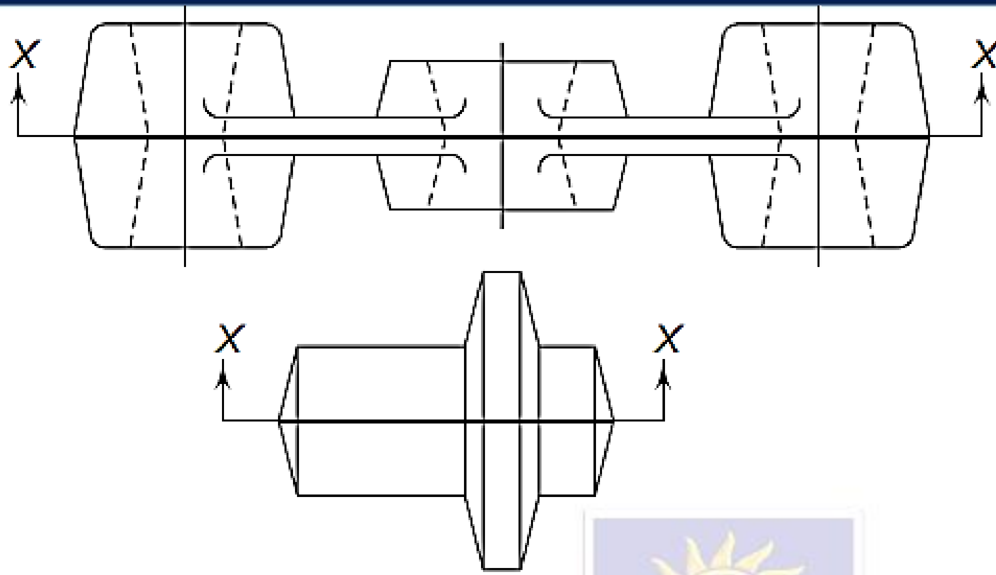

Fig. 3.15 *Location of Parting Line and Forging Plane (XX)*

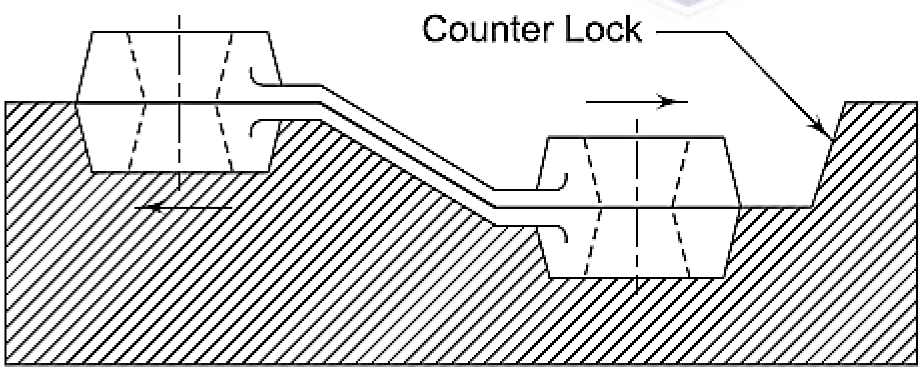

Fig. 3.16 *Unbalanced Forces*

- **DESIGN CONSIDERATIONS OF MACHINED PARTS**
- Machined components are widely used in all industrial products. They are usually made from ferrous and non-ferrous metals. They are as small as a miniature gear in a wristwatch and as large as a huge turbine housing. Machined components are used under the following circumstances:
- (i) Components requiring precision and high dimensional accuracy
- (ii) Components requiring fl atness, roundness, parallelism or circularity for their proper functioning
- (iii) Components of interchangeable assembly
- (iv) Components, which are in relative motion with each other or with some fi xed part
- The general principles for the design of machined parts are as follows:
- (i) Avoid Machining Machining operations increase cost of the component. Components made by casting or forming methods are usually cheaper. Therefore, as far as possible, the designer should avoid machined surfaces.
- (ii) Specify Liberal Tolerances The secondary machining operations like grinding or reaming are costly. Therefore, depending upon the functional requirement of the component, the designer should specify the most liberal dimensional and geometric tolerances. Closer the tolerance, higher is the cost.
- (iii) Avoid Sharp Corners Sharp corners result in stress concentration. Therefore, the designer should avoid shapes that require sharp corners.
- (iv) Use Stock Dimensions Raw material like bars are available in standard sizes. Using stock dimensions eliminates machining operations. For example, a hexagonal bar can be used for a bolt, and only the threaded portion can be machined. This will eliminate machining of hexagonal surfaces.
- (v) Design Rigid Parts Any machining operation such as turning or shaping induces cutting forces on the components. The component should be rigid enough to withstand these forces. In this respect, components with thin walls or webs should be avoided.
- (vi) Avoid Shoulders and Undercuts Shoulders and undercuts usually involve separate operations and separate tools, which increase the cost of machining.
- (vii) Avoid Hard Materials Hard materials are diffiult to machine. They should be avoided unless such properties are essential for the functional requirement of the product.

- HOT AND COLD WORKING OF METALS
- The temperature at which new stress-free grains are formed in the metal is called the recrystallization temperature. There are two types of metal deformation methods, namely, hot working and cold working.
- Metal deformation processes that are carried out above the recrystallization temperature are called hot working processes. Hot rolling, hot forging, hot spinning, hot extrusion, and hot drawing are hot working processes. Metal deformation processes that are carried out below the recrystallization temperature are called cold working processes. Cold rolling, cold forging, cold spinning, cold extrusion, and cold drawing are cold working processes. Hot working processes have the following advantages:
