## MODERN MACHINING & FORMING METHODS

(ELECTIVE - III) Instruction
4 Periods per week Duration of University Examination
3 Hours University Examination
75 Marks Sessional
25 Marks

## Unit-IV

**Syllabus**

**Rubber Pad Forming:** Principle of the process, process details & its types; Guerin, wheelon, Marfoming & Hydro forming processes & applications.

**High Energy Rate Forming (HERF):** HERF hammers, principle of explosive forming, Explosive materials, types of explosive forming, stand off operation & contact operation, the pressure pulse, Gas bubble & the process applications.

**Electro-Hydraulic forming (EHF):** Schematic of the process description & its applications.

### Suggested Reading:


1. P.C. Pandey & H.S. Shah, Modern Machining Process, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1980.
2. A. Bhattacharya, New Technology, The Institution of Engineers (India), 1984.
3. Davies & Austin, Developments in High Speed Metal Forming, The Machinery Publishing Co. Ltd., 1985.
4. Production Technology, HMT.

## METAL FORMING

The process in which the desired shape & size are obtained through plastic deformation of thin sheet metal.

- Very economical process.
- Any desired shape, size & finish can be obtained
- No significant loss of material.
- Improves the strength of the product due to strain hardening.

## Conventional Forming

- Force is applied using simple hammer blow or power press.
    - Source: Hydraulic / Pneumatic, gravity (drop forge)
- Disadvantages:
    - Tools are heavy & relative velocities are low.
    - Limited by size of parts.

    - Techniques include Forging, Extrusion, Drawing, Punching, Joining etc…
    - Spring back effect is significant.
- Applications:
    - Bending (Straight flanges, sections)
    - Flanged parts (Stretch, shrink)
    - Linear contoured parts (Angles, channels)
    - Plane contoured parts.

## Rubber Pad Forming:

Principle of the process, process details & its types; & applications.

### Basic Introduction

A metal forming process where a sheet metal is pressed between a die & a rubber pad.

- The rubber pad regains its original shape due to elastic property.
- The rubber pads can have a general purpose shape, like a membrane
- The sheet metal, undergoes plastic deformation & retains its final shape from die.
- Used in production lines since many years.
- It can be accomplished in many different ways.
- The applications for this simple process have advanced with the technology.

### Types if any

Guerin Process / Stamping
Verson Wheelon,
Marfoming
Hydro forming processes

### Working principle

Sheet metal is pressed between a die & a rubber block, made of polyurethane.

- The rubber drives sheet metal into the die under pressure.
- Both conform to die shape & thus form the part.
- The rubber pads can have a general purpose shape, like a membrane.
    - They can also be machined in the shape of die or punch.

### Equipment

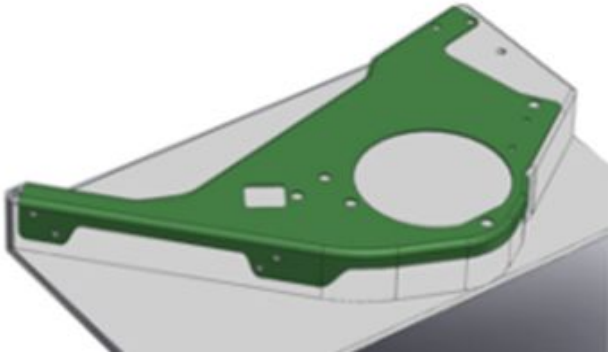
- An elastic upper die, usually made of rubber.
- Hydraulic Press.
- Form Block: A rigid lower die having shape of forming required.
- Sheet metal or blank to be formed.

### Process Description

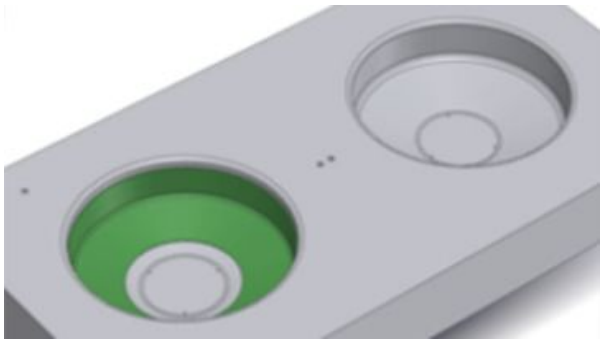
- A rubber pad is pressed against the lower rigid die with the sheet / blank in between.
    - A hydraulic press provides necessary force.
- The rubber deforms putting pressure on the sheet which takes shape of the lower die.
- After relaxation, the rubber regains is initial shape due to its elastic nature.
- The sheet retains the deformed shape from die as it undergoes plastic deformation.

- In positive pressing, the sheet is pressed over the tool.
- In negative pressing, the sheet is pressed inside the die.
- When combining both tools, a positive & a negative die, even more demanding designs can be created.

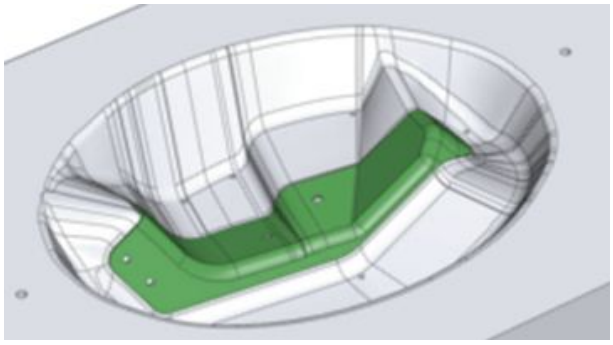
### Process Variations



In +ve pressing the sheet is pressed over the tool.



In -ve pressing the sheet is pressed inside the die.



When combining both tools, a positive & a negative die, even more demanding designs can be created.

### Process Parameters

Type of rubber used
Shape of rubber used
Forming shape

### Performance Characteristics

Surface finish
Spring back action

Strain hardening
Thickness uniformity

### Advantages

- Minimal damage of the material surface.
- Low tooling costs
- Shorter time to market
- Minimal damage of material surface.
- The same upper (male) die can be used with different lower (female) dies,
    - Hence, the process is relatively cheap & flexible.
    - Low tooling costs.
- Unique combination in shape, price & lead time
- Smart & efficient design by integrating functionalities
- Lightweight optimised constructions
- More hygiene through design (no welding seams).
- No sharp edges & little to no surface damages.
- Appealing specific design with flowing shapes.

### Disadvantages

- Rubber pads exert less pressure in the same circumstances as non-elastic parts.
    - This may lead to less deformation in forming.
- rubber pads wear more quickly than steel parts.

### Applications

- Up to 60% of all sheet metal parts in the aerospace industry are fabricated using this process.
- It is frequently used in prototyping shops & for the production of kitchenware.
- An important additional operation within the process is 3D cutting of the product with a CNC driven 3D laser cutting machine.