Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2018/2019

COURSE NAME	:	BUILDING SERVICES 1
COURSE CODE	:	BFB40603
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JUNE / JULY 2019
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **TEN (10)** PAGES

Q1 (a) Heat transfer mechanism in building can be divided into three categories which are by Conduction, Convection and Radiation. With the aid of sketches explain **TWO (2)** of the above heat transfer mechanism.

(6 marks)

(b) **Figure Q1(b)** shows the façade of an office building with its detailed construction layers of wall. The building needs to undergo a major renovation to improve its overall thermal transfer value (OTTV). By referring to the following information and **Table Q1(b)**, evaluate the current OTTV of the building.

Material properties of the building:

- Solar absorption factor of the paint (α): 0.54
- Glass windows and door: 8mm single-glass with shading coefficient of 0.70 and the U value of 4.8 W/m^2K.
- Thermal resistance (R) of external and internal plaster layer = 0.03 m^2k/W
- Thermal resistance (R) of concrete wall = 0.10 m^2k/W
- External surface resistance (R) of wall = 0.05 m^2k/W
- Internal surface resistance (R) of wall = 0.15 m^2k/W

(15 marks)

(c) Propose **TWO (2)** strategies that can be implemented to improve the OTTV of the building.

(4 marks)

Q2 (a) Six lamps were installed into a 12 V circuit as shown in **Figure Q2(a)**. Calculate the current flow through each lamp and the total resistance of the circuit. Given the equation of Power (watt) is equal to Volt times Current, (P=VI).

(7 marks)

(b) Propose **THREE (3)** safety practices that commonly applied for electrical systems or during conducting an electrical works.

(6 marks)

(c) A 13 storey's office block has a net floor area above ground level of 12 500 m^2. Assume 18% of the total building occupants are using the elevator during 5 min peak time and a population density of one person per 14 m^2 of floor net area. By referring to the information from **Table Q2(c)(i)** to **Table Q2(c)(iv)**, estimate the:

(i) Flow rate
(ii) Travel distance and speed
(iii) Minimum capacity and number of lifts and waiting time
(iv) Evaluate the quality of the elavator service

(12 marks)

Q3 (a) Air conditioning system can be classified into three types which are the individual air-conditioner system, a packaged system and a central system. Compare the refrigerant system of each air conditioning system.

(3 marks)

(b) A new two-storeys office building with separated rooms for office (multi-zones) will be constructed. With the aid of diagram, proposed a suitable air-conditioning system for the building.

(9 marks)

(c) Justify the selection of the proposed air-conditioning system in **Q3(b).**

(4 marks)

(d) Design a suitable supply duct system for an office room with the following specifications:

- Room size: 10 m x 5.5 m
- Room height: 4 m
- Recommended air flow rate in the supply duct: 3.5 m/s
- Recommended air change rate for the room: 3 air change rate per hour

(5 marks)

(e) Discuss **TWO (2)** practices of air-conditioning maintenance to keep the system run efficiently.

(4 marks)

Q4 (a) Explain why considering water pressure in design is important for water supply system?

(4 marks)

(b) An old water storage system needs to be replaced for a hostel in a boarding school. As a consulting engineer, you are required to design a suitable square shape water storage tanks, suction tanks, and supply pipe with a discharge rate of 1.50 litres/sec. The system should be based on the gravity supply system. The hostel consists of four (4) blocks of building with each building has 40 rooms. Meanwhile, each room can accommodate 4 students. Assume the head pressure is 6 m and the length of pipe is 32 m (allow 20% for bends) with negligible head loss. The design should consider the 24 hours' interruption of supply and 12 hours' disruption of supply by estimated cold water per person of 95 litres. Determine the total water requirement and design a suitable water storage tank system to store the water.

(10 marks)

(c) A double-storey house located in Johor Bahru is required to be installed with indoor rainwater harvesting system by using gravity fed with automatic top up system. Based on the following information and **Table Q4(c)(i)** and **Table Q4(c)(ii)**, design a rainwater harvesting system for the house.

