HK - BEAM

Version 5/04

HK-BEAM Society
香港環保建築協會

HONG KONG BUILDING ENVIRONMENTAL ASSESSMENT METHOD
香港建築環境評估法

Existing Buildings

HK-BEAM Society

HK-BEAM 5/04 ‘Existing Buildings’

An environmental assessment for existing buildings Version 5/04

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http://www. hkbeam.org.hk/
http://www.bse.polyu.edu.hk/Research_Centre/BEP/hkbeam/main.html

OVERVIEW

HONG KONG BUILDING ENVIRONMENTAL ASSESSMENT METHOD

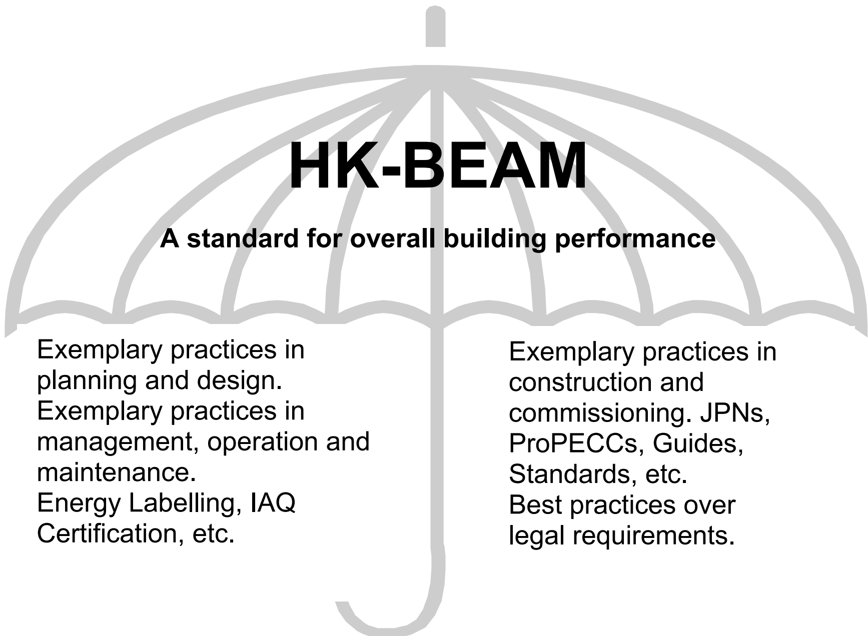
A STANDARD THAT DEFINES BUILDING QUALITY

HK-BEAM provides building users with a single performance label that demonstrates the overall qualities of a building, be it a new or refurbished building, or one that is already in use. A HK-BEAM assessed building will be safer, healthier, more comfortable, more functional and more efficient that a similar building which has not achieved the prescribed levels of performance. HK-BEAM is:

- the leading initiative in Hong Kong to assess, improve, certify and label the performance of buildings;
- a comprehensive standard and supporting process covering all building types, including mixed use complexes;
- a means by which to benchmark and improve performance;
- a voluntary scheme developed in partnership with, and adopted by the industry, at a level that makes it one of the leading schemes in the world; and
- a driver for and means by which to ensure healthier, efficient, and environmentally sustainable working and living environments.

COMPREHENSIVE ASSESSMENT

HK-BEAM embraces a range of good practices in planning, design, construction, and management, operation and maintenance of buildings, and is aligned with local regulations, standards and codes of practice.



A STANDARD FOR HEALTHY BUILDINGS

A healthy building is one that adversely effects neither the health of its users nor that of the larger environment. HK-BEAM emphasises indoor environmental quality and amenities as key performance indicators, but not without proper consideration of the local, regional and global environmental impacts.

A UNIQUE STANDARD

The HK-BEAM scheme is somewhat unique in that it:

- embraces a wide range of sustainability issues;
- covers the whole-life performance of buildings;
- assesses new buildings only upon completion, certifying actual performance; and

- embraces management, operation and maintenance practices to ensure a building performs at the highest level.

PURPOSE

HK-BEAM seeks to:

- enhance the quality of buildings in Hong Kong;
- stimulate demand for buildings that are more sustainable, giving recognition for improved performance and minimising false claims;
- provide a comprehensive set of performance standards that can be pursued by developers and owners;
- reduce the environmental impacts of buildings throughout their life cycle; and
- ensure that environmental considerations are integrated right from the onset rather than retrospectively.

VOLUNTARY ASSESSMENT

An assessment under HK-BEAM is voluntary, providing an independently certified performance rating for a building in clearly defined terms.

HK-BEAM covers all types of new and existing buildings: residential, commercial, institutional, and industrial. It embraces and endorses exemplary practices in the planning, design, construction, commissioning, management and operation of buildings in the context of Hong Kong's densely populated, predominantly high-rise development.

New buildings that are planned, designed, built and commissioned to the standards set under HK-BEAM Version 4/04 [1] will provide for safe, healthy, comfortable and efficient buildings that sustain the quality of life and workplace productivity, whilst minimising the depletion of natural resources and reducing their environmental loadings. Existing buildings managed and operated to the standards set under HK-BEAM Version 5/04 [2] will provide and maintain high levels of performance over the life of a building.

CLIENTS DECIDE

HK-BEAM provides a label for building quality. The label signifies levels of quality in respect of safety, health and comfort, which are important considerations for building users (buyers, tenants, occupants), and levels of performance in respect of environmental and social dimensions, which are of importance to society as a whole. It is for the Client (developer, owner) to decide on whether to undertake a HK-BEAM assessment and the performance standards that are considered appropriate for the building in the prevailing circumstances. The Client ultimately decides whether obtaining a HK-BEAM label is a worthwhile endeavour, but completion of a HK-BEAM assessment provides assurances as to the qualities of a building, not as a subjective promise, but as a measured reality.

DEVELOPMENT HISTORY

The HK-BEAM scheme was established in 1996 with the issue of two assessment methods, one for 'new' [3] and one for 'existing' office buildings [4] largely based on the UK Building Research Establishment's BREEAM. Environmental issues were categorised under 'global', 'local' and 'indoor' impacts, respectively. In 1999 the 'office' versions [5,6] were re-issued with minor revisions and updated references, together with an entirely new assessment method for high-rise residential buildings [7].

1 HK-BEAM Society. HK-BEAM 4/04. An Environmental Assessment Method for New Buildings.
2 HK-BEAM Society. HK-BEAM 5/04. An Environmental Assessment Method for Existing Buildings.
3 CET. HK-BEAM 1/96. An Environmental Assessment Method for New Air-conditioned Office Premises. 1996.
4 CET. HK-BEAM 2/96. An Environmental Assessment Method for Existing Air-conditioned Office Premises. 1996.
5 CET. HK-BEAM 1/96R. An Environmental Assessment Method for New Air-conditioned Office Premises. 1999.
6 CET. HK-BEAM 2/96R. An Environmental Assessment Method for Existing Air-conditioned Office Premises.
7 CET. HK-BEAM 3/99. An Environmental Assessment Method for New Residential Buildings.1999.

Both Version 4/04 'New Buildings' and Version 5/04 'Existing Buildings' represent significant upgrades to the previous HK-BEAM documents. These versions have been developed from the pilot versions 4/03 and 5/03 published in June 2003 following extensive review by the HK-BEAM Society Technical Review Panels, supported by further research and development. Besides expanding the range of building developments that can be assessed these versions of HK-BEAM widens the coverage to include additional issues that are regarded as further defining quality and sustainability of buildings.

HK-BEAM SOCIETY

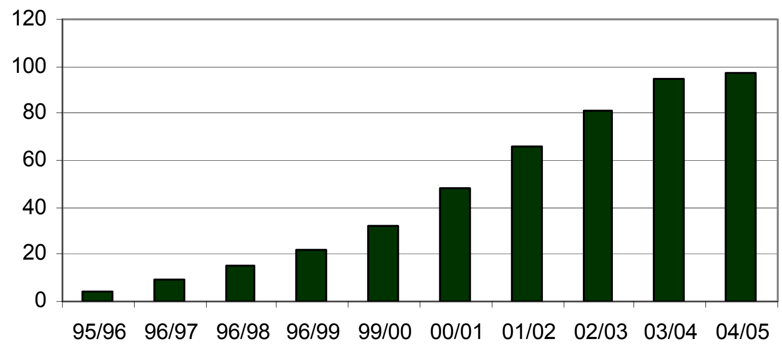
HK-BEAM is owned and operated by the HK-BEAM Society [8], an independent not-for-profit organisation whose membership is drawn from the many professional and interest groups that are part of Hong Kong's building construction and real estate sectors. Following initial funding from The Real Estate Developers Association of Hong Kong (REDA) HK-BEAM development is funded from assessment fees and the voluntary efforts of HK-BEAM Society members and associates.

A SUCCESS STORY

On a per capita basis HK-BEAM has assessed more buildings and more square meters of space than any other similar scheme in use worldwide. The take up of assessments has embraced mainly air-conditioned commercial buildings and high-rise residential buildings, the leading users of energy and other natural resources in Hong Kong. In raising awareness about the environmental impacts of buildings HK-BEAM has contributed the development of 'Green and Sustainable buildings' in the HKSAR. The new versions of HK-BEAM will continue to contribute to this development process through more comprehensive coverage and higher performance expectations.

HK-BEAM ACHIEVEMENTS

At the end of 2004 ninety-six landmark developments have been submitted for certification, covering some 5.1 million square meters and including 49,000 residential units.



FUTURE DEVELOPMENT

To build on this success HK-BEAM is being developed further by providing:

- on-line support to Clients; and
- web-based tools for the purposes of preliminary self assessments.

8 HK-BEAM Society. http://www.hk-beam.org.hk/
(Ref. 1, 2 are available at http://www.hk-beam.org.hk/)
(Ref. 1, 2, 5, 6, 7 are available at http://www.bse.polyu.edu.hk/Research_Centre/BEP/hkbeam/main.html)

ACKNOWLEDGEMENTS

HK-BEAM	The Hong Kong Building Environmental Assessment Method (HK-BEAM) is a significant private sector initiative in Hong Kong to promote buildings that are more sustainable, through enhanced design, construction, commissioning, management, and operation and maintenance practices. HK-BEAM Version 4/04 has been developed by the HK-BEAM Society. The scheme is owned by the HK-BEAM Society and is operated under the guidance of the HK-BEAM Society Executive Committee. Secretarial and logistics support is provided by the Business Environment Council.
HK-BEAM SOCIETY EXECUTIVE COMMITTEE	Michael Arnold, Chairman Cary Chan, Vice Chairman Chris Gabriel, Vice Chairman Kevin Edmunds, Secretary Ku Moon-lun, Agnes Ng, Daniel Chan, David Yau, John Burnett, Joseph Pereira, Martin King, Otto Poon, Reuben Chu, Thomas Ho, Toby Bath
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BSOMES PANEL	The contributions from members of the Building Services Operations & Maintenance Executives Society (BSOMES) who helped in the review of document 5/03 are acknowledged.
DEVELOPMENT TEAM VERSION 5/04	Research and development for version 5/04 was undertaken by the Department of Building Services Engineering, The Hong Kong Polytechnic University under the direction of the Technical Review Panels. John Burnett – Principle, Francis W H Yik, Lee Wai Ling (Energy), Greg Powell (Ventilation), Alice Tang (Site, Materials) Contributions from T M Chung, Hilda Cheung, C K Chau S K Tang, D W T Chan, W K Chow, K C Lam and K T Chan are also acknowledged.
FUNDING SUPPORT	Funding support for the pilot versions 4/03 and 5/03 was provided by The Real Estate Developers Association of Hong Kong. Support from the Faculty of Construction and Land Use, The Hong Kong Polytechnic University for the development of the latest versions is also acknowledged.

1 FRAMEWORK OF HK-BEAM 5/04

INTRODUCTION

HK-BEAM is intended to provide authoritative guidance to all stakeholders in the building construction and real estate sectors on practices which reduce the adverse effects of buildings on the environment, whilst providing quality built environments. It has been developed to set criteria for exemplary performance in buildings; performance that is independent verified and acknowledged through an independently issued certificate. An assessment under the scheme is voluntary.

HK-BEAM defines performance criteria for a range of sustainability issues relating to the planning, design, construction, commissioning, management and operation and maintenance of buildings. 'Credits' are awarded where standards or defined performance criteria are satisfied. Where these are not satisfied guidance is provided on how performance can be improved. The credits are combined to determine an overall performance grade.

This document describes HK-BEAM version 5/04 for existing buildings. Assessment of new buildings and buildings that have undergone major refurbishment is carried out using version 4/04. The two versions of HK-BEAM are designed to dovetail together to allow coverage of the life cycle performance of buildings.

Assessment under HK-BEAM 5/04 covers the management, operation and maintenance of a building and may be initiated at any time. HK-BEAM 5/04 aims to reduce the environmental impacts of existing buildings whilst improving quality and user satisfaction, by adoption of the best techniques available within reasonable cost.

ACKNOWLEDGING COMMITMENT TO SUSTAINABLE DEVELOPMENT

Increasingly organisations and companies are demonstrating their commitment and contribution to sustainable development, through:

- the maintenance of sustainable levels of economic growth;
- progress that recognises the needs of the community;
- efficient use of non-renewable natural resources; and
- enhanced protection of the environment.

AIMS

HK-BEAM aims to contribute to the development of buildings that are more sustainable and reduce the long-term impacts that buildings have on the environment by:

- enhancing safety, improving hygiene and the quality of indoor environments, and hence the health and well-being of occupants;
- minimising pollution of external environments;
- promoting and encouraging energy efficient buildings, systems and equipment, including the use of renewable energy;
- reducing the unsustainable consumption of increasingly scarce resources such as water and tropical timber; and
- improving waste management and encouraging recycling and reuse of materials.

A SPECIFICATION FOR SUSTAINABLE BUILDINGS

HK-BEAM provides for a comprehensive and fair assessment of the overall performance of a building in a range of key areas, at either the completion stage or during its life. An assessment:

- embraces many areas of sustainability, particularly social and environmental;
- recognises best practices;
- provides for a comprehensive method of quantifying overall performance;
- demonstrates performance qualities to end users; and
- provides economic benefits to stakeholders.

MARKET RECOGNITION

HK-BEAM:

- sets targets and standards which are independently assessed and so help to minimise false claims or distortions;
- provide recognition for buildings where the quality has been enhanced and environmental impacts have been reduced;
- enable developers and building operators to respond to user demands for better quality buildings that have less impact on the environment; and
- to help stimulate the market for more sustainable buildings.

Whilst HK-BEAM endeavours to provide for a comprehensive and fair assessment it recognises that assessment criteria, assessment methods and allocation of credits are not complete and comprehensive. However, the real value of HK-BEAM lies not in scientific rigour but in the actual improvements to building quality and the levels of awareness amongst stakeholders resulting from its application.

DYNAMIC SYSTEM

Since the collective knowledge as to what constitutes a sustainable building will continue to develop HK-BEAM will need to respond, requiring a dynamic system able to incorporate periodic changes and updates. With wider implementation it is also expected that the scheme will be subject to further scrutiny by, and feedback from, an increasing number of stakeholders.

The HK-BEAM documentation shall be revised on an annual basis. Where changes in regulations necessitate changes to the assessment criteria these will be issued to all parties involved in an assessment and will be announced on the HK-BEAM Society's website. An appropriate transitional period shall be allowed for buildings already under assessment.

The HK-BEAM Society website [1] provides further advice to users in the form of guidance notes and assessment tools.

1 HK-BEAM Society. http://www.hk-beam.org.hk/

1.1 SUSTAINABLE BUILDINGS

Much is said and written about sustainable development and the social, economic and environmental aspects, but with many definitions available it is very much a matter of viewpoint as to what is sustainable. As a consequence there are few clear definitions as to what constitutes a sustainable building, although ASTM [2] defines such as a 'green building' – "a building that provides the specified building performance requirements while minimizing disturbance to and improving the functioning of local, regional, and global ecosystems both during and after its construction and specified service life". Furthermore "a green building optimizes efficiencies in resource management and operational performance; and, minimizes risks to human health and the environment". To this can be added social equity and economic viability.

A WORKING DEFINITION

In the context of Hong Kong's sub-tropical climate and dense high-rise development HK-BEAM considers a sustainable building as one that is, in priority order, safe, healthy, comfortable, functional, and efficient.

Building safety is covered by a myriad of regulations, yet even for new buildings safety may be compromised through poor implementation or co-ordination of safety measures. For existing buildings much depends on the quality of building management and user awareness.

Post-SARs hygiene has become a major issue in both design and management of buildings. Indoor air quality also relates to health, but together with thermal aspects, lighting, noise, etc., it is also a comfort issue. Maintaining good indoor environmental quality (IEQ) depends on design, operation and user understanding of the many factors involved. Poor IEQ impacts on the quality of life and productivity in the workplace. The qualities of services, such as vertical transportation, also influence user satisfaction and workplace efficiency. Consequently, the needs of users and the efficiency of buildings needs to be balanced against the consumption of non-renewable natural resources and environmental loadings to air, land and waters.

ENVIRONMENTAL ASPECTS

An environmental aspect is defined in ISO 14004 [3] as an element of an organisations activity, products or services than can interact with the environment. ISO defines 'environment' as the surroundings in which an organisation operates, including air, water, land, natural resources, flora, fauna, humans, and their interrelation. Surroundings in this context extend from within an organisation to the global system. An environmental impact is any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's activities, products or services. A significant environmental aspect is an environmental aspect that has or can have a significant environmental impact.

The HK-BEAM scheme addresses items for which there is good evidence of the environmental problems they cause, and for which reasonably objective performance criteria can be defined. Certain performance aspects attributable to buildings and their use have yet to be included, either because the environmental impacts are not well defined, or because performance criteria have not been established. They may be included in future updates, when information becomes available to permit reasonably objective assessment.

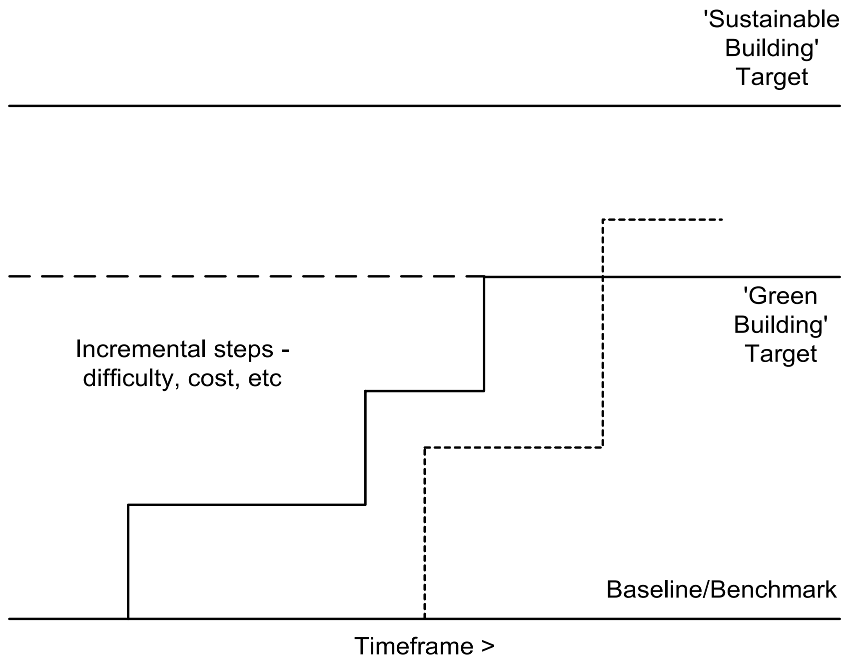
SOCIAL AND ECONOMIC ASPECTS

HK-BEAM recognises the need to include social and economic dimensions when assessing building performance. Where there is

2 ASTM International E 2114–01. Standard Terminology for Sustainability Relative to the Performance of Buildings. 2001.
3 International Organization for Standardization. ISO14004: Environmental management systems – General guidelines on principles, systems and supporting techniques.

consensus amongst stakeholders that an issue is important, and where a reasonably objective assessment can be made, the issue is included.

RAISING STANDARDS



Responding to environmental priorities and to social and economic issues, HK-BEAM strives to improve the overall performance of buildings. HK-BEAM encourages progressively higher standards of performance and innovations that contribute to such performance. For a voluntary scheme the extent to which performance can be enhanced is determined by market acceptance of the assessment criteria, the cost of undertaking assessments, the relative weighting of the credits counting towards the overall grade awarded, and the perceived benefits to the Client. The criteria included in HK-BEAM are considered to be realistic and attainable in practice.

1.2 ASSESSMENT FRAMEWORK

According to the emerging international consensus building assessments should be performance based as far as possible. Assessment needs to take a holistic view of building performance with emphasis on life-cycle impacts. Assessment purely on the basis of prescriptive features would preclude buildings without the features from obtaining a good assessment result regardless of the actual performance. Furthermore, assessment based on features may encourage feature-based design, construction and operating practices.

HOLISTIC ASSESSMENT

HK-BEAM integrates the assessment of many key aspects of building performance, embracing:

- hygiene, health, comfort, and amenity;
- land use, site impacts and transport;
- use of materials, recycling, and waste management;
- water quality, conservation and recycling; and
- energy efficiency, conservation and management.

TRANSPARENCY

HK-BEAM recognises that assessment criteria and methods to achieve compliance need to be transparent, providing details of the benchmarks (baselines), data, assumptions and issues taken into account in the assessments and the credit ratings.

ASSESSMENTS OF EXISTING BUILDINGS

HK-BEAM 5/04 attempts to cover all types of buildings, from small single buildings to large buildings on residential and commercial estates. The assessment needs to cover the various types of premises contained within the building, and may involve premises that are fitted-out by tenants.

The purpose is not only to assess the actual performance of a building, but also to give guidance on potential performance, that is, the best performance that can be obtained from the building given the prevailing levels of occupancy and nature of use. Actual performance determines operating costs, consumption of resources and the by-products from building use, and is the starting point for determining various improvement measures.

For existing buildings there are two facets to performance. Building and system performance is a consequence of technical features of the building and is dependent on the standards to which the building was built and/or subsequently modified. The building end use and the effectiveness of management practices in operating the building also have significant influence on performance. In order to encourage improvements HK-BEAM 5/04 distinguishes between the potential impacts of these two aspects of the performance of a building.

ESTATES

When a building forms part of an estate then certain features of the estate design will be included in the assessment. In an estate containing several buildings of essentially similar design, assessment of Site Aspects, Materials Aspects and Water Use for one building can apply to all the buildings, although Energy Use and IEQ assessments will require further evaluation if all the buildings are to graded under HK-BEAM.

SPECIAL CASES

It is possible that some buildings may not be fully embraced by the criteria currently presented in HK-BEAM 5/04, due to their unusual nature or variety of forms and system designs, etc. This will be particularly true in respect of assessment of energy use. In such circumstances certain assessment criteria or the method of demonstrating compliance may need to be modified. This would require agreement between the Client and the HK-BEAM Assessor, and be endorsed by the HK-BEAM Society Executive Committee.

ABSOLUTE VERSUS RELATIVE PERFORMANCE

Through an opinion survey of HK-BEAM Society members [4] it is clear that there should be a balance between assessment of 'absolute' performance, i.e. issues over which the Client may have little or no control (e.g. car parking provisions), and 'relative' performance, i.e. issues that can be influenced by the Client.

In addition, HK-BEAM takes the position that assessment of some aspects of building performance should not be penalised because of externalities that are not under the control of the Client, such as the efficiency of the utility supplying energy sources to a building. In this case only consumption is quantified (e.g. kWh) and rated, and not the consequent environmental loadings (e.g. CO_2) unless the mix of energy sources (gas, oil, electricity) is significant.

ASSESSMENT BOUNDARIES

HK-BEAM is concerned about the interactions between the assessed building, neighbouring properties, and the neighbourhood in general. The assessment seeks to reduce negative impacts on neighbours and rewards efforts that are aimed to improve the quality of the immediate surroundings to the benefit of the neighbourhood, the concept of 'good neighbour' buildings.

REGIONALLY RESPONSIVE CRITERIA

In Hong Kong's humid sub-tropical climate and dense urban living environment people need to be provided with options to enclosed, air-conditioned spaces, so that the provisions for natural ventilation and daylighting figure prominently in the assessment of indoor environments.

PERFORMANCE BENCHMARKS

The benchmark (zero credit level) for particular performance criteria is established by reference to legal requirements, which may be required as a pre-requisite. HK-BEAM uses local performance standards, codes and guides where these are available (e.g. indoor air quality). Where these are not available (e.g. impact noise) international or national standards, codes and guides are referenced. Where there are differences in the performance criteria set by the various authorities HK-BEAM will generally avoid specifying the performance criteria (e.g. thermal comfort), allowing the Client to specify what they consider to be appropriate for their building. A HK-BEAM assessment seeks to establish that the specified levels of performance are acceptable and have been achieved. Where performance standards are not well defined (e.g. energy use) HK-BEAM establishes its own performance benchmarks based on available data and stakeholder consensus. Credits are awarded for achieving higher levels of performance. It is intended that the assessment criteria be updated periodically as new information becomes available and as legal requirements evolve.

FLEXIBLE AND OBJECTIVE

HK-BEAM embraces a wide range of buildings, variable in terms of scale, location and mix of uses (types of premises). The assessment criteria and methods of assessment need to be flexible and allow for alternative means of compliance, yet be reasonably objective to enable the HK-BEAM Assessor to arrive at decisions without undue controversy.

Where issues are rather subjective, i.e. performance criteria cannot be quantified or determined through a compliance specification, HK-BEAM uses 'check-lists' to facilitate equitable and consistent assessments.

PERFORMANCE CATEGORIES

Different assessment methods in use world-wide arrange performance aspects under different headings to reflect the preferences of the tool developer. In HK-BEAM the various performance aspects covered are

4 HK-BEAM Society. Report on the Development of HK-BEAM Scheme – Survey I Framework.

grouped within the following categories:

SITE ASPECTS

Generally speaking site issues, as listed in HK-BEAM, will not vary significantly with the type of building. However, the scale and location of the building will determine the extent to which environmental aspects associated with the site are significant and can be addressed in the assessment. Site Aspects include:

- location and design of the building;
- emissions from the site; and
- site management.

MATERIALS ASPECTS

Similar to site issues, materials use issues included in HK-BEAM will be similar for all types of buildings, although the size of the building will have significance. Materials Aspects include:

- selection of materials;
- efficient use of materials; and
- waste disposal and recycling.

ENERGY USE

Assessment of energy use in a building containing a variety of uses, energy sources and building services systems and equipment is a somewhat complex process given the number of influencing variables. Where available HK-BEAM 5/04 uses benchmarks derived from audits of similar types of buildings, and/or a computational approach to determining the dominant energy uses, plus additional features known to have impact on overall performance. Energy Use includes:

- annual energy use;
- energy efficient systems and equipment; and
- energy management;

WATER USE

Assessments under Water Use includes quality and features that improve utilisation and reduce effluent, i.e.:

- water quality;
- water conservation and
- effluent discharges.

INDOOR ENVIRONMENTAL QUALITY

Indoor issues included in HK-BEAM are those aspects of building performance that impact on the health, comfort or well-being of the occupants, as well as aspects of performance that improve quality and functionality. Not included are the technical performance aspects of specialist premises, such as acoustic qualities of concert venues, stage lighting, or air quality in clean rooms. Indoor Environmental Quality (IEQ) includes:

- safety;
- hygiene;
- indoor air quality and ventilation;
- thermal comfort;
- lighting;
- acoustics and noise; and
- building amenities.

1.3 CREDIT WEIGHTINGS AND OVERALL GRADE

The weighing system, i.e. the relative number of credits given for compliance with a particular aspect, is a critical part of a building performance assessment method. It is logical that HK- BEAM should seek to assign credits or weightings to assessment criteria somewhat in accordance with the significance of the impact. However, it is not practical at present to assess all the issues covered in HK-BEAM on a common scale. There is insufficient information available to provide an objective weighting for all issues, because of the difficulty in assigning an economic cost to environmental effects as diverse as, for example, the health of individuals, global warming and resource depletion. For a voluntary scheme there is also a need to consider the credits awarded with regard to technical difficulty and cost, otherwise take-up of the scheme will be affected.

CREDITS ALLOCATED

Credits have been broadly allocated by taking into account the international consensus as given by an analysis of weightings used in similar assessment methods operating elsewhere, as well as surveys and informed opinions of those who have contributed to the development of HK-BEAM [4]. The award of fractions of a credit is possible under HK-BEAM.

EXCLUSIONS

Exclusions are included where an issue or part of an assessment is not applicable to particular circumstances or building type. A spreadsheet is available on the HK-BEAM WEB site to show as 'NA' (not applicable) the credits affected.

PRE-REQUISITES

For some of the environmental aspects detailed in HK-BEAM compliance with legal requirements is taken as a prerequisite for the award of credits. Consequently, when an assessed issue becomes subject to legislation it will no longer count for the award of credits, and would be amended or deleted in any future revisions of HK-BEAM.

ASSESSMENTS

Many of the assessments verifying compliance with the prescribed criteria in HK-BEAM will be undertaken by a suitably qualified person acting on behalf of the Client, who will submit evidence in the form of documents, data and reports confirming compliance. Others will be based on evidence collected by the HK-BEAM Assessor.

ALTERNATIVE ASSESSMENT METHODS

HK-BEAM does not seek to be overly prescriptive in setting assessment criteria and in defining methods of compliance, and encourages Client's representatives to consider alternative approaches which meet the objectives of HK-BEAM. Client representatives are invited to submit a 'method statement' if a credit is sought using an alternative approach. The statement shall address the stated objective of HK-BEAM for which the credit or credits are sought, the proposed alternative criteria, and the proposed method for assessment. The proposal should be submitted at the earliest opportunity in the assessment process. It would then be considered by the HK-BEAM Assessor and, if necessary, submitted for technical review to the HK-BEAM Society Executive Committee. A ruling shall be made to accept, accept with defined modifications, or reject the 'method statement', which shall be binding on the assessment.

In the event that an alternative approach is endorsed by the Executive Committee it shall be incorporated in the guidance notes used by HK-BEAM Assessors, and in future revisions to the HK-BEAM documentation, as deemed appropriate by the Committee.

INNOVATIONS AND ADDITIONS

Whilst innovative design solutions are encouraged, they do not necessarily justify credit. Innovation must demonstrate performance gains, such as through improved efficiency and/or improvements in the built environment. Indeed, it is anticipated that significant performance benefits will be realised from full and proper implementation of sound design, construction, installation, and operating practices.

HK-BEAM 5/04 does not presume to be comprehensive in its coverage of all performance aspects. Under the heading of 'Innovation' the Client are encouraged to submit proposals for the award of credits for aspects not covered elsewhere in HK-BEAM 5/04. In such circumstances the Client shall submit a proposal in which the performance gains are demonstrated. The HK-BEAM Society Executive Committee would examine the validity of the proposal and, weighting the performance gains against others covered by the scheme, award an appropriate number of credits. These credits would not count towards the total number of credits available, but would count towards the total of credits qualifying for an award classification, i.e., innovative credits can be regarded as bonus credits. Subsequent revisions of HK-BEAM may incorporate such credits as part of the core assessment, and would then be counted within the total number of credits available.

1.3.1 DETERMINATION OF OVERALL GRADE

The Overall Assessment Grade is based on the percentage (%) of applicable credits gained. Given the importance of IEQ it is necessary to obtain a minimum percentage (%) of credits for IEQ in order to qualify for the overall grade. The award classifications are:

	Overall	IEQ	
Platinum	75%	65%	(Excellent)
Gold	65%	55%	(Very Good)
Silver	55%	50%	(Good)
Bronze	40%	45%	(Above average)

1.3.2 GRADING A BUILDING COMPLEX

After allowing for exclusions for particular circumstances it is expected that applicable credits under Site Aspects, Materials Aspects and Water Use will not differ significantly for the different buildings that make up a building complex. However, it is clear that there may be significant differences in Energy Use and Indoor Environmental Quality aspects between buildings which differ in operating mode such as; for example, buildings that are use central air-conditioning, as opposed to buildings where natural ventilation may be utilised.

Centrally air-conditioned buildings can be expected to consume greater amounts of energy, so the relative weighting for energy use as compared to others environmental aspects can be higher than for buildings which are less energy intensive. In addition, aspects such as thermal comfort and IAQ are subject to tighter controls. To cater for a mix of building types in a complex and where an overall assessment for the complex is required, HK-BEAM weighs the available credits for energy and IEQ according to the 'normally occupied' floor area of each building type.

HK-BEAM assessment of energy use also allows for situations where several buildings within a complex are supplied from common central air-conditioning plant, so that energy use in a particular building in the complex can be estimated for assessment purposes.

IEQ CREDITS

For circumstances where a building complex consists of several different types of buildings, with each having different numbers of applicable IEQ credits, the overall number of credits for IEQ shall also be weighted according to the 'normally occupied floor area.

1.4 ASSESSMENT PROCESS

HK-BEAM assessments are currently undertaken by the Business Environment Council (BEC), an independent, non-profit, environmental information centre, under the guidance of the HK-BEAM Society Executive Committee. Assessment by other parties, as licensed HK-BEAM Assessors, is under consideration for implementation.

ELIGIBILITY

All existing buildings are eligible for certification under HK-BEAM 5/04, including, but not limited to offices, retail, catering and service establishments, libraries, educational establishments, hotels and residential apartment buildings. Whilst it is not expected that buildings used for primarily industrial purposes or low-rise residential buildings will seek certification under this assessment method, the method is sufficiently flexible to embrace all types of buildings.

INITIATION

Buildings can be assessed at any time, but the greatest benefit is derived if the assessment process begins at an earlier stage, allowing operators to make changes that will improve the building's overall performance.

GUIDANCE

The assessment process should be initiated at an early stage, since the issues raised requires a substantial review of management, operation and maintenance practices, as well as building and system performance data, covering at least the core building and possibly tenant areas. Not all information will be readily available. The method identifies and credits good management, operation and maintenance, and building and system performance where specific targets are met.

The Assessor will issue a questionnaire to potential Clients which details the information required for assessment. The BEC 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 outline enhancements necessary to obtain further credits. At this stage the Client may wish to implement additional management, operation and maintenance procedures, or make changes to the building or installed equipment.

Further guidance material is made available on the Society's website [1].

CERTIFICATION

When a building is registered for assessment the credits and assessment criteria current at the time of registration will be used in the assessment, unless the Client wishes to comply with credits and criteria introduced after registration. Certification is valid for a period of up to 5 years

APPEALS PROCESS

Any objection to any part or the entire assessment can be submitted direct to the HK-BEAM Society and will be adjudicated by the Society's Executive Committee. The Client is at liberty to submit an appeal to the Society at any time detailing in writing stating the grounds for the appeal.

DISCLAIMER

The HK-BEAM Building Environmental Assessment Method is intended for use by Clients and project teams engaged in new building design, and owners and operators of existing facilities as a guide to more environmentally sustainable building design and operation. The Method has been prepared with the assistance and participation of many individuals and representatives from various organisations. The final outcome represents general consensus, but unanimous support from each and every organisation and individual consulted is not implied.

This document represents the HK-BEAM Society's efforts to develop a standard that improves the performance of buildings using the latest techniques, practices and standards compatible with prevailing economic constraints. These are subject to changes, which will be included through periodic updating.

It should be noted that none of the parties involved in the funding of HK-BEAM, including the HK-BEAM Society and its members provide any warranties or assume any liability or responsibility to users of HK-BEAM, or any third parties for the accuracy, completeness or use of, or reliance on, any information contained in HK-BEAM, or from any injuries, losses, or damages arising out of such use or reliance.

As a condition of use, users covenant not to sue, and agree to waive and release the HK-BEAM Society and its members from any and all claims, demands and causes of actions for any injuries, losses or damages that users may now or hereafter have a right to assert against such parties as a result of the use of, or reliance on HK-BEAM.

FURTHER INFORMATION

Further information on how to participate in the scheme is available from the HK-BEAM Society Web site [1].

1.5 Summary of Credits

	Section:	Credit Requirement:	Exclusions	Credits	Target
2	**Site Aspects**				
2.1.2	**Contaminated Land**	1 BONUS credit where the building is located on land that was decontaminated or adjacent to a landfill site	None.	**1B**	
2.1.3	**Local Transport**	1 credit if no car parking is provided other than provisions intended for use by disabled persons, company vehicles and/or any shuttle service vehicles.	None.	**1**	
		1 credit where there exists convenient pedestrian access to mainstream public transport.		**1**	
2.1.4	**Neighbourhood Amenities**	1 credit where neighbourhood services are sufficient to provide for basic needs of the users of the building.	None.	**1**	
		1 credit where neighbourhood recreational facilities and open space is adequate and available for building users.		**1**	
		1 BONUS credit if recreational facilities and open space provided within the development are open to the public.		**1B**	
2.2.4	**Landscaping and Planters**	1 credit for providing pervious materials and/or appropriate planting for at least 50% of the external area of the site.	None.	**1**	
		1 credit for providing appropriate planting on a total area that is at least 30% of the area of the building footprint.		**1**	
2.2.5	**Microclimate Around Buildings**	1 credit for demonstrating that no pedestrian areas are subject to excessive wind velocities caused by site layout and building design.	None.	**1**	
		1 credit for demonstrating that steps have been taken to reduce elevated temperatures in exposed public areas due to site layout and choice of materials.		**1**	
2.2.7	**Vehicular Access**	1 credit for providing safe and efficient access for vehicles entering and leaving the site and buildings.	None.	**1**	
2.3.4	**Emissions from Wet Cooling Towers**	1 credit for a building development in which wet cooling towers: are not used, or use seawater, or water from an acceptable source and are designed and maintained as specified in the Code of Practice for the Prevention of Legionnaires Disease.	None.	**1**	
2.3.5	**Noise from Building Equipment**	1 credit for demonstrating that the level of the intruding noise at the facade of the nearest sensitive receiver is in compliance with the criteria recommended in the Hong Kong Planning Standards and Guidelines.	None.	**1**	

2.3.6	**LIGHT POLLUTION**	1 credit for demonstrating that obstrusive light from exterior lighting meets the specified performance for the environmental zone in which the building development is located.	None.	**1**	
2.4.1	**HEALTH, SAFETY AND ENVIRONMENTAL MANAGEMENT**	1 credit where the building management operates an Operational Health and Safety Management System certified to OHSAS 18001 or an Environmental Management System to ISO14001.	None.	**1**	
		1 BONUS credit where both a certified OHSMS and a certified EMS are in place.		**1B**	
2.4.2	**ENVIRONMENTAL PURCHASING PRACTICES**	1 credit for implementing purchases practices that encourage the supply and use of environmentally friendly materials, products and equipment.	None.	**1**	
2.4.3	**BUILDING AND SITE OPERATION AND MAINTENANCE**	1 credit for implementing an effective system of regular inspection, cleaning and maintenance of the building's fabric and structure.		**1**	
		1 credit for implementing an effective system of regular inspection, cleaning and maintenance of areas and facilities external to the building.		**1**	
		1 credit for providing a fully documented operations and maintenance manual for the building and site to the minimum specified.		**1**	
2.4.4	**BUILDING SERVICES OPERATION AND MAINTENANCE**	1 credit for demonstrating the operation of a planned programme of regular inspection, cleaning and maintenance of central HVAC plant.	Buildings without central HVAC system.	**1**	
		1 credit for demonstrating the operation of a planned programme of regular inspection, cleaning and maintenance of the building's engineering systems.		**1**	
		1 credit for having undertaken an audit of the effectiveness of the operation and maintenance practices for all building services engineering systems.		**1**	
2.4.5	**STAFFING AND RESOURCES**	1 credit for the adequacy of staffing and resources to meet the operation and maintenance requirements of the building.		**1**	
2.4.6	**USER GUIDANCE**	1 credit for providing with comprehensive guidance on building safety, hygiene and environmental issues in a building user's guide.		**1**	
		1 BONUS credit where relevant HK-BEAM performance criteria are included in contractual arrangements with tenants.	Buildings other than commercial buildings.	**1B**	

3	MATERIALS ASPECTS				
3.1.1	BUILDING REUSE	1 BONUS credit for the reuse of 15% or more of existing sub-structure or shell.	None.	1B	
3.1.2	MODULAR AND STANDARDISED DESIGN	1 credit for demonstrating the use of modular and standardized design.	None.	1	
3.1.4	ADAPTABILITY AND DECONSTRUCTION	1 credit for designs providing spatial flexibility that can adapt spaces for different uses.	Residential buildings.	1	
		1 credit for flexible design of services that can adapt to changes of layout and use.		1	
		1 BONUS credit for designs providing flexibility through the use of building structural systems that allows for change in future use.		1B	
3.2.1	RAPIDLY RENEWABLE MATERIALS	1 credit for demonstrating that in applications where rapidly renewable materials can be employed at least 50% are used.	None.	1	
3.2.2	SUSTAINABLE FOREST PRODUCTS	1 credit for sourcing timber and composite timber products which are from well managed sources, including reuse of salvaged timber.	None.	1	
		1 BONUS credit where 50% of forest products purchased over the past 3 years were from certified sources.		1B	
3.2.4	OZONE DEPLETING SUBSTANCES	1 credit for using refrigerants with a ozone depleting potential 0.03 or less and a global warming potential of 1600 or less. or: 1 credit for demonstrating a phased programme of refrigerant replacement together with limitations on leakage.	Buildings using split-units and/or window units.	1	
		1 credit for the use of products that avoids the use of ozone depleting substances in their manufacture, composition or use.		1	
3.3.3	WASTE RECYCLING FACILITIES	1 credit for providing facilities for the collection, sorting, storage and disposal of waste and recovered materials.	None	1	
3.3.4	WASTE MANAGEMENT	1 credit for undertaking a waste stream audit and developing a waste management system.		1	
		1 credit for an environmentally responsive waste management system. 1 credit where the waste management system demonstrates reductions in waste disposal to landfills and increased recycling.		2	

4	ENERGY USE				
4.1.1	ANNUAL ENERGY USE IN COMMERCIAL BUILDINGS	1 to 10 credits for a reduction in the annual energy consumption by 10% - 45%.	Other types of buildings.	**10**	
		1 to 3 credits for a reduction in the maximum electricity demand by 15% - 30%.		**3**	
		1 or 2 credits for compliance with the Energy Efficiency codes	(Alternative criteria)	**2**	
		Up to 4 credits based on energy consumption benchmarks.		**4**	
		1 or 2 credits for compliance with the Energy Efficiency codes.	(Alternative criteria)	**2**	
		Up to 3 credits for reduced energy use based on billing/metering data.		**3**	
		Up to 2 credits for reduced maximum electricity demand 10 - 20% based on billing/metering data.		**2**	
4.1.1	ANNUAL ENERGY USE IN HOTEL BUILDINGS	1 to 10 credits for a reduction in the annual CO_2 levels by 10% - 45%.	Other types of buildings.	**10**	
		Up to 2 credits for reduced maximum electricity demand 10 - 20% based on billing/metering data.		**2**	
		1 or 2 credits for compliance with the Energy Efficiency codes	(Alternative criteria)	**2**	
		Up to 4 credits based on energy consumption benchmarks.		**4**	
		1 or 2 credits for compliance with the Energy Efficiency codes.	(Alternative criteria)	**2**	
		Up to 3 credits for reduced energy use 10 - 20% based on billing/metering data.		**3**	
		Up to 2 credits for reduced maximum electricity demand based on billing/metering data.		**2**	
4.1.1	ANNUAL ENERGY USE IN EDUCATIONAL BUILDINGS	1 to 10 credits for a reduction in the annual CO_2 levels by 5% - 30%.	Other types of buildings.	**8**	
		Up to 2 credits for reduced maximum electricity demand 8 - 15% based on billing/metering data.		**2**	
		1 or 2 credits for compliance with the Energy Efficiency codes	(Alternative criteria)	**2**	
		Up to 4 credits based on energy consumption benchmarks.		**4**	
		1 or 2 credits for compliance with the Energy Efficiency codes.	(Alternative criteria)	**2**	
		Up to 3 credits for reduced energy use 8 - 16% based on billing/metering data.		**3**	
		Up to 2 credits for reduced maximum electricity demand 8 - 15% based on billing/metering data.		**2**	

4.1.4	**ANNUAL ENERGY USE IN RESIDENTIAL BUILDINGS**	1 to 8 credits for a reduction in the annual energy consumption by 3% to 22%.	Other types of buildings.	**8**	
4.1.5	**ANNUAL ENERGY USE IN MECHANICALLY VENTILATED BUILDINGS**	Number of credits will depend on the exact nature of the building and the types of mechanical ventilation systems and equipment installed.	Other types of buildings.	**TBA**	
4.1.6	**ANNUAL ENERGY USE IN OTHER BUILDING TYPES**	Number of credits will depend on the exact nature of the building and the types of systems and equipment installed.	NA	**TBA**	
4.2.2	**VENTILATION SYSTEMS IN MECHANICALLY VENTILATED BUILDINGS**	1 credit for ventilation systems that will consume less electricity than those meeting the zero credit requirements (baseline) by 15% or more. 2 credits where the consumption is reduced by 25% or more.	None for this category of building.	**2**	
		1 credit for installing control systems and devices that regulate the operation of the ventilation systems to reduce energy use whenever operating conditions permit.		**1**	
4.2.3	**LIGHTING SYSTEMS IN MECHANICALLY VENTILATED BUILDINGS**	1 credit for using lamps and, where applicable, ballasts that will consume less electricity than those meeting the zero-credit requirements by 15% or more. 2 credits where the consumption is reduced by 25% or more.	None for this category of building.	**2**	
		1 credit for installing control systems and devices that will switch off or dim the output of lighting installations when and where illumination is not required.		**1**	
4.2.7	**RENEWABLE ENERGY SYSTEMS**	1 credit where 2%/4% of building energy is obtained from renewable energy sources. 2 credits where 4%/8% of building energy is obtained from renewable energy. 3 credits where 6%/12% of building energy is obtained from renewable energy.	None.	**3B**	
4.3.1	**AIR-CONDITIONING UNITS**	1 credit for complying with the recommended installation positions for air-conditioners with regard to internal spaces.	Buildings not using window and/or split-type air-conditioners.	**1**	
		1 credit for complying with the minimum width of any external recess with regard to heat rejection.		**1**	
		1 BONUS credit for complying with the items listed in the assessment check-list.		**1B**	
4.3.3	**ENERGY EFFICIENT LIGHTING IN PUBLIC AREAS**	1 credit for installation of: energy efficient lighting equipment; and control for the lamps in areas where daylight is available.	None	**1**	
4.3.6	**ENERGY EFFICIENT APPLIANCES**	1 credit for specifying the use of certified energy efficient appliances.	Buildings where appliances are not provided by the Client.	**1**	

4.4.1	TESTING AND COMMISSIONING	1 credit for ongoing programme of commissioning of water side equipment of central air-conditioning system.	All 3 credits applicable to buildings with central HVAC/services.	1	
		1 credit for ongoing programme of commissioning of air side equipment of central air-conditioning system.		1	
		Alternatively: 1 credit for ongoing programme of commissioning of all HVAC equipment.	For residential and similar buildings only the last 2 credits apply.	1	
		1 credit for ongoing programme of commissioning of all non-HVAC equipment.		1	
4.4.3	METERING AND MONITORING	1 credit for ability to measure and monitor all major electrical loads in the building. 1 additional credit where central chiller plant is provided with adequate instrumentation to determine operating performance.	Residential buildings.	1	
4.4.4	ENERGY MANAGEMENT	1 credit for having carried out a comprehensive audit of energy use in the building.		1	
		1 credit for an effective energy monitoring and targeting system.		1	
		1 credit for an annual budget to improve the energy performance of the building.		1	
		1 credit for maintaining a comprehensive energy management manual.		1	
		1 BONUS credit where separate charges are made for energy use.		1B	

5	WATER USE			
5.1.1	WATER QUALITY	1 credit for certification under the Fresh Water Plumbing Quality Maintenance Recognition Scheme.	None.	1
		1 credit for demonstrating that the quality of potable water meets the referenced drinking water quality standards at all points of use.		1
5.2.1	ANNUAL WATER USE	1 credit for demonstrating that the use of water efficient devices leads to an estimated aggregate annual saving of 10%. 2 credits for demonstrating an estimated annual saving of 20%. 3 credits for demonstrating an estimated annual saving of 30%.	None.	3
		or:		
		1 credit for undertaking a water audit and maintaining a water use inventory.		1
		1 credit for the development of a water conservation plan endorsed by directorate level management.		1
5.2.2	MONITORING AND CONTROL	1 credit for installing devices that automatically shut-off faucets, taps and urinals for the purposes of water conservation; and devices that enables the monitoring and audit of fresh water consumption.	None.	1
5.2.3	WATER EFFICIENT IRRIGATION	1 credit for limited use of fresh water for the purposes of irrigation.	Where soft landscaping coverage is less than 50% of the area of the building footprint.	1
5.2.4	WATER RECYCLING	1 credit for harvesting rainwater and/or recycling greywater that leads to a reduction of 10% or more in the consumption of fresh water.	None.	1
		1 BONUS credit where harvesting and/or recycling leads to a reduction of 20% or more in the consumption of fresh water.		1B
5.3.1	EFFLUENT DISCHARGE TO FOUL SEWERS	1 credit for demonstrating a reduction in annual sewage volumes by 25% or more, or reduction in sewage concentration by a 35% or more.	None.	1

6	INDOOR ENVIRONMENTAL QUALITY				
6.1.1	FIRE SAFETY	1 credit for demonstrating that fire services systems are regularly inspected and tested.	None.	1	
		1 credit for provision of a fire safety management manual based on a fire risk assessment for the building.		1	
6.1.2	ELECTROMAGNETIC COMPATIBILITY	1 credit for designs that meet the electromagnetic compatibility requirements in respect of power quality and low frequency magnetic fields.	None.	1	
6.1.3	SECURITY	1 credit for scoring at least 75% of the applicable security measures and facilities for the building.	None.	1	
6.2.1	PLUMBING AND DRAINAGE	1 credit where system design, operation and maintenance is such as to reduce the potential for transmission of harmful bacteria viruses, and odours.	None.	1	
6.2.2	BIOLOGICAL CONTAMINATION	1 credit for complying with the recommendations given in the Code of Practice - Prevention of Legionnaires Disease, in respect of air-conditioning and ventilation systems, and water systems.	Residential buildings.	1	
6.2.3	WASTE DISPOSAL FACILITIES	1 credit for the provision of a hygienic refuse collection system.	None.	1	
6.2.4	INTEGRATED PEST MANAGMENT	1 credit for implementing an integrated programme for pest management.	None.	1	
6.3.1	CONSTRUCTION IAQ MANAGEMENT	1 credit for availability and effective implementation of a Construction IAQ Management.	Residential and similar buildings.	1	
6.3.2	OUTDOOR SOURCES OF AIR POLLUTION	1 credit for demonstrating compliance with appropriate criteria for CO.	None.	1	
		1 credit for demonstrating compliance with the appropriate criteria for NO_2..		1	
		1 credit for compliance with the appropriate criteria for ozone.		1	
		1 credit for compliance with the appropriate criteria for RSP.		1	

6.3.3	INDOOR SOURCES OF AIR POLLUTION	1 credit for compliance with the appropriate criteria for VOCs.	None.	1	
		1 credit for compliance with the appropriate criteria for formaldehyde.		1	
		1 credit for compliance with the appropriate criteria for radon.		1	
6.3.4	IAQ IN CAR PARKS	1 credit for compliance with the design requirements specified in ProPECC PN 2/96.	Buildings with no car park.	1	
6.3.5	IAQ IN PUBLIC TRANSPORT INTERCHANGES	1 credit for compliance with the design requirements specified in ProPECC PN 1/98.	Buildings with no PTI.	1	
6.4.1	VENTILATION IN AIR-CONDITIONED PREMISES	1 credit for demonstrating that the specified ventilation rate(s) in normally occupied areas is achieved.	Residential and similar buildings using window units and/or split units.	1	
		1 credit for demonstrating that the air change effectiveness in normally occupied areas meets the specified performance.		1	
6.4.2	BACKGROUND VENTILATION	1 credit for demonstrating the adequacy of ventilation in all normally occupied or habitable rooms with windows closed. 1 additional credit where it can be demonstrated that adequate ventilation is achieved by natural means.	Buildings not designed to utilise natural ventilation.	1 1	
6.4.4	LOCALISED VENTILATION	1 credit for the provision of an adequate ventilation system for rooms/areas where significant indoor pollution sources are generated.	None.	1 1	
6.4.5	VENTILATION IN COMMON AREAS	1 credit for demonstrating that all enclosed common areas in a building are provided with adequate ventilation.	Spaces covered under the section on Localised Ventilation	1	
		1 BONUS credit where the provision for ventilation is by natural means.		1B	
6.5.1	THERMAL COMFORT IN CENTRALLY AIR-CONDITIONED PREMISES	1 credit for sustaining the air temperature at the design value within ±1°C when the air side system is operating at steady state under conditions of zero occupancy.	Premises where air-conditioning is provided by window units or split units.	1	
		1 credit for sustaining the air temperature at the design value within ±1°C when the air side system is operating at steady state under simulated full-load conditions.		1	
		1 credit where room air diffusers satisfy the Air Diffusion Performance Index.		1	

6.5.2	THERMAL COMFORT IN AIR-CONDITIONED/ NATURALLY VENTILATED PREMISES	1 credit for demonstrating indoor operative temperatures in occupied/habitable rooms meet the 80% acceptability limits.	Buildings that are not designed to utilise natural ventilation.	1	
		1 credit for sustaining the air temperature at the design value within ±1.5°C when the air-conditioning unit is operating at steady state under conditions of zero occupancy.		1	
6.6.1	NATURAL LIGHTING	1 credit where the provision of daylight meets the levels specified in PNAP 278 for vertical daylight factor OR the average daylight factor (DF) is at least 0.5% for all normally occupied spaces. 2 credits where the average daylight factor in all normally occupied spaces is at least 1%. 3 credits where the average daylight factor in all normally occupied spaces is at least 2%.	None.	3	
6.6.2	INTERIOR LIGHTING IN NORMALLY OCCUPIED AREAS	1 credit where the prescribed lighting performance in each type of premises in respect of maintained illuminance and illuminance variation is achieved.	Residential buildings.	1	
		1 credit for lighting installations in which: the limiting unified glare rating is achieved; and light sources have an appropriate colour rendering index.		1	
6.6.3	INTERIOR LIGHTING IN AREAS NOT NORMALLY OCCUPIED	1 credit where the prescribed lighting performance in each type of common or service space in respect of light output and lighting quality is achieved.	None.	1	
6.7.1	ROOM ACOUSTICS	1 credit for demonstrating that the reverberation time in applicable rooms meets the prescribed criteria for given types of premises.	Buildings/premises where speech intelligibility is not important, and rooms of a special acoustical nature.	1	
6.7.2	NOISE ISOLATION	1 credit for demonstrating airborne noise isolation between rooms, spaces and premises meets the prescribed criteria.	Buildings/premises which are inherently noisy and unaffected by noise.	1	
		1 credit for demonstrating impact noise isolation between floors meets the prescribed criteria.		1	
6.7.3	BACKGROUND NOISE	1 credit for demonstrating background noise levels are within the prescribed criteria.	Buildings/premises in which speech intelligibility is not important.	1	

6.8.1	ACCESS FOR PERSONS WITH DISABILITY	1 credit for providing enhanced provisions for access for disabled persons.	None.	**1**	
6.8.2	AMENITY FEATURES	1 credit for providing 50% of listed amenity features that enhance the quality and functionality of a building. 2 credits for providing 75% of listed amenity features.	None.	**2**	
6.8.3	IT SERVICES	1 credit for including the required percentage of serviceability measures and IT facilities identified.		**1**	
7	**INNOVATIONS AND PERFORMANCE ENHANCEMENTS**				
7.1	INNOVATIVE TECHNIQUES	Maximum 5 BONUS credits under this Section.	NA.	**5B**	
7.2	PERFORMANCE ENHANCEMENTS		NA.		

