UTHM

Universiti Tun Hussein Onn Malaysia

# UNIVERSITI TUN HUSSEIN ONN MALAYSIA

## FINAL EXAMINATION
## (ONLINE)
## SEMESTER II
## SESSION 2020/2021

| | | |
|---|---|---|
| COURSE NAME | : | SUSTAINABILITY IN ARCHITECTURE |
| COURSE CODE | : | BFR21103 |
| PROGRAMME CODE | : | BFR |
| EXAMINATION DATE | : | JULY 2021 |
| DURATION | : | 3 HOURS |
| INSTRUCTION | : | ANSWER **ALL** QUESTIONS |

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

**Q1** (a) Define the following terms:

(i) Green roof
(ii) Soil erosion
(iii) Global warming
(iv) Sustainable design

(4 marks)

(b) Over the past 50 years, the average global temperature has increased at the fastest rate in recorded history and causes global warming. Explain what is global warming and how to stop it from happening.

(6 marks)

(c) As an architect for a project planned to be built on slope near to coastal line, describe **THREE (3)** climatic factors that influence building design in the context of Malaysia climate. Provide sketches to support your answers.

(15 marks)

**Q2** (a) The Sustainable Development Goals (SDGs), also known as the Global Goals, were adopted by all United Nations Member States in 2015 as a universal call in action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity by 2030. Explain briefly **FOUR (4)** SDGs that has close relationship related to sustainability in architecture.

(4 marks)

(b) Green roof is one of the important elements in sustainable architecture. Explain with sketches **THREE (3)** green roof strategies that contributes to sustainability in urban area.

(9 marks)

(c) Solar passive design strategies emphasis on sun orientation as a major design consideration. Explain with illustrations how external shading devices can be used to reduce solar radiation and optimize daylighting in Malaysia context.

(12 marks)

**Q3** (a) Discuss the significance of energy audits and the differences between desktop energy audits and detail energy audits. Briefly discuss the procedures in conducting a detailed energy audit.

(10 marks)

(b) Explain the significance of Overall Thermal Transfer Value (OTTV) concept in the construction of new buildings. Calculate the OTTV value for the space in **Figure 3 (a)** where the detail of a section is given in **Figure 3 (b)**. Give your comments on the calculated OTTV value according to **Appendix Q3**.

(15 marks)

**Q4** (a) Ventilation in buildings is the process of changing air in a room or in some other external spaces. Propose **TWO (2)** strategies in maximizing the natural ventilation through windows or other opening towards improving thermal comfort. Provide relevant sketches to support your answer.

(10 marks)

(b) Propose **THREE (3)** recommendations for energy efficiency and use of renewable energy for non-residential building. Justify and provide illustration to support your proposal.

(15 marks)

**– END OF QUESTIONS –**

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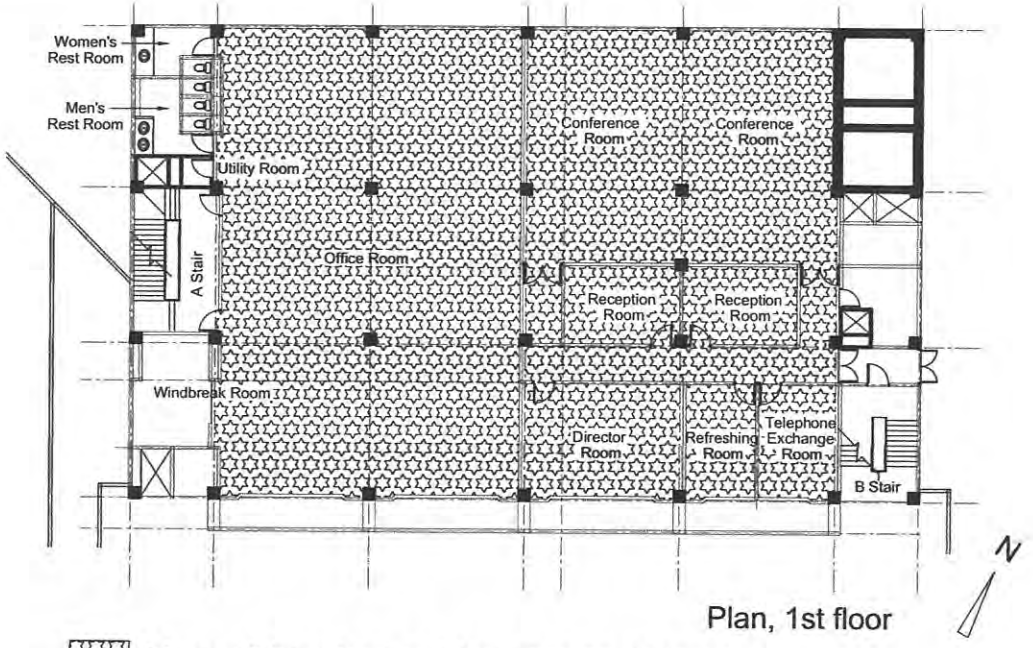