Typical features of a double storey house in Johor Bahru:

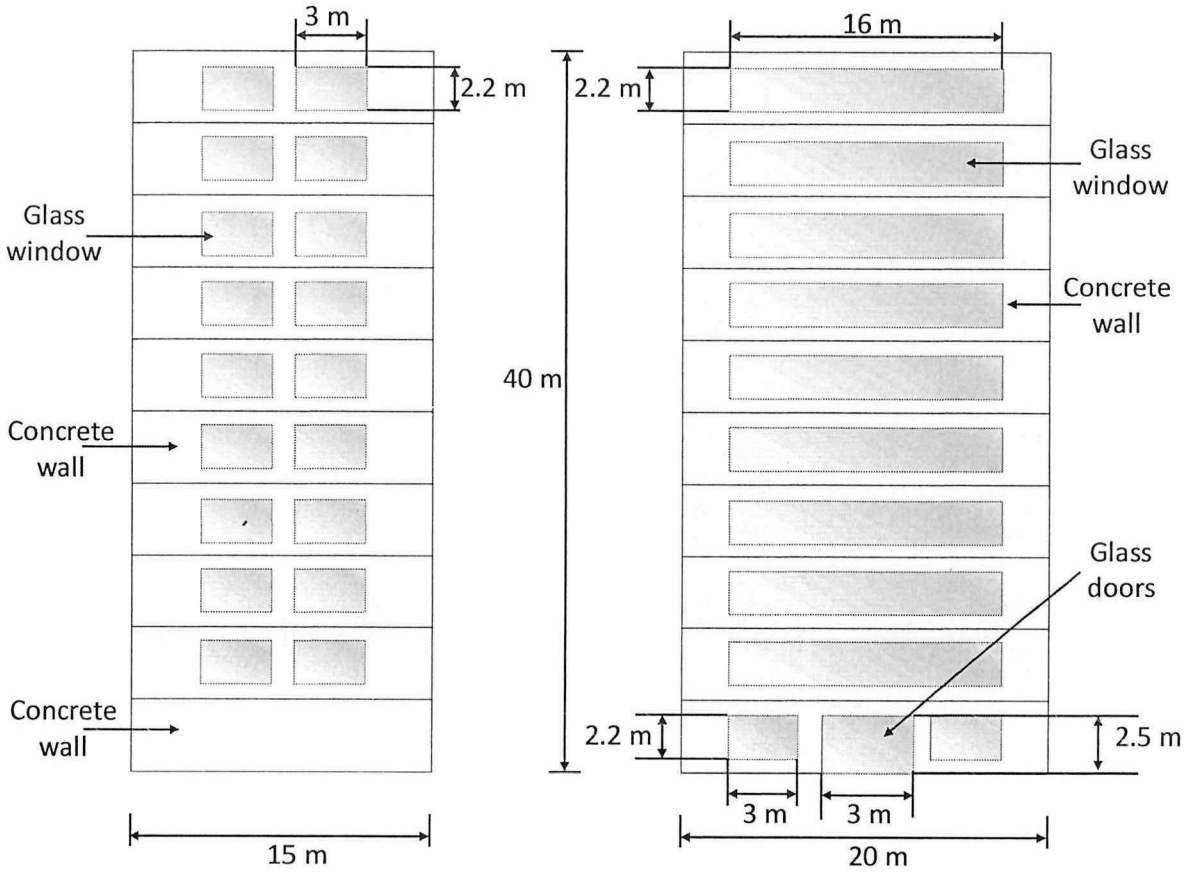
- dual flush toilet
- assume water usage 3.5 l/flush, 5 flushes per occupant per day and 5 occupants in the house
- metal roof with total of 120 m^2 roof size and less than 40° roof pitch
- rainfall intensity is assumed to be 150 mm/h
- rectangular gutter with 1:600 gradient with no bending
- 1.0 mm of rainfall is used as first flush depth

(11 marks)