2 SITE ASPECTS

BACKGROUND

The performance aspects included in this part focuses on the location of the building, ecological aspects, emissions from the site, and site management. Commitment to improving environmental performance is a key factor in reducing the environmental impacts of building operation and use. Site location is important with regard to adequacy of local amenities and public transport provisions, to reduce travel needs and reliance on private vehicles. There is often an opportunity to enhance the qualities of buildings through more thoughtful 'greening' and other features. The impacts on neighbouring developments and the various discharges and emissions from the site can be significant and considerable when taken over a building's lifetime. Building managers play a key role in enhancing building performance, but there will be significant differences between buildings of different size and complexity.

2.1 SITE LOCATION

BACKGROUND

The location of an existing building is already determined, but credit is given where use was made of contaminated land. Building location is important in respect of adequacy of local amenities and public transport provisions, in order to reduce travel needs and reliance on private vehicles.

2.2 SITE DESIGN

BACKGROUND

Credit is given where cultural heritage has been given due attention. Site development should seek to improve the qualities and ecology of the site through appropriate consideration to site features, landscaping and planters. Free and easy access to the site should be maintained to avoid traffic congestion and reduce local air pollution.

2.3 SITE EMISSIONS

BACKGROUND

Various emissions from the building development can have a negative impact on neighbouring properties. Certain emissions are within the control of the building management and efforts should be made to minimise any potential negative impacts on neighbours and anyone passing by the development.

The various discharges and emissions from the site should be considered over a building's lifetime. Of concern is any air pollution, noise pollution and light pollution arising from the building engineering systems and equipment, all of which can be alleviated by good design and proper installation and maintenance.

2.4 SITE MANAGEMENT

2.4.1 HEALTH, SAFETY AND ENVIRONMENTAL MANAGEMENT

2.4.2 ENVIRONMENTAL PURCHASING PRACTICES

2.4.3 BUILDING AND SITE OPERATION AND MAINTENANCE

2.4.4 BUILDING SERVICES OPERATION AND MAINTENANCE

2.4.5 STAFFING AND RESOURCES

2.4.6 USER GUIDANCE

BACKGROUND

No matter what the age and condition of a building there are initiatives that management can undertake to improve the quality and performance of a building. It is expected that the Client will have in place programmes to enhance health and safety, reduce environmental impacts and improve building services and amenities, which have appropriate levels of senior management support, staffing and resources, and can provide tangible evidence of the actions taken and results achieved.

2 SITE ASPECTS

2.1 SITE LOCATION

2.1.2 CONTAMINATED LAND

EXCLUSIONS None.

OBJECTIVE Reward buildings built on or adjacent to contaminated land.

CREDITS ATTAINABLE 1 BONUS

PRE-REQUISITES None.

CREDIT REQUIREMENT 1 BONUS credit where the building is located on land that was decontaminated or adjacent to a landfill site.

ASSESSMENT

a) Contaminated sites

The Client shall submit evidence in the form of a report prepared by a suitably qualified person that demonstrates that the issues and requirements outlined in ProPECC PN 3/94 [1] were addressed and that the immediate environs made free from any hazardous contamination. The report shall confirm that the required remedial measures were completed to restore the land to an acceptable condition for use for the existing building.

b) Sites adjacent to landfill

The Client shall provide evidence in the form of a report prepared by a suitably qualified person confirming that the site was properly assessed and all issues and requirements outlined in ProPECC PN 3/96 [2] were adequately addressed.

BACKGROUND

ProPECC PN3/94 sets out requirements for proper assessment and management of potentially contaminated sites, and practical remedial measures that can be adopted for the clean-up of a contaminated site. Although the requirements set out in the Practice Note are usually incorporated through the land use planning process, either as conditions to planning permission, or as special conditions in relevant land-title documents for cases associated with potential land contamination problems, it is a good practice to carry out an investigation of site contamination on developed or reclaimed land to eliminate any risk or hazard arising from potential land contamination.

The Practice Note [2] sets out the conditions when a landfill gas hazard assessment may be required and provides general guidelines on how such an assessment should be undertaken. A Guidance Note [3] describes in more detail the process which should be followed in evaluating the risks and designing appropriate protection measures. The Guidance Note is not intended to provide comprehensive guidance on all aspects of risk assessment or design of precautionary/protection measures, but rather to give general guidance on important issues such as the factors to be considered when assessing the level of risk and the procedures which should be followed in undertaking the assessment.

1 Environmental Protection Department. Practice Notes for Professional Persons. ProPECC PN 3/94. Contaminated Land Assessment and Remediation. http://www.epd.gov.hk/epd/textonly/english/resources_pub/publications/files/pn94_3.pdf
2 Environmental Protection Department. Practice Notes for Professional Persons. ProPECC PN 3/96. Landfill Gas Hazard Assessment for Developments Adjacent to Landfills. http://www.epd.gov.hk/epd/textonly/english/resources_pub/publications/files/pn96_3.pdf
3 Environmental Protection Department. Landfill Gas Hazard Assessment. http://www.epd.gov.hk/epd/textonly/english/environmentinhk/waste/guide_ref/guide_lgha.html

2 SITE ASPECTS

2.1 SITE LOCATION

2.1.3 LOCAL TRANSPORT

EXCLUSIONS

None.

OBJECTIVE

Discourage the use of private vehicles and taxis by building users, with the aim to reduce air pollution, energy use, and noise from traffic.

CREDITS ATTAINABLE

2

PRE-REQUISITES

None.

CREDIT REQUIREMENT

a) Car parking provisions

1 credit if no car parking is provided other than provisions intended for use by disabled persons, company vehicles and/or any shuttle service vehicles.

b) Public transport

1 credit where there exists convenient pedestrian access to mainstream public transport.

ASSESSMENT

a) Car parking provisions

The Client shall provide details of any car parking facilities and the restrictions on use. To obtain credit any car park shall comply with the following conditions:

- be provided with access that ensures simultaneous free flow of vehicles in and out of the car park; and
- provisions to avoid ground contamination from oil run-off.

b) Public transport

The site may be checked to ensure that building users have easy pedestrian access to and from a major transport interchange such as a station, or main stream mass transport such as multiple cross-harbour bus stops. As a guideline a walking distance that takes less than 5 minutes is regarded as reasonable. In dense urban centres the provision of elevated walkways and linked buildings to reduce pedestrian exposure to traffic are deemed to satisfy this requirement.

For sites not directly served by mainstream public transport a shuttle bus service which links to a main stream mass transport interchange may be deemed to satisfy the criteria. A shuttle bus service satisfies the requirement if it can be demonstrated through a survey that provisions are deemed adequate by building users. Records shall be submitted showing capacity, frequency, service hours and usage of the service for a period of up to one year, and confirmation that the service will continue for the foreseeable future and at the same level.

BACKGROUND

The increasing number of private vehicles in Hong Kong not only increases pressure on the highway and urban traffic system, but also worsens local air pollution. The most urgent problem to be resolved comes from fossil fuel burning vehicles, often aggravated by the street canyon effect of high-rise buildings. 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, another environmental nuisance.

Part of the solution to the air pollution problem is to reduce the use of private vehicles and taxis. Building users should be encouraged to use public transport to and from the development. Provision of pedestrian links which allow easy access to major public transport systems and local amenities can discourage use of private transport, thereby reducing air and noise pollution.

2 SITE ASPECTS

2.1 SITE LOCATION

2.1.4 NEIGHBOURHOOD AMENITIES

EXCLUSIONS

None.

OBJECTIVE

Encourage building development that is integrated within, and an asset to, the immediate neighbourhood.

CREDITS ATTAINABLE

2 + 1 BONUS

PRE-REQUISITES

None.

CREDIT REQUIREMENT

a) Provision of basic services

1 credit where neighbourhood services are sufficient to provide for basic needs of the users of the building.

b) Neighbourhood recreational facilities

1 credit where neighbourhood recreational facilities and open space is adequate and available for building users.

c) Provided recreational facilities

1 BONUS credit if recreational facilities and open space provided within the development are open to the public.

ASSESSMENT

Assessment is based on the overall provisions for local residents and building users within the immediate vicinity of the building development, whether these are provided within the immediate neighbourhood, or are an additional provision within the development for the benefit of the neighbourhood.

a) Provision of basic services

The Client shall provide a report based on a survey of the immediate neighbourhood and details of the development itself to demonstrate adequate provision of basic services for building users, such as restaurants and shops. The onus is on the Client to demonstrate that basic services, appropriate to the needs of the intended building users, exist within the site or within reasonable walking distances.

b) Neighbourhood recreational facilities

The Client shall provide a report based on a survey of the immediate neighbourhood and details of the development itself to demonstrate adequate provision of recreational facilities and open space for building users. The onus is on the Client to demonstrate that the facilities, appropriate to the needs of the intended building users, exist within the site or within reasonable walking distances.

c) Provided recreational facilities

The Client shall provide evidence that on-site facilities are made available for public use, including details of any restrictions or conditions of access that are in place. Credit shall be awarded where the provision of recreational facilities or open space adds to those available within the immediate neighbourhood, and provide for reasonable access by the public.

Judgement as to the nature of basic services and the provision of recreational facilities and open space with respect to a particular building development shall be made with reference to the Hong Kong Planning and Standards Guidelines [1].

1 Planning Department. Hong Kong Planning and Standards Guidelines. http://www.info.gov.hk/planning/index_e.htm

BACKGROUND

The provision of basic services such as shops, restaurants, clinics, etc., in the immediate vicinity of a building improves efficiency and the quality of living. Building users can benefit from existing provisions as well as those provided by the development that adds to the neighbourhood.

Provision of recreational facilities and open space are essential to the mental and physical well-being of the individual and the community as a whole [2]. It contributes to the quality of life of building users, and is more sustainability. Recreational open space is outdoor open-air space used for active and/or passive recreation use. Active recreation facilities include core activities such as ball games, swimming pool and sports facilities, etc, while passive recreational facilities refer to parks, gardens, sitting-out areas, waterfront promenades, paved areas for informal games, children's playgrounds, etc. The design and layout of these facilities should be of a high quality which meets the needs of the users and are perform to high environmental standards.

2 Hong Kong Planning and Standards Guidelines. Chapter 4 : Recreation, Open Space and Greening http://www.info.gov.hk/planning/tech_doc/hkpsg/english/ch4/ch4_text.htm

2 SITE ASPECTS

2.2 SITE PLANNING AND DESIGN

2.2.4 LANDSCAPING AND PLANTERS

EXCLUSIONS

None.

OBJECTIVE

Encourage building management to preserve or enhance urban greenery to enhance the quality of living environment, reduce surface runoff to drainage system and minimise impacts on fresh water and ground water systems during building use.

CREDITS ATTAINABLE

2

PRE-REQUISITES

None.

CREDIT REQUIREMENT

a) Exterior landscaping

1 credit for providing pervious materials and/or appropriate planting for at least 50% of the external area of the site.

b) Building greenery

1 credit for providing appropriate planting on a total area that is at least 30% of the area of the building footprint.

ASSESSMENT

The Client shall provide a report prepared by a suitably qualified person that details the landscape treatment on the site including the planting and hard finishes of all landscaping and greenery, including but not limited to details of:

- compliance with existing legislation and administrative measures relevant to preservation of vegetation, including the felling of trees;
- trees retained, replanted or removed, and work undertaken to protect existing trees;
- site formation with specific details of slope treatment;
- planting with the character and planting densities, details of the species used, and assessment of environmental benefits;
- the adequacy of soil depth and drainage for all planted areas;
- the method of irrigation used and source of water supply; and
- maintenance provisions.

a) Exterior landscaping

Where it can be demonstrated that a minimum 50% of landscaped areas (roadways, surface parking, plazas, pathways, etc) are pervious and measures are taken to restrict the contamination of ground waters by oil and similar contaminants, and/or covered by appropriate planting, the credit shall be awarded.

b) Building greenery

It is expected that due account shall be taken of the plant type and planter designs to minimise watering and maintenance requirements.

The Client shall demonstrate compliance through quantification of the areas of greenery on the building, including sky gardens, podium areas, roofs and other parts of the building.

BACKGROUND

In addition to mitigating any damage to site ecology, landscaping strategies can:

- enhance a site's microclimate (trees for shade and windbreaks, ponds and fountains, acoustic barriers, podium with gardens, etc.);

- provide for efficient irrigation (efficient use of direct rainfall, plant selection, water retention, materials in walkways allowing percolation to sub-soil, using well water, drip irrigation systems, etc.); and
- control surface run-off (roof ponds, holding tanks, semi-permeable surfaces on open areas, etc.)

Large expanses of greenery are difficult to secure in densely built city centres. However, the provision of plants on the outside and on rooftops contributes to making the city greener. For example, a building rooftop covered with greenery can significantly reduce surface temperature in summer, compared with bare asphalt or concrete rooftops. Roof greenery also can reduce peak roof runoff and alleviate storm drainage pressure. To protect and improve the built and natural environment the Government in promoting green and innovative buildings has identified communal sky gardens and communal podium gardens [1,2].

Water pollution in Hong Kong remains a problem. Measures that mitigate against pollution due to site run-off will help reduce the environmental loading.

1 Buildings Department et al. Joint Practice Note No. 1. Green and Innovative Buildings. February 2001. http://www.info.gov.hk/bd/english/documents/joint/JPN01.pdf

2 Buildings Department et al. Joint Practice Note No. 2. Second Package of Incentives to Promote Green and Innovative Buildings. February 2002. http://www.info.gov.hk/bd/english/documents/joint/JPN02.pdf

2 SITE ASPECTS — 2.2 SITE PLANNING AND DESIGN

2.2.5 MICROCLIMATE AROUND BUILDINGS

EXCLUSIONS

None.

OBJECTIVE

Ensure the microclimate around and adjacent to buildings has no significantly adverse impacts on users and passers-by.

CREDITS ATTAINABLE

2

PRE-REQUISITES

None.

CREDIT REQUIREMENT

a) Wind amplification

1 credit for demonstrating that no pedestrian areas are subject to excessive wind velocities caused by site layout and building design.

b) Elevated temperatures

1 credit for demonstrating that steps have been taken to reduce elevated temperatures in exposed public areas due to site layout and choice of materials.

ASSESSMENT

The microclimate includes sky and podium gardens, walkways, sitting-out areas, etc.

a) Wind amplification

The Client shall submit a report prepared by a suitably qualified person demonstrating compliance.

Relative wind speeds shall be assessed by measurements in both exposed and sheltered areas of public/common areas adjacent public and private pathways, etc. Measurements shall demonstrate that under prevails wind conditions no areas are subjected to wind speeds accelerated by a factor of 2 or more, or a maximum wind speed of $8MS^{-1}$ results, and in no area is the wind speed less than 1.5 m2 under coverage wind conditions. Alternatively, evidence shall be provided that the results of suitable modelling (scale model, computer model) the criteria is satisfied. Reference shall be made to section 2.2.5 of HK-BEAM 4/04 regarding the specification for modelling.

b) Elevated temperatures

The Client shall submit a report detailing strategies and design solutions to mitigate elevated temperatures in exposed public areas. This should consider adverse impacts on the microclimate within and immediately adjacent to the site, demonstrating the benefits through:

- appropriate choices of materials on the building;
- site surface finishes and landscaping features;
- shading devices;
- use of water features, etc.

Credit can be achieved by the adoption of one or more of the following measures or any alternatives demonstrating the effectiveness of reducing temperatures:

- provide shade on at least 50% of non-roof impervious surfaces on the site (parking, walkways, plazas) using light coloured high-albedo materials (reflectance of at least 0.3);
- provide high emissivity roofing (emissivity of at least 0.9) covering at least 50% of the total roof area;

- provide vegetation covering at least 50% of the total roof area.

BACKGROUND

The microclimate around buildings can suffer as a result of the restricted natural ventilation from winds and breezes, leading to stagnant areas of pollution and elevated temperatures. Conversely, the topology can lead to significant amplification of wind at pedestrian level, leading to discomfort and fatigue for pedestrians, damage to plant life, accumulation of debris, and in more extreme cases, danger from impeded walking and flying objects.

Wind flow around a site can be accelerated or decelerated due to the building form, typically 2 to 3 times greater than for open ground. Of particular concern are localised areas of accelerated wind around corners and between narrow channels.

The following table [1] indicates that mechanical discomfort sets in at wind speeds of about 5 ms^{-1}, with speeds above 8 ms^{-1} being very uncomfortable and speeds above 20 ms^{-1} being dangerous. Conversely, some areas may receive relatively low wind flow with free airflow being obstructed by buildings.

Beaufort Number	Wind speed ms^{-1}	Effect
0,1	0-1.5	No noticeable wind
2	1.6-3.3	Wind felt on face
3	3.4-5.4	Hair disturbed, clothing flaps
4	5.5-7.9	Raises dust, dry soil and loose paper, hair blown
5	8.0-10.7	Force felt on body, limit of agreeable wind
6	10.8-13.8	Umbrellas use difficult, difficult to walk steadily
7	13.9-17.1	Inconvenience felt when walking
8	17.2-20.7	Generally impedes progress
9	20.8-24.4	People blown over by gusts

The use of non-reflective external surfaces contributes to localised elevated temperatures created when solar heat gains are absorbed and then radiated back to the surroundings. The effect may be local to pedestrian and recreational areas, and contribute to urban heat islands. As a result, local ambient and effective temperatures can rise by several degrees or more when compared to more open and better ventilated areas. Penalties include local discomfort, detrimental effects on site vegetation and wildlife, etc. Elevated temperature can be mitigated through the choice of finishes on buildings and horizontal hard surfaces that reflect heat, the application of shading or planting vegetation.

Microclimatic conditions of the site can be improved through a thorough and balanced consideration of the wind, sunlight, temperature, and air quality.

1 British Building Research Station, Wind Environment Around Tall Buildings. Digest 141, May 1972.

2 SITE ASPECTS **2.2 SITE PLANNING AND DESIGN**

2.2.7 VEHICULAR ACCESS

EXCLUSIONS

None

OBJECTIVE

Encourage proper management of vehicles requiring access to the site and buildings.

CREDITS ATTAINABLE

1

PRE-REQUISITES

Compliance with the Building (Refuse Storage And Material Recovery Chambers And Refuse Chutes) Regulations Chapter 123H Regulation. Compliance with the requirements of PNAP 98 [1] deemed to satisfy the relevant provisions of the Regulations.

CREDIT REQUIREMENT

1 credit for providing safe and efficient access for vehicles entering and leaving the site and buildings.

ASSESSMENT

The Client shall submit a report prepared by a suitably qualified person detailing the provisions for the movement of all vehicles entering and leaving the site, within the site, and within premises, for the purpose of setting down and picking up passengers, delivery and collection of goods, collection of waste, etc.

The report shall state and confirm compliance with all requirements stipulated by the Transport Department in respect of run-ins and run-outs and the adjacent layout design, compliance with the Building (Refuse Storage And Material Recovery Chambers And Refuse Chutes) Regulations, and details of how the recommendations given in PNAP 236 [2] have been met.

Where there are deviations from the requirements due to site constraints, etc., the report shall highlight these and demonstrate that due care has been exercised to ensure the safety of building users, passers-by and operators.

Where it can be demonstrated that vehicular access to the building(s) is such that on-street queuing and parking of vehicles will be avoided the credit shall be awarded.

BACKGROUND

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

Where vehicles, building users and passers-by are in close contact with vehicles entering and leaving the site appropriate safety precautions should be in place.

1 Building Department, Practice Note for Authorized Persons and Registered Structural Engineers PNAP 98, Refuse Storage and Collection - Building (Refuse Storage and Material Recovery Chambers and Refuse Chutes) Regulations, Sep 2000. http://www.info.gov.hk/bd/english/documents/pnap/Pnap098.pdf

2 Building Department, Practice Note for Authorized Persons and Registered Structural Engineers PNAP 236, Design of Car Parks and Loading/Unloading Facilities, Mar 2000. http://www.info.gov.hk/bd/english/documents/pnap/Pnap236.pdf

2 SITE ASPECTS

2.3 EMISSIONS FROM THE SITE

2.3.4 EMISSIONS FROM COOLING TOWERS

EXCLUSIONS

None.

OBJECTIVE

Minimise the threat of Legionnaires' disease arising from cooling towers.

CREDITS ATTAINABLE

1

PRE-REQUISITES

None.

CREDIT REQUIREMENT

1 credit for a building development in which wet cooling towers:

are not used, or

use seawater, or

water from an acceptable source and are designed and maintained as specified in the Code of Practice for the Prevention of Legionnaires Disease.

ASSESSMENT

When wet cooling towers are used and do not use seawater they shall be designed and operated to the specifications outlined in the Code of Practice Prevention of Legionnaires Disease.

The Client shall submit details of the installation, records of the operation and maintenance practices adopted, and confirm compliance with the Code of Practice, else evidence shall be provided to demonstrate that the design and operation and maintenance practices provide are at least of a similar standard.

BACKGROUND

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 [1]. This risk can be eliminated by the appropriate design of the cooling towers and their proper operation and maintenance.

1 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. 2000.

2 SITE ASPECTS

2.3 EMISSIONS FROM THE SITE

2.3.5 NOISE FROM BUILDING EQUIPMENT

EXCLUSIONS

None.

OBJECTIVE

Reduce the nuisance caused to neighbours by noise from building services equipment.

CREDITS ATTAINABLE

1

PRE-REQUISITES

Compliance with the Noise Control Ordinance and Subsidiary Regulations.

CREDIT REQUIREMENT

1 credit for demonstrating that the level of the intruding noise at the facade of the nearest sensitive receiver is in compliance with the criteria recommended in the Hong Kong Planning Standards and Guidelines.

ASSESSMENT

Assessment should be made at the façade of the nearest or most affected adjacent building or its site boundary.

The noise assessments shall be conducted in accordance with the Technical Memorandum [1]. This lays down statutory Acceptable Noise Levels (ANL).

When assessed in accordance with the Technical Memorandum, the level of the intruding noise at the facade of the nearest sensitive receiver should be at least 5 dB(A) below the appropriate ANL shown in Table 3 of the Technical Memorandum or, in the case of the background being 5 dB(A) lower than the ANL, should not be higher than the background, in accordance with paragraph 4.2.13, Chapter 9 of the Hong Kong Planning and Standards Guidelines [2].

The Client shall provide evidence in the form of detailed analysis, appropriate calculations and/or measurements that the building complies with the assessment criteria. In cases where a Noise Abatement Notice has been served, evidence of full compliance with the required remedial action shall also be presented.

BACKGROUND

Unwanted sound from equipment on and around buildings contributes to noise pollution with potential impacts on neighbouring properties. Under the Noise Control Ordinance noise emanating from certain types of 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 ANLs as set out in a technical memorandum;
- is a source of annoyance to any person other than persons on the premises; and
- does not comply with any standard or limit contained in any current Regulations.

In practice the Authority will respond to complaints and compliance with the ANLs will be required only after a Noise Abatement Notice has been served. Non-compliance with such a notice will be an offence. The Technical Memorandum [1] contains the technical procedures that

1 Environmental Protection Department. Technical Memorandum for the Assessment of Noise from Places Other than Domestic Premises, Public Places or Construction Sites. http://www.epd.gov.hk/epd/english/environmentinhk/noise/guide_ref/files/tm_nondomestic.pdf

2 Hong Kong Planning and Standards Guidelines, Chapter 9 Environment http://www.info.gov.hk/planning/tech_doc/hkpsg/english/ch9/ch9_text.htm

should be adopted by the Authority when investigating a complaint regarding noise emanating from such premises to determine whether or not a noise abatement notice should be issued.

BS 4142 [3] suggests methods for noise prediction and a generalized description of prediction is given in ISO 9613-2 [4]. Good practices on building services system noise control is published by the Environmental Protection Department [5,6].

3 British Standards Institution. Method for rating industrial noise affecting mixed residential and industrial areas. British Standard BS 4142:1997. London, BSI, 1997.

4 International Standards Organisation. ISO 9613-2. Attenuation of Sound During Propagation Outdoors Part 2. General Method of Calculation 1st Ed. 1996.

5 Environmental Protection Department. Good practices on pumping system noise control. 1999. http://www.epd.gov.hk/epd/english/environmentinhk/noise/guide_ref/pump_sys.html

6 Environmental Protection Department. Good practices on ventilation system noise control. 1999. http://www.epd.gov.hk/epd/english/environmentinhk/noise/guide_ref/vent_sys.html

2 SITE ASPECTS

2.3 EMISSIONS FROM THE SITE

2.3.6 LIGHT POLLUTION

EXCLUSIONS

None

OBJECTIVE

Ensure that exterior lighting does not create unwanted and unnecessary light pollution.

CREDITS ATTAINABLE

1

PRE-REQUISITES

None

CREDIT REQUIREMENT

1 credit for demonstrating that obstrusive light from exterior lighting meets the specified performance for the environmental zone in which the building development is located.

ASSESSMENT

The Client shall provide evidence that the site and building lighting installations comply with the criteria given in the reference publications through submission of detailed measurements, calculations and/or modelling studies carried out by a suitably qualified person.

Compliance is achieved when the designs are within the maximum figure for each parameter (sky glow, light into windows, source intensity, and building luminance), taken from Tables 2.1 to 2.6 in CIE 150 [1], Table 1 in CIBSE Factfile7 [2], or Table 1 in ILE Guidance Notes [3].

BACKGROUND

Outdoor and public area lighting is necessary for illuminating public connections between premises, buildings and facilities to ensure the security and safety of users. Light pollution [4,5] may be regarded as waste light from lighting schemes that produce glare, obscures the night sky, adversely effects nocturnal ecosystems, and may intrude on neighbouring properties.

The brightness of advertising signs is also a concern [6].

1 International Commission on Illumination. Guide on the limitation of the effects of obstrusive light from outdoor lighting installations. Technical Report CIE 150:2003.
2 Chartered Institution of Building Services Engineers. Environmental Considerations for Exterior Lighting. Factfile No.7, 2003. http://www.cibse.org/pdfs/fact72003.pdf
3 The Institution of Lighting Engineers. Guidance notes for the reduction of light pollution. http://www.ile.org.uk/documents/guidance-notes-light-pollution.pdf
4 International Dark-sky Association. Information Resource Library. http://www.darksky.org/resources/library.html
5 International Commission on Illumination. Guidelines for Minimising Sky Glow. Technical Report CIE 126: 1997.
6 The Institution of Lighting Engineers. Brightness of Illuminated Advertisements. Technical Report No.5, 2001.

2 SITE ASPECTS

2.4 SITE MANAGEMENT

2.4.1 HEALTH, SAFETY AND ENVIRONMENTAL MANAGEMENT

EXCLUSIONS

None.

OBJECTIVE

Encourage development of systematic building management systems that embrace safety, health and environmental performance

CREDITS ATTAINABLE

1 + 1 BONUS

PRE-REQUISITES

None.

CREDIT REQUIREMENTS

1 credit where the building management operates an Operational Health and Safety Management System certified to OHSAS 18001 or an Environmental Management System to ISO14001.

1 BONUS credit where both a certified OHSMS and a certified EMS are in place.

ASSESSMENT

The Client shall provide documentation supporting any claim to having a certified OHSMS [1] and/or certified EMS [2] in place, plus a commitment confirmed at directorate level management that the intention is to renew certification(s) when next due.

As an alternative, where no certified OHSMS or EMS is in place the onus shall be on the Client to demonstrate that the key elements of a certified OHSMS and certified EMS are incorporated within the systems of building management that already exist.

Submittals to the HK-BEAM Assessor shall outline in summary form the appropriate policies, objectives and targets, communications, responsibilities, actions taken, results/outcomes, etc. The HK-BEAM Assessor shall be given access to the full documentation for the management systems for inspection.

BACKGROUND

The importance of managing Occupational Health and Safety is recognised by all interested parties: employers, employees, customers, suppliers, insurers, shareholders, the community, contractors, and regulatory agencies. OHSAS 18001 was released in April 1999. OHSAS 18002 [3] is the Occupational Health and Safety Management Systems Guidelines for the implementation of OHSAS 18001. OHSAS 18001 was developed in response to urgent customer demand for a recognisable occupational health and safety management system standard against which their management system may be assessed and certified. OHSAS 18001:1999 is compatible with ISO 9001:1994 and ISO 14001:1996.

The specification takes a structured approach to OH&S management. The emphasis is placed on practices being pro-active and preventive, by the identification of hazards and the evaluation and control of work related risks. OHSAS 18001 can be used by organisation of all sizes regardless of the nature of their activities or location. Organisations can now achieve third party certification for their Occupational Health and Safety management system.

OHSAS 18001 features include the following elements:

- OH&S policy;

1 British Standards Institution. OHSAS 18001:1999. Occupational health and safety management systems — Specification.
2 International Organization for Standardization. ISO 14001: Environmental management systems – Specification with guidance for use.
3 British Standards Institution. OHSAS 18002:2000, Occupational health and safety management systems –Guidelines for the implementation of OHSAS 18001.

- planning;
- implementation and operation;
- checking and corrective action;
- management review; and
- continual improvement

OHSAS 18001 is the sound solution to the ever increasing challenge facing most organisations due to high injury and illness, lost work days, increasing occupational health and safety regulations, large citations/penalties, rising worker's compensation costs, costly medical claims, worker retention and employee satisfaction.

For an organisation to be successful in addressing environmental issues it must set clear objectives at the highest level with an appropriate 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 [4] 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;
- a commitment to comply with relevant environmental legislation;
- a commitment to continual improvement and pollution prevention;
- providing a framework for setting and reviewing environmental objectives and targets; and
- being documented and communicated to all employees, suppliers, and customers.

Corporate environmental policies naturally vary between organisations [5]. HK-BEAM seeks a commitment to environmental protection and improvements where these can be demonstrated to be appropriate, practical and achievable within the context of the particular building development.

NOTES

Specific criteria in respect of management practices and performance are included elsewhere in HK-BEAM 5/04.

BSI-OHSAS 18001 will be withdrawn on publication of its contents in, or as, a British Standard.

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

5 Environmental Protection Department. http://www.epd.gov.hk/epd/english/how_help/tools_ems/overview.html

2 SITE ASPECTS

2.4 SITE MANAGEMENT

2.4.2 ENVIRONMENTAL PURCHASING PRACTICES

EXCLUSIONS

None.

OBJECTIVE

Encourage purchasing practices which reduce the environmental impact of products used in the operation and maintenance of buildings.

CREDITS ATTAINABLE

1

PRE-REQUISITES

None.

CREDIT REQUIREMENTS

1 credit for implementing purchases practices that encourage the supply and use of environmentally friendly materials, products and equipment.

ASSESSMENT

The Client shall provide documentary evidence that purchasing policies and practices are in place to source, and where available at an economic cost, to purchase materials, products and equipment which have no significant negative impacts on the safety and health of employees and building users, and have no significant negative impacts on the environment. The documentary evidence shall include correspondence with suppliers/potential suppliers, samples of invoices, records of purchases of environmentally benign materials, etc.

Purchasing practices shall be demonstrated by the use of:

- durable materials, products and equipment; materials with low embodied energy;
- locally produced materials where available;
- wood products from well-managed sources;
- products which do not use CFCs, HCFCs, halons;
- salvaged materials and components;
- rapidly renewable materials;
- durable materials;
- furnishes; paints, adhesives, etc with low levels of emissions;
- minimal packaging and/or recyclable packaging;
- products having significant recyclable content;
- products that are recyclable;
- energy efficient appliances and equipment; and
- water efficient appliances; etc

Credit shall be awarded where it can be demonstrated that policies and practices are in place and provide tangible results in sourcing and using environmentally materials, sound products and equipment.

BACKGROUND

An organisation's purchasing practices should form part of environmental management. Where major consumers include safety, health and environmental considerations in purchasing decisions, the market place does respond. HK-BEAM encourages purchasing practices that promotes the supply and use of environmentally friendly products, materials and equipment used in building operations and maintenance, redecoration, fit-out, etc.

There are no well-defined criteria to label materials as green or environmentally-friendly, although life-cycle analysis can be used to assess materials and products. This involves the identification and quantification of all of the raw materials and energy consumed in the production, use, and disposal of the product, as well as pollutants and by-products generated. Two of the most significant sources of environmental impact from materials used in buildings are waste streams and the possible impacts on the health and comfort of occupants. Many products used in buildings have environmentally-friendly alternatives that can be substituted.

NOTE Specific criteria in respect of the use of safe and environmentally friendly materials, products and equipment are included elsewhere in HK-BEAM 5/04.

2 SITE ASPECTS **2.4 SITE MANAGEMENT**

2.4.3 BUILDING AND SITE OPERATION AND MAINTENANCE

EXCLUSIONS

Refer to assessment criteria.

OBJECTIVE

Encourage, planned inspection, maintenance and repair of the building fabric and structure, external areas to enhance safety and reduce environmental impacts.

CREDITS ATTAINABLE

3

PRE-REQUISITES

None.

CREDIT REQUIREMENTS

a) Building maintenance

1 credit for implementing an effective system of regular inspection, cleaning and maintenance of the building's fabric and structure.

b) External areas and facilities

1 credit for implementing an effective system of regular inspection, cleaning and maintenance of areas and facilities external to the building.

c) Operations and maintenance manual

1 credit for providing a fully documented operations and maintenance manual for the building and site to the minimum specified.

ASSESSMENT

a) Building maintenance

The onus is on the Client to demonstrate that the system of inspections, cleaning, maintenance and general repairs to the building fabric and structural elements are effective in maintaining reliability and prolonging service life.

The general maintenance programme shall include as a minimum:

- list of all elements of the building fabric and structure subject to regular inspection, cleaning, servicing and maintenance, e.g. window frames, cladding, roof structures, etc;
- details of planned and pre-venture maintenance for each item;
- methods and frequency of cleaning;
- frequency of inspections;
- details of maintenance undertaken by outside agents;
- competence of personnel undertaking inspection, cleaning maintenance and repair, including outside contractors; and
- records of inspections, maintenance and repairs for a period of up to 3 years.

Where it can be shown that the frequency of inspections, adequacy preventive maintenance, and timely and adequate repairs are undertaken the credit shall be awarded.

b) External areas and facilities

This credit shall not apply where the building footprint exceeds 80% of the site area, unless the building roof, podium and/or sky gardens, etc., have facilities accessible to building users.

The assessment covers all external areas and facilities under the responsibility of the management team for example, slopes, retaining walls, roads, pavements, hard and soft landscaping, exterior lighting, stairs, ramps, barriers, recreational facilities and areas, etc.

In a similar manner to building maintenance, the onus is on the Client to provide evidence in terms of inspection schedules, preventive maintenance, repairs, etc., to demonstrate their adequacy in relation to the size of the external area and extent of the facilities provided.

Where there exists an appropriate frequency of inspections, adequate preventive maintenance, and timely and adequate repairs appropriate to type and extent of external areas and facilities, the credit shall be awarded.

c) Operations and maintenance manual

The documentation covering building and site maintenance shall provide sufficient information to allow personnel carrying out work on the fabric and structure at any time, including as a minimum:

- design specifications;
- as-built drawings and plans;
- details of construction methods and materials;
- maintenance requirements and any specific procedures;
- inspection schedules, including post-typhoon and emergencies;
- operation and maintenance of plant and equipment installed on the building;
- details showing type and location of utility services on and adjacent to the site, etc.

The Client shall submit a declaration that the operation and maintenance manual in use for the building is sufficiently detailed for the size and complexity of the building and external site elements. The details given in Section 8.7.5 should be used as a basis for submissions and assessment. The Assessor may wish to examine the manual.

BACKGROUND

Where buildings are not properly maintained they deteriorate more quickly, in extreme cases requiring major refurbishment or demolition. In such cases the process of refurbishment or reconstruction will require significant consumption of both energy and materials, placing an unnecessary burden on natural resources. Appropriate planned inspection, cleaning and 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 will assist owners and occupiers to manage the building in a more efficient and hence environmentally conscious manner. Regular inspections of the building fabric and structural elements should be carried out, with a management system to monitor the long-term planned maintenance programme, to ensure that all maintenance will continue in order to retain asset value of the building and meet the performance requirements.

A comprehensive Guidebook [1] is available that consolidates guidelines from the Buildings Department (BD) and other relevant sources for building owners, Owners' Corporations, Owners' Committees and personnel involved in building maintenance and management. Apart from identifying the legal responsibilities of owners and usual problems encountered, it also enhances readers' awareness of the existing conditions of buildings and facilitates the formulation of plans for rectification and improvement. Further guidance on the management and setting up of a building maintenance programme is given in ISO [2] and British standards [3].

1 Buildings Department. Building Maintenance Guidebook. http://www.info.gov.hk/bd/english/documents/code/bmg/BDG_ENG.pdf
2 International Organization for Standardization. ISO 15686 Buildings and constructed assets (3 parts).

2 SITE ASPECTS

2.4 SITE MANAGEMENT

2.4.4 BUILDING SERVICES OPERATION AND MAINTENANCE

EXCLUSIONS

None.

OBJECTIVE

Encourage proper and efficient operation of the engineering systems in and around buildings.

CREDITS ATTAINABLE

3 for buildings with central HVAC systems, otherwise 2.

PRE-REQUISITES

Compliance with applicable regulations [1].

CREDIT REQUIREMENTS

a) Central HVAC systems

1 credit for demonstrating the operation of a planned programme of regular inspection, cleaning and maintenance of central HVAC plant.

b) Other engineering systems

1 credit for demonstrating the operation of a planned programme of regular inspection, cleaning and maintenance of the building's engineering systems.

c) Assessment of operation & maintenance practices

1 credit for having undertaken an audit of the effectiveness of the operation and maintenance practices for all building services engineering systems.

ASSESSMENT

a) Central HVAC systems

The Client shall provide evidence in the form of maintenance manuals, inspection records, records of repairs, inventory of spares, etc. demonstrating the adequacy of inspection, maintenance and repair to all HVAC equipment. Maintenance undertaken by outside agents shall also be identified.

The maintenance manual covering HVAC systems and equipment shall provide sufficient information to allow personnel carrying out work at any time, including as a minimum:

- overview of the HVAC system and sub-systems and main equipment;
- modes of operation;
- schematic diagram of the systems and sub-systems;
- automatic controls diagrams and descriptions;
- 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 and re-commissioning results;
- the operating and maintenance strategy for the installation;
- equipment operating parameters and control settings to be monitored;
- full maintenance instructions with access points, monitoring points, etc., identified;

1 Lai J H K, Yik F W H. Law and Building Services Maintenance in Hong Kong. HKIE Trans. Vol. 11, No. 1, 2004, pp 7-14.

- maintenance schedules;
- inventories of parts held and/or details of supply of spares.

The maintenance programme shall include as a minimum:

- list of all equipment subject to regular inspection and maintenance;
- details of planned and pre-venture maintenance for each item;
- frequency of inspections;
- competence of personnel undertaking inspection, maintenance and repair, including outside contractors; and
- records of inspections, maintenance and repairs.

Where it can be shown that the frequency of inspections is appropriate, preventive maintenance is adequate, and that timely and adequate repairs are undertaken the credit shall be awarded.

b) Other engineering systems

The Client shall provide evidence in the form of maintenance manuals, inspection records, records of repairs, etc. demonstrating the adequacy of inspection, maintenance and repair to all equipment (other than central HVAC equipment covered in a). For buildings without central HVAC plant the coverage shall include unitary and other air-conditioning and ventilation equipment.

The maintenance manual shall have similar coverage as for a) above. Likewise, the maintenance programme shall include as a minimum the items listed in a) above.

c) Assessment of operation & maintenance practices

The Client shall provide a report detailing the steps taken, outcomes and actions taken or planned (with appropriate budget information) for improvements in the building services operation and maintenance practices. The audit approach should follow that detailed in BSRIA's guide [2] or similar equivalent approach.

BACKGROUND

Although some may still regard building services operation and maintenance (O&M) as simple and routine, the increase in sophistication of services provisions in buildings necessitated by the increasingly demanding user and statutory requirements has made management, operation and maintenance work much more complicated than hitherto [1]. Besides satisfying the occupants' demand for quality services, the management team shoulders the responsibility to safeguard the life-safety and health of occupants, visitors and any other passers-by.

Regulatory requirements include prescribing certain work be undertaken only by a qualified person or firm, which may be referred to as a competent person, a competent worker, a competent examiner, a registered specialist engineer, a registered specialist contractor etc. Apart from the rules or requirements documented in the statues, government departments issue statutory orders, directions or abatement or improvement notices as when and where installation defects or nuisance develop to such a stage that public health or safety is likely to be jeopardised, or the environment is threatened.

However, proper maintenance involves requirements far exceeding the regulatory requirements. Building owners and maintenance personnel may be held liable from breaching of the duties of care that they are required to exercise under the Common Law. There exists the concept of duty of care, whereby a reasonable man must take reasonable care to

2 Building Services Research and Information Association. Application Guide AG 13/2000. Toolkit for Building Operation Audits. BSRIA 2000.

avoid acts or omissions that would be likely to injure his neighbour, which he can reasonably foresee!

Effective operation and maintenance of the building services systems and equipment can have a significant impact on building performance. It will also help to prevent unexpected breakdowns and prolong the life of equipment, avoiding unnecessary use of resources for premature replacements.

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 [3,4]. 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.

The Building Maintenance Guidebook [5] provides guidelines on building maintenance work, which embraces also building services maintenance, but the coverage is confined to the basic provisions, such as electrical, fire services, lift and escalator and water supply. Good maintenance management planning includes proper cost analysis and a process to ensure that occupant comfort and health, energy use, and safety and security systems are at optimal levels of performance for the installed systems and equipment [6]. The effectiveness of operation and maintenance may be assessed through a systematic audit [7].

NOTE Additional management, operation and maintenance actions are covered elsewhere in HK-BEAM 5/04.

3 American Society of Heating, Air-conditioning, and Refrigerating Engineers. ASHRAE Guideline 4. Preparation of Operating and Maintenance Documentation for Building Systems.
4 Building Services Research and Information Association. Application Guide AG 1/87.1. Operating and maintenance manuals for building services installations.
5 Buildings Department. Building Maintenance Guidebook. http://www.info.gov.hk/bd/english/documents/code/bmg/BDG_ENG.pdf
6 Building Services Research and Information Association. Application Guide AG 1/98. Maintenance programme set-up.
7 Building Services Research and Information Association. Application Guide AG 24/97. Operation and maintenance audits.

