methodologies traditional production technique DeGarmo's Materials and Processes in

Manufacturing J. T. Black, Ronald A. Kohser, 2011-08-30 Now in its eleventh edition DeGarmo's Materials and Processes in Manufacturing has been a market leading text on manufacturing and manufacturing processes courses for more than fifty years. Authors J. T. Black and Ron Kohser have continued this book's long and distinguished tradition of exceedingly clear presentation and highly practical approach to materials and processes, presenting mathematical models and analytical equations only when they enhance the basic understanding of the material. Completely revised and updated to reflect all current practices, standards, and materials, the eleventh edition has new coverage of additive manufacturing, lean engineering, and processes related to ceramics, polymers, and plastics.

Cold and Hot Forging Taylan Altan, Gracious Ngaile, Gangshu Shen, 2004-01-01 Editors Altan, Ohio State University; Ngaile, North Carolina University; and Shen, Ladish Company Inc. offer this extensive overview of the latest developments in the design of forging operations and dies. Basic technological principles are briefly reviewed in the first two chapters.

Metal Forming William F. Hosford, Robert M. Caddell, 2011-02-07 This book helps the engineer understand the principles of metal forming and analyze forming problems. Both the mechanics of forming processes and how the properties of metals interact with the processes. In this fourth edition, an entire chapter has been devoted to forming limit diagrams and various aspects of stamping, and another on other sheet forming operations. Sheet testing is covered in a separate chapter. Coverage of sheet metal properties has been expanded. Interesting end-of-chapter notes have been added throughout, as well as references. More than 200 end-of-chapter problems are also included.

Sheet Metal Fabrication Eddie Paul, 2008-03-15 Sheet metal fabrication from fins and fenders to art with all the necessary information on tools, preparations, materials, forms, mock-ups, and much more.

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