Skill Development Exercises for Chapter 12

12-1. In the example you worked through in this chapter, you were told this is "an intermediate floor" of the multi-story office building. Assuming that the layout and use of each floor is the same and excluding the basement, would you expect the loads to be the same on each floor?

a) Yes b) No c) Inadequate information to make an assumption

Answer: b

The top floor has a roof above it instead of a conditioned floor, so you can expect the loads to be higher on the top floor. The main floor will have entrances, so additional conditioning is likely needed on this floor.

12-2. Due to a serious design error, you are being pressured to dramatically reduce the main duct sizes. You are asked how much the ducts would be reduced in size if the system were designed to provide the supply air at 41°F instead of 54°F while retaining the space design temperature of 75°F. As an example, you suggest that a 16 × 24 in. duct could be reduced to _____ although the insulation thickness may need to be increased.

a) 12 × 12 in. b) 16 × 12 in. c) 16 × 16 in. d) 16 × 20 in. e) 16 × 30 in.

Answer: c

The initial temperature difference is 75°F - 54°F = 21°F. With a 41°F supply, the temperature difference is 75 - 41 = 34°F. Therefore, the required flow wil be 21/34 or 62%. The 16 × 16 in. duct is about 66% in size.

12-3. One open area in the example office floor will be used initially for general storage and printing, with a room load of 17 Btu/h·ft^2. In the future, it will be developed for special use, but no layout has been established and no ceiling is to be installed at this stage. The ceiling is the flat concrete floor above and temporary sidewall diffusers blowing across the space will be used. Knowing the tenant organization, you believe part of the space will be used as temporary office space before any fitting out is done. Therefore, you want to choose sidewall grilles that will provide reasonable comfort. Using the table below, which range of T_{50}/L would you choose?

a) 0.8 to 2.2 b) 1.5 to 2.1 c) 0.9 to 1.8

Air Diffusion Performance Index (ADPI) Selection Guide

Terminal Device	Room Load (Btu/h·ft^2)	T_{50}/L for Max. ADPI	Maximum ADPI	For ADPI Greater Than	Range of T_{50}/L
High Sidewall Grilles	80	1.8	68	-	-
	60	1.8	72	70	1.5 - 2.2
	40	1.6	78	70	1.2 - 2.3
	20	1.5	85	80	1.0 - 1.9

Answer: c

The heat load is just below the tabulated data, so ideal ADPI will be slightly below.

12-4. Due to a misunderstanding, the electrician has run a conduit across the route for your main supply duct. The sheet metal contractor can narrow the 8,000 cfm, 24 × 24 duct down to 24 × 18 to get past the conduit by using a fitting. The fitting coefficient is 0.3. You tell the owner that it can be done at the slightly less cost than having the electrician reroute the conduit. However, as the system will be running 24 hours a day all year and electricity costs are already $0.12 per kWh, the ductwork change will add $___ to the annual electricity bill, as this problem adds to the total resistance of the ductwork system.

a) $51 b) $96 c) $133 d) $171

Answer: d

Duct velocity is 8000/(2×2) = 2000 fpm

Velocity pressure = $(2000/4005)^2$ = 0.25 in.

Pressure drop = velocity pressure × coefficient = 0.25 × 0.3 = 0.075

Approximate extra fan kW = cfm × static pressure / 3680

= (8000 × 0.075) / 3680 = 0.163 kW

Extra cost = kW × hrs running × electricity rate = 0.163 × 365 × 24 × 0.12 = $171

12-5. You are in a design office and notice a chart pinned on the wall (see below). What pressure drop (in. wg/100 ft) was used to produce this chart? (Use *Figure 12-5.*)

a) 0.1/100 b) 0.08/100 c) 0.05/100 d) 0.2/100 e) 0.4/100

Duct Size (in.)	Max. Flow (cfm)
6	120
8	250
10	440
12	700
14	1100

Answer: a

The duct size and flow pairs of values are all on the 0.1 in./100 ft line.

