

Prince of Songkla University
Faculty of Engineering

Final Examination

4 October 2005

215-663 Energy Management in Buildings

Semester 1/2548

Time 9:00-12:00

Room: R300

Directions

- This is an open book examination.
- All types of calculator and dictionary are permitted.
- Attempt all 3 questions.
- Do in the attached book.
- Students may not borrow books and note, nor talk to each other.

Juntakan Taweekun
Instructor

Problem	Marks
1	20
2	30
3	30
Total	80

Name _____

ID _____

Question 1 (20 points)

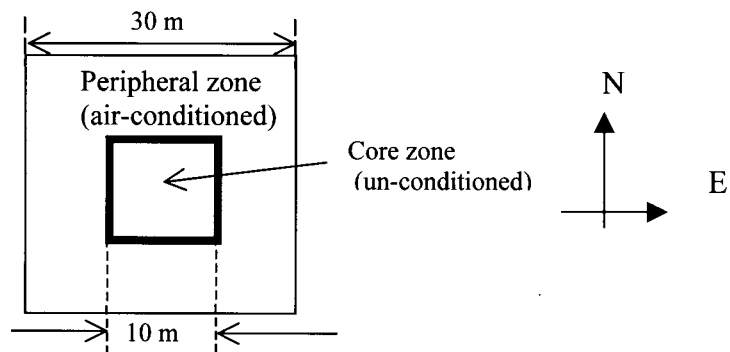
The reflectance values of the surfaces of a room of length 6 m, with 6 m and height 3.5 m are ceiling 80%, wall 50% and floor 20%. The work plan is at 0.75 m from the floor and the fixtures are on the ceiling. Use LLF of 0.70. Task area and general area of this room is 12.5 m² and 17.5 m², remaining area is non-critical area. The value of Luminaire Coefficient of Utilization (CU) can be obtained from the following table.

Room Cavity Ratio	0	1	2	3	4	5	6	7	8	9	10
Luminaire Coefficient of Utilization	.55	.55	.50	.45	.40	.36	.32	.26	.26	.26	.26

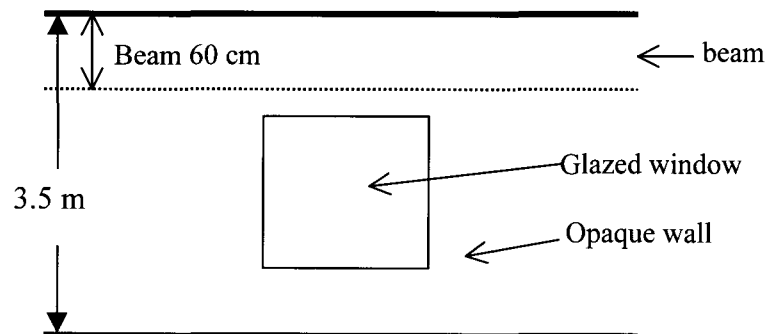
The efficacy of lamp is 55 lm/W. If the uniform illuminance of visual task of 490 lux is required, calculate total electric power required (in unit of Watt) and power intensity for this room

Question 2 (30 points)

The arrangement of a typical floor in a square office building is as shown.



A) Building plan



B) Details on the wall of a storey, WWR 0.35

The wall of the building comprises a beam, an opaque section, and a glazed window as shown. The height of each floor is 3.5 m and the ratio of window area to overall wall area (WWR) is 0.35. The facades of the building face cardinal directions. Material details of the beam, glazing and opaque wall are given in the following table.

