University of Technology

Engineering Department of Building and Construction

Final Exam-First attempt 2013-2014

Subject: Building services **Year: Fourth**

Division: Construction Engineering and Management **Time: 180min.**

Examiner: Assist prof.Haider Alwash **Date :31/ 5 /2014**

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 (35)m, head of critical fixture (3)m, the height of critical fixture (1.8)m, , 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 (2). (10Mark)

B) Design the Sprinkler system for the factory of (24x50) 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 (3). (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 (2)C, indoor temperature (22)C, the construction of the wall are tabulated below:-

Construction	Resistance(R)	Conductivity(K)
Rso	0.053	
Face brick (105mm)		1.2
Wood sheathing (25mm)		0.09
Rsi	0.123	

(20Mark)

Q5) :- A) 1- Design the cable required to feed (2Kw load, 3Kw load (Pf=0.7 lead), 50Kw load (Pf=0.8 lag), 2hp load (Pf=0.7 lead)), if the nominal voltage (220V, single phase) and the distance between circuit breaker and main board is (30m) and diversity factor (0.529),the cable is clipped direct to surface.

2- Show by sketch the connection of the cable to the main board and circuit breaker .

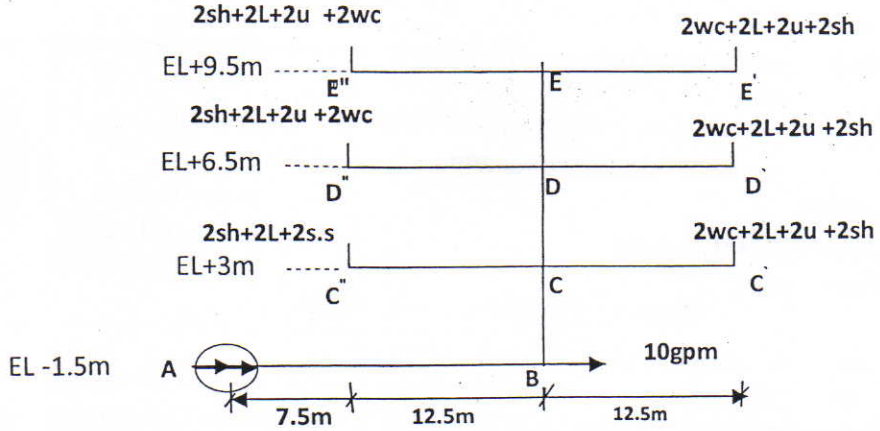
3- Calculate the overall power factor. (10Mark)

B) Use zonal cavity calculation and design the ceiling lightings for large office (100x60x8) ft, use luminaries type (7),(125 foot candles),reflectance of ceiling 80%,floor 30%,wall 30%,working plane (36)in., Maintenance factor (0.705),Correction factor (1.08). (10Mark)

Q6):- According to the data shown in fig. (4). Design the capacity of air condition knowing that:-

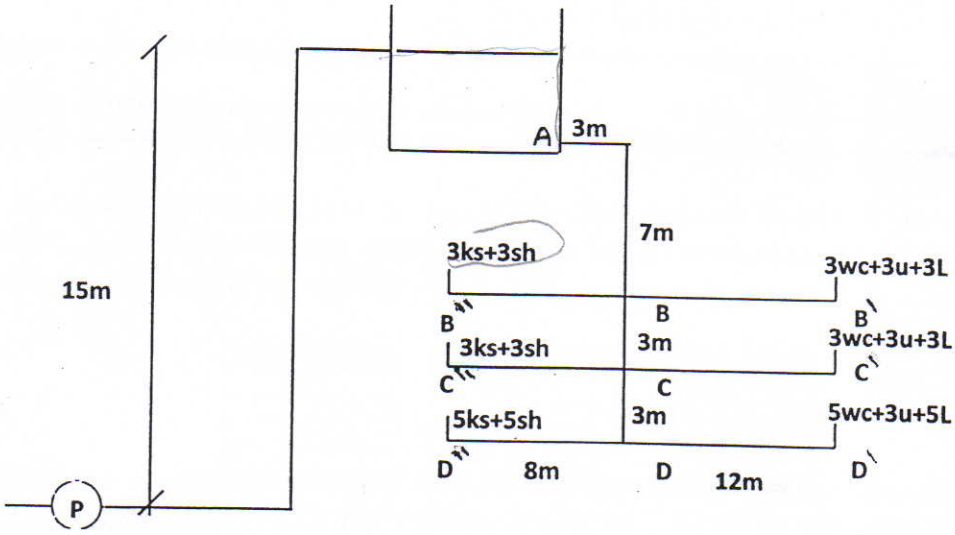
1) Windows type (regular single glass in side shading) (130 sft-W-direction)(145sft-N direction) (200 sft-E-direction).
2) Wood doors (88s.ft).
3) Walls type masonry, brick, plastered (190 sft).
4) Ceiling 4in Conc.Insulation,light (2848 sft).
5) Metal doors (44 sft)(U-value=0.42).
6) Temperature swing factor (0.75).

