Geometry of a Single Point Cutting Tool in ORS

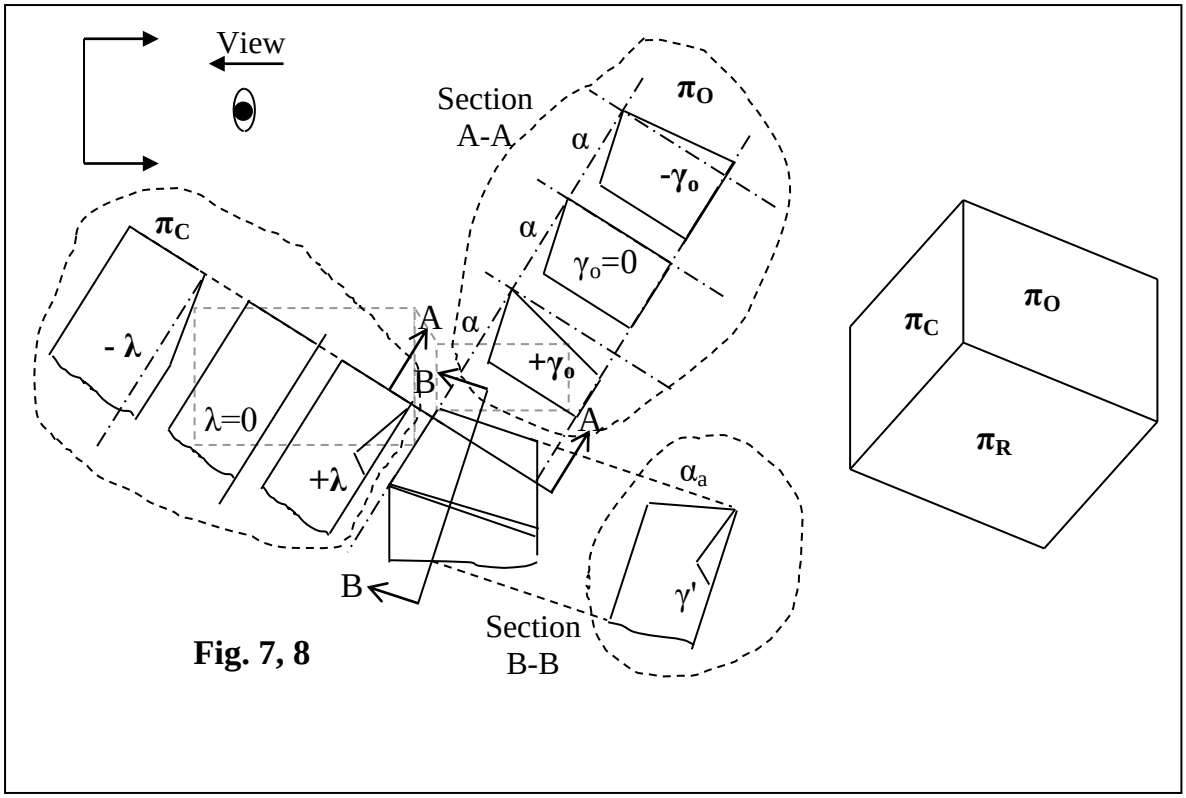


Fig. 7, 8

Geometry of a Single Point Cutting Tool in ASA System

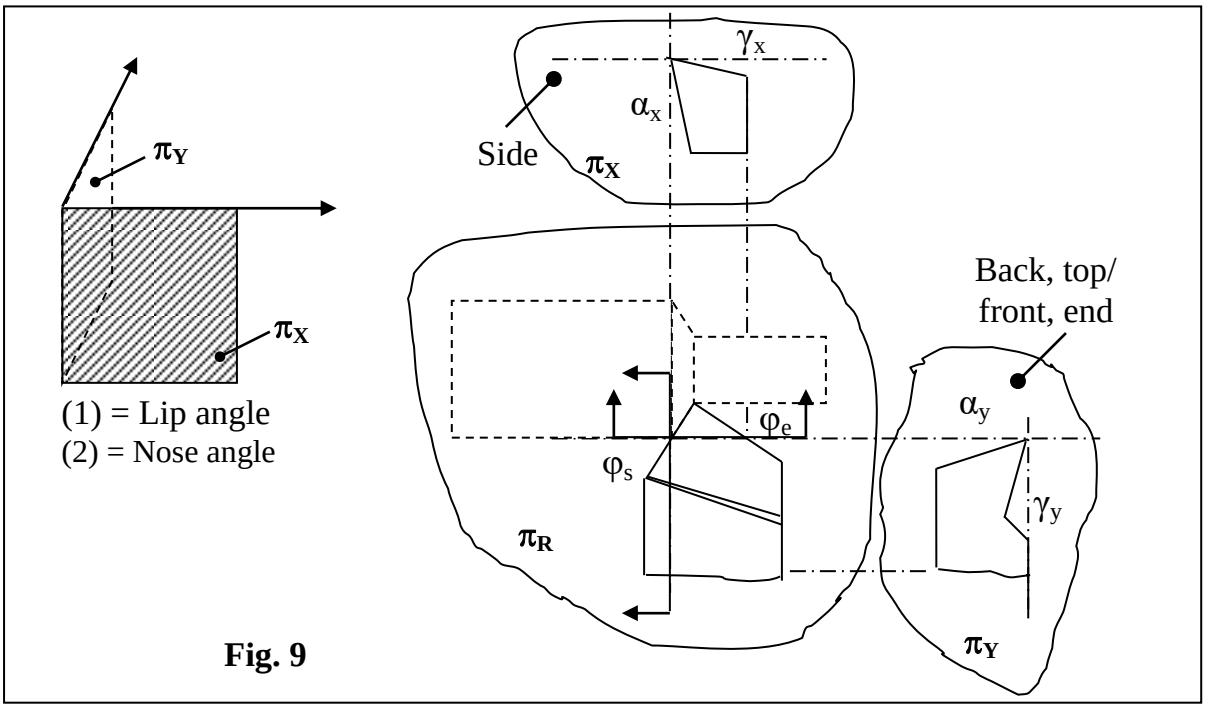


Fig. 9

Mechanism of Chip Formation

The main factor governing the formation of chips is the plastic deformation of metal followed by shearing. As the tool makes contact with the metal, it exerts a pressure on it resulting in the compression of the metal near the tool tip. This leads to severe plastic deformation of the metal in a zone called primary shear zone. The deformed metal fails by the process of shear and starts flowing over the rake face in the form of chip. The strong adhesion between the rake face and the newly formed chip results in a tendency of sticking, and the chip undergoes another deformation. This zone is called secondary shear zone. The chip after sliding over the tool face is lifted away from the tool and the resultant curvature of the chip is termed as chip curl. However, the width of primary shear zone is of the order of 0.025 mm, i.e., it is very narrow. This zone width decreases with increase in cutting speed. In normal cutting speed, this zone is considered as a plane, called shear plane along which maximum shear force acts and metal failure occurs.

