Today, we will:

- Continue our discussion about **hood suction velocities** and **isopleths**
- Discuss **capture velocity** and **capture of particles** in **Section 6.1**
- Do some example problems – capture velocity
- Do Candy Questions for Candy Friday

Example: Circular inlet without a flange (plain circular inlet:

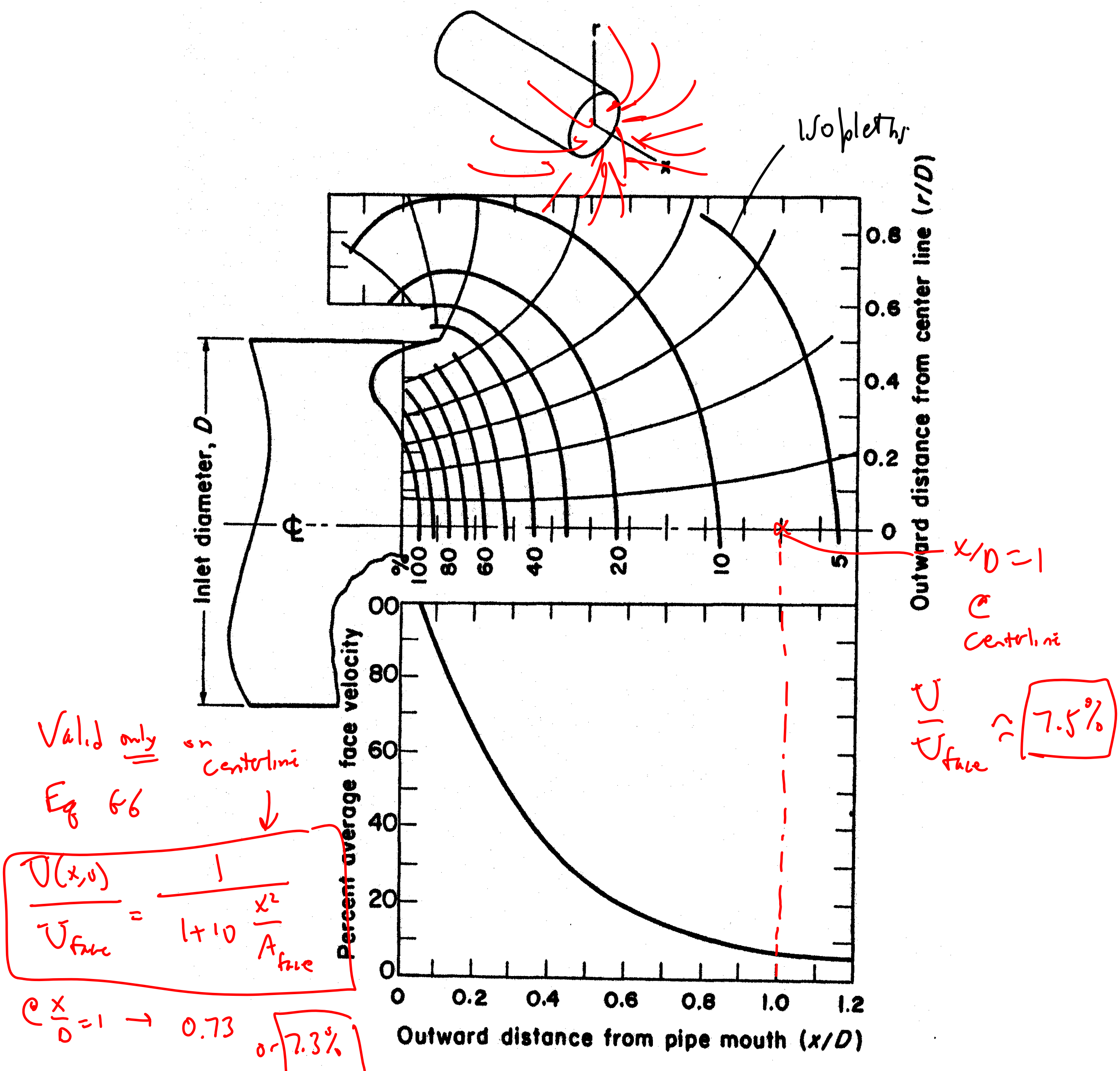


Figure 6.9 Velocity isopleths (curves of constant U/U_{face}, %) and decay of $U(x,0)/U_{face}$ (along the centerline, %) for a plain circular opening (adapted from ASHRAE HVAC Applications Handbook, 1995).

