Centre of Environmental Technology, Limited

HK-BEAM (Existing Offices)

An environmental assessment for existing office buildings

version 2/96R

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Acknowledgements

The HK-BEAM scheme is a significant private sector initiative in Hong Kong to promote environmentally friendly design, construction and management practices for buildings. HK-BEAM is the initiative of The Real Estate Developers Association of Hong Kong. This first edition of this document was prepared by the Department of Building Services Engineering, The Hong Kong Polytechnic University with the assistance of the Welsh School of Architecture, Cardiff University, and the Centre for Environmental Technology, Limited, under the direction of the HK-BEAM Steering Committee.

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Contributions from colleagues in the Department of Building Services Engineering and the Welsh School of Architecture are acknowledged.

Revisions to HK-BEAM 2/96

This version of HK-BEAM is a revised and updated version of the document issued in 1996. Other than the change of name, amendments include changes to layout, inclusion of a checklist of credits, minor revisions to assessment criteria and an updating of the reference material. The background material previously included in HK-BEAM 2/96 (Chapter 6) has been removed. It is proposed that a major revision to this document will take place during the next twelve months, with the object to align all three versions of HK-BEAM[1,2,3].

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1 HK-BEAM 1/96R, An Environmental Assessment Method for New Office Designs. CET 1999. ISBN 962-85076-2-1.

2 HK-BEAM 2/96R, An Environmental Assessment Method for Existing Office Buildings. CET 1999. ISBN 962-85076-4-8.

3 HK-BEAM 3/99, An Environmental Assessment Method for New Residential Buildings. CET 1999.

1 Building Environmental Assessment Method

1.1 INTRODUCTION TO HK-BEAM

Environmental issues are of fundamental importance world-wide. In Hong Kong there is growing concern about the quality of the local environment. Environmental impacts should be minimised and residents should be provided with a better quality of life. Building and real estate professionals are aware of the large impact buildings have on the global and local environments and how good building design and operation can reduce such impacts, whilst providing good quality indoor environments. Government and the private sector is being urged to improve the quality of Hong Kong's building stock, buildings of all types, both old and new. Improved environmental performance of buildings is economically justified, for society as a whole, for developers, owners, occupiers and users.

The Hong Kong Building Environmental Assessment Method (HK-BEAM) provides authoritative guidance to developers (and their consultants), owners, operators and users on practices which minimise the adverse effects of buildings on the global and local environments, whilst promoting a healthy indoor environment. It has been developed to set criteria for good environmental performance in buildings; performance that would be recognised through an independently issued certificate. Developers and creditors can use the guidance to inform on building procurement. Prospective purchasers and tenants can obtain independent assessment of building performance to inform or obtain advice on purchase or leasing decisions.

The HK-BEAM scheme is an initiative of The Real Estate Developers Association of Hong Kong. The first two versions[4,5] were developed through a HK-BEAM Steering Committee with the assistance of the Department of Building Services Engineering, The Hong Kong Polytechnic University (BSE), the Welsh School of Architecture, University of Wales College of Cardiff (WSA), and ECD Energy and Environment Limited, UK. The scheme continues to be developed through the same Steering Committee, assisted by BSE, WSA, and the Centre for Environmental Technology Limited (CET). The scheme continues to be operated by CET, the executive arm of the Private Sector Committee on the Environment. An assessment under the HK-BEAM scheme is voluntary.

HK-BEAM defines good practice criteria for a range of environmental issues relating to the design, operation, maintenance and management of buildings. The HK-BEAM scheme currently embraces both new and existing air-conditioned office premises, and new residential buildings.

This document describes HK-BEAM version 2/99 for existing air-conditioned office premises. Assessment under HK-BEAM 2/99 focuses on the operation, maintenance and management of the building and may be carried out at any stage during the life of a building. HK-BEAM defines good practice criteria for a range of environmental issues relating to the design, operation, maintenance and management of office buildings. Buildings are compared to these criteria by CET's Assessor. 'Credits' are awarded where the criteria is satisfied. Where these are not satisfied guidance is given on how performance can be improved. The results of the assessment are shown on the HK-BEAM certificate as a rating of "Fair," "Good," "Very Good," or "Excellent".

All of the criteria in HK-BEAM are set at a level over and above standards that are legally required. The HK-BEAM scheme documents, and assessment criteria, are updated periodically as new information becomes available and as legal requirements evolve.

The remainder of Chapter 1 of this document describes the approach taken in assessing new air-conditioned office premises. Chapters 2 to 4 describe in detail how credits are awarded for designs judged to follow improved environmental practices.

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4 HK-BEAM Version 1/96, An Environmental Assessment Method for New Air-conditioned Office Premises. CET 1996. ISBN 962-85076-2-1.

5 HK-BEAM Version 2/96, An Environmental Assessment Method for Existing Air-conditioned Office Premises. CET 1996. ISBN 962-85076-4-8.

1.2 AIMS

HK-BEAM specifies criteria for a range of environmental issues. Its main aims are:

- to reduce the long-term impact that buildings have on the environment;
- to raise awareness of the large contribution which buildings make to global warming, acid rain and depletion of the ozone layer, as well as local environmental issues;
- to promote and encourage energy efficient buildings, and building services systems and equipment;
- to reduce the unsustainable use of increasingly scarce resources such as water, timber, and natural materials;
- to improve the quality of the indoor environment and hence the health and well-being of the occupants;
- to provide recognition for buildings where the environmental impact has been reduced;
- to set targets and standards which are independently assessed and so help to minimise false claims or distortions;
- to enable developers, operators and users to respond to a demand for buildings which have less impact on the environment, and to help stimulate such a market.

1.3 ASSESSMENT APPROACH

The scheme addresses items for which there is good evidence of the environmental problems they cause, and for which effective performance criteria can be defined. These criteria have been developed so that they can be readily assessed or prescribed during a survey of the building, giving practical recommendations for improved performance. Many issues cannot at present be included, either because the environmental problems they cause are not yet well enough understood or because effective performance criteria have not yet been established. Additional issues may be included in future issues as information which enables their objective assessment becomes available.

HK-BEAM 2/99 aims to reduce a building's environmental impact using the best available techniques and within reasonable additional cost. Some of the actions needed to improve performance may have an economic return which justifies the action, for instance, the cost of investment in measures to achieve a reduction in carbon dioxide emission rates may be met through reduced electricity bills.

It is not at present practical to assess all the issues covered in HK-BEAM on a common scale. There is insufficient information available to carry out an objective weighting of all of the issues because of the difficulty in assigning an economic cost to environmental effects as diverse as, for example, the health of individuals, ozone depletion, global warming and the future value of our fossil fuel resources.

It is not expected that a building will meet all of the target requirements. However, meeting one or more means that the building has less environmental impact than one in which the requirements have been met.

HK-BEAM 2/99 caters for whether or not the building is occupied. Where the offices form a part of a building that includes other types of premises, only the offices and their attendant services provisions are assessed. The assessment covers the building fabric, the engineering service systems (space cooling, ventilation, lighting, etc.), the Owner/Operator finishes and fitting-out (panelling, decorations, etc.), and the operation and management of the building. It does not cover the furniture or the equipment used by tenants, except where the disposal of office products relates to the use of space, for instance the provision of storage facilities for waste collection.

It is recognised that both the operator and tenants of a building can contribute to improving the global and local environmental impacts of the building. Both parties share a responsibility for efficient utilisation of resources and for the quality of the environment within the occupied space. Co-operation between building operator and tenants is an asset in improving a building's overall environmental performance. However, HK-BEAM 2/99 is written as an environmental assessment which will be commissioned by the Owner/Operator.

It is not intended to assess office areas. However, the information given to tenants in the form of the 'Tenant Fitting-Out Specifications' (see below) is assessed. In addition, it may be possible for the Owner/Operator to demonstrate compliance with the indoor environmental assessment criteria through presentation of the results of appropriate tests undertaken within occupied offices (see Chapter 4).

1.4 TENANT FITTING OUT SPECIFICATIONS

It is expected that the base building and engineering services will be designed for certain flexibility in the end use of the office space, but to meet specified indoor environmental performance requirements. The Designer will have these in mind when designing the building services systems. However, HK-BEAM recognises that in most commercial office buildings the final decision and responsibility for features such as the lighting, partitions and fittings in tenant areas rests with the tenants.

Consequently, HK-BEAM 2/99 encourages the Owner/Operator to provide prospective tenants with sufficient information and guidelines for fitting out the office spaces. Compliance with the so-called 'Tenants Fitting-Out Specifications' should ensure the indoor environmental conditions are satisfactory when the space is fully occupied, reinforcing the overall environmental performance of the building. Non-compliance would serve to alert the Tenant that the indoor environmental conditions may be compromised. Whilst the 'Tenant Fitting-Out Specifications' form an important part of the assessment, checks on actual compliance lies outside the scope of the assessment.

1.5 ISSUES CONSIDERED IN THE ASSESSMENT

The environmental issues covered are grouped under three main headings:

- Global issues and use of resources (Chapter 2)
- Local issues (Chapter 3)
- Indoor issues (Chapter 4)

A summary of the issues is given below. Table I summarises the criteria for the award of credits.

Global issues and use of resources:

- Overall Environmental Policy
- Environmental Purchasing Policy
- Energy Management Programme
- Electrical Energy consumption
- Ozone Depleting Substances
- Facility for Recycling Materials

Local issues:

- Electricity Maximum Demand
- Water Conservation
- Legionella Bacteria from Wet Cooling Towers
- Noise from the Building
- Transport and Pedestrian Access
- Vehicular Access for Servicing and for Waste Disposal
- Building Maintenance

Indoor issues:

- Operations and Maintenance of Building Services Systems
- Metering and Monitoring Equipment
- Biological Contamination
- Indoor Air Quality
- Mineral Fibres
- Radon

- Hazardous Materials
- Interior Lighting
- Indoor Noise

1.6 ASSESSMENT PROCESS

The HK-BEAM scheme is owned and operated by the Centre of Environmental Technology, Limited (CET), an independent, non-profit, environmental information centre.

CET will issue a questionnaire to interested developers which details the information required for assessment. Designs can be assessed at an early stage, allowing the Designer to make changes that will improve the building's environmental performance. CET will arrange to meet the design team to discuss the details of the design. The CET Assessor will subsequently undertake a provisional assessment based on the information gathered from the questionnaire and the discussion, and produce a provisional report.

This report will identify which credits have been achieved, and also outline changes necessary to obtain further credits. At this stage the client may wish to make changes to the design or specification of the building. The modified design may then be re-submitted to be re-assessed, and the Final Report and a Provisional Certificate are then issued.

Given that some credits under HK-BEAM are based on actions taken during construction and upon certain deliverables provided upon completion, the confirmation of certification will be made upon building completion. The Owner shall confirm in writing to the assessor that no changes affecting the environmental assessment (as defined in the Final Report) have been made, or will advise of any changes that may affect the assessment credit ratings. The Assessor will be empowered to check that no changes are made which affect the award of credits and the overall assessment. The Final Certificate will then be issued.

The assessor may award discretionary credits for any environmentally proactive feature not covered in any of the documented assessment points.

HK-BEAM certificate ratings (“Fair,” “Good,” “Very Good,” or “Excellent”) are based on the number of credits achieved in each of the three categories (Global Issues and Use of Resources, Local Issues and Indoor Issues), and the total number of credits which are achieved.

Information on how to participate in the scheme is available from the Centre of Environmental Technology, Limited.

Table I: Summary of Credits and Checklist

GLOBAL ISSUES AND USE OF RESOURCES

Sect:	Credit requirement:	Obtainable Credit:	Credits Obtained:
2.1	**Overall Environmental Policy:**		
	for having an established overall company policy to minimise the impact of the company's buildings on the environment.	**1**	
2.2	**Environmental Purchasing Policy:**		
a)	for a purchasing policy by those responsible for managing the building and services, which encourages the use of timber only from well-managed and identified sources for use in partitions, doors, floors, skirting and other fittings used in areas of the premises under the direct control of the Owner/Operator	**1**	
b)	for a purchasing policy by those responsible for managing the building and services, which excludes the use of: insulation materials manufactured using or containing CFCs or HCFCs; and aerosol sprays containing CFCs or HCFCs; paint containing volatile organic compounds; lead-based primers; and asbestos of any grade or form.	**1**	
2.3	**Energy Management Programme:**		
a)	for having an energy policy and an action plan, with the responsibility for implementation vested in a senior executive	**1**	
b)	for having carried out an energy audit of the building within the previous three years	**1**	
c)	for an energy monitoring and targeting system which sets targets and quantifies savings, together with an energy efficiency improvement investment budget and suitably trained staff to undertake its implementation	**1**	
2.4	**Electrical Energy Consumption:**		
a)	for having undertaken a retrofit programme in 'spaces for common activities' which are under the control of the Owner/Operator and showing an improvement in efficiency, as demonstrated by calculation of installed power density, of 20%, alternatively	**1**	
	for the installation of energy efficient lighting in 'spaces for common activities' which are under the control of the Owner/Operator, such that the overall installed lighting power density for these spaces is 15 W/m^2 or less	**2**	
b)	for designing to an office lighting power density of less than 20 W/m^2	**1**	
	for designing to an office lighting power density of less than 17.5 W/m^2	**2**	
	for designing to an office lighting power density of less than 15 W/m^2	**3**	
c)	for "Tenant Fitting Out Specifications" which specifies the provision of one or more of the following types of lighting control systems: time switching: for example, in office areas which have clear time-tables of occupation; switches linked to occupancy sensors which switch lights off in the absence of occupants; photo-electric switching or dimming system arranged to maximise the use of daylight.	**1**	

d)	where heat recovery is provided on the general exhaust from the air-conditioned spaces	**1**	
	for providing heat reclaim on chillers for winter space heating or other hot water requirements, or where there is no provision of winter space heating	**1**	
e)	for air conditioning equipment electricity load of less than 150 kWh/m^2/year	**1**	
	for air conditioning equipment electricity load of less than 140 kWh/m^2/year	**2**	
	for air conditioning equipment electricity load of less than 130 kWh/m^2/year	**3**	
	for air conditioning equipment electricity load of less than 120 kWh/m^2/year	**4**	
	for air conditioning equipment electricity load of less than 110 kWh/m^2/year	**5**	
	for air conditioning equipment electricity load of less than 100 kWh/m^2/year	**6**	
	for air conditioning equipment electricity load of less than 90 kWh/m^2/year	**7**	
2.5	**Ozone Depleting Substances:**		
a)	where the refrigerants employed in the air conditioning system have an average ozone depletion potential of less than 0.06	**1**	
	where the refrigerants employed in the air conditioning system have an average ozone depletion potential of less than 0.03	**2**	
	where the refrigerants employed in the air conditioning system have an ozone depletion potential of zero	**3**	
or	for demonstrating a phased programme of refrigerant replacement to an average ozone depletion potential of less than 0.03.	**1**	
b)	for specifying automatic refrigerant leak detection for indoor chiller plant, or specifying monthly manual checking for leakage for outdoor plant, AND specifying full refrigerant recovery during maintenance using approved refrigerant recovery equipment and containers.	**1**	
c)	where either: a fixed or portable refrigeration recovery unit is provided permanently on site for systems with a refrigerant charge of greater than 15 kg in weight, or a maintenance agreement exists with a qualified contractor using approved equipment	**1**	
d)	where: no halon-based fixed or portable fire protection systems are used in the building, or a schedule of maintenance and testing of fixed halon fire protection systems has been drawn up with the specific aim of minimising unnecessary emissions of halon	**1**	
2.6	**Facility for Recycling Materials:**		
	for buildings that incorporate dedicated space(s) for collection, sorting and separate storage of recyclable materials, collected from office premises	**1**	
	for a management system that provides for the collection and sorting of waste from office premises	**1**	
Total Credits Under Global Issues		**29**	

