AMIRAJ

COLLEGE OF ENGINEERING & TECHNOLOGY

LABORATORY MANUAL

METAL FORMING ANALYSIS

SUBJECT CODE: 2171913

MECHANICAL ENGINEERING DEPARTMENT

B.E. 7th SEMESTER

NAME: _____
ENROLLMENT NO: _____
BATCH NO: _____
YEAR: _____

Amiraj College of Engineering and Technology,
Nr.Tata Nano Plant, Khoraj, Sanand, Ahmedabad.

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CERTIFICATE

This is to certify that Mr. / Ms. _____

Of class_____ Enrolment No _____has

Satisfactorily completed the course in _____as

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Mechanical Engineering in the Academic year_____.

Date of Submission:-

Faculty Name and Signature

(Subject Teacher)

Head of Department

(Mechanical)

MFA LAB

MECHANICAL ENGINEERING (19)
METAL FORMING ANALYSIS
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LIST OF EXPERIMENTS

Sr No.	Date	Title	Sign
1		Introduction to Forming Process	
2		To study of Yield Condition	
3		To Study of Slip lines, Upper bound and lower bound.	
4		To study and analysis of Forging Process	
5		To study and analysis of Rolling Process.	
6		To study of Extrusion & Drawing process	
7		To study and analysis of Sheet metal forming process.	

LAB: 1

Title: Introduction to Forming Process

Introduction:

Forming processes are particular manufacturing processes which make use of suitable stresses (like compression, tension, shear or combined stresses) to cause plastic deformation of the materials to produce required shapes. During forming processes no material is removed, i.e. they are deformed and displaced.

Compressive forming

It involves those processes where the primary means of plastic deformation is uni- or multiaxial compressive loading.

- Rolling, where the material is passed through a pair of rollers
- Extrusion, where the material is pushed through an orifice
- Die forming, where the material is stamped by a press around or onto a die
- Forging, where the material is shaped by localized compressive forces
- Indenting, where a tool is pressed into the workpiece

Tensile forming

Tensile forming involves those processes where the primary means of plastic deformation is uni- or multiaxial tensile stress.

- Stretching, where a tensile load is applied along the longitudinal axis of the workpiece
- Expanding, where the circumference of a hollow body is increased by tangential loading
- Recessing, where depressions and holes are formed through tensile loading

Combined tensile and compressive forming

This category of forming processes involves those operations where the primary means of plastic deformation involves both tensile stresses and compressive loads.

- Pulling through a die
- Deep drawing
- Spinning
- Flange forming
- Upset bulging

Bending

Main article: Bending (metalworking)

This category of forming processes involves those operations where the primary means

of plastic deformation is a bending load.

Shearing
Main article: Shear forming

This category of forming processes involves those operations where the primary means of plastic deformation is a shearing load.

Exercise

1.Classification of forming process and advantage of metal forming ?
2. State the fundamental conditions for stress - strain relations in plastic deformation. Explain the normality rule related to plastic stress strain relation?
3.Explain two dimensional Mohr's circle for stress analysis?
4. What is Strain rate? Explain the effect of strain rate in metal forming?

LAB: 2

Title: To study of Yield Condition

Introduction:-

A yield strength or yield point is the material property defined as the stress at which a material begins to deform plastically. Prior to the yield point the material will deform elastically and will return to its original shape when the applied stress is removed. Once the yield point is passed, some fraction of the deformation will be permanent and non-reversible.

The von Mises yield criterion [1] suggests that the yielding of materials begins when the second deviatoric stress invariant reaches a critical value. It is part of a plasticity theory that applies best to ductile materials, such as metals. Prior to yield, material response is assumed to be elastic.

In materials science and engineering the von Mises yield criterion can be also formulated in terms of the von Mises stress or equivalent tensile stress, a scalar stress value that can be computed from the Cauchy stress tensor. In this case, a material is said to start yielding when its von Mises stress reaches a critical value known as the yield strength, The von Mises stress is used to predict yielding of materials under any loading condition from results of simple uniaxial tensile tests. The von Mises stress satisfies the property that two stress states with equal distortion energy have equal von Mises stress.

Exercise

1. Derive the relationship between yield strength in Shear and Yield strength in tension according to Tresca's hypothesis.
2. Why most metals obey Von-Mises Yield condition? Explain it in detail.

LAB: 3

Title :- To Study of Slip lines, Upper bound and lower bound.

Introduction:-

The main purpose of forging design is to ensure cavity filling with minimum material wastage, minimum die load and minimum deformation energy. Given the desired shape of the component and the material to be forged, this goal is achieved by optimizing the initial volume of the billet, the geometrical parameters of the die and the process parameters. It is general industrial practice to fix the initial billet volume and the die parameters using empirical relationships derived from practical experience. In this paper a basis for optimizing some of the parameters for simple closed-die forging is proposed.

Slip-line field solutions are used to predict the flow, the load and the energy in a simple two-dimensional closed-die forging operation. The influence of the design parameters; flash-land width, excess initial workpiece area and forged cross-sectional size; on complete cavity filling and efficient cavity filling are investigated. Using the latter as necessary requirements for forging, the levels of permissible design parameters are determined, the variation of these levels with the size of the cross-section then being examined.

Upper bound of a subset S of some partially ordered set $(K, \leq)$ is an element of K which is greater than or equal to every element of S. The term Lower bound is defined dually as an element of K which is less than or equal to every element of S. A set with an upper bound is said to be bounded from above by that bound, a set with a lower bound is said to be bounded from below by that bound. The terms bounded above (bounded below) are also used in the mathematical literature for sets that have upper (respectively lower) bounds.

Exercise

1. Prove that the angle between two slip lines of one family at points where they are cut by a slip line of the other family is constant along their lengths.**?**
2. Explain the application of Upper bound theory in extrusion.