2 SITE ASPECTS

2.4 SITE MANAGEMENT

2.4.5 STAFFING AND RESOURCES

EXCLUSIONS None.

OBJECTIVE Ensure staffing resources are adequate for carrying out and maintaining improvements to building and system performance.

CREDITS ATTAINABLE 1

PRE-REQUISITES None.

CREDIT REQUIREMENTS 1 credit for the adequacy of staffing and resources to meet the operation and maintenance requirements of the building.

ASSESSMENT The Client shall provide evidence that the staffing arrangements and technical resources are sufficient to meet the demands of enhancing the quality of operation and maintenance for the building. Where outsourcing is used, the contractual arrangements and the experience, skills and technical resources of any appointed contractors shall be included. In-house technical resources shall include adequate space and equipment for undertaking inspection, basic testing, maintenance and general repairs. Resources for the testing the performance of equipment such boilers, resetting AHU controls, etc. may also be provided. Alternatively, it is expected that contractors will be assessed by the Client to ensure the adequacy of their technical resources.

The Client shall also provide details of training undertaken by staff responsible for operations and maintenance for up to three years previous, and details of plans and budgets for further training. The training should provide staff with updated knowledge on regulations, improved management, operation and maintenance practices, etc., relevant to such aspects of building performance as energy auditing, indoor air quality, use of materials, etc.

Where managers and engineers have appropriate qualifications and/or experience, and technical staff have appropriate technical and/or trade qualifications befitting their assigned duties, where technical resources are sufficient, and where appropriate continuing education and training to meet the demands of enhancing building performance are in place, the credit shall be awarded. Assessment of compliance shall be guided by the check-lists provided in Section 8.7.7.

BACKGROUND Staff skills and experience are important factors in achieving improvements in building performance [1]. The qualifications and experience of management, operation and maintenance staff should be commensurate with the size and complexity of the buildings and engineering systems under their control. Where maintenance is out-sourced the contractors should also be suitably qualified and resourced.

With new initiatives such as the Indoor Air Quality Certification Scheme, demand side management programme, etc., and new techniques for condition monitoring, automatic controls, power conditioning, etc., building management, operation and maintenance staff need to maintain currency of their knowledge and skills to meet new demands from a building and its users. As a guideline it is expected that on average staff undergo a minimum of 3 full days of appropriate training each year.

1 Yik F. W. H, Lee, W.L. A preliminary enquiry as to why buildings remain energy inefficient and potential remedy, HKIE Transactions. Vol. 9, No. 1, 2002, pp 32-36.

2 SITE ASPECTS **2.4 SITE MANAGEMENT**

2.4.6 USER GUIDANCE

EXCLUSIONS

None.

OBJECTIVE

Inform tenants/owners on the environmental, comfort and health impacts of their activities, and to encourage actions that reduce adverse impacts.

CREDITS ATTAINABLE

1 + 1 BONUS for commercial buildings only.

CREDIT REQUIREMENTS

1 credit for providing with comprehensive guidance on building safety, hygiene and environmental issues in a building user's guide.

1 BONUS credit where relevant HK-BEAM performance criteria are included in contractual arrangements with tenants.

ASSESSMENT

The Client shall provide details of the instructions and guidance materials issued to tenants/users of the building. Credit shall be awarded where it can be demonstrated that the guidance given encourages and promotes environmentally friendly building use and activities by users, including, but not limited to the following:

- fire safety management;
- emergency procedures;
- health and hygiene;
- the selection, installation and use of energy efficient equipment (for example equipment and appliances certified under the Energy Efficiency Labelling Scheme [1];
- energy efficient operation of equipment and facilities, for example, air conditioning units, ventilation fans, kitchen exhaust fans and hoods, etc;
- water conservation;
- the selection of sustainable materials for fit-out and redecoration, etc;
- cleaning, use of pesticides, etc;
- sorting, recycling, and hygienic disposal of waste materials, particularly hazardous waste;
- control of indoor pollutant sources, etc.

Where the contractual arrangements between the Client and tenants in commercial buildings reinforce HK-BEAM criteria in relation to materials use, energy efficiency, water use and indoor environmental quality, etc. the bonus credit may be awarded. The Client shall provide evidence as to how and to what extent any such contractual arrangements can achieve the objective of reducing environmental impacts of tenant fit-out and use of premises.

BACKGROUND

Overall performance can be improved, and environmental impacts reduced with the co-operation of the tenants or sub-owners of premises within a building. Very often users are not aware of the safety, hygiene, comfort and environmental issues. It is proven good practice to provide guidance on the design and use of premises, as they interface with the overall building performance. It should contain guidance and information on applicable regulations, recommendations or requirements regarding internal decoration and fit-out work in occupied areas, advice on partitioning to maintain adequate ventilation, etc.

1 Electrical and Mechanical Services Department. http://www.emsd.gov.hk/emsd/eng/pee/eels_pub.shtml

3 MATERIALS ASPECTS

3.1 EFFICIENT USE OF MATERIALS

3.2 SELECTION OF MATERIALS

3.3 WASTE MANAGEMENT

INTRODUCTION

The amount and range of materials used in the operation and maintenance and fitting-out of buildings represents a significant use of natural resources, in terms of extracted raw materials, emissions, and embodied energy. There are opportunities to reduce environmental impacts through interior design methods, choice of materials, and installation methods. Of concern are:

- toxic pollutants arising from manufacturing and combustion;
- waste generated and recycled.

3.1 EFFICIENT USE OF MATERIALS

3.1.1 BUILDING REUSE

3.1.2 MODULAR AND STANDARDISED DESIGN

3.1.3 OFF-SITE FABRICATION

3.1.4 ADAPTABILITY AND DECONSTRUCTION

3.1.5 ENVELOPE DURABILITY

BACKGROUND

Efficiency in the use of materials can be significantly improved through reuse of building elements. Flexibility in design allows for change in use and layout of the premises within a building. High standards of design detailing permits off-site fabrication of major building components, allows for deconstruction.

3.2 SELECTION OF MATERIALS

3.2.1 RAPIDLY RENEWABLE MATERIALS

3.2.2 SUSTAINABLE FOREST PRODUCTS

3.2.3 RECYCLED MATERIALS

3.2.4 OZONE DEPLETING SUBSTANCES

BACKGROUND

The selection of materials that can be planted and harvested within a relatively short time, that are otherwise sustainable, have significant recycled content, or otherwise have relatively low environmental impacts should be considered for maintenance, redecoration, fit-out and renovations.

3.3 WASTE MANAGEMENT

3.3.1 DEMOLITION WASTE

3.3.2 CONSTRUCTION WASTE

3.3.3 WASTE RECYCLING FACILITIES

3.3.4 WASTE MANAGEMENT

Hong Kong is running out of land for waste disposal, and without concerted effort the existing landfill sites could be exhausted by 2015. The latest situation indicates that the available public fill capacity (mainly reclamations) will be exhausted by mid-2005. Without new outlets for public fill materials, the landfills will be filled up in the next 5-7 years. To tackle the problem, much effort has been put on reducing waste generation and identifying outlets for reusing recycled materials.

With adequate provisions for waste collection and sorting, and a pro-active approach in seeking opportunities to recycle, the management of waste from buildings can be significantly improved.

3 MATERIALS ASPECTS

3.1 EFFICIENT USE OF MATERIALS

3.1.1 BUILDING REUSE

EXCLUSIONS

None.

OBJECTIVE

Encourage the reuse of major elements of existing buildings.

CREDITS ATTAINABLE

1 BONUS

PRE-REQUISITES

None.

CREDIT REQUIREMENT

1 BONUS credit for the reuse of 15% or more of existing sub-structure or shell.

ASSESSMENT

The Client shall provide a report prepared by a suitably qualified person outlining the extent to which major building elements from an previous building were used in the existing building. The report shall include pre-construction and post-construction details highlighting and quantifying the reused elements, be it foundations, structural elements or facades, but windows, doors and similar assemblies may be excluded.

The percentage of building materials shall be calculated as the amount (volume or weight) of building material elements reused as a percentage of the total amount (volume or weight) of that building material in the existing building.

When it can be demonstrated that the target percentage of original building elements are reused the credit shall be awarded.

BACKGROUND

The rehabilitation of old industrial buildings is as an example of successful commercial redevelopment in many cities around the world. There is potential to lower building costs and provide a mix of desirable building characteristics. However, the reuse of existing structural elements depends on many factors, not least fire safety, energy efficiency, and regulatory requirements, all of which should have been taken into account for reuse in the existing building.

HK-BEAM 4/04 provides credit for reuse of existing structural elements in new buildings. Where an existing building can demonstrate reuse of such elements a bonus credit is awarded in HK-BEAM 5/04.

3 MATERIALS ASPECTS

3.1 EFFICIENT USE OF MATERIALS

3.1.2 MODULAR AND STANDARDISED DESIGN

EXCLUSIONS

None.

OBJECTIVE

Encourage use of modular and standardised components in buildings in order to improve serviceability and reduce waste.

PRE-REQUISITES

Full compliance with the Building (Construction) Regulations.

CREDITS ATTAINABLE

1

CREDIT REQUIREMENT

1 credit for demonstrating the use of modular and standardized design.

ASSESSMENT

The Client shall submit a report that includes detailed drawings and specifications that demonstrates and highlights the extent of application of modular design of building systems and components. Where it can be demonstrated that the building development incorporates modular and standardised layouts and components for over 50% of the major elements and modules the credit shall be awarded.

For the purposes of assessment the extent of modular and standardised design shall make reference to the check-list provided herein. Additional or alternative examples may be submitted at the discretion of the Client.

CHECK-LIST

Structural elements	Structural beams system
	Concrete slab
	Concrete flooring
Façade elements	External wall
	Bay-window unit
	Cladding unit
	Utility platform
Architectural/Internal building elements	Internal partition/wall panels
	Door sets
	Staircases
	Fitted furniture
Building services elements	Fire services
	Sanitary fittings
	Luminaires
	Air-Conditioning components

BACKGROUND

This refers to use of standardised grid systems of design allowing standard size factory built and assembled components to be used. Standardisation of details goes hand in hand with optimisation of material quantity. It also generally has benefits for both quality and environmental cost. It simplifies the design and site operations. Building components produced in standard ranges of sizes can also be interchanged.

Materials should be dimensioned carefully to use standard-sized modules to the greatest extent to minimise construction off-cutting waste.

International standards [1,2] recommend that modular components shall be designed to have size of a multiple or subdivision of the basic module of 100mm. BS 6750 [3] provides background on the requirements for modular coordination.

Environment, Transport, and Works Bureau publishes a one-stop service to help you access and locate those standardised components and modular components that have been successfully used in construction, and find out the standardised practices, including standard designs, construction methods, and techniques adopted in the construction industry [4]. This contains a standardisation database of hyperlinks which promotes the wider use of standardised and modular components in local construction, with the public sector taking the lead.

1 International Standard Organization. ISO 1006 Building construction – Modular coordination – Basic module.
2 International Standard Organization. ISO 2848 Building Construction – Modular coordination – Principles and rules.
3 British Standards Institution. British Standard BS 6750. Specification for Modular coordination in building.
4 Environment, Transport, and Works Bureau. Standardised Components and Practices.
http://www.etwb.gov.hk/press_releases_and_publications/publications/standardised/index.aspx?langno=1&nodeid=1232

3 MATERIALS ASPECTS	**3.1 EFFICIENT USE OF MATERIALS**
	3.1.4 ADAPTABILITY AND DECONSTRUCTION
EXCLUSIONS	Residential buildings.
OBJECTIVE	Encourage the design of building interior elements and building services components that allow modifications to space layout, and to reduce waste during churning, refurbishment and deconstruction.
CREDITS ATTAINABLE	2 + 1 BONUS
PRE-REQUISITES	None.
CREDIT REQUIREMENT	a) Spatial adaptability 1 credit for designs providing spatial flexibility that can adapt spaces for different uses. b) Flexible engineering services 1 credit for flexible design of services that can adapt to changes of layout and use. c) Structural adaptability 1 BONUS credit for designs providing flexibility through the use of building structural systems that allows for change in future use.
ASSESSMENT	The Client shall provide a report prepared by a suitably qualified person presenting evidence as to how and the extent to which building adaptability and deconstruction is provided. The report shall include drawings and documents including building plans and detail specifications together with elaboration and justification of how the designs and installations can accommodate changes in use through deconstruction rather than demolition and replacement. Assessment shall be guided by the check-lists included herein. Additions to list may be proposed at the discretion of the Client. Where it can be demonstrated that building design and services installations allow for adaptability in respect of interior layout and changes in use mainly through deconstruction and reassembly the credit(s) shall be awarded. Where structural adaptability is provided the bonus credit shall be awarded.
SPATIAL ADAPTABILITY CHECK-LIST	ASTM provides guidance for various types of buildings and uses [e.g.1, 2,3]. • use of adaptable floor plans, including large grids that can be subdivided, etc. • spaces designed for a loose fit rather than tight fit; • inclusion of multifunctional spaces; • design that allows interior fitting-out to use modular and pre-fabricated components; • spaces designed such that minimum disruption will be caused to occupants due to physical change;

1 ASTM International. Designation E1692-95a Standard Classification for Serviceability of an Office for Change and Churn by Occupants.
2 ASTM International. Designation E1679-95 Standard Practice for Setting the Requirements for the Serviceability of a Building or Building-Related Facility
3 ASTM International. Designation E1334-95 Standard Practice for Rating the Serviceability of a Building or Building-Related Facility

- easy relocation of partition walls that causes minimum damage to flooring or ceiling systems;
- partition walls are fully salvageable;
- separating long-lived components from short-lived components to reduce the complexity of deconstruction and churning so as to facilitate the collection process for recycling; etc.
- use of interior partitions that are demountable, reusable and recyclable, etc.

SERVICEABILITY CHECKLIST

- design that allows interior fitting-out to use modular and pre-fabricated components;
- using hybrid HVAC systems, with a balance between centralised components and distributed components;
- luminaires are easily relocated within ceiling grid or uplighters are used;
- air diffusers on flexible ducts can be relocated at minimum cost with minimum disruption to occupants;
- exhaust air ducts for special exhausts are easy to install, and space and capacity are available in ceiling and duct shafts;
- sprinkler heads are easily relocated within ceiling grid;
- pre-wired horizontal distribution systems in ceilings or floors, with spare capacity and easy access to accommodate change of workplace layouts;
- reducing the use of embedded infrastructure for power, data and HVAC systems, etc.

STRUCTURAL ADAPTABILITY CHECK-LIST

Reference may be made to various publications [e.g.4]. Key points include:

- foundations allow for potential vertical expansion of the building;
- installation of isolation joints or other features avoid the potential for differential settlements and for progressive collapse due to accidental loading;
- reliance on a central core for lateral load resistance that allows for local modifications to the structure while maintaining complete structural integrity;
- wide structural grids;
- lower floors allow for heavier live load;
- sufficient height to lower floors to enable a range of uses;
- building envelope is independent of the structure (i.e., functionally discrete systems, with the interfaces designed for separation);
- versatile envelope capable of accommodating changes to the interior space plan;
- means for access to the exterior wall system from inside the building and from outside;
- structural floor system that accommodates a number of mechanical and electrical service distribution schemes based on different occupancies;

4 Assessing the Adaptability of Buildings. International Energy Agency. Annex 31. Energy-Related Environmental Impact of Buildings. November 2001. http://annex31.wiwi.uni-karlsruhe.de/Annex%2031%20Assessing%20the%20Adaptability%20of%20Buildings.doc

- provision of more than the minimum spatial areas and floor heights, etc.

BACKGROUND

Change of ownership, changing use of premises, changing demography of family units, future growth and expansion etc., require modifications to the layout of most types of premises. Large amounts of solid waste can be generated during the remodelling of premises, such as demolition of walls and partitions. Designs that allow users flexibility in the layout of premises and designs that allow for dismantling during deconstruction can significantly reduce consumption of resources and generation of waste.

Adaptability refers to the capacity of buildings to accommodate substantial changes. The concept of adaptability can be broken down into a number of simple strategies that are familiar to most designers:

- flexibility, or enabling minor shifts in space planning;
- convertibility, or allowing for changes in use within the building; and
- facilitating additions to the quantity of space in a building.

Designs for adaptability can also increase the longevity of buildings, improve operating performance, and allow more efficient use of space yielding economic benefits. The key design principles include independence of systems within a building, upgradeability of systems and components, and lifetime compatibility of building components.

Deconstruction is the process of selectively and systematically disassembling buildings that would otherwise be demolished to generate a supply of materials suitable for reuse in the construction or rehabilitation of other structures. Designing for deconstruction facilitates the salvage of recyclable materials during disassembly. The benefits include the reduction of pollution impacts, saving landfill space, and increase in resource and economic efficiency.

3 MATERIALS ASPECTS

3.2 SELECTION OF MATERIALS

3.2.1 RAPIDLY RENEWABLE MATERIALS

EXCLUSIONS

None.

OBJECTIVE

Encourage the wider use of rapidly renewable materials in appropriate applications.

CREDITS ATTAINABLE

1

PRE-REQUISITES

Compliance with the Building (Construction) Regulations.

CREDIT REQUIREMENT

1 credit for demonstrating that in applications where rapidly renewable materials can be employed at least 50% are used.

ASSESSMENT

The Client shall submit a report prepared by a suitably qualified person listing applications where rapidly renewable materials have been employed, and quantifying (in terms of area, weight or volume) the amount of materials employed, as a percentage of the total of the potential amount of materials that could be employed. The report shall include supporting documentation from suppliers listing the rapidly renewable materials and quantities contained in the products used.

The report should highlight where rapidly renewable materials could be used, where they have been used to replace other more commonly used materials, and provide calculations demonstrating that rapidly renewable building materials have been in at least 50% of possible applications.

For the purposes of assessment reference shall be made to the check-list given below.

CHECK-LIST

No material specified shall present a fire hazard when installed.

FLOORING

Bamboo
Natural Linoleum
Cork
Other rapidly renewable materials

PANELS/PARTITIONS

Sunflower Seed
Bamboo
Wheatboard
Other rapidly renewable materials

CABINETRY/FITTINGS

Wheatboard
Strawboard
Soy bean composite
Bamboo
Other rapidly renewable materials

INSULATION

Cotton
Strawbale
Soy-based foam
Other rapidly renewable materials

OTHER APPLICATIONS (MATERIAL)

BACKGROUND

Most building materials necessitate the consumption of large amounts of natural resources. Rapidly renewable materials are materials that substantially themselves faster than traditional extraction demand (i.e., planted and harvested in less than a 10 year cycle) and do not result in significant biodiversity loss, increased erosion, or air quality impacts. Rapidly renewable materials include, but are not limited to, bamboo, linoleum, cork, fast-growing poplar, pine and products such as wheat straw cabinetry. Materials such a bamboo, wool, natural linoleum, etc. require fewer inputs, have reduced environmental impacts, and can provide economic benefits.

3 MATERIALS ASPECTS — **3.2 SELECTION OF MATERIALS**

3.2.2 SUSTAINABLE FOREST PRODUCTS

EXCLUSIONS

None.

OBJECTIVE

Encourage the use of timber from well-managed forests.

CREDITS ATTAINABLE

1 + 1 BONUS

PRE-REQUISITES

None.

CREDIT REQUIREMENT

1 credit for sourcing timber and composite timber products which are from well managed sources, including reuse of salvaged timber.

1 BONUS credit where 50% of forest products purchased over the past 3 years were from certified sources.

ASSESSMENT

The Client shall provide a report prepared by a suitably qualified person demonstrating that reasonable effort has been made to secure forest products used in the building from well-managed sources. Evidence should include as far as practicable:

- the supplier's environmental policy with regard to the wood products;
- the species and country of origin;
- the country of origin supplying the timber;
- a copy of the forestry policy being pursued for the plantation or concession; and
- shipping documents confirming that the timber supplied was obtained from a well-managed source.

The assessment shall take into account the Client's efforts to secure forest products (building components including, but not limited to, structural framing, flooring, finishes, fitted furnishings, etc. from well-managed sources by adopting the stepwise approach recommended by EcoWood@sia [1], by seeking:

- sources that comply with sound forest management policies;
- legal sources;
- sources progressing towards certification; and
- creditable certified sources.

Recycled timber and timber products that replace virgin wood shall also be taken into account in the assessment.

The bonus credit shall be awarded when it can be demonstrated that 50% or more of forest products purchased over the previous 3 years were credibly certified products.

BACKGROUND

Timber is the most ecologically benign of construction materials. However, there are hardwoods which are being extracted from virgin forests in an unsustainable manner, destroying valuable forests and ecosystems. Similarly, some softwoods, such as redwood and cedar are being depleted. Where forests are being harvested in an unsustainable manner, the result is the extinction of indigenous species and the clearance of vegetation that would otherwise help regulate the amount of CO_2 in the atmosphere. Improved forestry practices can be encouraged by seeking timber from sources where the forests are well managed.

Hong Kong uses only imported timber, and is one of the largest importers of tropical hardwoods. The construction sector in Hong Kong is a major consumer of hardwoods from tropical rainforests, with a large proportion used wastefully, and ending up at landfill sites. Timber should originate only from well-managed sources and should be reused whenever possible. Guidelines, templates and implementation measures to help organisations develop purchasing policies and practices that help conserve forest resources are available [2,3]. PNAP 153 [4] gives guidance for alternatives to the use of hardwoods in order to reduce the amount of tropical hardwood timber used in building projects.

Certified Wood may be defined a wood-based materials originally sourced from forestlands participating in an acceptable system or program which certifies sustainable forest management. Acceptable systems or programs must include adherence to management practices which conserve biological diversity and maintain productive capacity of forest ecosystems, and be independently audited and monitored.

EcoWood@sia believes that a combination of a stepwise approach to forest management and the responsible purchase of forest products, culminating in purchasing credibly certified products, provide the foundation for solutions to the problems that are associated with the trade in forest products. The WWF guide [3] outlines the various ways in which purchasing organisations can demonstrate compliance with best practice and ultimately with their own procurement policies.

1 EcoWood@sia. http://www.ecowoodasia.org/
2 Certified Forest Products Council. Project Toolkit. Succeeding with Certified Wood. http://www.certifiedwood.org/documents/Certified_Wood_Project_Kit_C.PDF
3 World Wildlife Fund. http://www.ecowoodasia.org/en/pdf/GFTN%20RPG%20Feb04.pdf
4 Building Department, Practice Note for Authorized Persons and Registered Structural Engineers PNAP 153, Tropical Hardwood Timber. http://www.info.gov.hk/bd/english/documents/pnap/Pnap153.pdf

3 Materials Aspects

3.2 Selection of Materials

3.2.4 Ozone Depleting Substances

Exclusions

Buildings using split-units and/or window units.

Objective

Reduce the release of chlorofluorocarbons and hydrochlorofluorocarbons into the atmosphere.

Credits attainable

2

Pre-requisites

Compliance with the Ozone Layer Protection Ordinance Chapter 403.

Credit requirement

a) Refrigerants

1 credit for using refrigerants with a ozone depleting potential 0.03 or less and a global warming potential of 1600 or less.

or:

1 credit for demonstrating a phased programme of refrigerant replacement together with limitations on leakage.

b) Fire suppression and other materials

1 credit for the use of products that avoids the use of ozone depleting substances in their manufacture, composition or use.

Assessment

a) Refrigerants

The Client shall submit a report by a suitably qualified person giving details of the air-conditioning and refrigeration equipment installed and confirm that the global warming potential (GWP) of the refrigerants used in equipment meets the specified requirement. Reference shall be made to refrigerant supplies and/or equipment manufacturer's data together with guidance provided by recognised authorities such as ASHRAE, CIBSE, etc.

Where the refrigerant replacement programme has not been completed the Client shall provide details of the 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. Documentation shall be presented that demonstrates that emissions of refrigerants for equipment is limited to an average of 3% or less of the total charge per year, and that leakage over the remaining life of the equipment should be maintained to within 20%.

b) Fire suppression and other materials

A Client shall provide details of any fire suppression systems that use ozone depleting substances. These may include hand-held extinguishers or fixed fire protection systems serving, for example, computer rooms or electricity switch rooms. Where such systems are present in the building, the Client shall provide details of the practices adopted to ensure that emissions are reduced to a minimum.

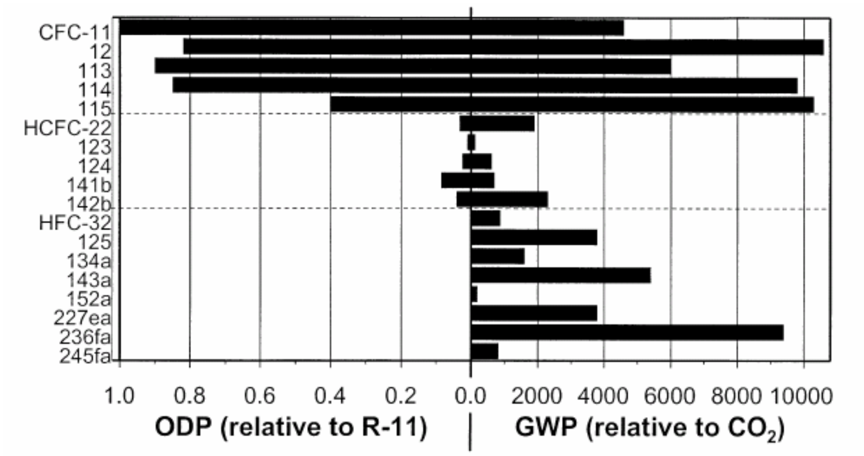
Replacement of fire suppressants, thermal insulations, and other applications shall avoid the use of materials that emit CFCs in there manufacture or use.

Background

The Montreal Protocol required scheduled phase out of controlled substances, including chemicals containing chlorine and bromine used as refrigerants, solvents, foam blowing agents, aerosol propellants, fire suppressants, and for other purposes. Ozone Layer Protection Ordinance (Cap. 403) 1989 gives effect to Hong Kong's international obligations to control the manufacture, import and export of ozone depleting substances [1]. Ozone Layer Protection (Controlled Refrigerants) Regulation 1994 requires the conservation of controlled refrigerants used in large scale installations and motor vehicles [2]. Ozone Layer Protection (Products Containing Scheduled Substances) (Import Banning) Regulation 1993 prohibits the import of portable fire extinguishers containing halons and other controlled products from a country or place not a party to the Montreal Protocol unless the Authority considers that it complies with the requirements of the Protocol. Scheduled substances under the Ozone Layer Protection Ordinance are listed by the Environmental Protection Department [3].

In addition to having suitable thermodynamic properties, the ideal refrigerant would be nontoxic, non-inflammable, completely staple, environmentally benign, readily available, self-lubricating, compatible with materials used in equipment, easy to handle and detect. No current refrigerants are ideal. Compounds that contain no chlorine or bromine have ozone depletion potential (ODP) nearly zero. Increasing the amount of fluorine generally raises the global warming potential (GWP). Hydrogen content tends to shorten the atmospheric lifetime [4].

Climate change is much more complex than ozone depletion, yet there is wide agreement that warming is occurring. While refrigerants contribute to the global environmental concerns, the impact is comparatively small [4]. The problem is not with refrigerants inside air-conditioning systems, but with their release. Given that ODP is largely addressed by legislation HK-BEAM basis assessment of refrigerants based on GWP. The figure below (taken from reference [4]) shows ODP contrasted with GWP for single-compound refrigerants. As can be seen, CFCs generally have high ODP and GWP. HCFCs generally have much lower ODP and GWP. HFCs offer near-zero ODP, but some have comparatively high GWP.



The US Environmental Protection Agency provides information on suitable substitutes for ozone depleting substances [5], including refrigerants for various types of air-conditioning and refrigeration equipment, fire suppression [6], blowing agents [7], solvents, etc. CIBSE GN01 [8] outlines the hazards of the use of these refrigerants and provides design guidance for refrigeration systems, thermal insulation

1 Environmental Protection Department. A Concise Guide to the Ozone Layer Protection Ozone Layer Protection Ordinance. http://www.epd.gov.hk/epd/english/laws_regulations/comp_guides/files/cgto_olpo_eng.pdf

2 Environmental Protection Department. A Concise Guide to the Ozone Layer Protection (Controlled Refrigerants) Regulation. http://www.epd.gov.hk/epd/english/laws_regulations/comp_guides/files/cgt_olp_cr_eng.pdf

3 EPD. http://www.epd.gov.hk/epd/english/application_for_licences/guidance/wn6_licen1_1.html

4 Calm S M. Option and outlook for chiller refrigerants. International Journal of Refrigeration. Vol. 25, 2002, pp 705-715.

5 US Environmental Protection Agency. http://www.epa.gov/docs/ozone/snap/lists/index.html#refac

6 US Environmental Protection Agency. http://www.epa.gov/docs/ozone/snap/fire/halo.pdf

7 US Environmental Protection Agency. http://www.epa.gov/docs/ozone/snap/foams/lists/index.html

8 Chartered Institution of Building Services Engineers. CFC's, HCFC's, HFC's and halons. 2000. ISBN 0900953993.

and fire protection systems. An ASHRAE guideline [9] recommends practices and procedures that will reduce inadvertent release of halogenated refrigerants. The practices and procedures in this guideline cover emission reduction of halogenated hydrocarbon and halogenated ether refrigerants:

- from stationary refrigeration, air-conditioning, and heat pump equipment and systems; and
- during manufacture, installation, testing, operation, maintenance, and disposal of equipment and systems.

9 ASHRAE Guideline 3-1996. Reducing Emission of Halogenated Refrigerants in Refrigeration and AS

3 MATERIALS ASPECTS — 3.3 WASTE MANAGEMENT

3.3.3 WASTE RECYCLING FACILITIES

EXCLUSIONS

None.

OBJECTIVE

Reduce pressure on landfill sites and help to preserve non-renewable resources by promoting recycling of waste materials.

PRE-REQUISITES

None.

CREDITS ATTAINABLE

1

CREDIT REQUIREMENT

1 credit for providing facilities for the collection, sorting, storage and disposal of waste and recovered materials.

ASSESSMENT

The assessment seeks to establish the extent to which facilities are provided to allow for the recycling of waste. The means to facilitate waste recycling is not prescribed as much depends on the design and type of building, and the activities carried out within.

The Client shall submit details of expected the prevailing steams and quantities for the building (organic, recyclable and non-recyclable), and demonstrate the adequacy of the waste storage, sorting and recycling facilities, appropriate to the type and size of the development.

The assessment shall take into account how waste collection, storage sorting, recycling and disposal can be managed for the buildings, with consideration given to the adequacy of space provisions on individual floors, within the building as a whole, and at local/estate level. Opportunity should exist to manage different waste types, such as organic, non-recyclable and recyclable waste. There should be easy access to facilities for cleaning staff/contractors and/or building users, and for waste recycling and collection companies. The storage area shall be adequately sized to allow for recycling of, as a minimum, paper, glass, plastics, metals and organic materials.

The HK-BEAM Assessor may undertaken inspections of the waste management facilities.

BACKGROUND

Well managed facilities for the recycling of solid waste encourage recycling and results in reductions in the disposal at landfill sites. Buildings should be provided with facilities for waste separation and sorting, and short term storage at appropriate locations.

PNAP 98 [1] provides details of the basic refuse storage and recovery chambers expected in new buildings, and can be used as a benchmark for assessment. As an indication the space requirements for offices and similar buildings are 2 m^2 per 1000 m^2 of floor area.

Reference should be made to Section 6 with regard to the hygiene aspects of waste disposal.

1 Buildings Department. Practice Note for Authorized Persons and Registered Structural Engineers, PNAP 98. Refuse Storage and Collection Building (Refuse Storage and Material Recovery Chambers and Refuse Chutes) Regulations. http://www.info.gov.hk/bd/english/documents/pnap/Pnap098.pdf

3 MATERIALS ASPECTS **3.3 WASTE MANAGEMENT**

3.3.4 WASTE MANAGEMENT

EXCLUSIONS

None.

OBJECTIVE

Reduce pressure on landfill sites and help to preserve non-renewable resources by promoting recycling of waste and obsolete materials.

PRE-REQUISITES

Compliance with regulations in respect of proper identification, collection and sorting of hazardous waste.

CREDITS ATTAINABLE

3

CREDIT REQUIREMENT

a) Waste management audit

1 credit for undertaking a waste stream audit and developing a waste management system.

b) Waste management practices

1 credit for an environmentally responsive waste management system.

1 credit where the waste management system demonstrates reductions in waste disposal to landfills and increased recycling.

ASSESSMENT

a) Waste management audit

The Client shall demonstrate that a detailed waste management audit of the prevailing waste streams (see a) above) that identifies the types of waste, and the amounts of each type that are expected regularly (from day to day use) and from activities such as renovations, fit-out, etc. The audit should determine the amounts of materials that have potential for recycling (paper, plastics, metals, obsolete equipment, etc), and the potential market for recycling.

The Client shall also demonstrate that a waste management system is in place and/or is being developed to deal with waste and recycling.

Where waste management has been a relatively new initiative for the building the credit may be awarded where it can be demonstrated that the on-going audit and developing waste management system will lead to improved waste management to the extent outlined above.

a) Waste management practices

The assessment seeks to establish the extent to which building management is pro-active in the management of waste streams from the building. All waste streams are covered, such as those from building renovations, redecoration, operation and maintenance, cleaning, etc. as well as from tenants/occupants and visitors. Waste in this context shall also include items such as obsolete or discarded building services components, office equipment, furniture, fittings, etc.

The Client shall provide details of waste management system for the building and records that quantify waste streams (hazardous, organic, non-organic, components, equipment, etc), disposal to landfill or elsewhere, recycled, sold or donated, etc. for up to the previous 3 years. Data may be provided in terms of percentage, volume and/or weight.

The waste management system shall be judged to be environmentally responsive if it:

- demonstrates compliance with all current regulations in respect of the management and disposal of hazardous waste (chemicals, asbestos, etc);
- is pro-active in the management of potentially hazardous waste

(such as batteries, light fittings, etc);

- is pro-active in reducing use of toxic materials;
- is pro-active in reducing incoming waste streams (packaging etc);
- is pro-active in sourcing opportunities for recycling waste;
- is pro-active in educating, advising and facilitating building users to adopt environmentally sound waste management practices; and
- is an ongoing commitment; and
- continues to be adequately resourced in time and effort.

The second credit can be awarded if the building management can demonstrate success in reducing waste disposal to landfills and increasing the amounts of waste recycled over at least 3 years previous. Where waste management has been in place for less than 3 years the onus shall be on the Client to demonstrate the extent of the gains achieved in the short term were significant, and can be prolonged or increased.

BACKGROUND

The managers of buildings can achieve a great deal in improving waste management and recycling, especially through positive engagement with building users [1]. Where waste management is in an emergent stage the starting point is a waste stream audit to establish current waste benchmarks, then to evaluate how each type of waste can be reduced through source reduction, reuse and recycling. Development of a waste management system, suitably resourced with facilities, staff and time, should follow. Targets should include the reduction of incoming waste streams, compliance with regulations in respect of hazardous waste, reducing waste disposal at land fill, identifying recycling opportunities, etc. Pro-active management should consider reducing use of toxic materials, or at least ensure environmentally sound disposal. Examples include mercury in lamps, batteries, equipment containing polychlorinated biphenyl, etc.

Hong Kong generates several different types of waste, and each has its own requirements for handling. The Environmental Protection Department [2] keeps regular statistics on each waste type, such as composition, quantity sent for disposal and quantity recycled, such as for example, municipal solid waste [3], waste paper [4], plastic waste [5] and glass bottles [6

NOTE

Purchasing practices, as covered elsewhere in HK-BEAM 5/04, can also contribute to reducing waste streams.

Reference should be made to Section 6 with regard to the hygiene aspects of waste disposal.

1 Good Practice Guide to Waste Management for Hotels in Hong Kong
http://www.bse.polyu.edu.hk/Research_Centre/BEP/hotels14000/acrobat/waste_guide.pdf

2 Environmental Protection Department. Waste Reduction Guidelines and Factsheets.
http://www.epd.gov.hk/epd/english/environmentinhk/waste/guide_ref/guide_wr.html

3 Environmental Protection Department. Waste Reduction and Recycling Factsheet No.1
http://www.epd.gov.hk/epd/english/environmentinhk/waste/guide_ref/files/wr_msw.pdf

4 Environmental Protection Department. Waste Reduction and Recycling Factsheet No.2.
http://www.epd.gov.hk/epd/english/environmentinhk/waste/guide_ref/files/wr_paper.pdf

5 Environmental Protection Department. Waste Reduction and Recycling Factsheet No.3.
http://www.epd.gov.hk/epd/english/environmentinhk/waste/guide_ref/files/wr_plastics.pdf

6 Environmental Protection Department. Waste Reduction and Recycling Factsheet No.6.
http://www.epd.gov.hk/epd/english/environmentinhk/waste/guide_ref/files/wr_glass.pdf

4 ENERGY USE

INTRODUCTION

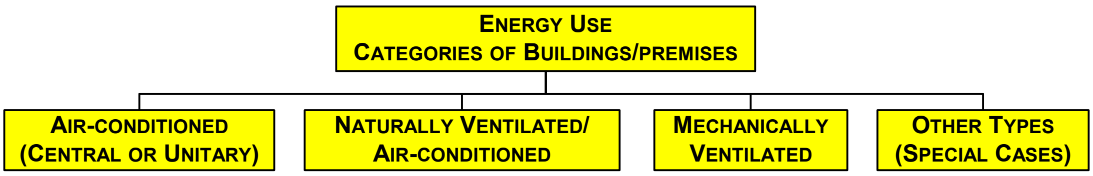
An objective of HK-BEAM is to encourage thorough evaluation of the performance of building and services system designs, and greater investments into measures that will help improve the energy performance of existing buildings, so as to reduce energy consumption and the associated environmental impacts, and to reduce summer peak electricity demand.

The assessment of the building and engineering systems is performance based as far as possible, but credits are also given for features which have proven to contribute to energy efficiency and conservation. Credits are given where management, operation and maintenance practices are such as to seek continued improvements in energy performance.

The number of Energy Use credits available for a particular building development will vary depending on particular circumstances.

CLASSIFICATION OF BUILDINGS

To deal with the wide range of building that may be encountered, buildings/premises are categorised according to the provisions for air-conditioning and ventilation. This is necessary as the operational needs of buildings together with the different air-conditioning and ventilation systems that serve their needs results in large variations in energy use between buildings.



AIR-CONDITIONED BUILDINGS

This refers to buildings and premises that are air-conditioned, either by a central plant serving the entire building or unitary equipment for individual spaces, and where the air-conditioning system operates almost throughout the year. When a significant portion of such buildings are mechanically or naturally ventilated additional assessments shall be included.

NATURALLY VENTILATED/AIR-CONDITIONED BUILDINGS

This refers to buildings that are designed to use natural ventilation, but may be air-conditioned when natural ventilation fails to provide adequate indoor comfort conditions. When a significant portion of such buildings are mechanically ventilated additional assessments shall be included.

MECHANICALLY VENTILATED BUILDINGS

This refers to buildings such as car parks, factories, godowns, etc., where the major areas rely solely on mechanical ventilation for indoor thermal environment and/or control of air quality. When a significant portion of such buildings are air-conditioned or naturally ventilated additional assessments shall be included.

OTHER BUILDINGS

This embraces buildings/premises that cannot be categorised as one of the above and comprise an unusual mix of premises or premises with special uses. Such buildings would be assessed based on either the generic framework for assessment of energy performance, with the required parameters and benchmarks determined as the first stage of the assessment, and/or feature specific assessments.

ASSESSMENTS

The Energy Use assessments take account of the specific characteristics of the building development, such as the type and usage of premises it houses and the range and operational characteristics of the systems and equipment required to meet the needs of users, and comprise three parts:

- estimated Annual Energy Use (and where appropriate, Maximum Electricity Demand) for air-conditioning the building, and for lighting and equipment in air-conditioned areas;
- features and performance of specific systems and equipment; and
- testing and commissioning of systems and provisions that facilitate energy efficient management, operation and maintenance.

ANNUAL ENERGY USE AND MAX ELECTRICITY DEMAND	SYSTEMS+EQUIPMENT PERFORMANCE	PROVISIONS FOR ENERGY MANAGEMENT

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ENERGY USED FOR AIR-CONDITIONING THE BUILDING/PREMISES

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ENERGY USED FOR LIGHTING AND EQUIPMENT IN AIR-CONDITIONED AREAS

BACKGROUND

Electricity generation accounts for around 60% of the total CO_2 emissions from energy use in Hong Kong and buildings, particularly air-conditioned buildings, account for more than half of the electricity consumed each year. Ensuring buildings are operated with good energy performance is the key to the conservation of resources and reductions in environmental loadings.

Power stations operate under licences issued by the Director of Environmental Protection, requiring operators to employ Best Practicable Means to control emissions to acceptable levels. However, a growth in demand is resulting in the construction of further generation, transmission and distribution capacity. Mainly because of air-conditioning, buildings are responsible for much of the peak load that occurs around midday during summer months. Demand side management can reduce the rate of expansion of supply-side capacity and emissions to the atmosphere.

4.1 ANNUAL ENERGY USE

4.1.1 ANNUAL ENERGY USE IN COMMERCIAL BUILDINGS

4.1.2 ANNUAL ENERGY USE IN HOTEL BUILDINGS

4.1.3 ANNUAL ENERGY USE IN EDUCATIONAL BUILDINGS

4.1.4 ANNUAL ENERGY USE IN RESIDENTIAL BUILDINGS

4.1.5 ANNUAL ENERGY USE IN MECHANICALLY VENTILATED BUILDINGS

4.1.6 ANNUAL ENERGY USE IN OTHER BUILDING TYPES

LIMITATIONS

As HK-BEAM is intended to be sufficiently comprehensive to embrace all types of buildings a generic framework for assessing the energy performance has been established. However, due to the large variety of buildings and types of premises that may be encountered in practice, it has not yet been possible to establish and include all the variables required for a full and comprehensive assessment for all permutations. Comprehensive audit data on energy use and patterns of use for the wide range of premises that may be encountered is not yet available. Consequently, HK-BEAM will need to evolve by drawing from the experiences gained through its implementation. In the absence of sufficient data to establish benchmarks (zero credit) and/or levels of attainable performance, the HK-BEAM Society Executive Committee will seek to develop appropriate criteria for an assessment in collaboration with the Client's representatives.

ENERGY BUDGET APPROACH

Whenever available, actual billing/metering data is used to assess the performance of an existing building. The actual annual energy use and electricity maximum demand of the Assessed Building are compared with estimations for an equivalent Baseline Building. The Energy Budget approach used for determining the Annual Energy Use and Maximum Electricity Demand of the baseline building model is described in detail in Section 8, together with the relevant data for use in the assessment.

Where billing/metering data is insufficient to undertake a meaningful assessment it may be possible to undertake assessment using the Energy Budget approach for both the Assessed Building and the Baseline Building.

SPECIFICATION FOR SIMULATION TOOLS

The performance of the equivalent Baseline Building is determined using a detailed building heat transfer simulation program HTB2 [1] and an air-conditioning system simulation program BECON [2]. Notwithstanding, for the purpose of assessment, building energy simulations may be performed using any suitable building energy simulation program, provided that:

- it has all the simulation capabilities required for modelling the features of the building being assessed, including its air-conditioning system;
- when it is applied to model the cases described in ASHRAE Standard 140 [3] according to the method and conditions of test stipulated therein, its predictions fall within the range of predictions given in the Standard; and
- its predictions for an existing building in Hong Kong have been compared with measured energy data of that building and the predictions are in good agreement with the measured data.

The Client shall submit documentation to confirm that the specific program used will have all the simulation capabilities required for modelling the building being assessed and that the stated requirements are met. Evidence demonstrating fulfilment of the first requirement must be included in the submission for each building. The second and third requirements above need not be submitted if the program has already been recognised in a prior HK-BEAM assessment.

ENERGY CONSERVATION MEASURES

If additional measures are adopted to effectively reduce the cooling load or enhance the efficiency of the air-conditioning systems in a building, their effects are ignored in predicting the annual energy use and maximum electricity demand of the Baseline Building model (i.e. the zero-credit levels will remain unchanged) but their impacts are taken into account in the prediction of the annual energy use and maximum electricity demand in the Assessed Building. Such measures may include but are not limited to:

- the use of air-to-air heat recovery devices;
- total enthalpy economiser cycles;
- demand controlled ventilation systems;
- chilled ceilings or chilled beams;

1 Alexander D K. HTB2 User Manual Version 2.0. Welsh School of Architecture, Cardiff University.
2 Yik F W H. User Manual for BECON for Windows. A Building Energy Consumption Simulation Program. Department of Building Services Engineering, The Hong Kong Polytechnic University.
3 American National Standards Institute/American Society of Heating, Refrigeration and Air-conditioning Engineers. ANSI/ASHRAE Standard 140-2001. Standard Method of Test for the Evaluation of Building Energy Analysis Computer Programs.

- desiccant dehumidification systems;
- variable speed fans or pumps;
- reduced duct static pressure reset or terminal regulated air volume control methods for variable air volume systems;
- chilled water temperature reset control for chillers, etc.

ALTERNATIVES APPROACHES

Where simplified models are available as an alternative to the detailed simulation method, the simplified models can be used only if the Assessed Building possesses characteristics that fall within a particular range. Section 8.5 provides descriptions of the regression models for commercial/office buildings.

ALIGNMENT WITH BUILDING ENERGY CODES

HK-BEAM seeks to embrace the Government's building energy codes where appropriate. Credits are awarded for compliance with the air-conditioning [4] and lighting codes [5], and the Performance-based Energy Code [6]. In addition, the use of the Electrical & Mechanical Services Department's Energy Consumption Indicators and Benchmarks [7] is also applicable as an alternative method of assessments.

4.2 ENERGY EFFICIENT SYSTEMS

4.2.1 EMBODIED ENERGY IN BUILDING STRUCTURAL ELEMENTS

4.2.2 VENTILATION SYSTEMS IN MECHANICALLY VENTILATED BUILDINGS

4.2.3 LIGHTING SYSTEMS IN MECHANICALLY VENTILATED BUILDINGS

4.2.4 HOT WATER SUPPLY SYSTEMS

4.2.5 LIFT AND ESCALATOR SYSTEMS

4.2.6 ELECTRICAL SYSTEMS

4.2.7 RENEWABLE ENERGY SYSTEMS

BACKGROUND

Whilst the estimation of annual energy use and maximum electricity demand takes into improvements to the efficiency of air-conditioning and lighting systems and equipment it does not embrace all aspects of energy use in buildings. Therefore, HK-BEAM credits additional measures that can improve the energy performance of buildings.

4.3 ENERGY EFFICIENT EQUIPMENT

4.3.1 AIR-CONDITIONING UNITS

4.3.2 CLOTHES DRYING FACILITIES

4.3.3 ENERGY EFFICIENT LIGHTING IN PUBLIC AREAS

4.3.4 HEAT RECLAIM

4.3.5 MECHANICAL VENTILATION IN HOTEL BUILDINGS

4.3.6 ENERGY EFFICIENT APPLIANCES

BACKGROUND

As for the case of energy performance of systems, HK-BEAM gives credit for the inclusion of particular equipment that provides for improved energy performance but account for which is not included in the estimation of annual energy use.

4 Electrical & Mechanical Services Department. Code of Practice for Energy Efficiency of Air Conditioning Installations. http://www.emsd.gov.hk/emsd/e_download/pee/accop.pdf
5 Electrical & Mechanical Services Department. Code of Practice for Energy Efficiency of Lighting Installations. http://www.emsd.gov.hk/emsd/e_download/pee/lightingcop.pdf
6 Electrical & Mechanical Services Department. Performance-based Energy Code. http://www.emsd.gov.hk/emsd/e_download/pee/forms%20-%20pb-bec.doc
7 Electrical & Mechanical Services Department. Energy Consumption Indicators and Benchmarks. http://www.emsd.gov.hk/emsd/eng/pee/ecib.shtml

4.4 PROVISIONS FOR ENERGY MANAGEMENT

BACKGROUND

One of the major reasons why buildings fail to meet performance expectations is the lack of adequate commissioning of systems and equipment, and the inadequacy of operations and maintenance manuals, commissioning data, and as-installed equipment data, as-fitted drawings, and operator training.

The installations considered in this section include the systems, equipment and components of the electrical and mechanical plant in the building development that have significant influence on energy consumption, electricity maximum demand and, to a lesser extent indoor environmental conditions. Indoor environmental conditions are verified in a series of tests which may be regarded as 'enhanced commissioning' and which are detailed in the section covering indoor environmental quality.

The management and operation of a building and the way the tenants use the building can have a major impact on its energy consumption. 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.

4 ENERGY USE

4.1 ANNUAL ENERGY USE

4.1.1 ANNUAL ENERGY USE IN COMMERCIAL BUILDINGS

EXCLUSIONS

Other types of buildings.