Table 1 : continued

LOCAL ISSUES

3.1	**Electricity Maximum Demand:**		
	for demonstrating peak electricity demand less than 160 VA/m^2 (in typical office areas)	**1**	
	for demonstrating peak electricity demand less than 140 VA/m^2	**2**	
	for demonstrating peak electricity demand less than 120 VA/m^2	**3**	
3.2	**Water Conservation:**		
a)	for providing an arrangement of water meters which permits the monitoring of fresh water consumption by the Owner/Operator for each of the major engineering services, separate from that of tenants	**1**	
b)	for specifying and detailing fresh water systems which are fitted with: a flow control and balancing system to control flow characteristics of each faucet, for the purposes of water economy, or devices to automatically control the operation of taps and urinals which use fresh water, for the purposes of water conservation	**1**	
3.3	**Legionella Bacteria from Wet Cooling Towers:**		
	for a building in which: wet cooling towers are not used, or the wet cooling towers use seawater, or the wet cooling towers use water from an acceptable source and are designed and maintained as specified in the Code of Practice for the Prevention of Legionnaires Disease	**1**	
3.4	**Noise from the Building:**		
	for complying with the acceptable noise levels for neighbouring sensitive receivers in accordance with the Technical Memorandum for the Assessment of Noise from places Other Than Domestic Premises, Public Places or Construction Sites	**1**	
3.5	**Transport and Pedestrian Access:**		
a)	for achieving at least one of the following: no car parking provided, or restricted provision of car parking space to the minimum required to comply with lease conditions with access which ensures simultaneous free flow of vehicles in and out of the car park	**1**	
b)	for providing easy and substantially sheltered pedestrian access to a mainstream mass transport system	**1**	
3.6	**Vehicular Access for Servicing and for Waste Disposal:**		
a)	for providing access for delivery vehicles to the service areas of the building which lies within the site boundary and which are enclosed and/or segregated from pedestrian access routes	**1**	
b)	for providing access for waste collection vehicles which lies within the site boundary and which are enclosed and/or segregated from pedestrian access routes	**1**	
3.7	**Building Maintenance:**		
	where a planned programme of regular maintenance, cleaning and inspection of the building's fabric is in operation supported by a comprehensive and easy-to-follow manual	**1**	
Total Credits Under Local Issues		**12**	

Table 1 : continued

INDOOR ISSUES

4.1	**Operations and Maintenance of Building Services Systems:**		
a)	for having an easy-to-follow, regularly updated manual detailing the operating methods, instructions and standard control settings for HVAC services equipment	**1**	
b)	for an established programme of regular inspections, cleaning and maintenance of the building services engineering systems under the authority of a senior executive	**1**	
4.2	**Metering and Monitoring Equipment:**		
a)	for metering that allows measurement of electricity use and energy consumed by Owner/Operator's major building services systems	**1**	
b)	for specifying metering which allows separate monitoring of electricity use by the main chiller plant and auxiliaries, and for specifying metering which allows separate monitoring of cooling energy output from the main chiller plant	**1**	
c)	for metering which allows separate monitoring of electricity use by the air side of the HVAC system	**1**	
4.3	**Biological Contamination:**		
a)	for complying with the recommendations described in the Code of Practice for the Prevention of Legionnaires Disease that are applicable to indoor HVAC equipment	**1**	
b)	for complying with the recommendations described in the Code of Practice for the Prevention of Legionnaires Disease that are applicable to domestic water systems	**1**	
4.4	**Indoor Air Quality:**		
a)	for confirming that the positioning of outdoor air intake(s) and exhaust(s) are such to minimise pre-contamination, prevent short-circuiting of exhaust back into air intakes, and avoid nuisance to neighbours from exhaust discharge(s)	**1**	
b)	for demonstrating: a ventilation rate of 8 l/s per person or above is achieved in office premises in which smoking is not permitted, or the ventilation rate meets ASHRAE or CIBSE recommended ventilation rate for a smoking environment, or through proper measurement that the carbon dioxide level in offices premises with an occupant density equal or greater than the design density is less than 800 parts per million.	**1**	
c)	for demonstrating through measurement that the air distribution in the occupied areas of office premises is adequate	**1**	
d)	for installing filters for intake air and air handling units with dust spot efficiency ≥ 80% tested in accordance with ASHRAE Standard 52.1-92 or European Standard EN-799:1993, or for areas mainly served by fan coil systems installing filters for intake air and air handling units with dust spot efficiency ≥ 80%, and fan coil units with dust spot efficiency ≥ 35%, or demonstrating that the filtration system installed shall be capable of maintaining the indoor respirable suspended particulate level below 180 $\mu g/m^3$ for 24 hour time weighted average	**1**	
	for specifying filters for intake and recirculating air with dust spot efficiency ≥ 80% or otherwise showing that this higher efficiency is not necessary	**1**	
e)	for designs which include provision for separate ventilated system for areas where significant indoor pollution sources are present, such as print rooms, etc	**1**	

4.5	**Mineral Fibres:**		
a)	where the original building specification specifically excluded the use of asbestos in the building, or for having carried out a professional asbestos survey, keeping written record of the location of all asbestos, and taking appropriate action to deal with all asbestos identified	**1**	
b)	for demonstrating that the following conditions are satisfied: fibrous duct liners are not used inside the ventilation ducts or equipment, excepting coated or uncoated sound attenuation liners up to 4 m in length, or fibrous duct liners inside the ventilation ducts or equipment are covered with durable polymer or foil or similar fibre control, and fibre release is confined to the return air ducts, and uncoated duct liners are not used in supply air ducts.	**1**	
	where no significant quantities of uncontained man-made mineral fibre materials are located in the air handling plant rooms or air plenums	**1**	
or	for demonstrating through measurements of unoccupied office areas levels of mineral fibres less than 1000 fibres/m^3	**2**	
4.6	**Radon:**		
	for having undertaken a radon survey, and for having taken appropriate action where the levels are shown to exceed 200 Bq/m^3	**1**	
4.7	**Hazardous Materials:**		
a)	for specifying particleboard conforming to British Standard BS 5669 and fibreboard conforming to British Standard BS 1142 excluding use of treated timber where it is not recommended in any relevant codes and standards, and specifying all preserved timber shall be industrially pre-treated ready for finishing on site	**1**	
b)	for use of paints that contain no lead, and paint containing volatile organic compounds (VOC) conforms to British Standards relating to solvent	**1**	
4.8	**Interior Lighting:**		
a)	for "Tenant Fitting Out Specifications" which specifies that: fluorescent and other lamps with modulating (fluctuating) output should be fitted with high-frequency ballasts in all the areas used for office work, and lamps shall have a CIE general colour rendering index 80 or above (i.e. colour rendering groups 1A or 1B)	**1**	
b)	for "Tenant Fitting Out Specifications" which demonstrates by calculations for a typical office floor plan and surface finishes that CIBSE guidelines on the following items of office lighting design are followed: maintained illuminance on the working plane; illuminance variation; and glare	**1**	
4.9	**Indoor Noise:**		
	for noise levels below the following values: 45 dB $L_{Aeq,T}$ in private offices, small conference rooms. 50 dB $L_{Aeq,T}$ in large offices	**1**	
Total Credits Under Local Issues		**22**	
Total Credits Available		**63**	

2 Global Issues and Use of Resources

Apart from population growth the construction and use of buildings has a greater impact on the global environment than almost any other human activity. Environmental damage arises as a result of, for example, energy and materials used during construction, energy used for cooling and lighting, the chemicals present in materials used in building services and components, and waste streams during construction, operation, refurbishment and demolition.

The first principle is to recognise environmental management to be among the higher corporate priorities and a key determinant to sustainable development. Enterprises should establish policies, programmes and practices for conducting their operations in an environmentally sound manner. They should develop, design and operate facilities and conduct activities taking into consideration the efficient use of energy and materials, the sustainable use of renewable resources, minimise generation and ensure responsible disposal of wastes. They should also promote the adoption of these principles by contractors acting on behalf of the enterprise, encouraging, and where appropriate, requiring improvements in their practices, and to encourage the wider adoption of these principles by suppliers.

This chapter covers the effects that buildings have on the planet and it's atmosphere beyond the local region: global warming, ozone depletion, acid rain and sustainable resources.

2.1 OVERALL ENVIRONMENTAL POLICY

For an organisation to be successful in addressing environmental issues, it must set clear objectives at the highest level with a programme for their management, checking and review. An environmental policy, endorsed by directorate level management, is a key element of such a programme. ISO 14004[6] sets out guidelines for establishing an environmental management system (EMS) and specifies the key features of an effective environmental policy as:

- being appropriate to the nature, scale and environmental impacts of the organisation's activities, products and services (e.g. in real estate, property and facility management);
- committing to continual improvement and pollution prevention (e.g. in energy efficiency and the reduction of associated green house gases);
- committing to comply with relevant environmental legislation (e.g. in the use of ozone depleting substances or other hazardous materials);
- providing a framework for setting and reviewing environmental objectives and targets (e.g. in energy or material consumption); and
- is documented and communicated to all employees, suppliers, and customers.

Corporate environmental policies naturally vary between organisations. The HK-BEAM criteria provide flexibility to embrace all commitments to environmental protection and improvement where these can be demonstrated to be appropriate, practical and achievable.

Objective of HK-BEAM

To promote business practices which acknowledge and promote the need to protect the environment.

Maximum number of credits attainable: 1

Credit requirement

❖ 1 credit for having an established overall company policy to minimise the impact of the company's buildings on the environment.

6 International Organization for Standardization. ISO 14004 Environmental management systems – General guidelines on principles, systems and supporting techniques. 1996.

Method of assessment

The Owner/Operator will be required to provide a copy of the Company's overall policy with regard to the environment. HK-BEAM assessment focuses on the implementation of an effective Environmental Policy in respect of the most pressing environmental issues associated with existing office buildings; improving energy efficiency and providing a safe, healthy and comfortable indoor environment. In addition, at least two other suitable policy commitments should be included. Such commitments may, for example, seek to:

- reduce material consumption, and to reuse or recycle wastes whenever practicable;
- promote the use of recycled and recyclable materials which represent value for money;
- encourage suppliers to identify the impacts of their goods, and work on reducing them;
- require suppliers to avoid unnecessary packaging, and encourage to use returnable, recycled, recyclable, biodegradable and non-toxic packaging materials;
- ensuring operational plant is so designed as to minimise visual, noise and other impacts on the local environment; and
- provide a framework for setting and reviewing environmental objectives and targets.

Where such a document has been produced and the company is able to demonstrate that it is published or openly available to customers, suppliers and staff, a credit shall be given.

2.2 ENVIRONMENTAL PURCHASING POLICY

An organisation's purchasing policy forms part of environmental management. Where major consumers include environmental considerations in purchasing decisions, the market place will respond. HK-BEAM targets purchasing activities for certain materials used in building maintenance and refurbishment.

All the timber used in Hong Kong is imported. Hong Kong is a major user of tropical timber, figuring in the top ten of importers.[7] Large quantities of tropical hardwoods are still specified for interior use, such as for parquet flooring, doors, framing, skirting, etc. Alternatives for fittings and interior use exist in the form of chipboard, medium density fibreboard and suitably treated softwood. Non-load bearing, built-in wall panels, are often framed in hardwood timber, whereas non-timber framed proprietary wall panel systems are available.

CFCs and HCFCs have been identified as a cause of damage to the earth's stratospheric ozone layer and materials that contain them, or require there use during manufacture, should be avoided where possible.[8] The use of paints containing organic solvents can contribute a significant health hazard if used in unventilated conditions. There may also be a small hazard and annoyance to occupants returning to recently painted areas or to the occupants of adjacent offices during application and drying out of the paint.

Objective of HK-BEAM

To minimise the environmental impacts through choice of materials and products used in maintaining and refurbishing buildings. This affects use of natural resources, as well as indoor issues.

Maximum number of credits attainable: 2

Credit requirement

a) Use of timber

❖ 1 credit for a purchasing policy by those responsible for managing the building and services, which encourages the use of timber only from well-managed and identified sources, for use in partitions, doors, floors, skirting and other fittings used in areas of the premises under the direct control of the Owner/Operator.

b) Ozone depleting substances and hazardous materials

❖ 1 credit for a purchasing policy by those responsible for managing and operating the building and services, which excludes the use of:

- ♦ insulation materials manufactured using or containing CFCs or HCFCs; and
- ♦ aerosol sprays containing CFCs or HCFCs;
- ♦ paint containing volatile organic compounds;
- ♦ lead-based primers; and
- ♦ asbestos of any grade or form.

Method of assessment

a) The Owner/Operator will be required to provide details of the company's purchasing policy for timber used in the refurbishment of the building for partitioning, doors, floors, skirting and other fixed internal fittings.

All softwood and hardwood timbers used in permanent solid joinery (such as lippings, framing, veneers) and all plywoods shall originate from sustainably managed sources. Softwoods (such as Radiata Pine and Douglas Fir) and temperate hardwoods (such as Beech

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7 Friends of the Earth. Report on the use and waste of tropical timber by Hong Kong's construction industry. January 1992.

8 Building Research Establishment. CFCs in buildings. BRE Digest 358. October 1992.

and China Oak) are considered to originate from sustainable sources. The use of softwoods and temperate hardwoods for permanent joinery is acceptable. Tropical hardwoods shall be considered to originate from unsustainable sources unless independent certification can be provided to demonstrate otherwise. Tropical hardwoods include species such as Meranti, Iroko, Sapele, Angre, Mahogany and Ramin. Solid timbers and plywoods from tropical origins should be avoided unless the Owner/Operator can provide the following details:

- the species and country of origin;
- the name of the concession or plantation within the country of origin supplying the timber;
- a copy of the forestry policy being pursued for the plantation or concession;
- shipping documents confirming that the timber supplier has indeed obtained their timber from that concession.

b) Details of the company's purchasing policy with respect to the materials listed shall be provided. The policy should identify acceptable products or materials for use and the names of the suppliers from whom they can be obtained. If the policy is to avoid these materials and products, credit will be given.

The ‘Tenants Fitting-Out Specifications’ will be assessed to verify that information and advice is given to tenants to encourage them to meet the above criteria.

2.3 ENERGY MANAGEMENT PROGRAMME

For most office buildings the energy used for running the building over its lifetime is many times greater than the sum of the energy used during construction. Energy efficient operation is therefore the most effective means of reducing carbon dioxide emissions. The management and operation of a building and the way the tenants use the building can have a major impact on its energy consumption. Credits are achieved when energy management forms part of the Owner/Operator's environmental policy. Energy management should:

- be fully integrated into the organisation's management systems;
- have monitoring and targeting systems in place based on sub-metering of the fuels used;
- include regular reports and reviews of the monitored data;
- set targets for energy efficiency improvements, and
- be supported by an action plan.

Staff awareness of the importance of energy costs and efficiency is important if efficiency is to be improved through management procedures. Financial support for an action plan for implementing energy-saving measures is essential, either by a budget allocation or by allocation of all or part of savings in fuel bills. It is also vital that an appropriate person in the organisation is responsible for energy saving.

Objective of HK-BEAM

To encourage concerted action by directorate level management to improve the utilisation of energy used in the building. This covers actions aimed to improve system and equipment performance, i.e., improved energy efficiency, and to promote energy conservation, i.e., reduce wastage of energy.

