Air-Conditioning & Refrigeration

BSc

Lecture 13

Course weekly Outline &

Ch. (Introduction to Air conditioning & Refrigeration)

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Chapter Four: Cooling load calculations:

Cooling load is the rate at which heat must be removed to maintain the temperature and humidity required at design values through :
Structural components ,
Windows ,
Infiltration ,
Occupants and appliances .

4.1 : Cooling load through structural components :

The Cooling Load Temperature Difference (CLTD) method will be used to calculate the structural components load .This method combine the effect of the temperature difference between indoor and outdoor , solar radiation and considered thermal capacity of the enclosure .

$Q = U A (CLTD)$ where :

U : overall heat transfer coefficient
A : area of wall ,roof ,or glass
CLTD : cooling laod temperature difference given in tables for walls ,roofs and glass

4.2 : Cooling loads through windows:

Q = A SHG SF CLF , where :

Solar Heat Gain (SHG) includes effects of both transmission and solar radiation ,
SF is the shade factor ,
CLF is the cooling load factor.

4.3 : Cooling load through partitions ,ceiling , and floor :

$Q = U A \Delta T$ where ΔT is ~~the adjacent space temperature~~ given by

$\Delta T = \frac{5}{3}(T_o - T_r)$ summer

4.4 : Cooling load due to ventilation and infiltration :

$Qs = \rho . V . c_p (T_o - T_i) = 1.22 \dot{V}_{flow} (T_o - T_r)$

$Ql = 2500 \rho V_{flow} (W_o - W_i) = 2940 \dot{V}_{flow} (W_o - W_r)$

$Qtotal = \rho V_{flow} (h_o - h_i) = 1.2 \dot{V}_{flow} (h_o - h_r)$

$\dot{V}_{flow} = \dot{V}_{out}$

Where : V_{flow} is the ventilation requirements from standard tables .

4.5: Internal cooling load due to occupants , lights and appliances :

People :
Q = 70 W/person or from tables according to activities .
Qs =N * (sensible heat gain) * CLF
Ql = N * (latent heat gain)

Where N is the number of people in the space and , CLF is cooling load factor .

Lights :

$Q_{elc} = W F_u F_s CLF$, where : W is the watts input of the light , F_u is lighting use factor , F_s is special allowance factor.

Power :

$Q_p = P\ E_f\ CLF$ where P is power rating , E_f is efficiency factor .

Appliances :
Q = 470 W for both kitchen and laundry for single family
Q = 350 W for multi-family
For latent cooling load calculate for individual components or estimate as 30% Q_s .
OR :
Qs = sensible heat gain * F_u
Ql = latent heat gain * F_u

~~Examples~~

4.6 Applications

Six examples. lecture (9 & 10/11)

Load of Partitions

$Q = U_p \cdot A_p \times \Delta T$

$\Delta T = \frac{2}{3}(T_o - T_r)$ for summer

$\Delta T = \frac{1}{2}(T_r - T_o)$ for Winter

OUT SIDE DESIGN CONDITION DATA FOR IRAQ

(MECHANICAL SEC.)

No.	CITIES	LOCATION	ACTUAL LATITUDE °N	APPROX. LATITUDE °N	LONGITUDE °E	ELEVATION ABOVE MSL* M	SUMMER			WINTER	
							D.B. °C	R.H. %	DAILY RANGE °C	D.B. °C	R.H. %
1	SALAHADDIN	NORTH	36° 23′	35°	44° 13′	1088	37.5	23	11.4	-0.5	50
2	SINJAR		36° 19′		41° 50′	538	39.5	17	12.5	1.5	78
3	MOUSLE		36° 19′		43° 09′	222.6	44	18.5	21.2	0.5	92
4	SULAIMANIYA		35° 33′		45° 27′	853	40	15	15	-1.5	77
5	KIRKUK		35° 28′		44° 24′	330.8	44	14	16	3	81
6	AKA	MIDDLE	34° 28′	33°	41° 57′	138.5	43	21	17.6	1	66
7	KHAKAQIN		34° 18′		45° 26′	202.2	45	15	18.4	3	81
8	HADITHA		34° 04′		42° 22′	108	43.5	15	18	1	93
9	HABBANIYA		33° 22′		43° 34′	43.6	44	17	18.3	7.5	85
10	BAGHDAD		33° 14′		44° 14′	34.1	45	15	18.7	1.5	84
11	RUTBA		33° 02′		40° 17′	615.5	40	15	17.3	0.5	82
12	HAI		32° 10′		46° 03′	14.9	45	18.5	17.9	4	84
13	NAJAF	SOUTH	32° 01′	31°	44° 19′	50	45.5	14	17	4	82
14	DIWANIYA		31° 59′		44° 59′	20.4	44.5	19.5	19.3	3.5	80
15	AMARA		31° 51′		47° 10′	7.5	45	16	19	4.5	80
16	SAMAWA		31° 18′		45° 16′	6	45	14	13.5	4.5	86
17	NASIRIYA		31° 05′		46° 14′	3	45	18	18.4	4.5	79
18	BASRAH		30° 34′		47° 47′	2.4	43	38	15	5.5	89

*MEAN SEA LEVEL °F = $\frac{9}{5}$°C + 32°