

جامعة تكريت

قسم الميكانيك

كلية الهندسة

محاضرة تصميم الدكت للفصل الدراسي الثاني المرحلة الرابعة

المادة: تكييف وتثليج التاريخ ٢٦ نيسان ٢٠٢١

Example: Find The Dimension of the Air duct and the total pressure drop for the building shown in the figure below if the building has the following data:

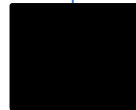
And the maximum height of the duct (70 cm) , T supply equal to 15 °C and the outdoor and indoor temperatures 40 & 20 °C respectively.

Room	Flower Area(m ²)	Room Height(m)	Number of Persons	Qs	Ventilation Rate
Office	200	3	40	20	12 L/s. Person
Corridor	90	3	—	3	2 Air Change/hr
W.c	50	3	—	2	20 L/s.m ²

Office	Corridor	W.c
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10 m 10 m 10 m

20 m 15 m 40 m



Solution:

1-Office

$V = \text{No of Persons} \times V_p$

$$= 40 \times 12 = 480 \text{ L/s} = 0.48 \text{ m}^3/\text{s}$$

$$Q_v = 1.21 \times V \times (T_{od} - T_{id})$$

$$= 1.21 \times 0.48 \times (40 - 20)$$

$$= 11.52 \text{ kW}$$

$$Q_{\text{Office}} = Q_s + Q_v$$

$$= 20.0 + 11.52 = 31.52 \text{ kW}$$

$$Q_{\text{Office}} = 1.21 \times V_{\text{Office}} \times (T_{id} - T_s)$$

$$V_{\text{Office}} = 31.52 / (1.21 \times (20 - 15))$$

$$\text{Air Flow rate } V_{\text{Office}} = 5.21 \text{ m}^3/\text{s} \text{ (*1000)} = 5210 \text{ L/s}$$

2 -Corridor

$$\dot{V} = 2 \times 90 \times 3 \times 1000 / 3600$$

$$= 150 \text{ L/s} = 0.15 \text{ m}^3/\text{s}$$

$$Q_v = 1.21 \times V \times (T_{od} - T_{id})$$

$$Q_v = 1.21 \times 0.15 \times (40 - 20)$$

$$= 3.63 \text{ kW}$$

$$Q_{\text{Corridor}} = Q_s + Q_v$$

$$= 3.0 + 3.63$$

$$= 6.63 \text{ kW}$$

Air Flow rate

$$Q_{\text{Corridor}} = 1.21 \times V_{\text{Corridor}} \times (T_{id} - T_s)$$

$$V_{\text{Corridor}} = 6.63 / (1.21 \times (20 - 15))$$

$$\text{Air Flow rate } V_{\text{Corridor}} = 1.095 \text{ m}^3/\text{s} (*1000) = 1095 \text{ L/s}$$

3 -Water Cycle W.c

$$\dot{V} = 20 \times 50 = 1000 \text{ L/s} = 1.0 \text{ m}^3/\text{s}$$

$$Q_v = 1.21 \times 1.0 \times (40 - 20)$$

$$= 24.2 \text{ kW}$$

$$Q_{W.c} = Q_s + Q_v$$

$$= 2.0 + 24.2$$

$$Q_{W.c} = 26.2 \text{ kW}$$

Air Flow rate

$$Q_{W.c} = 1.21 \times V_{w.c} \times (T_{id} - T_s)$$

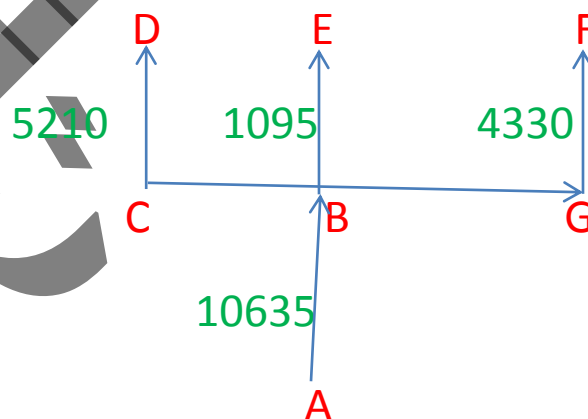
$$V_{w.c} = 26.2 / (1.21 \times (20 - 15))$$

$$= 4.33 \text{ m}^3/\text{s} \text{ (*1000)} = 4330 \text{ L/s}$$

$$\text{Total Air Flow rate } V_{\text{Total}} = V_{\text{Office}} + V_{\text{Corridor}} + V_{w.c}$$

