Today, we will:

- "Skim" **Design Plates** in **Section 6.3**, and the **ACGIH Ventilation Manual**
- "Skim" **Bulk Materials Handling** in **Section 6.4**
- "Skim" **Canopy Hoods** in **Section 6.5**
- "Skim" **Air Curtains for Buoyant Hoods** in **Section 6.6**
- Discuss **Unsatisfactory Performance** in **Section 6.9**
- Discuss **Exhaust Duct System Design** in **Section 6.10**

Sec. 6.3 → Design Plates → drawings for hoods of various kinds

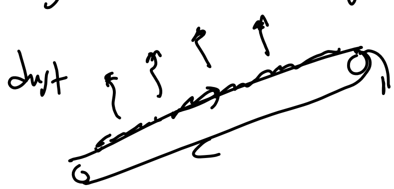
ACGIH vent. manual is the "bible" of HVAC engineers

Sec 6.4 → Bulk Materials Handling

terminology → Point Source Emissions → emissions from a well-defined location (e.g. a chimney or "stack")

Fugitive emissions → emissions from vaguely defined locations

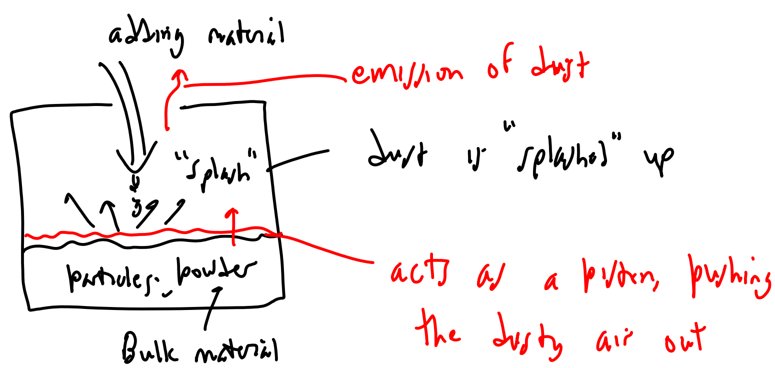
eg conveyor belts in a quarry



How to control? — Add a cover

— Spray with water

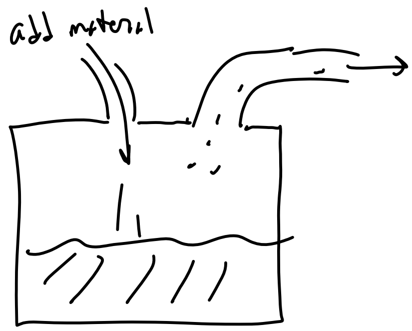
Tank filling:



Analysis is same as with filling tank with liquid

Namely — <u>Displacement effect</u>

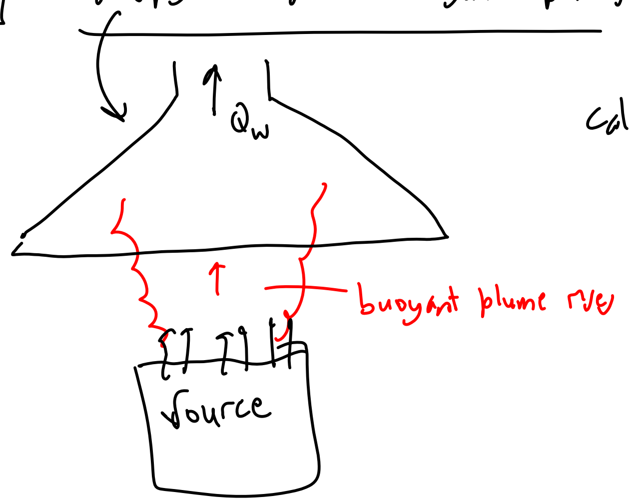
Control it with a vacuum system



Q_w = withdrawal volume flow rate

See book for semi-empirical eq's for Q_w, etc

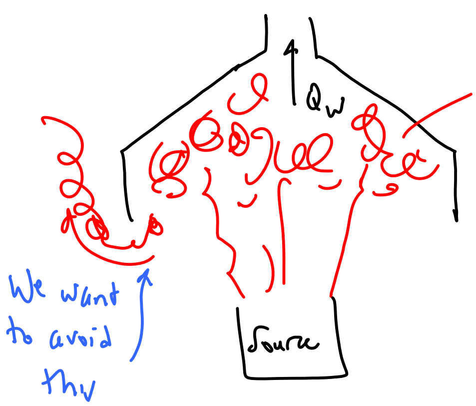
$\boxed{\text{Sec. 6.5}}$ — Canopy hoods & buoyant plumes



calc. Q_w based on semi-empirical eq's

Surges sometimes occur → how to handle

If we design the hood with a large volume, we can handle surges.