OBJECTIVES

Reduce the consumption of non-renewable energy resources and the consequent harmful emissions to the atmosphere. Encourage energy conservation and methods to reduce maximum electricity demand.

CREDITS ATTAINABLE

13

PRE-REQUISITES

None.

CREDIT REQUIREMENT

a) Estimated annual energy consumption

1 credit for a reduction in the annual energy consumption by 10%.

2 credits for a reduction in the annual energy consumption by 14%.

3 credits for a reduction in the annual energy consumption by 18%.

4 credits for a reduction in the annual energy consumption by 22%.

5 credits for a reduction in the annual energy consumption by 26%.

6 credits for a reduction in the annual energy consumption by 30%.

7 credits for a reduction in the annual energy consumption by 34%.

8 credits for a reduction in the annual energy consumption by 38%

9 credits for a reduction in the annual energy consumption by 42%

10 credits for a reduction in the annual energy consumption by 45%.

b) Estimated maximum electricity demand

1 credit for a reduction in the maximum electricity demand by 15%.

2 credits for a reduction in the maximum electricity demand by 23%.

3 credits for a reduction in the maximum electricity demand by 30%.

ALTERNATIVE CREDIT REQUIREMENT FOR ENERGY USE

1 credit for compliance with the Code of Practice for Energy Efficiency of Air Conditioning Installations.

1 credit compliance with the Code of Practice for Energy Efficiency of Lighting Installations.

and energy use in comparison with similar premises:

1 credit where annual energy use is ≤ 40% cumulative percentage.

2 credits where annual energy use is ≤ 30% cumulative percentage.

3 credits where annual energy use is ≤ 20% cumulative percentage.

4 credits where annual energy use is ≤ 10% cumulative percentage.

or, energy use reductions as demonstrated by billing/metering data:

1 credit where the reduction in annual energy use has been 10%.

2 credits where the reduction in annual energy use has been 15%.

3 credits where the reduction in annual energy use has been 20%.

plus a reduction in electricity maximum demand as demonstrated by billing/metering data:

1 credit for a reduction in electricity maximum demand of 10%

2 credits for a reduction of electricity maximum demand of 20%.

ASSESSMENT

a) Estimated annual energy use

The number of credits awarded will be determined with reference to the percentage reduction in the annual energy use and maximum electricity demand, respectively, of the Assessed Building relative to the benchmark (zero-credit) criteria evaluated from an equivalent Baseline Building model (see Section 8.1).

An existing commercial building or commercial complex, which may be an office-only building, an office/commercial building, a commercial building (such as a standalone shopping centre, or the commercial portion of a residential development) will be assessed based on the method for air-conditioned buildings, as described in Section 8.1. The assessment embraces the overall energy use in the building except, for multi-tenanted buildings, the individual consumption of tenants. Fan energy use in air-handling equipment powered by tenants' supply, however, is included.

The determination of annual energy use and maximum electricity demand of the Baseline Building model will be based on the default indoor conditions and occupancy, lighting and equipment load densities and patterns for the relevant types of premises in the assessed building, as summarised in Tables 8.4 and 8.5 in Section 8.2. Performance of air-conditioning equipment shall be taken as being at a level that it barely complies with the minimum requirements stipulated in the Code of Practice for Energy Efficiency of Air Conditioning Installations [1].

The zero-credit criteria for the annual energy use of the assessed building shall then be determined by scaling up the annual energy use of the baseline building model by 150%.

b) Estimated maximum electricity demand

Credits for this assessment will be determined with reference to the factor of reduction in the maximum electricity demand of the Assessed Building relative to that of the Baseline Building model.

The zero-credit criteria for maximum electricity demand of the assessed building shall then be determined by scaling up the maximum electricity demand of the baseline building model by 125%.

USE OF REGRESSION MODELS

For some types of buildings regression models may be used as an alternative to the generic simulation method, for the determination of the zero-credit energy use and maximum electricity demand criteria (based on the baseline building model) for the assessed building. Currently available regression models and their applicable limits are described in Section 8.5.

USE OF ENERGY CONSUMPTION INDICATORS AND BENCHMARKS

The assessment covers all areas, premises and energy uses under the control of the building management, i.e. the building management is responsible for energy and fuel bills.

As an alternative to the prescriptive codes for air-conditioning [1] and lighting [2] compliance with the Performance-based Building Energy Code [3] also satisfies the first two credits. Certification under either scheme shall be submitted to demonstrate compliance.

The first alternative assessment is limited to premises for which energy consumption indicators and benchmarks are available in EMSD's Energy

1 Electrical & Mechanical Services Department. Code of Practice for Energy Efficiency of Air Conditioning Installations. http://www.emsd.gov.hk/emsd/e_download/pee/accop.pdf
2 Electrical & Mechanical Services Department. Code of Practice for Energy Efficiency of Lighting Installations. http://www.emsd.gov.hk/emsd/e_download/pee/lightingcop.pdf
3 Electrical & Mechanical Services Department. Performance-based Energy Code. http://www.emsd.gov.hk/emsd/e_download/pee/forms%20-%20pb-bec.doc

Consumption Indicators and Benchmarks [4]. Up to 4 additional credits are available using this alternative assessment criterion.

The Client shall submit details of the premises/areas/facilities in the building, their areas (m^2) and uses, billing data for up to 3 years previous, and details as per submissions to the on-line documentation provided by EMSD.

Where a building includes variety of premises/uses as identified in the Indicators and Benchmarking the credits awarded shall be weighting by percentage of floor area of the areas/premises covered in the submission. For example, assuming A, B and C are various 'Principle Group/Major Group' areas as identified in the database, and have percentages of 30%, 30% and 40%, respectively of the total building area. A is within the 30% cumulative percentage, B is within 10%, and C is within 40%. The weighted credit score is then (0.3x2) + (0.3x4) + (0.4x1) = 2.2 > 2 credits.

USE OF BILLING/ METERING DATA

Alternatively, in addition to compliance with the air-conditioning and/or lighting codes up to 3 credits are available for demonstrating a reduction in annual energy use, and up to 2 credits for demonstrating a reduction in electricity maximum demand, based on billing/metering data.

The starting point for the audit shall be any period after which the building became fully occupied, or for at least the past 3 years. Changes of occupancy, use, etc. over the audit period shall be stated, and an estimation of energy saving resulting from under utilisation of the building or change of use shall be included.

Whichever of the alternative assessments are submitted the onus shall be on the Client to demonstrate what management initiatives (rather than changes in occupancy or use) have served to reduce annual energy use and/or maximum demand, that there has been consistent improvement, and the gains are likely to be maintained.

BACKGROUND

HK-BEAM seeks to encourage energy saving and reduction in maximum electricity demand. The alternative credit and assessment criterion takes into account that existing buildings may or may not have been assessed under previous versions of HK-BEAM, but also the accuracy and reliability of data used.

4 Electrical & Mechanical Services Department. Energy Consumption Indicators and Benchmarks. http://www.emsd.gov.hk/emsd/eng/pee/ecib.shtml

4 ENERGY USE

4.1 ANNUAL ENERGY USE

4.1.2 ANNUAL ENERGY USE IN HOTEL BUILDINGS

EXCLUSIONS

Other types of buildings.

OBJECTIVES

Reduce the consumption of non-renewable energy resources and the consequent harmful emissions to the atmosphere. Encourage energy conservation and methods to reduce maximum electricity demand.

CREDITS ATTAINABLE

12

PRE-REQUISITES

None.

CREDIT REQUIREMENT

a) Estimated reduction in CO_2 emissions

1 credit for a reduction in CO_2 emissions by 10%.

2 credits for a reduction in CO_2 emissions by 14%.

3 credits for a reduction in CO_2 emissions by 18%.

4 credits for a reduction in CO_2 emissions by 22%.

5 credits for a reduction in CO_2 emissions by 26%.

6 credits for a reduction in CO_2 emissions by 30%.

7 credits for a reduction in CO_2 emissions by 34%.

8 credits for a reduction in CO_2 emissions by 38%

9 credits for a reduction in CO_2 emissions by 42%

10 credits for a reduction in CO_2 emissions by 45%.

b) Reduction in electricity maximum demand

1 credit for a reduction in electricity maximum demand of 10%

2 credits for a reduction of electricity maximum demand of 20%.

ALTERNATIVE CREDIT REQUIREMENT

1 credit for compliance with the Code of Practice for Energy Efficiency of Air Conditioning Installations.

1 credit compliance with the Code of Practice for Energy Efficiency of Lighting Installations.

and energy use in comparison with similar premises:

1 credit where annual energy use is ≤ 40% cumulative percentage.

2 credits where annual energy use is ≤ 30% cumulative percentage.

3 credits where annual energy use is ≤ 20% cumulative percentage.

4 credits where annual energy use is ≤ 10% cumulative percentage.

or, energy use reductions as demonstrated by billing/metering data:

1 credit where the reduction in annual energy use has been 10%.

2 credits where the reduction in annual energy use has been 15%.

3 credits where the reduction in annual energy use has been 20%.

plus a reduction in electricity maximum demand as demonstrated by billing/metering data:

1 credit for a reduction in electricity maximum demand of 10%

2 credits for a reduction of electricity maximum demand of 20%.

ASSESSMENT

a) Estimated reduction in CO_2 emissions

The number of credits to be awarded to an existing hotel for its energy performance shall be determined on the basis of the percentage reduction in the CO_2 emissions relative to a zero-benchmark value, and reduction in electricity maximum demand based on billing data.

In view of the more complex energy characteristics of hotels, the method for assessing air-conditioned buildings, as described in Section 8.1 has been expanded for application to an existing hotel building. Instead of setting a zero-credit 'energy use' benchmark for an existing hotel, the zero-credit benchmark is to with reference to the incurred CO_2 emission per annum that embraces all fuel types being used in the hotel.

A baseline value for the annual electricity use of air-conditioning and lighting installations shall be predicted based on a Baseline Building model following the method as described in Section 8, including the mark-up by 50%. This prediction shall embrace all lighting installations in the hotel.

A baseline value for the annual electricity use of ventilation systems shall be predicted following the method for assessing mechanically ventilated buildings, as described elsewhere in this document.

The baseline annual electricity use of vertical transportation systems shall be taken as 106 kWh per m² of the gross floor area of the hotel.

The total of the baseline annual electricity use values for the air-conditioning, lighting, ventilation and vertical transportation installations shall then converted into an equivalent CO_2 emission per annum using the conversion factor as given in Section 8.5.

The zero-credit benchmark, in kg of CO_2 emission incurred per m² of the gross floor area of the hotel per annum, shall be the value evaluated above plus 16.4 kg/m²-year (equivalent to the emission incurred by using around 1,000 MJ/m^2 of heat energy generated from burning town gas), which is to account for the emission incurred by using town gas or fuel oil for cooking, water heating and other processes. With this allowance made for the use of town gas, use of other fuels that will generate more CO_2 per unit heat energy derived may lead to lower assessment scores.

The total CO_2 emission incurred due to energy use in the assessed hotel shall be determined from the annual consumption of electricity and other fuels, as reflected by the billing records in the past year, converted into total incurred CO_2 emission using the conversion factors given in Section 8.5 and normalised by the gross floor area of the hotel.

The Code of Practice for Energy Efficiency of Air Conditioning Installations (Clause 7.4.2 in the Code) specifies that each hotel guestroom should be provided with a single master switch that will turn off conditioned air supply or reset the thermostat setting upward with or without simultaneously reducing the fan speed during the unoccupied periods to save energy. Since compliance with the Code is not yet a mandatory requirement, the effect of equipping guestrooms with such control devices will not be taken into account in predicting the annual electricity use for air-conditioning for the Baseline Building model. In this prediction, the patterns of occupation, lighting load and equipment load, as given in Table 8.5.4 a), shall be used. The assumption shall be made in the energy use prediction that all the guestrooms will be air-conditioned 24 hours a day keeping indoor temperatures steadily at 22ºC throughout the year.

b) Reduction in electricity maximum demand

Up to 2 credits for demonstrating a reduction in electricity maximum demand based on billing/metering data.

The starting point for the audit shall be any period from which the building became fully occupied. Changes of occupancy, use, etc. over the audit period shall be stated, and an estimation of reduction in electricity maximum demand resulting from under utilisation of the building or change of use shall be included.

The onus shall be on the Client to demonstrate what management initiatives (rather than changes in occupancy or use) have served to reduce electricity maximum demand, that there has been consistent improvement, and the gains are likely to be maintained.

USE OF ENERGY CONSUMPTION INDICATORS AND BENCHMARKS

The assessment covers all areas, premises and energy uses under the control of the building management, i.e. the building management is responsible for energy and fuel bills.

As an alternative to the prescriptive codes for air-conditioning [1] and lighting [2] compliance with the Performance-based Building Energy Code [3] also satisfies the first two credits. Certification under either scheme shall be submitted to demonstrate compliance.

The first alternative assessment is limited to premises for which energy consumption indicators and benchmarks are available in EMSD's Energy Consumption Indicators and Benchmarks [4]. Up to 4 additional credits are available using this alternative assessment criterion.

The Client shall submit details of the premises/areas/facilities in the building, their areas (m^2) and uses, billing data for up to 3 years previous, and details as per submissions to the on-line documentation provided by EMSD.

Where a building includes variety of premises/uses as identified in the Indicators and Benchmarking the credits awarded shall be weighting by percentage of floor area of the areas/premises covered in the submission. For example, assuming A, B and C are various 'Principle Group/Major Group' areas as identified in the database, and have percentages of 30%, 30% and 40%, respectively of the total building area. A is within the 30% cumulative percentage, B is within 10%, and C is within 40%. The weighted credit score is then (0.3x2) + (0.3x4) + (0.4x1) = 2.2 > 2 credits.

USE OF BILLING/ METERING DATA

Alternatively, in addition to compliance with the air-conditioning and/or lighting codes up to 3 credits are available for demonstrating a reduction in annual energy use, and up to 2 credits for demonstrating a reduction in electricity maximum demand, based on billing/metering data.

The starting point for the audit shall be any period after which the building became fully occupied, or for at least the past 3 years. Changes of occupancy, use, etc. over the audit period shall be stated, and an estimation of energy saving resulting from under utilisation of the building or change of use shall be included.

Whichever of the alternative assessments are submitted the onus shall be on the Client to demonstrate what management initiatives (rather than changes in occupancy or use) have served to reduce annual energy use and/or maximum demand, that there has been consistent improvement, and the gains are likely to be maintained.

BACKGROUND

Besides electricity, a hotel may use gas and/or oil for cooking, water heating, steam production and winter space heating. Since these fuels

1 Electrical & Mechanical Services Department. Code of Practice for Energy Efficiency of Air Conditioning Installations. http://www.emsd.gov.hk/emsd/e_download/pee/accop.pdf

2 Electrical & Mechanical Services Department. Code of Practice for Energy Efficiency of Lighting Installations. http://www.emsd.gov.hk/emsd/e_download/pee/lightingcop.pdf

3 Electrical & Mechanical Services Department. Performance-based Energy Code. http://www.emsd.gov.hk/emsd/e_download/pee/forms%20-%20pb-bec.doc

4 Electrical & Mechanical Services Department. Energy Consumption Indicators and Benchmarks. http://www.emsd.gov.hk/emsd/eng/pee/ecib.shtml

are an alternative of one another as an input for producing heat, the mix of these fuels being used in one hotel can be significantly different from that of another hotel, depending on the types of heating systems the hotels use. Hotel energy surveys indicated that electricity use in hotels in Hong Kong can vary between 41% and 91% of the total energy use. This highlights that rather than focusing on the electricity use, there is a need to base the assessment of the environmental impacts due to energy use in hotels on the incurred CO_2 emission per annum. The energy surveys also revealed that the energy use for air-conditioning in hotels accounted for, in average, 31% of the total energy use. Although this is less dominant compared to other types of commercial buildings, it is still a significant portion of the total energy use.

HK-BEAM seeks to encourage energy saving and reduction in maximum electricity demand. The alternative credit and assessment criterion takes into account that existing buildings may or may not have been assessed under previous versions of HK-BEAM, but also the accuracy and reliability of data used.

4 ENERGY USE

4.1 ANNUAL ENERGY USE

4.1.3 ANNUAL ENERGY USE IN EDUCATIONAL BUILDINGS

EXCLUSIONS

Other types of buildings.

OBJECTIVES

Reduce the consumption of non-renewable energy resources and the consequent harmful emissions to the atmosphere. Encourage energy efficiency and other means to reduce maximum electricity demand.

CREDITS ATTAINABLE

10

PRE-REQUISITES

None.

CREDIT REQUIREMENT

a) Estimated annual energy consumption

1 credit for a reduction in the annual energy consumption by 5%.

2 credits for a reduction in the annual energy consumption by 9%.

3 credits for a reduction in the annual energy consumption by 13%.

4 credits for a reduction in the annual energy consumption by 17%.

5 credits for a reduction in the annual energy consumption by 21%.

6 credits for a reduction in the annual energy consumption by 24%.

7 credits for a reduction in the annual energy consumption by 27%.

8 credits for a reduction in the annual energy consumption by 30%.

b) Reduction in electricity maximum demand

1 credit for a reduction in electricity maximum demand of 8% or more.

2 credits for a reduction of electricity maximum demand of 15% or more.

ALTERNATIVE CREDIT REQUIREMENT

1 credit for compliance with the Code of Practice for Energy Efficiency of Air Conditioning Installations.

1 credit compliance with the Code of Practice for Energy Efficiency of Lighting Installations.

and energy use in comparison with similar premises:

1 credit where annual energy use is ≤ 40% cumulative percentage.

2 credits where annual energy use is ≤ 30% cumulative percentage.

3 credits where annual energy use is ≤ 20% cumulative percentage.

4 credits where annual energy use is ≤ 10% cumulative percentage.

or, energy use reductions as demonstrated by billing/metering data:

1 credit where the reduction in annual energy use has been 8% or more.

2 credits where the reduction in annual energy use has been 12%.

3 credits where the reduction in annual energy use has been 16%.

plus a reduction in electricity maximum demand as demonstrated by billing/metering data:

1 credit for a reduction in electricity maximum demand of 8% or more.

2 credits for a reduction of electricity maximum demand of 15% or more.

ASSESSMENT

a) Estimated annual energy use

The number of credits awarded will be determined with reference to the percentage reduction in the annual energy use and maximum electricity demand, respectively, of the assessed building relative to the respective benchmark (zero-credit) criteria evaluated from a Baseline Building model.

Assessment of the energy performance of an air-conditioned educational establishment follows generally the method for buildings accommodating predominantly air-conditioned premises if the major teaching and learning areas, particularly the classrooms, are air-conditioned. Otherwise, the method for assessing buildings accommodating predominantly non-air-conditioned premises shall apply.

For an establishment comprising predominantly air-conditioned premises, standard/default occupation densities and schedules, lighting and equipment power densities and operation patterns shall be used for the prediction of the annual energy use for air-conditioning in both the assessed building and the Baseline Building model (the zero credit level). The occupancy and lighting and equipment power densities shall be the standard provisions defined by the Government's Education Department. For buildings of non-standard designs, the design values for the lighting and equipment power densities shall be used for determining the annual energy use for air-conditioning in the assessed building. The default patterns of occupation and lighting and equipment load are as summarised in Table 8.5.7.

In the prediction of the annual electricity use for air-conditioning, the rooms to be included in the simulation are those rooms that will be consistently air-conditioned, such as classrooms, staff offices and common rooms, libraries, computer rooms, special teaching rooms, etc. The months in the year that air-conditioning is provided shall be from September to December and from April to June. Classrooms are assumed to be occupied only for five days per week, following the Summer Schedule in the first two weeks in September and in May and June; and following the Normal Schedule for other days (see Table 8.5.7).

The energy use of air-conditioning equipment that will only be intermittently operated, e.g. equipment serving assembly halls, shall be excluded. However, as a basic requirement for credits, such equipment shall comply, where applicable, with the minimum performance requirements as stipulated in the Code of Practice for Energy Efficiency of Air Conditioning Installations or, where appropriate those shown in Table 8.6.

b) Reduction in electricity maximum demand

Up to 2 credits for demonstrating a reduction in electricity maximum demand based on billing/metering data.

The starting point for the audit shall be any period from which the building became fully occupied. Changes of occupancy, use, etc. over the audit period shall be stated, and an estimation of reduction in electricity maximum demand resulting from under utilisation of the building or change of use shall be included.

The onus shall be on the Client to demonstrate what management initiatives (rather than changes in occupancy or use) have served to reduce electricity maximum demand, that there has been consistent improvement, and the gains are likely to be maintained.

USE OF ENERGY CONSUMPTION INDICATORS AND

The assessment covers all areas, premises and energy uses under the control of the building management, i.e. the building management is responsible for energy and fuel bills.

BENCHMARKS

As an alternative to the prescriptive codes for air-conditioning [1] and lighting [2] compliance with the Performance-based Building Energy Code [3] also satisfies the first two credits. Certification under either scheme shall be submitted to demonstrate compliance.

The first alternative assessment is limited to premises for which energy consumption indicators and benchmarks are available in EMSD's Energy Consumption Indicators and Benchmarks [4]. Up to 4 additional credits are available using this alternative assessment criterion.

The Client shall submit details of the premises/areas/facilities in the building, their areas (m^2) and uses, billing data for up to 3 years previous, and details as per submissions to the on-line documentation provided by EMSD.

Where a building includes variety of premises/uses as identified in the Indicators and Benchmarking the credits awarded shall be weighting by percentage of floor area of the areas/premises covered in the submission. For example, assuming A, B and C are various 'Principle Group/Major Group' areas as identified in the database, and have percentages of 30%, 30% and 40%, respectively of the total building area. A is within the 30% cumulative percentage, B is within 10%, and C is within 40%. The weighted credit score is then (0.3x2) + (0.3x4) + (0.4x1) = 2.2 > 2 credits.

USE OF BILLING/ METERING DATA

Alternatively, in addition to compliance with the air-conditioning and/or lighting codes up to 3 credits are available for demonstrating a reduction in annual energy use, and up to 2 credits for demonstrating a reduction in electricity maximum demand, based on billing/metering data.

The starting point for the audit shall be any period after which the building became fully occupied, or for at least the past 3 years. Changes of occupancy, use, etc. over the audit period shall be stated, and an estimation of energy saving resulting from under utilisation of the building or change of use shall be included.

Whichever of the alternative assessments are submitted the onus shall be on the Client to demonstrate what management initiatives (rather than changes in occupancy or use) have served to reduce annual energy use and/or maximum demand, that there has been consistent improvement, and the gains are likely to be maintained.

BACKGROUND

The number of credits to be awarded under the building energy performance assessment will be determined with reference to the percentage reduction in the annual energy use of the assessed building relative to the respective zero-credit criteria evaluated from the Baseline Building model.

The criteria and method of assessment for existing school and similar establishments shall be the same as for new educational establishments. This is appropriate when an existing school is submitted for assessment having not been assessed when new, or those for which significant improvement work has been undertaken, such as a major retrofit, conversion from predominantly non-air-conditioned to air-conditioned, etc. The reasons for basing the assessment of existing schools on the method for assessing new schools include:

1 Electrical & Mechanical Services Department. Code of Practice for Energy Efficiency of Air Conditioning Installations. http://www.emsd.gov.hk/emsd/e_download/pee/accop.pdf
2 Electrical & Mechanical Services Department. Code of Practice for Energy Efficiency of Lighting Installations. http://www.emsd.gov.hk/emsd/e_download/pee/lightingcop.pdf
3 Electrical & Mechanical Services Department. Performance-based Energy Code. http://www.emsd.gov.hk/emsd/e_download/pee/forms%20-%20pb-bec.doc
4 Electrical & Mechanical Services Department. Energy Consumption Indicators and Benchmarks. http://www.emsd.gov.hk/emsd/eng/pee/ecib.shtml

- schools may utilise natural ventilation as far as practicable, but the durations during which adequate indoor environmental conditions could be maintained with natural ventilation varies from facility to facility and from year to year, and is beyond the control of the management;
- other than the building envelope design, which is often difficult to change, the energy performance of educational establishments is dependent on the efficiency of various equipment and appliances, such as air-conditioners, lighting installations, lifts, and various other equipment (e.g. computers and laboratory equipment); and
- there is insufficient information for determining energy use benchmarks for all the types of equipment and installations that are found in various educational establishments.

HK-BEAM seeks to encourage energy saving and reduction in maximum electricity demand. The alternative credit and assessment criterion takes into account that existing buildings may or may not have been assessed under previous versions of HK-BEAM, but also the accuracy and reliability of data used.

4 ENERGY USE

4.1 ANNUAL ENERGY USE

4.1.4 ANNUAL ENERGY USE IN RESIDENTIAL BUILDINGS

EXCLUSIONS

Other types of buildings.

OBJECTIVES

Reduce the consumption of non-renewable energy resources and the consequent harmful emissions to the atmosphere. Encourage energy efficiency and other means to reduce maximum electricity demand.

CREDITS ATTAINABLE

8

PRE-REQUISITES

None.

CREDIT REQUIREMENT

1 credits for a reduction in the annual energy consumption by 3%.

2 credits for a reduction in the annual energy consumption by 6%.

3 credits for a reduction in the annual energy consumption by 9%.

4 credits for a reduction in the annual energy consumption by 12%.

5 credits for a reduction in the annual energy consumption by 15%.

6 credits for a reduction in the annual energy consumption by 18%.

7 credits for a reduction in the annual energy consumption by 20%.

8 credits for a reduction in the annual energy consumption by 22%.

ASSESSMENT

The number of credits to be awarded under the building energy performance assessment will be determined with reference to the percentage reduction in annual energy use of the assessed building relative to the respective zero-credit criteria evaluated from the Baseline Building model.

For residential buildings, the assessment method will follow generally the method used for assessing buildings accommodating predominantly air-conditioned premises, as described in Section 8.1. There are specific conditions that apply to residential buildings, such as the method for quantifying the building envelope performance of the Baseline Building model and the use of standardised internal load intensities. Where the estate development includes a commercial portion, the commercial and the residential portions will be separately assessed, with the commercial portion assessed according to the approach used for commercial buildings.

In the prediction of the annual energy use for air-conditioning in a residential tower, the months in the year that air-conditioners will be run to serve living rooms and bedrooms (the air-conditioned premises in a residential building) is taken to be April to October inclusive. The assessment assumes that no air-conditioning will be needed outside this period. The annual energy use for lighting and equipment in these rooms, however, shall be their total energy use throughout the year. The patterns of occupancy and the patterns of operation of the air-conditioners and the lighting and equipment shall be as given in Tables 8.5.5 and 8.5.6 in Section 8.5.

In predicting the annual air-conditioning energy use in various flats in a high-rise residential building, the inter-shadowing effects among different parts of the same building and among different building blocks in the same development shall be taken into account. For simplicity, simulation calculations will need to be carried out, for a N-storey building, only for the Nth floor (the top floor), the (N-1)th floor, the (N-3)th floor (representing the (N-4)th to the (N-2)th floor), and the (N-10)th floor (representing the 1st floor to the (N-5)th floor). Such inter-shadowing effects will be ignored in predicting the annual air-conditioning energy use in the Baseline Building model.

BACKGROUND

It is not expected that an existing residential building containing individually owned units will be submitted for assessment. However, rented, vacant or refurbished buildings can be assessed in the same away as for new buildings. The reasons for basing the assessment of existing residential buildings on the method for assessing new residential buildings include:

- the large variations in energy usage amongst flat owners/tenants;
- the difficulty in obtaining energy bills from all flat owners/tenants for assessing actual energy use;
- management companies can do little to affect the way in which owners/tenants use energy; and
- assessment of the energy performance of landlord services for new buildings applies equally well to existing residential buildings.

4 ENERGY USE

4.1 ANNUAL ENERGY USE

4.1.5 ANNUAL ENERGY USE IN MECHANICALLY VENTILATED BUILDINGS

EXCLUSIONS

Other types of buildings.

OBJECTIVES

Promote the use of energy efficient mechanical ventilation systems and equipment.

CREDITS ATTAINABLE

Depends on the exact design of the building.

PRE-REQUISITES

To be advised.

CREDIT REQUIREMENT

Number of credits will depend on the exact nature of the building and the types of mechanical ventilation systems and equipment installed.

ASSESSMENT

For buildings where the majority of spaces therein are not air-conditioned, the assessment will be limited to the energy performance of the mechanical ventilation and lighting installations, according to the assessment method detailed in Sections 4.2 and 4.3. The assessment requires fulfilment of some basic requirements as pre-requisite for credits, and includes performance assessments on the ventilation and lighting systems. Furthermore, trade-offs of performance between the ventilation and the lighting systems are allowed. The assessment, however, does not include maximum electricity demand.

Apart from the basic requirements, assessment of the energy performance will be based on component-performance and feature specific criteria, but trade-offs of performance among components within the same system and between the ventilation and the lighting systems are allowed. Where any one of the criteria for ventilation system or lighting system performance cannot be met but the criterion of either system is exceeded by a large margin, trade-off is allowed. The basic requirements include:

- the air leakage limit on ductwork as stipulated in Section 5.1 in the Code of Practice for Energy Efficiency of Air Conditioning Installations [1]; and
- where there are limited air-conditioned premises in the assessed building, the air-conditioning equipment shall comply with the minimum performance requirements as stipulated in the Code of Practice for Energy Efficiency of Air Conditioning Installations and, where applicable, those in Table 8.6.

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

4 ENERGY USE

4.1 ANNUAL ENERGY USE

4.1.6 ANNUAL ENERGY USE IN OTHER BUILDING TYPES

OBJECTIVES

Promote the use of energy efficient systems and equipment.

CREDITS ATTAINABLE

Depends on the exact design of the building.

PRE-REQUISITES

To be advised.

CREDIT REQUIREMENT

Number of credits will depend on the exact nature of the building and the types of systems and equipment installed.

ASSESSMENT

Buildings falling outside the types already listed will be assessed on individual case basis. For buildings that are pre-dominantly air-conditioned, the method shall follow generally that described in Section 8.1, while criteria given in Section 4.2 shall apply to buildings that are pre-dominantly mechanically ventilated. If a building comprises a mix of premises that fall into different categories of buildings, the method appropriate to each type will apply, and a weighted total score will be determined for the building according to the method described in Section 1.

The principle of the assessment remains that is, a comparison of the energy performance of the assessed building against what would be achieved if any relevant regulatory requirements are barely met, or the design would be just on a par with common practice locally, taking into consideration the constraints on the building management in making improvements.

Where a comparison with the performance of a baseline building model is involved but default values for defining the baseline are unavailable, suitable criteria will be established for the assessed building based on the principle stated above.

The maximum number of credits achievable and the assessment scale, however, would have to be established taking into consideration the typical intensity of energy use and maximum electricity demand in the type of building being assessment, the least possible energy use and maximum electricity demand, and the financial implications of implementing the energy efficient measures for reducing energy use and maximum demand in such buildings.

For special buildings where the establishment of the benchmark and the assessment scale proves to be difficult, the assessment may have to be based solely on feature specific criteria. For any buildings that fall into the category of 'other buildings', the scope and method of assessment will be developed and agreed upon between the Client and the HK-BEAM Society prior to commencement of the assessment.

4 ENERGY USE

4.2 ENERGY EFFICIENT SYSTEMS

4.2.2 VENTILATION SYSTEMS IN MECHANICALLY VENTILATED BUILDINGS

EXCLUSIONS

None for this category of building.

OBJECTIVES

Encourage energy efficient design and control of ventilation systems in large mechanically ventilated building/premises.

CREDITS ATTAINABLE

3

PRE-REQUISITES

Compliance with the Building (Ventilating Systems) Regulations, Chapter 123J Regulation 4.

CREDIT REQUIREMENT

a) Energy efficient ventilation systems and equipment

1 credit for ventilation systems that will consume less electricity than those meeting the zero credit requirements (baseline) by 10% or more.

2 credits where the consumption is reduced by 20% or more.

b) Controls for energy conservation

1 credit for provisions that can regulate the operation of the ventilation system(s) to reduce energy use whenever conditions permit.

ASSESSMENT

a) Energy efficient ventilation systems and equipment

The baseline (zero credit) performance criteria for mechanical ventilation systems shall be determined based on the following:

- a mechanical ventilation system that consumes a fan power of 2 W per l/s of the total ventilation flow rate maintained in the ventilated spaces in the building; and
- where a space is served by both a supply and an extraction system, the system fan power shall be the sum of the fan power of the supply and the extraction system whilst the ventilation flow rate shall either be the total supply or the total extraction flow rate, whichever is the larger.

b) Controls for energy conservation

Examples of control systems referred to in the credit requirements include variable fan speed control, duty cycling of multiple ventilation fans according to the CO concentration in car parks, etc.

The Client shall submit the following information to demonstrate that the installations meet the basic requirements and the requirements for credits:

- the criteria adopted in the design of the ventilation systems;
- the calculated ventilation rates;
- the design performance and operating patterns of the ventilation equipment;
- the energy use predictions for the zero-credit case and the as designed case for the ventilation system installation;
- reports of air leakage tests on selected ducting systems (to be confirmed subsequently if the assessment is conducted prior to on-site testing and commissioning of the ventilation systems); and
- the specified performance of any air-conditioning equipment for the building.

The air leakage limit on ductwork shall conform to the criteria given in the

Code of Practice for Energy Efficiency of Air Conditioning Installations [1], and the test method shall be based on DW143 [2], SMACNA [3] or equal equivalent method.

Where there is a need to take into account trade-off of performance between the mechanical ventilation and the lighting installations, the submitted calculations shall show that the extra energy used due to non-fulfilment of one criterion has been more than compensated by the extra energy saving due to a better performance over and above the other criterion.

1 Electrical and Mechanical Services Department. Code of Practice for Energy Efficiency of Air Conditioning Installations. http://www.emsd.gov.hk/emsd/e_download/pee/accop.pdf

2 Heating and Ventilation Contractors Association, UK. DW143 A Practical Guide to Ductwork Leakage Testing. 2000.

3 Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guideline for Occupied Buildings under Construction. 1995. http://www.smacna.org/index.cfm

4 ENERGY USE

4.2 ENERGY EFFICIENT SYSTEMS

4.2.3 LIGHTING SYSTEMS IN MECHANICALLY VENTILATED BUILDINGS

EXCLUSIONS

None for this category of building.

OBJECTIVES

Encourage the adoption of lighting equipment and controls that will provide for energy conservation.

CREDITS ATTAINABLE

3

PRE-REQUISITES

None.

CREDIT REQUIREMENT

a) Energy efficient luminaires

1 credit for using lamps and, where applicable, ballasts that will consume less electricity than those meeting the zero-credit requirements by 15% or more.

2 credits where the consumption is reduced by 25% or more.

b) Controls for energy conservation

1 credit for installing control systems and devices that will switch off or dim the output of lighting installations when and where illumination is not required.

ASSESSMENT

The zero credit performance criteria for the interior lighting installations (not including that in public areas in and adjacent to the assessed building) shall be determined based on the following:

- The use of 40W fluorescent tubes, each with a 10W control gear and will produce 2,400 lm; and
- The use of the minimum number of lighting fittings with lamps of performance as given above that will allow the required illumination levels in various premises in the building to be achieved

The illumination levels required in various types of premises in the assessed building shall follow guidance given in relevant lighting design guides, such as the CIBSE Code for interior lighting [1]. Determination of the minimum number of lighting fittings required shall be based on the Lumen formula, based on a utilisation factor (UF) of 0.45 and a light loss factor (LLF) of 0.8.

The Client shall submit the following information to demonstrate that the installations will meet the basic requirements and the individual requirements above for the related credits:

- the criteria adopted in the design of the lighting systems;
- the quantity of lighting fittings designed for various premises, the wattage of each fitting and the operation patterns of the lighting systems; and
- the energy use predictions for the zero-credit case and the as designed case for the lighting installations.

Where there is a need to take into account trade-off of performance between the mechanical ventilation and the lighting installations, the submitted calculations shall show that the extra energy used due to non-fulfilment of one criterion has been more than compensated by the extra energy saving due to a better performance over and above the other criterion.

1 The Chartered Institution of Building Services Engineers. Code for interior lighting.

4 ENERGY USE

4.2 ENERGY EFFICIENT SYSTEMS

4.2.7 RENEWABLE ENERGY SYSTEMS

EXCLUSIONS

None

OBJECTIVES

Encourage the wider application of renewable energy sources in buildings.

CREDITS ATTAINABLE

3 BONUS

PRE-REQUISITES

None

CREDIT REQUIREMENT

Credits will be given on a 3-point sliding scale to building developments for which the predicted energy supply from renewable sources meets the following criteria:

a) Densely populated urban centres:

1 credit where 2% or more of building energy is obtained from renewable energy sources.

2 credits where 4% or more is obtained from renewable energy sources.

3 credits where 6% or more is obtained from renewable energy sources.

b) Less densely populated areas:

Less densely populated areas means areas where buildings are separated by the height of the tallest adjacent building on at least two sides.

1 credit where 4% or more of building energy is obtained from renewable energy sources.

2 credits where 8% or more is obtained from renewable energy sources.

3 credits where 12% or more is obtained from renewable energy sources.

ASSESSMENT

The Client shall submit a report providing details of the installations, and calculations showing the estimated energy use provided from renewable energy sources.

In the case of systems that generate electricity from renewable sources (e.g. photovoltaic panels), the estimated amount of electricity that will be generated by the system for use by equipment in the building, either instantaneously or from an associated storage system

In the case of using systems that produce services direct from renewable sources, which will otherwise require the use of fuel or electricity to produce those services (e.g. hot water supply from solar panels or chilled water supply from absorption chillers powered by solar heat), the equivalent amount of electricity use that will be avoided

The calculation shall take due account of the diurnal and seasonal variations in the external environmental conditions (e.g. solar intensity and wind speed and direction) and in the demand for the electricity and/or services generated by the systems. Any energy use and losses by the systems shall be discounted from their output.

BACKGROUND

If energy consumption continues to increase at existing levels, projected carbon dioxide emissions generated for the year 2010 are expected to grow by 39% from the 2000 level. The effective use of renewable energy resources will help to reduce Hong Kong's reliance on fossil fuels and also to reduce greenhouse gas emissions arising from the use of fossil fuels. EMSD's information pamphlet [1] explains the meaning of renewable energy, the benefits of using renewable energy, and the current status of application of renewable energy in Hong Kong.

Although large scale application of renewable energy in buildings does not yet exist in Hong Kong, its use should be promoted in the interest of sustainable development. To ensure credits will only be awarded to meaningful installations, the criteria of assessment have been set with reference to the percentage of the energy use in the assessed building that will be replaced by renewable sources. Furthermore, no distinction will be made of the means chosen for substituting electricity or fuel by renewable energy. Hence, different or a combination of systems and equipment may be incorporated into a building, such as solar hot water systems, building integrated photovoltaic panels, wind turbines, etc.

Recognising the fact that the application of renewable energy in densely populated urban centres is more difficult than in less densely populated settings, the performance criteria is relaxed for building developments in urban centres.

The credits that will be awarded under this assessment will be regarded as bonus credits, i.e. any credits obtained will add to the total credits achieved in other aspects of the energy performance assessment without affecting the total number of achievable credits. This will allow buildings incorporated with means for capturing renewable energy sources to obtain a better assessment outcome.

1 Electrical and Mechanical Services department. http://www.emsd.gov.hk/emsd/e_download/sgi/re_pamphlet.pdf

4 ENERGY USE

4.3 ENERGY EFFICIENT EQUIPMENT

4.3.1 AIR-CONDITIONING UNITS

EXCLUSIONS

Buildings not using window and/or split-type air-conditioners.

OBJECTIVES

Ensure the installation of air-conditioning units provides for near optimum performance.

CREDITS ATTAINABLE

2 + 1 BONUS

PRE-REQUISITES

Proper disposal system for the drainage of the condensation shall be provided in accordance with Buildings Department requirements [1].

CREDIT REQUIREMENT

a) Positioning of units

1 credit for complying with the recommended installation positions for air-conditioning units with regard to internal spaces.

1 credit for complying with the minimum width of any external recess with regard to heat rejection.

b) Additional installation requirements

1 BONUS credit for complying with the items listed in the assessment check-list.

ASSESSMENT

a) Positioning of units

i) Window type air-conditioning units

The Client shall provide relevant drawings and specifications demonstrating that the air-conditioning units installed comply with the installation requirements given in Tables 8.10 and 8.11 in Section 8.6.

ii) Split-type air-conditioning units

The Client shall provide relevant drawings and specifications demonstrating that the air-conditioning units installed comply with the relevant dimensions given in Table 8.10 in respect of internal unit, and with the relevant dimensions given in Table 8.11 in respect of the external unit.

Compliance with the requirements shall be demonstrated for each type of domestic unit in a block, or each type of space or room in other types of premises, unless the Client can demonstrate either that circumstances mitigate against compliance in not more than 10% of installations, or that non-compliance will not affect the performance of air-conditioning units in respect of room cooling, or heat rejection.

b) Additional installation requirements

The Client shall confirm that the installation conforms with any four of the following items that are relevant to the type of air-conditioning units used:

- to reduce penetration of noise units shall be located on walls which do not face major noise sources (road traffic, major pedestrian walkways, playgrounds, etc);
- to reduce intake of polluted air units shall be located in walls such that air is not drawn in from pollution sources such as roads, commercial activities, etc;
- for improved acoustics properties and better circulation, the internal discharge shall be close to the centre of the wall in which it is

1 Buildings Department. Practice Note for Authorised Persons and Registered Structural Engineers. PNAP 238. Disposal of Condensation from Air-Conditioning Units. http://www.info.gov.hk/bd/english/documents/pnap/Pnap238.pdf

located;

- for the purpose of reducing noise from rain, and to reduce the potential for water dripping on to lower units, slabs shall be provided to as support and as cover;
- to encourage proper maintenance, the installation of units shall be such to allow for safe and convenient removal;
- where air-conditioning units are provided by the developer, the units selected shall be labelled as Grade 1 or 2 under the Government's energy efficiency labelling scheme for room coolers [2].

BACKGROUND

Due to the hot and humid weather, the majority of residential units in Hong Kong are equipped with window-type air-conditioners. However, the provisions made in the building envelope design for their installation are often inadequate, particularly in the clearances for intake and disposal of outdoor air for condenser cooling. Consequently, the air-conditioners would consume an unnecessarily high amount of electricity and at the same time output less cooling [3].

Proper location of air-conditioning units will improve internal operating efficiency and comfort, and the efficiency of external heat rejection. Good design of openings can improve the quality of air intake, reduce intrusion of external noise, reduce nuisance to neighbours and provide for better operation and maintenance.

For air-conditioning for residential buildings, wall boxes or platforms in reinforced concrete or other suitable material may be constructed as a permanent feature, even over streets, and as such may be excluded from site coverage considerations [4].

2 Electrical & Mechanical Services Department, the Government of the Hong Kong SAR. The Hong Kong Voluntary Energy Efficiency Labelling Scheme for Room Coolers. http://www.emsd.gov.hk/emsd/e_download/pee/eels_room_cooler_(jan_2003).pdf

3 Bojic M, Lee M, Yik F, Burnett J. Influence of clearances on the energy performance of window-type air-conditioners at the same level outside residential buildings. Building and Environment 37 (2002) 713 – 726

4 Buildings Department Practice Note for Authorized Persons and Registered Structural Engineers. PNAP 116. Amenity Features. http://www.info.gov.hk/bd/english/documents/pnap/Pnap116.pdf

4 ENERGY USE **4.3 ENERGY EFFICIENT EQUIPMENT**

4.3.3 ENERGY EFFICIENT LIGHTING IN PUBLIC AREAS

EXCLUSIONS

None.

OBJECTIVES

Ensure energy efficient lighting equipment and robust energy conserving controls are used to meet the needs for user safety, security and accessibility in all exterior, public and service areas of buildings.

CREDITS ATTAINABLE

1

PRE-REQUISITES

None.

CREDIT REQUIREMENT

1 credit for installation of:

energy efficient lighting equipment; and

control for the lamps in areas where daylight is available.

ASSESSMENT

The Client shall submit a report prepared by suitably qualified person demonstrating that the criteria has been met for lighting systems used.

a) Exterior play areas, footpaths, services areas, walkways, etc:

- all lamps have luminous efficacy greater than the minimum values specified in the Code of Practice for Energy Efficiency of Lighting Installations;
- fluorescent lamp control-gear loss less than the maximum allowable lamp control gear loss specified in the Code of Practice for Energy Efficiency of Lighting Installations; and
- the average circuit efficacy for all areas not less than 65 lm/W.

The lamp luminous efficacy, lamp control-gear loss and installed lighting power density for outdoor areas and spaces should be assessed using the method and the standard forms published in the Code of Practice for Energy Efficiency of Lighting Installations [1]. The assessment of the average circuit efficacy shall be based on the method given in the Appendix of the Code, or equivalent alternative.

b) Interior public areas such as lift lobbies, staircases, etc., and service areas such as plant rooms:

- lighting power density is less than 85% of the maximum allowable lighting power density specified for "Spaces for Common Activities" (Space Code A) in Table LG4 of the Code of Practice for Energy Efficiency of Lighting Installations; and
- the average circuit efficacy for all areas not less than 65 lm/W.

The lamp luminous efficacy, lamp control-gear loss and installed lighting power density for indoor spaces should be assessed using the method and the standard forms published in the Code of Practice for Energy Efficiency of Lighting Installations. The assessment of the average circuit efficacy shall be based on the method given in the Appendix of the Code.

c) Controls

Provisions for daylighting controls in all applicable areas demonstrating that lighting will be maintained at a level required for the intended use of the space, and can be dimmed or switched-off when daylight is adequate.

1 Electrical and Mechanical Services Department, The Government of the Hong Kong Special Administrative Region. Code of Practice for Energy Efficiency of Lighting Installations. http://www.emsd.gov.hk/emsd/e_download/pee/lightingcop.pdf.

BACKGROUND

The assessment of energy use for lighting in normally occupied and air-conditioned spaces is taken into account in the energy estimation. The use of energy efficient lighting in non air-conditioned premises is encouraged through the award of additional credit. The lighting levels provided, luminaire design and controls determine energy efficiency.

4 ENERGY USE	**4.3 ENERGY EFFICIENT EQUIPMENT**
	4.3.6 ENERGY EFFICIENT APPLIANCES
EXCLUSIONS	Buildings where appliances are not provided by the developer.
OBJECTIVES	Encourage the wider use of energy efficient appliances.
CREDITS ATTAINABLE	1
PRE-REQUISITES	None.
CREDIT REQUIREMENT	1 credit for specifying the use of certified energy efficient appliances.
ASSESSMENT	The Client shall provide details of all the appliances installed in the building and evidence as to the efficiency ratings of each type and size of the appliances. Where appliances listed under the Energy Efficiency Labelling Scheme [1] are efficiency Grade 1 or 2, or the appliances conform to similar grades under a recognised energy efficiency labelling scheme, such as USEPA Energy Star Products [2], the credit shall be awarded.
BACKGROUND	To make it easier for the public to choose energy efficient products, EMSD operates a voluntary Energy Efficiency Labelling Scheme for appliances and equipment used both in the home and office. The scheme aims to save energy by informing potential customers of the product's level of energy consumption and efficiency rating, so that buyers can take these factors into consideration when making their purchasing decision. The scheme now covers thirteen types of electrical appliances, in which nine types are household appliances including refrigerators, room coolers, washing machines, electric clothes dryers, compact fluorescent lamps, electric storage water heaters, electric rice-cookers, dehumidifiers and televisions as well as four types are office equipment including photocopiers, multifunction devices, laser printers and LCD monitors. Products in more than 40 categories are eligible for the Energy Star. They use less energy, save money, and help protect the environment.

1 Electrical and Mechanical Services Department. Energy Efficiency Labelling Scheme. http://www.emsd.gov.hk/emsd/eng/pee/eels_pub.shtml

2 US Environmental Protection Agency. Energy Star. http://208.254.22.7/index.cfm?fuseaction=find_a_product.

4 ENERGY USE

4.4 ENERGY MANAGEMENT

4.4.1 TESTING AND COMMISSIONING

EXCLUSIONS

None.

OBJECTIVES

Ensure that commissioning of electrical and mechanical systems that impact on energy use is adequate, that systems perform as specified, and can be operated as intended.

CREDITS ATTAINABLE

3 for centrally air-conditioned buildings, otherwise 2.

PRE-REQUISITES

None.

CREDIT REQUIREMENT

a) HVAC systems and equipment

1 credit for ongoing programme of commissioning of water side equipment of central air-conditioning system.

1 credit for ongoing programme of commissioning of air side equipment of central air-conditioning system.

Alternatively:

1 credit for ongoing programme of commissioning of all HVAC equipment.

b) Non-HVAC systems and equipment

1 credit for ongoing programme of commissioning of all non-HVAC equipment.

ASSESSMENT

The Client shall submit copies of original commissioning records and/or testing and commissioning following changes to building use, systems and equipment (as these form part of the building's operation and maintenance manual), details of how testing and commissioning was undertaken, and shall be undertaken in future, and the personnel involved.

