## 8. Practical Consequences

The theory implies some optimum strategies for hydraulic rock cutting, and they will serve as an appropriate conclusion.

Suppose the requirement is to make the deepest possible cut with a single pass of a water jet. The feed rate should be low according to (28) but not necessarily infinitesimal. The depth is sufficiently close to the asymptotic maximum (29) when v is perhaps one-third c. For a coefficient of Coulomb friction $\mu_w = 0.42$, the bracketed term in (29) reaches a softly defined maximum at an impingement angle $\theta_o = 150°$. The conditions for maximum penetration can be summarized as follows:

$$\left.\begin{aligned} 0 < v \lesssim (1/3)c \ , \\ \theta_o = 150° \ , \\ h_{max} = 1.01 \frac{d_o P_o}{\tau_o} \ . \end{aligned}\right\} \tag{33}$$

Under normal impingement, $\theta_o = 90°$, the coefficient in the third member of (33) is 0.67, so the oblique impingement offers a 50% improvement in slot depth. In machinist's terminology, the jet should be set at a <u>high positive rake</u>, which forces it to swing through a large angle and cut deep. Note that shear strength $\tau_o$ is the only material property regulating $h_{max}$.

It is possible to imagine situations in which h would be important, but usually multiple passes would permit cuts of any depth. When multiple passes are feasible, then the quantity of most importance is hv, <u>the slot area created per unit time</u>. It pays to raise the feed rate v as long as hv increases, because any degradation of h can be made up by multiple passes. According to (28), the rate of area creation hv rises monotonically with v toward the asymptote implicit in (30). For practical purposes v need not be more than four times c and must not be so large that the critical pressure $P_c$ of (25) exceeds $P_o$. For $\mu_w = 0.42$, the conditions that maximize the rate of slot-area creation are as follows:

$$\left.\begin{aligned} (4)c \lesssim v \lesssim (0.42\ P_o/\tau_o - 1)c \ , \\ \theta_o \rightarrow 180° \ , \\ (hv)_{max} = 1.47 \frac{k d_o P_o}{\mu_r g} \ . \end{aligned}\right\} \tag{34}$$