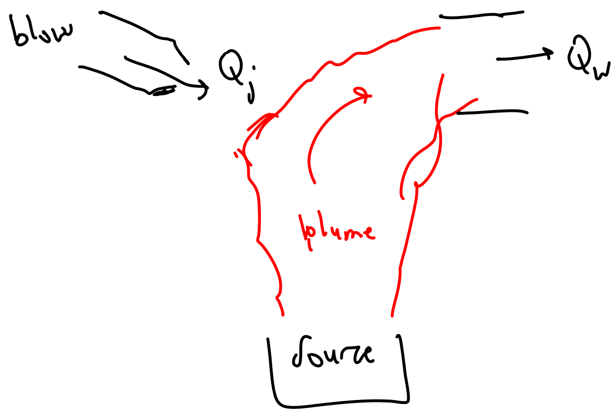


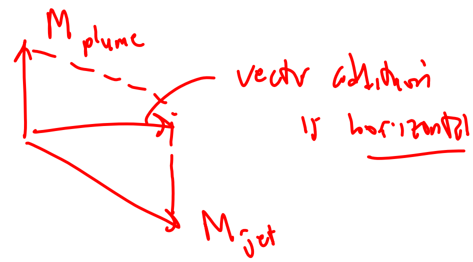
Idea is to have a large enough V to hold all the smoke from a surge.

Then — slowly remove it

$\boxed{\text{Sec. 6.6}}$ – Air curtain for buoyant plumes

→ Similar to the "push-pull" system discussed previously





Sec's 6.7 & 6.8 – skip

$\boxed{\text{Sec. 6.9}}$ – Mostly qualitative – Unsatisfactory Performance

real world problems – hoods do not always work the way they are designed

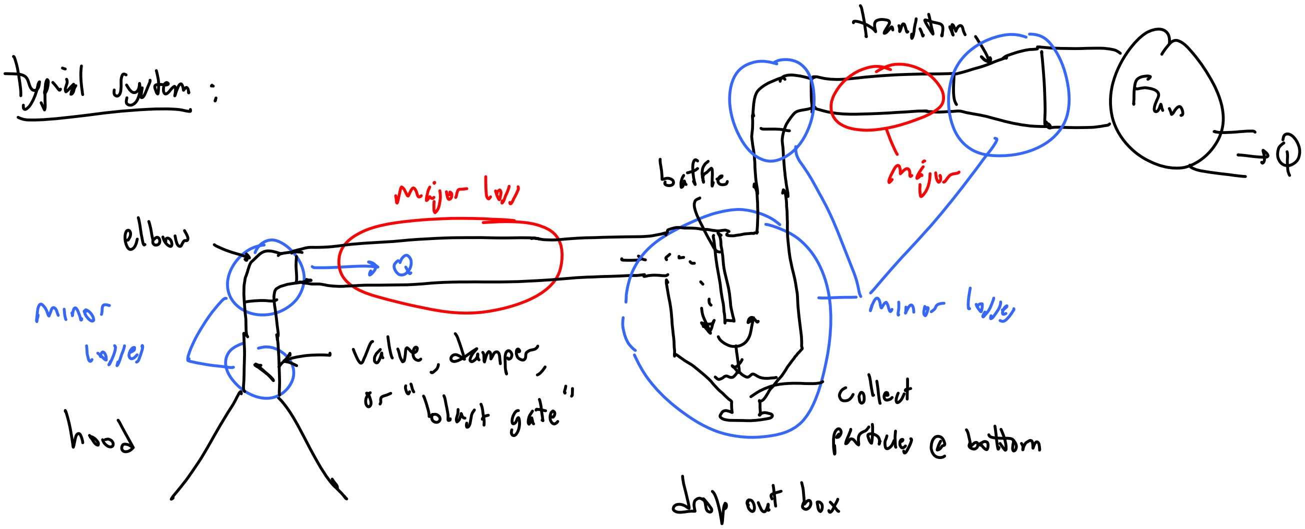
- spurious air currents
- blocked inlets or blocked ducts
- leaks
- inadequate make-up air (as previously

etc.

SEC. 6.10 Exhaust Duct System Design

[Mostly review of ME 33 or equiv. (fluid mechanics)]

typical system:

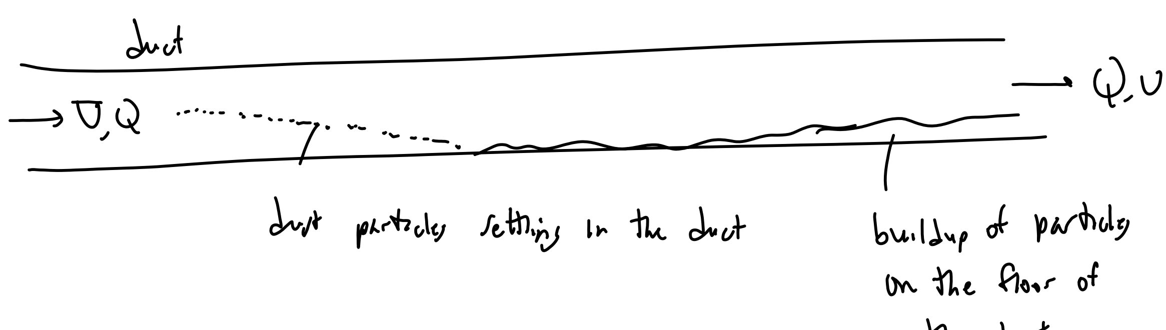


Just as in ME 33, there are major losses & minor losses

major losses: due to long, straight sections of duct (use Moody chart or Colebrook eq.)