– END OF QUESTIONS –

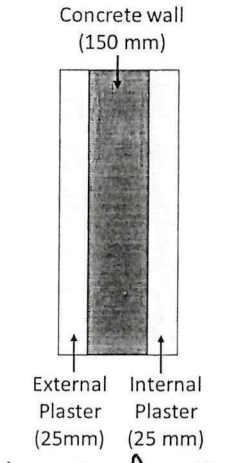
FINAL EXAMINATION

SEMESTER/SESSION : SEM II / 2018/2019
COURSE NAME : BUILDING SERVICES 1
PROGRAMME CODE : 4 BFF
COURSE CODE : BFB40603



East and West facades

North and South facades



Layers of wall

FIGURE Q1(b)

FINAL EXAMINATION

SEMESTER/SESSION : SEM II / 2018/2019
COURSE NAME : BUILDING SERVICES 1
PROGRAMME CODE : 4 BFF
COURSE CODE : BFB40603

TABLE Q1(b)

Solar correction factor

Orientation	CF
North	0.90
North-East	1.09
East	1.23
South-East	1.13
South	0.92
South-West	0.90
West	0.94
North-West	0.90

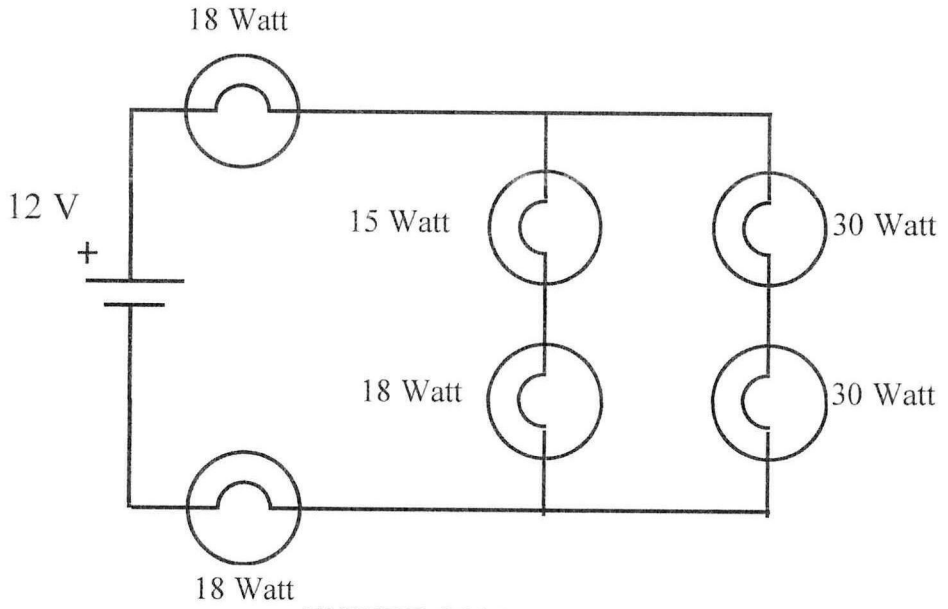


FIGURE Q2(a)

FINAL EXAMINATION

SEMESTER/SESSION : SEM II / 2018/2019
COURSE NAME : BUILDING SERVICES 1
PROGRAMME CODE : 4 BFF
COURSE CODE : BFB40603

TABLE Q2(c)(i)

Passenger lift performance (based on 3.3 m floor to floor heights) and lifts serving all of 15 floors				Interval (s)	Handling capacity (persons)
Number of cars	Speed (m/s)	12 Passengers	16 Passengers	20 Passengers	24 Passengers
		29	32	37	41
4	2.50	103	112	127	137
			31	36	40
4	3.50		116	132	142
			25	29	32
5	3.50		146	165	178
				24	27
6	3.50			198	213

TABLE Q2(c)(ii)