Maximum number of credits attainable: 3

Credit requirement

a) Energy policy and action plan

❖ 1 credit for having an energy policy and an action plan, with the responsibility for implementation vested in a senior executive.

b) Energy audit

❖ 1 credit for having carried out an energy audit of the building within the previous three years.

c) Energy monitoring and targeting

❖ 1 credit for an energy monitoring and targeting system which sets targets and quantifies savings, together with an energy efficiency improvement investment budget and suitably trained staff to undertake its implementation.

Method of assessment

a) The Owner/Operator shall submit documentation demonstrating the commitment, at directorate level, to responsible energy management, and an action plan aimed at achieving greater energy efficiency throughout the building, and its main building services engineering systems and equipment. The energy policy shall include commitment to control energy consumption, such as[9]:

- avoiding unnecessary expenditure;
- improving cost-effectiveness, productivity and plant operating condition;
- investing in the clean, energy efficient technologies;
- to reduce as far as practicable the impact on the environment; and

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9 UK Department of the Environment's Energy Efficiency Best Practice programme. BRESCU. Building Research Establishment. http://www.bre.co.uk/bre/otherprg/eebp/default.html. Good Practice Guide 186. Developing an effective energy policy. June 1996.

- reducing the consumption of fossil fuels.

The action plan shall include:

- details of the channels of communication for staff at all levels responsible for energy use;
- monitoring of consumption; and
- quantification of savings.

The action plan and regular review shall be integrated into management and operations structure and have clear delegation of responsibility for energy consumption.

b) The Owner/Operator shall provide a written report, endorsed by a Registered Professional Engineer or person with similar professional qualifications, confirming that an audit has been completed essentially in accordance with the practice outlined in CIBSE Applications Manual AM5.(10) The Owner/Operator shall provide evidence from energy consumption records, operation and maintenance records, and other documentation, to verify actions to improve energy efficiency were identified, those that have been completed, and those that are in progress. The audit may exclude energy consumption by tenants.

c) The Owner/Operator shall provide details of the energy monitoring and targeting system, details of the investment in energy efficiency improvements, and the credentials of the staff who are undertaking implementation.(11)

10 The Chartered Institution of Building Services Engineers. Energy audits and surveys. Applications Manual AM5. 1991.

11 BRESCU. Building Research Establishment. General Information Report 12. Aspects of energy management. Energy management guide. 1998.

2.4 ELECTRICAL ENERGY CONSUMPTION

Since this version HK-BEAM applies to air-conditioned office buildings wherein, but for a few exceptions, energy use is limited to electricity it is sufficient to focus on reducing electrical energy consumption. The environmental impact is both global, in terms of carbon dioxide (CO_2) emissions, and more localised, in terms of emissions of sulphur dioxide (SO_2) and nitrogen oxides (NO_x). Gaseous emissions from power stations depend on the amount and type of primary fuel used. However, delivered electricity does not directly reflect CO_2 production because CO_2 production per unit of electrical energy delivered depends on the fuel used and the efficiency of conversion at power stations.

For a typical Hong Kong office building, about 80% of the electrical energy consumed is for air conditioning and lighting. The remaining 20% is consumed by 'small power' appliances (12%), lifts and miscellaneous items (8%). The main electrical energy saving that can be achieved is therefore associated with reducing the lighting and air conditioning loads. There is much that can be done in operating, controlling and maintaining the system to optimise the seasonal electrical energy consumption and maximum demand.

It is recognised that control of the lighting installations often rests with the tenants. The 'Tenants Fitting Out specifications' is a means of encouraging tenants to adopt environmentally friendly practices. It should contain advice on energy efficiency and conservation measures that can be adopted by tenants. HK-BEAM seeks to encourage levels of efficiency which are better than those given in the Government's Lighting Energy Code[12,13].

Objective of HK-BEAM

To reduce electrical energy consumption so as to reduce the release of CO_2 into the atmosphere and thus reduce the potential for global warming. Related benefits will be to reduce acid rain due to oxides of nitrogen and sulphur, and to reduce the rate of depletion of fossil fuels.

Maximum number of credits attainable: 15

Credit requirement

a) Owner/Operator installed lighting

- 1 credit for having undertaken a retrofit programme in 'spaces for common activities' which are under the control of the Owner/Operator and showing an improvement in efficiency, as demonstrated by calculation of installed power density, of 20%.

alternatively:

- 2 credits for the installation of energy efficient lighting in 'spaces for common activities' which are under the control of the Owner/Operator, such that the overall installed lighting power density for these spaces is 15 W/m^2 or less.

b) Office lighting power density

Credit will be given on a 3 point scale to office designs where the 'Tenants Fitting Out Specifications' demonstrates a design lighting power density (in W/m^2 of office floor area, including tube and ballast losses, etc) which is less than that given in Table (LG4) of the Lighting energy code.

- 1 credit for designing to an office lighting power density of less than 20 W/m^2.
- 2 credits for designing to an office lighting power density of less than 17.5 W/m^2.
- 3 credits for designing to an office lighting power density of less than 15 W/m^2.

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12 Electrical and Mechanical Services Department, The Government of the Hong Kong Special Administrative Region. Code of Practice for Energy Efficiency of Lighting Installations. 1998.

13 Electrical and Mechanical Services Department, The Government of the Hong Kong Special Administrative Region. Guidelines on Energy Efficiency of Lighting Installations. 1998.

c) Office lighting control

- ❖ 1 credit for "Tenant Fitting Out Specifications" which specifies the provision of one or more of the following types of lighting control systems:
- ♦ time switching: for example, in office areas which have clear time-tables of occupation;
- ♦ switches linked to occupancy sensors which switch lights off in the absence of occupants;
- ♦ photo-electric switching or dimming system arranged to maximise the use of daylight.

d) Heat recovery

- ❖ 1 credit where heat recovery is provided on the general exhaust from the air-conditioned spaces.
- ❖ 1 credit for providing heat reclaim on chillers for winter space heating or other hot water requirements, or where there is no provision of winter space heating.

e) Annual air conditioning electricity consumption

Credit will be given on a 7 point scale to offices which have a predicted annual electricity load for the air conditioning system (in kWh per square metre for a typical office floor area per year) less than would be achieved by a typical new Hong Kong office building.

- ❖ 1 credit for air conditioning equipment electricity load of less than 150 kWh/m^2/year.
- ❖ 2 credits for air conditioning equipment electricity load of less than 140 kWh/m^2/year.
- ❖ 3 credits for air conditioning equipment electricity load of less than 130 kWh/m^2/year.
- ❖ 4 credits for air conditioning equipment electricity load of less than 120 kWh/m^2/year.
- ❖ 5 credits for air conditioning equipment electricity load of less than 110 kWh/m^2/year.
- ❖ 6 credits for air conditioning equipment electricity load of less than 100 kWh/m^2/year.
- ❖ 7 credits for air conditioning equipment electricity load of less than 90 kWh/m^2/year.

Method of assessment

a) This applies to the lighting systems used in all areas of the building which serve the office premises and which are under the control of the Owner/Operator. This includes lift lobbies, staircases, plant rooms, etc., as listed in Table (LG4) of the Lighting energy code[8]. The design illuminance in each applicable area shall comply with the CIBSE Code for interior lighting[14].

To demonstrate the gain in efficiency, the Owner/Operator shall provide details of the lighting systems for each of the areas, before and after the retrofit, in the format given in Tables LG-1 and LG-2 of the Lighting code. To qualify for credit the Owner/Operator would demonstrate a minimum of 20% improvement in efficiency based on aggregated sum of computed power savings. In situations where installed power density has been raised in order to achieve compliance with the CIBSE Code for interior lighting, credit can still be considered if it can be shown that this has been achieved using light sources having higher efficacy when compared to the original installation.

To qualify for the credits based on overall installed power density the Owner/Operator shall provide details of the lighting systems provided for each of the areas in the format given in Tables LG-1 and LG-2 of the Lighting code. Given the variability of lighting needs in each type of space it is not intended to be too prescriptive as to the requirements for each, but the average installed lighting power density in all areas under owner/operator control shall not exceed 15 W/m^2.

In the event that the retrofit of energy efficient lighting has not been completed, credit shall be awarded if the Owner/Operator can provide details of the planned retrofit, together with confirmation of the retrofit schedule signed by the Chairman of the Board. Technical details of the planned retrofit shall be in the same report format as above, and shall satisfy the criteria for credit upon completion. The deadline for completion shall be six months from the date of completing the assessment.

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14 The Chartered Institution of Building Services Engineers. Code for interior lighting. London. CIBSE, 1994.

b) The office design installed lighting load shall be demonstrated by calculations based on CIBSE Code for interior lighting (see also the section on Interior Lighting under Indoor Issues, Chapter 4). The Owner/Operator shall submit a lighting layout plan for a typical floor of the office building, details of lamps and luminaires, and calculation of lighting power density, to be provided as guidance in the 'Tenants Fitting Out Specifications'. The submission shall be in the format given in Tables LG-1 and LG-2 of the Lighting code. Where more than one layout or system is specified, the Designer shall submit the details for each.

c) The designer shall submit drawings and specifications for a typical office floor plan to demonstrate that at least one type of lighting control system is detailed in the 'Tenants Fitting Out Specifications'. To be eligible for credit, the interior lighting control shall conform with Table (LG5) of the Lighting code[8] with respect to minimum number of lighting control points.

   In addition, the 'Tenants Fitting-Out Specifications' shall specify and show design details for a typical office floor layout, with no more than 10 m^2 of installed luminaires controlled from one switch point.

d) For the assessment of heat recovery the Owner/Operator shall provide details of the installed plant, together with a written confirmation by a Registered Professional Engineer that the plant is fully operational and evidence of energy savings are demonstrated. The installed plant and any records detailing operating performance may be subject to an inspected by the Assessor.

e) The annual air-conditioning electricity load will be calculated by a two-stage approach. The building energy simulation program HTB2 will be used to calculate the hourly space cooling loads for various building zones. The zone cooling loads predicted by HTB2 will then be used as input data to a plant performance simulation program BECON to calculate the corresponding air-conditioning equipment electricity consumption[15]. In the calculation of both the zone cooling load and the equipment load, the assumption is made that the control systems are "perfect" in that they can always maintain the controlled variables at their respective set-point values. Also, equipment dynamics are ignored. Default values used in determining the assessment criteria are as given in Appendix A, together with the building and equipment performance data required to be submitted for the assessment.

   Where the building and plant designs fall within a given range of criteria, an alternative, simplified method may be used for assessing air-conditioning electricity consumption. This method is based on a regression model that predicts the annual electricity consumption from a set of key building and plant parameters that are most influential on the consumption. The model was developed on the basis of detailed simulation predictions for a range of buildings. A similar regression model has also been developed for assessment of the maximum electricity demand of a building. Criteria for using the alternative method are given in Appendix B, together with the building and equipment performance data required to be submitted for the assessment.

   Being regression models developed from a set of data obtained for existing buildings, their applicability is restricted to buildings whose characteristics fall within the range of characteristics of those buildings on which the models are based. The criteria for using the simplified method are as follows:

   - there are insignificant differences in the indoor design condition, occupancy density and ventilation rate that are maintained in all office premises within the building.
   - building and air-conditioning system parameters are within the range as summarised in Table B1 (Appendix B).
   - There are no recessed windows, or overhangs and/or side-fins at the building envelop.

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15 Yik, W.H. Francis, Burnett, J., BECON: A program for predicting building energy consumption for air-conditioning buildings. HKIE Transactions, Vol. 5, No. 3, pp. 89-94, 1998.

2.5 OZONE DEPLETING SUBSTANCES

The stratospheric ozone layer reduces the amount of short-wavelength ultraviolet radiation from the Sun which reaches the Earth's surface. Exposure to this radiation can have harmful effects on plants, agricultural crops and marine organisms, and cause skin cancer and eye cataracts. A number of natural and man-made trace gases are known to decompose ozone in the stratosphere. Chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs) and halons are man-made gases which have been released in increasing concentrations since the 1950s, and these have contributed to the holes in the ozone layer above the polar regions.

Buildings have contributed to this depletion partly through leaks of CFC and HCFC refrigerants from air conditioning systems. In addition CFCs and HCFCs have also been used as blowing agents for some thermal insulants, whilst halons have been used in fire protection systems. Alternative materials and systems are available which avoid ozone depleting substances.

Objective of HK-BEAM

To encourage proper management of the phase-out of ozone depleting substances, through replacement, conversion and good maintenance of refrigeration and air-conditioning plant. To significantly reduce the release of CFCs, HCFCs and halons into the atmosphere and thus reduce damage to the Earth's stratospheric ozone layer.

Maximum number of credits attainable: 6

Credit requirement

a) Refrigerants in air conditioning

Where all refrigerants used are classified as having low ozone depletion potential (ODP):

- ❖ 1 credit where the refrigerants employed in the air conditioning system have an average ozone depletion potential of less than 0.06.
- ❖ 2 credits where the refrigerants employed in the air conditioning system have an average ozone depletion potential of less than 0.03.
- ❖ 3 credits where the refrigerants employed in the air conditioning system have an ozone depletion potential of zero.

Alternatively, where only part of the refrigerants used are classified as having low ozone depletion potential (ODP) and the remainder are being replaced in a phased programme:

- ❖ 1 credit for demonstrating a phased programme of refrigerant replacement to an average ozone depletion potential of less than 0.03.

b) Refrigerant leak detection

- ❖ 1 credit for;
- ♦ specifying automatic refrigerant leak detection for indoor chiller plant, or specifying monthly manual checking for leakage for outdoor plant, AND
- ♦ specifying full refrigerant recovery during maintenance using approved refrigerant recovery equipment and containers.

c) Refrigerant recovery

- ❖ 1 credit where either:
- ♦ a fixed or portable refrigeration recovery unit is provided permanently on site for systems with a refrigerant charge of greater than 15 kg in weight, or
- ♦ a maintenance agreement exists with a qualified contractor using approved equipment.

d) Halon fire protection

- ❖ 1 credit where:
- ♦ no halon-based fixed or portable fire protection systems are used in the building, or
- ♦ a schedule of maintenance and testing of fixed halon fire protection systems has been drawn up with the specific aim of minimising unnecessary emissions of halon.

Method of assessment

a) The Owner/Operator shall provide documentation detailing the refrigerant(s) used in the air conditioning system(s). This shall include details of quantities of each refrigerant by trade name, chemical composition and ODP.

   Where the refrigerant replacement programme has not been completed the Owner/Operator shall provide details of the replacement programme. This shall include details of all existing plant, existing quantities of each refrigerant by trade name, chemical composition and ODP, and similar details upon planned completion of the programme.

b) A survey of the building will reveal if automatic refrigerant detection systems have been installed. A credit will be given where sensors have been installed to sample the air at various points around the refrigeration system with the specific aim of detecting small refrigerant leaks. The sensors should be situated in the main compressor housing, in ducts carrying refrigeration pipework and adjacent to the condensers. The sensors should be linked to alarm signals in the plant room and preferably the reception area and designed to trigger the alarm when refrigerant gases are detected. The intention of the system must be to detect leaks and therefore the sensors will need to be set to raise an alarm at refrigerant concentrations lower than those considered to be hazardous to health.