Good Luck (20Mark)

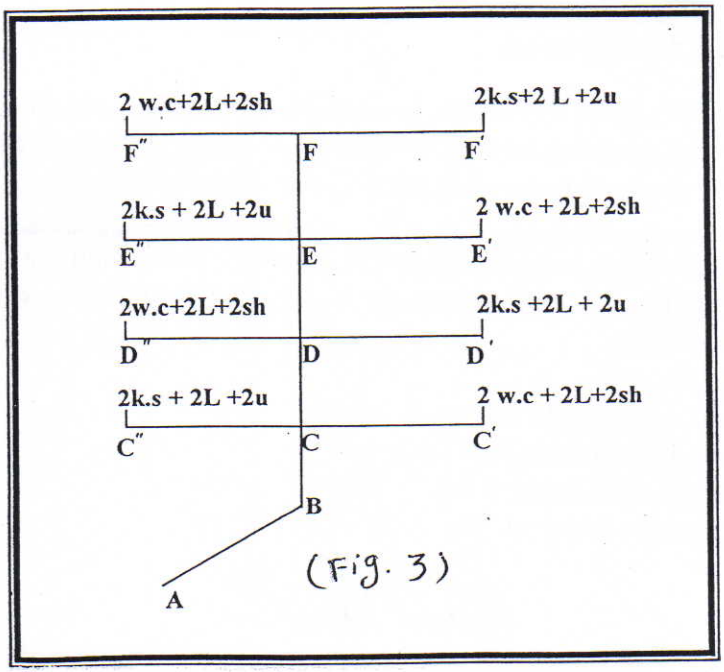


s.s= Service sink

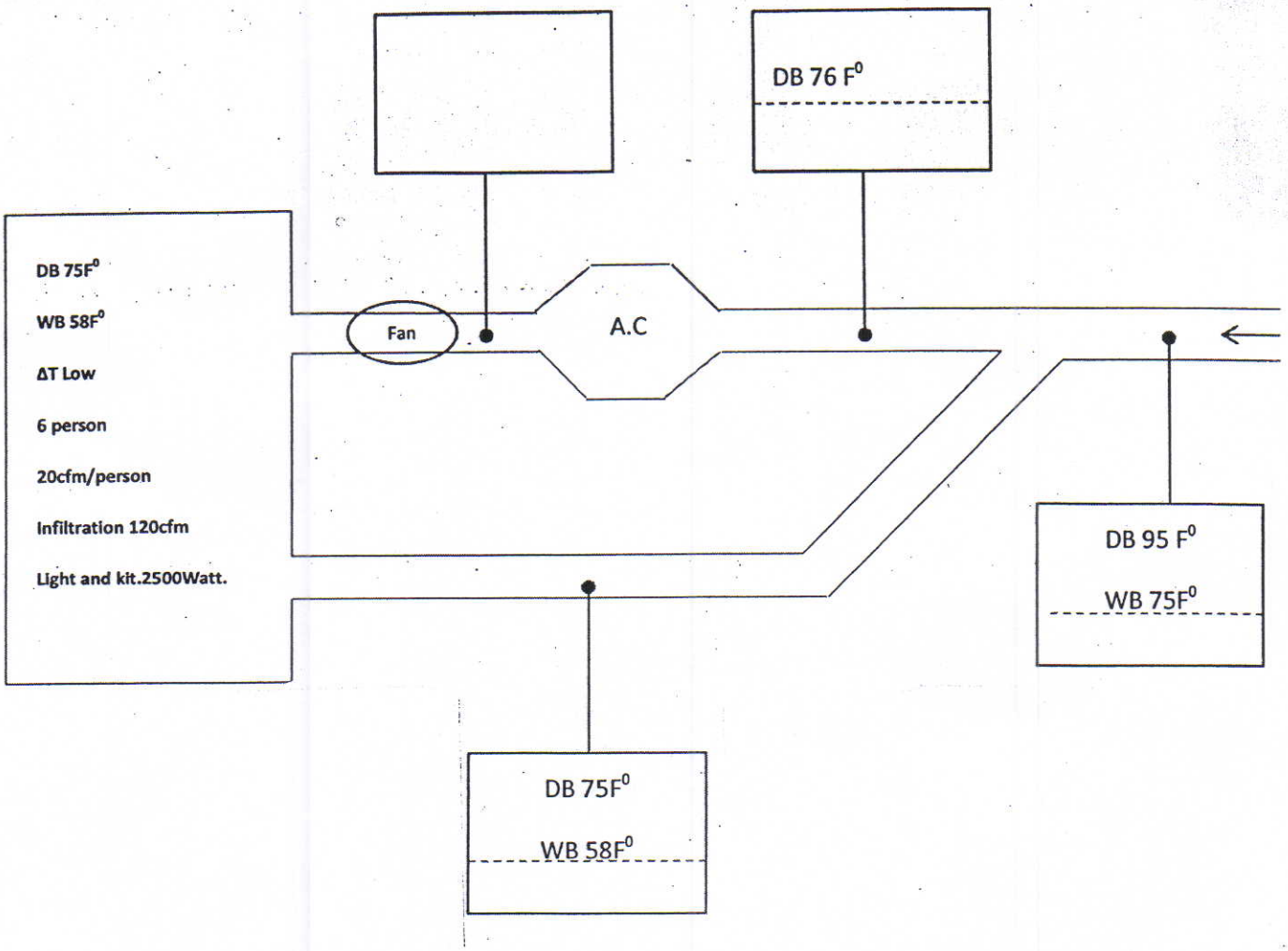
Fig. 1



(Fig. 2)



(Fig. 3)


DB 76 F0
DB 75F0
WB 58F0
ΔT Low
6 person
20cfm/person
Infiltration 120cfm
Light and kit.2500Watt.
Fan
A.C
DB 95 F0
WB 75F0
DB 75F0
WB 58F0

(Fig. 4)

(1) مشروع
2014 - 2013

Q1

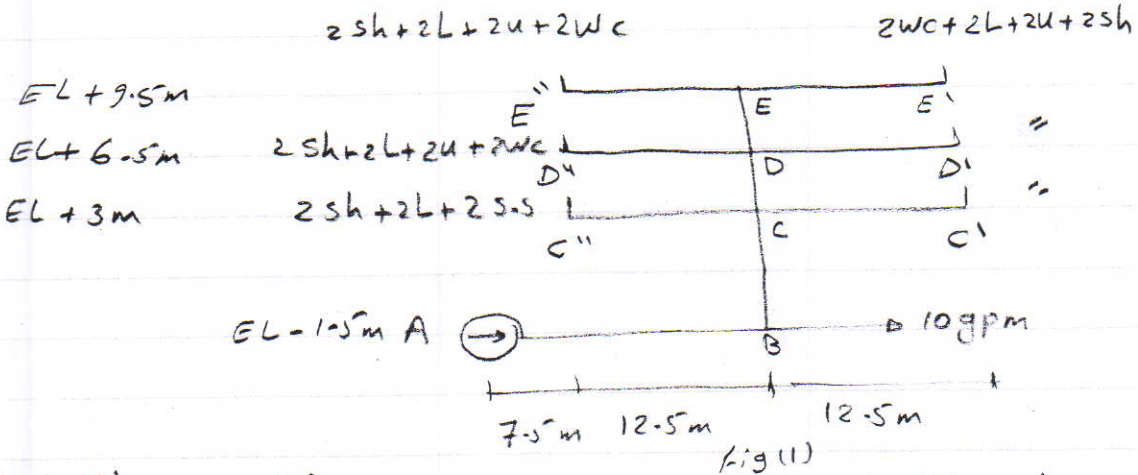


Fig (1)

$$F = \frac{35 - ((9.5+1.5)+3+1.8)}{(7.5+12.5+11+12.5+1.8)1.25} * 0.434 * 100 = 14.7 \text{ Psi}/100'$$

use table (2-6)

fixture	F.u	Σ F.u
W.C	5	2×5 = 10
L	2	2×2*0.75 = 3
u	3	2*3 = 6
sh	4	2*4*0.75 = 6
S.S	3	2*3*0.75 = 4.5

Σ Fu = EE' = 6+3+6+10 = 25

Σ Fu CC'' = 6+3+4.5 = 13.5

use fig 2-23 and Fig 2-22

line	Σ F.u	Q gpm	F Psi/100'	Dia."
AB	138.5	55+10=65	14.7	2"
BC	138.5	55	=	2"
CD	100	45	=	$1\frac{1}{2}$"
DE	50	30	=	$1\frac{1}{4}$"
CC'	25	17.5	=	$1\frac{1}{4}$"
CC''	13.5	10	=	1"
DD'	25	17.5	=	1"
DD''	25	17.5	=	1"

line	Σ F.u	Q gpm	F	Dia"
EE'	25	17.5	14.7	1"
EE''	25	17.5	14.7	1"

(11 2.3.2

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Q2/

A)

