DIE DESIGN PARAMETERS

1. Parting Line
   - is at the largest c/s of the part
   - is a st. line at centre for simple shapes
   - may not be in a single plane for complex shape

2. Flash and Gutter
   - Flash material is allowed to flow into a gutter
   - Prevents unnecessary increase of forging load (because of excess/extra flash)
   • Guidelines for flash and clearance between dies:
     - 3% of max. thickness of the forgings
     - The length of the land = 2 to 5 times the flash thickness

3. Draft Angles
   - For easy removal of forgings from the die
     - Similar to draft in casting design
     - Internal draft angles are larger – 7°- 10°
     - External draft angles are smaller – 3°- 5°

4. Fillet: It is a small radius provided at corners.
   - To ensure smooth flow of metal into die cavity
- To improve die life
- As a general rule, should be as large as possible

- Small fillet radii lead to;
  - Improper metal flow
  - Rapid wear of die
  - Fatigue cracking of dies

5. **Die material : requirements are**

- Strength and toughness at elevated temperature
- Hardenability and ability to harden uniformly
- Resistance to mechanical and thermal shocks
- Wear resistance – to resist abrasion wear due to scales present on work piece

**Selection of proper die material depends on :**

- Die size
- Composition and properties of work piece
- Complexity of shape- no of performing steps
- Forging temperature
- Type of forging operation
- Cost of die material
- No. of forgings required
- Heat transfer from work piece to dies

- **Die materials used:**
  - Tool and die steels with Cr, Ni, Mo, Va

**Die Manufacturing: It consists of the following steps:**

- -- Initially castings
- – then forged
- – finally machined and finished to required shape and surface finish
Material Flow Lines in Forgings:

- The deformation produced by forging gives a certain degree of directionality to the microstructure of the work material.

- Due to this, second phases and inclusions are oriented parallel to the direction of greatest deformation.

- When magnified, this appears as flow lines or fiber structure, a major characteristic of all forgings.

**Limitation of flow lines:**

- Flow lines (fiber structure) lead to lower tensile ductility and lower fatigue properties in the direction normal to it (in transverse direction).

- Hence optimal balance between ductility in longitudinal and transverse directions is very essential. (Deformation limited to 50% to 70% reduction in c/s area.)

Source: [http://elearningatria.files.wordpress.com/2013/10/mp3_unit3_forging_final.pdf](http://elearningatria.files.wordpress.com/2013/10/mp3_unit3_forging_final.pdf)