University of Technology
Engineering Department of Building and Construction
Final Exam-First attempt 2012-2013

Subject: Building services **Year: Fourth**
Division: Construction Engineering and Management **Time: 180min.**
Examiner: Assist prof.Haider Alwash **Date :24 6 /2013**

Answer FIVE Questions Only

Note: - All tables must be return with exam. papers

Q1): Design the cold water pipes for the public building shown in fig.(1) when the street main head (105)ft, head of critical fixture (8)ft, the height of critical fixture (6)ft, gage loss (7)ft , and the minor losses (25%) of the pipes length , system uses (Flash Tank) . (20Mark)

Q2) :- A) Use the Equivalent pipe method and Design the cold water pipes shown in figure (1). (10Mark)

B) Design the Sprinkler system for the factory of (100x48) m2, ordinary hazard with standard arrangement and center with central feed. (10Mark)

Q3):- Design the Sanitary drainage and Vent pipes System for the plumbing system shown in figure (2). (20Mark)

Q4):- Calculate the coefficient of transmission (U) of masonry wall and the rate of heat loss and temperature drop through the section of the wall and the position of dew point. The outdoor temperature (zero) F, indoor temperature (70) F, the construction of the wall are:-

Construction	Resistance(R)
Rso	0.17
Face brick (4in)	0.39
Cement mortar	0.1
Concrete block	1.11
Air space	0.97
Gypsum lath (3/4 in)	0.32
Rsi	0.68

(20Mark)

Q5) :- A) A building contains electrical loads :- (10K.V.A lead) with power factor (0.6) and (5K.V.A lag) with power factor (0.7) , single phase (220V),Calculate:- (10Mark)

1) Over all power factors. 2) Total current.

3) Design the cable required, if the distance (30m) and the cable clipped direct to a surface.

B) Use zonal cavity calculation and design the ceiling lightings for large business office (100x60x8) ft ,use luminaries type (10),(125 foot candles),reflectance of ceiling 80%,floor 30%,wall 30%, working plane (36) in., Maintenance factor (0.67), Correction factor (1.08). (10Mark)

Q6):- According to the data shown in fig. (3).Calculate the max. number of person in the room and ventilation rate per person and the capacity of air condition.

(20Mark)

Good Luck

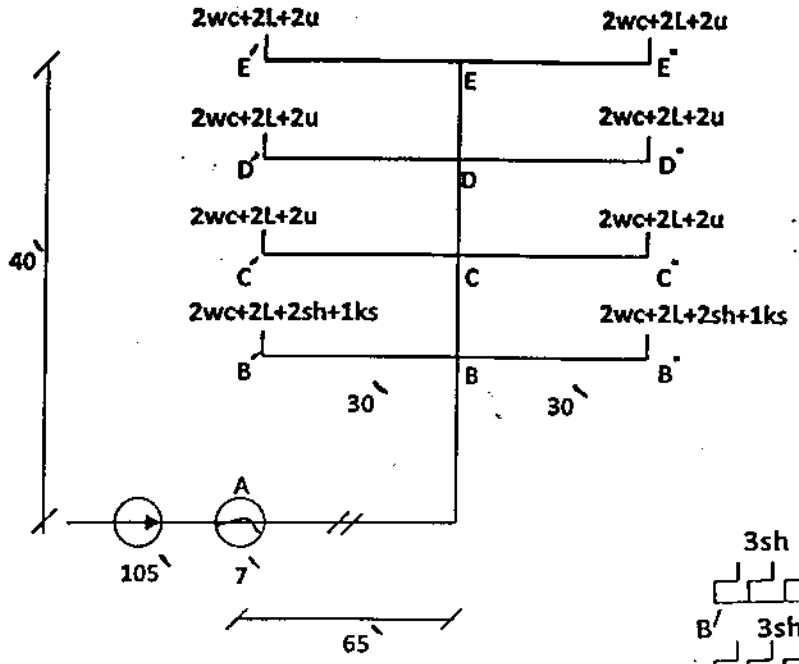


Fig.(1)