The onus is on the Client to demonstrate that ongoing plan is in place, appropriate budgets and personnel are available, and that repairs, replacements and testing has been systematic and continuous in the building since first occupancy, or for a period of not less than 3 years.

Credits are awarded when it can be demonstrated that the buildings engineering systems are regularly tested and where necessary re-commissioned to meet the building operational requirements.

BACKGROUND

Commissioning is a quality assurance process for buildings. It involves achieving, verifying, and documenting the performance of each system to meet the building's operational needs within the capabilities of the documented design and equipment capacities, according to the owner's functional criteria. Commissioning includes preparing project operational and maintenance documentation and training operation and maintenance personnel. The result should be fully functional systems that can be properly operated and maintained throughout the life of the building.

CIBSE [e.g. 1,2,3], BSRIA [e.g. 4] and ASHRAE publications provide guidance on commissioning requirements and procedures, such as

1 The Chartered Institution of Building Services Engineers. Air distribution systems. CIBSE. Commissioning Code A. http://www.cibse.org/index.cfm
2 The Chartered Institution of Building Services Engineers. Water distribution systems. CIBSE Commissioning Code W.
3 The Chartered Institution of Building Services Engineers. Automatic controls. CIBSE Commissioning Code C.
4 Building Services Research and Information Association. Commissioning air systems. Application procedures for buildings. http://www.bsria.co.uk/

management, design for commissioning, access, testing, measurements and tolerances, installed transducers, specification for portable measuring equipment, etc.

Ongoing commissioning and proper instructions on operations and maintenance procedures have been shown to improve the operating efficiency and environmental performance of a building over its life cycle. The systems to be commissioned are all installed building heating, ventilating, and air-conditioning (HVAC) systems, equipment and components that affect energy use

4 ENERGY USE

4.4 PROVISIONS FOR ENERGY MANAGEMENT

4.4.3 METERING AND MONITORING

EXCLUSIONS

Residential buildings.

OBJECTIVES

Enable building operators to measure, monitor and develop measures to improve the performance of the building's engineering systems, particularly concerning energy use.

CREDITS ATTAINABLE

2 for centrally air-conditioned buildings, otherwise 1.

PRE-REQUISITES

None.

CREDIT REQUIREMENT

a) Electrical loads

1 credit for ability to measure and monitor all major electrical loads in the building.

b) Central HVAC plant

1 additional credit where central chiller plant is provided with adequate instrumentation to determine operating performance.

ASSESSMENT

The Owner/Operator shall provide details of the measuring and monitoring equipment installed and records of consumption, in order to demonstrate that electricity use in the building can be adequately monitored for audit purposes.

a) Electrical loads

Metering provision shall identify the electricity use pattern for each major system fed from the Landlord's main switchboard(s), i.e., landlords lighting and small power, transportation, plumbing & drainage systems, major air handling equipment, such as centralized air handling units for floors/zones, large designated areas, etc.

Electricity metering (for input power, energy and maximum demand), together with associated measuring transducers/transformers for indicating power and energy, shall comply with an appropriate standard such as BS EN [1] and to at least accuracy class 1. Sensors for temperature, flow rate and pressure measurements shall meet the minimum accuracy requirements in ASHRAE Standard 114 [2] or similar equivalent.

b)Central HVAC plant

Monitoring of central chiller plant will be assessed on the basis of BSRIA Technical Note TN 7/94 [3] or similar specification published by an appropriate authority. The monitoring system shall allow the overall performance of the plant and individual chillers to be determined for all operating modes and range of operating conditions.

BACKGROUND

Surveys of a large number of buildings in Hong Kong [4] revealed 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 plant, such as central chiller plant.

1 British Standard BS EN 60521:1995. Class 0.5, 1 and 2 alternating-current watthour meters.

2 ASHRAE. Standard 114-1986: Energy Management Control Systems Instrumentation, American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc., USA. 1987.

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

4 Yik F W H, Chiu T W. Measuring instruments in chiller plants and uncertainties in performance evaluation, Transactions, The Hong Kong Institution of Engineers, 5(3) 95-99.

Opportunities for reducing energy consumption can be identified only if it is possible to monitor performance of the systems. 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.

4 ENERGY USE

4.4 PROVISIONS FOR ENERGY MANAGEMENT

4.4.4 ENERGY MANAGEMENT

EXCLUSIONS

None.

OBJECTIVES

Encourage actions that can improve energy efficiency and conservation.

CREDITS ATTAINABLE

4 plus 1 BONUS.

PRE-REQUISITES

None.

CREDIT REQUIREMENT

a) Energy auditing

1 credit for having carried out a comprehensive audit of energy use in the building

b) Monitoring and targets

1 credit for an effective energy monitoring and targeting system.

c) Financial resources

1 credit for an annual budget to improve the energy performance of the building.

d) Energy management manual

1 credit for maintaining a comprehensive energy management manual.

e) Energy charge

1 BONUS credit where separate charges are made for energy use.

ASSESSMENT

a) Energy auditing

The Client shall provide a report prepared by a suitably qualified person, confirming that an audit has been completed essentially in accordance with the practice outlined in CIBSE Applications Manual AM5 [1] or similar authoritative guide. The audit result should include breakdown of energy use by departments/units, individual major services systems and equipment. The audit should embrace, where possible, energy consumption by tenants. The evidence shall include energy consumption records, operation and maintenance records, etc.

Where the report shows evidence of auditing practices appropriate to the size and complexity of the development, the credit shall be awarded.

b) Monitoring and targets

The submitted audit report should verify where actions to improve energy efficiency or reduce energy consumption have been identified, those that have been completed, and those that are in progress. The report should include recommendations on measures to reduce consumption with costs, savings and payback periods, and comparison with any available benchmarks (targets) for efficient operation. The subsequent energy monitoring and analysis should provide detailed energy use data for facilitating the energy performance assessment as specified in others sections of this document.

Where the Client can demonstrate that appropriate monitoring, record keeping and target setting is in place the credit shall be awarded.

c) Financial resources

Documents shall be submitted to provide information about how financial and other resources are deployed for building energy management. The submission shall include data on expenditures on energy use and on the

1 The Chartered Institution of Building Services Engineers. Energy Audits and Surveys, Application Manual AM5.

costs to implement measures to enhance the energy performance of the building for up to three years previous.

Credit shall be awarded where energy efficient measures are financed at an appropriate level, either from operating budgets and/or from savings in energy costs.

d) Energy management manual

The onus is on the Client to demonstrate that an appropriate energy management manual (or sections of the operation and maintenance manual) covers the details given in Section 8.7.6 as a minimum.

e) Energy charge

The bonus credit shall be awarded where, in buildings with tenants, energy costs to tenants are charged separately and not included in base rents. In buildings under single ownership/occupancy the credit may be awarded if it can be demonstrated that individual departments within the organisation are charged for energy use from within their operating budgets. In all cases the accounting details shall be provided.

BACKGROUND

Proactive management will seek to improve the performance of systems and equipment, i.e., improved energy efficiency, and promote energy conservation, i.e., minimise wastage of energy. 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 saving in fuel bills. It is also vital that an appropriate senior person in the organisation be responsible for energy management. End-users of premises in a building should also be made aware that reducing energy use within their premises not only will reduce their own energy bills, it will also lead to reduced energy cost for providing air-conditioning for their premises. Tenants will be motivated to reduce their own energy use and to minimise use of air-conditioning if they can share the benefits of reduced energy cost on the landlord side.

Similar to the function of financial audit to a company, energy audit needs to be conducted at regular intervals to provide the building management with a clear picture about the types and quantities of energy being used in a building and for what purposes, whether energy has been used efficiently and effectively, and the room for improvements.

Effective energy management in a building services requires an easy-to-follow up-to-date manual. 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.

5 WATER USE

INTRODUCTION

Water is known to be in scarce supply in many parts of the world, even though it is also in surplus elsewhere. Globally, water conservation is already a major issue [1]. Hong Kong has long enjoyed a reliable and economic supply of most of its fresh water needs from the Mainland. However, with increased industrialisation of Guangdong Province there is likely to be greater competition for water supply, meaning that water conservation may become a significant issue for Hong Kong in the future.

Although the Water Supplies Department (WSD) has sought to reassure consumers, concerns about the quality of the water supplied from the Mainland have been raised. Hong Kong should look to means to improve the utilisation and conservation of water resources.

5.1 WATER QUALITY

BACKGROUND

In Hong Kong the WSD controls water quality, such as taste, odour, hardness, sediment, pH, the quantity of dissolve iron, etc., in order to provide water that meets the Guidelines for Drinking-water Quality recommended by the World Health Organization (WHO). Samples are taken at treatment works, service reservoirs, consumer taps and analysed at site and at WSD's laboratories. Nevertheless, the quality of potable water delivered at taps is often perceived to be unsatisfactory by consumers. The problems may be due to the corrosion of water pipes or the cleanliness of water tanks. As a consequence the use of bottled water is widespread, but is not considered to be an environmentally preferred solution on account of the production and transport requirements. To ensure the health of consumers' buildings need to ensure optimal potable water quality at the tap - potable water that is both safe and acceptable in terms of taste, colour and odour.

5.2 WATER CONSERVATION

WATER SUPPLY

Except for a small number of villages scattered in the remotest areas, over 99.9 per cent of Hong Kong's population receives piped fresh water supply of purity that, according to WSD, is among the best to be found anywhere else. Sea water is supplied to about 80 per cent of the population for toilet flushing, though mains fresh water is supplied to areas that are not close to the seafront, or where the population is scattered and sparse. Raw water from the Dongjiang River in Guangdong continues to be Hong Kong's main source of supply and makes up about 70-80 per cent of Hong Kong's needs.

In 2003 the average daily consumption of fresh water was 2.67 million cubic metres while the average daily use of sea water for flushing stood at 0.66 million cubic metres [2]. Total freshwater consumption was 974 million cubic metres, with domestic consumption accounting for over

1 OECD. Environmental Performance Reviews - Water. Performance and Challenges in OECD Countries. 2003. http://www.oecd.org/dataoecd/12/38/2498050.pdf
2 Water Supplies Department. Facts About Water. http://www.info.gov.hk/wsd/en/html/pdf/w_facts.pdf

50%, with around 25% consumed by the service trade. Despite the continued decline in industrial consumption there is an annual trend of rising consumption due to an increase in domestic consumption. Based on projected population growth for the period, the domestic and service uses, being the key components of our fresh water consumption, are expected to increase at an average annual rate of three per cent and one per cent respectively. Industrial use, for the same period, is expected to drop on average by five per cent per year because of further decline in water intensive industries. Wider use of fresh water in water-cooled air-conditioning systems (WACS) will contribute to consumption by the non-domestic sector.

CONSERVATION

Although the demand growth has slowed in recent years, additional water resources are still required to secure a full supply. The lack of reservoir sites and high development costs limit the development of further areas as water-gathering grounds. Other than expanding the use of sea water for flushing and adopting water conservation measures, Hong Kong has few options to reduce dependency on the Mainland, where water resources are becoming increasingly limited. There is opportunity to reduce potable water use through better design, management and user awareness. There are also opportunities to recycle used water and rain water in order to reduce the use of potable water. Additional benefit of potable water conservation is reduced energy use for transport and the cost of treatment of raw water.

BENCHMARKS

Currently there is little available data in Hong Kong to benchmark water consumption for many uses. Consequently, it is not possible to provide exact targets for reducing consumption. However, there is sufficient evidence to show that devices that improve the efficient use of water can significantly reduce consumption.

5.3 EFFLUENT

5.3.1 EFFLUENT DISCHARGE TO FOUL SEWERS

BACKGROUND

Whilst some 80% of users in Hong Kong are supplied with seawater for flushing purposes there are environmental impacts associated with the treatment and delivery of seawater, and the load imposed on municipal sewage treatment plants. Measures taken to reduce volumes of effluent flows have significant environmental benefits.

5 WATER USE

5.1 WATER QUALITY

5.1.1 WATER QUALITY

EXCLUSIONS

None.

OBJECTIVE

Ensure that the quality of potable water delivered to building users is satisfactory.

CREDITS ATTAINABLE

2

PRE-REQUISITES

All fresh water fixtures are supplied with an adequate supply of fresh water at an appropriate pressure.

CREDIT REQUIREMENT

a) Fresh water plumbing

1 credit for certification under the Fresh Water Plumbing Quality Maintenance Recognition Scheme.

b) Water quality surveys

1 credit for demonstrating that the quality of potable water meets the referenced drinking water quality standards at all points of use.

ASSESSMENT

a) Fresh water plumbing

The credit shall be awarded when the Client can provide copies of documents to confirm that the fresh water plumbing is currently certified under the Scheme [1], and confirmation from management at directorate level that the building management shall continue to ensure ongoing certification under the scheme.

Where the fresh water plumbing is not certified the onus is on the Client to demonstrate that the fresh water plumbing is maintained to at least an equivalent standard.

b) Water quality survey

The Client shall provide details of the analysis of samples taken from a selection of potable water outlets used to supply human consumption. Sampling should be systematic, such as described in ISO 5667 [2], but as a minimum samples shall be taken at all the furthest point(s) of delivery from the storage tank, and shall include sampling for each water supply tank used in the building. The frequency of sampling at any outlet shall be determined by the Client, as dictated by expectations from building users, or any management concerns about water quality following maintenance, outages, leaks, etc.

The credit shall be awarded if water quality at all sample points meets with the World Health Organization (WHO) Guidelines [3], and additional measures are taken which reassure building users of the quality of the water supplied to all parts of the building. Such measures include a suitable frequency of sampling, publicising the details and results of sampling to building users, and surveying opinions of users as to satisfaction with the fresh water supply.

BACKGROUND

The treated fresh water provided by the Water Supplies Department complies fully with the drinking water standard according to the guidelines of the World Health Organization. However, in order to ensure that consumers can enjoy good quality of water at the taps, building

1 Water Supplies Department. Circular Letter No. 4/2002. Fresh Water Plumbing Quality Maintenance Recognition Scheme. http://www.info.gov.hk/wsd/en/html/pdf/cir/cir0402.pdf
2 ISO 5667-5: 1991. Water quality — Part 6: Sampling — Section 6.5 Guidance on sampling of drinking water and water used for food and beverage processing.
3 World Health Organization. Guidelines for Drinking-water Quality. Vol. 1 - Recommendations 1993. http://www.who.int/water_sanitation_health/dwq/gdwq2v1/en/index.html

owners have to maintain their plumbing systems properly as well. To encourage the building owners to do this, the Water Supplies Department launched the Fresh Water Plumbing Quality Maintenance Recognition Scheme [1] in July 2002. Participation of this Scheme is voluntary. The target groups to join this Scheme are the owners, operators and management agents of buildings in general.

The successful applicants will be awarded a Certificate to recognize proper maintenance of the plumbing systems inside a building for keeping the good quality of government supplied water throughout the inside service up to the consumers' taps. The Certificate is valid for one year subject to the satisfactory maintenance of the plumbing system. The Certificate may be displayed in the building, and on stationeries and promotional materials, subject to the guidelines issued by the Water Supplies Department. The Scheme aims to:

- enable local residents and overseas visitors to have greater confidence of the water quality at the tap;
- strengthen the capability of building management agents to achieve value-added performance in meeting the needs of consumers with respect to quality of tap water;
- give recognition to those building management agents who can demonstrate consistent compliance of the prescribed criteria under the Scheme; and
- assist the owners, operators and building management agents to conduct self assessments on plumbing conditions and to identity areas for necessary maintenance.

The application will be assessed based on the following criteria:

- the plumbing system is inspected at least once every three months by licensed plumbers or qualified building services surveyors or engineers and is found to be in good physical condition;
- all defects identified in the inspections are promptly rectified by licensed plumbers or qualified persons;
- the water tanks are cleaned at least once every three months.
- water samples are taken in accordance with the recommended procedure and tested for items specified at least once a year and the test results comply with the acceptable limits of these water quality indicators.

SAMPLING

Part 6 of ISO 5667 establishes detailed principles to be applied to the design of sampling programmes, to sampling techniques and to the handling and preservation of samples of drinking water and water used for food and beverage processing (drinking water). It is important that the sampling purpose be defined as accurately as possible and that the measurements provide the required information in the most efficient and statistically representative manner.

5 WATER USE

5.2 WATER CONSERVATION

5.2.1 ANNUAL WATER USE

EXCLUSIONS

None.

OBJECTIVE

Reduce the consumption of fresh (potable) water through the application of water saving devices that has proven performance and reliability.

CREDITS ATTAINABLE

3

PRE-REQUISITES

None.

CREDIT REQUIREMENT

1 credit for demonstrating that the use of water efficient devices leads to an estimated aggregate annual saving of 10%.

2 credits for demonstrating an estimated annual saving of 20%.

3 credits for demonstrating an estimated annual saving of 30%.

Alternatively:

1 credit for undertaking a water audit and maintaining a water use inventory.

1 credit for the development of a water conservation plan endorsed by directorate level management.

ASSESSMENT

Given the paucity of available data for Hong Kong and variability of circumstances for different buildings and uses, rather than being prescriptive, HK-BEAM seeks to provide flexibility in the assessment by allowing Clients to submit justification for the award of credits.

a) Water efficient devices installed at onset

Where water efficient devices were installed in the building at the onset demonstration of compliance shall be based on calculation, whereby the assessed building is assessed against a benchmark building. The estimation of annual water saving shall be based on the following basic equations.

Fresh water use (in litres):

Flow devices = Frequency of use x duration (sec) x flow rate (litres/sec)

Flush/cycle devices = Frequency of use x capacity (litre)

The Client shall submit a report prepared by a suitably qualified person detailing the capacities (volume, flow-rate, etc) of water using equipment for both the assessed building and a similar 'benchmark' (zero credit) building, i.e., a building where water using devices and appliances are not deemed to be efficient in water use.

Justification for capacities of devices and equipment used in the benchmark building shall be provided by making reference to regulations, standards, guides and other publication published by various authorities (e.g. Water Supplies Department, Institute of Plumbing, etc). This would justify maximum capacities/flows allowed by regulations, or where devices not regarded as water efficient/saving are in general use.

Justification for the capacities used in the assessed building shall be in the form of specifications (manufacturers confirmed performance data) for the installed devices and equipment, taking into account any regulatory restrictions.

The estimated frequency of use for each device or equipment installed shall be justified by reference to appropriate published data or surveys conducted by the Client. The frequency of use shall be the same for the calculation for both the assessed building and the benchmark building.

All assumptions as to the number and gender of users, duration and frequency of use, etc. shall be stated and used for both the baseline case and the assessed building. Where fresh water is used for flushing purposes it shall be included in the calculations.

The report shall include the following details:

- type and number of each fresh water using device;
- frequency, duration and/or water consumption per use, for each type;
- estimated water used by each type of fixture;
- sum of water volumes used for each device, use for cleaning, irrigation, etc;
- defined number of days of use of the facilities (work days, school days, etc) to annualise water consumption;
- any deduction in annual use of fresh water by using harvested or recycled water.

The submitted report shall contain two tables, one for the assessed building, and one for the benchmark building, with the following format.

Flow	Device/ equipment	Daily Uses	Volume	Users	Water Use
Flush/cycle	Device/ equipment	Daily Uses	Flow rate	Users	Water Use

Estimated total daily consumption (litres) – Assessed building and Benchmark building

Annual days of use

Annual water use less any recycled water

Estimated annual savings (litres) and percentage

In the table each type of water using device shall be listed and all data used shall be referenced to the source.

Confirmation of the award of credits shall take into account the appropriateness of the data used and the estimated percentage of fresh water saved.

b) Retrofit of water efficient devices with consumption data

Where consumption records are submitted to demonstrate compliance the percentage annual saving shall take into account the occupancy patterns and use of the building in order to discount savings due to low occupancy or change of use of premises within the building.

The Client shall submit a report prepared by a suitably qualified person detailing the capacities (volume, flow-rate, etc) of water using equipment in the building, occupancy patterns and uses of the premises over a period of up to 3 years, together with an estimation of the water saving corrected to allow for any changes in occupancy and/or use.

c) Recent retrofit of water efficient devices

The Client has the option to demonstrate compliance either by calculation (method a) above) or by use of water consumption records (method b) above) or a combination of both.

d) Water audit, inventory and conservation plan

The Client shall submit documentation prepared by a suitably qualified person confirming that an audit has been completed, together with a copy of the water conservation plan which is endorsed at directorate level management.

The report shall include water consumption records, operation and maintenance records, etc. for all areas of water use, but may exclude water consumption by tenants. The report shall include a spreadsheet listing each water-using fixture and end use data, such as:

- frequency of floor cleaning and water volume per use;
- frequency of garden irrigation and water volume per use;
- frequency, duration and water volume per use of each fixture in kitchens and laundry;
- frequency of male and female daily uses of the water-using fixture, duration per use, and the water volume per use.

The conservation plan shall provide details of the water conservation measures, and the credentials of the staff who are undertaking implementation. The plan and regular review shall be integrated into management and operations structure and have clear delegation of responsibility for auditing and/or monitoring water consumption. The plan shall include:

- details of the channels of communication for staff at all levels, and building users;
- monitoring of consumption;
- details of actions taken to reduce water consumption, including those already completed, those in progress, and those for future implementation; and
- provide a quantification of the savings.

The assessment will seek to establish if mechanisms are in place effectively limit wastage of water, and to set targets for water saving with an appropriate budget for upgrading the installations.

BACKGROUND

There is an increasing availability of devices and plumbing fixtures which have demonstrated an ability to save water over the lifetime of the system if installed and maintained properly. Flow rates can be controlled to reduce excessive discharge at taps, faucets and showers without detriment to the quality of water delivery. Substantial evidence shows that the use of water-efficient plumbing fixtures conserves water [1]. A number of studies in the US have measured the impact of installing water-efficient plumbing fixtures through sophisticated sensors, before-and-after comparisons of water bills, or other means. Although the results varied, the studies generally concluded that low-flow fixtures are effective in saving water.

WATER USE DATA

Deng and Burnett have reported on a study of water use in 17 hotels in Hong Kong. A multiple variable analysis indicated that the laundry load, number of guests and number of food made would collectively affect the water use in a hotel [2]. Installation of water efficient shower heads and faucets in a local hotel have demonstrated savings of the order of 30% [3].

Cheng [4] introduces the Taiwanese Green Building program and proposes a water conservation index with quantitative methodology and

1 United States General Accounting Office. Report to Congressional Requesters. Water Infrastructure. Water-Efficient Plumbing Fixtures Reduce Water Consumption and Wastewater Flows. GA RCED-00-23. August 2000.
2 Deng S M, Burnett J. Water use in hotels in Hong Kong. Hospitality Management. Vol. 21 (2002), pp 57–66.
3 Department of Building Services Engineering. Good Practice Guide to Water Conservation for Hotels in Hong Kong. http://www.bse.polyu.edu.hk/Research_Centre/BEP/hotels14000/acrobat/water_guide.pdf
4 Cheng C L. Evaluating water conservation measures for Green Building in Taiwan. Building and Environment 38 (2003) 369 – 379.

case study. This evaluation index involves standardized scientific quantification and can be used in the pre-design stage to obtain the expected result. The measure of evaluation index is also based on the essential research in Taiwan and is a practical and applicable approach.

Cheng and Hong [5] have reported on the water utilization of primary schools and establishes a quantitative evaluation system to promote the conservation of water in Taiwan. Databases of water utilization in primary schools are arranged and analyzed by using statistical methods and calculation.

WATER USE CALCULATORS

A number of water use calculators are available for download from the Web. Typically they are spreadsheet based, combining in-built default values and user entered data [6].

The HK-BEAM Society web page will, over the course of time, contain data for use in the calculations, and will refer to this data when making an assessment of submissions. A water use calculator is also under development for use with HK-BEAM.

5 Cheng C L, Hong Y T. Evaluating water utilization in primary schools. Building and Environment 39 (2004) 837 – 845.

6 Green Building Council Australia. Green Star Rating Tool. http://www.gbcaus.org/greenstar/docs/greenstar_office_design_pre-assessment_tool_v1_0.xls

5 WATER USE

5.2 WATER CONSERVATION

5.2.2 MONITORING AND CONTROL

EXCLUSIONS

None.

OBJECTIVE

Reduce wastage of fresh water and allow for auditing of water use.

CREDITS ATTAINABLE

1.

PRE-REQUISITES

Compliance with Waterworks Regulation Chapter 102A Regulation 32.

CREDIT REQUIREMENT

1 credit for installing devices that automatically shut-off faucets, taps and urinals for the purposes of water conservation; and devices that enables the monitoring and audit of fresh water consumption.

ASSESSMENT

The Client shall submit a report detailing the measures used to reduce the wastage of water, and evidence to show that water use for building cleaning, operation and maintenance is being monitored.

The assessment will seek to establish if mechanisms are in place that effectively limits wastage of water by shutting off fixtures automatically when not in use. The provision of devices for monitoring consumption for each of the major water using sectors shall be identified.

Various approaches are available and HK-BEAM is not intended to be prescriptive as to which should be used.

BACKGROUND

The provision of automatic shut-off devices, particular in public use areas, can save significant amounts of water. Examples of automatic shut-off devices are spring-loaded taps, electronic proximity sensors, etc., but excluding timed shut-off devices.

Generally in Hong Kong buildings there is very limited provision for monitoring water use other than the meters required for utility billing purposes. The provision of measurement devices for major water uses can assist facility managers to audit water use and can encourage the introduction of water saving measures.

5 WATER USE **5.2 WATER CONSERVATION**

5.2.3 WATER USE FOR IRRIGATION

EXCLUSIONS Where soft landscaping and planting coverage is less than 50% of the area of the building footprint.

OBJECTIVE Reduce the reliance on potable water for irrigation.

CREDITS ATTAINABLE 1

CREDIT REQUIREMENT 1 credit for limited use of fresh water for the purposes of irrigation.

ASSESSMENT The Client shall provide a report prepared by a suitably qualified person describing the soft landscaping design, species of plants, etc, and confirm that, after a period of establishment of the plants and vegetation is complete, irrigation will not require the use of municipal potable (fresh) water supply.

Alternatively, the Client shall demonstrate highly efficient irrigation technology and/or the use of harvested rainwater and/or recycled grey water to reduce fresh (mains) water consumption for irrigation by 75% or more in comparison with conventional irrigation of water intensive planting.

The water use reduction may be demonstrated by use of metered data compared to any suitable benchmark, or may be demonstrated by calculations provided by a suitably qualified person.

BACKGROUND Where a building development contains significant landscaping, as defined by the coverage of soft landscaping, greenery and planters there is likely to be a significant consumption of potable water. Irrigation by lower quality (harvested or recycled) water can be equally effective. Native plants can survive without additional watering, and require less fertilizer and pesticides, thereby reducing impacts on local waters.

5 WATER USE

5.2 WATER CONSERVATION

5.2.4 WATER RECYCLING

EXCLUSIONS

None.

OBJECTIVE

Encourage harvesting of rainwater and recycling of grey water in order to reduce consumption of fresh water.

CREDITS ATTAINABLE

1 + 1 BONUS

PRE-REQUISITES

Compliance with the water quality standards appropriate to the use of the recycled water.

CREDIT REQUIREMENT

1 credit for harvesting rainwater and/or recycling greywater that leads to a reduction of 10% or more in the consumption of fresh water.

1 BONUS credit where harvesting and/or recycling leads to a reduction of 20% or more in the consumption of fresh water.

ASSESSMENT

Harvested and/or recycled water shall satisfy the water quality requirements for the intended reuse, e.g., cleaning, irrigation, use in heat rejection systems, toilet flushing, etc.

The Client shall provide a report detailing the system or systems installed for the purpose of harvesting rainwater and/or recycling grey water, the details (such as metering data) of the savings in the consumption of fresh water, and shall demonstrate that the rainwater and/or recycled greywater is of a quality appropriate to the end use. Where it can be demonstrated that the savings in fresh water use is 10% or more the credit shall be awarded.

Where it can be demonstrated that the savings in fresh water use is 20% or more the bonus credit shall be awarded.

BACKGROUND

Recycling of grey water not only helps to reduce the demand for potable water supply, but also provides a reliable source in case of supply interruptions. When properly done it is possible to reuse all wastewater for various purposes. A grey water recycling system is one which collects grey water (reclaimed condensate, etc) for treatment and distributes the treated water to the points of use, such as for irrigation, cleaning, or for toilet flushing where seawater supply is not available. Another potential use of the recycled water is for evaporative heat rejection system in air conditioning, which will provide an energy benefit and improves the cost-effectiveness of water recycling.

The problem for Hong Kong's high-rise dense built environments is that the potential for collecting rainwater is limited. Yang et al [1] provide the main parameters and their relationship to estimate the amount of rainwater that may be collected on different roof areas and different sizes of tanks, based on the amount of rainfall as recorded by the Hong Kong Observatory.

Well-populated buildings not supplied with seawater for flushing would be a good candidate from water recycling, otherwise reuse is likely to be limited to cleaning, irrigation, heat rejection, etc., which depends on the extent of cleaning, irrigation and the types of equipment used for cooling, respectively.

1 Yang H X, Chow W H, Burnett J. Water and Energy Conservation of Rainwater Collection Systems on Building Roofs. Advances in Building Technology, Vol. 2. Elsevier. 2002. pp 1281-1288.

Water quality should meet appropriate criteria, such as that outlined by ACQWS [2], the Building Research and Information Association [3], or similar authoritative guidance.

NOTE Given the difficulty and cost of achieving harvesting and recycling only one credit is this section counts towards the total of applicable credits.

Water recycling that leads to the reduced use of fresh water is also counted in the estimated percentage of reduction in the consumption of fresh water that leads to credits under Annual Water Use.

2 Water Supplies Department. ACQWS Paper No. 14 – Treated Effluent Reuse at Ngong Ping.
3 BSRIA, Greywater and Rainwater Systems: Recommended UK Requirements, The Building Services Research and Information Association, Final Report 13034/1.

5 WATER USE

5.3 EFFLUENT

5.3.1 EFFLUENT DISCHARGE TO FOUL SEWERS

EXCLUSIONS

None.

OBJECTIVE

Reduce the volumes of sewage discharged from buildings thereby reducing burdens on municipal sewage supply and treatment facilities.

CREDITS ATTAINABLE

1

PRE-REQUISITES

Compliance with the Water Pollution Control Ordinance.

CREDIT REQUIREMENT

1 credit for demonstrating a reduction in annual sewage volumes by 25% or more, or reduction in sewage concentration by a 35% or more.

ASSESSMENT

a) Devices/equipment installed at onset

The Client shall submit a report prepared by a suitably qualified person detailing the capacities (volume, flow-rate, etc) of water using equipment for both the assessed building and a similar 'benchmark' (zero credit) building, i.e., a building where flushing devices and appliances are not deemed to be efficient in water use.

Justification for capacities of devices and equipment used in the benchmark building shall be provided by making reference to regulations, standards, guides and other publication published by various authorities (e.g. Water Supplies Department, Institute of Plumbing, etc). This would justify maximum capacities/flows allowed by regulations, or where devices not regarded as water efficient/saving are in general use. Justification for the capacities used in the assessed building shall be in the form of specifications (manufacturers confirmed performance data) for the installed devices and equipment, taking into account regulatory restrictions.

The estimated frequency of use for each device or equipment installed shall be justified by reference to appropriate published data or surveys conducted by the Client. The frequency of use shall be the same for the calculation for both the assessed building and the benchmark building. All assumptions as to the number and gender of users, duration and frequency of use, etc. shall be stated and used for both the baseline case and the assessed building. The report shall follow a format that details:

- type and number of devices using flushing water;
- frequency, duration and water consumption per use for each;
- sum of water volumes used for each for male and female users;
- estimated daily flushing water use;
- defined number of days of use of the facilities (work days, school days, etc) to annualise effluent discharge;
- any deduction for annual use of recycled water.

The submitted report shall contain two tables, one for the assessed building, and one for the benchmark building, with the following format.

Flow	Device/ equipment	Daily Uses	Volume	Users	Flushing Water Use
Flush/cycle	Device/ equipment	Daily Uses	Flow rate	Users	Flushing Water Use

Estimated total daily consumption (litres) – Assessed building and Benchmark building

Annual days of use

Annual flushing water use less any recycled water

Estimated annual reduction in flushing water (litres) and percentage

In the table each type of device shall be listed and all data used shall be referenced to the source.

Likewise, where credit is claimed for reducing sewage concentration the details of any equipment used shall be provided together with evidence that the reduction in concentration shall meet the performance criteria.

Confirmation of the award of credit shall take into account the appropriateness of the data provided and the estimated percentage of effluent reduction.

b) Retrofit of devices/equipment with recorded data

Where consumption or sewage concentration data is submitted to demonstrate compliance the percentage annual saving or percentage reduction is sewage concentration shall take into account the occupancy patterns and use of the building in order to discount savings due to low occupancy or change of use of premises within the building.

The Client shall submit a report prepared by a suitably qualified person detailing the capacities (volume, flow-rate, etc) of equipment in the building, occupancy patterns and uses of the premises over a period of up to 3 years, together with an estimation of the reduction corrected to allow for any changes in occupancy and/or use.

c) Recent retrofit of devices/equipment

The Client has the option to demonstrate compliance either by calculation (method a) above) or by use of water consumption records (method b) above) or a combination of both.

BACKGROUND

With the application of modern technology in the design of water closet flushing system, the effectiveness of flushing can be maintained with a reduced discharge. Similarly, the concentration of sewage in discharges can be reduced at the building level to reduce requirements for treatment at sewage treatment plants.

6 INDOOR ENVIRONMENTAL QUALITY

6.1 SAFETY AND SECURITY

6.2 HYGIENE

6.3 INDOOR AIR QUALITY

6.4 VENTILATION

6.5 THERMAL COMFORT

6.6 LIGHTING QUALITY

6.7 ACOUSTICS AND NOISE

6.8 BUILDING AMENITIES

INTRODUCTION

This section of HK-BEAM considers some of the broader issues of sustainable buildings as well as the most significant indoor performance issues. The broader issues include safety, provisions for maintaining hygiene, and the amenities provided in the building, which have impact on the quality of working and living environments. Indoor environmental quality (IEQ) includes indoor air quality and ventilation provisions that safeguard health. Considerations of these issues, as well as thermal comfort, lighting, acoustics and noise impact on well-being, comfort and productivity.

Given that on average a person in Hong Kong spends around 85% of their time indoors [1], indoor environmental conditions have a significant impact on the quality of life. Buildings should provide safe, healthy, convenient and efficient indoor spaces. Poor indoor environments in commercial and institutional buildings can impact on productivity and may impose health risks to users. The design, management, operation and maintenance of buildings should seek to provide for good quality indoor environments, but with optimum use of energy and other resources.

ASSESSMENT OF INDOOR ENVIRONMENTS

In keeping with the HK-BEAM assessment approach the assessment of indoor environments is mainly performance based, with the majority of credits awarded for meeting the levels of performance specified for the building. In addition to performance, credits are also awarded for compliance with certain building features with known potential to enhance performance.

Assessment is not intended to embrace negative impacts resulting from the activities of building users, unless these can be avoided by good management. In commercial buildings access to tenant areas may preclude or limit measurements, so alternative performance criteria may be needed. Where areas of the building are unoccupied measurements can take place as for a new building. HK-BEAM 5/04 seeks to ensure that buildings and systems are tested are far as possible to ensure that intended performance is likely being achieved or can be achieved, providing that tenants/occupants follow the fitting-out specifications and guidance for use appropriate to the type of the premises they occupy.

The assessment of indoor air quality (IAQ), ventilation and thermal comfort takes into account:

- the extent to which the building and installed engineering systems can provide for comfortable and healthy premises; and
- the potential 'worst-case' scenario in respect of exposure to harmful substances found in indoor air.

To allow for the differences in environmental conditions likely to be found

1 Chau C K, Tu E Y, Chan D W T, Burnett J. Estimating the total exposure to air pollutants for population age groups in Hong Kong. Environment International. Vol. 27. 2002. pp 617–630.

in different buildings/premises, for the purposes of assessment HK-BEAM considers buildings as follows:

- Air-conditioned Buildings;
- Naturally Ventilated Buildings; and
- Mechanically Ventilated Buildings.

AIR-CONDITIONED BUILDINGS

Thermal comfort conditions and ventilation in air-conditioned buildings/premises which are designed on the principle of 'build tight, ventilate right' are intended to be controlled within prescribed design limits. The thermal comfort criteria used adopted, such as ISO 7730 [2], ASHRAE 55 [3] etc, will be defined by the Client appropriate to the type and use of the premises included in the building.

HK-BEAM 5/04 takes into account the Government's Indoor Air Quality Certification Scheme [4], as implementation of the Scheme can have a significant impact on the performance of air-conditioned buildings through improved design, construction, and operating practices.

AIR-CONDITIONED/ NATURALLY VENTILATED BUILDINGS

In buildings/premises with operable windows or other ventilation openings the extent to which natural ventilation is utilised will be dependent on user preference. Besides the prevailing climatic conditions this is likely to be influenced by the level of outside air pollution and noise. Thermal comfort conditions when operating air-conditioning will also depend on user preference, which can be met providing units are sized and installed to meet the required cooling load. Considerations for thermal comfort and IAQ in occupied/habitable rooms need to take into account conditions when premises are air-conditioned or otherwise 'closed' because of cold or inclement weather, and when more 'open' to take advantage of natural ventilation. Consideration is given to worst case conditions that might impact on the health of building users.

6.1 SAFETY AND SECURITY

6.1.1 FIRE SAFETY

6.1.2 ELECTROMAGNETIC COMPATIBILITY

6.1.3 SECURITY

BACKGROUND

Operation and maintenance of fire safety systems needs to ensure the highest level of performance. Whilst current legislation and codes dealing with fire safety are quite comprehensive, an integrated fire engineering approach in the management of premises will reduce risks to life and property. In some more complex buildings electromagnetic interference should not affect safety systems, nor should the provisions made for security compromise safety.

6.2 HYGIENE

6.2.1 PLUMBING AND DRAINAGE

6.2.2 BIOLOGICAL CONTAMINATION

6.2.3 WASTE DISPOSAL FACILITIES

6.2.4 INTEGRATED PEST MANAGEMENT

BACKGROUND

Post-SARs has seen a lot more attention to building hygiene. Clearly, certain features of building and building services design, e.g. plumbing and drainage systems, may have contributed to health problems. Proper provisions for inspection, cleaning and maintenance allows for

2 International Organization for Standardization. International standard 7730, Moderate thermal environments – Determination of the PMV and PPD indices and specification of the conditions for thermal comfort. Geneva 1995.

3 American Society of Heating, Refrigeration and Air-conditioning Engineers. ASHRAE 55-2004: Thermal Environmental Conditions for Human Occupancy. Atlanta 2004.

4 Indoor Air Quality Management Group. A Guide on Indoor Air Quality Certification Scheme for Offices and Public Places. http://www.iaq.gov.hk/cert/doc/CertGuide-eng.pdf

comprehensive management of hygiene in buildings.

6.3 INDOOR AIR QUALITY

6.3.1 CONSTRUCTION IAQ MANAGEMENT

6.3.2 OUTDOOR SOURCES OF AIR POLLUTION

6.3.3 INDOOR SOURCES OF AIR POLLUTION

6.3.4 IAQ IN CAR PARKS

6.3.5 IAQ IN PUBLIC TRANSPORT INTERCHANGES

BACKGROUND

Indoor air quality (IAQ) is defined by a list of the constituents, in both solid and gaseous states, in air. Subjectively, IAQ is the human perceived response to nasal irritants in the air. ASHRAE [5] defines 'Acceptable Indoor Air Quality' as "air in which there are no known contaminants at harmful concentrations as determined by cognizant authorities and with which a substantial majority (80% or more) of the people exposed do not express dissatisfaction."

A key factor in determining appropriate standards for IAQ is the duration of exposure. Exposure to indoor pollutants for a matter of minutes (e.g. car parks), hours (e.g. entertainment establishments), or over a working day (e.g. offices, classrooms, etc) will be different for most parameters depending on dose and response. For example, limits of the exposure considered acceptable for the general public, include the young and infirm, are different from exposures considered acceptable for the sedentary workplace, and certainly, the industrial workplace.

Sources of indoor pollutants include outdoor pollutants, building fabric materials, interior finishes, building systems and equipment, appliances, consumer products, and the occupants and their activities. The selection of building materials is important, as pollutants can be emitted for weeks, months or even years after installation. Air intakes should be sited away from pollutant sources and avoid short-circuiting with exhausts. Ventilation system design should not introduce pollutants, and filtering should be effective in removing outdoor pollutants.

6.4 VENTILATION

6.4.1 VENTILATION IN AIR-CONDITIONED PREMISES

6.4.2 BACKGROUND VENTILATION

6.4.3 UNCONTROLLED VENTILATION

6.4.4 LOCALISED VENTILATION

6.4.5 VENTILATION IN COMMON AREAS

BACKGROUND

The outside air ventilation to a centrally air-conditioned building should be adequate for the intended levels of occupancy. The criteria often used to indicate satisfactory provision of ventilation in occupied premises is the level of carbon dioxide (CO_2) at design occupancy. In Hong Kong it is usual that the minimum values for ventilation are rates for various spaces will be specified in accordance with an appropriate version of ASHRAE 62 [5], or equivalent design standard. However, what is critical to the adequacy of the ventilation is the amount of supply reaching the breathing zone of occupants. Inadequate distribution within zones or within rooms can result in dissatisfaction at a local level, event if the total ventilation supplied to a space meets specification. It is not possible to use CO_2 as a measure of satisfactory performance in unoccupied premises, but it is possible to determine if ventilation will be satisfactory through measurement of ventilation rate and ventilation effectiveness.

There are three basic requirements for ventilation of occupied rooms and

5 American Society of Heating, Refrigeration and Air-conditioning Engineers. ASHRAE 62-2001: Ventilation for Acceptable Indoor Air Quality. Atlanta 2001.

rooms used for habitation [6,7]; background ventilation, local exhaust, and source control. The concepts can be applied to workplaces, classrooms and similar workplaces where people spend long periods of time. Background ventilation is intended to dilute the unavoidable contaminant emissions from people and materials. Background ventilation should be provided for control of radon levels in occupied and habitable rooms, and reduce possibility of mould growth under conditions of high humidity. Local exhaust is intended to remove contaminants from those specific rooms, such as kitchens, in which concentrated sources are expected.

6.5 THERMAL COMFORT

6.5.1 THERMAL COMFORT IN AIR-CONDITIONED PREMISES

6.5.2 THERMAL COMFORT IN NATURALLY VENTILATED PREMISES

BACKGROUND

HK-BEAM does not specify the performance criteria for air-conditioned buildings, as the criteria will be a variable amongst building/premises types, and is also a matter of choice for the Client. For example, preference may be for operating an air-conditioned space at higher temperatures for the purposes of energy conservation. HK-BEAM seeks to ensure that buildings and systems are tested are far as practicable to ensure that specified thermal comfort conditions can be achieved under conditions of minimum and maximum occupancy and expected heat gains.

6.6 LIGHTING QUALITY

6.6.1 NATURAL LIGHTING

6.6.2 INTERIOR LIGHTING IN NORMALLY OCCUPIED AREAS

6.6.3 INTERIOR LIGHTING IN AREAS NOT NORMALLY OCCUPIED

BACKGROUND

Although difficult to achieve in many building developments located in the dense urban environments of Hong Kong daylight penetration into work places and habitable rooms should be encouraged. Lack of daylight and views to the external environment contributes to discomfort and to dissatisfaction of users. Where daylight is accessible some form of control at windows may be required to avoid glare from direct sunlight.

A consequence of poor lighting in work places is discomfort and loss of working efficiency. Although interior lighting in workplaces presents one of the most challenging design tasks, unfortunately often relatively little attention is given to design for work spaces where productive and creative activities take place.

To focus only on luminance level on the horizontal plane is insufficient. The quality of an interior lighting scheme cannot be specified or demonstrated through measurement of light sources and outputs alone, but needs to consider the relationship of the light sources to the nature of the space being illuminated, and visual tasks of users in the space.

6.7 ACOUSTICS AND NOISE

6.7.1 ROOM ACOUSTICS

6.7.2 NOISE ISOLATION

6.7.3 BACKGROUND NOISE

6.7.4 INDOOR VIBRATION

BACKGROUND

Above certain levels indoor noise can cause discomfort, irritation and interference with workplace activities. In addition, poor acoustics in certain premises will interfere with speech intelligibility. Background noise inside buildings comes from a number of sources, including noise break-in from the surrounding environment and noise produced inside

6 ASHRAE Standard 62.2. Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings. Atlanta 2003.
7 UK Department of the Environment and Welsh Office. The Building Regulations Part F Ventilation.

the building, such as from building services equipment and adjoining premises. Background noise should be limited to levels suitable for the use of the premises in a building development, expressed as appropriate criteria.

Many Hong Kong buildings housing noise sensitive premises are built close to roads and railway lines such that ground transportation noise impacts on occupants. Noise from fixed sources and aircraft may also pose a problem for some buildings.

Building services systems and equipment also influences the background noise levels in certain locations, and may also induce unwanted vibration. The sound insulation properties of floors and internal walls are crucial in controlling noise propagation inside a building. It is also necessary to consider how the design of premises affects speech intelligibility.

6.8 BUILDING AMENITIES

6.8.1 ACCESS FOR PERSONS WITH DISABILITY

6.8.2 AMENITY FEATURES

6.8.3 IT PROVISIONS

BACKGROUND

In recent years the HKSAR Government has sought to encourage better building designs through various 'green and innovative' features [8,9] that can enhance the quality of buildings, and have put in place a number of incentives to encourage the adoption of such features. Provisions that improve access for users, make for more enjoyable living and working spaces, and ensure efficient services to meet the needs of users, etc., all enhance the quality and efficiency of built environments and thereby ensure buildings are more sustainable.

8 Buildings Department, Land Department, Planning Department. Joint Practice Note No. 1. Green and Innovative Buildings. http://www.info.gov.hk/bd/english/documents/joint/JPN01.pdf

9 Buildings Department, Land Department, Planning Department. Joint Practice Note No. 2. Second Package of Incentives to Promote Green and Innovative Buildings. http://www.info.gov.hk/bd/english/documents/joint/JPN02.pdf

6 **IEQ** **6.1 SAFETY AND SECURITY**

HK-BEAM 5-04 **6.1.1 FIRE SAFETY**

EXCLUSIONS

None.

OBJECTIVE

Ensure that fire safety systems can operate as designed and to provide for enhanced fire safety management.

CREDITS ATTAINABLE

2

PRE-REQUISITES

All fire services provisions (both passive construction designs and active protection systems) shall be maintained to comply with the Fire Services Ordinance and the Building Ordinance, covering the means of escape [1], access for fire fighting [2], and fire resistant construction [3]. Compliance with the Fire Service (Installations and Equipment) Regulations.

CREDIT REQUIREMENT

a) Maintenance of systems

1 credit for demonstrating that fire services systems are regularly inspected and tested.

a) Fire safety management manual

1 credit for provision of a fire safety management manual based on a fire risk assessment for the building.

ASSESSMENT

a) Maintenance of systems

The Client shall provide a report prepared by a suitably qualified person detailing the passive and active fire safety systems in the building, and provide documentary evidence that the fire safety systems are regularly maintained and tested in accordance with:

- applicable regulations under the cited Ordinances;
- the original design intent and/or alterations to the design;
- periodic inspections are undertaken in according with the recommendations of the Authority [4]; and
- additional pro-active inspection and testing in accordance with the CoP [5].

It shall be for the Client to demonstrate that the frequency and suitability of inspections and testing undertaken is appropriate to type, size and use of the building. The credit shall be awarded where it can be demonstrated that management, operation and maintenance is carried out in a pro-active manner to ensure the integrity of all fire safety systems and equipment installed in the building.

b) Fire safety manual

The Client shall submit the fire safety manual which describes the specific aspects of fire safety management for the building. The manual shall be based on risk assessment, and shall include the following:

- a set of relevant documents (standards, codes, guides, etc) covering

1 Building Authority. The Provision of Means of Escape in Case of Fire. http://www.info.gov.hk/bd/english/documents/code/e_moe.htm
2 Building Authority. Code of Practice for the Provision of Means of Access for Fire Fighting and Rescue Purposes. http://www.info.gov.hk/bd/english/documents/code/moa_code1995.PDF
3 Building Authority. Fire Resisting Construction. http://www.info.gov.hk/bd/english/documents/code/e_frc.htm
4 Fire Services Department. Fire Services Checklist. http://www.hkfsd.gov.hk/home/eng/source/efschlst.pdf
5 Fire Services Department. Code of Practice for Inspection, Testing and Maintenance of Installations and Equipment. http://www.hkfsd.gov.hk/home/eng/source/safety/testing.pdf

fire safety, fire safety system design, and on-going certification requirements;

- relevant details of building design, construction and layout;
- details of hydrants, access for fire appliances, exits from the building, exterior lighting, hazards, etc;
- location of significant ignition sources;
- presence and influence of inter-spatial openings;
- characteristic responses of occupants to fire emergencies;
- techniques of fire detection employed;
- communications and warnings systems;
- provisions for smoke management;
- emergency lighting, signs and notices for way finding;
- provisions for fire fighting by building operators and users; and
- operation and maintenance requirements for all systems.

