DEKET

Engineering Data

اطلاعات مهندسی

INTRODUCTION

It's a unique challenge for mechanical engineers to design and select the air distribution items. the selection and choice of air distribution equipment involves product efficiency to meet space requirement as well as architectural features which compliment the interior design in the modern HVAC system, the wrongly chosen air outlets lead to failure of the entire HVAC system.

The considerations while doing a perfect and competitive selection of air outlet are occupant comfort, energy conservation, air quality and the cost. It is the foremost purpose of this Air Distribution Engineering section . The details provided in this section are referred from ASHRAE Handbooks and standards.

TERMINOLOGY

Grille: A covering for any area through which air passes.
Register: A grille equipped with a damper or control valve.
Diffuser: An outlet discharging supply air in various directions and planes.
Slotted outlet: A long narrow air distribution outlet comprised of deflecting members; located in the ceiling, side wall or sill with an aspect ratio greater than 10.Designed to distribute supply air in varying directions and planes and arranged to promote mixing of primary air and secondary room air.
Return: An outlet for return or exhaust air.
Damper: A device used to control the volume of air passing through an outlet or inlet.
Aspect ratio: Ratio of the length to the width of rectangular opening.
Free area= Effective area: Total minimum area of the opening in air outlet through which air can pass.
Throw: The horizontal or vertical axial distance an air stream travels after leaving an air outlet before the maximum stream velocity is reduced to a specified terminal velocity (e.g., 50, 100, 150, or 200 fpm) defined by ASHRAE standard 70.
Terminal velocity: The maximum air stream velocity at the end of the throw.
Primary air: The air coming directly from the outlet.
Secondary air: The room air which is picked up and carried along by the primary air.
Total air: Mixture of primary and secondary air.
Stratified zone: A region in which room air velocity is less than 0.075m/sec (15FPM).
Draft: Undesired local cooling of a body caused by low temperature and movement of air.
Isothermal jet: Air jet with the same temperature as the surrounding air.
Non isothermal jet: Air jet with an initial temperature different from the surrounding air
Jet velocity = Face velocity = Outlet velocity: The average velocity of air passing from the outlet , measured in the plane of the opening.

RECOMMENDED NOISE CRITERIA FOR ROOMS AND FACE VELOCITY

TYPE	SPACE	NR LEVEL	RECOMMENDED FACE VELOCITY m/s	(F.P.M)
Auditoriums And Music Halls	Concert and Opera Halls, Studios for sound reproduction	20-25	2.5	(500)
	Legitimate Theatres, Multi-Purpose Halls	25-30	2.5-3.75	(500-750)
	Movies theatres, Lectures Halls, Planetarium, TV Audience Studios	30-35	2.5-3.75	(500-750)
	Lobbies	35-45	2.5-5.0	(500-1000)
Churches And Schools	Sanctuaries	20-30	2.5-3.75	(500-750)
	Libraries, schools and classrooms	30-40	2.5-5.0	(500-1000)
	Laboratories	35-45	2.5-5.0	(500-1000)
	Recreation halls, corridors and halls	35-50	2.5-6.5	(500-1300)
Offices	Boardroom	20-30	2.5-3.75	(500-750)
	Executive office	30-40	2.5-5.0	(500-1000)
	Conference rooms	25-35	2.5-3.75	(500-750)
	General Open offices	35-50	2.5-6.5	(500-1300)
	Halls and corridors, computer room	35-55	2.5-6.5	(500-1300)
Hospitals And Clinics	Intensive care wards, Private room	25-35	2.5-3.75	(500-750)
	Hospitals wards, Operating room	30-40	2.5-5.0	(500-1000)
	Waiting rooms and reception areas	35-45	2.5-5.0	(500-1000)
	Wash rooms and toilets	40-50	3.0-6.5	(600-1300)
Hotels/ Motels	Individual Rooms, suites or Ball Rooms	30-40	2.5-5.0	(500-1000)
	Halls, corridors, Lobbies	35-40	2.5-5.0	(500-1000)
	Kitchen and laundries, bars and lounges	40-50	3.0-6.5	(600-1300)
Public	Public Libraries, museums, court rooms Post offices, Banking Areas, Department Stores, Restaurants, Night Clubs, Bowling	30-40	2.5-5.0	(500-1000)
	Alleys, Gymnasiums	35-45	2.5-5.0	(500-1000)
	Cocktail Lounges	35-50	2.5-6.5	(500-1300)
Transportation	Ticket sales offices	30-40	2.5-5.0	(500-1000)
	Lounges, Waiting Rooms	35-50	2.5-6.5	(500-1300)
Stores Retail	Clothing Stores, Department Stores (upper floor)	35-45	2.5-5.0	(500-1000)
	Department Stores (main floor), small Retail Stores, Supermarkets	40-50	3.0-6.5	(600-1300)
Factory Areas	Light maintenance shops, Assembly lines	40-50	3.0-6.5	(600-1300)
	Office area, control room	40-50	3.0-6.5	(600-1300)
	Heavy industrial processing	60-75	6.5-10.0	(1300-2000)

