
UNIVERSITI SAINS MALAYSIA

Second Semester Examination
Academic Session 2008/2009

April/May 2009

RET 523 - Energy and Building Maintenance
[Tenaga dan Penyelenggaraan Bangunan]

Duration: 2 hours
[Masa: 2 jam]

Please check that this examination paper consists of SIX pages of printed material before you begin the examination.

Sila pastikan bahawa kertas peperiksaan ini mengandungi ENAM muka surat yang tercetak sebelum anda memulakan peperiksaan ini.

Students are allowed to answer all questions either in English OR in Bahasa Malaysia only.

Pelajar dibenarkan menjawab semua soalan dalam Bahasa Inggeris ATAU Bahasa Malaysia sahaja.

Answer **ALL** questions.

Jawab **SEMUA** soalan.

1. (a) What are the strategies that can be taken to reduce energy consumption in existing stock of Malaysian buildings?

Apakah strategi yang boleh diambil untuk mengurangkan penggunaan tenaga pada bangunan-bangunan yang sedia ada di Malaysia?

- (b) Wind condition in Malaysia cannot be considered as a factor to be included in the design of building because of its unpredictability, except for two localised condition. What are they? Elaborate.

Keadaan angin di Malaysia tidak boleh diambilkira sebagai satu faktor dalam merencanakan bangunan kerana ketidaktentuan keadaannya. Sebaliknya ada dua keadaan tempatan sahaja. Huraikan apakah keadaan tersebut?

(25 marks/markah)

2. (a) State the **Four (4)** steps in the development of a maintenance program.

*Nyatakan **Empat (4)** langkah dalam penjanaaan program senggaraan.*

- (b) List the main energy-related systems which should be given attention in terms of probable high energy consumption. What are the tasks involved?

Senaraikan sistem kaitan-tenaga utama yang perlu diberi perhatian dalam terma penggunaan tenaga yang berkemungkinan tinggi. Apakah langkah-tugasan yang terlibat?

- (c) Give example of **Three (3)** chosen system classification from the above and describe how related problems could be addressed. (Use an appropriate format and make assumptions where necessary in order to support your discussions).

*Beri contoh pilihan terhadap **Tiga (3)** klasifikasi dari sistem di atas dan huraikan bagaimana masalah berkaitan dapat diatasi. (gunakan format sesuai dan buat andaian di mana perlu untuk menyokong perbincangan anda).*

(25 marks/markah)

3. (a) In addition to proper maintenance, however, there are many operating changes that together can save a large fraction of the materials handling of energy cost. These cost savings can be realised if a systematic approach is followed. Identify the approach and discuss it briefly.

Tambahan kepada senggaraan yang teratur, walaubagaimana pun, terdapat perubahan pengoperasian di mana secara bersama boleh menjimatkan sebahagian besar penanganan bahan terhadap kos tenaga. Penjimatan kos ini dapat direalisasikan sekiranya satu pendekatan sistematik diikuti. Kenalpasti pendekatan tersebut dan bincangkannya secara ringkas.

- (b) Name **TWO** recent developments that have had dramatic impacts on energy management.

*Namakan **DUA** kemajuan terbaru yang telah memberi impak dramatis terhadap pengurusan tenaga.*

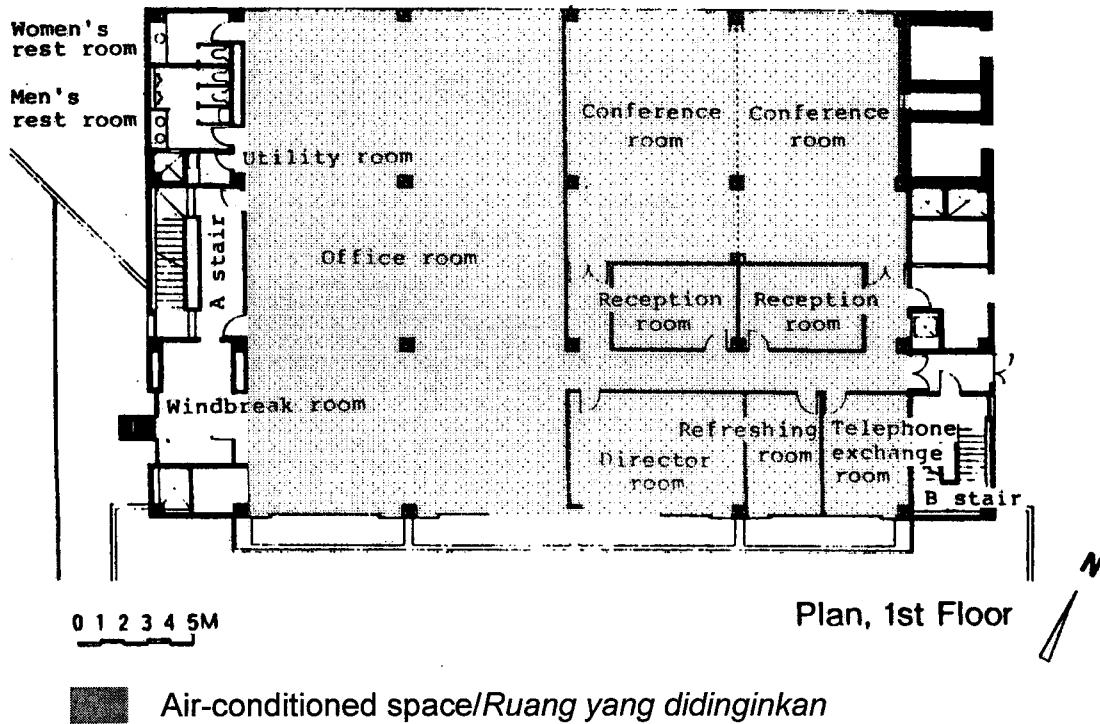
(25 marks/markah)

4. (a) Discuss the significance of energy audits and the differences between desktop energy audits and detail energy audits. Discuss in brief the procedures in conducting a detailed energy audit.