   For circumstances where automatic refrigerant detection systems may prove unreliable, such as air cooled chillers or chillers with remote air cooled condensers, suitable alternatives can be considered. For example, the use of a fluorescent dye added to the refrigerant to allow leaks to be detected using an ultra-violet lamp, and where checks are carried out on a regular basis. The Owner/Operator shall provide details of the system used.

c) A survey of the building will reveal the quantity of refrigerant contained within the refrigeration systems. Where the total weight contained within any single system exceeds 15 kg, refrigerant recovery must be available on site for use during maintenance. The recovery equipment should consist of either a fixed or a portable recovery unit with suitable connections to match the valves on the refrigeration system. Portable refrigerant storage cylinders must also be provided, with sufficient capacity to hold the full refrigerant charge from the largest refrigeration circuit. These cylinders should be correctly labelled to match the refrigerant in the system.

   Alternatively, if the Owner/operator can demonstrate compliance through an acceptable maintenance agreement with a qualified contractor, then credit would be awarded.

d) A survey of the building will reveal if halon fire protection systems have been installed. These may take the form of either hand-held extinguishers or fixed fire protection systems serving, for example, computer rooms or electricity switch rooms.

   Where either hand-held or fixed halon fire protection systems are present in the building, the Owner/Operator will be asked to provide written details of their practices for ensuring that emissions are reduced to a minimum.

   The practices covering any maintenance, filling or decommissioning of the systems shall be carried out in accordance with the guidelines given in ISO Standard 72101-2[16]. Testing and inspection procedures for portable fire extinguishers should be carried out according to British Standard BS 5306: Part 3:1985: Section 8.12[17]. For total flooding systems the fan pressure

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16 International Standard ISO 72101-2: 1991. Fire extinguishing media – Halogenated hydrocarbons – Part 2: Code of practice for safe handling and transfer procedures of halon 1211 and halon 1301. (Identical with BS EN 27201-2: 1994).

17 British Standards Institution. Fire extinguishing installations and equipment on premises. Part 3. Code of practice for selection, installation and maintenance of portable fire extinguishers. British Standard BS 5306: Part 3: 1985.

testing procedure set out in British Standard BS 5306: Section 5: 1992[18] should be specified. Written agreements will need to have been drawn up with any contractor undertaking work on the system, to ensure that these requirements are being met.

Where staff are trained in the use of hand-held extinguishers, the policy should require that training does not proceed to discharge of the halon contents. The policy should also require that all halon contained within the fire protection system is recovered for recycling or proper disposal at the end of its life or when equipment is replaced.

18 British Standards Institution. Fire extinguishing installations and equipment on premises. Part 5. Halon systems. Section 5.1. Halon 1301 total flooding systems. British Standard BS 5306: Part 5: Section 5.1: 1992.

2.6 FACILITIES FOR RECYCLING MATERIALS

In Hong Kong most solid waste is disposed of at landfill sites, the capacity of which is quickly being exhausted. Landfills are likely to be exhausted by 2015 and another 860 hectares of land for new sites will be required within the next 20 years[19]. It is therefore important to reduce the amount of waste requiring disposal. Furthermore some waste, such as paper decomposes forming methane, a powerful greenhouse gas contributing to global warming. Offices generate vast quantities of waste paper including computer paper, letterhead, photocopying and notepaper, much of which could be recycled. Apart from waste paper, other materials can be collected for recycling. These include photocopier toner cartridges, glass and plastic bottles, metal cans, and plastic batteries.

The Hong Kong Government and environmental groups encourage recycling schemes. To make these schemes worthwhile both environmentally and financially, it is essential that a reasonable quantity of paper be collected before a collection is made[20]. The fewer trips that are needed the lower the energy requirement for transportation and the lower the staff costs. Unless suitable separate storage space is provided, the accumulated paper could become unsightly or present a fire hazard, thus discouraging continued participation in the scheme. Furthermore, if paper for recycling is stored next to conventional refuse, it may inadvertently be removed during the conventional refuse collection. Day-to-day consumables such as paper and glass are more likely to be recycled if suitable separation and storage provision are available.

Objective of HK-BEAM

To reduce energy consumption during manufacture, to reduce pressure on landfill sites, and to help to preserve non-renewable resources by promoting recycling of waste materials.

Maximum number of credits attainable: 2

Credit requirement

- 1 credit for buildings that incorporate dedicated space(s) for collection, sorting and separate storage of recyclable materials, collected from office premises.
- 1 credit for a management system that provides for the collection and sorting of waste from office premises.

Method of assessment

The Owner/Operator shall provide details of the storage space(s) provided for collection, sorting and separate storage of recyclable materials such as paper, plastic cups, glass and aluminium cans. The guideline is that 2 square metres of storage space shall be provided for each 1000 m^2 of office floor area solely for the purpose of storage, with a maximum requirement of 20 m^2. The storage space shall be clearly labelled as a recycling store and have good access for cleaners, and for removal of materials by recycling contractors or the local authority. It should also be enclosed and adequately ventilated.

The Owner/Operator shall provide details of the management system that provides for the collection and sorting of waste from office premises. The system shall provide information to tenants/occupants as to what constitutes good practice in recycling office wastes, and encourage office users to separate their waste by providing appropriate containers and a regular system of collection. The management system shall monitor the waste collection and disposal system, including the practices of the waste collection contractor to ensure recycling takes place within the economic framework available.

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19 Environmental Protection Department. Waste reduction framework plan. 1998. http://www.pelb.wpelb.gov.hk/wrfp/chl.htm.

20 Environmental Protection Department. Recovery and recycling of paper waste in Hong Kong. 1998. http://www.info.gov.hk/epd/E/wastereduce/std4e_97.htm.

3 Buildings and Local Issues

As a community Hong Kong must accept the principle that we have a responsibility for stewardship of the environment, a responsibility to ensure that it is properly sustained. It is necessary to overcome the environmental degradation caused by past practices, protect the environment from ourselves, and provide for future generations. It has been observed that Hong Kong's urban micro-climate is modified by the high density, high rise development, where temperatures are increasing, visibility decreasing, and air pollution levels are not being effectively reduced by the natural ventilation effects of the climate.

This chapter covers those issues that affect either the Hong Kong environment in general, or the immediate surroundings of a building.

3.1 ELECTRICITY MAXIMUM DEMAND

Power stations operate under licences issued by the Director of Environmental Protection, requiring operators to employ Best Practicable Means to control emissions to an acceptable level. However, a growth in peak demand is resulting in the development of further generation, transmission and distribution capacity, and may add to global and local emissions when less efficient plant needs to be operated.

Buildings are not only responsible for more than half of the electricity consumed in Hong Kong but also, due mainly to air-conditioning demand, are responsible for much of the peak load that occurs around midday during summer months. Reduction of maximum demand, by limiting building's peak cooling load, can reduce the rate of expansion of power station generating capacity and reduce overall flue gas emissions.

Objective of HK-BEAM

To reduce summer peak electricity demand in order to alleviate growth in power station generating capacity and construction of new power stations.

Maximum number of credits attainable: 3

Credit requirement

Credit will be given on a 3 point scale to offices which have a predicted electricity demand (in VA per square metre for a typical office floor area) less than would be achieved by a typical new Hong Kong office building.

- ❖ 1 credit for demonstrating peak electricity demand less than 160 VA/m^2.
- ❖ 2 credits for demonstrating peak electricity demand less than 140 VA/m^2.
- ❖ 3 credits for demonstrating peak electricity demand less than 120 VA/m^2.

Method of assessment

Credit shall be given on a 3 point scale for office buildings which have a predicted maximum demand better than would be achieved by a typical new Hong Kong office building. The maximum demand will be calculated using:

- the computed peak electricity load of the air conditioning system (refer to the section on Electrical Energy Consumption in Chapter 2);
- the lighting load based on the design figures supplied by the Owner/Operator (refer to the section on Electrical Energy Consumption in Chapter 2);
- the appliance load design figure supplied by the Owner/Operator; and
- an allowance for other miscellaneous loads.

The sum of these loads (in W/m^2) are then converted to maximum demand (in VA/m^2) using a default power factor of 0.85.

Where the alternative method is used for assessing the air-conditioning electricity consumption, the alternative method, also based on a regression model, will be used for the prediction of the peak electricity demand of the air-conditioning system (Appendix B).

3.2 WATER CONSERVATION

Water is a precious natural resource and conservation in its use by all concerned should be encouraged. Potable water is used in office buildings predominantly for washing, cleaning and in some cases for kitchens, air-conditioning systems, showers and urinals. Whilst many flushing systems use seawater, there is an energy and sewage penalty for excessive consumption. Measures can be taken to restrict water usage in all aspects.

Objective of HK-BEAM

To reduce wastage of water, which is a valuable resource, and to increase awareness of its importance. To reduce the environmental impact of sewage discharged from office buildings.

Maximum number of credits attainable: 2

Credit requirement

a) Metering

- 1 credit for providing an arrangement of water meters which permits the monitoring of fresh water consumption by the Owner/Operator for each of the major engineering services, separate from that of tenants.

b) Water economy

- 1 credit for specifying and detailing fresh water systems which are fitted with:
  - a flow control and balancing system to control flow characteristics of each faucet, for the purposes of water economy, or
  - devices to automatically control the operation of taps and urinals which use fresh water, for the purposes of water conservation.

Method of assessment

a) The provision of water meters will be identified by a survey of the building, or other evidence provided by the Owner/Operator that demonstrates that water use by the Owner/Operator's systems is being monitored. The consumption by all tenants in total may be monitored from a separate meter, or ascertained by difference between the supply check meter and meters provided for the Owner/operator's systems.

b) The assessment will seek to establish if mechanisms are in place that effectively limits wastage of water by shutting off faucets automatically when not in use, and/or reducing excessive flow at faucets. Various approaches are available and HK-BEAM is not intended to be too prescriptive as to which should be used. Examples of automatic shut-off devices are spring-loaded taps, electronic proximity sensors, pressure reducing valves, etc., but excluding timed shut-off devices. It is not intended to assess the efficiency of such measures, but to assess reasonable attempts to reduce fresh water consumption.

3.3 LEGIONELLA BACTERIA FROM WET COOLING TOWERS

Legionnaires' disease is an illness characterised by pneumonia, and can be fatal if not adequately treated. The causative agent is Legionella pneumophila, one member of a large family of bacteria, the Legionellaceae. It also causes a self-limiting influenza-like illness without pneumonia, called Pontiac fever. Lochgoilhead fever, caused by Legionella micdadei, is similar to Pontiac fever. Risk of infection is dependent upon the presence of legionellae bacteria, the ability of the water system to generate aerosols, the concentration of bacteria and size of aerosol, and the susceptibility of the people exposed to the aerosol. Factors contributing to the growth of legionellae include temperature, stagnation and presence of contamination's which serve as a nutritional source within the system.

Cooling towers and evaporative condensers are potential breeding grounds for Legionella, as their temperature is ideal for growth. That water is poured or sprayed over the filler pack also generates water spray, and it is this spray that has been the cause of a number of outbreaks elsewhere. The risk increases with the number of illness causing bacteria in the air and the length of time a person is exposed. The concentration of bacteria in the air is determined by the amount of contaminated water dispersed into a given air volume. Contamination from cooling towers can be drawn into air intakes and reach street levels over distance of several hundred meters. The duration of exposure for occupants depends on the operating time of the cooling tower.

Where cooling towers form part of an air conditioning system and are not properly maintained, Legionella bacteria can be dispersed in airborne droplets up to several hundred metres from the building, with a risk of causing Legionnaires' disease. This risk can be eliminated by the appropriate design of the cooling towers and their proper operation and maintenance.

Objective of HK-BEAM

To minimise the threat of Legionnaires' disease arising from wet cooling towers associated with air conditioning systems.

Maximum number of credits attainable: 1

Credit requirement

- 1 credit for a building in which:
  - wet cooling towers are not used, or
  - the wet cooling towers use seawater, or
  - the wet cooling towers use water from an acceptable source and are designed and maintained as specified in the Code of Practice for the Prevention of Legionnaires Disease.

Method of assessment

When wet cooling towers are used they shall be constructed and maintained to the specifications given the Code of Practice Prevention of Legionnaires Disease[21]. This shall be confirmed in writing by the Owner/Operator, based on a survey conducted by a Registered Professional Engineer. The Assessor may check the appropriate maintenance records.

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21 Prevention of Legionnaires' Disease Committee, Electrical and Mechanical Services Department, Hong Kong Government. "Code of Practice for the Prevention of Legionnaires' Disease in Hong Kong". November 1994.

3.4 NOISE FROM THE BUILDING

Unwanted sound from equipment on office buildings can cause serious noise pollution and consequent problems for surrounding noise sensitive receivers, particularly residential premises and schools. Minimal noise pollution can be achieved by ensuring that noise from fans and other plant associated with the building does not exceed the limits given in criteria published by the Environmental Protection Department. The purpose of the Noise Control Ordinance is to provide statutory controls to restrict and reduce the nuisance caused by environmental noise. The Ordinance deals also with noise from commercial premises.

Noise emanating from commercial premises is controlled by means of Noise Abatement Notices which may be served on owners or occupiers of offending premises if the noise emitted:

- does not comply with the Acceptable Noise Levels as set out in a technical memorandum[(22)];
- is a source of annoyance to any person other than persons on the premises;
- does not comply with any standard or limit contained in any Regulations which may be made in future.

There is no immediate requirement to achieve the Acceptable Noise Levels. The Authority will in practice respond to complaints and compliance with the Acceptable Noise Levels will be required only after a Noise Abatement Notice has been served. Non-compliance with such a notice will be an offence.

Objective of HK-BEAM

To reduce the nuisance caused by noise from building services plant and equipment, disturbing neighbouring householders, particularly at night.

Maximum number of credits attainable: 1

Credit requirement

❖ 1 credit for complying with the acceptable noise levels for neighbouring sensitive receivers in accordance with the Technical Memorandum for the Assessment of Noise from places Other Than Domestic Premises, Public Places or Construction Sites.

Method of assessment

The building services shall be so installed that the rating of the noise does not exceed the limits given in the Technical Memorandum. The Owner shall provide evidence that the building complies with the criteria given in the Technical Memorandum through a survey carried out by a Registered Professional Engineer. The general calibration and measurement procedures shall be in accordance with the Annex to the Technical Memorandum for the assessment of noise[(19)].

Alternatively, where the Owner/Operator has been issued with a Noise Abatement Notice within the past three years and has taken steps to rectify the situation, the outcome of a satisfactory response to the Authority shall be accepted for compliance for this credit.

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22 Environmental Protection Department. What to do when you receive a Noise Abatement Notice. Technical Memorandum for the Assessment of Noise from places Other Than Domestic Premises, Public Places or Construction Sites. May 1989.

3.5 TRANSPORT AND PEDESTRIAN ACCESS

Exhaust fumes from cars contain volatile organic compounds: some of these are known carcinogens while others contribute to photochemical smog by assisting in the rapid formation of ozone in the atmosphere. The exhaust fumes also contain CO, CO_2, NO_x and SO_2 which contribute a variety of environmental problems. Apart from the health effects of traffic fumes, motor vehicles also generate noise, which can be a nuisance. Employees should be encouraged to use mass transport to and from work. Provision of pedestrian links which allow easy access to major public transport systems may discourage use of private transport, thereby reducing air and noise pollution and improving safety.

Objective of HK-BEAM

To encourage employees to reduce pollution, fuel use and noise from private cars and public taxis by encouraging the use of mass transit systems.

Maximum number of credits attainable: 2

Credit requirement

a) Car parking

- ❖ 1 credit for achieving at least one of the following:
  - ♦ no car parking provided, or
  - ♦ restricted provision of car parking space to the minimum required to comply with lease conditions with access which ensures simultaneous free flow of vehicles in and out of the car park.

b) Pedestrian access

- ❖ 1 credit for providing easy and substantially sheltered pedestrian access to a mainstream mass transport system.