minor losses: due to everything else (elbows, drop-out boxes, transitions, valves, etc.) (use loss coefficients)

Additional problems when we have dusty (particle-laden) flow



There is a minimum duct transport velocity to keep particles from settling

Particle build-up in ducts is bad because:

1) Can clog the duct → if restrict the flow area, it slows down the flow! (acts like a valve)

[eg. dryer hose]

2) Structural problems (too much weight)

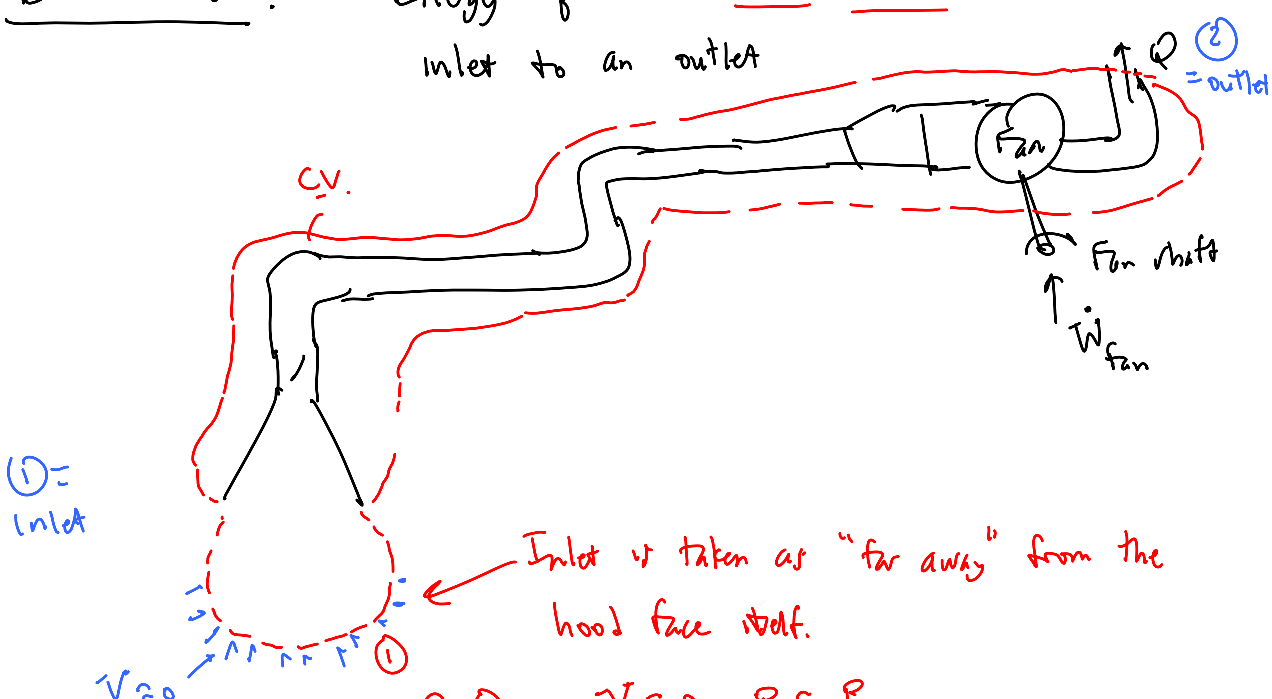
3) Possibility of explosions

For vapors in ducts — also can cause problems

1) Usually vapors are generated hot, then condense on the cold duct walls

2) conc. usually high in duct → can have explosions etc.

EQUATIONS: Energy eq. for a control volume from an inlet to an outlet



@ ① → $V \approx 0$, $P \approx P_{room}$

Head form of the energy eq. for Steady-State, Steady Flow (SSSF)

$$\left(\frac{P_1}{\rho g} + \alpha_1 \frac{V_1^2}{2g} + z_1\right)_{inlet} = \left(\frac{P_2}{\rho g} + \alpha_2 \frac{V_2^2}{2g} + z_2\right)_{outlet} + \cancel{h_{turbine}} - h_{\cancel{pump}} + \sum h_{losses}$$

no turbines

"fan"

Generally, kinetic energy factors are ignored (set $\alpha_1 = \alpha_2 = 1$)

(major + minor losses)

Notation:

$$\boxed{\underbrace{\delta P_{fan}}_{\text{pressure rise through the fan}} = \rho g \underbrace{h_{fan}}_{\text{fan head}}}$$

ρ_{air}

But, δP is usually listed in catalogs as inches of water

Be careful not to confuse ρ_{air} & ρ_{water}