Example: Circular inlet with a flange (flanged inlet):

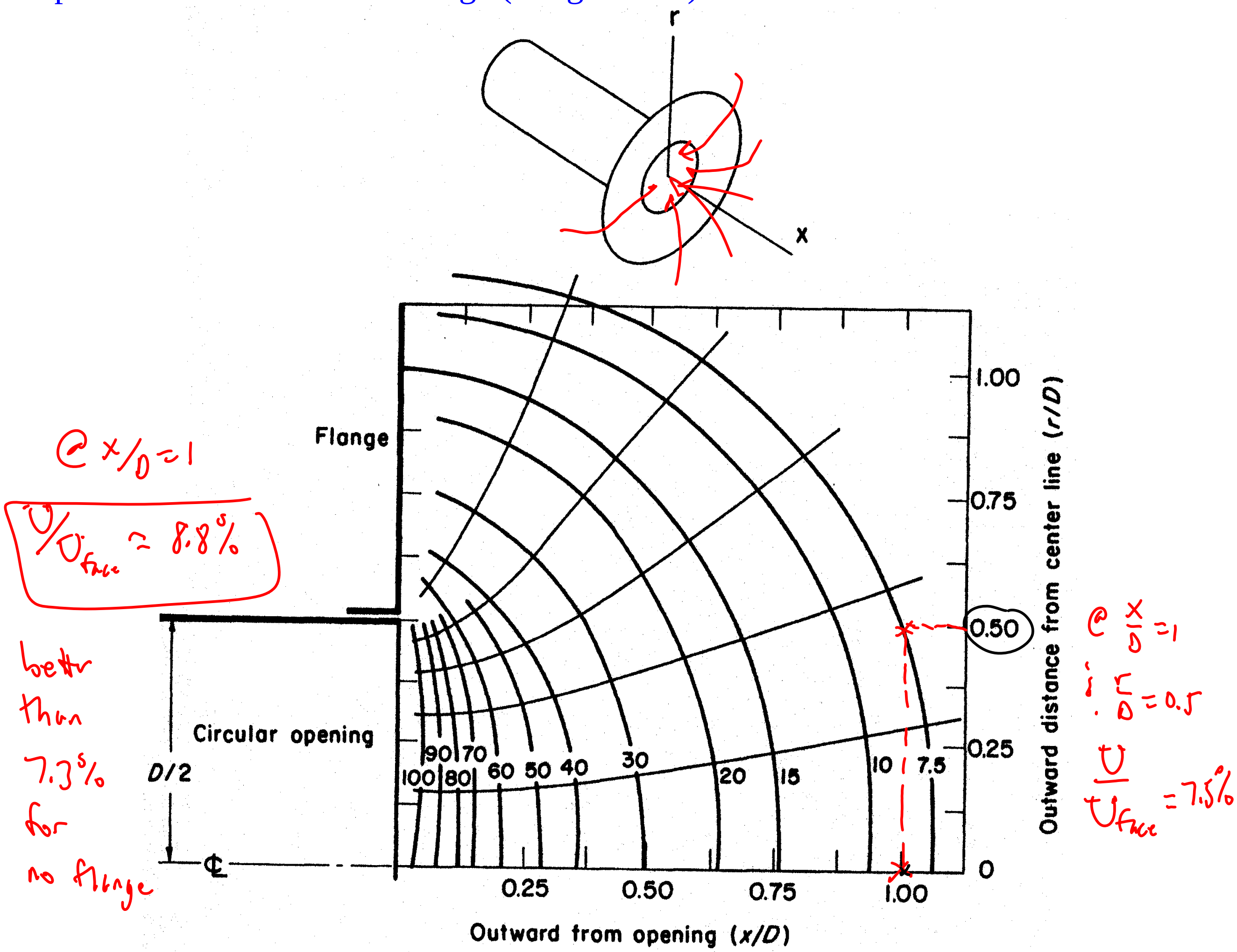


Figure 6.10 Velocity isopleths (curves of constant U/U_{face}, %) for a flanged circular opening (adapted from ASHRAE HVAC Applications Handbook, 1995).