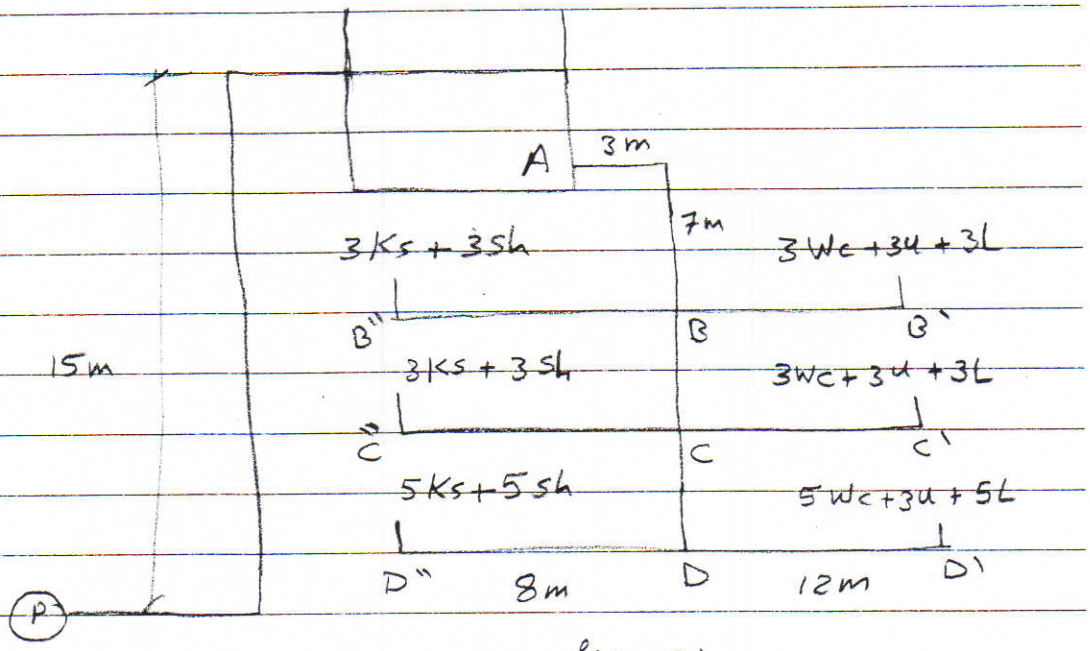


fig (2)

Sol

Pipe	fixtures	table (1)	table (2)	table (2) Dia"
DD"	5Ks + 5Sh	$1\frac{1}{2} + 1\frac{1}{2}$	17.4 + 17.4 = 34.8	2"
DD'	5Wc + 3U + 5L	$1\frac{1}{4} + 1 + 1$	10.9 + 6.2 + 6.2 = 23.3	2"
DC	(DD" + DD')		= 58.1	$2\frac{1}{2}$"
CC'	3Wc + 3U + 3L	1" + 1" + 3/4"	6.2 + 6.2 + 2.9 = 15.3	$1\frac{1}{2}$"
CC"	3Ks + 3Sh	$1\frac{1}{4}$" + $1\frac{1}{4}$"	10.9 + 10.9 = 21.8	2"
CB	(DD" + DD' + CC' + CC")		= 95.2	3"
BB'	3Wc + 3U + 3L	1" + 1" + 3/4"	6.2 + 6.2 + 2.9 = 15.3	$1\frac{1}{2}$"
BB"	3Ks + 3Sh	$1\frac{1}{4}$" + $1\frac{1}{4}$"	10.9 + 10.9 = 21.8	2"
BA	(DD" + DD' + CC" + CC' + BB' + BB")		= 132.2	$3\frac{1}{4}$"