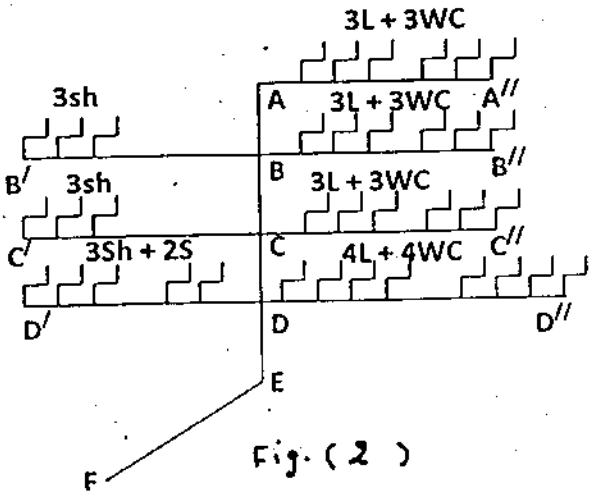


Fig.(2)

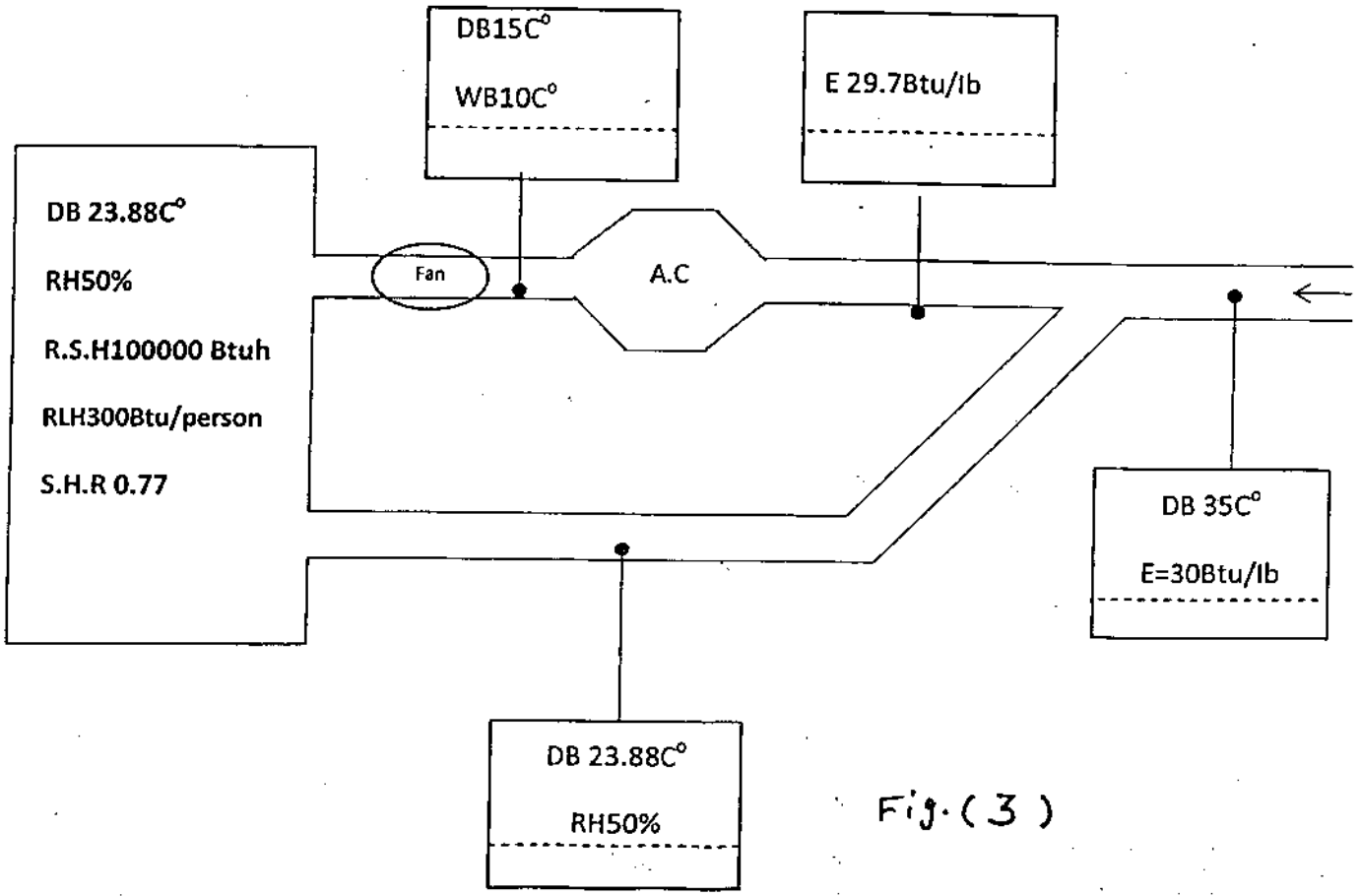
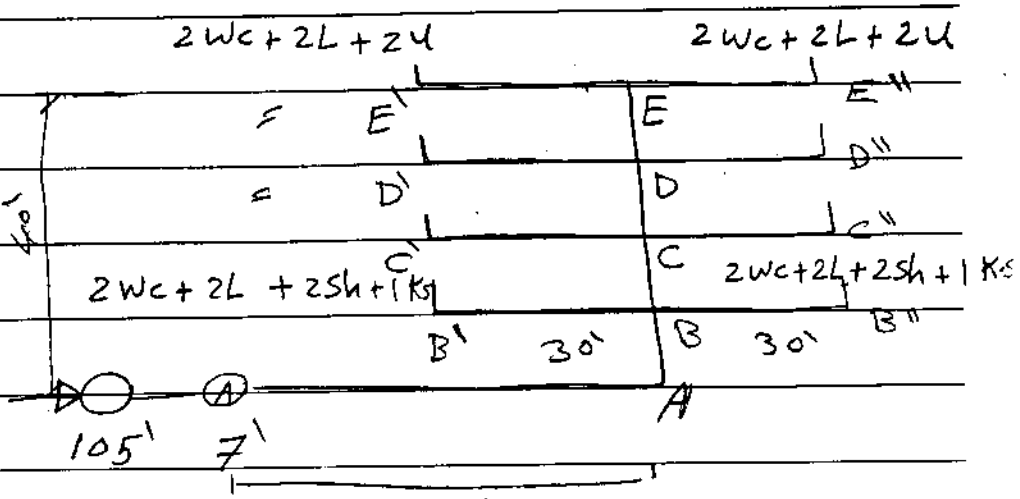


Fig.(3)

عوذج رقم (1)

الحل النموذجي لاسئلة الدور الاول / 2012/2013 الصف الرابع/خدمات بنا

2- Sol.



from Table 2-6

Fixture	F.U
W.C	5
U	3
L	2×0.75 = 1.5
Sh	4 × 0.75 = 3
K.S	4 × 0.75 = 3

$$i = \frac{105 - (7+40+6+8)}{(65+40+30+6)(1.25)} \times 0.434 \times 100 = 10.87 \text{ Psi/100 ft}$$

Pipe	ΣF.U	Fig (2-23) Q gpm	Fig (2-22) Diameter (in)
EE"	19	15	1"
EE'	19	15	1"
DE	38	25	$1\frac{1}{4}$"
DD"	19	15	1"
DD'	19	15	1"
CD	76	38	$1\frac{1}{4}$"
CC"	19	15	1"
CC'	19	15	1"
BC	114	47	2"
BB"	22	17	1"
BB'	22	17	1"
AB	158	60.5	2"

عقود.2 رقم (1)

Q2/

A) sol.

