CONTENTS

Clause

0 Introduction

1 Scope

2 Normative references

3 Terms & definitions

4 Architectural and passive design strategy

5 Building envelope

6 Lighting

7 Electric power and distribution

8 Air-conditioning and mechanical ventilation (ACMV) system

9 Energy management control system

10 Building energy peformance

Building energy simulation method (an alternative compliance method)

WG members for Building Energy Performance

- ASHRAE Malaysia Chapter
- Association of Consulting Engineers Malaysia
- Building Automation System Association of Malaysia
- Greenbuildingindex Sdn Bhd
- Jabatan Kerja Raya
- Malaysia Green Building Confederation (Council)
- Malaysian Association of Energy Service Companies
- SEDA Malaysia
- SIRIM Berhad (Secretariat)
- The Institution of Engineers, Malaysia

Major modifications for Chapter 10

a) Amended heading of Clause 10 to cater for introduction of new content.
b) Refined write-up on scope of building energy simulation method.
c) Added notes on parameters for simulation of energy use relating to population, working hours and building function.
d) Extended list of freewares.
e) New section on Building Energy Intensity benchmark for office building established.

10. Building energy performance

10.1 Scope of building energy simulation method (an alternative compliance)

10.2 Building energy simulation

10.3 Design building

10.4 Base building

10.5 Simulation programs

10.6 Compliance

10.7 Exceptional compliance

10.8 Building energy intensity benchmark (BEI)

10.1 Scope of building energy simulation method (an alternative compliance)

The building energy simulation method is a performance based approach to compute the predicted energy use of buildings.

10.2 The building energy simulation should be performed twice. The first simulation should be for the building as designed, referred to as the design building. The second simulation is for a reference building referred to as the base building. The base building shall meet the relevant minimum requirements as specified in this standard (see Clauses 5, 6, 7 and 8).

10.3 The design building shall be modelled accurately from the architectural design drawings available.

10.4 The *base building* shall be modelled as, the model assumed for deriving the OTTV with the following characteristics:

10.4.1 The *base building* shall be as functional as the *design building* and shall share all the same characteristic of the *design building* with the exception of the following:

a) building envelope;

b) lighting, daylighting & lighting control; and

c) ACMV system.

NOTES:

1. This simulation permits designers to compensate for a poor building envelope with a daylighting control system and/or a more efficient ACMV system.
2. Other parameters such as population, working hours and building function shall remain the same for both the design and base buildings.

10.5 Simulation programs

The simulation programmes should be a computer-based programme for the analysis of energy consumption in buildings. The simulation programme should include calculation methodologies for the building components being modelled and incorporate the following:

a) a minimum of hourly variation in occupancy, lighting power, miscellaneous equipment power, thermostat set-points, and ACMV system operation, defined separately for each day of the week and holidays;

b) thermal mass effects; and

c) sufficient thermal zone to model the design building.

10.5 Simulation programs cont'd

NOTE. Freeware and commercially available softwares such as, but not limited to, DOE-2, TRNSYS, ESP-r, IES, EnergyPlus, eQUEST, OpenStudio may be used for this purpose.

10.5.1 The simulation program should have a report such as ANSI/ ASHRAE 140, CIBSE Applications manual AM11 or equivalent and the report should be furnished by the software developer.

10.5.2 Climatic data

The simulation program should perform the simulation using a Test Reference Year weather data that consist of, at least, hourly values of climatic data, such as temperature and humidity from representative climatic data, for the city in which the design building is to be located. For cities or urban regions with several climatic data entries, and for locations where weather data are not available, the designer should select weather data that best represent the climate at the construction site, but should not be more than 300 km away of a design location and be of similar altitude and land/cityscape

10.6 Compliance

Compliance will be established if:

a) the design building annual energy use, does not exceed the base building annual energy use as calculated by the same simulation programmes; and

b) the energy performance rating for equipment or components specified in the design building are not less than the rating used to calculate the base building energy consumption.

10.7 Exceptional compliance

10.7.1 Utilisation of on-site renewable energy sources (such as photovoltaic) or site-recovered energy, is encouraged. The annual energy consumption of the design building is permitted to be reduced by subtracting 100 % of the annual renewable energy or site-recovered energy utilised.

10.7.2 If the on-site renewable energy sources or site-recovered energy sources meet or exceed the energy used by the design building as simulated as per the requirement here, modelling or simulation of the base building need not be performed.

10.8 Building Energy Intensity (BEI) Benchmark

10.8.1 The BEI benchmark for Office Building conforming to this standard is **200** kWh/m^2/year and is derived using the following equation;

$$BEI_{benchmark} = \frac{(TBEC - CPEC) \times (52)}{(GFA_{excl\ carpark}) \times (WOH)}$$

where;
TBEC denotes Total Building Energy Consumption in kWh/year
CPEC denotes Car Park Energy Consumption in kWh/year
GFA denotes Gross Floor Area in m^2
WOH denotes Weighted Weekly Operating Hours of the Office in hrs/wk

Parameters used to simulate BEI for office

Building Envelope	
Building Length	38m
Building Width	38m
No. of Floor	20
Floor Efficiency	70%
Typical Floor Total GFA	1444m^2
Typical Office West Zone Area	510m^2
Typical Office East Zone Area	510m^2
Typical Lift Lobby	22m^2
	(2 banks of lifts each 4 x 20 kW)
Typical Toilet	57m^2
Window to Wall Ratio	50%
OTTV	50W/m^2
External Glazing Specification U-value	0.26W/m^2K
SC	0.35
External Wall U-value	2.65W/m^2K
Roof U-Value	0.6W/m^2K

Parameters used to simulate BEI for office cont'd

Internal Office Load - Typical Office

Lighting Power Density (LPD) :	12 W/m^2
Occupancy Density :	10 m^2/person
Maximum Sensible Gain :	75 W/person
Maximum Latent Gain :	55 W/person
Equipment Load :	*6 W/m^2
Equipment Profile : Based on Occupancy Profile	
Typical Lift Lobby	
Lighting Power Density (LPD) :	5 W/m^2
Typical Toilet	
Lighting Power Density (LPD) :	5 W/m^2
(Change profile to start 7.00am and off 7.00pm)	

*Average plug load 3.75 W/m^2 excl facade lighting
Data from Putrajaya government buildings 1.0 to 7.0 W/m^2; Av 4.7W/m^2

Parameters used to simulate BEI for office cont'd

ACMV Design

Design Temp / RH :	24 °C / 50 – 70%
Chiller COP :	6.26
Chilled Water Temp :	6.67 / 13.33 °C
Condenser Water Temp :	36.11 / 30.55 °C
AHU System :	CAV
AHU Fan Power :	0.42 W/CMH
Outdoor Air Ventilation :	2.5 lps/p (UBBL)
Cooling Tower Fan Power :	3.23 L/s · kW

Change profile for AC to start at 7.30 am (50 % load) stop at 5 pm (50 % load) 530 pm (0%)

ACMV Profile for Lift Lobby :

Change profile for AC to start at 8 am stop at 5 pm (if using FCU)

Parameters used to simulate BEI for office cont'd

Ventilation Rate : Based on UBBL (10ACH or 0.61 cmm/m2 whichever is lower)

Typical Toilet Area :		52 m^2
Typical Toilet Height :		3 m
Typical Toilet Volume :		156 m^3
Ventilation Flow Rate :	10ACH =	26 cmm ,
	0.61 cmm/m^2 =	31.72 cmm
Fan Power :		0.42 W/CMH
Ventilation Load :		655 W/Typical toilet

(Change profile to start 7.00am and off 7.00pm)