Clamping surfaces

- Generally the clamping surface should be opposite to that of a location surface for clamping to be effective.
- However, normally the surface opposite to location would be the surface to machined.
- Hence this choice would only be possible if all of that surface is not to be machined or a parallel surface to this is available.
Clamping surfaces

- If the surface opposite to location is not available for clamping, alternate surfaces should be chosen for clamping such that resultant clamping force is acting against the locators.
- As far as possible already machined surfaces should be avoided as clamping surfaces as they are likely to be spoiled under the clamping forces.

As far as possible already machined surfaces should be avoided as clamping surfaces as they are likely to be spoiled under the clamping forces.

Clamping surfaces

- Care has to be exercised to distribute this large clamping force over a large area of the workpiece surface.
- Choose a surface with enough rigidity such that no deformation of the component takes place under the clamping forces.

Choose a surface with enough rigidity such that no deformation of the component takes place under the clamping forces.

Clamping surfaces

- Always choose the clamping surface area large enough such that the clamping forces are properly distributed and no surface plastic deformation takes place on the component.
- The clamping force used should take care of the cutting forces likely to come and maintain the stability of the workpiece within the fixture.
Tool Forces

- Magnitude and direction of cutting forces is useful for designing the clamping.
Figure 4-62. Workholder for broaching operation.

Figure 4-64. Cutting force resisted only by friction.
Figure 4-63. Cutting force resisted by solid jaw of visc.

Cutter action should always be against FIXED jaw or location.
Machining action should be firmly backed up and where possible clamped in more than one position.
- distributing clamping force to more than one point equally from one point of application
1. Simple clamps are preferred because complicated ones lose effectiveness as they wear.

2. Some clamps are more suitable for large and heavy work, others for small pieces.

3. Rough work pieces call for a longer travel of the clamp in the clamping range, but clamps may be made to dig into rough surfaces to hold them firmly.

4. The type of clamp required is determined by the kind of operation to which it is applied. A clamp suitable for holding a drill jig leaf may not be strong enough for a milling fixture.

5. Clamps should not make loading and unloading of the work difficult, nor should they interfere with the use of hoists and lifting devices for heavy work.
Factors for Clamping Design

6. Clamps that are apt to move on tightening, such as plain straps, should be avoided for production work.

7. The anticipated frequency of setups may influence the clamping means. For example, the use of hydraulic clamps, even if simple and of low cost, might be inadvisable if frequent installation and removal of piping and valves is necessary.
Figure 4-73. Accessories for strap clamps.

Strap Clamps

Spherical washer

screw

Threaded

Part

Effort

Fulcrum

First class lever action

Strap Clamps

Rest button

Eye bolt

Quarter-turn screw

Part

Fulcrum

Effort

Second class lever action
Strap Clamps

- Spherical nut and washer
- Fulcrum
- Heel pin
- Third class lever action
Cam clamps

Figure 4-80. Cylindrical cam clamps.

Toggle Clamps

[Diagrams of cam and toggle clamps]
Figure 4.85: Automatic adjustment to workpiece variations. (Courtesy, Carr Lane Manufacturing Co.)

Wedge action clamp

Figure 4.86: The wedge clamp.

Figure 4.84: Location and clamping of metal workpieces.
Expansion of a split bushing

Figure 4-102. Split collet.

Figure 4-103. High-range type collet.
Basic Construction Principles

- Cast
  - Stability and vibration damping
  - Good material distribution
  - Used for high volume production

- Welded
  - Easy fabrication and low lead time

- Built-up
  - Most versatile
  - Frequently used