12-6. You are designing a dead-end length of supply duct to provide air at regular intervals in a pedestrian tunnel between the office and somewhat dirty manufacturing buildings. The architect would like an unpainted galvanized steel spiral steel duct with diffusers mounted from it. You warn the architect that:

a) The unpainted surface will attract dust.

b) The unsealed duct will likely produce dirt smudging at joint leaks making it look bad.

c) The leakage of air will reduce the conditioning air in the tunnel.

Answer: b

The surface will have little effect on dust collection. The leakage will act exactly the same as the air from the grilles in conditioning the tunnel. Leakage at the joints will cause eddying of the surrounding dusty are, which will cause smudging around the joint leaks.

12-7. The system is working well and a near-peak design day is experienced. You are showing a visitor round the control room and they ask why the return temperature is up at 78°F when the system is meant to be maintaining 75°F. You explain that:

a) Unfortunately, this was a lowest bid DDC system and the sensor accuracy is not particularly good or reliable.

b) The air from the occupied spaces at 75°F gets warmed by heat from the lights between the occupied spaces and the return air sensor at the air-handling unit inlet.

c) The energy from the supply fan increases the return temperature several degrees.

Answer: b

12-8. You are in a design office and notice a chart pinned on the wall (see below). What limiting velocity was used to produce the chart? (Use *Figure 12-5.*)

a) 1000 fpm b) 1500 fpm c) 2000 fpm d) 2500 fpm e) 3000 fpm

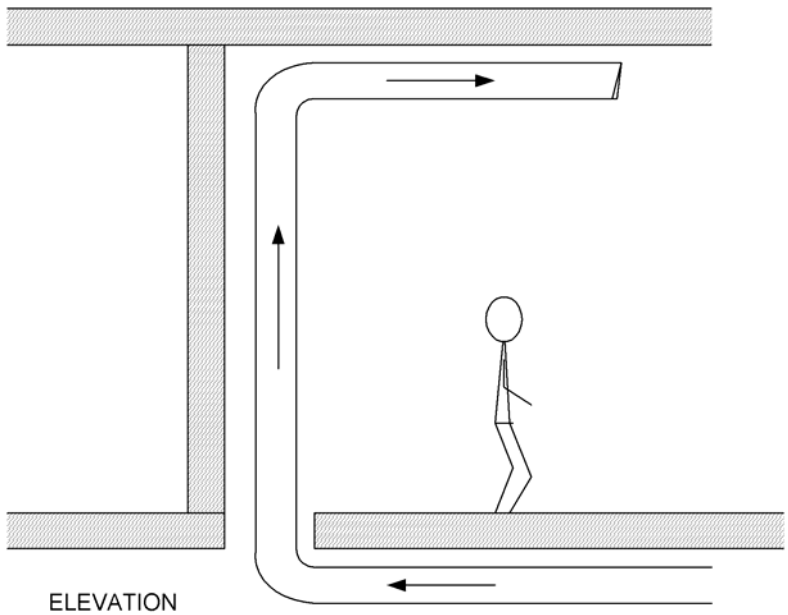
Duct Size (in.)	Max. Flow (cfm)
28	11,000
30	12,000
32	15,000
36	18,000

Answer: d

Each point at a size and flow are on the 2500 fpm line.

12-9. An 18 in. high × 36 in. wide supply duct carrying 4500 cfm runs along the ceiling before turning upwards to rise a floor and run back along the corridor above (see below). What is the total pressure loss in the pair of smooth elbows assuming they are type CR3-1 smooth radius elbow fittings with r/W of 1.5?

a) 0.00875 in. wg b) 0.0125 in. wg c) 0.0175 in. wg d) 0.025 in. wg



Answer: c

The fitting width (W) is actually the height, 18 in. Be careful, because the fittings are labeled for horizontal ductwork. In this case, H/W = 36/18 = 2. With r/W = 1.5 and H/W = 2, the coefficient is 0.14. The air velocity is (4500 × 144)/(18 × 36) = 1000 fpm. The pressure drop across two fittings is $2 \times 14 \times (1000/4000)^2$ = 0.0175 in. wg.