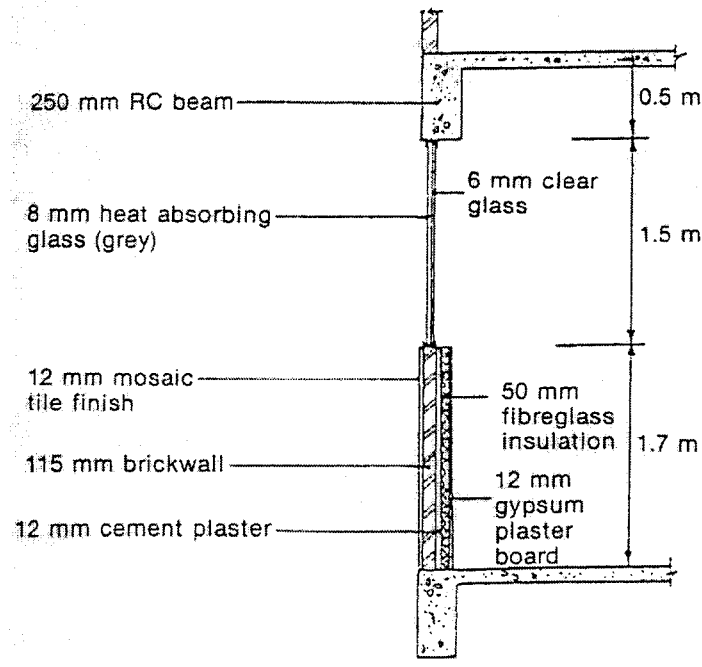
Bincangkan kepentingan audit tenaga dan perbezaan antara audit tenaga meja dan audit tenaga terperinci. Bincangkan secara ringkas prosedur dalam menjalankan audit tenaga terperinci.

- (b) What is the significance of OTTV concept in the construction of new buildings? Calculate the OTTV value for the space in **Figure 1** where the detail of a section is given in **Figure 2**. Give your comments on the calculated OTTV value.

*Apakah kepentingan konsep OTTV dalam pembinaan bangunan baru? Kirakan nilai OTTV bagi ruang yang diberikan pada **Rajah 1** dengan perincian keratan diberikan dalam **Rajah 2**. Beri komen anda tentang nilai OTTV yang diperolehi.*



**FIGURE 1 - FLOOR PLAN
RAJAH 1 - PELAN LANTAI**



**FIGURE 2 - SECTION A-A DETAILS
RAJAH 2 - PERINCIAN KERATAN A-A**

(25 marks/markah)

APPENDICES FOR QUESTION 4(b)
LAMPIRAN UNTUK SOALAN 4(b)

TABLE 1 – Surface Film Resistances for Walls and Roofs
JADUAL 1 – Rintangan Permukaan untuk Dinding dan Bumbung

Type of Surface	Thermal Resistance m ² K/W
A Surface Film Resistance for Walls: 1. Inside surface (R _i) (a) High Emissivity (b) Low Emissivity 2. Outside surface (R _o) (High Emissivity)	 0.120 0.299 0.044
A Surface Film Resistance for Roofs: 1. Inside surface (R _i) (a) High Emissivity (i) Flat roof (ii) Sloped roof 22½° (iii) Sloped roof 45° (b) Low Emissivity (i) Flat roof (ii) Sloped roof 22½° (iii) Sloped roof 45° 2. Outside surface (R _o) (High Emissivity) Flat or Sloped	 0.162 0.148 0.133 0.801 0.595 0.391 0.055

TABLE 2 – Solar Correction Factors
JADUAL 2 – Faktor Pembetulan Solar

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

TABLE 3 – k-values for basic materials
JADUAL 3 – nilai-k untuk bahan-bahan asas

Sr No.	Material	Density kg/m ³	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:		
	(a) dry (covered by plaster or tiles outside)	1760	0.807
	(b) common brickwall (brickwall directly exposed to weather outside)		1.154
6	Concrete	2400	1.442
		64	0.144
7	Concrete, light weight	960	0.303
		1120	0.346
		1280	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:		
	(a) standard	1024	0.216
	(b) medium	640	0.123
15	Metals:		
	(a) aluminium alloy, typical	2672	211
	(b) copper, commercial	8784	385
	(c) steel	7840	47.6
16	Mineral wool, felt	32 - 104	0.035 -
17	Plaster:		0.032
	(a) gypsum	1216	
	(b) perlite	616	0.370
	(c) sand/cement	1568	0.115
	(d) vermiculite	640 - 960	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:		0.713
	(a) sand stone	2000	0.375
	(b) granite	2640	
	(c) marble/terrazzo/ceramic/mosaic	2640	1.298
23	Tile, roof	1890	2.927
24	Timber:		1.298
	(a) across grain soft-wood	608	0.836
	(b) hardwood	702	
	(c) plywood	528	0.125
25	Vermiculite, loose granules	80 - 112	0.138
26	Wood chipboard	800	0.138
27	Woodwool slab	400	0.065
		480	0.144
			0.086
			0.101