Pipe	fixtures	table 1	table 2		table 2 D"
EE"	2WC + 2L + 2U	$\frac{3}{4}" + \frac{1}{2}" + \frac{3}{4}"$	2.9 + 1 + 2.6	= 6.8	1" → 1 1/4"
EE'	=	=		= 6.8	1" → 1 1/4"
ED	all above			= 13.6	1 1/2"
DD"	2WC + 2L + 2U	$\frac{3}{4}" + \frac{1}{2}" + \frac{3}{4}"$		= 6.8	1 1/4"
DD'	=	=		= 6.8	1 1/4"
DC	all above			= 27.2	2"
CC"	2WC + 2L + 2U	$\frac{3}{4}" + \frac{1}{2}" + \frac{3}{4}"$		= 6.8	1 1/4"
CC'	=	=		= 6.8	1 1/4"
CB	all above			= 40.8	2 1/2"
BB"	2WC + 2L + 2Sh + K.S	$\frac{3}{4}" + \frac{1}{2}" + \frac{3}{4}" + \frac{3}{4}"$		= 9.7	1 1/4"
BB'	=	=		= 9.7	1 1/4"
AB	all above			= 60.2	2 1/2"

B) sol.

Area = 48 * 100 = 4800 m²

table 1 Let a = 10 m²

No. of sprinklers = $\frac{4800}{10}$ = 480

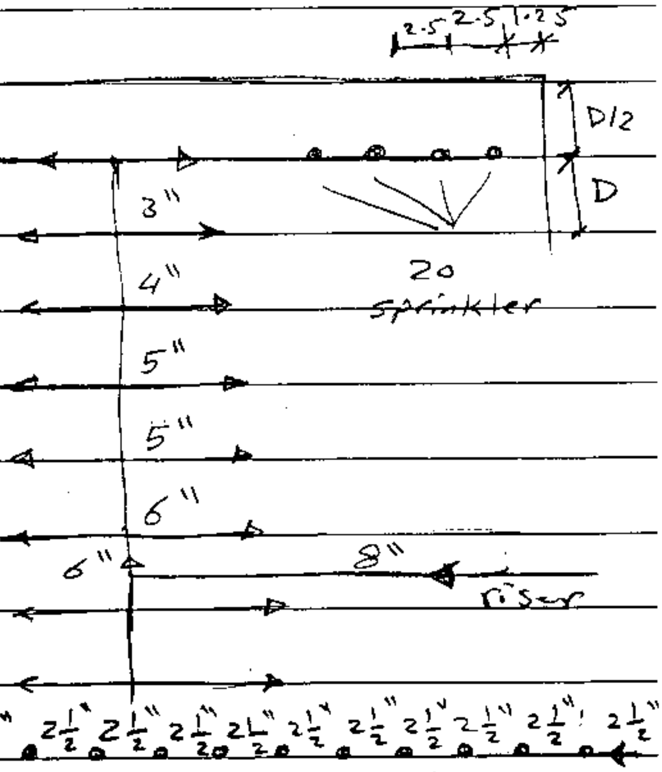
Let D = 4m

No. of pipes = $\frac{48}{4}$ = 12

No. of sprinklers/pipe = $\frac{480}{12}$ = 40

S = $\frac{a}{D} = \frac{10}{4}$ = 2.5 m

table (2)