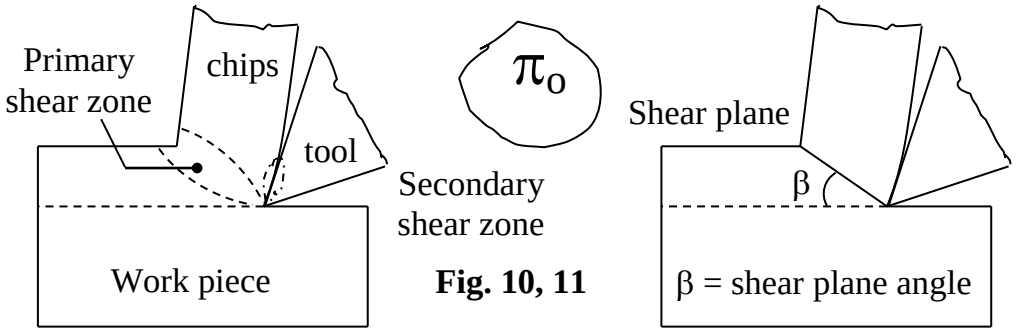
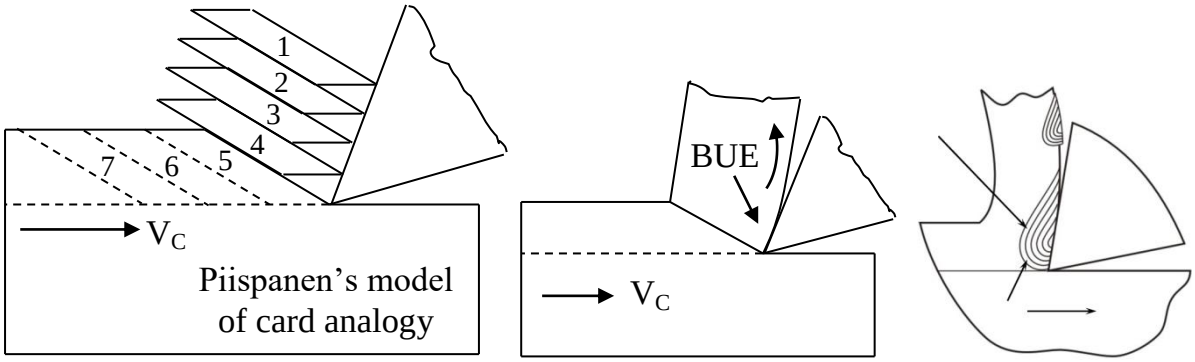


Fig. 10, 11

However, in cases of machining with higher cutting speeds, the width of shear zone is very small and is only about 1-10 μm. It confirms that the deformation of layer takes place in a small zone and is of local shearing in character. This idea enabled Piispanen to develop a model of card analogy where thin lamellae of the metal appears to move over the tool face one after another as shown in the figure. The process of formation of chips is represented here as a process of successive slip through shear of the sections of the layers being cut.



At a considerably high speed the temperature increases and the tendency of the plastically deformed material to adhere to the rake face increases and a lump is formed at the cutting edge. This is called built-up edge (BUE). It grows up to a certain size but ultimately breaks due to increased force on it by the adjacent flowing material. The BUE protects the tool rake face from the action of heat and friction wear. Thus, it may result in greater tool life but surface finish becomes poor as BUE interferes with the finished surface. The formation of BUE can be avoided with the use of suitable cutting fluid.