(1) عفوز 2
2014 - 2013

Q2

B) Sol Use table 1 & 2 for sprinklers

area = 50 * 24 = 1200 m^2

let a = 10 m^2

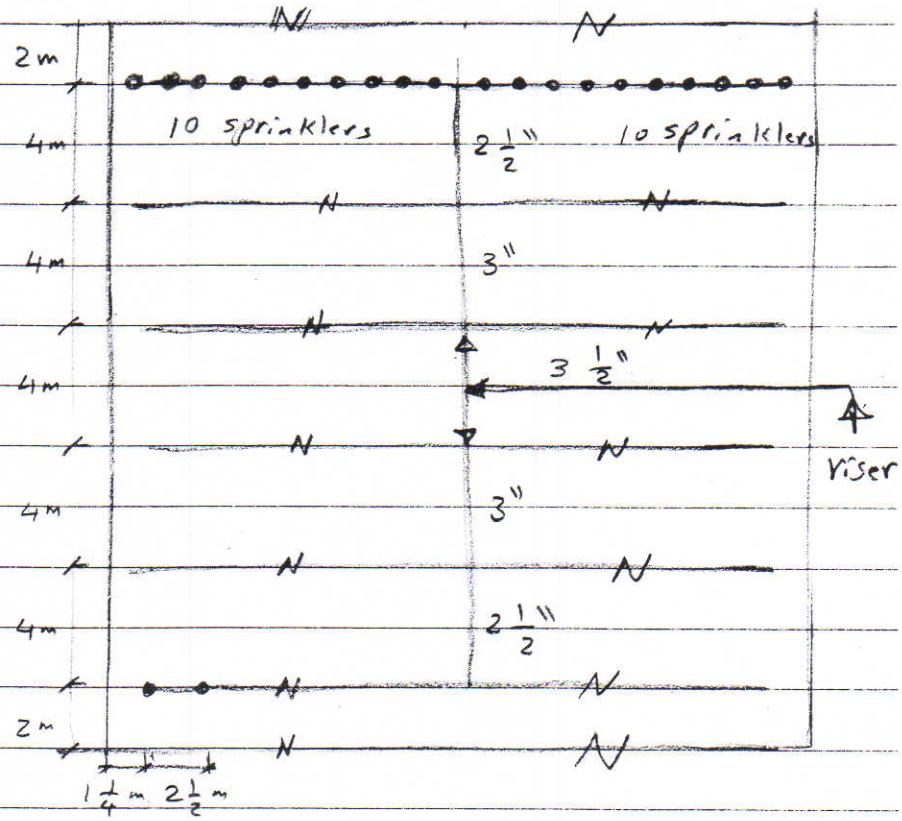
No. of sprinklers = $\frac{1200}{10}$ = 120

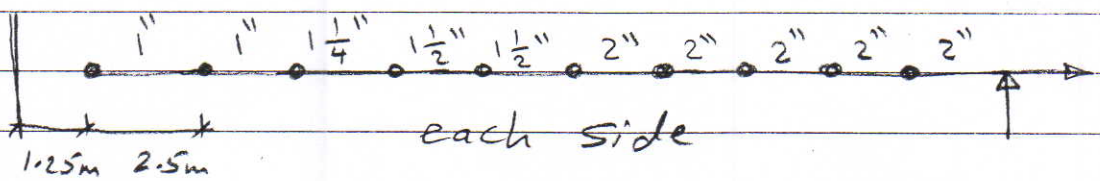
let D = 4 m

∴ No. of pipes = $\frac{24}{4}$ = 6

No. of sprinkler/pipe = $\frac{120}{6}$ = 20

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





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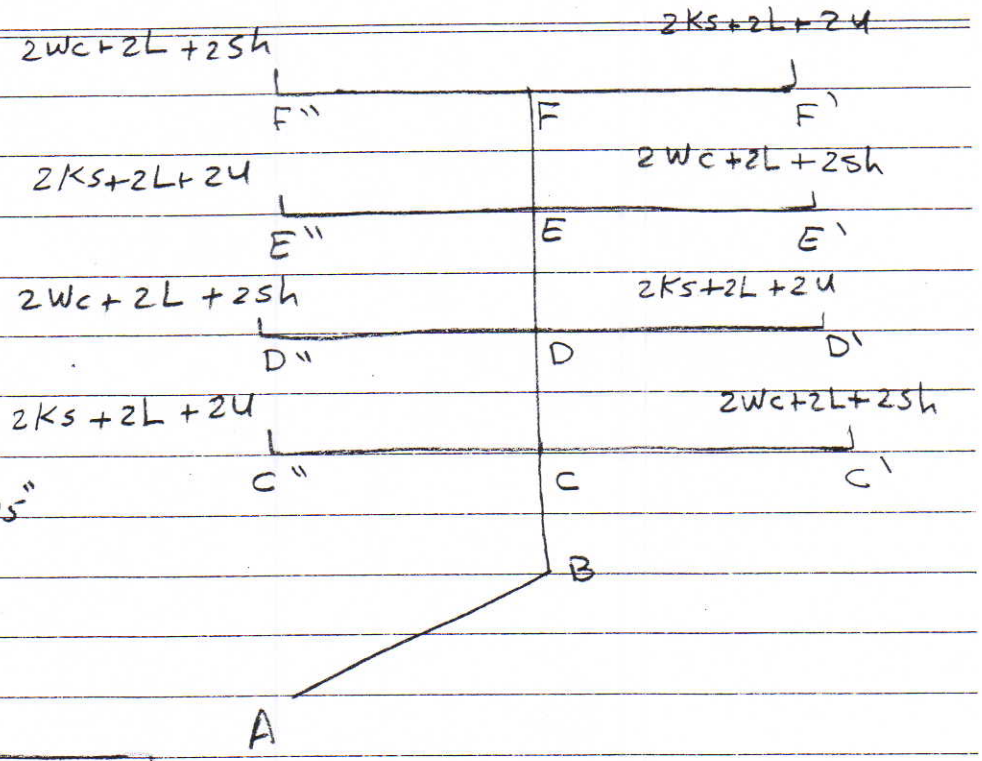
Q3/