- (i) Hot working reduces strain hardening.
- (ii) Hot rolled components have higher toughness and ductility. They have better resistance to shocks and vibrations.
- (iii) Hot working increases the strength of metal by refi ning the grain structure and aligning the grain of the metal with the fi nal counters of the part. This is particularly true of forged parts.
- (iv) Hot working reduces residual stresses in the component.
- Hot working processes have the following disadvantages:
- (i) Hot working results in rapid oxidation of the surface due to high temperature.
- (ii) Hot rolled components have poor surface fi nish than cold rolled parts.
- (iii) Hot working requires expensive tools.
- Cold working processes have the following advantages:
- i) Cold rolled components have higher hardness and strength.
- (ii) Cold worked components have better surface fi nish than hot rolled parts.
- (iii) The dimensions of cold rolled parts are very accurate.
- (iv) The tooling required for cold working is comparatively inexpensive.
- Cold working processes have the following disadvantages:
- (i) Cold working reduces toughness and ductility. Such components have poor resistance to shocks and vibrations.
- (ii) Cold working induces residual stresses in the component. Proper heat treatment is required to relieve these stresses.

- DESIGN CONSIDERATIONS OF WELDED ASSEMBLIES
- Welding is the most important method of joining the parts into a complex assembly. Design of welded joints is explained in a separate chapter on welded joints. In this article, general principles in design of welded assemblies are discussed. The Guidelines are as follows:
- (i) Select the Material with High Weldability
- (ii) Use Minimum Number of Welds
- (iii) Do not Shape the Parts Based on Casting or Forging
- (iv) Use Standard Components
- (v) Avoid Straps, Laps and Stiffeners
- (vi) Select Proper Location for the Weld
- (vii) Prescribe Correct Sequence of Welding
- Examples of 'incorrect' and 'correct' ways of welded design are illustrated from Fig. 3.17 to Fig. 3.19. In Fig. 3.17(a), it is necessary to prepare bevel edges for the components prior to welding operation. This preparatory work can be totally eliminated by making a slight change in the arrangement of components, which is shown in Fig. 3.17(b). Many times, fabrication is carried out by cutting steel plates followed by welding.
- The aim of the designer is to minimise scrap in such process. This is illustrated in Fig. 3.18. The circular top plate and annular bottom plate are cut from two separate plates resulting in excess scrap as shown in Fig. 3.18(a).
- Making a slight change in design, the top plate and annual bottom plate can be cut from one plate reducing scrap and material cost, which is shown in Fig. 3.18(b). Accumulation of welded joints results in shrinkage stresses. A method to reduce this accumulation is illustrated in Fig.