Outdoor Air Required for Ventilation*

OCCUPANCY	CFM PER PERSON
Spaces in which there is no smoking AUDITORIUMS CHURCHES THEATERS	5 TO 7.5
Spaces in which there is moderate smoking BARBER SHOPS BEAUTY PARLORS FUNERAL PARLORS OPEN SPACES IN BANKS RETAIL SHOPS	7.5 TO 10
APARTMENTS DRUGSTORES HAVING LUNCH COUNTERS HOSPITAL ROOMS HOTEL ROOMS OPEN SPACES IN GENERAL OFFICES RESTAURANTS AND PUBLIC DINING ROOMS	10 TO 15
Spaces in which there is heavy smoking BROKERS BOARD ROOMS DIRECTORS ROOMS NIGHT CLUBS PRIVATE OFFICES TAVERNS AND COCKTAIL BARS	20 TO 30

* TRAIN

Recommended and Maximum Duct Velocities for Conventional Systems**

Designation	Recommended Velocities, Fpm		
	Residences	Schools, Theaters, Public Buildings	Industrial Buildings
Outdoor Air Intakes[a]	500	500	500
Filters[a]	250	300	350
Heating coils[a]	450	500	600
Air Washers	500	500	500
Fan Outlets	1000-1600	1300-2000	1600-2400
Main Ducts	700-900	1000-1300	1200-1800
Branch Ducts	600	600-900	800-1000
Branch Risers	500	600-700	800
	Maximum Velocities, Fpm		
Outdoor Air Intakes[a]	800	900	1200
Filters[a]	300	350	350
Heating Coils[a]	500	600	700
Air Washers	500	500	500
Fan Outlets	1700	1500-2200	1700-2800
Main Ducts	800-1200	1100-1600	1300-2200
Branch Ducts	700-1000	800-1300	1000-1800
Branch Risers	650-800	800-1200	1000-1600

[a] These velocities are for total face area, not the net free area; other velocities in table are for net free area.

** ASHRAE

Recommended Return Grilles Velocities *

GRILLE LOCATION	F.P.M. Over Cross Area
Commercial	
Above occupied zone	800 and above
Within occupied zone not near seats	600-800
Within occupied zone near seats	400-600
Door or wall louvers	500-1000
Undercutting of doors	600 [a]
Industrial	800 and above
Residential	400

*Carrier
[a] Thru undercut area

Weight of duct material **

Gauge	Galvanized steel u.s. gauge		Aluminum B&S gauge		Stainless steel u.s. gauge	
	Thickness mm	Weight Kg/m^2	Thickness mm	Weight Kg/m^2	Thickness mm	Weight Kg/m^2
28	-----	-----	-----	-----	0.41	3.227
26	0.56	4.43	-----	-----	0.48	3.863
24	0.71	5.653	0.51	1.408	0.64	5.134
22	0.86	6.875	0.64	1.736	0.79	6.406
20 [a]	1.00	8.098	0.81	2.229	0.97	7.726
18	1.32	10.543	1.01	2.812	1.27	10.269
16	1.63	12.988	1.3	3.540	1.6	12.861
14	2.00	16.044	1.62	4.469	2.00	16.039
12	-----	-----	1.80	5.037	-----	-----

** ASHRAE

Recommended construction for *** Rectangular sheet-metal Ducts (Low pressure)

Duct Dimension Inch	Galvanized mm	Aluminum mm
UP Thru 12	0.5	0.6
13 Thru 30	0.6	0.7
31 Thru 54	0.75	0.85
55 Thru 84	1.00	1.25
Over 84	1.25	1.40