$$V_{\text{Total}} = 5210 + 1095 + 4330$$

$$V_{\text{Total}} = 10635 \text{ L/s}$$



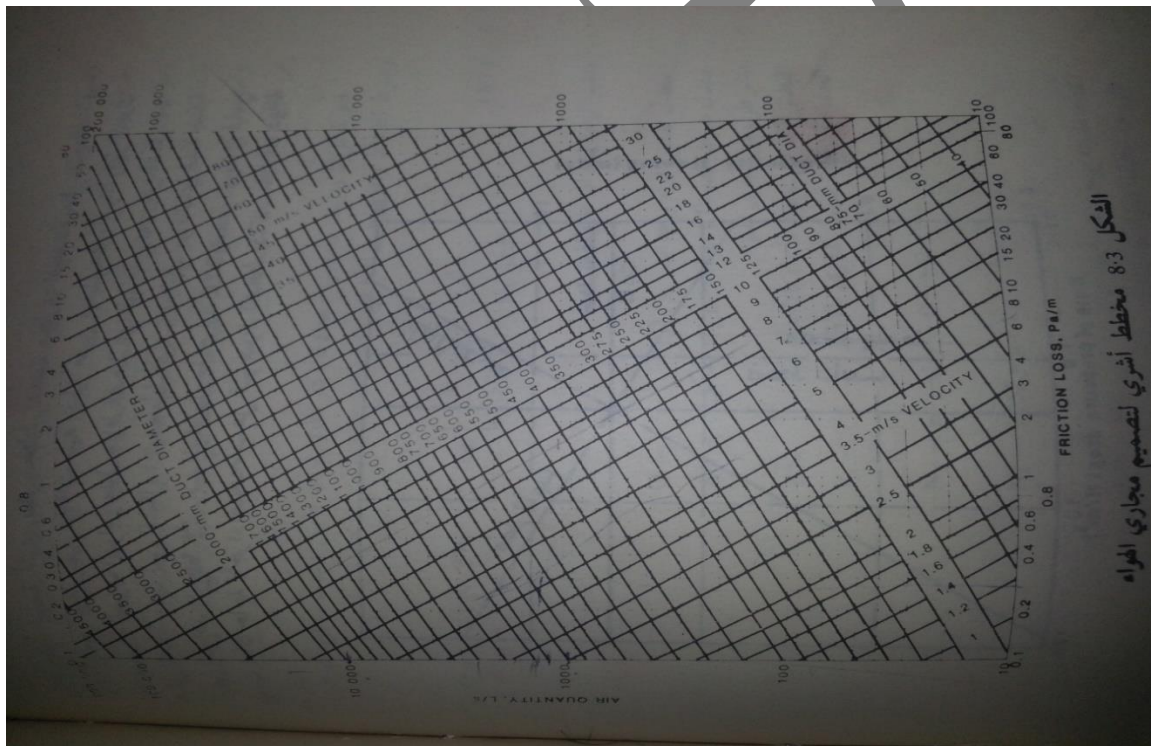
جدول 8.3 تحويل لقطع الدائري الى مستطيل مكافئ.

$$\text{Equivalent diameter} = (1.30) \left[\frac{\text{height} \times \text{width}}{1.0625} \right]$$