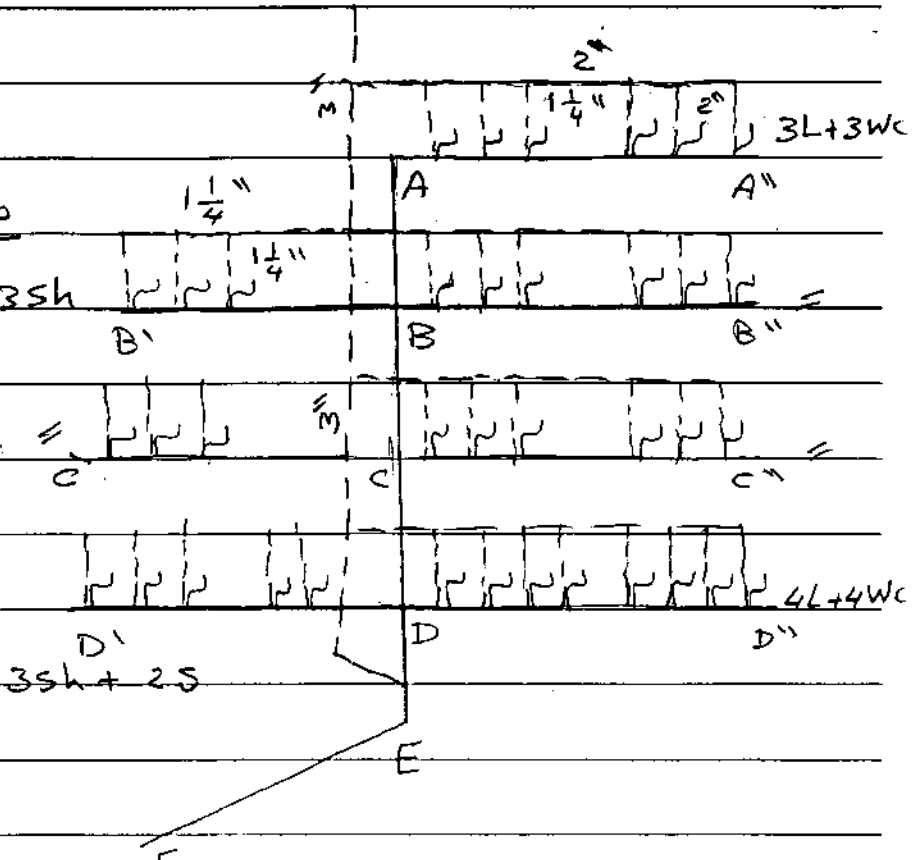
الشكل يوضح الخط الثانوي الذي يحتوي على 20 مرشة في كل جهة

(Q3) sol.

use table 4-2

fixture	F.U	min size of trap
W.C	4	3" → 4"
L	2 or 1	1.5" or 1.25"
Sh	2	2"
S	2	2"

use table 4-3 & 4-4



Pipe	Σ F.U	type	Dia"
AA"	15 or 18	branch	4"
AB	15 or 18	stack	4"
BB"	15 or 18	branch	4"
BB'	6	=	2"
BC	36	stack	4"
CC"	15 or 18	branch	4"
CC'	6	=	2"
CD	57	stack	4"
DD"	20	branch	4"
DD'	10	=	2 1/2"
DE	87	stack	4"
EF	87	Building drain	4"

Vent pipes

individual Vent

Wc = 0.5 * 4 = 2" ⟶ 1.25"

L = 0.5 * 1.5 = 0.75" ⟶ 1.25"

Sh = 0.5 * 2 = 1" ⟶ 1.25"

S = 0.5 * 2 = 1" ⟶ 1.25"

Vent stack

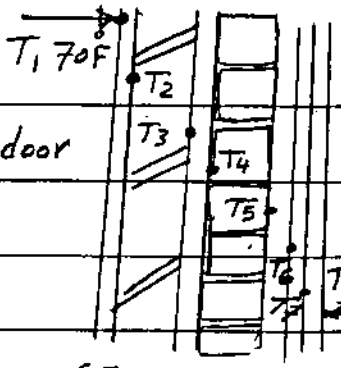
0.5 * 4 = 2" ⟶ 3"

relief Vent

0.5 * 2" = 1" ⟶ 1.25"

0.5 * 4 = 2" ⟶ 2"

Q4) sol:



Construction	R
RSO	0.17
face brick	0.39
Cement mortar	0.1
Concrete block	1.11
Airspace	0.97
Gypsum lath	0.32
Rsi	0.68
	$\Sigma R = 3.74$

$$U = \frac{1}{\Sigma R}$$

$$= \frac{1}{3.74} = 0.2673$$

$$Q = U * A * \Delta T$$

$$= 0.2673 * 1 * 70$$

$$= 18.716 \text{ Btuh}$$

$18.716 = \frac{1}{0.17} \Delta T_1$ $\quad \Delta T_1 = 3.1818 = T_1 - T_2 \therefore T_2 = 66.818^\circ F$

$18.716 = \frac{1}{0.39} \Delta T_2$ $\quad \Delta T_2 = 7.299 = T_2 - T_3 \therefore T_3 = 59.5187^\circ F$

$18.716 = \frac{1}{0.1} \Delta T_3$ $\quad \Delta T_3 = 1.8716 = T_3 - T_4 \therefore T_4 = 57.6471^\circ F$

$18.716 = \frac{1}{1.11} \Delta T_4$ $\quad \Delta T_4 = 20.7747 = T_4 - T_5 \therefore T_5 = 36.8723^\circ F$

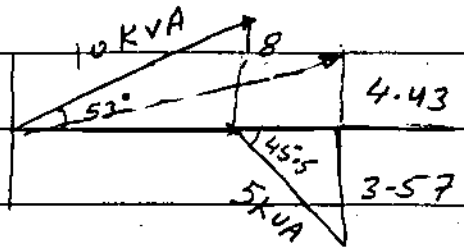
$18.716 = \frac{1}{0.97} \Delta T_5$ $\quad \Delta T_5 = 18.15452 = T_5 - T_6 \therefore T_6 = 18.7177^\circ F$

$18.716 = \frac{1}{0.32} \Delta T_6$ $\quad \Delta T_6 = 5.98912 = T_6 - T_7 \therefore T_7 = 12.72858^\circ F$

$18.716 = \frac{1}{0.68} \Delta T_7$ $\quad \Delta T_7 = 12.7268 = T_7 - T_8 \therefore T_8 \approx 0^\circ F$

Q5)

A) Sol



$P_{KVA} = 10$

$P_{KW} = 10 * 0.6 = 6\ KW$

$P_{KVAR} = 10 \sin 53° = 8$

$P_{KW} = 5 * 0.7 = 3.5\ KW$

$P_{KVAR} = 5 * \sin 45.5 = 3.57$

Total actual power $= 6 + 3.5 = 9.5\ KW$

Total reactive power $= 8 - 3.57 = 4.43$ lead

$\theta = \tan^{-1} \frac{4.43}{9.5} = 25°$

overall Power factor $= \cos\theta = 0.906$

$I_{total} = \frac{9.5 * 1000}{220 * 0.906} = 47A$

Use table 12 — Use $16\ mm^2$ → vol. drop $= 2.6\ mV/amp/m$

$V.d = 47 * 30m * 2.6 \times 10^{-3} = 3.66 < 5.5$

O.K

b) Sol

$R_{cc} = 0$, $h_{rc} = 5'$, $h_{fc} = 3'$ $R_c = 80\%$, $R_w = 30\%$, $R_f = 30\%$

$RCR = 0$, $RCR = 5 \times 5 \frac{60+100}{60*100} = 0.66 \approx 0.7$, $FCR = 3 \times 5 \frac{60+100}{60*100} = 0.4$

Table 28-7

$\rho_{cc} = 80\%$ $\rho_{fc} = 27\%$

$\rho_w = 30\%$ $\rho_w = 30\%$

Table 28-9 type (10)