BACKGROUND

Fire safety is a key performance characteristic of sustainable buildings. The functions of fire safety systems interact with other building services systems, particularly environmental control systems. However, fire safety systems are often treated as an isolated set of technical systems that have limited interaction with other systems [6]. Design of fire services installations (FSI) [7] need to take into account the important links between systems, and provisions for security and communications systems serving a building. Operation and maintenance manuals should make it clear to building operators how systems interact in the event of an alarm or fire situation. An aspect of relationships between FSI and the normal operation of a building is a fire risk assessment (which for workplaces is matter covered by legislation throughout Europe). Contributions to fire safety from non-fire services systems can have a significant influence on the degree and level of improvements that may be needed to FSI.

Whilst fire safety legislation covers most aspects of fire safety system design and operation, the proper management, operation and maintenance of buildings and fire safety systems is essential to limiting the impacts of fires on occupants, contents and structures.

The provisions for means of escape and other fire safety measures should be based on an assessment of the risk to the occupants should an event occur [8,9,10]. The assessment should take into account the nature of the building structure, the use of the building, the processes undertaken and/or materials stored in the building; the potential sources of fire; the potential of fire spread through the building; and the standard of fire safety management proposed. Where it is not possible to identify with any certainty any of these elements a judgment as to the likely level of provision must be made.

There are four major fire safety objectives:

6 Eric W. Marchant. Fire safety systems - interaction and integration. Facilities. Vol. 16, No. 4. 1998. pp 229-235.

7 Fire Services Department. Codes of Practice for Minimum Fire Service Installations and Equipment and Inspection, testing and Maintenance of Installations and Equipment. http://www.hkfsd.gov.hk/home/eng/code.html

8 Buildings Department Practice Note for Authorized Persons and Registered Structural Engineers, PNAP 204. Guide to Fire Engineering Approach. http://www.info.gov.hk/bd/english/documents/pnap/Pnap204.pdf

9 British Standards Institution. BS PD 9754. Application of fire safety engineering principles to the design of buildings — Part 7: Probabilistic risk assessment.

10 British Standards Institution. BS 7899. Code of practice for Assessment of hazard to life and health from fire - Part 1. General guidance.

- life safety;
- property protection, including protection of the building fabric and the contents of the building;
- non-disturbance of business activities; and
- minimisation of the impacts on the environment.

The need for easy and rapid evacuation of a building in case of fire may conflict with the control of entry and exit in the interest of security. Measures intended to prevent unauthorised access can also hinder entry of the fire service to rescue people trapped by fire. Potential conflicts should be identified and resolved at the design stage and not left to ad hoc expedients after completion [6].

For environmental protection the two most important aspects of fire safety are the impact of the products of combustion on the surroundings (people and buildings in urban areas and the flora and fauna in rural areas) and the degree of contamination that may be caused by the modification of the chemical and physical properties of the fire fighting water due to the effects of the combustion process on the water. Fire safety should not be compromised by the inappropriate introduction of measures that are regarded as 'green and sustainable' [11,12].

11 Chow W. K, Chow C L. Awareness of fire safety for green and sustainable buildings. International Conference – Fire Asia 2003, 26-28 February 2003, Hong Kong – Paper 2, Session 3 (2003); appeared also in Asian Fire Fighting and Security, Vol. 11, April, pp. 55-58 (2003).

12 Chow C. L, Chow W K. Assessing Fire Safety Provisions For Satisfying Green Or Sustainable Building Design Criteria: Preliminary Suggestions. International Journal on Architectural Science. pp 141-146. Department of Building Services Engineering, The Hong Kong Polytechnic University.

6 IEQ

6.1 SAFETY AND SECURITY

6.1.2 ELECTROMAGNETIC COMPATIBILITY

EXCLUSIONS None.

OBJECTIVE Reduce occupant exposure and the potential interference of susceptible devices to interference from power distribution equipment.

CREDITS ATTAINABLE 1

PRE-REQUISITES None.

CREDIT REQUIREMENT 1 credit for designs that meet the electromagnetic compatibility requirements in respect of power quality and low frequency magnetic fields.

ASSESSMENT The Client shall submit a report prepared by a suitably qualified person detailing the design of the electrical distribution system in the building. The report submitted shall demonstrate that the designs of the installations are such as to avoid excessive external magnetic fields, and the selection of power consuming equipment is such as to mitigate the impact of non-linear loads. As a minimum the report shall confirm compliance with:

a) Section 6 of the Code of Practice for Energy Efficiency of Electrical Installations [1] in respect of power quality; and

b) the occupational exposure in the ELF frequency range from 1 to 300 Hz not exceed the ceiling value given by:

$B_{TVL} = 60/f$;

where f is the frequency in Hz, and B_{TVL} is the magnetic flux density in millitesla (mT) [2].

Compliance may be demonstrated through an assessment of the electrical loads in the building and the design of the electrical installation, or by measurement during normal operation of the building. Measurements of power quality shall be taken at major distribution points in the building, e.g. tee-off at the end of rising mains. Measurements of ELF magnetic fields shall be taken in normally occupied areas located above and below major electrical equipment such as transformers, and at locations close to rising mains.

BACKGROUND Electromagnetic compatibility or, in another sense, electromagnetic interference, is major issues in respect of safe and reliable operation of sensitive equipment in buildings [e.g. 3]. Problems caused by harmonics, which affects both power quality, and power factor, are not uncommon in buildings in Hong Kong [e.g. 4]. The tendency is to seek solutions to any problems through power conditioning, rather than treating the problems at sources, through the proper selection of equipment.

Interest in magnetic fields has been stimulated in recent years by concern over the physiological effects they may have on humans and

1 Electrical and Mechanical Services Department. Code of Practice for Energy Efficiency of Electrical Installations. http://www.emsd.gov.hk/emsd/e_download/pee/eleccop.pdf

2 American Conference of Government Industrial Hygienists. Threshold Limit Values for Chemical Substances and Physical Agents & Biological Exposure Indices.

3 Wu M K T. Interference Problems of Fluorescent Lamps Operating on High Frequency Electronic Ballasts with Infrared Remote Control Equipment and Infrared Simultaneous Interpretation System. Electrical and Mechanical Services Department. August 2003. http://www.emsd.gov.hk/emsd/e_download/pee/infrared_interference_emsdweb.pdf

4 Wu M K T. Standards of Power Quality with reference to the Code of Practice for Energy Efficiency of Electrical Installations. Energy Efficiency Office, Electrical & Mechanical Services Department. September 2003. http://www.emsd.gov.hk/emsd/e_download/pee/EEC&harmonic.pdf

animals and the deleterious effects they have on the performance of some electrical equipment, particularly video display units. Investigations have yielded results which are presented in an IEC report [5] as reference values.

Small commercial buildings experience general levels of magnetic fields similar to those present in residential environments. Large and multi-storey buildings experience higher background levels of magnetic fields because their electrical installations carry high currents and behave more like power distribution networks, often with a significant third harmonic current in neutral conductors. It is not uncommon for distribution substations to be sited within premises and this practice often produces relatively high levels of magnetic field in occupied spaces located within 10 m of a substation. 1 micro-Tesla (μT) is representative of flux density in the centre of an office and not in proximity to any electrical appliances.

In general the internal wiring and equipment within a building do not contribute significantly to the background level of magnetic field. However, in apartment blocks the conditions may be similar to those encountered in multi-storey commercial buildings where rising mains and a substation are adjacent to dwellings. The background level of magnetic field within a residence is dependent on the proximity and loading of adjacent power supply network cables. In general strengths are within the range of 0.01 to 10 μT, unless wiring is incorrectly installed.

OCCUPATIONAL EXPOSURE

It is believed that below the threshold limit value's (TLVs) recommended by ACGIH [2] building users may be exposed repeatedly without adverse health effects. At 50 Hz the TLV is 1.2, and 0:4 mT for the third harmonic frequency. For occupants wearing cardiac pacemakers the recommended level is 0.1 mT (100 μT). These levels are in general agreement with those suggested by other authorities such as IRPA/INIRC [6].

In normal circumstances levels of magnetic fields found to be produced by electrical distribution circuits [e.g. 7] are of an order of magnitude below the recommended threshold value, and should not be a cause for concern on the grounds of direct health impact.

5 International Electrotechnical Commission. Technical Report 6100-2-7. Electromagnetic compatibility (EMC) – Part 2: Environment – Section 7: Low frequency magnetic fields in various environments. 1998.

6 International Non-ionizing Radiation Committee of the International Radiation Protection Association. Interim guidelines on limits of exposure to 50=60 Hz electric and magnetic fields. Health Physics. Vol. 58(1), pp113–22. 1990.

7 Burnett J, Du Y P. Mitigation of extremely low frequency magnetic fields from electrical installations in high-rise buildings. Building and Environment. Vol. 37. pp. 769 – 775. 2002.

6 IEQ

6.1 SAFETY AND SECURITY

6.1.3 SECURITY

EXCLUSIONS None.

OBJECTIVE Engender a feeling of well-being amongst building users.

CREDITS ATTAINABLE 1

PRE-REQUISITES Burglar alarm systems shall comply with the Noise Control Ordinance.

CREDIT REQUIREMENT 1 credit for scoring at least 75% of the applicable security measures and facilities for the building.

ASSESSMENT The Client shall submit a report prepared by a suitably qualified person which includes: a completed checklist of the security measures and facilities provided, justification for each checked item, details of the physical security systems provided, and a detailed security manual explaining how the physical provisions (hardware) integrates with the management system (software) for the building.

Where 75% compliance of applicable items is demonstrated the credit shall be awarded.

Alternatively, the Client may provide detailed rationale and arguments to demonstrate that security systems are integrated and an enhanced standard of security can be provided.

ASSESSMENT GRID

Site perimeter controls:	Pt	**Surveillance:**	Pt	**Building Security:**	Pt	**Site/Building Layout**	Pt
Site is fenced, gate(s) attended during active hours, intercom and camera surveillance during silent hours.	2 or	Lighting of site: Overall illumination of the site is between 50 and 200 lux.	2 or	Entry from adjacent building(s): Access is prevented by a separating distance of 6m.	2 or	Pathways are short, wide and straight	1
Restricted areas of the site are fenced with a locked gate.	1	Site is illuminated by street and building exterior lighting.	1	Access from adjacent building is inhibited by barriers.	1	Footpaths are well lit, convex steel mirrors to forestall concealment.	1
Vehicle Access Control: Parking is indoor and with attended control station.	2 or	Monitoring of site: Colour monitoring of building entrances and perimeter.	2 or	Security guards can verify by TV monitor and card reader.	2 or	Amenity/play areas overlooked from the building.	1
Parking for visitors and building users are separated with guard patrol.	1	B&W monitoring of building entrances and perimeter.	1	All people and traffic from parking must pass security control or parking control station.	1	Elevators are monitored by CCTV.	1
Security of stored vehicles: Company vehicles in indoor parking or fenced compound with TV monitoring in silent hours.	2 or	Guard patrol: Frequent patrol of building and fence perimeter.	2 or	Doors and windows at grade: Secured with heavy duty hardware, security glazing and deadlocks.	2 or	Staircases are wide, open and well lit.	1
Company vehicles in separate well lit area.	1	Single guard patrol during silent hours.	1	Secured with high grade hardware.	1	Meters are located in common areas	1
Optional (by Client)	2 or	Planting: clear of building pathways and parking.	2 or	Alarmed for opening and breakage to central control and perimeter is monitored with TV.	2 or	Optional (by Client)	2 or
Optional (by Client)	1	Planting 6m clear of building.	1	Alarmed locally for opening and breakage.	1	Optional (by Client)	1
Total Applicable Points:		Points Achieved:		Percentage Achieved:			

BACKGROUND Local surveys undertaken in recent years shows that security is a serious concern for residents of estates. This may be in the context of personal safety and in the context of loss of belongings. For commercial and institutional buildings security is also an issue, in public buildings where strangers congregate, in common areas such as staircases and toilets, etc.

The design of building, landscape and the implementation of security facilities can effectively reduce most burglaries and other crimes relating to different building types by influencing the behaviour of offenders, guardians and potential victims. The security facilities and measures required depend on the type of premises and level of security needed. In general, effective security incorporates three elements: natural and architectural barriers that discourage access, human security, and electronic security.

Security can be enhanced through the integrated use of reliable hardware (surveillance cameras, security barriers, etc) coupled to a sound management system (watchman tour, etc). Security systems need also be integrated with fire safety management and communications systems.

Assessment should take into account the guidelines provided in ASTM [1,2], BS [3], and similar authoritative guidance, and the extent to which the security provisions 'score' against the assessment grid provided herein.

1 ASTM International. Designation E 1665-95a. Standard Classification for Serviceability of an Office Facility for Facility Protection.
2 ASTM International. Designation E 1693 -95a. Standard Classification for Serviceability of an Office Facility for Occupant Assets.
3 British Standards Institution. BS8220. Standard Guide for Security of Buildings Against Crime.

6 IEQ

6.2 HYGIENE

6.2.1 PLUMBING AND DRAINAGE

EXCLUSIONS

None.

OBJECTIVE

Reduce the potential for contamination of plumbing and drainage systems, reduce the ability of systems to carry infections, and reduce the likelihood of odours.

CREDITS ATTAINABLE

1

PRE-REQUISITES

Compliance with the provisions of the Building (Standards of Sanitary Fitments, Plumbing, Drainage Works and Latrines) Regulations.

CREDIT REQUIREMENT

1 credit where system design, operation and maintenance is such as to reduce the potential for transmission of harmful bacteria viruses, and odours.

ASSESSMENT

The Client shall submit details of the plumbing and drainage systems in the building, and confirmation that installation of the systems and equipment satisfies applicable regulations. A summary report shall be submitted highlighting appropriate means are in place to ensure the safe and hygienic operation of the systems and components.

The 'appropriate means' shall include, but is not limited to, reference to the following:

- adequacy of flushing water supply to meet peak demand;
- adequacy of drainage stacks under peak loading;
- venting of stacks;
- access to pipework and ducts for maintenance purposes;
- attention to leaks at joints, seals, etc;
- design of floor drains; and
- maintenance of water seals.

Where it can be demonstrated that the management, operation and maintenance of the plumbing and drainage systems and equipment, and any other provisions that can impact on performance (e.g. ventilation of bathrooms) have been given due attention, e.g. comply with the recommended practices promoted by various authorities, then the credit shall be awarded.

BACKGROUND

Since the outbreak of the SARs virus there has been a great deal of attention on the design of buildings to improve building hygiene. There appears to be sufficient evidence to conclude that building drainage systems were a path for the transmission of the SARs virus. Subsequent investigations have identified that certain features of drainage and sewage system design should be improved. HK-BEAM seeks to ensure greater attention is paid to the maintenance of plumbing and drainage systems in buildings in order to reduce the risk of transmission of bacteria, viruses and odours into occupied areas.

Water seal traps are required to be provided for all sanitary fitments, including floor drains (if provided), before they are connected to a common drainage stack [1]. Trap seal retention can be a problem in multi-level drainage systems. The main ways that air passes a trap are:

1 Buildings Department. Practice Note for Authorized Persons and Registered Structural Engineers, PNAP 277. Floor Drains in Kitchens and Bathrooms. http://www.info.gov.hk/bd/english/documents/pnap/Pnap277.pdf

- system pressure variations cause air-entrained bubbles to pass through the water seal; and/or
- complete or partial trap seal loss.

Unless water is replenished, from time to time, by the building users or through discharge of waste water cross-contamination is likely. Viruses can enter in indoor spaces through water traps if water seals are dried out or contaminated, or there is leakage in pipework. Under working and test conditions traps should retain a minimum seal of 25mm of water or equivalent.

INSTALLATIONS

Leaky joints and broken drainage pipes are the result of the lack of regular inspection and maintenance. Pipework needs to be as accessible as possible in order to carry out such work, and building management should be provided with means for regular inspection, maintenance and repair of building drainage systems.

VENTILATION

Where mechanical ventilation in the form of extractor fan is provided, such as in bathrooms and lavatories, care should be taken to ensure that water seals are intact and operate according to the design intent [2]. Consideration should be given to the quality and quantity of air intake, air-flow path and fan capacity.

The Environmental Health Team of the World Health Organisation (WHO) has advised that the optimum volume for bathroom ventilation is 2 cfm/sq ft (10.2 l/s per sq. metre). WHO is of the view that a larger volume does not add much on the comfort side and has the hidden risk of building up negative pressure. Designers are advised to provide an opening to bathrooms and lavatories for make-up air, such as an undercut to the door or an opening with a louvre at the door or wall, in order to minimise the build-up of negative pressure where an extractor fan is used for ventilation. The airflow path created should avoid circuiting of the ingress and exhaust air.

2 Buildings Department. Practice Note for Authorized Persons and Registered Structural Engineers, PNAP 285. Extractor Fans in Bathrooms and Lavatories in Domestic Buildings. http://www.info.gov.hk/bd/english/documents/pnap/Pnap285.pdf

6 IEQ

6.2 HYGIENE

6.2.2 BIOLOGICAL CONTAMINATION

EXCLUSIONS

Residential buildings.

OBJECTIVE

Ensure that the design, installation and facilities for operation and maintenance of air conditioning systems, and water systems and features, are such as to reduce the risk of biological contamination.

CREDITS ATTAINABLE

1

PRE-REQUISITES

None.

CREDIT REQUIREMENT

1 credit for complying with the recommendations given in the Code of Practice - Prevention of Legionnaires Disease, in respect of air-conditioning and ventilation systems, and water systems.

ASSESSMENT

The Client shall submit a report prepared by a suitably qualified person detailing how the operation and maintenance of the air-conditioning and ventilation systems and equipment meet with the requirements and recommendation contained in the Code of Practice - Prevention of Legionnaires Disease [1], or at least equal equivalent code. The report shall also detail how water supply, particularly hot water supply, and water use in features such as spas, fountains, etc., are operated and maintained in compliance with the Code or Practice, or equivalent.

BACKGROUND

The majority of cases of legionnaires' disease (LD), are caused by the bacterium Legionella pneumophila, but there are many other species of the organism which have been implicated in human disease is a pneumonia, but other milder illnesses may be caused by these organisms. All illnesses due to legionella species are known collectively as 'legionelloses'; Pontiac Fever is one of the milder conditions. Legionella pneumophila is found in natural water supplies and in soil. It is also found in many recirculating and water supply systems.

Measurements in a building may reveal problems with biological contamination caused by either air-conditioning and ventilation systems, or water systems. HK-BEAM seeks confirmation that the operation and maintenance of systems and equipment is such as to reduce the possibility of problems arising.

1 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. http://www.emsd.gov.hk/emsd/e_download/pps/code.doc

6 IEQ

6.2 HYGIENE

6.2.3 WASTE DISPOSAL FACILITIES

EXCLUSIONS

None.

OBJECTIVE

Ensure that the design, installation and facilities for waste disposal and recycling are such as to reduce the risk of odours entering occupied areas or public areas.

CREDITS ATTAINABLE

1

PRE-REQUISITES

Compliance with the Building (Refuse Storage Chambers and Material Recovery Chambers and Refuse Chutes) Regulations where applicable.

CREDIT REQUIREMENT

1 credit for the provision of a hygienic refuse collection system.

ASSESSMENT

The Client shall submit details of the refuse collection system to demonstrate that refuse is disposed of in an hygienic manner and prevents any significantly discernable odours from entering occupied areas or public areas in or immediately adjacent to the building.

For buildings whose design was completed after the regulations came into force, the system shall comply with those recommendations contained in PNAP 98 [1] in respect of refuse storage and recovery chambers appropriate to the given circumstances. For other buildings the Client shall demonstrate that the facilities available offer at least a similar degree of performance.

The provision of a purpose designed automated/mechanical system for waste disposal is deemed to meet the requirements.

BACKGROUND

Where refuse contains large amounts of food and other organic waste there are potential odours and health problems if refuse is not well contained from the points of disposal by users to the place of final collection. Automatic systems are available to isolate refuse from users.

REFUSE CHAMBERS

Where a centralised ventilation system is adopted, a single air purifier may be installed before final discharge into the atmosphere. Alternatively where there is no particular odour problem a mechanical fan coupled with a particulate filter at each RS&MRR/MRC may be considered. The main exhaust outlet for a centralised ventilation system should be located at upper roof level away from other buildings; however in the case where the building is surrounded by taller buildings the discharge may be located at the main RS&MRC.

The noise level of the system should conform with the Technical Memorandum published under the Noise Control Ordinance (Cap 400). Fire dampers should be provided if the system has exhaust grilles and ducting at each floor.

Air purifying devices such as 'Chemical Air Scrubber', 'Bio-oxygen Generator', 'Photo-oxidation Generator' or other appropriate devices should be provided within a RS&MRC.

1 Buildings Department. Practice Note for Authorized Persons and Registered Structural Engineers, PNAP 98. Refuse Storage and Collection Building (Refuse Storage and Material Recovery Chambers and Refuse Chutes) Regulations. http://www.info.gov.hk/bd/english/documents/pnap/Pnap098.pdf

6 IEQ

6.2 HYGIENE

6.2.4 INTEGRATED PEST MANAGEMENT

EXCLUSIONS

None.

OBJECTIVE

Ensure that the management of pests is safe, hygienic and with limited environmental impacts.

CREDITS ATTAINABLE

1

PRE-REQUISITES

None.

CREDIT REQUIREMENT

1 credit for implementing an integrated programme for pest management.

ASSESSMENT

The onus is on the Client to demonstrate the suitability of the pest management programme or system adopted for the particular circumstances. The Client shall submit details of the measures taken to control pests in the least harmful manner to humans and the environment.

Assessment shall take into account:

- the methods used to monitor pets and to keep records on problems;
- actions to identify the root causes of pest problems
- the extent to which pest treatment actions avoid chemicals and pesticides that may be harmful to staff, building users and passers-by, and to the environment;
- details of reference/educational material maintained in-house, and extent of staff training that deals with pest management;
- availability of documentation detailing pest management in the buildings and its surrounding site.

BACKGROUND

Pesticides pose risks to human health and the environment when people do not follow directions on product labels or use products irresponsibly. For example, pesticides might be used when they are not really needed, too much is applied, or disposal is in a manner that could contaminate the environment. Even alternative or organic pesticides can have these unintended consequences if not used correctly. Building management should adopt pest control in ways that offer a means to reduce the risk from, and in some cases, the amount of pesticides needed.

Integrated pest management is an approach to pest control that utilizes regular monitoring and record keeping determining if and when treatments are needed, and employs a combination of strategies and tactics to keep pest numbers low enough to prevent unacceptable damage or annoyance. Biological, cultural, physical, mechanical, educational, and chemical methods are used in site-specific combinations to solve the pest problem. Chemical controls are used only when needed, and in the least-toxic formulation that is effective against the pest. Educational strategies are used to enhance pest prevention and to build support for the IPM program.

The US EPA promotes integrated pest management through documents such as for schools [1], because IPM represents a prudent approach to understanding and dealing with environmental concerns. Because IPM is a decision-making process and not a rote method, an IPM program will

1 US Environmental Protection Agency. Integrated Pest Management for Schools: A How-to Manual. http://www.epa.gov/pesticides/ipm/schoolipm/index.html

always be able to take into account the wide spectrum of pest problems and the diversity of people involved. IPM methods equip pest control operators and other members of the IPM team to design flexible, site-specific pest management plans scaled to the severity of the problems and the level of resources available.

An IPM program is built around the following components:

- monitoring the pest population and other relevant factors;
- accurate identification of the pest;
- determining injury and action levels that trigger treatments; and
- timing treatments to the best advantage.

An IPM manual would contain, for example:

- management policies;
- purchasing practices;
- pest management objectives;
- biological and ecological information on pests;
- monitoring of each type of pest;
- field data and interpretation;
- proper storage, cleaning and use of equipment and supplies;
- tactics allowed for treatment;
- evaluation of effectiveness of treatments, etc.

6 IEQ

6.3 INDOOR AIR QUALITY

6.3.1 CONSTRUCTION IAQ MANAGEMENT

EXCLUSIONS

Residential and similar buildings not provided with central air-conditioning and ventilation systems.

OBJECTIVE

Ensure that building users are not affected and ventilation systems are not contaminated during renovation work.

CREDITS ATTAINABLE

1

PRE-REQUISITES

If applicable, compliance with the Air Pollution Control Ordinance with regard to asbestos control.

CREDIT REQUIREMENT

1 credit for availability and effective implementation of a Construction IAQ Management.

ASSESSMENT

To demonstrate compliance the Client shall submit a report prepared by a suitably qualified person documenting effective implementation of Construction IAQ Management appropriate to the scale and extent of the work.

Where renovations require the removal or treatment of asbestos containing materials the work shall be carried out in accordance with the instructions given by the Environmental Protection Department [1].

Where due attention has been paid to construction IAQ management as detailed in the check-list below, the credit shall be awarded.

CHECK LIST

Written Construction IAQ Management procedures should exist which shall meet or exceed the minimum requirements, as follows:

- details of the procedures adopted during renovation, fit-out and redecoration;
- contract documentation that demonstrates implementation of the construction IAQ management measures;
- operation and maintenance measures in place during construction work;
- measures to avoid contamination of adjacent normally occupied areas;
- measures to avoid contamination of common areas or public areas, including outside areas;
- contaminant source control;
- provision of adequate outside air continuously during installation of materials and finishes;
- evidence of measures providing protection of ducts, on-site storage or protection of installed absorptive materials, etc;
- cleaning procedures to be employed prior to the building being occupied, in the event that ventilation system components and air pathways are not adequately protected;
- details of any procedures for building flush-out; and
- replacement of all construction-related filtration media used on permanent HVAC equipment at substantial completion of the work.

Events shall be scheduled to protect indoor air quality by:

1 http://www.epd.gov.hk/epd/english/environmentinhk/air/guide_ref/asbestos_control_02.html#removeasbestos

- permitting adequate airing-out of new materials;
- sequencing the installation of finish materials; and
- proper curing of concrete before covering.

The procedures should include emergency procedures and cover the following:

- a list of participants in the process and their responsibilities;
- communication and documentation;
- designate a representative with daily responsibility for IAQ issues;
- keeping the premises free from accumulations of waste materials, rubbish and other debris resulting from the work. Identify the storage, disposal and housekeeping practices to be applied to building supplies and waste materials;

BACKGROUND

Buildings, especially those with extensive ventilation systems, can suffer from indoor air pollution problems arising from residuals left in HVAC and mechanical ventilation systems. Proper management during renovation, fit out and redecoration, followed by cleaning and replacement strategies can significantly reduce the potential for air pollution. Materials directly exposed to moisture through precipitation, plumbing leaks, or condensation is susceptible to microbial contamination. Absorptive materials to be protected and sequenced during installation include; insulation, fabrics, ceiling tiles, and gypsum products. During construction the IAQ management should be monitored and reported.

6 IEQ

6.3 INDOOR AIR QUALITY

6.3.2 OUTDOOR SOURCES OF AIR POLLUTION

EXCLUSIONS

None.

OBJECTIVE

Demonstrate that airborne contaminants from external sources will not give rise to unacceptable levels of indoor air pollution in normally occupied spaces.

CREDITS ATTAINABLE

4

PRE-REQUISITES

Compliance with relevant chapters of the Occupational Safety and Health Ordinance.

CREDIT REQUIREMENT

a) Carbon monoxide (CO)

1 credit for demonstrating compliance with appropriate criteria for CO.

b) Nitrogen dioxide (NO_2)

1 credit for demonstrating compliance with the appropriate criteria for NO_2.

c) Ozone (O_3)

1 credit for compliance with the appropriate criteria for O_3.

d) Respirable suspended particulate (RSP, PM_{10})

1 credit for compliance with the appropriate criteria for RSP.

ASSESSMENT

The Client shall provide a report prepared by the suitably qualified person detailing the criteria adopted for indoor air quality for each type of normally occupied premises within the building development.

Where the Client does not offer criteria, HK-BEAM aligns with the HKSAR IAQ Certification Scheme [1]. The criteria for air-conditioned buildings shall be those defined under Good Class in Table 1 of the scheme Guide. For other occupied areas and habitable rooms the criteria can be that defined in the Guide, in ASHRAE 62-2001 [2] or equivalent standard.

Compliance shall be demonstrated by measurement. The report shall identify the measurement protocol. i.e., the measuring equipment used, duration of measurements, number and details of the sampling points, the measurement results, and overall conclusions from the measurements survey.

For RSP the instrument type used shall be of gravimetric type, such as cyclone elutricator or impactor. An instrument based on the optical scattering method is acceptable with a referenced calibration curve with respect to a gravimetric instrument. In a zone where it can be demonstrated that CO, NO_2, ozone and RSP are solely from outside, measurements can be taken at the outdoor air intake locations where CO, NO_2, ozone and RSP are likely to infiltrate.

The objective of sampling is to ensure that the building will not suffer unduly from outside sources of pollution. The sampling protocol (number and locations of samples) shall follow as a minimum that given in Appendix 8.8. Any other protocol demonstrated to be of equal rigour appropriate to the nature of the premises surveyed would be acceptable.

1 Indoor Air Quality Management Group. A Guide on Indoor Air Quality Certification Scheme for Offices and Public Places. http://www.iaq.gov.hk/cert/doc/CertGuide-eng.pdf

2 American Society of Heating Refrigeration and Air Conditioning Engineers. ASHRAE Standard 62. Ventilation for Acceptable Indoor Air Quality, Atlanta 2001.

In the case of occupied/habitable rooms in air-conditioned/naturally ventilated buildings the measurement of indoor air pollutants shall take place whilst operating in the naturally ventilated mode. Given that air and pollutant exchange with the outside depends on prevailing climatic conditions, particularly wind speed and direction, it is expected that due account is taken and that measurements will be taken under typical or average climatic conditions.

Where access to premises is limited, e.g. due to the presence of tenants, the onus shall be on the Client to demonstrate measurements in those areas that are accessible is representative of the building as a whole.

Where it can be demonstrated that the identified pollutants are unlikely to exceed the limits prescribed, and as determined from an appropriate sample of measurements the relevant credit(s) shall be awarded.

Where certification under the IAQ Certification scheme is current and covers all parts of the building for which HK-BEAM certification is being sought then the credits shall be awarded.

BACKGROUND

This section deals with pollutants found in indoor air which are mainly attributable to sources external to occupied spaces when the sources attributable to occupants and their activities is excluded. In the case of occupied/habitable rooms in air-conditioned/naturally ventilated buildings the concern is indoor air pollutant from outdoor sources whilst operating in the naturally ventilated mode. Undertaking appropriate measurements in air-conditioned buildings will demonstrate that the design and construction of the building and services serve to reduce indoor air pollution from all sources.

CO is toxic gas which interferes with the oxygen transport capacity of the blood, and at levels to which people can be exposed in buildings, leads to symptoms such as headaches, nausea, chest constriction, etc, as well as affecting concentration. Exposure to oxides of nitrogen (NO_x, NO_2) can result in irritations to the eyes and respiratory system. Sources in occupied areas include infiltration from vehicle exhausts and enclosed car parks, and incomplete combustion within premises. Ozone irritates the eyes and respiratory system. Sources of ozone in occupied areas include infiltration from outside occupied areas, and from equipment which utilises ultra-violet light or causes ionisation of air.

Respirable Suspended Particles (PM_{10}) are suspended airborne particles with a nominal aerodynamic diameter of 10 μm or less. The health impacts from inhalation of particles depend on size, shape and chemical reactivity. Outdoor sources are numerous, but vehicular exhaust and construction activity are significant sources. Particulate from outside sources are carried into air-conditioned buildings through outside air intakes and through uncontrolled infiltration. Indoor sources include air ducts, equipment and user activities. Levels of RSP may be used as an indicator of the effectiveness of the air filtration system, so sampling should be carried out at one representative zone in each type of premises.

6 **IEQ** **6.3 INDOOR AIR QUALITY**

6.3.3 INDOOR SOURCES OF AIR POLLUTION

EXCLUSIONS None.

OBJECTIVE Demonstrate that airborne contaminants, predominantly from inside sources, do not give rise to unacceptable levels of indoor air pollution in normally occupied spaces.

CREDITS ATTAINABLE 3

PRE-REQUISITES Compliance with relevant chapters of the Occupational Safety and Health Ordinance.

CREDIT REQUIREMENT

a) Volatile organic compounds (VOCs)

1 credit for compliance with the appropriate criteria for VOCs.

b) Formaldehyde (HCHO)

1 credit for compliance with the appropriate criteria for formaldehyde.

c) Radon (Rn)

1 credit for compliance with the appropriate criteria for radon.

ASSESSMENT The Client shall provide a report prepared by the suitably qualified person detailing the criteria adopted for indoor air quality for each type of normally occupied premises within the building development.

Where the Client does not offer criteria, HK-BEAM aligns with the HKSAR IAQ Certification Scheme [1]. The criteria for air-conditioned buildings shall be those defined under Good Class in Table 1 of the scheme Guide. For other occupied areas and habitable rooms the criteria can be that defined in the Guide, in ASHRAE 62-2001 [2] or equivalent standard.

Compliance shall be demonstrated by measurement. The report shall identify the measurement protocol. i.e., the measuring equipment used, duration of measurements, number and details of the sampling points, the measurement results, and overall conclusions from the measurements survey.

A sample at the lowest outdoor air intake location can help to identify the relative contribution of VOCs from indoor and outdoor. However, the common alpha track detector and gamma ray detector for radon detection are not regarded as suitable for measurement. Scintillation cells and electronic monitors are more suitable for both grab sampling and continuous measurements.

The objective of sampling is to ensure that the building will not suffer unduly from outside sources of pollution. The sampling protocol (number and locations of samples) shall follow as a minimum that given in Appendix 8.8. Any other protocol demonstrated to be of equal rigour appropriate to the nature of the premises surveyed would be acceptable.

In the case of occupied/habitable rooms in air-conditioned/naturally ventilated buildings the measurement of indoor air pollutants shall take place whilst operating in the background ventilation mode, or where there is no specific provision for background ventilation, with all windows and doors closed.

1 Indoor Air Quality Management Group. A Guide on Indoor Air Quality Certification Scheme for Offices and Public Places. http://www.iaq.gov.hk/cert/doc/CertGuide-eng.pdf

2 American Society of Heating Refrigeration and Air Conditioning Engineers. ASHRAE Standard 62. Ventilation for Acceptable Indoor Air Quality, Atlanta 2001.

Where access to premises is limited, e.g. due to the presence of tenants, the onus shall be on the Client to demonstrate measurements in those areas that are accessible is representative of the building as a whole.

Where it can be demonstrated that the identified pollutants are unlikely to exceed the limits prescribed, and as determined from an appropriate sample of measurements the relevant credit(s) shall be awarded.

Where certification under the IAQ Certification scheme is current and covers all parts of the building for which HK-BEAM certification is being sought then the credits shall be awarded.

BACKGROUND

This section deals with pollutants found in indoor air which are mainly attributable to indoor sources, but excluding those from occupants or their activities. In the case of occupied/habitable rooms in air-conditioned/naturally ventilated buildings the concern is indoor air pollutant from indoor sources whilst operating in the background ventilation mode, i.e. all openings other than those provided for background ventilation are 'closed'.

Volatile Organic Compounds (VOCs) includes hundreds of chemical compounds found in indoor environments from trace levels to levels that can cause various symptoms such as eye and throat irritations, respiratory problems, headaches, etc. Reactions can occur as a result of exposure to a single sensitising dose or sequence of doses, even at low levels. VOCs may enter from outdoors, but are more likely to be emitted from building materials, finishes and furnishings, pesticides and cleaning products.

Formaldehyde is a type volatile organic compound which is separately identified due to its abundance in many building materials, adhesives, fabrics and carpets, etc. Formaldehyde is a suspected human carcinogen, and in sufficiently high concentrations is known to cause eye, nose and respiratory irritation and sensitisation. Since formaldehyde is most likely to come from indoor sources, sampling should be carried out in at least one representative zone of each type of occupied area.

Radon is a colourless radioactive gas that exhibits no taste or smell. There is concern that exposure to elevated levels of radon indoors increases the risk of lung cancer. Radon is mainly emitted from granite and marble which are major building materials in Hong Kong. The concentration of radon may accumulate to an unaccepted level in an enclosed space without adequate ventilation. Choice of building materials and surface coverings can have significant impact on emission rates. Since outdoor radon infiltration is minimal. Radon and its progenies are mainly generated indoor.

6 IEQ

6.3 INDOOR AIR QUALITY

6.3.4 IAQ IN CAR PARKS

EXCLUSIONS

Buildings not provided with enclosed or semi-enclosed car parks.

OBJECTIVE

Meet the minimum requirements of performance in respect of air quality.

CREDITS ATTAINABLE

1

PRE-REQUISITES

Compliance with relevant chapters of the Occupational Safety and Health Ordinance.

CREDIT REQUIREMENT

1 credit for compliance with the air quality criteria specified in ProPECC PN 2/96.

ASSESSMENT

The Client shall submit a report prepared by a suitably qualified person demonstrating that the design of the ventilation system meets or exceeds the guidelines given in ProPECC PN 2/96 [1], including provisions for the monitoring and automatic control of air pollution. The report shall include an estimation of peak pollutant loading and the ventilation system performance to meet the maximum concentration of pollutants as listed in ProPECC PN 2/96.

Alternatively, compliance may be demonstrated by a series of measurements taken at appropriate locations during peak periods of use. Locations shall include main vehicular routes and main pedestrian areas. Where it can be demonstrated that monitoring systems and ventilation systems are able to respond to maintain the target pollutants within the prescribed limits of PN 2/96 the credit shall be awarded.

BACKGROUND

This applies to enclosed and semi-enclosed car parks that rely on mechanical ventilation or mechanically assisted natural ventilation.

1 Environmental Protection Department. Practice Notes for Professional Persons. ProPECC PN 2/96. Control of Air Pollution in Car Parks. http://www.epd.gov.hk/epd/english/resources_pub/publications/files/pn96_2.pdf

6 IEQ

6.3 INDOOR AIR QUALITY

6.3.5 IAQ IN PUBLIC TRANSPORT INTERCHANGES

EXCLUSIONS

Buildings without a Public Transport Interchange (PTI) included, or where the PTI does not form a part of the overall assessment.

OBJECTIVE

Meet the minimum requirements of performance in respect of air quality.

CREDITS ATTAINABLE

1

PRE-REQUISITES

None.

CREDIT REQUIREMENT

1 credit for compliance with the air quality criteria specified in ProPECC PN 1/98.

ASSESSMENT

The Client shall submit a report prepared by a suitably qualified person demonstrating that the design of the ventilation system meets or exceeds the guidelines given in ProPECC PN 1/98 [1], including any provisions for the monitoring and automatic control of air pollution. The report shall include an estimation of peak pollutant loading and the ventilation system performance to meet the maximum concentration of pollutants as listed in ProPECC PN 1/98.

Alternatively, compliance may be demonstrated by a series of measurements taken at appropriate locations during peak periods of use. Locations shall include main pedestrian areas. Where it can be demonstrated that monitoring systems and ventilation systems are able to respond to maintain the target pollutants within the prescribed limits of PN 1/98 the credit shall be awarded.

BACKGROUND

This applies to enclosed and semi-enclosed car parks that rely on mechanical ventilation or mechanically assisted natural ventilation.

1 Environmental Protection Department. Practice Notes for Professional Persons. ProPECC PN 1/98. Control of Air Pollution in Semi-confined Public Transport Interchanges. http://www.epd.gov.hk/epd/english/resources_pub/publications/files/pn98_1.pdf

6 IEQ

6.4 VENTILATION

6.4.1 VENTILATION IN AIR-CONDITIONED PREMISES

EXCLUSIONS

Residential and similar buildings using window units and/or split units.

OBJECTIVE

Ensure that ventilation systems provide for effective delivery to support the well being and comfort of occupants in normally occupied spaces.

CREDITS ATTAINABLE

2

PRE-REQUISITES

Compliance with CAP 123J Building (Ventilating Systems) Regulations.

CREDIT REQUIREMENT

a) Outdoor air ventilation rate

1 credit for demonstrating that the specified ventilation rate(s) in normally occupied areas is achieved.

b) Air change effectiveness

1 credit for demonstrating that the air change effectiveness in normally occupied areas meets the specified performance.

ASSESSMENT

The Client shall provide evidence in the form of a report prepared by a suitably qualified person detailing the performance criteria that has been adopted for each category of premises included in the building, and the results of measurements in the specified sample of premises to demonstrate compliance with the assessment criteria.

a) Outdoor air ventilation rate

Measurements shall demonstrate that the required amount of outdoor air corresponding to the corrected design ventilation rate is actually provided. Air flow measurements may be made using conventional procedures, such as described in ASHRAE 111 [1], or by tracer gas techniques in accordance with ASTM E 741 [2] or equivalent.

Where the corrected ventilation rate is achieved in a sample of each type of premises the credit shall be awarded.

b) Air change effectiveness

Compliance shall be demonstrated through measurement in accordance with ASHRAE 129 [3] or equivalent.

The measurement locations shall include at least one representative sample of each type of premises (normally occupied spaces) as defined by the type of HVAC system used, design occupancy density, nature of usage, zoning, etc. Measurements are required at the occupied zone in each representative test space. The measurements shall be undertaken under design occupancy conditions. All airstreams of the air-side system serving the measured spaces shall have a constant flow rate to the degree practical (e.g. the difference between the maximum and minimum should be within 10%).

Where the air change effectiveness is demonstrated to be equal or greater than 1, and matches the design intent in all sampled premises, the credit shall be awarded.

Alternatively, where it can be demonstrated that the levels of carbon

1 American Society of Heating Refrigeration and Air Conditioning Engineers. ASHRAE Standard 111. Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air Conditioning and Refrigeration Systems, Atlanta 1998
2 American Society for Testing and Materials. ASTM Standard E 741-00, Standard Test Methods for Determining Air Change in a Single Zone by Means of a Tracer Gas Dilution. Philadelphia, 2000.
3 American Society of Heating Refrigeration and Air Conditioning Engineers. ANSI/ASHRAE Standard 129 (RA 2002). Measuring Air-change Effectiveness. Atlanta 1997.

dioxide (CO_2) measured at appropriate locations in a representative sample of normally occupied areas is within the limits specified in the performance criteria the credits shall be awarded.

Where certification under the IAQ Certification scheme is current and covers all parts of the building for which HK-BEAM certification is being sought then the credits shall be awarded.

BACKGROUND

The purpose of this assessment is to demonstrate the adequacy of ventilation to provide for the control of odours, that is, the supply, distribution and control of ventilation to maintain carbon dioxide (CO_2) levels within design targets in normally occupied spaces when fully occupied. Design targets are set be the Client, but may take into account the targets set in the IAQ Certification Scheme [4]. Contamination of indoor air is dealt with under Indoor Air Quality. Air movement within spaces is dealt with under Thermal Comfort criteria.

It should be noted that the key references for this section, namely ASHRAE 62 and ASHRAE 129 use the terms ventilation effectiveness and air change effectiveness, respectively, for the same quantity, i.e., the ratio of the nominal time constant to the arithmetic mean of the ages of air in the breathing zone.

The air change effectiveness (ACE) is a measurement based on a comparison of the age of air in the occupied areas to the age of air that would exist under ideal conditions of perfect mixing (effectiveness = 1). ASHRAE 129 [3] provides a method for measuring ACE in mechanically ventilated spaces, however, the standard places limitations on the characteristics of the spaces that can be tested.

Different ventilation systems will generate different air flow patterns and therefore deliver different proportions of the outdoor air to the occupants' breathing zone. ACE has the value 1 for complete mixing systems. A value higher than 1 indicates a system with displacement ventilation characteristics, whereas a value less than 1 indicates ventilation short circuiting.

The design ventilation rate then needs to be corrected for the air change effectiveness, where the corrected design ventilation rate = design ventilation rate/(air change effectiveness). For displacement ventilation, the outdoor air flow rate will be less than the design ventilation rate. Conversely, for systems where some supplied air can bypass the breathing zone, the corrected design ventilation rate will be higher than the design ventilation rate.

For simple systems where the outdoor air serves only a single space, or a small number of similar spaces, the outdoor air flow rate can be measured either:

- using a pitot tube [5] and manometer to perform a pitot tube traverse in accordance with ASHRAE 111-98 [1] or ASHRAE Handbook [6] or
- using an installed Wilson Flow Grid with a manometer.

The majority of systems will be too complex for such measurements and the supply of outdoor air should be verified using a tracer gas measurement. ASTM 741-00 [2] describes the required properties of tracer gases and discusses procedures for tracer decay, tracer step up and constant concentration measurements.

4 Indoor Air Quality Management Group. A Guide on Indoor Air Quality Certification Scheme for Offices and Public Places. http://www.iaq.gov.hk/cert/doc/CertGuide-eng.pdf

5 International Organization for Standardization. ISO 3966-1977. Measurement of fluid flow in closed circuits - Velocity area method using Pitot static tubes.

6 American Society of Heating Refrigeration and Air Conditioning Engineers. ASHRAE Handbook Fundamentals. Atlanta 2001.

6 IEQ

6.4 VENTILATION

6.4.2 BACKGROUND VENTILATION

EXCLUSIONS

Buildings not designed to utilise natural ventilation.

OBJECTIVE

Ensure that normally occupied premises designed to utilise natural ventilation are provided with a minimum of background ventilation to control indoor air pollutants.

CREDITS ATTAINABLE

2

PRE-REQUISITES

Compliance with the Building (Planning) Regulations (B(P)Reg.) 30, 31 and 32.

CREDIT REQUIREMENT

1 credit for demonstrating the adequacy of ventilation in all normally occupied or habitable rooms with windows closed.

1 additional credit where it can be demonstrated that adequate ventilation is achieved by natural means.

ASSESSMENT

The Client shall provide evidence in the form of a report by a suitably qualified person stating the ventilation criteria adopted in the design of normally occupied and/or habitable spaces, and that the appropriate analysis or measurements have been undertaken to verify the adequacy of background ventilation (minimum air change rate). Compliance should be demonstrated using any suitably verified or scientifically validated method, , for example a tracer gas decay test [1], for at least one representative worst case sample of each occupied space for average wind conditions under 'windows closed' conditions, but with any purpose designed ventilators 'open'.

The credit shall be awarded where it can be demonstrated that background ventilation in normally occupied and/or habitable rooms under conditions when windows are closed meets minimum levels as prescribed in standards and guidelines from a recognised authority.

Where this can be achieved wholly by natural means the second credit shall be awarded.

BACKGROUND

Background ventilation is a combination of uncontrolled air infiltration and ventilation through purposely designed vents. Purpose designed ventilation is preferable to relying on uncontrolled infiltration. HK-BEAM seeks to encourage designs that provide for adequate background ventilation by natural means when windows are closed, i.e., through the provision of purpose designed ventilators. Where this is not feasible, recourse may be made to reliable means of mechanical ventilation, e.g. extract fans drawing air through normally occupied/habitable rooms.

Background ventilation is intended to dilute the unavoidable contaminant emissions from people and materials (e.g. radon) and for control of internal moisture levels due to occupant activities in order to minimise risk of mould growth. During periods when windows and other openings are closed it is possible for indoor radon levels to rise above the criteria recommended by the Environmental Protection Department [2]. Local research on residential buildings suggests that 0.5 to 1 Ach would be sufficient to maintain radon below the target level 3.

For domestic buildings the Building Authority (BA) advises the following performance criteria for the provision of natural ventilation in habitable rooms [4]:

1 ASTM E 741-00. Standard Test Method for Determining Air Change in a Single Zone by means of a Tracer Gas Dilution. American Society for Testing Materials. Pasadena USA. 2000.

Room of domestic building	Air Change per Hour (ACH)
Habitable Room	1.5 (natural means)
Kitchen	1.5 (natural means) plus 5 (mechanical means)

2 Indoor Air Quality Management Group. A Guide on Indoor Air Quality Certification Scheme for Offices and Public Places. http://www.iaq.gov.hk/cert/doc/CertGuide-eng.pdf

3 Chao C Y H, Tung T C W, Burnett J. Influence of ventilation on indoor radon level. Building and Environment. Vol. 32, No. 6. pp 527-534. 1997.

4 Buildings Department Practice Note for Authorized Persons and Registered Structural Engineers, PNAP 278. Lighting and Ventilation Requirements – Performance-based Approach. http://www.info.gov.hk/bd/english/documents/pnap/Pnap278.pdf

6 IEQ

6.4 VENTILATION

6.4.4 LOCALISED VENTILATION

EXCLUSIONS

None.

OBJECTIVE

Prevent exposure of building occupants to concentrated indoor sources of pollutants.