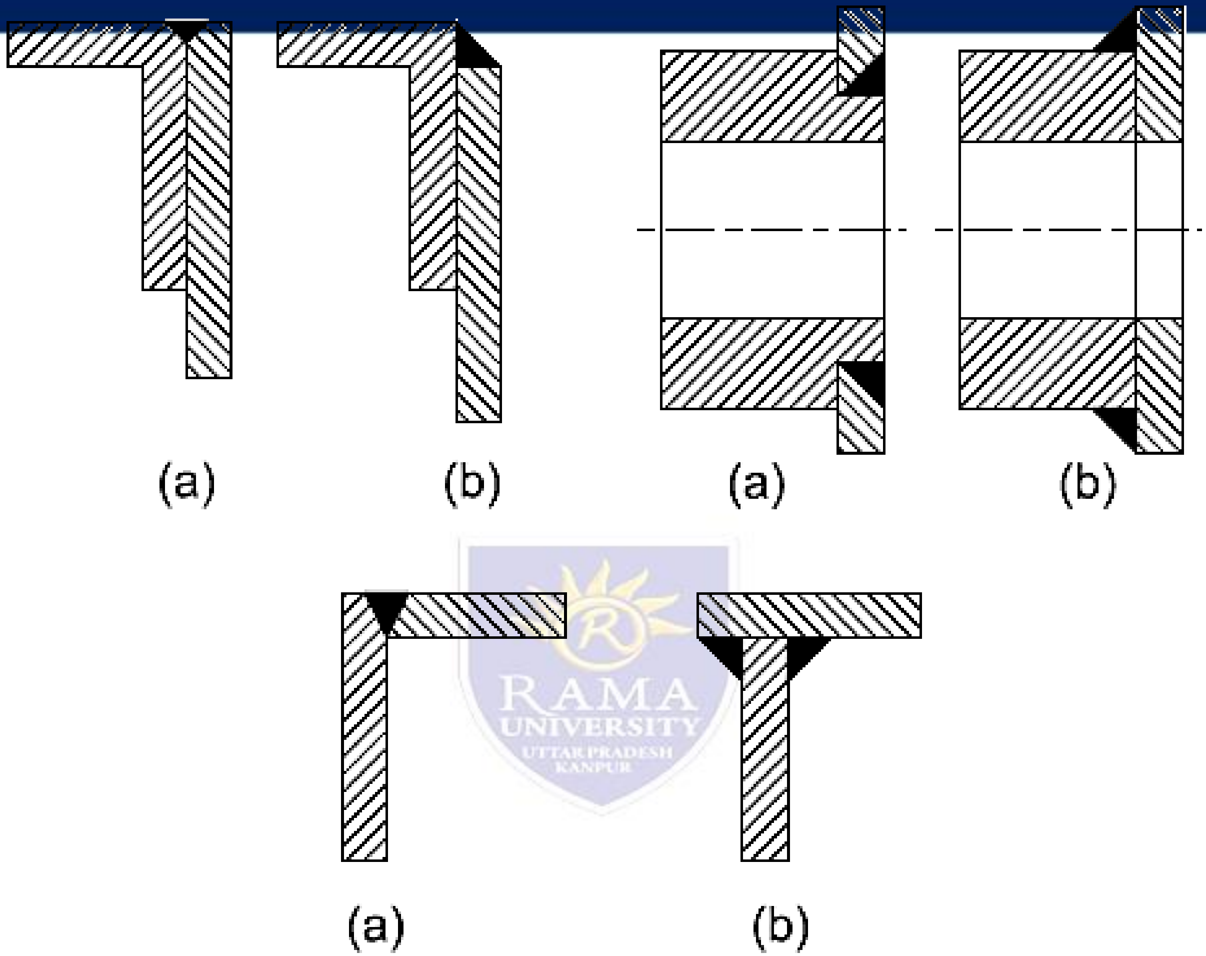

Fig. 3.17 *Saving of Preparatory Bevelling: (a) Incorrect (b) Correct*