by linear extrapolation

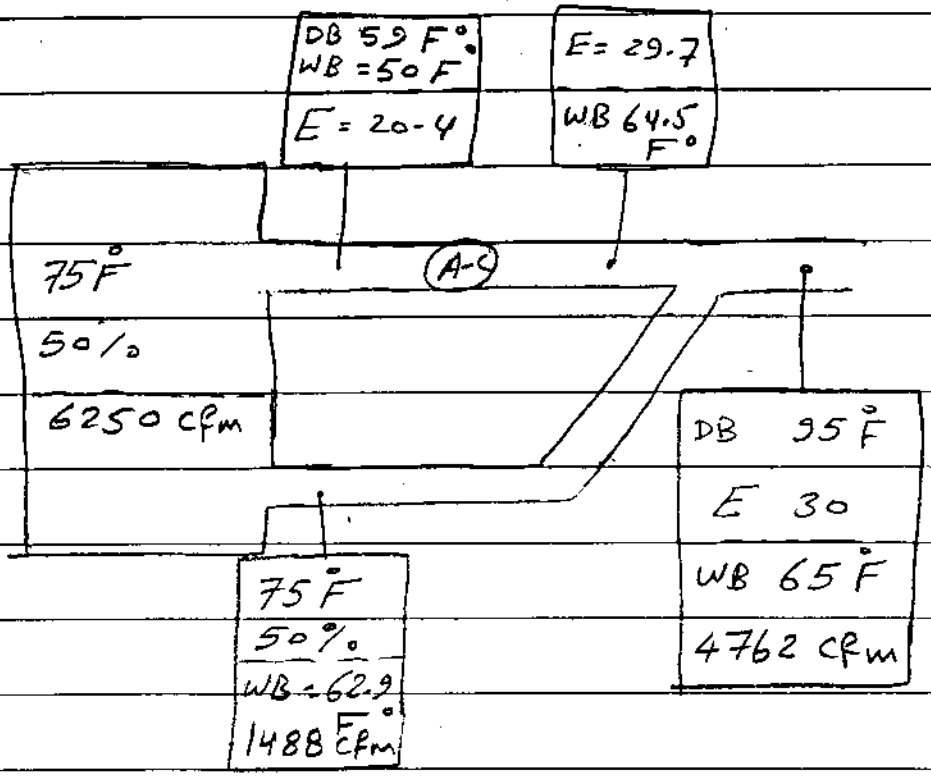
0.7 → $\frac{\rho_{cc}}{RCR}$ 1	$\frac{80}{0.47}$ $\rho_w = 30$ $\rho_{fc} = 20$
RCR 2	0.42
$C_u = 0.47 + 0.05(0.3) = 0.485$	
$C_{u\ correction} = 0.485 * 1.08 = 0.53$	
area/luminaire $= \frac{4 * 3250 * 0.53 * 0.67}{125} = 40\ ft^2$	
$\max \frac{S}{MH} = 0.9$	$\therefore S = 0.9 * 5 = 4.5\ ft$

Q6) Sol:

$35^\circ C \longrightarrow 95^\circ F$

$23.88^\circ C \longrightarrow 75^\circ F$

$15^\circ C \longrightarrow 59^\circ F$



$$S\text{-}H\text{-}R = \frac{RSH}{RSH + RLH}$$

$$0.77 = \frac{100\,000}{100000 + RLH} \quad \therefore RLH = 29870 \text{ Btuh}$$

$$\text{No of person} = \frac{29870}{300} = 99.56 \simeq 100 \text{ person}$$

$$Q_3 = \frac{RSH}{75 - 59} = \frac{100\,000}{16} = 6250 \text{ cfm}$$

Use chart

$E = 20.4$ Btu/lb after A.C

$WBT = 65^\circ F$ out door

$WBT = 62.9^\circ F$ Return air

$WBT = 64.5^\circ F$ mix. air

heat to be removed by A.C $= 60 * 0.075 * 6250 (29.7 - 20.4)$

$= 261562.5$ Btuh $\simeq$ 22 Ton

$$WBT_{mix} = 64.5 = \frac{Q_2 * 62.9 + (6250 - Q_2) * 65}{6250} = 1488 \text{ cfm}$$

$Q_1 = 6250 - 1488 = 4762$ cfm

$$\text{cfm/Person} = \frac{4762}{100} = 47.62 \text{ cfm}$$