

Advanced Building Science

- Duct Systems
 - Basics
 - Fans
 - Air-Diffusing Equipment
- Readings
 - HF Chapter 21 (focus on 21.7 to 21.17)
 - RVS Handout Chapter 2 (pages 6 – 12)

Duct Systems

Duct Systems

– Basics

- pressure
- losses (frictional & dynamic)
- design methods

– Fans

- principles, definitions, testing
- fan laws
- fan types and selection

– Air-diffusing equipment

- supply air outlets
- outlet selection and location
- noise control

Duct Pressure

- Total pressure is a measure of the total energy available
 - always decreases in the direction of the airflow
- Total pressure = velocity pressure + static pressure
 - static and velocity pressures are mutually convertible
- Helpful Notes
 - Velocity in fpm = $144 * \text{airflow rate in cfm/area}$
 - Circular equivalents of rectangular ducts
 - most systems are designed for round and then converted
 - Flow becomes laminar in straight duct after 6 to 10 duct diameters

Duct Losses

- Frictional Losses
 - in smooth straight duct pressure drop is caused by friction
- Dynamic Losses
 - a loss in pressure in excess of a straight duct due to eddy effects
 - flow disturbances caused by fittings that change flow direction or area
 - entries, exits, transitions, junctions

Duct Design

- Convey air as directly as possible at permissible velocities
 - see recommended duct velocities
- Avoid sudden changes in direction or velocity (area)
- For greatest air handling capacity per unit area use aspect ratio of 4 to 1 or less
- Ducts should be smooth (steel/aluminum sheet metal)
- In actual installations, resistances and airflows may vary considerably -- provide a small factor of safety
- Avoid obstructing ducts with pipes, conduit, or structural members

Duct Design Methods

- Key principles
 - energy required to move air is the change in total pressure
 - the total pressure is the sum of the static and velocity pressures
 - the total pressure always decreases in the direction of flow
 - if multiple branches, the loss in total pressure is the same in each
 - static pressure and velocity pressure are mutually convertible
- Common design methods
 - equal friction method
 - velocity reduction method
 - static regain method

Fans

- Two main fan types
 - centrifugal – well suited to higher pressure
 - axial - well suited for higher flow
- Fan testing
 - tested from shutoff to free delivery
 - fan curves
- Fan selection
 - manufacturer's fan performance curve

Air Diffusers

- Supply air outlets
 - grille
 - slot diffuser
 - ceiling diffuser
 - perforated panels
- Returns
 - grilles (typically very simple)

Air Diffusers

- Outlet selection and location
 - determine amount of air supplied to each room
 - select type and quantity of outlets for each room (air flow, throw)
 - locate outlets to distribute air as uniformly as possible
 - select proper outlet size (air flow, discharge velocity, sound levels)
- Noise is function of discharge velocity & systemic noise
 - both are dependent on area and configuration

In Summary

Questions and Discussion

Next Class

- Ventilation
 - Ventilation Overview
 - Key Concepts
 - Ten Ways to Ventilate
 - Good Design and Installation
- Readings
 - HF: Chapter 16.17 to 16.31
 - RVS Handout: Chapter 1 & 2