CREDITS ATTAINABLE

1

PRE-REQUISITES

Compliance with CAP 123J Building (Ventilating Systems) Regulations

CREDIT REQUIREMENT

1 credit for the provision of an adequate ventilation system for rooms/areas where significant indoor pollution sources are generated.

ASSESSMENT

The Client shall provide evidence in the form of a report prepared by a suitably qualified person detailing the design criteria that has been adopted and details of the ventilation system providing for local exhaust where concentrated pollutant sources are likely to be present. The report shall provide details of tests and the results demonstrating that the design performance is achieved. Where the design ventilation rate specified is lower than that specified in a recognised international or national standard the client shall demonstrate through appropriate testing that there is 99% isolation between areas with concentrated pollutant sources and occupied areas.

BACKGROUND

Concentrated pollution sources are best managed at source. The provision of localised ventilation, segregated from the general ventilation, is an appropriate strategy. In commercial and similar premises sources such as photocopying equipment, smoking lounges, etc. should be provided with dedicated exhaust systems. In other buildings local exhaust is intended to remove contaminants from specific rooms such as kitchens, in which concentrated sources are expected.

DOMESTIC KITCHENS

PNAP 278 [1] specifies performance based criteria for kitchen ventilation as an alternative means of satisfying Building (Planning) Regulations (B(P)Reg.) 30, 31 and 32. These criteria are 1.5 Ach under natural ventilation, plus 5 Ach from mechanical means i.e. these values are by definition the minimum legal requirement. Whilst these are performance based alternatives to the prescriptive criteria they are considered worthy of credit. It should be noted that specifying higher values may result in negatively pressurising the building and causing other IAQ problems with in flow of air from other spaces.

Elsewhere, ASHRAE 62.2 [2] states that kitchen fans are mandatory as this standard considers that windows do not provide sufficient ventilation, although this standard specifically applies to low rise residential units (3 storeys or less above grade) and wind conditions may not be as favourable for ventilation as in the case of high rise buildings. The basic requirement is that a vented cooker hood can exhaust 100 cfm (approx 50 l/s). An alternative approach is that ventilation (either continuous or intermittent) of 5 Ach be achieved.

1 Buildings Department. Practice Note for Authorized Persons and Registered Structural Engineers, PNAP 278. Lighting and Ventilation Requirements - Performance Based Approach.http://www.info.gov.hk/bd/english/documents/pnap/Pnap287.pdf

2 ASHRAE 62.2-2003. Ventilation and Acceptable Indoor Air Quality in Low Rise Residential Buildings. American Society of Heating, Refrigerating and Air Conditioning Engineers. Atlanta. 2003.

COMMERCIAL KITCHENS In commercial kitchens a mechanical ventilation rate of 20 Ach may be appropriate [3] for the cooking styles found in Hong Kong.

BATHROOMS AND TOILETS Where mechanical ventilation in the form of extractor fan is provided in bathrooms and lavatories, care should be taken to ensure that plumbing seals are intact and operate according to the design intent [4]. In addition, consideration should be given to the quality and quantity of air intake, air-flow path and fan capacity. The Environmental Health Team of the World Health Organisation (WHO) has advised that the optimum flow rate for bathroom ventilation is 2 cfm/sq ft (10.2 $l\ s^{-1}\ m^{-2}$). WHO is of the view that a larger flow rate does not add much on the comfort side and has the hidden risk of building up negative pressure in the room. It is recommended to provide an opening to bathrooms and lavatories for air relief, such as an undercut to the door or an opening with louver at the door or wall, in order to minimise the build-up of negative pressure in case an extractor fan is provided for ventilation.

REFUSE AREAS Exhaust from refuse storage areas and material recovery centres (RS & MRC) should follow the principles of PNAP 98 [5]. In the cases where a centralised ventilation system is adopted, a single air purifier may be installed prior to the air being exhausted to the atmosphere. If there are no odour problems then a mechanical fan and filter can be used. The main exhaust outlet for a centralised system should be located at roof level away from other buildings. If the building is surrounded by taller buildings then the air may be exhausted at the main RS & RMC location.

The noise level of the system should conform with the Technical Memorandum published under the Noise Control Ordinance (Cap 400). Fire dampers should be provided if the system has exhaust grilles and ducting at each floor.

CHIMNEYS AND FLUES The siting and height of chimneys and flues should follow PNAP 45 [6]. In particular, chimneys and flues should be situated so that products of combustion cannot enter windows, ventilation openings, supply air intakes.

3 Singapore Standard SS CP13. Code of Practice for Mechanical Ventilation and Air Conditioning in Buildings.

4 Buildings Department. Practice Note for Authorized Persons and Registered Structural Engineers, PNAP 285. Extractor Fans in Bathrooms and Lavatories in Domestic Buildings. http://www.info.gov.hk/bd/english/documents/pnap/Pnap285.pdf

5 Buildings Department. Practice Note for Authorized Persons and Registered Structural Engineers, PNAP 98. Refuse Storage and Collection Building (Refuse Storage and Material Recovery Chambers and Refuse Chutes) Regulations. http://www.info.gov.hk/bd/english/documents/pnap/Pnap098.pdf

6 Buildings Department. Practice Note for Authorized Persons and Registered Structural Engineers, PNAP 45. Chimneys and Flues. http://www.info.gov.hk/bd/english/documents/pnap/Pnap045.pdf

6 IEQ

6.4 VENTILATION

6.4.5 VENTILATION IN COMMON AREAS

EXCLUSIONS

Spaces covered under the section on Localised Ventilation.

OBJECTIVE

Ensure adequate ventilation in common areas and circulation routes within premises and to avoid cross-contamination between areas.

CREDITS ATTAINABLE

1 + 1 BONUS

PRE-REQUISITES

Compliance with applicable regulations covering ventilation provisions in buildings.

CREDIT REQUIREMENT

a) Ventilation by any means

1 credit for demonstrating that all enclosed common areas in a building are provided with adequate ventilation.

b) Use of natural ventilation

1 BONUS credit where the provision for ventilation is by natural means.

ASSESSMENT

The Client shall provide evidence in the form of a report prepared by a suitably qualified person detailing the performance criteria that has been adopted for each type of common area included in the building, and the results of measurements in the specified sample of spaces to demonstrate compliance with the assessment criteria.

a) Ventilation by any means

Design ventilation rates shall be defined by the Client, but should comply with recommendations from recognised authorities, e.g. BS 5925 [1], ASHRAE 62 [2] or equivalent. Compliance shall be demonstrated by measurements on a representative sample of each type of space, including worst cases, under average wind conditions.

b) Use of natural ventilation

Where natural ventilation is employed it shall demonstrated that the ventilation rate specified is achieved under average wind conditions in at least 80% of the common areas, aggregated by floor area. Compliance may be demonstrated by suitable commissioning measurements such as a tracer gas test [3] on a representative sample of spaces, including worst cases. In the case of naturally ventilated spaces, measurements should be made under conditions when windows are closed and purpose designed ventilators are open.

Compliance is conditional that outside air brought in to common areas should be free from known or potential localised sources of pollution (e.g. motor vehicle exhaust, workshops, etc), and exhausted air contain does not contaminate public areas or occupied areas.

BACKGROUND

Building owners should consider the provision of ventilation to common areas, such as corridors, lift lobbies, entrance lobbies, etc. [4]. Where design constraints render the provision of natural ventilation as not feasible, mechanical ventilation should be provided to improve the indoor environment. Good practices when designing mechanical ventilation in

1 BS 5929: 1991 (Amendment No. 1) Code of practice for Ventilation Principles and designing for Natural Ventilation. British Standards Institute, London, 1995.
2 American Society of Heating, Refrigerating and Air Conditioning Engineers. ASHRAE 62-2001. Ventilation for Acceptable Indoor Air Quality. American Society of Heating, Refrigerating and Air Conditioning Engineers. Atlanta, 2001.
3 ASTM International. E 741-00. Standard Test Method for Determining Air Change in a Single Zone by means of a tracer Gas Dilution. 2000
4 Buildings Department. Practice Note for Authorized Persons and Registered Structural Engineers, PNAP 287. Ventilation of Common Corridors and Lift Lobbies in Buildings. http://www.info.gov.hk/bd/english/documents/pnap/Pnap287.pdf

public areas require:

- the ventilation system to be capable of providing sufficient fresh air taking into account the anticipated population;
- intake and exhaust points be properly designed to prevent contamination of fresh air supply and avoid short-circuiting; and
- the ventilation system and its associated ductwork, where provided, should be conveniently accessible for maintenance.

Ventilation for bathrooms, kitchens, refuse rooms, etc., as covered elsewhere in HK-BEAM, may be sources of pollution affecting common areas.

6 IEQ

6.5 THERMAL COMFORT

6.5.1 THERMAL COMFORT IN AIR-CONDITIONED PREMISES

EXCLUSIONS

Premises where air-conditioning is provided by window units or split units.

OBJECTIVE

Ensure that the air-conditioning system can provide the stated design conditions in occupied spaces under changing load conditions.

CREDITS ATTAINABLE

3

PRE-REQUISITES

None.

CREDIT REQUIREMENT

a) Temperature

1 credit for sustaining the air temperature at the design value within ±1°C when the air side system is operating at steady state under conditions of zero occupancy.

1 credit for sustaining the air temperature at the design value within ±1°C when the air side system is operating at steady state under simulated full-load conditions.

b) Room air distribution

1 credit where room air diffusers satisfy the Air Diffusion Performance Index.

ASSESSMENT

The Client shall provide evidence in the form of a report prepared by a suitably qualified person detailing the performance criteria with respect to thermal comfort conditions for all types of premises included in the building, and the results of the measurements in the specified sample of premises.

a) Temperature

The measurement locations shall include at least one representative sample of each type of premises (occupied spaces) as defined by the type of HVAC system used, design occupancy density, nature of usage, zoning, etc. The main physical parameters of the indoor climate (air temperature and relative humidity) are undertaken: i) with no occupants, and ii) with full or simulated full occupancy. The results shall demonstrate compliance with the prescribed design criteria within the prescribed limits, for a minimum of 90% of the prescribed locations. In the case of i) it will demonstrate that the HVAC system is capable of 'turn-down' to the lower limit and for ii) it can demonstrate the ability to meet the design load. The sensors used in the measurement survey shall have an accuracy that complies with ASHRAE 55-1992 [1], ISO 7726 [2] or equivalent.

Where certification under the IAQ Certification scheme [3] is current and covers all parts of the building for which HK-BEAM certification is being sought then the credits shall be awarded.

b) Room air distribution

The measurement locations shall be as for a). The assessment of

1 American Society of Heating, Refrigeration and Air-conditioning Engineers. ASHRAE 55-1992: Thermal Environmental Conditions for Human Occupancy. Atlanta 1992.
2 International Standard Organization. International standard 7726, Ergonomics of the thermal environment — Instruments for measuring physical quantities. 1998.
3 Indoor Air Quality Management Group. A Guide on Indoor Air Quality Certification Scheme for Offices and Public Places. http://www.iaq.gov.hk/cert/doc/CertGuide-eng.pdf

performance shall be in accordance with ASHRAE 113 [4] or equivalent standard method.

BACKGROUND The ability of the HVAC system to respond to part-load demand (i.e. partial occupancy and activity levels) is a key determinant for maintaining thermal comfort (as well as saving energy). It should be possible to maintain room conditions (within acceptable tolerances) with no occupants present, and with full occupancy. Measurements under such circumstances can demonstrate compliance with the operating requirements.

4 American Society of Heating, Refrigerating and Air-conditioning Engineers. ASHRAE 113-1990: Method of Testing for Room Air Diffusion. Atlanta.

6 **IEQ** **6.5 THERMAL COMFORT**

6.5.2 THERMAL COMFORT IN NATURALLY VENTILATED PREMISES

EXCLUSIONS Buildings that are not designed to utilise natural ventilation.

OBJECTIVE Promote the application of measures that reduce elevated temperatures caused by external heat gains, and ensure installed air-conditioning units can provide adequate control of indoor temperature.

CREDITS ATTAINABLE 2

PRE-REQUISITES None

CREDIT REQUIREMENT

a) Performance with natural ventilation

1 credit for demonstrating indoor operative temperatures in occupied/habitable rooms meet the 80% acceptability limits.

b) Performance with air-conditioning

1 credit for sustaining the air temperature at the design value within ±1.5°C when the air-conditioning unit is operating at steady state under conditions of zero occupancy.

ASSESSMENT

a) Performance with natural ventilation

The assessment will seek to establish the extent to which the building envelope mitigates the effects of external heat gains. The indoor operative temperature shall be compared with the criteria given in ASHRAE 55 [1] under the 'Optional Method for Determining Acceptable Thermal Conditions in Naturally Conditioned Spaces'.

Assessment may be confined to the 'worst case' scenarios, i.e., for those normally occupied areas of the building most susceptible to external heat gains and/or do not benefit from the prevailing climatic conditions. The spaces in question must be equipped with operable windows that can be readily opened and adjusted by the occupants. Mechanical cooling for the space shall not be provided, although mechanical ventilation with unconditioned air may be utilized.

Compliance may be demonstrated under appropriate summer conditions through the measurement of temperature in suitable locations in a sample of premises most exposed to external heat gains.

The Client shall provide evidence in the form of a report prepared by a suitably qualified person detailing any means used to control the external (solar) heat gains, the details of measuring equipment, sampling locations, sampling time, time of measurements, external temperature and prevailing weather conditions.

Where it can be demonstrated that the indoor temperature lies within the 80% acceptability limits given in ASHRAE 55-2004 a credit shall be awarded.

b) Performance with air-conditioning

The measurement locations shall include at least one representative sample of each type of premises (occupied spaces) as defined by the type of HVAC system used, design occupancy density, nature of usage, zoning, etc. The measurements shall be undertaken with no occupants. The sensors used in the measurement survey shall have an accuracy

1 American Society of Heating, Refrigeration and Air-conditioning Engineers. ASHRAE 55-2004: Thermal Environmental Conditions for Human Occupancy. Atlanta 2004.

that complies with ISO 7726 [2] or equivalent. To earn credit the results shall demonstrate compliance with the prescribed design criteria within the prescribed limits, for a minimum of 90% of the prescribed locations.

BACKGROUND

Thermal comfort standards such as ISO 7730 [3] and ASHRAE 55 establish relatively tight limits on recommended indoor thermal environments, and do not distinguish between what would be considered thermally acceptable in buildings conditioned with natural ventilation. Field studies and research has demonstrated that occupants of buildings with centralized HVAC systems become finely tuned to the very narrow range of indoor temperatures provided, developing high expectations for homogeneity and cool temperatures, and soon became critical if thermal conditions do not match these expectations [4,5]. In contrast, occupants of naturally ventilated buildings are more tolerant of a wider range of temperatures. This range extends beyond the comfort zones established for air-conditioned buildings, and may more closely reflect the local patterns of outdoor climate.

Analysis of the available data has established that behavioural adaptations, such as changes in clothing insulation or indoor air speeds, could account for only half the observed variance in thermal preferences of people when in naturally ventilated buildings. Given that physiological adaptation is unlikely to play much of a role; it is suggested that the rest of the variance is attributable to psychological factors [4]. Relaxation of thermal expectations may be due to a combination of higher levels of perceived control and a greater diversity of thermal experiences in a naturally ventilated building.

For the purposes of ASHRAE 55-2004, occupant-controlled naturally conditioned spaces are those spaces where the thermal conditions of the space are regulated primarily by the occupants through opening and closing of windows. The 'Optional Method for Determining Acceptable Thermal Conditions in Naturally Conditioned Spaces' is intended for such spaces. In order for this optional method to apply, the space in question must be equipped with operable windows that open to the outdoors and that can be readily opened and adjusted by the occupants of the space. Allowable indoor operative temperatures for spaces that meet these criteria may be determined from Figure 5.3 in ASHRAE 55-2004. This figure includes two sets of operative temperature limits—one for 80% acceptability and one for 90% acceptability. The 80% acceptability limits are for typical applications and shall be used when other information is not available.

The allowable operative temperature limits in Figure 5.3 may not be extrapolated to outdoor temperatures above and below the end points of the curves in this figure. If the mean monthly outdoor temperature is less than 10°C or greater than 33.5°C, this option may not be used, and no specific guidance for naturally conditioned spaces is included in this standard. Consequently, for the HK-BEAM assessment, months for which the mean monthly outdoor temperatures are outside these limits can be discounted.

When air-conditioning is likely to be installed the type, rating and installation of units should be such as to provide for control over thermal comfort conditions over the range of thermal loads that are likely to arise.

2 International Standard Organization. ISO 7726, Ergonomics of the thermal environment — Instruments for measuring physical quantities. 1998.
3 International Standard Organization. ISO 7730. Moderate thermal environments – Determination of the PMV and PPD indices and specification of the conditions for thermal comfort.
4 de Dear R, Brager G S, Reardon J, Nicol F et al. Developing an adaptive model of thermal comfort and preference/ Discussion. ASHRAE Transactions. Vol. 104. 1998. pp 145-167.
5 Brager G S, de Dear R. A Standard for Natural Ventilation. ASHRAE Journal. October 2000. pp 21-28.

6 IEQ

6.6 LIGHTING QUALITY

6.6.1 NATURAL LIGHTING

EXCLUSIONS

None.

OBJECTIVE

Maximise access to daylight for the purposes of improved health and comfort.

CREDITS ATTAINABLE

3

PRE-REQUISITES

None.

CREDIT REQUIREMENT

1 credit where the provision of daylight meets the levels specified in PNAP 278 for vertical daylight factor OR the average daylight factor (DF) is at least 0.5% for all normally occupied spaces.

2 credits where the average daylight factor in all normally occupied spaces is at least 1%.

3 credits where the average daylight factor in all normally occupied spaces is at least 2%.

ASSESSMENT

The Client shall submit evidence in the form of a report prepared by a suitably qualified person demonstrating compliance with the assessment criteria. Daylight availability, based on 'worst case' scenarios, i.e., the most obstructed windows, shall be demonstrated by either one of the following methods.

a) Measurement of VDF

On-site measurements for a selection of windows that are shown by design drawings to have the greatest external obstructions. The measurements should be carried out during stable overcast sky conditions.

To assess vertical daylight factor (VDF) an illuminance meter should be placed at the centre of the window and another illuminance meter on a horizontal plane under an unobstructed sky. In practice, a completely unobstructed horizontal plane may be difficult to achieve in the Hong Kong urban environment and the roof of the building may be a good approximation to an unobstructed horizontal plane. The two illuminance meters should be read simultaneously and the ratio of the illuminance on the window and the illuminance on the unobstructed horizontal plane is taken as the vertical daylight factor.

To qualify for credit the glazing visual transmittance, obtained from manufacturer's specification of the glazing product or by measurement, shall be equal or greater than 70%.

b) Measurement of DF

Measurement of average daylight factor (DF) shall be by the methods recommended by CIBSE [1], or equal equivalent.

Given that the specified sky condition can be difficult to obtain in practice the following modelling methods are acceptable alternatives.

BACKGROUND

Access to daylight is an important aspect of building design from the perspectives of comfort and health. Critical to providing sufficient daylight is the provision of a view of the sky. The amount of daylight available for specific rooms is related to:

1 The Chartered Institution of Building Services Engineers. Applications Manual – Window design.

- window and room geometry and room surface finishes;
- sky obstruction due to the form of the building and its overshadowing from neighbouring buildings;
- glazing transmittance.

In Hong Kong's congested built form rooms on lower floors of buildings may be considerably overshadowed by the built form. This can result in significantly reductions in natural light, and will incur increased electricity consumption for artificial lighting, and degradation of internal comfort and health conditions.

A typical overcast sky condition in Hong Kong provides 5000 to 10000 lux, so a 1% average DF is an average of 50 to 100 lux in the space.

6 IEQ **6.6 LIGHTING QUALITY**

6.6.2 INTERIOR LIGHTING IN NORMALLY OCCUPIED AREAS

EXCLUSIONS

Residential buildings, hotels and apartment buildings.

OBJECTIVE

Ensure the adequacy and maintenance of visual comfort conditions achieved by the electric lighting provisions in occupied spaces.

CREDITS ATTAINABLE

2.

PRE-REQUISITES

None.

CREDIT REQUIREMENT

a) Illuminance

1 credit where the prescribed lighting performance in each type of premises in respect of maintained illuminance and illuminance variation is achieved.

b) Lighting quality

1 credit for lighting installations in which:

the limiting unified glare rating is achieved; and

light sources have an appropriate colour rendering index.

ASSESSMENT

The design criteria for interior lighting shall be at the discretion of the Client but shall embrace both 'quantity' and 'quality' of the lighting system performance including: maintained horizontal, and where appropriate vertical, illuminance, illuminance variation, limiting glare index, colour rendering, and modulation of light output appropriate to the type and use of the premises/indoor spaces.

The criteria adopted shall be based on authoritative guidance, such as that provided in CIE [1,2], CIBSE [3] and/or IESNA [4] publications, or equivalent. As the focus is on lighting for comfort and productivity, lighting for performing arts, display decoration, ambience. etc., shall normally be excluded from consideration.

Compliance with the assessment criteria shall be demonstrated by measurements using a standardised measurement protocol appropriate to the parameter being assessed. Demonstration of compliance requires that the maintained illuminance take into account lighting maintenance plan (the period for luminaire cleaning and group re-lamping) appropriate to the circumstances [5].

The Client shall submit a report prepared by a suitably qualified person detailing the 'as installed' lighting systems or, for premises/spaces not fitted-out, the technical details of the proposed lighting systems for each type of normally occupied space within the building. The report shall detail the design criteria and the results of measurements or other means demonstrating compliance. For premises to be fitted out by tenants compliance shall be confirmed if the technical details and contractual arrangements with tenants in respect of lighting installations is deemed to meet the assessment criteria.

MEASURED PERFORMANCE

For lighting installations that are already installed, horizontal and vertical illuminance and luminance can be measured using a lux meter and a luminance meter. The colour quality of lamps can be assessed from the

1 Commission Internationale de l'Eclairage (CIE). Lighting of Indoor Work Places. CIE Standard S 008/E.
2 Commission Internationale de l'Eclairage (CIE). Discomfort Glare in Interior Lighting. CIE 117-1995.
3 The Chartered Institution of Building Services Engineers. Code for interior lighting. London. CIBSE.
4 Illuminating Engineering Society of North America. Lighting Handbook, Reference & Applications. 9th edition., New York.
5 Commission Internationale de l'Eclairage (CIE). Maintenance of indoor electric lighting systems. CIE Technical Report - Publication No. 97. Vienna.

lamp specifications. Colour appearance (correlated colour temperature) can be checked from the lamp labels or by measurement using a colour meter. Flicker can be assessed by whether the specified ballasts are magnetic or electronic, and can be tested using a simple 'flicker meter'.

COMPUTATION

The 'lumen method' can 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 or in Appendix 3 of the CIBSE Lighting Guide [6]. The calculated maintained illuminance will then be checked for compliance with the recommendations given in Section 2.6.4 of the Code, or the recommendations given in Chapter 5 of the Guide.

The illuminance variation consists of 'unifomity' which is concerned with illuminance conditions on the task and immediate surroundings, and 'diversity' which expresses changes in illuminance across a larger space. The uniformity and diversity can be calculated according to that described in Section 4.5.4 of the Code. 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 can be calculated according to either of the two methods described by CIE [2], or the CIBSE Technical Memoranda [7]. These methods are also summarised in Section 4.5.6 of the CIBSE Code [3]. The calculated glare index shall be checked for compliance with the recommendations given in Section 2.6.4 of the Code or Chapter 5 of the Lighting Guide.

For assessment using the IESNA Lighting Criteria, the calculation methods described in Chapter 9 of the IESNA Lighting Handbook can be used for the calculation of the following parameters:

- horizontal and vertical illuminance;
- glare: VCP or UGR; and
- luminance.

Alternatively, a validated computer program such as RADIANCE, LIGHTSCAPE etc can be used for the calculation. The calculated results will then be checked for compliance with the recommended criteria in the IESNA Lighting Design Guide.

BACKGROUND

Energy efficiency aspects of electric lighting are dealt with in the assessment of energy use. This section deals with the lighting quality and maintenance aspects of lighting. Lighting quality is a complicated subject and is an integration of task performance, visual comfort, social communication, mood, health, safety and well-being and aesthetic judgement. It is also related to economics and the environment in respect of the installation, maintenance and operation of the lighting system.

Proper lighting maintenance (clean lamps and luminaires, lamps replaced periodically to avoid the depreciation) is important to maintain good lighting quality throughout the whole life of the lighting installation.

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

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

6 IEQ

6.6 LIGHTING QUALITY

6.6.3 INTERIOR LIGHTING IN AREAS NOT NORMALLY OCCUPIED

EXCLUSIONS

None.

OBJECTIVE

Ensure the adequacy of artificial lighting provisions in common areas and service areas such as plant rooms.

CREDITS ATTAINABLE

1

PRE-REQUISITES

Compliance with the Building Regulations for those common areas covered by regulations, e.g. Building (Planning) Regulation (B(P)R) 40 in respect of lighting of staircases.

CREDIT REQUIREMENT

1 credit where the prescribed lighting performance in each type of common or service space in respect of light output and lighting quality is achieved.

ASSESSMENT

Here the focus is on lighting for safety, security and work activities required for operation and maintenance. The design criteria is at the discretion of the Client but shall embrace both 'quantity' and 'quality' of the lighting system performance including: maintained horizontal, and where appropriate vertical, illuminance, illuminance variation, limiting glare index, colour rendering, and modulation of light output appropriate to the type and use of the premises/indoor spaces. The criteria adopted shall be based on authoritative guidance, such as that provided in CIE [1,2], CIBSE [3] and/or IESNA [4] publications, or equal.

The Client shall submit a report prepared by a suitably qualified person detailing the 'as installed' lighting systems or, for spaces yet to be fitted-out, the technical details of the proposed lighting systems for each type common or service space within the development. The report shall detail the design criteria and the results of measurements or other means demonstrating compliance.

Compliance with the assessment criteria shall be demonstrated either by measurements using a standardised measurement protocol appropriate to the parameter being assessed, and/or by modelling (calculation), providing the calculation method or software used is based on a standardised method, and uses data/assumptions appropriate to the circumstances. Notwithstanding, demonstration of compliance with a) requires that the maintained illuminance take into account the influence on light output appropriate to the circumstances, such as the recommendations given by CIE [5].

BACKGROUND

Energy efficiency aspects of electric lighting are dealt with in the assessment of energy use. This section deals with the lighting quality and maintenance aspects of lighting systems provided in both common areas and service areas of a building.

Reference should be made to Section 6.6.2 for further information on measurements and modelling on interior lighting systems.

1 Commission Internationale de l'Eclairage (CIE). Lighting of Indoor Work Places. CIE Standard S 008/E.
2 Commission Internationale de l'Eclairage (CIE). Discomfort Glare in Interior Lighting. CIE 117-1995.
3 The Chartered Institution of Building Services Engineers. Code for interior lighting. London. CIBSE.
4 Illuminating Engineering Society of North America. Lighting Handbook, Reference & Applications. New York.
5 Commission Internationale de l'Eclairage (CIE). Maintenance of indoor electric lighting systems. CIE Technical Report - Publication No. 97. Vienna.

6 IEQ

6.7 ACOUSTICS AND NOISE

6.7.1 ROOM ACOUSTICS

EXCLUSIONS

Buildings/premises where speech intelligibility is not important, and rooms of a special acoustical nature.

OBJECTIVE

Improve the acoustical properties of rooms in which speech intelligibility is important.

CREDITS ATTAINABLE

1

PRE-REQUISITES

None.

CREDIT REQUIREMENT

1 credit for demonstrating that the reverberation time in applicable rooms meets the prescribed criteria for given types of premises.

ASSESSMENT

There is no single all-encompassing set of criteria that will define good acoustical properties for all types of rooms and uses. The Client shall define the criteria appropriate to the type and use of the premises/rooms in the building. However, for the purposes of assessment account should be taken of the criteria given below. Where alternative criteria is used the Client shall provide evidence as to the suitability of the alternative, e.g. by making reference to authoritative guidance. Likewise, where criteria appropriate to the type and use of premises/spaces is not stated herein, the Client shall provide evidence as to the suitability of the criteria adopted.

Compliance shall be demonstrated by detailed calculations, or measurement, or both, depending on the Client's preference. The reverberation time shall be assessed using Sabine's formula [1] or similar alternative taking into account the room details and appropriate assumptions about the materials in the space. Measurements during commissioning shall use the method given in ISO 3382 [2] or equal equivalent.

The Client shall submit details in the form of a report prepared by a suitably qualified person providing a schedule of the premises and spaces in the building, relevant design details as they impact on acoustical properties, the rooms/premises subject to field tests or for which detailed calculations have been made, the acoustical criteria used, underlying assumptions, and the results of tests or calculations demonstrating compliance with the criteria.

Where it can be demonstrated that the acoustical quality in a sample of each type of room in which speech intelligibility is important, as measured or calculated, meets appropriate performance criteria the credit shall be awarded.

PERFORMANCE CRITERIA

a) Office type premises

The reverberation time of A-weighted sound pressure level, in modular (private) offices and conference rooms, shall be 0.6 s or below.

b) Classrooms and similar premises

The reverberation time of A-weighted sound pressure level in teaching rooms, other than specialist teaching rooms such as laboratories and workshops, shall be 0.6 s or below.

c) Residential premises, hotel and apartments

1 I.Sharland. Woods practical guide to noise control. Colchester, England.
2 International Standard Organization. ISO 3382. Acoustics - Measurement of the reverberation time of rooms with reference to other acoustical parameters.

The reverberation time of A-weighted sound pressure level, in bedrooms and living rooms, shall be between 0.4 and 0.6 s.

Criteria from standards and guides from authoritative sources should be referenced. For example, Table 8 of BS 8233 [3] provides a guide to reverberation time in unoccupied rooms for speech and music.

BACKGROUND

The focus for HK-BEAM is on the acoustical qualities in workplaces such as offices and classrooms, libraries, and places of residence, etc. Whilst the matter of room acoustics is complex, and defining performance by a single indicator is problematic, an important acoustical measurement is the reverberation time. It is used to determine how quickly sound decays in a room, and offers a relatively simple assessment of acoustical design.

HK-BEAM is not intended to substitute the design standards. It set criteria for good acoustical quality while the design guidelines and standards established in other countries can also be considered.

Whilst reverberation time continues to be regarded as a significant parameter, there is reasonable agreement than other types of measurements are needed for a more complete evaluation of acoustical quality of rooms. With respect to the standards and guides recommendations, ANSI [4] suggests the maximum reverberation time of A-weighted sound pressure level in classrooms and similar learning spaces. However, the offices type premises, residential premises, hotel and apartment there seems to be little available in the way of standards or guides. ASTM [5] gives alternative parameter, speech privacy in open offices, for an average speech spectrum using the Articulation Index Method.

3 British Standards Institution BS8233:1999 – Sound insulation and noise reduction for buildings – Code of Practice.
4 American National Standard ANSI S12.60-2002.
5 ASTM International. Designation E1130-02. Standard Test Method for Objective Measurement of Speech Privacy in Open Offices Using Articulation Index.

6 IEQ

6.7 ACOUSTICS AND NOISE

6.7.2 NOISE ISOLATION

EXCLUSIONS

Buildings/premises which are inherently noisy and unaffected by noise from adjacent premises/spaces.

OBJECTIVE

Improve the noise isolation of normally occupied premises/rooms to reduce impact of unwanted noise.

CREDITS ATTAINABLE

2

PRE-REQUISITES

None.

CREDIT REQUIREMENT

1 credit for demonstrating airborne noise isolation between rooms, spaces and premises meets the prescribed criteria.

1 credit for demonstrating impact noise isolation between floors meets the prescribed criteria.

ASSESSMENT

As there are a number of ways to quantify or classify noise isolation (insulation) in buildings, the exact performance criteria used to define both airborne noise isolation and impact noise isolation shall be stated by the Client. However, for the purposes of assessment account should be taken of the criteria given below. Where alternative criteria is used the Client shall provide evidence as to the suitability of the alternative, e.g. by making reference to authoritative guidance. Likewise, where criteria appropriate to the type and use of premises/spaces is not stated herein, the Client shall provide evidence as to the suitability of the criteria adopted.

Compliance shall be demonstrated by measurement or by detailed calculations, or both, depending on the Client's preference. Measurements shall follow the protocols given in the referenced standards. Calculations should be done with reference to appropriate standards.

The Client shall submit details in the form of a report prepared by a suitably qualified person providing a schedule of the premises and spaces in the building, the noise isolation criteria adopted, relevant structural details as they impact on noise isolation, the rooms/premises subject to field tests or for which detailed calculations have been made, underlying assumptions, and the results of tests or calculations demonstrating compliance with the criteria (expressed in parameters that are consistent with the test and/or calculation methods).

Where it can be demonstrated that airborne noise isolation, as measured or calculated for the most susceptible spaces/rooms/premises, meets appropriate performance criteria the credit shall be awarded. Similarly, where it can be demonstrated that impact noise isolation (insulation) meets appropriate performance criteria in the most susceptible spaces/ rooms/premises, the credit shall be awarded.

MEASUREMENTS

Procedures for measuring the sound isolation between rooms shall follow that given in either ISO [1], ASTM [2] or equal equivalent. The measurements shall be undertaken in at least one sample of each type of normally occupied space, but shall include the worst case circumstances likely to occur (e.g., conference rooms adjacent to corridors, hotel rooms adjacent to lift lobbies, etc). No special preparation

1 International Standard Organization. ISO 140-4: 1998. Acoustics - Measurement of sound Insulation in buildings and of building elements. Part 4: Field measurements of airborne sound insulation between rooms.

2 ASTM International. Designation E 336 – 97. Standard Test Method for Measurement of Airborne Sound Insulation in Buildings.

of the tested spaces or rooms is permitted, i.e., tests are carried out in as-built premises/rooms. The measurements shall be interpreted to a single number indicator using either ISO [3], ASTM [4], or equal equivalent.

Similar considerations shall apply to the measurement of impact noise isolation, following the methods given in either ISO [5], ASTM [6] or equal equivalent. No floor coverings, such as carpets, shall be used during the measurements. The measurements shall also be interpreted as a single number using either ISO [7], ASTM [8] or equivalent.

PERFORMANCE CRITERIA

a) Office premises

- Between two offices D_w = 38 dB minimum.
- Where privacy is important: D_w = 48 dB.
- Noise Isolation Class (NIC) of at least 40 for cellular offices.

b) Classrooms

Sound Transmission Class of walls between classrooms to be equal to or greater than STC37 for classrooms on the same floor and equal or greater than STC50, Impact Insulation Class IIC46 between floors.

c) Residential premises and hotel rooms

- Partitions separating a WC from a noise sensitive room: $D_{nT,w}$ of at least 38 dB.
- In hotels, partitions and floors between rooms and between rooms and corridors: $D_{nT,w}$ of at least 50 dB.

d) Residential premises

- Bedroom to living room: STC46 (same residential unit)
- Bedroom to bedroom: STC52, IIC52 (between residential units); STC44 (same unit)
- Living room to living room: STC52, IIC52 (between residential units).

BACKGROUND

Noise from outside sources, and consequently the noise isolation provided by the building envelope, is covered under the assessment of background noise. Noise from building equipment is also covered under the assessment of background noise, and to some extent under the assessment of vibration. There remains the problem of noise transmitted between spaces, through walls and through floors, which are not addressed under the local Building Regulations, but have been a matter for legislation elsewhere.

The extent to which walls and floor can attenuate unwanted noise from neighbours and neighbouring spaces is an important aspect of controlling noise levels in interiors. Ventilation openings, doors, etc., are likely to be the weakest part of the envelope enclosing a space as far as airborne noise transmission is concerned.

3 International Standard Organization. ISO 717-1. 1996. Acoustics – Rating of sound Insulation in buildings and of building elements. Part 1 – Airborne sound insulation.

4 ASTM International. Designation: E413 – 04. Classification for Rating Sound Insulation.

5 International Standard Organization. ISO 140-7. Acoustics - Measurement of sound Insulation in buildings and of building elements. Part 7: Field measurements of impact sound insulation of floors.

6 ASTM International. Designation: E 1007 – 97. Standard test method for field measurement of tapping machine impact sound transmission through floor-ceiling assemblies and associated support structures.

7 International Standard Organization. ISO 717-2. Acoustics – Rating of sound Insulation in buildings and of building elements. Part 2 – Impact sound insulation.

8 ASTM International. Designation: E 989 -89. Standard Classification for determination of impact Insulation Class (IIC).

6 IEQ

6.7 ACOUSTICS AND NOISE

6.7.3 BACKGROUND NOISE

EXCLUSIONS

Buildings/premises in which speech intelligibility is not important.

OBJECTIVE

Control as far as practicable the background noise in premises at levels appropriate to the intended use of the premises.

CREDITS ATTAINABLE

1

PRE-REQUISITES

None.

CREDIT REQUIREMENT

1 credit for demonstrating background noise levels are within the prescribed criteria.

ASSESSMENT

HK-BEAM regards background noise in premises/rooms as a matter having an important bearing on quality and productivity. Given that different criteria maybe used the Client shall define the criteria appropriate to the type and use of the premises/rooms in the building. However, for the purposes of assessment account should be taken of the criteria given below. Where alternative criteria is used the Client shall provide evidence as to the suitability of the alternative, e.g. by making reference to authoritative guidance. Likewise, where criteria appropriate to the type and use of premises/spaces is not stated herein, the Client shall provide evidence as to the suitability of the criteria adopted.

Compliance shall be demonstrated by detailed calculations or measurements, or both, depending on the Client's preference. Sufficient numbers of calculations and/or measurements shall be made to ensure that the requirements are met in all specified premises, but in particular for premises near street level and major outdoor sources.

Site measurements on the completed building should be on at least one sample of each type of premises/room, taking account the worst case conditions of exposure to noise sources external to the space, and undertaken during periods appropriate to the usage pattern for the space. Measuring equipment shall conform to the accuracy requirements given in IEC 60804 [1] to type 2 or better, or equal equivalent standard.

For centrally air-conditioned buildings the assessment shall take into account noise from building services equipment.

The Client shall submit details in the form of a report prepared by a suitably qualified person providing a schedule of the premises and spaces in the building, relevant design details as they impact on noise isolation, the rooms/premises subject to field tests or for which detailed calculations have been made, the background noise criteria used, underlying assumptions, and the results of tests or calculations demonstrating compliance with the criteria (expressed in parameters that are consistent with the test and/or calculation methods).

Where it can be demonstrated that background noise isolation, as measured or calculated for the most susceptible spaces/rooms/premises, meets appropriate performance criteria the credit shall be awarded.

ASSESSMENT CRITERIA

a) Offices

- Modular (private) offices and small conference rooms: 40dB $L_{Aeq,T}$=8hr or 45dB L_{Aeq},T=5min.
- Large landscaped offices: 45dB $L_{Aeq,T}$=8hr or 50dB $L_{Aeq,T}$=5min.

1 International Electroctechnical Commission. IEC 60804: 2000. Integrating-averaging sound level meters.

b) Classrooms

Background noise shall be below 45dB L_{Amax} in schools in urban areas, otherwise at or below 40dB L_{Amax}, effective between the hours of 08:00 to 16:00.

c) Residential premises and hotel rooms

- In bedrooms under window closed conditions at or below 30dB $L_{Aeq,T}$=8 hr, and < 45 dB between 23:00 to 07:00.
- In habitable rooms (other than kitchens) under closed window conditions < 55dB $L_{Aeq,T}$=16 hr between 07:00 to 23:00.

Tables 5 and 6 of BS 8233 [2] gives criterion for various activities in buildings.

BACKGROUND

Background noise sources include that from external sources as well as from the building services equipment. Table 4.1 in Chapter 9 of the Hong Kong Standards and Planning Guidelines provides a summary of maximum permissible noise levels at the external facade applicable to building uses which rely on operable windows for ventilation. Guidance on separation distances between road traffic and rail traffic and residential buildings is given in the Guidelines.

Calculations can be made in terms of $L_{Aeq,T}$ according to BS 8233, where T = 16 h (daytime) and 8 h (night time), appropriate to the criteria chosen. Calculations using the statistical energy analysis [3] are also acceptable. In centrally air-conditioned premises while NC, NR, PNC, NCB and RC are acceptable criteria for noise from air-conditioning equipment, the presence of outside noise sources renders $L_{Aeq,T}$ a better performance indicator for the aural environment [4].

Noise levels at the façade of a building can be established by measurement or prediction by simulation methods approved by the Environmental Protection Department. The Environmental Protection Department also describes practical measures that can be taken at the design stages to achieve an acceptable noise environment in new noise sensitive developments [5], and for planning residential developments against road traffic noise [6]. The Environmental Protection Department also provides guidelines on practical noise control measures for ventilation systems [7], and for pumping systems [8].

2 British Standard Institution. BS 8233 Code of Practice for sound insulation and noise reduction for buildings.
3 European Committee for Standardization. CEN EN 12354 Building Acoustics – Estimation of acoustic performance of buildings from the performance of elements. Bruxelles.
4 Chan D W T, Tang S K, Burnett J. Noise Criteria for Hong Kong Building Environmental Assessment Method for New Offices and Existing Offices (HK-BEAM). HKIE Transactions. HKIE Transactions, Vol. 5, No. 2, 1998, pp. 1-5.
5 Environmental Protection Department. Practice Note for Professional Persons. ProPECC PN 4/93. Planning and Designing Noise Sensitive Developments. http://www.epd.gov.hk/epd/english/resources_pub/publications/files/pn93_4.pdf
6 Environmental Protection Department. Practice Note for Professional Persons. ProPECC PN 1/97. Streamlined Approach for the Planning of Residential Developments Against Road Traffic Noise. http://www.epd.gov.hk/epd/english/resources_pub/publications/files/pn97_1.pdf
7 Environmental Protection Department. Good Practices on Ventilation System Noise Control. http://www.epd.gov.hk/epd/english/environmentinhk/noise/guide_ref/files/pump_sys.pdf
8 Environmental Protection Department. Good Practices on Pumping System Noise Control. http://www.epd.gov.hk/epd/english/environmentinhk/noise/guide_ref/files/vent_sys.pdf

6 IEQ

6.8 BUILDING AMENITIES

6.8.1 ACCESS FOR PERSONS WITH DISABILITY

EXCLUSIONS

None.

OBJECTIVE

Ensure full access to pertinent building facilities for persons with disability.

CREDITS ATTAINABLE

1

PRE-REQUISITES

Full compliance with Building (Planning) Regulation (CAP 123F) Regulation 72 'Buildings to be planned for use by persons with a disability' and Schedule 3 'Persons With A Disability', and the obligatory design requirements set out in the Code of Practice for Barrier Free Access [1].

CREDIT REQUIREMENT

1 credit for providing enhanced provisions for access for disabled persons.

ASSESSMENT

The Client shall provide evidence that details the building to demonstrate full compliance with the pre-requisites, and demonstrate what enhanced levels of access for disabled persons are provided.

Credit shall be awarded where, apart from the regulatory requirements the enhanced provisions as identified in the CoP for Barrier Free Access, or similar provisions, are provided where applicable to the type(s) of premises in the building.

BACKGROUND

In order to enhance social integration disabled persons should have the same rights as any other individuals. Under Disability Discrimination Ordinance, discrimination against persons with a disability by failing to provide means of access to any premises that the public is entitled to enter or use, or by refusing to provide appropriate facilities is prohibited, unless the premises are designed to be inaccessible to persons with a disability. The legal requirements for the provision of facilities for the disabled are prescribed in the Building (Planning Regulations (CAP 123F) Regulation 72 'Buildings to be planned for use by persons with a disability' and Schedule 3 'Persons With A Disability'.

Full access for disabled persons means more than just being able to enter and leave a building, or use the toilets. It enables persons with a disability to make full use of the basic facilities in a building without assistance and undue difficulties. The Code of Practice for Barrier Free Access [1] sets out design requirements to cater for the special needs of persons with locomotory disabilities, visual impairment and hearing impairment.

Facilities that cater for the special needs of the physically impaired should be provided, which include but not limited to shaded areas for walking and sitting; accessibility to public toilets; adequate lighting; emergency phones; visual-free walking areas; ramps with handrails; and car or bus dropping-off points near to venues.

1 Code of Practice for Barrier Free Access. http://www.info.gov.hk/bd/english/documents/code/e_bfa.htm

6 IEQ

6.8 BUILDING AMENITIES

6.8.2 AMENITY FEATURES

EXCLUSIONS

None.

OBJECTIVE

Improve the standard and quality of buildings.

CREDITS ATTAINABLE

2

PRE-REQUISITES

Compliance with the Building Regulations.

CREDIT REQUIREMENT

1 credit for providing 50% of listed amenity features that enhance the quality and functionality of a building.

2 credits for providing 75% of listed amenity features.

ASSESSMENT

With reference to the Check List below and the cited documents the Client shall submit details of the amenities provided in the building. The onus is on the Client to demonstrate that the provisions meet one or a combination of the following objectives :

- provide for efficient and effective building management, operation and maintenance;
- enhance the living and/or working experience of building users;
- improves the environmental and social compatibility with the neighbourhood.

Where it can be demonstrated that the building, appropriate to its size, type and use, provides 50% or more of the amenities to the appropriate standard, a credit shall be awarded. Where 75% are provided to the appropriate standard, the second credit is awarded.

In this context, the standard refers to the criteria given in the cited documents, including dimensional information where this is provided. Alternatively, the Client is free to argue for the use of alternative criteria, provided they meet the objectives.

Given that the nature and extent of amenities will vary with the type and scale of the development the Client should provide the rationale if any of the listed amenities is not included.

CHECK-LIST

The amenity features identified [1] includes:

- provisions for air-conditioning installations;
- security gates;
- counters, kiosks, offices, stores, guard rooms, lavatories for building management staff;
- logistics service room;
- mail room;
- horizontal screens;
- recreational facilities;
- satellite dishes.

Listed under the incentives for 'green and innovative building [2]:

1 Buildings Department. Practice Note for Authorized Persons and Registered Structural Engineers, PNAP 116. Amenity Features. http://www.info.gov.hk/bd/english/documents/pnap/Pnap116.pdf

2 Buildings Department, Land Department, Planning Department. Joint Practice Note No. 1. Green and Innovative Buildings. http://www.info.gov.hk/bd/english/documents/joint/JPN01.pdf

- balconies;
- wider common corridors and lift lobbies;
- communal sky gardens; and
- communal podium gardens.

In addition [3]:

- mail delivery rooms with mailboxes; and
- communal sky gardens for non-residential buildings.

Other features include:

- land or area within a building for use as public passage [4];
- space within the site for recreational use by neighbours and/or visitors [5,6];
- prestige entrances such as large voids in front of cinema and theatre balconies, in banking halls and shopping arcades, entrance lobbies, etc [7];
- air-conditioning plant rooms with 1% or more of the total floor area of a building, air handling units with 4% or more of the GFA of each floor;
- enhanced standards of lift services [8]; and
- communications systems [9].

Projects such as wall boxes or platforms, window cills, flower boxes, etc., of prescribed dimensions [10].

Canopies, balconies, air-conditioner platforms, etc., need to be properly designed and constructed [11].

BACKGROUND

Amenity features are loosely defined as those elements of design that, whilst not statutory requirements are desirable to improve the standard and quality of a building. To encourage these features, the Building Authority is prepared to consider modification and exemption, under the Buildings Ordinance and Regulations, for the provision of new amenities in both new developments and existing buildings [2].

3 Buildings Department, Land Department, Planning Department. Joint Practice Note No. 2. Second Package of Incentives to Promote Green and Innovative Buildings. http://www.info.gov.hk/bd/english/documents/joint/JPN02.pdf

4 Buildings Department. Practice Note for Authorized Persons and Registered Structural Engineers, PNAP 233. Dedication of Land/Area for Use as Public Passage. http://www.info.gov.hk/bd/english/documents/pnap/Pnap233.pdf

5 Lands Administration Office, Lands Department. Practice Note 4/2000. Recreational Facilities in Domestic Development.

6 Buildings Department. Practice Note for Authorized Persons and Registered Structural Engineers, PNAP 229. Exclusion of Floor Areas for Recreational Use. http://www.info.gov.hk/bd/english/documents/pnap/Pnap229.pdf

7 Buildings Department. Practice Note for Authorized Persons and Registered Structural Engineers, PNAP 13. Calculation of Gross Floor Area and Non-accountable Gross Floor Area Building (Planning) Regulations 23(3) (a) and (b). http://www.info.gov.hk/bd/english/documents/pnap/Pnap013.pdf

8 Buildings Department. Practice Note for Authorized Persons and Registered Structural Engineers, PNAP 207. Provision of better lift service. http://www.info.gov.hk/bd/english/documents/pnap/Pnap207.pdf

9 Buildings Department. Practice Note for Authorized Persons and Registered Structural Engineers, PNAP 201. Access Facilities for Telecommunications and Broadcasting Services. http://www.info.gov.hk/bd/english/documents/pnap/Pnap201.pdf

10 Buildings Department. Practice Note for Authorized Persons and Registered Structural Engineers, PNAP 68. Projections in relation to site coverage and plot ratio Building (Planning) Regulations 20 & 21. http://www.info.gov.hk/bd/english/documents/pnap/Pnap068.pdf

11 Buildings Department. Practice Note for Authorized Persons and Registered Structural Engineers, PNAP 173. Safe Design and Construction of Cantilevered Projecting Structures. http://www.info.gov.hk/bd/english/documents/pnap/Pnap173.pdf

6 IEQ

6.8 BUILDING AMENITIES

6.8.3 IT SERVICES

EXCLUSIONS None.