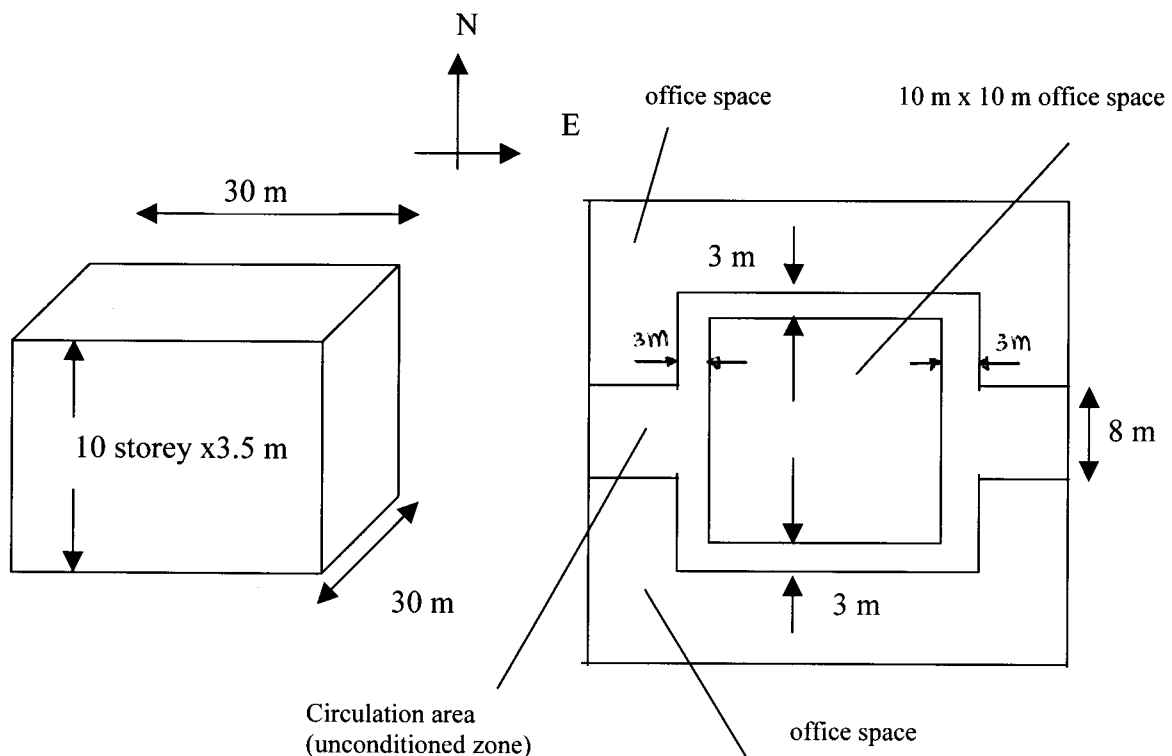
Section	Details
Beam	Concrete slab, thickness 40 cm, width 60 cm, Medium color exterior ($\alpha_b=0.5$) $k = 1.442 \text{ Wm}^{-1}\text{K}^{-1}$, density = $2,400 \text{ kgm}^{-3}$
Glazing	Single, reflective gray 6 mm, SC = 0.65, $U_f = 5.96 \text{ Wm}^{-2}\text{K}^{-1}$
Opaque wall	Plaster-brick-plaster, 1-8-1 cm Medium color exterior ($\alpha_w=0.5$) Plaster: $k = 0.9 \text{ Wm}^{-1}\text{K}^{-1}$, density = $1,850 \text{ kgm}^{-3}$ Brick: $k = 0.807 \text{ Wm}^{-1}\text{K}^{-1}$, density = $1,760 \text{ kgm}^{-3}$

Here, the columns are neglected. The value of h_o is $22 \text{ Wm}^{-2}\text{K}^{-1}$ and h_i is $8 \text{ Wm}^{-2}\text{K}^{-1}$.

- Calculate the OTTV of this building.

Question 3 (30 points)

A office building has a square shape as shown. The building comprises 10 floors.



The following information are applicable.

- OTTV = 55 Wm^{-2}
- RTTV = 15 Wm^{-2} .
- Uniform lighting is used
 - Office space 25 Wm^{-2}
 - Circulation area 10 Wm^{-2}
- Office equipment 10 Wm^{-2}
- Number of people: 1 person/ 10 m^2 of office space
- Ventilation in office space 1 l/(s.m²), 25 W/(l/s)
- Total average power taken by lifts are 60 kW during office hours.
- System COP of air-conditioning system is 3.0.
- Security lighting during night time totals 45 kW
- Day time operating hours 2,500 per annum
- Night time operating hours 4,200 per annum

Compute the followings

- i) Average cooling load due to external factor (kW)
- ii) Average cooling load of the building (kW)
- iii) Average electrical power for day time (kW)
- iv) Average electrical power for night time (kW)
- v) Annual energy consumption ($\text{kWhm}^{-2}\text{Yr}^{-1}$)