Sol



Use table 4-2

fixture	F.U	min. Dia of trap
W.C	4	~~3"~~ 4"
L	2 or 1	1.5" — 1.25"
Sh	2	2"
U	4	2"
K.S	2	$1\frac{1}{2}$"

Use table 4-3 & 4.4

Pipe	Σf.u	type	Dia".
CC', DD", EE', FF"	16 - 14	Soil branch	3" ⟶ 4"
CC", DD', EE", FF'	16 - 14	waste branch	3"
FE	32 or 28	Soil stack	$2\frac{1}{2}$" ⟶ 4"
ED	64 or 56	=	4"
DC	96 or 84	=	4"
CB	128 or 112	=	4"
BA	Building drain	=	4"

Vent pipes

Individual vent

W.C = 0.5 * 4 = 2"

U = 0.5 * 2 = 1" ⟶ $1\frac{1}{4}$"

L = 0.5 * $1\frac{1}{4}$ = 0.625 ⟶ $1\frac{1}{4}$"

Sh 0.5 * 2 = 1" ⟶ $1\frac{1}{4}$"

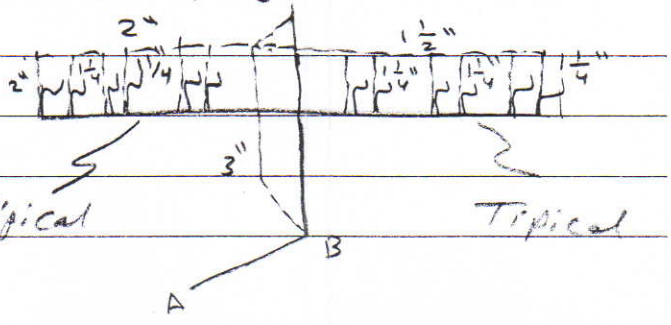
K.S 0.5 * 1.5 = 0.75 ⟶ $1\frac{1}{4}$"

Vent stack 0.5 * 4 = 2" ⟶ 3"

relief vent

FF', EE", DD', CC" = 0.5 * 3 = 1.5" ⟶ 1.5"

FF", EE', DD", CC' = 0.5 * 4 = 2" ⟶ 2"



(1) 2.خ

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Q4/ sol

$$U = \frac{1}{0.053 + 0.123 + \frac{0.105}{1.2} + \frac{0.025}{0.09}} = 1.847 \quad W/m^2.^\circ C$$

$$\dot{q} = U \times A \times \Delta T = 1.847 * 1 * (22 - 2) = 36.94 \text{ Watt}$$

$$36.94 = \frac{1}{0.123} \Delta T_1 \quad \therefore \Delta T_1 = 4.543^\circ C$$

$$T_2 = 22 - 4.543 = 17.457^\circ C$$

$$36.94 = \frac{1}{\frac{0.25}{0.09}} \Delta T_2 \quad \therefore \Delta T_2 = 10.27^\circ C \quad \therefore T_3 = 7.187^\circ C$$

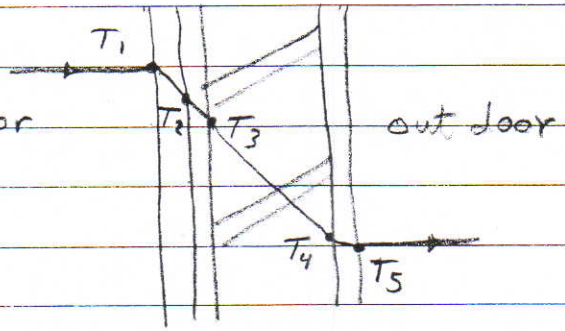
$$36.94 = \frac{1}{\frac{0.105}{1.2}} \Delta T_3 \quad \therefore \Delta T_2 = 3.232$$

$$\therefore T_4 = 7.187 - 3.232 = 3.955 < 5^\circ C$$

$$36.94 = \frac{1}{0.053} \Delta T_4 \quad \therefore \Delta T_4 = 1.9578$$

$$\therefore T_5 = 3.955 - 1.9578 \approx 2^\circ C$$

The position of dew point is between $T_3 - T_4$



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Q5/

① A)