Sec. 6.1 — Particle Capture

Capture Velocity = V_c = velocity magnitude required to "capture" a contaminant particle & suck it into the hood

There is a range of V_c for various activities that produce particles

See Table 6.1

Capture velocity, v_c:

Table 6.1 Capture velocities (abstracted from ACGIH, 2001).

characteristics of contaminant emission	examples	capture velocity (FPM)
1. contaminant enters quiescent air with negligible velocity	degreasing tank, evaporation	50-100
2. contaminant enters slightly moving air with a low velocity	welding, vessel filling	100-200
3. contaminant actively generated and enters rapidly moving air	spray painting, stone crushers	200-500 ft/min
4. contaminant air enters rapidly at high velocity	grinding, abrasive blasting	500-2000

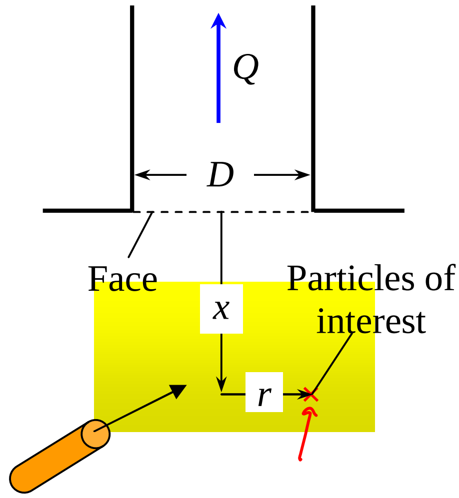
Lower values of capture velocity:

- room air movement minimal or conducive to capture
- contaminants of low toxicity
- intermittent use or low production rates
- large hood and large mass of air moved

Upper values of capture velocity:

- adverse room air movement
- contaminants of high toxicity
- heavy use and high production rates
- small hood and small mass of air moved

Given: A flanged round inlet is used as a hood to capture overspray particles from spray painting. The hood inlet (face) diameter is 0.50 m. The spray paint region of concern extends to x = 0.50 m (axially) and r = 0.25 m (radially) as sketched.



To do: Calculate the range of required volume flow rate through the hood.

Solution:

capture velocity

Table 6.1 → $V_c = 200$ to 500 ft/min

Set $\mathcal{U} = V_c = 200$ ft/min to 500 ft/min

($\mathcal{U}$ → air velocity at the location of interest)

Fig. 6.10 → @ $\frac{x}{D} = \frac{0.5}{0.5} = 1.0$; $\frac{r}{D} = \frac{0.25}{0.5} = 0.5$

@ $\frac{x}{D} = 1$; $\frac{r}{D} = 0.5$ → $\frac{\mathcal{U}}{\mathcal{U}_{face}} = 7.5\% = 0.075$

$$Q = \mathcal{U}_{face} A_{face}$$

$$= \frac{\mathcal{U}}{\mathcal{U}/\mathcal{U}_{face}}\left(\frac{\pi}{4}D^2\right) = \frac{V_c}{\mathcal{U}/\mathcal{U}_{face}}\frac{\pi}{4}D^2 =$$

Range from $V_c = 200$ to 500 ft/min

@ 200 ft/min $\quad Q = \frac{200 \text{ ft/min}}{0.075}\frac{\pi}{4}(0.5\text{ m})^2\left(\frac{1\text{ ft}}{0.3048\text{ m}}\right)^2$

$$= 5636 \text{ ft}^3/\text{min}$$

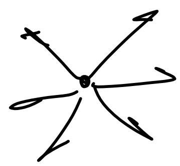
$$\cong 5600 \text{ CFM}$$

@ 500 ft/min $\quad Q = 14000$ CFM

← Range of Q required

Fundamental Problem with this technique

- We are using **only** the magnitude of particle velocity (speed)



nothing is said about **direction** of particle motion.

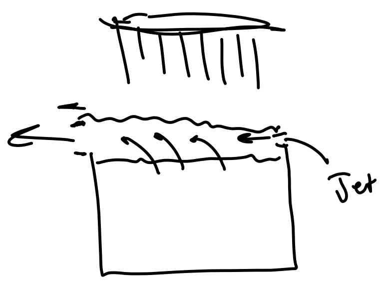
- V_c values are conservative — worst case scenario

Reach → The size of the region in front of an inlet that is capable of drawing contaminants into the inlet.

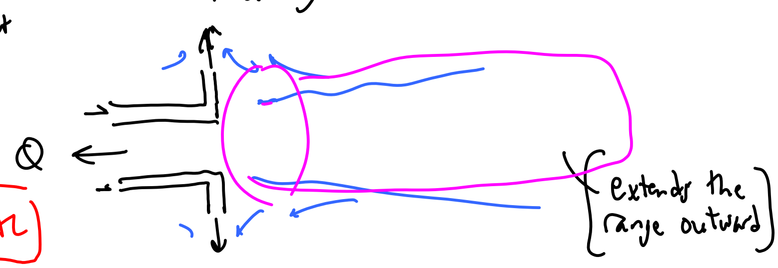
Problem with inlets & hoods → Reach is much smaller than we desire

"Candle problem"

If the contaminant is buoyant, we put the hood on **top** & it helps tremendously



Aaberg inlet – see **text**



★ END OF EXAM 2 MATERIAL