Reciprocating surface grinders are used to move the wheel with rectilinear motion relative to the workpiece to generate a plane surface or a profiled surface with zero curvature in the direction of motion. The wheel strokes back and forth over the workpiece, making "conventional" or up-cutting strokes in one direction and "climb"-cutting strokes in the return direction. The principles of reciprocating surface grinding are closely related to the principles of cylindrical grinding outlined in Chapters 1 and 2. It is suggested that those chapters be read before proceeding with this chapter. There are, however, some unique features of reciprocating surface grinding that are developed below.

Principles of Reciprocating Surface Grinding

The general metal-removal relation for cylindrical grinding operations is presented in Eq. 1.11. Using that relation to obtain Eq. (1.13):

$$\bar{v}_w = \frac{WRP}{\pi D_w} (F'_n - F'_th)^*$$

(10.1)
which gives the plunge-grinding velocity $\tilde{v}_w$ as a function of the interface normal force per unit width of contact $F'_n$. Dividing both sides of that equation by the work rotational speed $N_w$ yields:

$$\frac{\tilde{v}_w}{N_w} = \frac{\text{WRP}}{\pi D_w N_w} \left( F'_n - F'_{th} \right) \quad (10.2)$$

The left-hand term is recognized as the "wheel depth-of-cut" $h$.

The denominator of the right-hand side is recognized as the work surface speed $V_w$. Therefore:

$$h = \frac{\text{WRP}}{V_w} \left( F'_n - F'_{th} \right) \quad (10.3)$$

That equation applies to surface grinding and gives the wheel depth-of-cut $h$ in terms of normal force intensity $F'_n$. The "work removal parameter," WRP, applies to internal, external and surface grinding with the understanding that it varies, somewhat, with the "Equivalent Diameter" $D_e$. See (Eq. 1.6). For surface grinding:

$$D_e = D_s \quad (10.4)$$

where $D_s$ is the diameter of the grinding wheel.

The work removal parameter is described in Chapter 1 and also in Chapter 2. If one uses Eqs. (10.3) and (10.4), many of the relations presented in Chapters 1 and 2 for cylindrical grinding apply also to surface grinding.

Most surface-grinding machines are provided with an incremental feed that takes place at the end of each stroke (called the downfeed $d$). As the wheel engages the workpiece, normal force is developed, causing the system to deflect. Accordingly, the wheel depth-of-cut $h$ is less than the downfeed $d$, as illustrated in Fig. 10.1. $K_m$ represents the overall system rigidity. (See chapter 7 for a discussion of system rigidity.) The elastic force $F_e$ generated in the system is:

$$F_e = K_m (d - h) \quad (10.5)$$

The normal component of the grinding force $F_n$ required to remove the depth-of-cut $h$ is:

$$F_n = K_c h \quad (10.6)$$

where $K_c$ is the "cutting stiffness." (See Eq. (1.19).) Since those 2 forces are equal and opposed:

$$K_c h = K_m (d - h) \quad (10.7)$$

* See Nomenclature in Chapter 1.