**Figure Q3 (a): Layout plan**

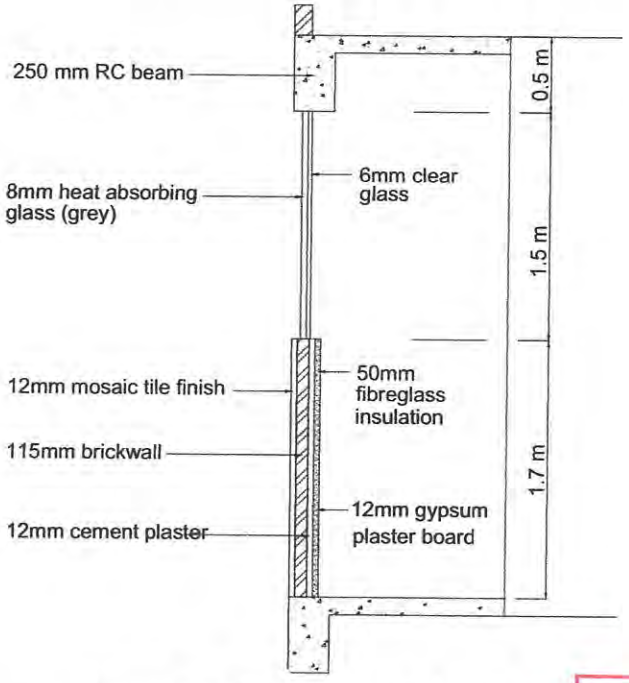


**Figure Q3 (b): Sectional detail of wall**

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## Appendix Q3

**Table 1:** Surface film resistance for walls and roofs

| Type of Surface | Thermal Resistance m2 K/W |
|---|---|
| A. Surface Film Resistance for Walls: | |
| 1. Inside surface (Ri) | |
| (a) High Emissivity | 0.120 |
| (b) Low Emissivity | 0.299 |
| 2. Outside surface (Ro) | |
| (High Emissivity) | 0.044 |
| A. Surface Film Resistance for Roofs: | |
| 1. Inside surface (Ri) | |
| (a) High Emissivity | |
| (i) Flat roof | 0.162 |
| (ii) Sloped roof 22 ½° | 0.148 |
| (iii) Sloped roof 45° | 0.133 |
| (b) Low Emissivity | |
| (i) Flat roof | 0.801 |
| (ii) Sloped roof 22 ½° | 0.595 |
| (iii) Sloped roof 45° | 0.391 |
| 2. Outside surface (Ro) | |
| (High Emissivity) | |
| Flat or Sloped | 0.055 |

**Table 2:** Solar Correction Factor

| Orientation | N | NE | E | SE | S | SW | W | NW |
|---|---|---|---|---|---|---|---|---|
| CF | 0.83 | 1.01 | 1.15 | 1.02 | 0.85 | 1.02 | 1.14 | 0.99 |

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## Appendix Q3

**Table 3:** k-value for basic materials

| Sr No | Material | Density Kg/m³ | k-value W/m K |
|---|---|---|---|
| 1 | Asbestos cement sheet | 1488 | 0.317 |
| 2 | Asbestos insulating board | 720 | 0.108 |
| 3 | Asphalt, roofing | 2240 | 1.226 |
| 4 | Bitumen | | 1.298 |
| 5 | Brick<br>(a) dry (covered by plaster or tiles outside)<br>(b) common brickwall (brickwall directly exposed to weather outside) | 1760 | 0.807<br>1.154 |
| 6 | Concrete | 2400<br>64 | 1.442<br>0.144 |
| 7 | Concrete, light weight | 960<br>1120<br>1280 | 0.303<br>0.346<br>0.476 |
| 8 | Cork board | 144 | 0.042 |
| 9 | Fibre board | 264 | 0.052 |
| 10 | Fibre glass (see glass wool and mineral wool) | | |
| 11 | Glass, sheet | 2512 | 1.053 |
| 12 | Glass wool, mat or quilt (dry) | 32 | 0.035 |
| 13 | Gypsum plaster board | 880 | 0.170 |
| 14 | Hard board:<br>(a) standard<br>(b) medium | 1024<br>640 | 0.216<br>0.123 |
| 15 | Metals:<br>(a) aluminium alloy, typical<br>(b) copper, commercial<br>(c) steel | 2672<br>8784<br>7840 | 211<br>385<br>47.6 |
| 16 | Mineral wool, felt | 32 - 104 | 0.035 - 0032 |
| 17 | Plaster<br>(a) gypsum<br>(b) perlite<br>(c) sand/cement<br>(d) vermiculite | 1216<br>616<br>1568<br>640 - 960 | 0.370<br>0.115<br>0.533 |
| 18 | Polystyrene, expanded | 16 | 0.202 |
| 19 | Polyurethane, foam | 24 | 0.303 |
| 20 | PVC flooring | 1360 | 0.035 |
| 21 | Soil, loosely packed | 1200 | 0.204 |
| 22 | Stone, tile :<br>(a) sand stone<br>(b) granite<br>(c) marble/terrazzo/ceramic/mosaic | 2000<br>2640<br>2640 | 0.713<br>0.375<br>1.298 |
| 23 | Tile roof | 1890 | 2.927 |
| 24 | Timber :<br>(a) across grain soft-wood<br>(b) hardwood<br>(c) plywood | 608<br>702<br>528 | 1.298<br>0.836<br>0.125 |
| 25 | Vermiculite, loose granules | 80-122 | 0.138 |
| 26 | Wood chipboard | 800 | 0.138 |
| 27 | Woodwool slab | 400<br>480 | 0.065<br>0.144<br>0.086 |