

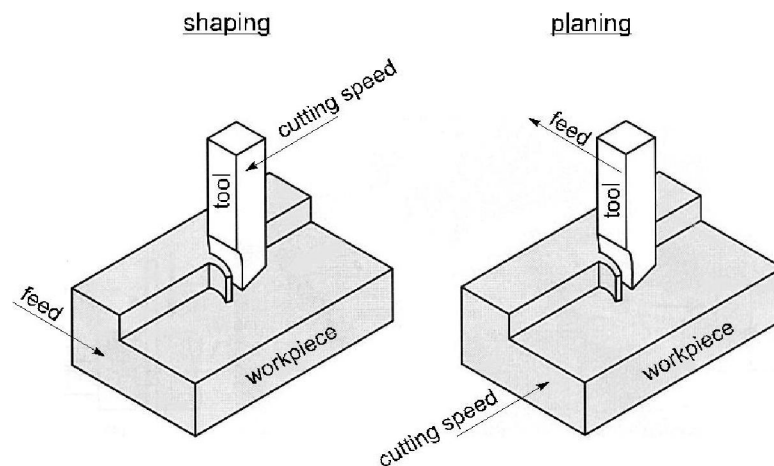
4.1 PLANING AND SHAPING

This section covers several machining operations that are used to machine straight and open external or internal surfaces:

- ❖ *Planing and shaping*: these operations are used to machine straight open mainly external surfaces with a single-point cutting tool;
- ❖ *Broaching* is used to machine straight and open basically internal surface of complex cross-section shapes by means of a special tool called a *broach*.

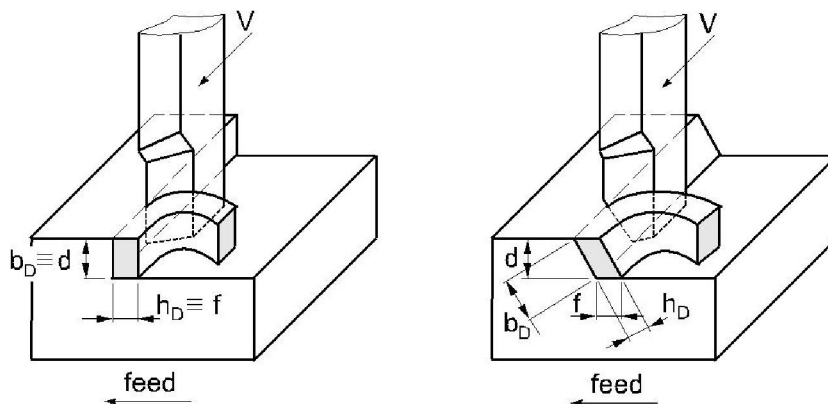
PLANING AND SHAPING

Planing and shaping are similar operations, which differ in the kinematics of the process. Planing is a machining operation in which the primary cutting motion is performed by the workpiece and feed motion is imparted to the cutting tool. In shaping, the primary motion is performed by the tool, and feed by the workpiece:



Kinematics of shaping and planing.

The *cutting conditions* in planing and shaping are illustrated in the figure. Only the shaping operation is portrayed but the cutting conditions are essentially the same and for planing:



Cutting conditions in orthogonal (Left) and oblique (Right) shaping.

Cutting velocity V in planing is linear and constant along the cutting path.

In shaping, the picture is more complicated. The cutting tool is held in the tool post mounted in the ram, which reciprocates over the work with a forward stroke, cutting at velocity V and a quick return stroke at higher velocity. The cutting velocity is therefore not constant along the cutting path. It increases from zero to maximum in the beginning of the stroke and gradually decreases to zero at the end of the stroke. The cutting speed V is assumed to be twice the average forward ram velocity.

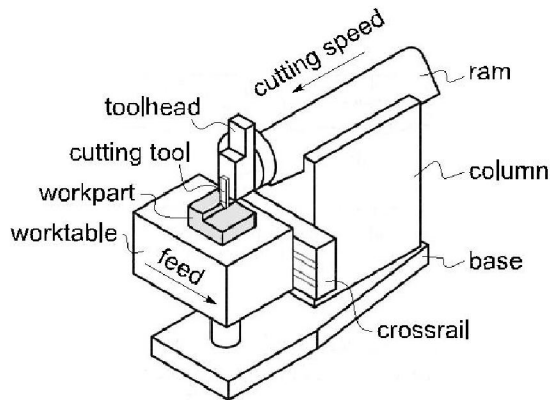
Feed f in planing and shaping is in mm per stroke and is at right angles to the cutting direction.

Depth of cut d is defined as usual as the distance between the work and machined surfaces.

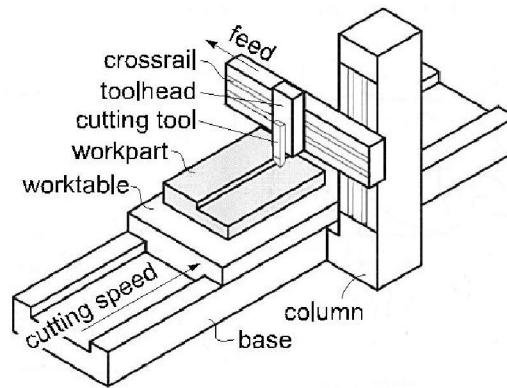
Machine tools for shaping and planing

Shapers

Shaping is performed on a machine tool called a *shaper*. The major components of a shaper are the *ram*, which has the *toolpost* with cutting tool mounted on its face, and a *worktable*, which holds the part and accomplishes the feed motion.



Components of a shaper



Components of an open-side planer.

Planers

The machine tool for planing is a *planer*. Cutting speed is achieved by a reciprocating worktable that moves the part past the single-point cutting tool. Construction and motion capability of a planer permit much larger parts to be machined than on a shaper. Planers can be classified as either open side planers or double-column planers.

The *open side planer*, also known as a *single-column planer* has a single column supporting the crossrail on which a toolhead is mounted. The configuration of the open side planer permits very wide workparts to be machined.

A *double-column planer* has two columns, one on either side of the bed and worktable. The columns support the crossrail on which one or more toolheads are mounted. The two columns provide a more rigid structure for the operation but limit the width of the work that can be handled.

Cutting tools for shaping and planing

Cutting tool for shaping or planing is essentially the same single-point cutting tool that is used in turning. The only difference is that the cutting tool for planing and shaping must be more rigid to withstand the higher impact cutting forces. The clearance angle must be bigger to avoid plunging of the cutting tool into the machined surface during the quick return of the ram over the work piece.