Power watt $I = \frac{\text{Power}}{V \cos\theta}$

2000 W	2000/220	= 9.09 amp
3000 W	3000/220*0.7	= 19.48 amp
50 000 W	50 000/220*0.8	= 284.09 amp
2hp*746 = 1492W	1492/220*0.7	= 9.688 amp

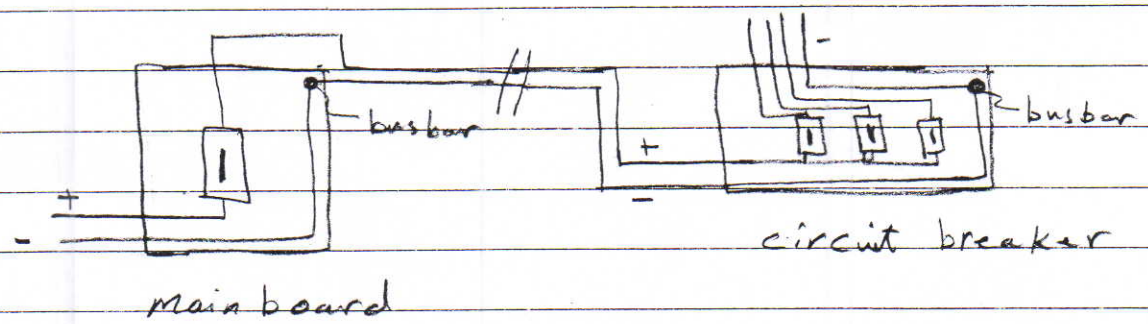
$I_t = 322.35$ amp

$I = 322.35 * 0.529 = 170.523$ amp

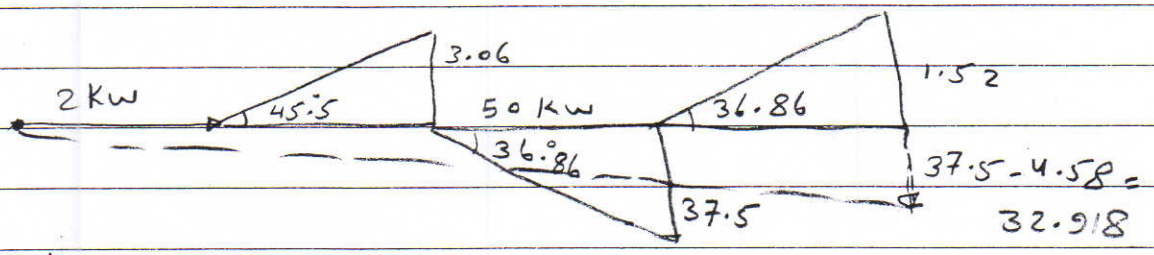
Use table 13 — $50 mm^2$ ⟶ vol-drop = 0.93 mV/amp/meter