*** BUILDING NATIONAL REGULATIONS

Check Figures for Cooling Estimates.*

Classification		Sensible-Heat factor			Grand total heat[a]			Room sensible heat[a]			Square feet per person			Watts per square foot			Tons per person			Cfm per Square foot		
		Low	Avg	High	Low	Avg	High	Low	Avg	High	Low	Avg	High	Low	Avg	High	Low	Avg	High	Low	Avg	High
Apartments and hotel guest rooms		0.80	0.84	0.94	13	20	30	9	12	17	100	175	325	0.2	0.6	0.9	0.446	0.58	0.72	0.5	0.7	0.9
Art museums and libraries		0.73	0.83	0.90	30	51	75	20	35	45	40	60	80		1.0	2.0	0.12	0.23	0.40	0.92	1.6	2.1
Banks (not incl. private offices)		0.75	0.83	0.88	35	54	75	21	38	48	40	59	80	0.87	1.5	2.3	0.135	0.258	0.405	1.1	2.0	2.5
Dept. stores	Basement	0.65	0.73	0.85	24	34	39	16	21	26	20	25	30	0.79	1.9	2.1	0.066	0.113	0.126	0.75	1.0	1.2
	Main floor	0.72	0.80	0.88	26	40	60	18	30	43	16	25	44	1.43	3.0	5.1	0.078	0.106	0.145	0.85	1.4	2.0
	Upper floors	0.74	0.82	0.94	24	31	40	16	21	26	39	56	73	1.19	1.9	3.0	0.104	0.125	0.227	0.75	1.0	1.2
Hotels-public spaces		0.74	0.82	0.89	32	53	74	20	36	46	40	58	78	0.85	1.2	2.2	0.13	0.24	0.41	0.92	1.7	2.1
Office buildings		0.84	0.91	0.93	23	36	52	19	26	37	81	110	130	0.83	1.66	2.6	0.204	0.283	0.389	1.0	1.3	1.9
Offices-small suites		0.82	0.89	0.93	33	45	64	24	33	43	49	73	128	0.53	1.44	3.4	0.195	0.308	0.463	1.2	1.7	2.2
Restaurants		0.65	0.72	0.80	90	118	155	40	52	80	13	15	17	1.50	1.7	2.0	0.121	0.164	0.225	1.8	2.4	3.7
Specialty Shops	Beauty and barber	0.69	0.80	0.91	50	76	117	33	56	90	25	41	46	2.72[b]	5.1[b]	9.3[b]	0.140	0.262	0.392	1.5	2.6	4.2
	Dress	0.70	0.796	0.85	35	43	65	20	26	35	30	40	50	0.74	1.77	3.5	0.087	0.143	0.271	0.9	1.2	1.6
	Drug	0.66	0.72	0.79	67	88	109	40	50	65	17	23	35	1.00	1.83	2.5	0.180	0.198	0.24	1.8	2.3	3.0
	5¢ and 10¢	0.65	0.725	0.825	35	55	100	15	31	42	15	24	36	1.14	2.5	5.4	0.075	0.102	0.168	0.7	1.4	2.0
	Hat	0.72	0.79	0.86	38	45	65	22	28	40	30	40	50	0.75	1.8	2.7	0.088	0.145	0.273	1.0	1.3	1.9
	Shoe	0.74	0.795	0.877	40	55	80	26	35	45	19	30	50	1.20	1.80	3.0	0.100	0.146	0.185	1.2	1.6	2.1
Theaters and auditoriums		0.65	0.70	0.722	635[c]	667[c]	707[c]	325[c]	363[c]	385[c]	6.06	7.63	8.65				0.053	0.055	0.059	15[d]	20[d]	30[d]

Notes: [a] Btu per hour per square foot. [b] Total wattage for lights and equipment. [c] Btu per hour per seat. [d] Cfm per seat.

* Modern Air Conditioning, Heating, and Ventilating

Unit Conversions

Length	1 in = 25.4 mm 1 ft = 0.3048 m					
Area	1 in^2 = 645.16 mm^2 1 ft^2 = 0.0929 m2					
Volume	1 in^3 = 16387 mm^3 1 ft^3 = 0.0283 m^3 1 UK gallon (liquid) = 4.546 litre 1 US gallon (liquid) = 3.785 litre					
Mass	1 ounce (av) = 28.3 (gramme) 1 gr (grain) = 0.0648 g 1 lb = 0.4536 kg					
Force	1 lbf = 0.4536 kp 1 lbf = 0.00445 kN 1 kp = 0.00981 kN					
Pressure		Lbf/in^2	Lbf/ft^2	kg/m^2	$KPa=KN/m^2$	Torr =mm Hg
	1lbf/in^2 =	1	144	703	6.895	51.71
	1lbf/ft^2 (psf) =	0.00694	1	4.882	0.04788	0.36
	1 kg/m^2 =	0.00142	0.2048	1	0.00981	0.0736
	1kPa =1 kN/m^2 =	0.145	20.556	102	1	7.50
	1Torr = mmHg =	0.0193	2.78	13.59	0.133	1
Density	1 lb/ft^3/pcf = 16.018 kg/m^3					
Energy		Btu	Kcal	KJ	kWh	
	1 Btu =	1	0.252	1.055	0.00029	
	1 kcal =	3.968	1	4.187	0.001163	
	1 KJ =	0.948	0.239	1	0.000278	
	1 kWh =	3412	860	3600	1	
Thermal conductivity		Btu/ft hF	Btu in/ft^2hF	Kcal/m hK	W/m K	
	1 Btu/ft hf =	1	12	1.488	1.73	
	1 Btu in/ft^2 hF =	0.0833	1	0.124	0.144	
	1 kcal/m hK =	0.672	8.064	1	1.163	
	1 W/m K =	0.578	6.933	0.860	1	
Thermal conductance		Btu/ft^2 hF	Btu in/ft^2 hF	Kcal/m^2 hK	W/m^2 K	
	1 Btu/ft hF =	1	144	703	818	
	1 Btu in/ft^2 hF =	0.0694	1	4.882	5.678	
	1 kcal/m hK =	0.00142	0.2048	1	1.163	
	1 W/m K =	0.00122	0.1761	0.860	1	
Heat flow	1 Btu/ft h = 0.8268 kcal/m 1 Btu/ft h = 0.9615 W/m 1 kcal/m h = 1.163 W/m 1 Btu/ft^2 h = 2.712 kcal/m^2H 1 Btu/ft^2 h = 3.155 W/m^2 1 kcal/m^2 h = 1.163 W/m^2					
Temperature	°F=9/5° C + 32 °C=5/9 (° F-32)					