Method of assessment

a) The lease conditions and car parking provisions agreed and approved by the Authority shall be checked. Credit shall be given where the developer demonstrates minimum provision of car parking to meet lease conditions, or those of the Government's Master Development Plans applicable at the time of construction of the building.

b) The building will be checked to ensure that employees have easy sheltered pedestrian access to and from a major transport interchange, such as a station, or main stream mass transport, such as cross-harbour bus route stops. Credit will be awarded for provision of footbridge, covered walkway, or other substantial means of improving access over and above that already provided.

3.6 VEHICULAR ACCESS FOR SERVICING AND FOR WASTE DISPOSAL

Traffic densities in Hong Kong are often very high. Traffic congestion and the pollution from exhausts is worsened by vehicles queuing to enter buildings. This can be alleviated by providing suitable access for vehicles.

Objective of HK-BEAM

To reduce traffic congestion caused by vehicles queuing to enter buildings. To encourage proper management of service vehicles requiring access to the building for the purposes of deliveries and waste disposal, etc.

Maximum number of credits attainable: 2

Credit requirement

a) Access for deliveries

❖ 1 credit for providing access for delivery vehicles to the service areas of the building which lies within the site boundary and which are enclosed and/or segregated from pedestrian access routes.

b) Access for waste disposal

❖ 1 credit for providing access for waste collection vehicles which lies within the site boundary and which are enclosed and/or segregated from pedestrian access routes.

Method of assessment

The building will be checked to ensure that a system is provided which allows for delivery of goods and removal of waste, etc., which does not require waiting or parking on streets adjacent to the building, and which does not impact on pedestrian access.

3.7 BUILDING MAINTENANCE

Where buildings are not properly maintained, they may start to deteriorate, in extreme cases requiring major refurbishment or demolition. In such cases the process of refurbishment or reconstruction will require a large consumption of both energy and materials, thus putting an unnecessary burden on natural resources.

Appropriate planned maintenance is necessary to retain a building's value as an asset, sustain utility, and to ensure compliance with legal requirements, such as health and safety regulations, and it will assist owners and occupiers to manage the building in a more efficient and hence environmentally conscious way. Regular building fabric inspections should be carried out by to set up and subsequently to monitor a long-term planned maintenance programme and to ensure that all maintenance will continue, to retain asset value of the building and meet the set environmental requirements.

Objective of HK-BEAM

To encourage proper planned maintenance of the building's fabric and structure, thus prolonging its life and avoiding unnecessary use of resources resulting from premature replacement. An associated benefit will be to reduce the risk of hazards resulting from poorly maintained structures.

Maximum number of credits attainable: 1

Credit requirement

❖ 1 credit where a planned programme of regular maintenance, cleaning and inspection of the building's fabric is in operation supported by a comprehensive and easy-to-follow manual.

Method of assessment

The Owner/Operator of the building will be asked to provide details of their maintenance programme for the building fabric, which shall include:

- a list of the elements of the building fabric that require maintenance, for example window frames, sealants, roof cladding and membranes, etc.;
- a description of the planned maintenance procedures to be adopted for each item, including frequency of inspection and maintenance, and the name of the person or company responsible for undertaking the maintenance;
- a log book or computer system for recording and monitoring maintenance visits.

Where a planned programme of maintenance has been drawn up and documented in the form of an easy-to-follow manual and where it is being implemented, credit will be given.

Guidance on the management and selling up of a building maintenance programme is given in British Standard BS 8210[23]. British Standard BS 7543[24] sets auto standard procedure for documenting the expected durability and hence maintenance requirements for the components of a building.

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23 British Standards Institution. Guide to building maintenance management. British Standard BS 8210: 1986.

24 British Standards Institution. Durability of buildings and building elements, products and components. British Standard BS 7543: 1992.

4 Indoor Issues

The indoor environment is known to play an important role in productivity. HVAC and lighting systems are key elements in the control of the environmental conditions. Thermal conditions in Hong Kong office buildings are on the cool side of the comfort boundary during summer months, when energy demand is greatest. Poor lighting, excessive noise and inadequate fresh air supply can exacerbate comfort conditions. Poor lighting reduces the efficiency and effectiveness with which people work, whilst noise is a frequent cause of complaint in offices. The poor location of fresh air intakes, filtration and openings in buildings, and the distribution of air within the building all contribute to inadequate air quality.

Buildings can have a significant influence on the health, comfort and well-being of the occupants. The highest concentrations of many airborne pollutants are found indoors, where the adult population typically spends around 90% of its time. These include formaldehyde, wood preservatives, volatile organic compounds, living organisms (e.g., bacteria, moulds, dust mites), particulate and fibres, combustion products (e.g., oxides of nitrogen), and lead. In some office buildings the occupants can experience building related illnesses.

Indoor issues include all those aspects of a building design, operation and fitting-out, such as thermal comfort, air quality, lighting and hazardous materials, which have an impact on the health, comfort and well-being of the occupants.

4.1 OPERATION AND MAINTENANCE OF BUILDING SERVICES SYSTEMS

Effective maintenance and operation of the building services can have a significant effect on both indoor environmental performance and energy efficiency. It will also help to prevent unexpected breakdowns and prolong the life of equipment, avoiding unnecessary use of resources in premature replacement.

To ensure the correct operation of the building's engineering services an easy-to-follow manual is required. This should list all the services contained within the building, giving for each a description of its function, operating instructions and the standard control settings to be adopted. Where controls require manual alteration, either daily or seasonally, the person or contractor responsible for making these adjustments should be identified and a schedule of visits arranged.

All documentation, including operating manuals and maintenance instructions should be clearly written, detailing the design approach and describing the actual systems and equipment and controls installed. Unfortunately, there is much evidence to show that this is not always adequate and that this lack of care for detail can have significant negative impact on the indoor environment and/or efficiency of energy use.

Objective of HK-BEAM

To enable building operators to fully implement the design intent, maintain the indoor environmental performance, and the efficiency of the building services engineering systems .

Maximum number of credits attainable: 2

Credit requirement

a) Operations & maintenance manual

❖ 1 credit for having an easy-to-follow, regularly updated manual detailing the operating methods, instructions and standard control settings for HVAC services equipment.

b) Operations & maintenance programme

❖ 1 credit for an established programme of regular inspections, cleaning and maintenance of the building services engineering systems under the authority of a senior executive.

Method of assessment

a) A credit shall be given when the Owner/Operator can confirm in writing that an original (or properly updated) set of O&M manuals exist, which details the following:

- overview of each system and their integration;
- modes of operation;
- schematic diagram of major systems;
- automatic controls diagram and description;
- record drawings of the installations as built;
- safety procedures and instructions;
- manufacturers information on all major equipment (not just catalogue copies);
- relevant statutory regulations and codes of practice;
- commissioning results;
- the operating and maintenance strategy for the installation;
- the indoor environmental conditions for which the building is designed, covering seasonal variations;
- the control strategies to achieve this objective;
- equipment operating parameters and control settings to be monitored.;
- full maintenance instructions with access points, monitoring points, etc., identified; and
- maintenance schedules.

Material should be arranged in order of ascending detail, and with appropriate indexing. The final documentation should be capable of being used without other reference material.[25,26]

The Owner/Operator shall confirm in writing that the original set of O&M manuals have been maintained, and can provide:

- a list of all building services equipment and control systems requiring maintenance, e.g., fans, pumps, dampers, etc.;
- a description of the maintenance procedures adopted for each item of equipment, including frequency of inspection and maintenance, and the name of the person(s) or company responsible for undertaking the maintenance; and
- details of the system used for recording and monitoring maintenance activities.

b) A credit is given where an established O&M programme exists and is placed under the authority of a senior executive. The maintenance schedules, either in-house or under external contract, shall address on a regular basis HVAC system efficiency and the setting and operation of controls for ventilation and air-conditioning. Means of checking the performance need to be in place and to be readily understandable by the organisation's management through regular reports. The Heating and Ventilating Contractors Association (HVCA) standard maintenance specifications for mechanical services[27] give guidance on suitable maintenance procedures to be adopted.

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25 American Society of Heating, Air-conditioning, and Refrigerating Engineers. Preparation of Operating and Maintenance Documentation for Building Systems. ASHRAE Guideline 4. Atlanta(USA), ASHRAE, 1993.

26 J H Armstrong. The Building Services Research and Information Association. Operating and Maintenance Manuals for Building Services Installations. Application Guide 1/87.1. 1990.

27 Heating and Ventilating Contractors Association. Standard maintenance specification for mechanical services in buildings, Parts 1-5. 1992.

4.2 METERING AND MONITORING EQUIPMENT

Following surveys of a large number of buildings in Hong Kong it is clear that buildings are in general insufficiently equipped with measuring and monitoring devices for measurement of energy performance. This makes it particularly difficult when attempting to improve the energy efficiency of buildings and major plan, such as central chiller plant. It is often the practice to install the minimum of metering, and often this is of relatively low accuracy and reliability.

Monitoring can be useful in several important aspects. It provides opportunities for reducing energy consumption. Good monitoring systems can allow better control of part load performance, not only improving efficiency, but also improving the control of the building's thermal comfort conditions. Plant control can be altered and the results monitored to show how energy consumption changes. Unseen plant faults, which are not evident during routine maintenance, but which can be identified from analysis of performance trend data. Control problems can be detected and control strategies improved to match the building demand.

The cost of instrumentation is not significant when compared to installation costs and the accuracy should be such as to provide meaningful readings. The payback on improved performance can be very high taking into account the reduction in electricity consumption and demand charges resulting from more efficient plant operation.

Objective of HK-BEAM

To enable building operators to measure, monitor and develop measures to improve the performance of the building's engineering systems, particularly concerning energy use and indoor environmental conditions.

Maximum number of credits attainable: 3

Credit requirement

a) Metering and monitoring of electricity consumption for landlord services

❖ 1 credit for metering that allows measurement of electricity use and energy consumed by Owner/Operator's major building services systems.

b) Metering and monitoring of central chiller plant

❖ 1 credit for specifying metering which allows separate monitoring of electricity use by the main chiller plant and auxiliaries, and for specifying metering which allows separate monitoring of cooling energy output from the main chiller plant.

c) Metering and monitoring of air handling plant

❖ 1 credit for metering which allows separate monitoring of electricity use (input power, energy and maximum demand) by the air side of the HVAC system.

Method of assessment

a) Metering provision shall identify the electricity use pattern for each major system fed from the Owner/Operator's main switchboard(s), i.e., landlords light and small power, transportation, plumbing & drainage systems, etc. The Owner/Operator shall confirm that metering provisions meet the requirement of the Government's electrical code.[28]

b) Monitoring of central chiller plants will be assessed on the basis of BSRIA Technical Note TN 7/94[29]. The monitoring system shall allow the overall performance of the plant and individual chillers to be determined for all operating modes and the full range of operating conditions.

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28 Electrical and Mechanical Services Department, The Government of the Hong Kong Special Administrative Region. Code of Practice for Energy Efficiency of Electrical Installations. 1998.

29 K Calder. The Building Services Research and Information Association. Practical Chiller System Monitoring. Technical Note TN 7/94. 1994.

In both cases metering current transformers shall be specified to IEC 185 [30] to at least accuracy class 1. Electricity metering for indicating power and energy shall comply with IEC 521[31] to at least accuracy class 1.

c) Metering provision shall identify electricity use patterns for major air handling equipment, such as centralised air handling units for floors/zones, large designated areas, etc.

The Owner/Operator shall provide details of the measuring equipment installed and commissioning records of consumption and chiller plant performance, to demonstrate that electricity use and performance can be monitored as stipulated. The Assessor may undertake checks during a site survey.

30 International Electrotechnical Commission, CEI/IEC 185:1987. Amended 1995. Current Transformers.

31 International Electrotechnical Commission, CEI/IEC 521:1988. Class 0.5, 1 and 2 alternating-current watthour meters. Equivalent is BS EN 60521:1995.

4.3 BIOLOGICAL CONTAMINATION

Biological contaminants of concern in indoor air are suspended viable particles, suspended allergens and other biologically derived suspended materials having impact on the health and well-being of building occupants. Micro-organisms: fungal spores, bacteria and viruses occur virtually everywhere as part of the normal environment. They are found in buildings, in the air, on surfaces and in materials. These micro-organisms should be regarded as contaminants is their presence can be harmful. The various types of contaminants are: transient bioaerosols, airborne infectious agents, contamination of water systems, microbial growth on surfaces or within structures. Growth is regulated by the availability of moisture. The main principle to control contamination is the control of moisture in the buildings and it's engineering systems, coupled with adequate ventilation. The most dramatic microbial contaminant in air conditioning and water systems is the bacterium Legionella.

Free-standing water may occur in air conditioning ductwork where the system has been badly designed or maintained. Particular areas where this is likely to occur are in the condensate drip trays of cooler coils. Water systems containing stagnant water can also reach over 30°C in Hong Kong buildings. Legionella organisms have been found in many water samples taken from air conditioning systems and fresh water supplies in buildings in Hong Kong.

Objective of HK-BEAM

To significantly reduce biological contamination from air conditioning and water systems, and the risk of diseases, particularly Legionnaires' disease.

Maximum number of credits attainable: 2

Credit requirement

a) HVAC systems and equipment

❖ 1 credit for complying with the recommendations described in the Code of Practice for the Prevention of Legionnaires Disease that are applicable to indoor HVAC equipment.

b) Domestic water systems

❖ 1 credit for complying with the recommendations described in the Code of Practice for the Prevention of Legionnaires Disease that are applicable to domestic water systems.

Method of assessment

The Owner/Operator shall be required to demonstrate that a regular survey is being carried out on the building's indoor HVAC and domestic hot water services by a Registered Professional Engineer, and that appropriate action and maintenance schedules are in use which satisfy the recommendations described in relevant sections of the Code of Practice Prevention of Legionnaires Disease.[32] The survey is required to confirm that regular cleaning, inspection and maintenance is carried out on HVAC equipment, including:

- drain trays at AHUs and FAUs (to prevent blockages and the build up of stagnant water);
- air breaks and U-traps at AHU and FCU condensate drains (to prevent back flow at drain);
- air ducts, bends, branches, heaters, mixing boxes, VAV boxes, humidifiers, fans, dampers, silencers, etc, (to avoid the build up of standing water and corroded materials); and
- filters and thermal insulation for air ducts, AHUs and FCUs.

The survey shall confirm that operation and maintenance of domestic water systems (DWS) meets the following requirements:

- where hot water storage devices (HWSD) of capacity above 300 litres in use, should be:

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32 Prevention of Legionnaires' Disease Committee, Electrical and Mechanical Services Department, Hong Kong Government. "Code of Practice for the Prevention of Legionnaires' Disease in Hong Kong". November 1994.

  - ♦ able to be purged regularly at 60^{o}C or above and hot tap outlets at 50 ^{o}C or above;
  - ♦ drained and cleaned at least once a year as required to avoid accumulation of sludge and rust, etc (drain outlets should be at the lowest point) ; and
  - ♦ capable to provide secondary pumped circulation to reduce stratification of temperature.
- regular flushing (at least one minute each month) of hot water outlets which are infrequently used or connected to stagnant water pipe work;
- thermostatic mixing valves to be maintained as recommended by manufacturer with fail-safe testing after servicing checks of outlet temperature
- cold water tanks and cisterns to be regularly inspected, drained and scrubbed; and
- original cistern covers to be made / and corroded covers to be replaced by neoprene or other suitable materials to avoid microbial growth and these materials to be also used for washers, joints and other parts of the domestic water system.