$$\left[\frac{\text{height} \times \text{width}}{1.0625} \right]$$

Width m	Height, m																								
	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00	1.10	1.20	1.30	1.40	1.50	1.60	1.70	1.80	1.90	2.00	2.20	2.40	2.60	2.80	3.00	
0.20	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00	1.05	1.10	1.15	1.20	1.25	1.30	1.35	1.40
0.30	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00	1.05	1.10	1.15	1.20	1.25	1.30	1.35	1.40	1.45
0.40	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00	1.05	1.10	1.15	1.20	1.25	1.30	1.35	1.40	1.45	1.50	1.55
0.50	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00	1.05	1.10	1.15	1.20	1.25	1.30	1.35	1.40	1.45	1.50	1.55	1.60	1.65
0.60	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00	1.05	1.10	1.15	1.20	1.25	1.30	1.35	1.40	1.45	1.50	1.55	1.60	1.65	1.70	1.75
0.70	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00	1.05	1.10	1.15	1.20	1.25	1.30	1.35	1.40	1.45	1.50	1.55	1.60	1.65	1.70	1.75	1.80	1.85
0.80	0.75	0.80	0.85	0.90	0.95	1.00	1.05	1.10	1.15	1.20	1.25	1.30	1.35	1.40	1.45	1.50	1.55	1.60	1.65	1.70	1.75	1.80	1.85	1.90	1.95
0.90	0.85	0.90	0.95	1.00	1.05	1.10	1.15	1.20	1.25	1.30	1.35	1.40	1.45	1.50	1.55	1.60	1.65	1.70	1.75	1.80	1.85	1.90	1.95	2.00	2.05
1.00	0.95	1.00	1.05	1.10	1.15	1.20	1.25	1.30	1.35	1.40	1.45	1.50	1.55	1.60	1.65	1.70	1.75	1.80	1.85	1.90	1.95	2.00	2.05	2.10	2.15
1.10	1.05	1.10	1.15	1.20	1.25	1.30	1.35	1.40	1.45	1.50	1.55	1.60	1.65	1.70	1.75	1.80	1.85	1.90	1.95	2.00	2.05	2.10	2.15	2.20	2.25
1.20	1.15	1.20	1.25	1.30	1.35	1.40	1.45	1.50	1.55	1.60	1.65	1.70	1.75	1.80	1.85	1.90	1.95	2.00	2.05	2.10	2.15	2.20	2.25	2.30	2.35
1.30	1.25	1.30	1.35	1.40	1.45	1.50	1.55	1.60	1.65	1.70	1.75	1.80	1.85	1.90	1.95	2.00	2.05	2.10	2.15	2.20	2.25	2.30	2.35	2.40	2.45
1.40	1.35	1.40	1.45	1.50	1.55	1.60	1.65	1.70	1.75	1.80	1.85	1.90	1.95	2.00	2.05	2.10	2.15	2.20	2.25	2.30	2.35	2.40	2.45	2.50	2.55
1.50	1.45	1.50	1.55	1.60	1.65	1.70	1.75	1.80	1.85	1.90	1.95	2.00	2.05	2.10	2.15	2.20	2.25	2.30	2.35	2.40	2.45	2.50	2.55	2.60	2.65
1.60	1.55	1.60	1.65	1.70	1.75	1.80	1.85	1.90	1.95	2.00	2.05	2.10	2.15	2.20	2.25	2.30	2.35	2.40	2.45	2.50	2.55	2.60	2.65	2.70	2.75
1.70	1.65	1.70	1.75	1.80	1.85	1.90	1.95	2.00	2.05	2.10	2.15	2.20	2.25	2.30	2.35	2.40	2.45	2.50	2.55	2.60	2.65	2.70	2.75	2.80	2.85
1.80	1.75	1.80	1.85	1.90	1.95	2.00	2.05	2.10	2.15	2.20	2.25	2.30	2.35	2.40	2.45	2.50	2.55	2.60	2.65	2.70	2.75	2.80	2.85	2.90	2.95
1.90	1.85	1.90	1.95	2.00	2.05	2.10	2.15	2.20	2.25	2.30	2.35	2.40	2.45	2.50	2.55	2.60	2.65	2.70	2.75	2.80	2.85	2.90	2.95	3.00	
2.00	1.95	2.00	2.05	2.10	2.15	2.20	2.25	2.30	2.35	2.40	2.45	2.50	2.55	2.60	2.65	2.70	2.75	2.80	2.85	2.90	2.95	3.00			
2.20	2.15	2.20	2.25	2.30	2.35	2.40	2.45	2.50	2.55	2.60	2.65	2.70	2.75	2.80	2.85	2.90	2.95	3.00							
2.40	2.35	2.40	2.45	2.50	2.55	2.60	2.65	2.70	2.75	2.80	2.85	2.90	2.95	3.00											
2.60	2.45	2.50	2.55	2.60	2.65	2.70	2.75	2.80	2.85	2.90	2.95	3.00													
2.80	2.55	2.60	2.65	2.70	2.75	2.80	2.85	2.90	2.95	3.00															
3.00	2.65	2.70	2.75	2.80	2.85	2.90	2.95	3.00																	
3.20	2.75	2.80	2.85	2.90	2.95	3.00																			
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3.60	2.95	3.00																							
3.80	3.05																								
4.00	3.15																								

The table used to find **Duct Dimensions**



The table used to find **ΔP Pa/m**

$$U_{\text{Maximum}} = 7.5 \text{ m/s}$$

Constant Pressure Drop Method

$$\Delta P/L = 0.35 \text{ Pa/m}$$

Section	V or Q (L/s)	D (mm)	U m/s	H (mm)	W (mm)
AB	10635	1370	7.5	700	2400
BCD	5210	1050	6.3	700	1400
BGF	4330	1000	6	700	1200
BE	1095	575	4.3	600	700

$$\Delta P_{\text{Total}} = \Delta P_L + \Delta P_F$$

$$\Delta P_L = (40 + 15 + 10) \times \Delta P/L$$

$$= 65 \times 0.45$$

$$= 29.25 \text{ Pa}$$

$$\Delta P_F = \Delta P_{\text{tee ABG}} + \Delta P_{\text{elbo G}}$$

$$= (k_e \times k_T \times 0.6 \times U^2) + (K_e \times 0.6 \times U^2)$$

$$\text{Let } k_e = 0.67 \text{ \& } k_T = 0.825$$

$$= (0.67 \times 0.825 \times 0.6 \times (7.5^2)) + (0.67 \times 0.6 \times (6^2))$$

$$= 34.605 \text{ Pa}$$

$$\Delta P_{\text{Total}} = \Delta P_L + \Delta P_F$$

$$\Delta P_{\text{Total}} = 29.25 + 34.605$$

$$\Delta P_{\text{Total}} = 63.855 \text{ Pa}$$

شماره ۱۰۰