Speed (m/s)	Lift travel in metres			
	Municipal flats	Luxury flats	Offices	Bed lifts
0.25-0.375	-	-	-	5
0.50	30	15	10	10
0.75	45	20	15	-
1.00	55	25	20	20
1.50	-	-	30	45
2.50	-	-	45	100
3.50	-	-	60	-
5.00	-	-	125	-

FINAL EXAMINATION

SEMESTER/SESSION : SEM II / 2018/2019
COURSE NAME : BUILDING SERVICES I
PROGRAMME CODE : 4 BFF
COURSE CODE : BFB40603

TABLE Q2(c)(iii)

Interval	Quality of service
25-35	Excellent
35-45	Acceptable for offices
60	Acceptable for hotels
90	Acceptable for flats

TABLE Q2(c)(iv)

Minimum number of lifts for offices

Interval	Quality of service
One lift for every three floors	Excellent
One lift for every four floors	Average
One lift for every five floors	Below average

Note: A lower standard than the above would be acceptable for hotels and blocks of flats. Where large numbers of people have to be moved, cars smaller than tvelve-person capacity are not satisfactory.

FINAL EXAMINATION

SEMESTER/SESSION : SEM II / 2018/2019
COURSE NAME : BUILDING SERVICES 1
PROGRAMME CODE : 4 BFF
COURSE CODE : BFB40603

TABLE Q4(c)(i)

Roof Area (m^2)	Roof Runoff Rate (L/s)	Rectangular/ Eave Gutters (mm)				Rectangular Downpipe * (mm)			
		Cal. Size		Ava. Size		Cal. Size		Ava. Size	
		width	depth	width	depth	width	depth	width	depth
50	1.98	115	57.5	190	150	75.9	38	100	50
60	2.38	120	60	190	150	79.2	40	100	50
70	2.77	130	65	190	150	85.8	43	100	50
80	3.17	135	67.5	190	150	89.1	45	100	50
100	3.96	150	75	190	150	99	50	100	50
120	4.75	160	80	190	150	105.6	53	120	80
150	5.94	175	87.5	190	150	115.5	58	120	80
200	7.92	195	97.5	250	178	128.7	64	150	75

**Downpipe size is 66% of gutter width*

TABLE Q4(c)(ii)

Demand (liter/day)	Optimum Rainwater Storage Tank Cistern Capacity (m^3) Roof Catchment Area (m^2)					
	50	100	200	300	400	500
50	0.5	0.5	0.5	0.5	0.5	0.5
100	0.5	0.5	0.5	0.5	0.5	0.5
200	1.2	0.8	0.7	0.7	0.7	0.7
300	4.2	1.4	0.9	0.9	0.9	0.9
400	-	2.4	1.6	1.3	1.3	1.3
500	-	4.3	2.1	1.6	1.6	1.6

FINAL EXAMINATION

SEMESTER/SESSION	: SEM II / 2018/2019	PROGRAMME CODE	: 4 BFF
COURSE NAME	: BUILDING SERVICES 1	COURSE CODE	: BFB40603

The following information may be useful. The symbols have their usual meaning.

Formulae

$$q = u\,x\,A\,x\,(T_1-T_2)$$

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

$$OTTV = 15\alpha\,(1-WWR)\,U_w + 6\,(WWR)\,U_f + (194\,x\,CF\,x\,WWR\,x\,SC)$$

$$V_f = \frac{ACH\,x\,V}{3600}$$

$$V = IR$$

$$d = \sqrt[5]{\frac{q^2\,x\,25\,x\,L\,x\,10^5}{H}}$$

$$Q = CIA$$

$$Q = (9.67/10^5)\,x\,\sqrt{(A_o^2/W)}$$

$$Q = 1.4\,x\,(9.67/10^5)\,x\,\sqrt{(A_o^2/W)}$$

$$Q = 1.4\,x\,0.9\,x\,(9.67/10^5)\,x\,\sqrt{(A_o^2/W)}$$

$$Q = 1.4\,x\,0.9\,x\,0.75\,x\,(9.67/10^5)\,x\,\sqrt{(A_o^2/W)}$$