For both HVAC and DWS systems O&M staff shall maintain the following records:

- maintenance logs, schedules and instructions for inspections, cleaning and remedial work
- monitoring of temperature, total dissolved solids, conductivity and suspended solids.
- contact details, equipment description, schematics and maintenance programmes

4.4 INDOOR AIR QUALITY

Outdoor air pollution is a matter for concern for building designers and operators. Ambient air quality in urban areas of Hong Kong often fails to meet the targets set by the Hong Kong Air Quality Objectives (AQO)[33]. Much of the ambient air pollution in urban areas is attributable to motor vehicles, with diesel engines making a significant contribution to particulate levels. Building designers and operators should take account of outside air pollution when considering the location of 'fresh air' intakes, filtration and infiltration, and access points to buildings.

Objective of HK-BEAM

To achieve a satisfactory level of indoor air quality while promoting energy efficiency.

Maximum number of credits attainable: 6

Credit requirements

a) Outside air intake(s) and exhaust(s)

❖ 1 credit for confirming that the positioning of outdoor air intake(s) and exhaust(s) are such to minimise pre-contamination, prevent short-circuiting of exhaust back into air intakes, and avoid nuisance to neighbours from exhaust discharge(s).

b) Ventilation rate

❖ 1 credit for demonstrating:
- ♦ a ventilation rate of 8 l/s per person or above is achieved in office premises in which smoking is not permitted, or
- ♦ the ventilation rate meets ASHRAE or CIBSE recommended ventilation rate for a smoking environment, or
- ♦ through proper measurement that the carbon dioxide level in offices premises with an occupant density equal or greater than the design density is less than 800 parts per million.

c) Ventilation effectiveness

❖ I credit for demonstrating through measurement that the air distribution in the occupied areas of office premises is adequate.

d) Filter selection

❖ 1 credit for
- ♦ installing filters for intake air and air handling units with dust spot efficiency ≥ 80% tested in accordance with ASHRAE Standard 52.1-92 or European Standard EN-799:1993, or
- ♦ for areas mainly served by fan coil systems installing filters for intake air and air handling units with dust spot efficiency ≥ 80%, and fan coil units with dust spot efficiency ≥ 35%, or
- ♦ demonstrating that the filtration system installed shall be capable of maintaining the indoor respirable suspended particulate level below 180 $\mu g/m^3$ for 24 hour time weighted average
- ♦

❖ 1 credit for installing filters for recirculating air with dust spot efficiency ≥ 80% or otherwise demonstrating that this higher efficiency is not necessary.

d) Separate ventilation system for significant indoor pollution sources

❖ 1 credit for designs which include provision for separate ventilated system for areas where significant indoor pollution sources are present, such as print rooms, etc.

Method of assessment

a) The Owner/Operator must be able to demonstrate that the quality of the outside air drawn in through the ventilation system outside air intake(s) meets the Hong Kong Air Quality standard, or else provision is made for adequate air cleaning to meet the standard. Outside air intake and ventilation exhaust points shall be at least 10 m apart. Outside air intakes shall

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33 Air Pollution Control (Amendment) Ordinance, Cap. 311.

be free of pollution from local sources such as car park exhaust, cooling towers discharges, etc. Alternatively, assessment shall be made against the recommendations given in Section 5.5 of ASHRAE 62[34] covering locations of exhaust air and vent outlets.

To obtain credit, the Owner/Operator shall provide evidence in the form of a survey undertaken by a suitably qualified authority.

b) To obtain credit, the ventilation rate of the system shall be demonstrated by measurement to conform to the criteria specified.

c) The internal room air distribution should avoid supply air being exfiltrated before use or being distributed to unintentional areas. If some short-circuiting cannot be avoided, the measurement or calculation should show the necessary compensation to ensure the net fresh air can be supplied to the office areas.

d) To obtain credit, the specification of filters shall be demonstrated to take account of appropriate guidelines and outside air conditions for the site. Filter performance shall be specified according to ASHRAE Standard 52.1-92[35] or European Standard EN-779[36].

e) Areas so designated shall be physically separated from the rest of the occupied areas by full-height partitions and closed doors, shall have its own ventilation extract system distinct from that of the rest of the office zone. Provision shall be made to avoid recirculation of air from this separately ventilated area into other areas of the office premises.

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34 American Society of Heating, Air-conditioning, and Refrigerating Engineers. Ventilation for Acceptable Indoor Air Quality. ASHRAE Standard 62-1989R, Public Review Draft, 1996.

35 American Society of Heating, Air-conditioning, and Refrigerating Engineers. Method of testing air filters in general ventilation for removing particulate matter. ASHRAE Standard 52-1, Atlanta(USA), ASHRAE.

36 European Standard EN-779:1993. Particulate air filters for general ventilation - Requirements, testing, marking. 1993.

4.5 MINERAL FIBRES

Objective of HK-BEAM

To minimise health risks resulting from the presence of fibrous materials potentially hazardous to health.

Maximum number of credits attainable: 3

Credit Requirement

a) Asbestos

- 1 credit
- where the original building specification specifically excluded the use of asbestos in the building, or
- for having carried out a professional asbestos survey, keeping written record of the location of all asbestos, and taking appropriate action to deal with all asbestos identified.

b) Mineral Fibres

- 1 credit for demonstrating that the following conditions are satisfied:
- fibrous duct liners are not used inside the ventilation ducts or equipment, excepting coated or uncoated sound attenuation liners up to 4 m in length, or
- fibrous duct liners inside the ventilation ducts or equipment are covered with durable polymer or foil or similar fibre control, and fibre release is confined to the return air ducts, and
- uncoated duct liners are not used in supply air ducts.
- 1 credit where no significant quantities of uncontained man-made mineral fibre materials are located in the air handling plant rooms or air plenums.

Alternatively:

- 2 credits for demonstrating through measurements of unoccupied office areas levels of mineral fibres less than 1000 fibres/m^3.

Method of Assessment

a) Where the Owner/Operator is able to provide a copy of the original specifications for the building and where they specifically excludes the use of asbestos and asbestos-based products, a credit will be given. Where this is not the case, the Owner/Operator will be required to provide records of any past survey of asbestos in the building. Where a full professional survey has been carried out by a registered consultant[37] within the past 3 years and appropriate decisions and any necessary actions have been taken, a credit will be given. The Owner/Operator must have the results of the survey available, enabling them to implement both of the following:

   - a system of management which would provide information when asbestos may be encountered in the future, for example when maintenance work is being considered, including suitable precautions to be taken when asbestos is likely to be disturbed, AND
   - a system of review to assess the need for action at this time.

b) A survey by the Assessor will include a visual inspection of air supply paths at a selection of duct access points. Duct liners using coatings that have been retrofitted in-situ or those containing biocidal agents will not normally qualify as they are not a proven solution. This includes sprayed acoustic coatings and thermal insulation with exposed fibre materials, etc., but does not include fabric covered panels showing no signs of deterioration.

As an alternative, the Owner/Operator can provide evidence in the form of a professionally validated survey of measured levels of mineral fibres in unoccupied office areas. This survey should embrace at least one typical floor layout with the ventilation system in full operation.

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37 Environmental Protection Department. Code of Practice on the Handling and Disposal of Asbestos Waste. January 1993.

4.6 RADON

Indoor radon comes from several major sources, principally building materials and the soil and rock underlying and surrounding building foundations. Surveys in buildings have shown that relatively high radon levels can be found in rooms with low ventilation rates. Surveys can be carried out using integrating dosimeters in the rooms of interest, but the duration for measurement and the prevailing ventilation rates need to be carefully considered for meaningful conclusions to be drawn. There are no internationally agreed safe limits for exposure to radon. For HK-BEAM remedial action is to be taken when the levels of radon in commercial buildings exceed 200 Bq/m^3.

Objective of HK-BEAM

To minimise the potential risk to health arising from exposure to radon.

Maximum number of credits attainable: 1

Credit Requirement

- 1 credit for having undertaken a radon assessment survey, and for having taken appropriate action where the levels shown to be in excess of 200 Bq/m^3.

Method of Assessment

Where the Owner/Operator can provide evidence of a survey undertaken within the past three years by a suitably qualified consultant using an appropriate methodology, which demonstrates that the radon levels measured are less than 200 Bq/m^3, a credit shall be awarded. Where they are greater than this, credit will only be given if it can be demonstrated that appropriate measures have been taken to reduce the levels below 200 Bq/m^3.

4.7 HAZARDOUS MATERIALS

Objective of HK-BEAM

To reduce health impacts from pollutants released indoors.

Maximum number of credits attainable: 1

Credit requirement

a) Use of board and timber

❖ 1 credit for:
- ♦ specifying particleboard, fibreboard, and similar composite boards conforming to European Standard EN 321-1, or alternative equivalent standards.
- ♦ excluding use of treated timber where it is not recommended in any relevant codes and standards, and
- ♦ specifying all preserved timber shall be industrially pre-treated ready for finishing on site.

b) Use of paint

❖ 1 credit for:
- ♦ use of paints that contain no lead, and
- ♦ paint containing volatile organic compounds (VOC) conforms to British Standards relating to solvent.

Method of assessment

Specifications for the base building and the "Tenant Fitting Out Specifications' will be checked.

a) Where particleboards, fibreboards or similar types of composite wood products are specified they shall comply with EN 312-1[38] or similar specification[39] as far as formaldehyde emissions are concerned.

   The concern about timber is the use of any wood preservatives. It is a prerequisite that timber treatment be restricted to the provisions made in the relevant codes and standards which are applicable to particular building components.

b) The materials specification must show the absence of paints containing lead. The materials specification must show that VOC in paints conform to British Standards[40,41,42] relating to solvent and using latex paint where possible in lieu of solvent based paint.

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38 European Standard EN 312-1:1997. Particleboards – Specifications. Part 1. General requirements for all board types.

39 British Standards Institution. Specification for fibre building boards. British Standard BS1142: 1989. London, BSI, 1989. (Superseded).

40 British Standards Institution. Mineral solvents (white spirit and related hydrocarbon solvents) for paints and other purposes. British Standard BS 245:1976. London, BSI, 1976.

41 British Standards Institution. Water-borne priming paints for woodwork. British Standard BS 5082:1993. London, BSI, 1993.

42 British Standards Institution. Solvent-borne priming paints for woodwork. British Standard BS 5358:1993. London, BSI, 1993.

4.8 INTERIOR LIGHTING

Excessively high artificial lighting levels greatly increase energy consumption in air conditioning offices. Often a large proportion of the cooling load is to compensate for the heat from artificial lighting. Lighting is the second main component of the energy bill after air conditioning. Energy consumption due to artificial lighting is dealt with in the part of the BEAM assessment that covers electricity consumption.

Headaches and eyestrain have been reduced in offices when high-frequency ballasts have been substituted for conventional ballasts used in fluorescent lights[72]. High-frequency ballasts also reduce energy consumption and cooling load, and extend lamp life producing a return on their extra cost. A range of compact fluorescent lamps with high-frequency ballasts is becoming available as direct replacements for tungsten lamps. There are other factors that will affect the visual comfort of the occupants. These include glare, contrast and overall lighting levels. Most offices now have visual display units and require appropriate lighting conditions.

A well maintained lighting installation will have clean lamps and luminaires. In addition, the lamps will be replaced at the end of their useful life, which usually will be before failure. The light output of discharge lamps, such as fluorescent tubes, decreases throughout their life while the power consumed remains constant. Their efficacy (light output per watt consumed) therefore declines. A maintenance schedule giving details of cleaning and lamp replacement is therefore essential for a well maintained lighting installation. In most cases cleaning intervals will depend on the rate of soiling likely to occur. Air-handling luminaires generally have a lower soiling rate than non-ventilated luminaires. Recommended cleaning intervals for luminaires in offices are one or two times a year.

Lamp replacement can usefully be on a bulk replacement basis, all lamps being changed at the same lime, and related to cleaning of the luminaires. If lamps are only replaced on failure, the majority of lamps in an installation become relatively old and inefficient. The period between bulk replacements will depend on the operating period with, for most office applications, replacement every 2 or 3 years. Where the spaces are predominantly daylit, longer periods may be appropriate. Lamp lumen depreciation may be less with high-frequency electronic gear. Much of the energy used for lighting is wasted when unoccupied spaces are lit because of the limited provision of control switches. Large areas are often controlled from one switch point. Credit is given where lighting controls allow conservation through switching off when not required.

Objective of HK-BEAM

To reduce eyestrain and headache, maintain the design level of visual comfort and performance and to maintain energy efficiency.

Maximum number of credits attainable: 2

Credit requirement

a) Lamps and ballasts

- ❖ 1 credit for “Tenant Fitting Out Specifications” which specifies:
  - ♦ that any fluorescent and other lamps with modulating (fluctuating) output should be fitted with high-frequency ballasts in all the areas used for office work, and
  - ♦ the use of lamps with CIE general colour rendering index 80 or above (i.e. colour rendering groups 1A or 1B).

b) Lighting design

- ❖ 1 credit for “Tenant Fitting Out Specifications” which demonstrates by calculations for a typical office floor plan and surface finishes that CIBSE guidelines[43,44,45] on the following items of office lighting design are followed:

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[43] The Chartered Institution of Building Services Engineers. Code for interior lighting. London. CIBSE, 1994.

- maintained illuminance on the working plane;
- illuminance variation; and glare.

Method of assessment

a) The Owner/Operator will provide a design and fitting out specification for the lighting system recommended to tenants, in the "Tenant Fitting-Out Specifications". This will be checked for design information on luminaires with high-frequency ballasts and good colour rendering (group 1A or 1B) lamps to be fitted in areas to be used as offices.

b) The 'lumen method' formula will be used to calculate the maintained illuminance over the working plane according to the calculation procedure described in Section 4.5.3 of the CIBSE Code for Interior Lighting[29] or in Appendix 3 of the CIBSE Lighting Guide LG7. The calculated maintained illuminance will be checked for compliance with the recommendations given in the Lighting schedule (Section 2.6.4) of the CIBSE Code for Interior Lighting or the recommendations given in Chapter 5 of the CIBSE Lighting Guide LG7.

The illuminance variation consists of 'unifomity' which is concerned with illuminance conditions on the task and immediate surround, and 'diversity' which expresses changes in illuminance across a larger space. The uniformity and diversity will be calculated according to that described in Section 4.5.4 of the CIBSE Code for Interior Lighting[29]. A computer program which calculates illuminance using the point-by-point method and includes inter-reflection should be used for the calculation. The calculated uniformity (minimum to average illuminance) over any task area and immediate surround should not be less than 0.8. The diversity of illuminance expressed as the ratio of the maximum illuminance to the minimum illuminance at any point in the 'core area' of the interior should not exceed 5:1. The core area is that area of the working plane having a boundary 0.5 m from the walls.

The glare index will be calculated according to either of the two methods described in CIBSE TM10[46]. These methods are also summarised in Section 4.5.6 of the CIBSE Code for Interior Lighting[29]. The calculated glare index will be checked for compliance with the recommendations given in the Lighting schedule (Section 2.6.4) of the CIBSE Code for Interior Lighting[29] or the recommendations given in Chapter 5 of the CIBSE Lighting Guide LG7[NR2].