$v.d = 30 * 170.523 * 0.93 \times 10^{-3} = 4.75 < 5.5$ V o.k

②



③



$\theta = \tan^{-1} \frac{32.918}{56.492} = 0.582 \therefore \cos\theta = 0.999$

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2014 – 2013

Q5

B) $h_{ss} = 0$, $h_{rc} = 5'$, $h_{fc} = 3'$

$R_c = 80\%$, $R_w = 30\%$, $R_f = 30\%$

$CCR = 0$, $RCR = 0.7$, $FCR = 0.4$

Table 28-7

$\rho_{cc} = 80\%$, $\rho_{fc} = 27\%$, $\rho_w = 30\%$

Table 28-9

$\rho_{cc} = 80\%$ $\rho_w = 30\%$

$RCR = 0.7$

1	0.72	extrapolation
2	0.63	$Cu = 0.72 + 0.09 * 0.3 = 0.747$

$Cu_{Correction} = 0.747 * 1.08 = 0.805$

$$area/luminaire = \frac{2 * 3250 * 0.705 * 0.805}{125} = 29.5 \approx 30 ft^2$$

$$No. of luminaires = \frac{60 \times 100}{30} = \underline{\underline{200}}$$

(1) نموذج
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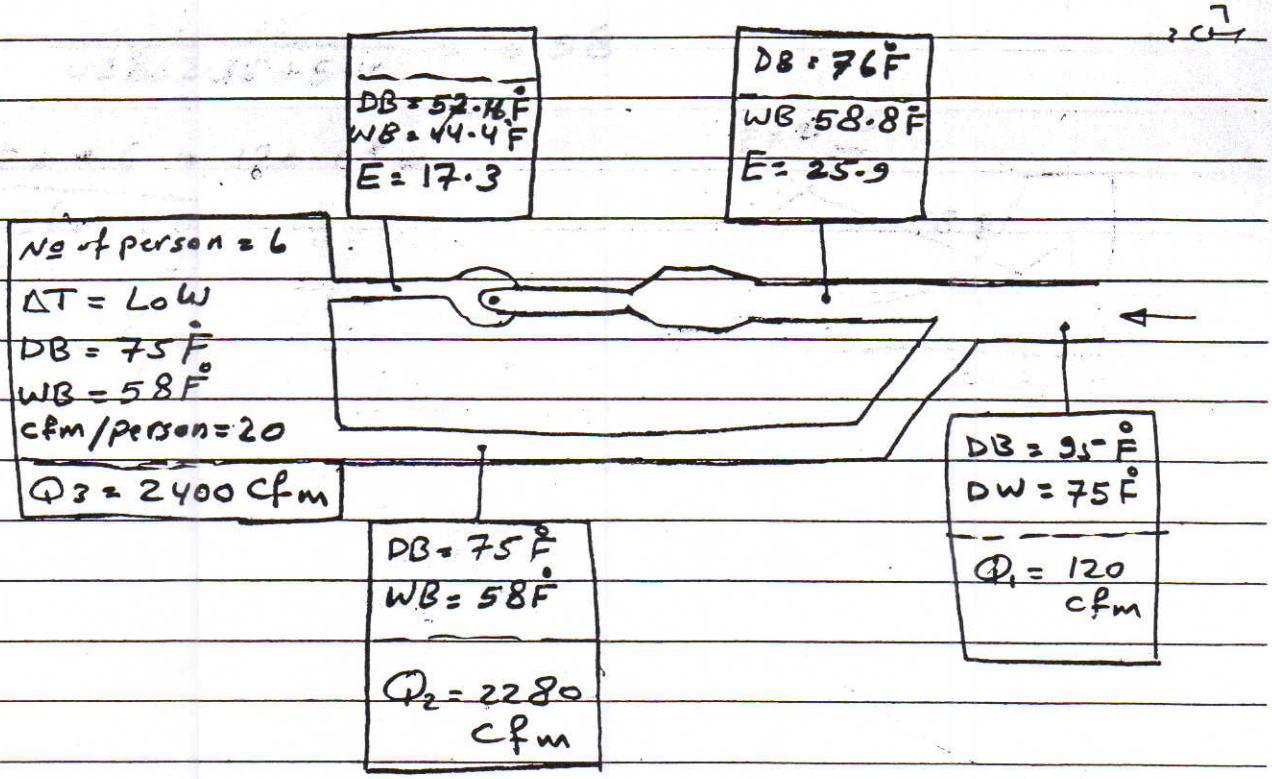
Q6



(1) RSH = 300 * 6 = 1800 Btuh
RLH = 90 * 6 = 540 Btuh

(2) windows use table (10-4)

	area	H.T.M	RSH
E	200	89	17800
W	130	89	11570
N	145	31	4495

(3) wall use table 10-3

190 * 9.7 = 1843

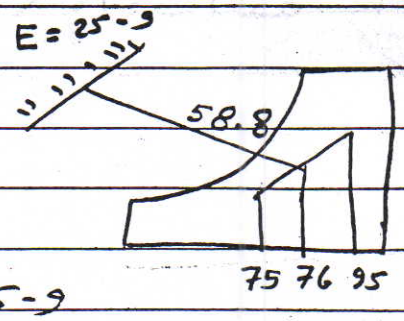
(4) Ceiling 2848 * 2.4 = 6835.2
(5) Matel door 44 * 0.42 * 20 = 369.6
(6) wood door 88 * 14 = 1232
(7) infiltration 120 cfm * 22 = 2640
(8) lights & kit. 2500 watt * 3.41 = 8525

Σ RSH = 57109.8 * 0.75 = 42832.35 Btuh
RLH = 540 Btuh

$$SHR = \frac{42832.35}{42832.35 + 540} = 0.98$$

$Q_1 = 20 * 6 = 120$ cfm

use Chart



mixing air

DBT = 76 F°, WBT = 58.8 F°, E = 25.9

$$DBT_{mix} = 76 = \frac{120 * 95 + (Q_3 - 120)75}{Q_3}$$

$\therefore Q_3 = 2400$ cfm

$Q_2 = 2400 - 120 = 2280$ cfm

$$\Delta T = \frac{42832.35}{2400} = 17.84$$

DBT (المخلوط) $= 75 - 17.84 = 57.16$ F°

use chart

$\therefore$ WBT = 44.4 F°, E = 17.3 Btu/lb

Btuh (A.C) $= 2400 * 60 * 0.075 (25.9 - 17.3)$

$= 92880$

$$A.C = \frac{92880}{12000} = 8 \text{ ton}$$