the basic relation of Equation 2, and a nomogram for calculating the parameters

$$\frac{X}{A_0} \quad \text{and} \quad \frac{V_x}{V_c} \quad \text{from} \quad \frac{X}{\sqrt{A_c}} \quad \text{and} \quad \frac{V_x}{V_0}$$

through R_{fa} and C_d is given in the same illustration.

The variation of the centerline velocity ratio with distance from outlet, or more properly, from start of jet expansion, is also shown on Fig. 3 for

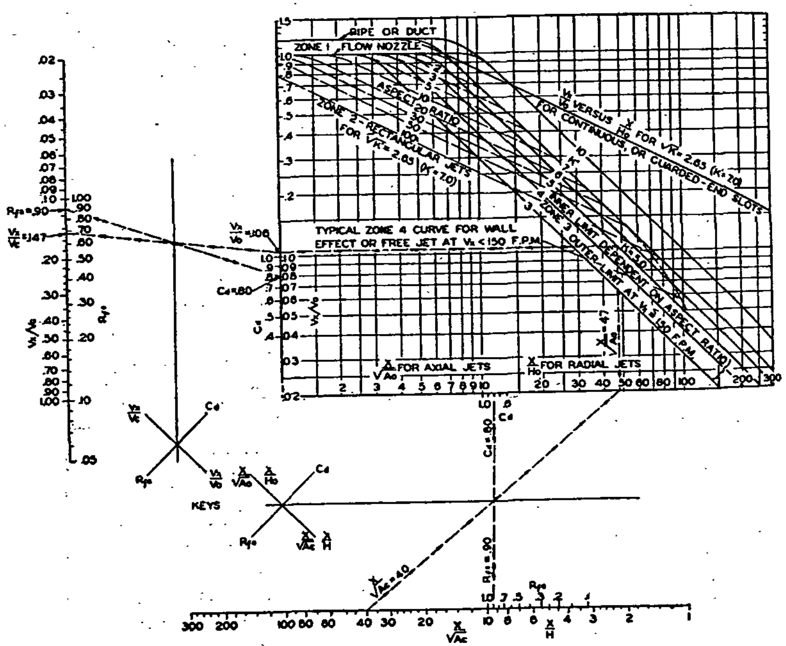

Fig. 3. Chart for Determining Centerline Velocities of Axial and Radial Jets

Zones 1 and 2. V_x/V_0 is plotted against X/H_0 and, for a range of aspect ratios, against $X/\sqrt{A}$ for the single value of $K' = 7.0$. Values of V_x/V_0 for other values of K' may be obtained by direct proportioning of $\sqrt{K'}$ to $\sqrt{7.0}$.

The following *Example 1* which is solved on Fig. 3 will illustrate the use of the chart.

Example 1: A grille has a core area 12 in. x 18.75 in., $R_{fa} = 0.90$, $C_d = 0.80$, and $K' = 5.0$. Find V_c (velocity through core area) when V_x is 50 fpm for throw of 50 feet ($X = 50$).

Solution:

$$A_c = \frac{12 \times 18.75}{144} = 1.56 \text{ sq ft}$$

$$\frac{X}{\sqrt{A_c}} = \frac{50}{1.25} = 40$$

$$A_0 = 1.56 \times 0.80 \times 0.90 = 1.123$$

$$\frac{X}{\sqrt{A_0}} = \frac{50}{1.06} = 47.2$$

$$\frac{V_x}{V_0} = \frac{K'\sqrt{A_0}}{X} = \frac{5\sqrt{1.123}}{50} = 0.106$$

$$\frac{V_x}{V_c} = \frac{V_x}{V_0(C_d R_{fa})} = \frac{0.106}{0.80 \times 0.90} = 0.147$$

For $V_x = 50$,

$$V_c = \frac{50}{0.147} = 340 \text{ fpm.}$$

The quantity of air discharged is then,

$$Q = V_c A_c = 340 \times 1.56 = 530 \text{ cfm.}$$

Throw

Equation 2a can be used to determine the *throw* X of an outlet, if the discharge volume and the center velocity are known.

$$X = \frac{K'}{V_x} \cdot \frac{Q}{\sqrt{A_c \times C_d \times R_{fa}}} \qquad (4)$$

or, if

$$Z = \sqrt{C_d \times R_{fa}}$$

$$X = \frac{K'}{V_x} \cdot \frac{Q}{Z\sqrt{A_c}} \qquad (4a)$$

The maximum throw L is usually defined as the distance from the outlet face where the centerline velocity is 50 fpm. Therefore, for $V_x = 50$ fpm,

$$L = X = \frac{K'}{50} \cdot \frac{Q}{Z\sqrt{A_c}} \qquad (4b)$$

Velocity Profiles of Jets

In Zone 3 of both axial and radial jets, the velocity distribution may be expressed by a single curve (Fig. 4) in terms of dimensionless coordinates, and this same curve can be used as a good approximation for adjacent portions of Zones 2 and 4. Experiments have shown that temperature and density differences have but a small effect on cross-sectional velocity profiles.

Velocity distribution in Zone 3 can be expressed by the Gauss error-function or probability curve which is approximated by a simple equation using common logarithms

$$\left(\frac{r}{r_{0.5}}\right)^2 = 3.3 \log \frac{V_x}{V} \qquad (5)$$

where

r = the radial distance of the point under consideration from the centerline of the jet.