The "Tenant Fitting Out Specifications" will include a specification of the Category of the luminaire according to the CIBSE Lighting Guide LG3[30]. In areas where a high density of visual display screens is envisaged, Category 1 luminaires should be specified. In areas where wide spread of display screens is intended, Category 2 luminaires should be specified. In areas where the density of screens is relatively low and the screens are not intended to be used for sustained periods, Category 3 luminaires should be used. The luminance limit angle of the luminaire, which defines the Category of the luminaire, will be checked using the method described in Appendix 2 of the CIBSE Lighting Guide LG3[30] if information on the category of the luminaire is not available from the luminaire manufacturer.

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44 The Chartered Institution of Building Services Engineers. Lighting Guide LG3: The visual environment for display screen use. London, CIBSE, 1996.

45 The Chartered Institution of Building Services Engineers. Lighting Guide LG7: Lighting for offices. London, CIBSE, 1993.

46 The Chartered Institution of Building Services Engineers. Technical Memoranda TM10. Calculation of glare indices. London, CIBSE, 1985.

4.9 INDOOR NOISE

Objective of HK-BEAM

To achieve a satisfactory indoor noise environment.

Maximum number of credits attainable: 1

Credit Requirement

- ❖ 1 credit for noise levels below the following values:
- ♦ 45 dB $L_{Aeq,T}$ in private offices, small conference rooms.
- ♦ 50 dB $L_{Aeq,T}$ in large offices.

Method of Assessment

The Owner/Operator may provide evidence in the form suitable measurements undertaken by a Registered Professional Engineer, otherwise measurements shall be carried out by the Assessor. Measurements will be made using an integrating sound-level meter with an 'A' weighting the instrument will be of type 2 or better according to British Standard BS 6698[47]. Where the predominant noise is steady (e.g. from a ventilation system) the measuring period will be 1 minute; where the noise fluctuates (e.g. from traffic noise) the measuring period will be 5 minutes.

Measurements will be carried out under normal operating conditions. When windows are required for ventilation they are to be left open during the measuring period. Permanent installations such as mechanical ventilation will be left running, but office equipment such as photocopiers will be switched off.

Measurements will be carried out at ear height. Measurements will be taken in a sample of typical offices around the building. Where, for example there is a significant difference in noise exposure on different facades the assessment will be based on the worst case. Attention will be drawn in the accompanying report to any problem areas observed.

L_{Aeq},T is the 'equivalent, standby noise level' of a fluctuating noise, i.e. a logarithmic average of the A-weighted level over the period T. Noise is a frequent cause of complaint in office buildings and can be distracting. However, in open-plan areas low noise levels can result in a lack of acoustic privacy and a balance needs to be struck. The credited noise levels are based on the maximum intrusive noise levels used for building design given in British Standard BS 8233[48].

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47 British Standards Institution. Specification for integrating-averaging sound level meters. BS 6698:1986. London, BSI, 1986.

48 British Standards Institution. Sound insulation and noise reduction for buildings. British Standard BS 8233: 1987. London, BSI, 1987.

5 Appendices

5.1 APPENDIX A ELECTRICITY CONSUMPTION FOR AIR-CONDITIONING

The electricity consumption of the air-conditioning system, it will be estimated using the building energy simulation programme HTB2 and a plant performance simulation programme BECON. The submitted data, together with those parameters that are pre-assigned with default values, will be input to these programmes for defining the characteristics and operating conditions of the building and the air-conditioning system. Figure A1 illustrates the computational processes involved. Table A1 gives the values used in establishing the air conditioning electricity consumption criteria. Table A2 gives operating schedules for the occupation density, lighting load profiles and fresh air supply system used in the simulation. Table A3 details the building and equipment performance data required for the simulation.

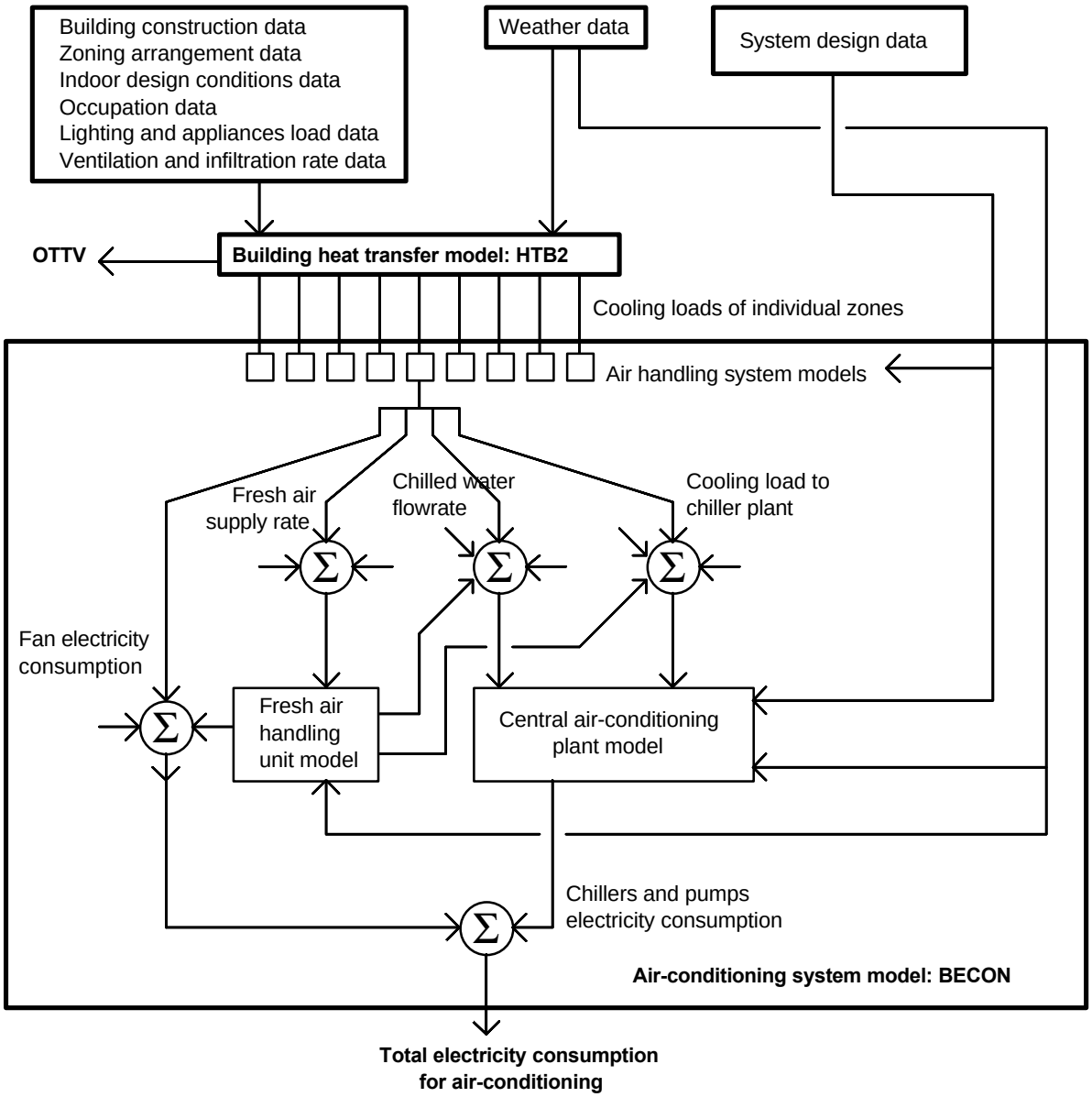

Fig. A1: Illustration of procedures for air-conditioning equipment load calculation

Table A1: Values used in establishing air conditioning electricity consumption criteria

Parameters		**For establishing criteria**	**For assessing a building**
Outdoor weather conditions		Weather data of year 1989	
Indoor design conditions:			
Cooling	Indoor dry-bulb temperature	25.5 °C	Design criteria for
	Indoor relative humidity	54 %	the building
Heating	Indoor dry-bulb temperature	22.0 °C	
	Indoor relative humidity	Not specified	
Normal occupation periods:			
Weekdays		9:00 - 17:00	
Saturdays		9:00 - 13:00	
Sundays and public holidays		Not occupied	
Maximum occupation density		9 m^2 per person	Design criteria for the building
Schedule of occupation densities for various hours in the day (in fractions of the maximum density)		As shown in Table A2	As shown in Table A2
Ventilation rates:			
When ventilation system is on		10 l/s per person	Design criteria for
When ventilation system is off		0	the building
Operating hours of ventilation system			As shown in Table A2
Infiltration rates:			
When ventilation system is on		0.1 air change/hr.	
When ventilation system is off		0.5 air change/hr.	
Maximum lighting load and ratio of heat-of-light to space		25 W/m^2	Design criteria for the building
Lighting load at various occupied and unoccupied hours in fraction of max. lighting load		As shown in Table A2	As shown in Table A2
Maximum appliances load (assumed constant load)		25 W/m^2	Design criteria for the building

Table A2: Occupation Density, Lighting Load Profiles and Fresh Air Supply System Operating Schedule

Hour	Day in the Week	Occupancy	Lighting (Perimeter)	Lighting (Interior)	Fresh Air Supply
1-7	Weekdays	0.0	0.05	0.05	Off
7-8		0.05	0.1	0.1	Off
8-9		0.4	0.5	0.5	On
9-10		0.95	0.9	1.0	On
10-11		0.95	0.9	1.0	On
11-12		0.95	0.9	1.0	On
12-13		0.95	0.9	1.0	On
13-14		0.45	0.8	0.9	On
14-15		0.95	0.9	1.0	On
15-16		0.95	0.9	1.0	On
16-17		0.95	0.9	1.0	On
17-18		0.5	0.8	0.8	On
18-19		0.25	0.5	0.5	On
19-20		0.1	0.3	0.3	Off
20-21		0.05	0.2	0.2	Off
21-24		0.0	0.05	0.05	Off
1-7	Saturdays	0.0	0.05	0.05	Off
7-8		0.05	0.1	0.1	Off
8-9		0.3	0.5	0.5	On
9-13		0.6	0.75	0.8	On
13-17		0.1	0.2	0.2	Off
17-18		0.05	0.1	0.1	Off
18-24		0.0	0.05	0.05	Off
1-9	Sundays	0.0	0.05	0.05	Off
9-17	and Public	0.05	0.1	0.1	Off
17-24	Holidays	0.0	0.05	0.05	Off

†Note: Values denote fractions of maximum occupancy or lighting power.

Table A3: Building and equipment performance data

General building data

The site plan, floor plans, elevations, building sectional views, and details of the plot ratio area calculations for the building.

The drawings and information should enable the following data to be determined:

- location of the building
- building orientation (exposure directions of individual facets of the building)
- number of storeys
- total gross floor area (m^2)

and for each floor:

- usage
- plot ratio gross floor area (m^2)
- floor to floor height (m)
- air-conditioned area (m^2), i.e. the total floor area less the plant room and pipe duct areas and the public areas where no air-conditioning is provided (e.g. toilets, staircases)

(Note: air-conditioned public areas such as lift lobby and corridors should be taken as part of the air-conditioned area)

Building construction data

Drawings showing the construction details for each type of construction elements and the following data pertaining to these elements:

For each external wall and roof element of the building envelope on each floor:

- exposure direction (for walls)
- location
- net area (excluding window or sky-light area, if any) (m^2)
- type of construction

For each partition wall or floor slab on each floor:

- location
- area (m^2)
- type of construction

And, for each type of wall/roof/floor-slab construction:

- number of layers of materials
- type of material of each layer
- thickness (m), thermal conductivity (W/mK), density (kg/ m^3) and specific heat (kJ/kgK) of each layer of material
- for internal partitions and floor slabs, emissivities of the two surfaces
- for external walls and roofs, outer surface solar absorptance for the outermost layer of material and the inner surface emissivity of the innermost layer of material

For each window or skylight element of the building envelope on each floor:

- exposure direction (for windows)
- location
- area (m^2)
- type of window/sky-light construction

And, for each type of window/skylight construction:

- number of layers (for double or multi-pane windows/skylights)
- U-value and shading coefficient for each type of window or skylight

(Note: these are for checking consistency of related glass properties below)

- thickness (m), thermal conductivity (W/mK), density (kg/ m^3), specific heat (kJ/kgK), short-wave radiation absorptance and transmittance (for the range of incident angles from 0 to 90° in increments of 10°) and longwave emissivity for each glass layer

(Note: these are the required data for simulation using HTB2)

Lighting load data

Lighting system design data and drawings including:

- total designed/installed lighting load (W) for the air-conditioned area of each floor

(Note: see 1.1 for meaning of air-conditioned area)

- type(s) of luminaires used on each floor
- lighting layout for each floor with the type(s) of luminaire(s) indicated
- and for each type of luminaire :
- whether room air will flow through the lighting fixture before it returns to the air-handling unit
- number and type of lamps in each luminaire
- wattage of each type of lamp and that of the associated ballast, if any

Air-conditioning design load data (for offices)

- indoor design conditions for cooling and heating
- maximum occupancy density
- ventilation rates
- infiltration rates
- maximum appliance load

System design data

Documents (design reports or specifications) and drawings (schematic and layout plans) sufficient for providing the following information :

- design peak cooling load of the building
- design peak heating load of the building (if winter space heating is provided)

For the chillers:

- heat rejection method/medium used (e.g. direct/indirect seawater/air cooled)
- number of chillers and their equipment identification numbers (e.g. C01 for chiller no. 1)
- type(s) and model size(s) (capacities) of chillers
- for each type of chiller :
    - type of refrigerant
    - type of compressor (centrifugal/screw/reciprocating)
    - type of compressor motor (open/ hermetic)

(Note: the assumption is made here that electric motor driven vapour compression chillers are used. Different approach will have to be used should other type of drives or absorption chillers be used)

For each of the seawater, condenser water, and chilled water circuit:

- design total water flow rate
- design in/out temperatures
- circuit design including :
    - parallel or series arrangement for the equipment (chillers, heat exchangers and pumps)
    - single- or two-loop pumping
    - stepped or variable flowrate
    - constant or variable pump speed
- number of pumps and their model sizes
- equipment identification number of each pump (e.g. ChWP01 for chilled water pump no. 1)
- number of heat exchangers and their model sizes

- equipment identification number of each heat exchanger
- sequencing control strategy for the pumps (including those for the primary- and secondary-loop chilled water pumps if two loop pumping design is used)
- details of each water-side control system including :
  - function and method of control for each control loop (e.g. control of chilled water supply flowrate to match demand by sequencing on/off of pumps or varying the speed of the pumps or modulating the degree of opening of a differential pressure bypass control valve)

Where winter space heating is provided by heat recovery chillers with or without supplementary start-up heat sources:

- heat output capacity of each of heat recovery chiller and supplementary heating equipment (e.g. heat pumps)
- source of heat for heat pumps, if applicable

For each of the seawater, condenser water and chilled water piping systems:

- routing of the piping system
- size of each pipe section

For each of the air-side systems:

- location (and name) of the air-conditioned space (or zone) served by the system
- room sensible, latent and total cooling loads of the space
- system type (e.g. fresh air supply system, primary air fan-coil system, VAV system with terminal reheat, dual conduit VAV system, dual duct VAV system, etc.)
- type(s) of equipment involved (e.g. air-handling units, fan-coil units, VAV boxes, etc.)
- equipment identification number of each equipment (e.g. FAU01, AHU01) in the system
- model size of each equipment
- design supply air flow rate for the space
- design fresh air supply flow rate for the space
- design general exhaust air flow rate from the space
- supply air duct routing
- size of each duct section
- details of the control system, including
  - function and method of control for each control loop (e.g. control of indoor or supply air temperature by varying the air or water flowrate through fan speed, inlet guide vane, damper or control valve modulation)
  - for VAV systems, minimum air flow rate