LAB: 4

Title:- To study and analysis of Forging Process

Introduction:-

Forging is a manufacturing process involving the shaping of metal using localized compressive forces. The blows are delivered with a hammer (often a power hammer) or a die. Forging is often classified according to the temperature at which it is performed: cold forging (a type of cold working), warm forging, or hot forging (a type of hot working). For the latter two, the metal is heated, usually in a forge. Forged parts can range in weight from less than a kilogram to hundreds of metric tons.[1][2] Forging has been done by smiths for millennia; the traditional products were kitchenware, hardware, hand tools, edged weapons, and jewellery.

Since the Industrial Revolution, forged parts are widely used in mechanisms and machines wherever a component requires high strength; such forgings usually require further processing (such as machining) to achieve a finished part.

History:

Forging is one of the oldest known metalworking processes. Traditionally, forging was performed by a smith using hammer and anvil, though introducing water power to the production and working of iron in the 12th century allowed the use of large trip hammers or power hammers that exponentially increased the amount and size of iron that could be produced and forged easily.

In modern times, industrial forging is done either with presses or with hammers powered by compressed air, electricity, hydraulics or steam. These hammers may have reciprocating weights in the thousands of pounds. Smaller power hammers, 500 lb (230 kg) or less reciprocating weight, and hydraulic presses are common in art smithies as well. Some steam hammers remain in use, but they became obsolete with the availability of the other, more convenient, power sources.

Exercise

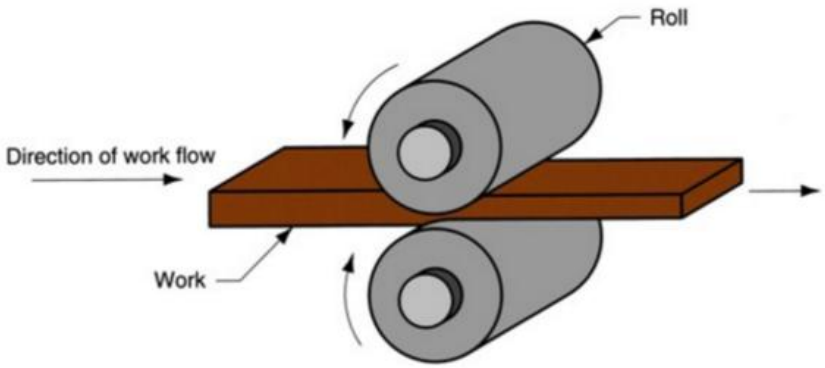
1. What is Forging? Write Characteristics of forging?
2. Explain Classification of forging ?
3. Analysis for Forming of a rectangular plate under condition of plane stain and Circular Disc.

LAB: 5

Title: To study and analysis of Rolling Process.

Introduction:-

Roll forging is a process where round or flat bar stock is reduced in thickness and increased in length. Roll forging is performed using two cylindrical or semi-cylindrical rolls, each containing one or more shaped grooves. A heated bar is inserted into the rolls and when it hits a spot the rolls rotate and the bar is progressively shaped as it is rolled through the machine. The piece is then transferred to the next set of grooves or turned around and reinserted into the same grooves. This continues until the desired shape and size is achieved. The advantage of this process is there is no flash and it imparts a favorable grain structure into the workpiece.



Exercise

1. Explain type of Rolling mill with nest sketch?
2. Explain analysis of longitudinal strip or Sheet rolling process or Flat rolling process?
3. Write difference between hot working and cold working?

LAB: 6

Title:-To study of Extrusion & Drawing process

Introduction:-

Extrusion is a process used to create objects of a fixed cross-sectional profile. A material is pushed through a die of the desired cross-section. The two main advantages of this process over other manufacturing processes are its ability to create very complex cross-sections, and to work materials that are brittle, because the material only encounters compressive and shear stresses. It also forms parts with an excellent surface finish.

Drawing is a similar process, which uses the tensile strength of the material to pull it through the die. This limits the amount of change which can be performed in one step, so it is limited to simpler shapes, and multiple stages are usually needed. Drawing is the main way to produce wire. Metal bar and tube are also often drawn.

Exercise

1. Explain extrusion process? What is direct and indirect extrusion?
2. Analysis of simple forward extrusion and the stress action or an element in the extrusion zone?
3. Explain analysis of the Drawing process for solid rod though a circular die.

LAB: 7

Title:-To study and analysis of Sheet metal forming process.

Introduction:-

Sheet metal is metal formed by an industrial process into thin, flat pieces. It is one of the fundamental forms used in metalworking and it can be cut and bent into a variety of shapes. Countless everyday objects are constructed with sheet metal. Thicknesses can vary significantly; extremely thin thicknesses are considered foil or leaf, and pieces thicker than 6 mm (0.25 in) are considered plate. Sheet metal is available in flat pieces or coiled strips. The coils are formed by running a continuous sheet of metal through a roll slitter.

The thickness of sheet metal is in the USA commonly specified by a traditional, non-linear measure known as its gauge. The larger the gauge number, the thinner the metal. Commonly used steel sheet metal ranges from 30 gauge to about 7 gauge. Gauge differs between ferrous (iron based) metals and nonferrous metals such as aluminum or copper; copper thickness, for example is measured in ounces (and represents the thickness of 1 ounce of copper rolled out to an area of 1 square foot). In the rest of the world the sheet metal thickness is given in millimeters.

Exercise

1. Explain bending in sheet metal forming. Show various stresses in bending process.
2. Differentiate between Punching and Blanking operation in context of purpose, metal scrap, punch and die dimension.
3. By Slab Analysis for Sheet Drawing, Prove $P=2K-\sigma x$. Write the assumptions.