Equipment performance data

For each type and model size of chiller:

- equipment identification nos. of chillers of the same type and model size
- rated cooling capacity
- power consumption at rated output
- design chilled water in/out temperatures and flow rate
- design condenser water (for air-cooled chillers, condenser air) in/out temperatures and flow rate
- water (and air) pressure drops across evaporator and condenser at design flow rates
- performance curves showing variations in power consumption with load changes under several condenser inlet water or air temperatures

For each type and model size of heat exchanger:

- equipment identification nos. of heat exchangers of the same type and model size
- kind(s) of primary and secondary fluids (fresh water/seawater)
- design heat exchange rate
- effectiveness at design heat exchange rate
- design in/out temperatures and flow rates of primary and secondary fluids

- primary and secondary side pressure drops
- variations in heat exchange performance with operating conditions

For each type and model size of pump:

- equipment identification nos. of pumps of the same type and model size
- design duty (flow rate and pumping pressure) of each pump
- design pump rotational speed
- performance curve showing variations in pump power consumption and pump total pressure with water flow rate at the design pump speed (and curves at reduced speeds for pumps under variable speed control)

For each type and model size of air-handling equipment (fresh air supply or general exhaust fans, fan coil units and air-handling units):

- equipment identification nos. of air-handling equipment of the same type and model size
- fan performance data on :
    - design fan rotational speed
    - design supply air flow rate
    - design supply fan total pressure at design flow rate and speed
    - type of air flow rate regulation device associated with the fan (e.g. inlet guide vane, discharge damper, variable speed motor drive, variable blade pitch angle etc.)
    - performance curve showing variations in fan power consumption and fan total pressure with supply air flow rate at the design fan speed
    - for variable flow fans, curves at reduced fan speeds, degree of opening of inlet guide vane or damper or blade pitch angle
- where applicable, cooling and dehumidifying coil performance/construction data including:
    - design sensible and total cooling capacities
    - chilled water flow rate under design conditions

For each type and model size of air-to-air heat recovery wheel:

- equipment identification nos. of heat recovery wheels of the same type and model size
- air flow rates of both air streams
- effectiveness of sensible and total heat exchange between the two air streams

5.2 APPENDIX B ALTERNATIVE METHOD FOR ASSESSMENT OF ELECTRICITY CONSUMPTION FOR AIR CONDITIONING

Criteria for Using the Simplified Assessment Method

This simplified assessment method is intended to facilitate the assessor to quickly assess the credits to be awarded for energy-related issues, and to formulate feedback to the Owner/Operator on improvements that can be made, and which may lead to obtaining further credits. The time and effort required for collection and preparation of data for assessment is much reduced when compared with the detailed simulation method given in Appendix A.

The simplified method is based on a regression model relating annual air-conditioning energy use to a number of key parameters of the building and the plant. The model was developed on the basis of detailed simulation predictions for a range of buildings. A similar regression model has also been developed for assessment of the maximum electricity demand of a building. Being regression models developed from a given set of data, their applicability is restricted to buildings that have characteristics falling within the range of characteristics of those buildings on which the models were based. The simplified method will not be used if a building possesses characteristics outside this range, since extrapolation of the models may lead to unascertainable inaccuracies. In such cases, the simulation method given in Appendix A will be used.

The following summarises the criteria for using the simplified method for assessing energy performance and maximum electricity demand under HK-BEAM 2/99:

- There are insignificant differences in the indoor design condition, occupancy density and ventilation rate that are maintained in all office premises within the building.
- Building and air-conditioning system parameters are within the range as given in Table B1.
- There are no recessed windows, or overhangs and/or side-fins at the building envelop.

Table B1: Acceptable Range of Variables

Symbol	Variable	Unit	Range
FP	installed fan power per unit floor area	W/m^2	3.8-16.6
PP	installed pump power per unit floor area	W/m^2	4.5-23.3
VR	ventilation rate per unit floor area	$l/s\text{-}m^2$	0.36-2.7
VR × W	VR × design indoor air moisture content	$g\text{-}l / kg\text{-}m^2\text{-}s$	3.7-30.7
LGT	power intensity of lighting installation	W/m^2	14-29
COP	average rated coefficient of performance of chillers	-	2.4-5.1
SPW	small power intensity	W/m^2	18-29
AG × UG	(total glazed area) × (U-value of glass) per unit floor area	$W/m^2.^oC$	0.19-1.58
AG × SC	(total glazed area) × (shading coefficient of glass) per unit floor area	-	0.03-0.21
AG × UG × T	AG × UG × design indoor temperature	W/m^2	8.6-68.8

† Refer to the data input forms (Forms 1 to 3) for more detailed description of the variables

The information required for assessment according to the simplified method is summarised in Table B2.

Energy Computation Forms

Based on the energy and maximum demand regression models, three forms have been developed to aid assessment of the air conditioning energy performance of a building:

- Form 1 – for data input and evaluation of the eleven independent variables to be entered into Forms 2 and 3.
- Form 2 – for predicting the annual electricity consumption of the A/C system.
- Form 3 – for predicting the maximum demand of the A/C system.

Table B2: Information Required for Annual A/C Electricity Consumption and Maximum Electricity Demand Assessment

DATA		Simulation Approach	Simplified Method
BUILDING DATA			
General Building Data			
	location of building	□	□
	building orientations	□	
	elevations of different orientations	□	
	floor layout drawings	□	
	number of storeys	□	□
	floor to floor height (m)	□	
	total air-conditioned area (m^2)	□	□
	total un-airconditioned area (m^2)	□	□
Building Construction Data			
	construction details of wall	□	
	construction details of roof	□	
	construction details of floor	□	
	construction details of partitions	□	
	construction details of window	□	
	thickness (m), thermal conductivity (W/mK), density (kg/m^3)and specific heat (kJ/kgK) for each type of construction material	□	
	U-value (W/m^2K) and shading coefficient of glass		□
	shortwave radiation absorptance and transmittance (for the range of incident angles from 0^0 to 90^0) and longwave emissitivity for each type of glass	□	
Indoor Data			
	design/installed lighting intensity (W/m^2)	□	□
	design/actual occupancy density (W/m^2)	□	□
	design/installed small power intensity (W/m^2)	□	□
	fresh air rate per occupant (l/s per person)	□	□
	summer design cooling temperature (^0C)	□	□
	summer design relative humidity (%)	□	□
	winter design heating temperature (^0C)	□	□
AIR-CONDITIONING SYSTEM AND EQUIPMENT DATA			
System Design Data			
	peak cooling load of building (kW)	□	
	peak sensible cooling load of different zones (kW)	□	
	peak latent cooling load of different zones (kW)	□	
	condenser water in/out temperatures (^oC)	□	
	condenser water flow rate (kg/s)	□	
	chilled water in/out temperatures (^oC)	□	
	total chilled water flow rate (kg/s)	□	
	chilled water flow rate for individual zone (kg/s)	□	
Chiller Plant			
	heat rejection method of chillers	□	
	number of installed chillers	□	□
	capacities (kW) and rated power consumption (kW) of chillers	□	□
	type of compressor (centrifugal/screw/reciprocating)	□	
	nos of pumping loop	□	
	number of pumps	□	□
	type of pumps (variable/constant)	□	□
	flow rate of pumps (kg/s)	□	
	rated power of pumps (kW)	□	□
Air-Side System			
	type of system (VAV, CAV or FCU)	□	□
	type of VAV system (inlet guide vane/variable speed)	□	□
	min. turn down ratio of VAV system	□	□
	design supply air flow rate for different zone (m^3/s)	□	
	design fresh air flow rate for different zone (m^3/s)	□	
	rated power consumption of AHUs/FCUs (kW)	□	□
	Total Nos of □	45	21
	Total Nos of	1	25

HK-BEAM - Building Energy Performance Assessment Form

FORM 1: DATA INPUT

Building Name : _____ **Assessor :** _____

Date : _____

Design Parameters				**Computed variables**				
	Units	**Symbols**	**Values**	**Variables**	**Values**	**Allowable range[4]**	**Variables**	**Values**
Building Data:								
Total air-conditioned floor area	m^2	TFA =						
U-value of glass	W-m^2°C	UG =						
Total glass area per unit floor area	m^2/m^2	AG =		AG x UG =		0.19 - 1.58	**E1** = (AG x UG) / (0.4 x COP) =	
Shading coefficient	-	SC =		AG x SC =		0.03 - 0.21	**E2** = (AG x SC) / (0.05 x COP) =	
General Design Data:								
Ventilation rate	l/s-m^2	VR =		---------->		0.36 - 2.70	**E3** = VR / (0.76 x COP) =	
Lighting intensity	W/m^2	LGT =		---------->		14 - 29	**E4** = LGT / (12 x COP) =	
Small power intensity	W/m^2	SPW =		---------->		18 - 29	**E5** = SPW / (12 x COP) =	
Indoor design temperature	°C	T =		AG x UG x T =		8.6 - 68.8	**E6** = (AG x UG x T) / (11.05 x COP) =	
Indoor design moisture content (Note 1)	g/kg	W =		VR x W =		3.7 - 30.7	**E7** = (VR x W) / (7.4 x COP) =	
Chiller Plant Data:								
Average COP	-	COP =		---------->		2.4 - 5.1		
Installed pump (& cooling tower) power	W/m^2	PP =		---------->		45.0 - 23.3	**E8** = PP / 23.4 =	
Type of pumping system (Note 2)	-	CPP =		---------->		0 - 1	**E9** = CPP x PP / 18.63 =	
Air System Data:								
Installed fan power	W/m^2	FP =		---------->		3.8 - 16.6	**E10** = FP / 14.76 =	
Type of air system (Note 3)	-	CFP =		---------->		0 - 1	**E11** = CFP x FP / 14.76 =	

Notes (1) Refer to the following for values of W:

Temperature (°C)	RH = 50%	RH = 55%	RH = 60%
23	8.9	9.8	10.7
23.5	9.2	10.2	11.1
24	9.5	10.4	11.4
24.5	9.8	10.8	11.7
25	10	11.2	12.1
25.5	10.4	11.4	12.4

(2) CPP = 0 for single-loop & 2-loop with constant speed pumps
CPP = 1 for two-loop with variable speed secondary loop pumps

(3) FPP = 0 for CAV system
FPP = 1 for VAV with variable speed fan
FPP = minimum turn-down ratio for VAV with inlet guide vanes

(4) This method should not be used if any variable falls outside the allowable range

HK-BEAM - Building Energy Performance Assessment Form

FORM 2: ENERGY CONSUMPTION ASSESSMENT

Building Name : _____ **Assessor :** _____

Date : _____

Select (Note 1) →	Values of Variables E1 - E11											
	0	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**	**1**	
↑	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	
Variables Values	**Annual Electricity Consumption (AEC) (kWh/m^2) (Note 2)**											**AEC**
E2 =	*	*	5.2	4.5	3.9	3.2	2.6	1.9	1.3	0.6	0	→
E3 =	*	-148.9	-132.4	-115.8	-99.3	-82.7	-66.2	-49.6	-33.1	-16.5	0	→
E4 =	*	*	*	-7.3	-6.3	-5.2	-4.2	-3.1	-2.1	-1	0	→
E5 =	*	*	*	-13.3	-11.4	-9.5	-7.6	-5.7	-3.8	-1.9	0	→
E6 =	*	-30.5	-27.1	-23.7	-20.3	-16.9	-13.6	-10.2	-6.8	-3.4	0	→
E7 =	*	*	*	79.2	67.9	56.6	45.3	33.9	22.6	11.3	0	→
E8 =	*	*	-17.8	-15.6	-13.4	-11.1	-8.9	-6.7	-4.5	-2.2	0	→
E9 =	6.1	5.5	4.9	4.3	3.7	3.1	2.5	1.8	1.2	0.6	0	→
E10 =	*	*	*	-64.7	-55.5	-46.2	-37	-27.7	-18.5	-9.2	0	→
E11 =	60.3	54.3	48.2	42.2	36.2	30.1	24.1	18.1	12.1	6	0	→
											Σ AEC (Note 3))=	
											Annual Air-conditioning Electricity Consumption = 167.9 + Σ AEC (Note 4) =	**kWh/m^2**
											Credits for Annual Air-conditioning Electricity Consumption (Note 5) =	**Credits**

Notes

(1) Variables are as defined and calculated in Form 1. Values of E1 to E11 range from 0.0 to 1.0.

(2) For each variable, select the column corresponding to the value of the variable, look for the AEC value at the corresponding row and write the AEC value at the rightmost column. The symbol " * " denotes variable value out of allowable range. For a value falling between two values in the column header, interpolation is permitted.

(3) Algebraic sum of AEC values for all variables.

(4) Compute annual air-conditioning electricity consumption according to the formula given.

(5) Credits shall be awarded according to the following criteria:
1 Credit for < 150; 2 for < 140; 3 for < 130; 4 for < 120; 5 for < 110; 6 for < 100; 7 for < 90 kWh/m²-year

HK-BEAM Building Energy Performance Assessment Form **FORM 3: MAXIMUM DEMAND ASSESSMENT**

Building Name : _____ **Assessor :** _____

Date : _____

Select (Note 1) → ↑	Values of Variables E1 - E11											
	0	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**	**1**	
	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	
Variables Values	**Maximum Electricity Demand (MED) (VA/m^2) (Note 2)**											**MED**
E1 =	*	-3.9	-3.5	-3.1	-2.6	-2.2	-1.8	-1.3	-0.9	-0.4	0	
E2 =	*	*	-2.4	-2.1	-1.8	-1.5	-1.2	-0.9	-0.6	-0.3	0	→
E3 =	*	-77.2	-68.6	-60.0	-51.5	-42.9	-34.3	-25.7	-17.2	-8.6	0	→
E5 =	*	*	*	-6.3	-5.4	-4.5	-3.6	-2.7	-1.8	-0.9	0	→
E7 =	*	*	*	27.3	23.4	19.5	15.6	11.7	7.8	3.9	0	→
E10 =	*	*	*	-23.2	-19.9	-16.6	-13.3	-10.0	-6.6	-3.3	0	→
E11 =	8.5	7.7	6.8	6.0	5.1	4.3	3.4	2.6	1.7	0.9	0	→
											Σ MED (Note 3))=	
											1. Maximum Electricity Demand of A/C System = (99 + Σ MED) / 0.85 (Note 4) =	**VA/m^2**
											2. Maximum Demand of Small Power =	**VA/m^2**
											3. Maximum Demand of Lighting Installations =	**VA/m^2**
											4. Maximum Demand of Miscellaneous Installations (Default) = 17.6	**VA/m^2**
											Total Maximum Electricity Demand = Sum of items 1 to 4 above =	**VA/m^2**
											Credits for Annual Air-conditioning Electricity Consumption (Note 5) =	**Credits**

Notes

(1) Variables are as defined and calculated in Form 1. Values of E1 to E11 range from 0.0 to 1.0.

(2) For each variable, select the column corresponding to the value of the variable, look for the MED value at the corresponding row and write the MED value at the rightmost column. The symbol " * " denotes variable value out of allowable range. For a value falling between two values in the column header, interpolation is permitted.

(3) Algebraic sum of MED values for all variables.

(4) Compute maximum air-conditioning electricity demand according to the formula given.

(5) Credits shall be awarded according to the total maximum demand and the following criteria:
1 Credit for < 160; 2 for < 140; 3 for < 120 VA/m²