OBJECTIVE Enhance facilities for IT and communications.

CREDITS ATTAINABLE 1

PRE-REQUISITES None.

CREDIT REQUIREMENT 1 credit for including the required percentage of serviceability measures and IT facilities identified.

ASSESSMENT The Client shall submit a report prepared by a suitably qualified person that includes: a completed checklist of the facilities and measures provided, justification for each checked item, and details of the physical systems provided.

In the case of offices and similar workplaces the credit shall be awarded for 70% compliance of applicable items. In the case of residential buildings, hotels and apartment buildings the credit shall be awarded for 35% compliance of applicable items.

The Client may provide a rationale and arguments to demonstrate additional enhancements to serviceability and IT facilities, which can be submitted within the assessment grid.

ASSESSMENT GRID

Locations for IT intensive activity	Pt	Incoming services	Pt	Floor services:	Pt	Horizontal distribution	Pt
Any location, any floor	5 or	Space, with demarcation, for at least 3 service providers	2 or	Closet on each floor 1.5% or 15 m^2 minimum	3 or	Overhead drop down, or raised floor, with 50% spare capacity	4 or
Designated locations, any floor	4 or	Space, with demarcation, for at least 2 service providers	1	Closet on each floor 1% or 10 m^2 minimum	2 or	Overhead drop down, or raised floor	3 or
Any location, some floors	3 or	Equipment room 0.1% GFA, minimum 20 m^2	1	Closet alternative floors 1.5% or 15 m minimum	1	Under floor trunking 1 m grid with 50% spare capacity	2 or
Designated locations, some floors	2 or	**Plug and play risers:**		**Workstation services**		Under floor trunking 1.5 m grid with 25% spare capacity	1
Specially designated floor	1	Fibre or equivalent feeds	1	Fibre optic cable or equivalent	1	HVAC services can meet 40 Wm^{-2} cooling any floor	2 or
UPS provided on demand	2 or	Multiple copper riser cables	1	Fast Ethernet of equivalent	1	HVAC meet 40 Wm^{-2} cooling any floors	1
Space for UPS equipment	1	50% free space in risers	1	Voice cables	1	Optional (by Client)	2 or
Optional (by Client)	1	Optional (by Client)	1	4 fixed electrical s/o	1	Optional (by Client)	1
Total Applicable Points:		Points Achieved:		Percentage Achieved:			

BACKGROUND Assessment should take into account the guidelines provided in ASTM [1,2], and similar authoritative guidance, and the extent to which the security provisions 'score' against the assessment grid provided herein.

1 ASTM International. Designation E 1663-03. Standard Classification for Serviceability of an Office Facility for Typical Office Information Technology

2 ASTM International. Designation E 1334-95. Standard Practice for Rating the Serviceability of a Building or Building-Related Facility

7 INNOVATIONS AND ADDITIONS

7.1.1 INNOVATIVE TECHNIQUES

7.1.2 PERFORMANCE ENHANCEMENTS

INTRODUCTION

This section allows for a Client to submit for consideration for the award of bonus credits any innovative techniques or performance enhancements which the Client deems to provide environmental benefits additional to those already covered in HK-BEAM.

CREDITS

Maximum 5 BONUS credits under this Section.

7.1 INNOVATIVE TECHNIQUES

This section applies to advanced practices and new technologies that have not hitherto found application in Hong Kong or even elsewhere. Any credits gained under this heading shall be regarded as 'bonus' credits, counting towards the total credits obtained, but not towards the total credits obtainable.

Credits may be awarded to an assessed building for innovative and/or unconventional designs, construction techniques or provisions for operation that will improve the environmental performance of a building development during any part of its life cycle.

OBJECTIVE

Encourage adoption of practices, new technologies and techniques that have yet to find application in Hong Kong.

ASSESSMENT

The onus will be on the Client to present evidence of the application of new practices, technologies and techniques and the associated benefits. The benefits may be considered in relation to sustainable living, energy use, materials use, improved comfort, reduced pollution, etc. The Assessor will refer the proposal to the HK-BEAM Steering Committee who will consider each aspect on its merits and award credits accordingly.

The Client shall make a submission for granting additional credits that identifies the intent of the proposed innovative technique, the proposed criteria for assessing compliance, and the assessment criteria. The weighting (number of credits) proposed would be considered in the light of existing weightings under the various environmental impacts categorised in HK-BEAM, i.e. a technique which can demonstrate a resource saving or reduced environmental loading would be compared to existing criteria deemed to achieve similar levels of benefit.

7.2 PERFORMANCE ENHANCEMENTS

An alterative approach to achieving bonus credits under HK-BEAM is to demonstrate significant performance enhancements, i.e. strategies and techniques that greatly exceed the requirements of existing HK-BEAM credits. For example, features that result in significantly higher levels of service, energy, water or materials savings. Any credits gained under this heading shall be regarded as 'bonus' credits, counting towards the total credits obtained, but not towards the total credits obtainable.

OBJECTIVE

Encourage adoption of practices, technologies and techniques that provide for performance enhancements over and above stated performance criteria in HK-BEAM.

ASSESSMENT

The onus will be on the Client to present evidence of the performance gains as compared to existing criteria. The Assessor will refer the proposal to the HK-BEAM Steering Committee who will consider each aspect on its merits and award credits accordingly.

The Client shall make a submission for granting additional credits which identifies the level of enhancement in performance in any environmental aspect. The weighting (number of credits) proposed would be considered in the light of existing weightings provided under the various environmental impacts categorised in HK-BEAM, i.e. a demonstrated resource saving would be compared to existing criteria on a pro-rata basis to determine the bonus credits to be awarded.

8.1 ANNUAL ENERGY USE

8.1.1 ASSESSMENT FRAMEWORK

8.1.2 ENERGY BUDGET APPROACH

8.1.3 PRE-REQUISITES

ASSESSMENT FRAMEWORK

The assessment framework described in this Appendix embraces all types of existing buildings and complexes, including commercial, hotel, school and other types of buildings with or without air-conditioning. Buildings comprising predominantly air-conditioned premises and those comprising predominantly non-air-conditioned premises will be assessed following different procedures, with the former assessed somewhat more rigorously than the latter. This is because air-conditioning is the dominant energy end-use in modern buildings in Hong Kong and hence it is crucial to ensure the air-conditioning installations are energy efficient.

8.1.1 ASSESSMENT FRAMEWORK

The assessment of the energy performance of a building development comprises three parts. The first part of the assessment is on the in-use energy performance, which includes a comparison of the energy use of the building against a predicted/calculated annual energy use benchmark that is dependent on the 'as-built' characteristics of the building, the types of premises it houses and the range and operational characteristics of services systems required to meet the functional needs of the premises. Where a mix of fuel is used in the same building, e.g. a hotel, the assessment is based on the incurred CO_2 emission due to energy use.

The assessment will be based, as far as practicable, on metered energy use in buildings. Variations in the assessment method also exist between multi-tenanted and single-user buildings, due to the different energy use metering arrangements involved. Since the energy use data required for the assessment can be made available from a thorough energy audit, having an energy audit completed right before the assessment is highly preferred.

Included in the second part are assessments of relevant features specific to individual types of buildings, which are based either on component-performance or feature specific criteria. Also included in this part is renewable energy use in buildings, such as the use of solar panels for water heating and photovoltaic panels, fuel cells and wind turbines for electricity generation. Considering that renewable energy application in buildings in Hong Kong is still in its infancy and most methods remain economically non-viable and require a quantum jump in product efficiency and/or a large drop in price to change the situation, the relevant credits will be awarded as bonus credits so as to encourage wider application of renewable energy, without diminishing the scores for buildings that have not incorporated such measures. The third part covers provisions that facilitate energy efficient operation and maintenance.

8.1.2 ENERGY BUDGET APPROACH

In order to allow Clients the greatest flexibility in achieving the energy performance targets for their buildings, the assessment will be based primarily on the 'energy budget approach', supplemented by a range of basic requirements. The key features of the assessment framework developed for assessing air-conditioned buildings are as described below.

The 'energy budget' for an assessed building development is the zero-credit annual energy use benchmark, which will be determined on an individual building basis taking into account the specific characteristics of the building, particularly those that will be difficult or impossible to change even if the landlord is willing to invest in energy efficiency improvement measures (which is a constraint to existing buildings). This is intended to make allowance in the assessment outcome for buildings possessing unfavourable features (e.g. a west facing façade), which are impractical to rectify, and to encourage landlords to concentrate on areas where improvements are possible.

The zero-credit benchmark will be determined from the predicted annual energy use of a Baseline Building model, which would have the same shape, dimensions, and envelope characteristics, would comprise the same mix of areas for the same range of types of premises, and would have the same types of major services systems, including the cooling medium and the type of system used for condenser heat rejection, as the Assessed Building.

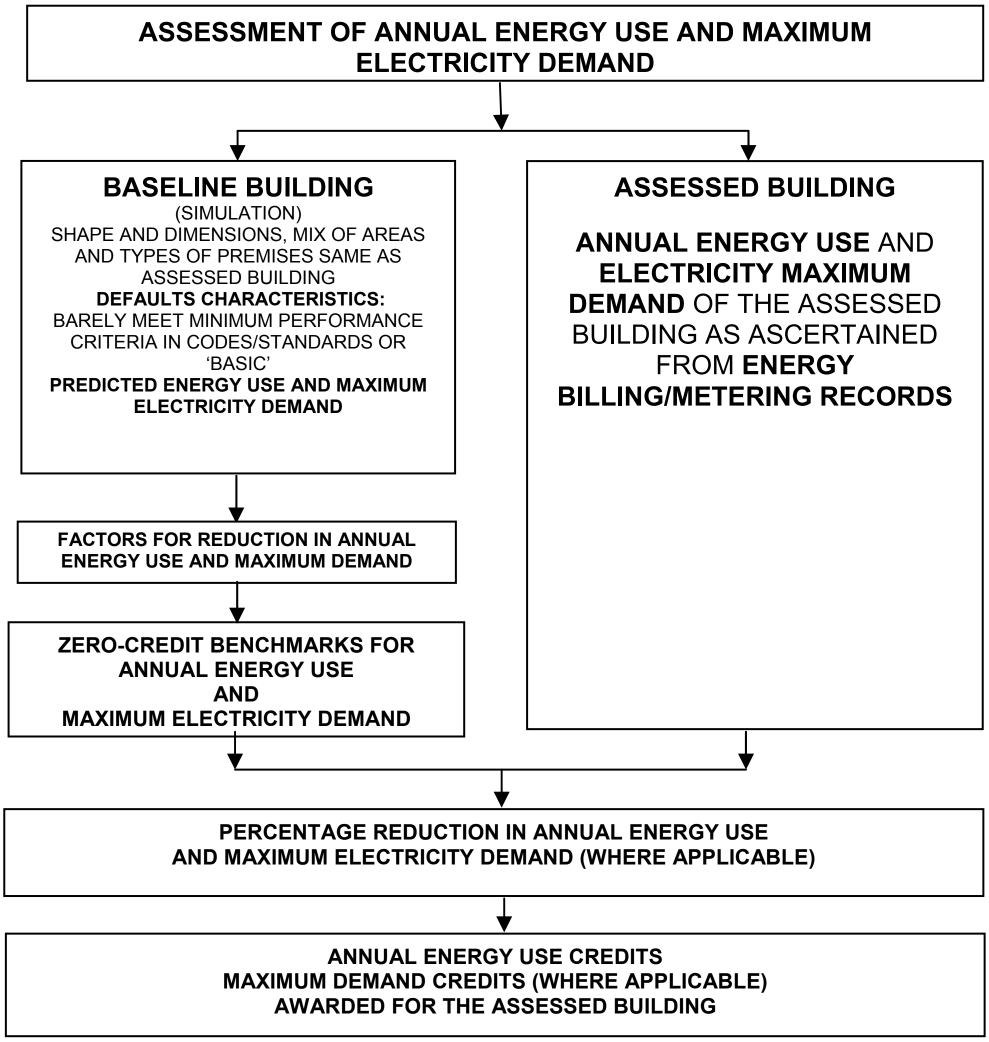

Figure 8.1 Building energy performance assessment

The Baseline Building model will be incorporated with a range of standard (default) parameters that characterise the performance of the services systems and the operating conditions in the building. Such parameters are either the minimum requirements stated in relevant energy code of practices or design guides (e.g. indoor thermal environment set points, lighting load intensities, coefficient of performance of chillers, ventilation rates etc.) or those that can represent situations in 'average' buildings in Hong Kong, ascertained from previous surveys (e.g. occupation density, hours of occupation, non-air-conditioning energy use, etc). Where buildings are equipped with services installations with energy efficiency that exceeds the 'average' buildings (e.g. use of energy efficient lamps and ballast, variable speed drives for VAV systems and chilled water pumping systems, smart control over lift banks, etc), the effects of such energy efficient measures will be ignored in the prediction of the annual energy use and maximum electricity demand of the Baseline Building model.

The zero-credit benchmark for the Assessed Building (the existing building) will equal 150% of the predicted annual energy use of the Baseline Building. The 50% margin is meant for making allowances for operating conditions that will inevitably arise which will cause more energy to be used, e.g. over-time air-conditioning provision for offices in an office/commercial building and deterioration in performance of the air-conditioning equipment, etc.

The annual energy use of the assessed building will be determined based on the records of energy use in the building, as given in available energy billing and audit data. For a single-user building (e.g. a government complex), the records will reflect the total energy use in the entire building. However, for a multi-tenanted building (e.g. a typical office/commercial building), individual tenants have their consumption separately metered and it is impossible to ask all tenants to provide their consumption records for the assessment. The assessment for multi-tenanted buildings, therefore, will be limited to the consumption of the landlord. However, where there is air-handling equipment inside tenants' premises, which are supplied with electricity from the tenants' meters, the annual energy use of such air-handling equipment will be estimated and added to the landlord's consumption. The zero-credit energy use benchmark will also take this into account.

Besides the annual energy use, the assessment of the energy performance of a building includes, where applicable, an assessment of its maximum electricity demand. This will be undertaken in a way similar to the energy use assessment. The zero-credit benchmark for maximum electricity demand will be 125% of that of the Baseline Building model. Credits for this assessment will be determined with reference to the factor of reduction in the maximum electricity demand of the Assessed Building relative to that of the Baseline Building model. Note that this part of the assessment will apply only to those buildings where electricity charges are based either on the Bulk Tariff, Large Power Tariff or Maximum Demand Tariff. Buildings not using one of these tariff will not be assessed for maximum electricity demand under this approach, due to lack of reliable data.

The characteristics to be incorporated into the Baseline Building model, including the indoor design conditions, ventilation rates, occupation density and patterns, internal load intensities and patterns, and performance of air-conditioning equipment are to be as described in Section A.2.

The energy use and maximum electricity demand of installations and equipment other than the air-conditioning installations will be predicted based on the installed power, the operating hours and the pattern of use for each type of installations. The assessment will be based on the sum of the energy use, and the maximum electricity demand, of the air-conditioning and other installations. Here, the assumption is made that the air-conditioning energy use is the dominant time-varying load whilst the energy use of other installations is relatively stable and may be regarded as a steady load.

8.1.3 PRE-REQUISITES

A pre-requisite for obtaining credits for Annual Energy Use under the Energy Budget approach is compliance with specific items in the HKSAR Government's energy efficiency codes, as follows:

- items listed in Table 8.1 in Section 8 (from the Code of Practice for Energy Efficiency of Lighting Installations [1]);
- items listed in Table 8.2 in Section 8 (from the Code of Practice for Energy Efficiency of Air Conditioning Installations [2].

Where applicable, those requirements labelled as 'basic' in Table 8.1 for lighting installations and in Table 8.2 for air-conditioning installations shall be strictly complied with as a pre-requisite for credits under the building energy performance assessment. Substitutes or trade-offs in performance for such requirements are not accepted.

Items covered in the referenced codes not defined here as basic requirements are regarded as the minimum (benchmark) performance for the relevant systems or components, but trade-off in performance of such systems or components with other systems or components is allowed within the overall energy performance assessment.

Other building specific requirements are given in relevant sections that define the assessment method for the particular building type.

TABLE 8.1 REQUIREMENTS FOR LIGHTING INSTALLATIONS

Section(1)	Requirements in the Code Practice for Energy Efficiency of Lighting Installations (2)	Nature of the requirement in HK-BEAM	
		New Buildings	Existing Buildings
4.1	Minimum allowable luminous efficacy of lamps	Basic (3)	Basic (3)
4.2	Maximum allowable lamp control gear loss	Basic (3)	Basic (3)
4.3	Maximum allowable lighting power density	Component-performance (4)	Base-line setting (4,5)
4.4	Interior lighting control points to meet minimum requirements and to be accessible to the occupants	Basic	Basic (6)

(1) Section numbers as in the Code.
(2) Refer to the Code for the Scope of application of the requirements, details of the criteria and exceptions.
(3) For HK-BEAM, the requirements in Sections 4.1 and 4.2 in the Code shall be applicable to all types of buildings.
(4) Refer to Table 8.4 for maximum allowable lighting power densities for premises types not covered by the Code.
(5) Used as the lighting power density in premises for the prediction of the annual energy use of the Baseline Building model for determining the zero-credit level.
(6) For multi-tenanted buildings, this shall be confirmed by submitting a "Tenant's fitting out specification" that governs lighting installations and controls inside tenants' areas.

1 Electrical and Mechanical Services Department. Code of Practice for Energy Efficiency of Lighting Installations. http://www.emsd.gov.hk/emsd/e_download/pee/lightingcop.pdf

2 Electrical and Mechanical Services Department. Code of Practice for Energy Efficiency of Air Conditioning Installations. http://www.emsd.gov.hk/emsd/e_download/pee/accop.pdf

TABLE 8.2 REQUIREMENTS FOR AIR-CONDITIONING INSTALLATIONS

Section (1)	Requirements in the Code of Practice for Energy Efficiency of Air Conditioning Installations (2)	Nature of the requirement in HK-BEAM: New Buildings	Nature of the requirement in HK-BEAM: Existing Buildings
4.1	Load calculation & plant sizing methods	Basic	Base-line setting(4)
4.2 & 4.3	Indoor and outdoor design conditions	Basic	Base-line setting(4)
5.1	Air distribution system: requirement for separate distribution systems for zones with special temperature requirements and air leakage limit on ductwork	Basic	Basic
5.2.2	Constant air volume (CAV) fan system power ≤ 1.6 W per l/s	Component-performance	Base-line setting(4)
5.2.3.1	Variable air volume (VAV) fan system power ≤ 2.1 W per l/s	Component-performance	Base-line setting(4)
5.2.3.2	VAV fan power no more than 55% of design wattage at 50% design flow rate	Basic	Base-line setting(4)
6.1	Variable flow water pumping system to be capable of reducing system flow to ≤ 50% of design flow	Basic	Base-line setting (4)
6.2	Water pipe frictional loss ≤ 400 Pa/m	Component-performance	Base-line setting (4)
7.1.1	Provision of at least one automatic temperature control device per system	Basic	Basic
7.1.2	Thermostatic controls for comfort should allow setting set point up to 29ºC or above	Basic	Basic
7.1.3	Thermostatic controls for comfort should allow setting set point down to 16ºC or below	Basic	Basic
7.1.4	Thermostatic controls for comfort should allow setting a dead-band of at least 2ºC between cooling and heating operation	Basic	Basic
7.2	Active humidity control, where used for comfort control, should be capable of preventing humidifying to above 30% and dehumidifying to below 60% in relative humidity	Basic	Basic
7.3.1	Each air-conditioned zone should be controlled by individual thermostatic corresponding to temperature within the zone	Basic	Basic
7.3.2	The controls should not permit heating and cooling to take place in sequence or simultaneously	Basic	Basic
7.4.1	AC systems should be equipped with automatic setback control or could be shut down during non-use periods	Optional feature (3)	N/A (5)
7.4.2	Each hotel guestroom should be provided with a single master switch that will turn-off conditioned air supply or reset thermostat setting with or without reduction in fan speed	Optional feature (3)	N/A (5)
8	Minimum insulation thickness for chilled water and refrigerant pipes, ductworks and air handling unit casings	Basic	Basic
9	Minimum AC equipment efficiency	Component-performance	Base-line setting (4)

(1) Section numbers as in the Code
(2) Refer to the Code for the Scope of application of the requirements, details of the criteria and exceptions
(3) The prediction of the annual energy use for the Assessed Building will take the effect of the feature into account
(4) Applicable to the prediction of the annual energy use of the Baseline Building model for determining the zero-credit level
(5) Effects to be reflected in the metered energy consumption in the Assessed Building

8.2 BASELINE BUILDING MODEL

8.2.1 ENVELOPE CHARACTERISTICS

8.2.2 INDOOR DESIGN CONDITIONS, OCCUPANCY DENSITIES, AND VENTILATION AND INFILTRATION RATES

8.2.3 INTERNAL LOADS

8.2.4 AIR-CONDITIONING SYSTEM DESIGN AND EQUIPMENT PERFORMANCE

8.2.1 ENVELOPE CHARACTERISTICS

Since the building façade design is considered as difficult to change for an existing building, the envelope characteristics of the baseline building model for assessing an existing building will be basically same as the "as-built" characteristics of the assessed building, except that features like overhangs and side-fins will be ignored for two reasons: i) for simplicity in establishing the zero-credit benchmark; and ii) to be consistent with the basis upon which the simplified models (see Section 8.5) were established.

8.2.2 INDOOR DESIGN CONDITIONS, OCCUPANCY DENSITIES, AND VENTILATION AND INFILTRATION RATES

The default indoor design conditions to be used for various types of premises in the baseline building model for assessing an existing building shall be as shown in Table 8.4. These design indoor conditions correspond to the threshold design conditions as stipulated in the Code of Practice for Energy Efficiency of Air Conditioning Installations or, for those types of premises for which such threshold values are unavailable in the Code, to typical conditions observed in existing buildings.

The default occupancy density and pattern, and ventilation and infiltration rates, for various types of premises in the baseline building model for assessing an existing building shall be as summarised in Tables 8.4 and 8.5. The default per-occupant ventilation rates are higher than those used in the design of some existing buildings, particularly those older ones. The application of these higher ventilation rates to the baseline building model will, therefore, make allowances for such existing buildings to upgrade their ventilation provision from the sub-standard rates to the acceptable rates being used in designing new buildings.

8.2.3 INTERNAL LOADS

The lighting power intensities to be used for various types of premises in the baseline building model for an existing building shall be the threshold compliance values as stipulated in the Code of Practice for Energy Efficiency of Lighting Installations for the respective types of premises. For those types of premises that the lighting energy code does not cover, default values established from previous surveys will be used. The relevant default values for lighting power intensity for use with the baseline building model are as summarised in Table 8.4. Likewise, default values of equipment power density as summarised in Table A.4 will be applied to the baseline building model.

8.2.4 AIR-CONDITIONING SYSTEM DESIGN AND EQUIPMENT PERFORMANCE

The minimum permissible energy performance of air-conditioning system designs and equipment, as stipulated in the Code of Practice for Energy Efficiency of Air Conditioning Installations, will be assumed to be the performance of the air-conditioning installations in the baseline building model.

Where unitary air-conditioners or window- or split-type air-conditioners of capacities that falls outside the control of the air-conditioning energy code, performance data as summarised in Table 8.6 will be assumed for both the baseline building model.

Other than those stated in 8.2.1, no adjustment to the envelope performance will be applied to the baseline building model for assessing an existing building.

TABLE 8.4 BASELINE BUILDING DEFAULT INDOOR DESIGN CONDITIONS FOR VARIOUS PREMISES

Type of Premises	Indoor design condition	Occupancy density	Ventilation rate	Lighting power intensity	Equipment power intensity
	(Temp. ºC/RH %)	(m²/person)	(l/s-person)	(W/m²)	(W/m²)
Offices	23 / 50%	9	10	25	25
Retails	22 / 50%	4.5	7	70	30
General retail shops:					
Area < 28 m²	22 / 50%	4.5	7	85	50
28 m² ≤ Area < 43 m²	22 / 50%	4.5	7	60	40
Area > 43 m²	22 / 50%	4.5	7	40	40
Clothing	22 / 50%	4.5	7	50	30
Jewellery	22 / 50%	4.5	7	95	25
Restaurants	22 / 50%	2.5	7	35	55
Eastern	22 / 50%	2.0	7	35	55
Western	22 / 50%	3.0	7	20	35
Fast food	22 / 50%	1.6	7	40	220
Cinemas					
Concert halls					
Hotel guestrooms	22 / 50%	2 (per Rm)	35 (l/s-Rm)	600 (W/Rm)	100 (W/Rm)
Residential flats					
Bedrooms	22 / 50%	Note (1)	Note (2)	17	Note (1)
Living/dinning rooms	22 / 50%	Note (1)	Note (2)	14	Note (1)
Schools					
Classrooms	23 / 50%				
Assembly halls					
Staff offices	23 / 50%				
Laboratories					
Libraries					
Pubic libraries					

(1) Quantified on per room basis; see Tables 8.5.5 and 8.5.6.
(2) The assumption is made that there will not be a dedicated ventilation supply for living and dining rooms and bedrooms in residential buildings. Also see footnotes in Tables 8.5.5 and 8.5.6.

TABLE 8.5 DEFAULT DAILY PATTERNS OF OCCUPANCY, FRESH AIR SUPPLY, AND LOADS

TABLE 8.5.1 OFFICE PREMISES (1)

Hour From	To	Occupancy	Fresh Air Supply	Infiltration rate (ach)	Lighting (Perimeter)	Lighting (Interior)	Equipment
				Weekdays			
0	6	0.00	Off	0.50	0.05	0.05	0.10
6	7	0.00	Off	0.50	0.05	0.05	0.10
7	8	0.05	Off	0.50	0.10	0.10	0.15
8	9	0.40	On	0.10	0.50	0.50	0.50
9	10	0.95	On	0.10	0.90	1.00	1.00
10	11	0.95	On	0.10	0.90	1.00	1.00
11	12	0.95	On	0.10	0.90	1.00	1.00
12	13	0.95	On	0.10	0.90	1.00	1.00
13	14	0.45	On	0.10	0.80	0.90	0.80
14	15	0.95	On	0.10	0.90	1.00	1.00
15	16	0.95	On	0.10	0.90	1.00	1.00
16	17	0.95	On	0.10	0.90	1.00	1.00
17	18	0.50	On	0.10	0.80	0.80	0.60
18	19	0.25	On	0.10	0.50	0.50	0.40
19	20	0.10	Off	0.50	0.30	0.30	0.20
20	21	0.05	Off	0.50	0.20	0.20	0.15
22	23	0.00	Off	0.50	0.05	0.05	0.10
23	24	0.00	Off	0.50	0.05	0.05	0.10
				Saturdays			
0	7	0.00	Off	0.50	0.05	0.05	0.05
7	8	0.05	Off	0.50	0.10	0.10	1.00
8	9	0.30	On	0.10	0.50	0.50	1.00
9	13	0.60	On	0.10	0.75	0.80	1.00
13	17	0.10	Off	0.50	0.20	0.20	0.20
17	18	0.05	Off	0.50	0.10	0.10	0.10
18	24	0.00	Off	0.50	0.05	0.05	0.05
				Sundays and Public Holidays			
0	9	0.00	Off	0.50	0.05	0.05	0.05
9	17	0.05	Off	0.50	0.10	0.10	0.10
17	24	0.00	Off	0.50	0.05	0.05	0.05

(1) Occupancy, lighting load and equipment load patterns are in fractions of their respective peak values.

TABLE 8.5.2 RETAIL PREMISES (ALL DAYS) (1)

Hour From	To	Occupancy	Fresh Air Supply	Infiltration rate (ach)	Lighting	Equipment
0	9	0.00	Off	0.50	0.00	0.05
9	10	0.00	Off	0.50	0.00	0.05
10	11	0.25	On	0.10	0.95	0.75
11	12	0.25	On	0.10	0.95	0.75
12	13	0.75	On	0.10	0.95	0.75
13	14	0.75	On	0.10	0.95	0.75
14	15	0.25	On	0.10	0.95	0.75
15	16	0.25	On	0.10	0.95	0.75
16	17	0.25	On	0.10	0.95	0.75
17	18	0.25	On	0.10	0.95	0.75
18	19	0.75	On	0.10	0.95	0.75
19	20	0.75	On	0.10	0.95	0.75
20	21	0.75	On	0.10	0.95	0.75
21	22	0.75	On	0.10	0.95	0.75
22	23	0.00	Off	0.50	0.00	0.05
23	24	0.00	Off	0.50	0.00	0.05

(1) Occupancy, lighting load and equipment load patterns are in fractions of their respective peak values

TABLE 8.5.3 RESTAURANT PREMISES (ALL DAYS) (1)

Hour From	To	Occupancy	Fresh Air Supply	Infiltration rate (ach)	Lighting	Equipment
0	5	0.00	Off	0.50	0.10	0.10
5	6	0.00	Off	0.50	0.10	0.10
6	7	0.60	On	0.10	0.90	0.75
7	8	0.60	On	0.10	0.90	0.75
8	9	0.60	On	0.10	0.90	0.75
9	10	0.60	On	0.10	0.90	0.75
10	11	0.60	On	0.10	0.90	0.75
11	12	0.90	On	0.10	0.90	0.75
12	13	0.90	On	0.10	0.90	0.75
13	14	0.90	On	0.10	0.90	0.75
14	15	0.05	On	0.10	0.90	0.60
15	16	0.05	On	0.10	0.50	0.60
16	17	0.05	On	0.10	0.50	0.60
17	18	0.05	On	0.10	0.50	0.60
18	19	0.75	On	0.10	0.95	0.75
19	20	0.75	On	0.10	0.95	0.75
20	21	0.75	On	0.10	0.95	0.75
21	22	0.75	On	0.10	0.95	0.75
22	23	0.05	On	0.10	0.75	0.10
23	24	0.05	On	0.10	0.25	0.10

(1) Occupancy, lighting load and equipment load patterns are in fractions of their respective peak values.

TABLE 8.5.4 HOTEL GUESTROOMS (ALL DAYS) (1)

A) ROOMS WITHOUT ENERGY SAVING CONTROLS(2) DURING UNOCCUPIED PERIODS

Hour From	To	Occupancy	Fresh Air Supply	Infiltration rate (ach)	Lighting	Equipment
0	7	0.95	On	0.10	0.20	0.30
7	8	0.95	On	0.10	0.20	0.30
8	9	0.20	On	0.10	0.35	0.35
9	10	0.20	On	0.10	0.35	0.35
10	11	0.20	On	0.10	0.35	0.35
11	12	0.20	On	0.10	0.35	0.35
12	13	0.20	On	0.10	0.35	0.35
13	14	0.20	On	0.10	0.35	0.35
14	15	0.20	On	0.10	0.35	0.35
15	16	0.20	On	0.10	0.35	0.35
16	17	0.20	On	0.10	0.35	0.35
17	18	0.20	On	0.10	0.35	0.35
18	19	0.20	On	0.10	0.35	0.35
19	20	0.20	On	0.10	0.35	0.35
20	23	0.95	On	0.10	0.90	0.60
23	24	0.95	On	0.10	0.90	0.60

B) ROOMS WITH ENERGY SAVING CONTROLS DURING UNOCCUPIED PERIODS(3)

Hour		Occupancy			Fresh Air Supply	Infiltr-ation rate	Lighting			Equipment			Indoor temperature		
From	To	(i)	(ii)	(iii)		(ach)	(i)	(ii)	(iii)	(i)	(ii)	(iii)	(i)	(ii)	(iii)
0	7	1.0	1.0	0.0	On	0.10	0.20	0.20	0.00	0.30	0.30	0.30	22	22	28
7	8	1.0	1.0	0.0	On	0.10	0.20	0.20	0.00	0.30	0.30	0.30	22	22	28
8	9	0.0	1.0	0.0	On	0.10	0.00	0.80	0.00	0.30	0.50	0.30	28	22	28
9	10	0.0	1.0	0.0	On	0.10	0.00	0.80	0.00	0.30	0.50	0.30	28	22	28
10	11	0.0	1.0	0.0	On	0.10	0.00	0.80	0.00	0.30	0.50	0.30	28	22	28
11	12	0.0	1.0	0.0	On	0.10	0.00	0.80	0.00	0.30	0.50	0.30	28	22	28
12	13	0.0	1.0	0.0	On	0.10	0.00	0.80	0.00	0.30	0.50	0.30	28	22	28
13	14	0.0	1.0	0.0	On	0.10	0.00	0.80	0.00	0.30	0.50	0.30	28	22	28
14	15	0.0	1.0	0.0	On	0.10	0.00	0.80	0.00	0.30	0.50	0.30	28	22	28
15	16	0.0	1.0	0.0	On	0.10	0.00	0.80	0.00	0.30	0.50	0.30	28	22	28
16	17	0.0	1.0	0.0	On	0.10	0.00	0.80	0.00	0.30	0.50	0.30	28	22	28
17	18	0.0	1.0	0.0	On	0.10	0.00	0.80	0.00	0.30	0.50	0.30	28	22	28
18	19	0.0	1.0	0.0	On	0.10	0.00	0.80	0.00	0.30	0.50	0.30	28	22	28
19	20	0.0	1.0	0.0	On	0.10	0.00	0.80	0.00	0.30	0.50	0.30	28	22	28
20	23	1.0	1.0	0.0	On	0.10	0.90	0.90	0.00	0.60	0.60	0.30	22	22	28
23	24	1.0	1.0	0.0	On	0.10	0.90	0.90	0.00	0.60	0.60	0.30	22	22	28

(1) Occupancy, lighting load and equipment load patterns are in fractions of their respective peak values.
(2) Controls over lighting, air-conditioning and power supply
(3) Three groups of patterns have been defined: i) for hired rooms that will not be occupied during day time; ii) for hired rooms that will be occupied all day long; and iii) for spare rooms, as denoted by the column sub-headings (i), (ii) & (iii) respectively. The assumption shall be made in the energy use prediction that 75% of the rooms belong to pattern group (i), 20% to group (ii) and 5% to group (iii).

TABLE 8.5.5 LIVING AND DINING ROOMS IN RESIDENTIAL FLATS (ALL DAYS)(1)

Hour From	To	Occupancy (No./Rm)	AC Operation (2)	Fresh Air Supply	Infiltration rate (ach)	Lighting	Equipment (W/Rm)
0	5	0.00	Off			0.00	27
5	6	0.00	Off			0.00	27
6	7	0.00	Off			0.30	52
7	8	0.50	Off			0.50	77
8	9	1.00	Off			0.00	77
9	10	1.00	Off			0.00	77
10	11	1.00	Off			0.00	77
11	12	1.00	Off			0.00	77
12	13	0.90	Off			0.00	77
13	14	1.00	On			0.50	89
14	15	1.00	On	Note (3)	Note (4)	0.00	61
15	16	1.00	On			0.00	61
16	17	1.00	On			0.00	61
17	18	1.00	On			0.00	61
18	19	1.00	On			0.50	61
19	20	1.50	On			1.00	142
20	21	2.00	On			1.00	142
21	22	2.00	On			1.00	142
22	23	2.00	Off			1.00	142
23	24	0	Off			0.5	142

(1) Lighting load pattern is in fractions of the peak values. Occupancy and equipment load patterns are defined directly in number of persons per room and Watt per room.
(2) The air-conditioner operation pattern applies to all days in April to October inclusive. The assumption is made that Air-conditioners will not be used in other months in the year.
(3) Fresh air supply assumed to be absent.
(4) Infiltration rate assumed to be 0.5 air change per hour (ach) during air-conditioned periods and unoccupied periods. Infiltration rate assumed to be 3 ach during non-air-conditioned periods while indoor temperature stays at or below 22 ºC and to be 12 ach when this temperature is exceeded.

TABLE 8.5.6 BEDROOMS IN RESIDENTIAL FLATS (ALL DAYS) (1)

Hour From	To	Occupancy (No./Rm)	AC Operation(2)	Fresh Air Supply	Infiltration rate (ach)	Lighting	Equipment (W/Rm)
0	1	2.00	On			0.30	36
1	5	2.00	On			0.00	0
5	6	2.00	On			0.00	0
6	7	2.00	On			0.50	0
7	8	0.50	Off			0.20	0
8	9	0.00	Off			0.30	0
9	10	0.00	Off			0.00	0
10	11	0.00	Off			0.00	0
11	12	0.00	Off			0.00	0
12	13	0.00	Off			0.00	0
13	14	0.50	On	Note (3)	Note (4)	1.00	0
14	15	0.50	On			1.00	15
15	16	0.50	On			1.00	15
16	17	0.50	On			1.00	15
17	18	0.50	On			0.00	15
18	19	0.50	On			1.00	15
19	20	0.50	On			1.00	36
20	21	1.00	On			1.00	36
21	22	1.00	On			1.00	36
22	23	1.00	On			1.00	45
23	24	2.00	On			0.6	45

(1) Lighting load pattern is in fractions of the peak values. Occupancy and equipment load patterns are defined directly in number of persons per room and Watt per room.
(2) The air-conditioner operation pattern applies to all days in April to October inclusive. The assumption is made that Air-conditioners will not be used in other months in the year.
(3) Fresh air supply assumed to be absent.
(4) Infiltration rate assumed to be 0.5 air change per hour (ach) during air-conditioned periods and unoccupied periods. Infiltration rate assumed to be 3 ach during non-air-conditioned periods while indoor temperature stays at or below 22 ºC and to be 12 ach when this temperature is exceeded.

8.5.7 CLASSROOMS IN SCHOOLS (1)

A) SUMMER SCHEDULE, MONDAY TO FRIDAY

Hour From	To	Occupancy	Fresh Air Supply	Infiltration rate (ach)	Lighting	Equipment
0	8	0.00			0.00	0.00
7	8	0.00			0.00	0.00
8	9	0.90			0.95	0.95
9	10	0.90			0.95	0.95
10	11	0.90			0.95	0.95
11	12	0.90	Note (2)	Note (3)	0.95	0.95
12	13	0.90			0.95	0.95
13	14	0.45			0.50	0.50
14	15	0.00			0.00	0.00
15	16	0.00			0.00	0.00
16	24	0.00			0.00	0.00

B) NORMAL SCHEDULE, MONDAY TO FRIDAY

Hour From	To	Occupancy	Fresh Air Supply	Infiltration rate (ach)	Lighting	Equipment
0	8	0.00			0.00	0.00
7	8	0.00			0.00	0.00
8	9	0.90			0.95	0.95
9	10	0.90			0.95	0.95
10	11	0.90			0.95	0.95
11	12	0.45	Note (2)	Note (3)	0.75	0.75
12	13	0.45			0.75	0.75
13	14	0.90			0.95	0.95
14	15	0.90			0.95	0.95
15	16	0.90			0.95	0.95
16	17	0.45			0.50	0.50
17	24	0.00			0.00	0.00

(1) Occupancy, lighting load and equipment load patterns are in fractions of the peak values. Classrooms will be occupied only for five days per week, following the Summer Schedule in the first two weeks in September and in May and June, and following the Normal Schedule for other school days.
(2) Fresh air supply assumed to be maintained by infiltration for replenishing exhaust by fan(s) during air-conditioned periods
(3) Infiltration rate assumed to be 5 air change per hour (ach) during occupied periods and 1 ach during unoccupied periods.

TABLE 8.6 MINIMUM ACCEPTABLE RATED COP OF AIR-CONDITIONING EQUIPMENT [1]

Rated Input Power		Window type	Split Type and Floor Standing
0.56 - 2.24	(kW)	2.3	2.4
0.75 - 3.0	(hp)		
> 2.24	(kW)	n/a	2.5
> 3.0	(hp)		

[1] The rated COP shall be based on 35ºC outdoor dry-bulb temperature; 27ºC indoor dry-bulb temperature and 19ºC indoor wet-bulb temperature; and power supply at 220V, 50Hz.

8.3 ASSESSMENTS FOR A BUILDING COMPLEX

For a large development that includes several major parts, such as a number of building blocks with or without a common podium, all of which are served by a centralised chiller plant (as illustrated in Figure 8.2), each part of the complex will be assessed according to the criteria for the building type to which each part belongs. A baseline building model with its own central chiller plant shall be devised for determining the zero-credit energy use and maximum electricity demand benchmarks for each part of the complex.

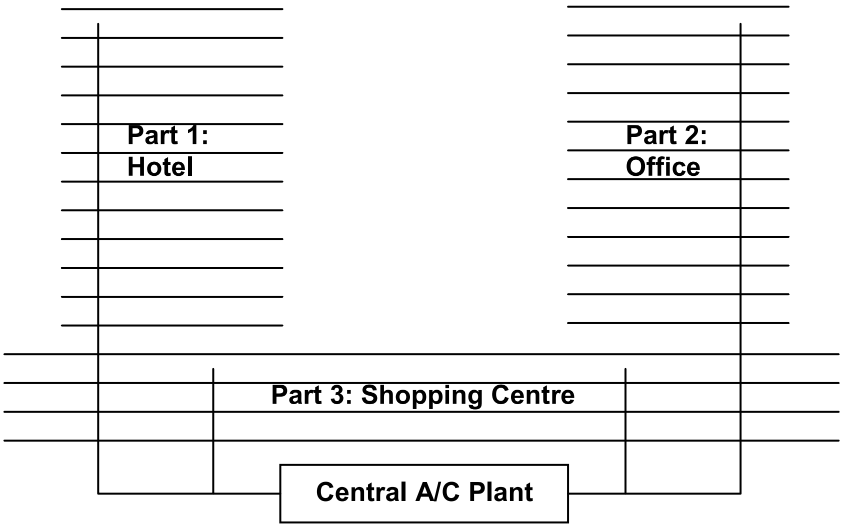

Figure 8.2 A building complex served by a central air-conditioning plant

METHODOLOGY

The annual energy use and maximum electricity demand of the central plant shall be predicted based on the simultaneous hourly cooling loads from all parts of the complex throughout the year, and the central plant performance characteristics. The predicted annual energy use and maximum electricity demand of the central chiller plant shall then be apportioned to individual parts of the complex based on the ratio of the annual cooling load of each part of the complex to the total annual cooling load of the entire complex. The share of each part of the complex in the annual energy use and the maximum electricity demand of the central plant shall be added respectively to the annual energy use and the maximum electricity demand of the air-conditioning and other installations in the corresponding part of the complex. The result will then be compared with the predicted annual energy use and maximum electricity demand of the baseline building model for that part of the complex for the determination of the number of credits to be awarded to each part of the complex.

For residential developments that include residential towers resting upon a common podium that accommodates commercial premises, or an estate development comprising both residential and commercial blocks, the residential blocks and the commercial portions in the development will be separately assessed, according to the assessment methods that apply to the respective types of buildings, and a weighted overall score will then be determined for the overall development.

NOTE

Reference should be made to HK-BEAM 4/04 Section 8.3 for further details.

8.4 EQUIVALENT CARBON DIOXIDE EMISSIONS

There are at present two power companies generating and selling electricity to consumers in Hong Kong. One of the power companies uses primarily coal for generating electricity but the other uses natural gas as well. The carbon dioxide emission per unit electricity consumed, therefore, depends on from which power company the electricity was generated. For the purpose of converting electricity consumption into the equivalent carbon dioxide emission for HK-BEAM assessment, an average value, weighted by the market shares of the two power companies, is used irrespective of from which power company an Assessed Building will be fed with electricity supply. Besides electricity, buildings in Hong Kong may also use gas for water heating, cooking and other purposes. Majority of the buildings use town gas but buildings in certain areas may use natural gas instead.

Where a mix of fuel is used in an existing building, such as a hotel, the energy performance assessment will be based on the incurred carbon dioxide emission rather than the amount of energy used. The following lists the conversion factors to be used for this purpose:

ELECTRICITY 0.615 kg CO_2 per kWh electricity consumed

TOWN GAS 0.279 kg CO_2 per m^3 of town gas consumed

NATURAL GAS 2.31 kg CO_2 per kg of natural gas consumed

8.5 REGRESSION MODELS

8.5.1 OFFICE BUILDINGS

The regression models shown in equations (1) and (2) are for predicting the annual electricity consumption (AEC_{AC}) and the maximum electricity demand (MED_{AC}) of the air-conditioning system in an office building. Values of the model coefficients are summarised in Table 8.7.

These models apply only to commercial buildings that comprise SOLELY OFFICES premises, and with characteristics that fall within the applicable ranges for the respective independent variables in the model, as summarised in Table 8.8. They can be used to determine the air-conditioning components in the zero credit energy use and maximum electricity demand benchmarks for assessing a building, as well as the annual energy use and maximum electricity demand of the Assessed Building.

$$\begin{aligned} AEC_{AC} = a_0 + a_1(AG \times UG \times Ta / COP) + a_2(AG \times UG / COP) + a_3(VR / COP) + \\ a_4(W_{LGT} / COP) + a_5(W_{EQP} / COP) + a_6(CPP \times PP) + a_7(CFP \times FP) \end{aligned} \tag{1}$$

$$\begin{aligned} MED_{AC} = b_0 + b_1(AG \times SC / COP) + b_2(VR / COP) + b_3(VR \times Wa / COP) + \\ b_4(W_{LGT} / COP) + b_5(W_{EQP} / COP) + b_6(FP) \end{aligned} \tag{2}$$

Where:

AEC_{AC}	=	the annual electricity consumption for air-conditioning per square meter gross floor area of the building (kWh/m²-yr)
AG	=	total window area per square meter gross floor area of the building (m²/m²)
a_i & b_i	=	coefficients in the models (see Table 8.7 for values of the coefficients)
CFP	=	air handling system control parameter (= 1 for constant air volume systems; = 0.67 for variable air volume systems with inlet guide vane control; = 0.4 for variable air volume systems with variable fan speed control)
COP	=	rated coefficient of performance of chillers
CPP	=	pumping system control parameter (= 1 for constant speed constant flow pumps; = 0.9 for using two-loop chilled water pumping system with constant speed pumps; = 0.6 for using two-loop chilled water pumping system with variable speed secondary-loop pumps)
FP	=	installed fan power per square meter gross floor area of the building (W/m²)
MED_{AC}	=	the maximum electricity demand of the air-conditioning system in the year per square meter gross floor area of the building (VA/m²)
PP	=	installed pumping power per square meter gross floor area of the building (W/m²)
SC	=	area (of windows) weighted average shading coefficient of glazing
Ta	=	indoor design temperature (ºC)
UG	=	area (of windows) weighted average heat-transfer coefficient of window glasses (W/m²K)

VR	=	fresh air supply flow rate per square meter gross floor area of the building (l/s·m²)
Wa	=	indoor design moisture content (g/kg dry air)
W_{EQP}	=	area (of floor) weighted average equipment power per square meter gross floor area of the building (W/m²)
W_{LGT}	=	area (of floor) weighted average lighting power per square meter gross floor area of the building (W/m²)

TABLE 8.7 COEFFICIENTS IN EQUATIONS (1) AND (2)

Coefficients	i	a_i	b_i
	0	4.763	9.404
	1	–13.84	125.5
	2	364.7	160.5
	3	75.68	–8.114
	4	2.359	0.813
	5	1.484	0.865
	6	0.688	1.856
	7	4.966	-

TABLE 8.8 APPLICABLE RANGE OF THE REGRESSION MODELS (EQUATIONS (1) AND (2))

Variable	Description	Unit	Range
AG×SC	total glazed area per unit GFA × area weighted shading coefficient of window glasses	-	0.03 – 0.21
AG×UG	total glazed area per unit GFA × area weighted average heat-transfer coefficient of window glasses	W/m²·ºC	0.19 – 1.58
AG×UG×Ta	total glazed area per unit GFA × area weighted average heat-transfer coefficient of window glasses × design indoor temperature	W/m²	8.6 – 68.8
COP	rated coefficient of chiller performance	-	2.4 – 5.1
FP	installed fan power per square meter GFA	W/m²	8.3 – 20.1
PP	installed pumping power per square meter GFA	W/m²	4.5 – 23.3
VR	fresh air supply flow rate per square meter GFA	l/s·m²	0.36 – 2.7
VR×Wa	VR × design indoor air moisture content	g·l/kg·m²·s	3.7 – 30.7
W_{EQP}	area weighted average equipment power per square meter GFA	W/m²	18 – 29
W_{LGT}	area weighted average lighting power per square meter GFA	W/m²	14 – 29

Note: GFA = Gross Floor Area (m²)

The annual electricity consumption (AEC) and maximum electricity demand (MED) with reference to which the energy performance of a new office building will be assessed shall include also the annual electricity consumption and the maximum electricity demand of the lighting and equipment in all tenants' premises and those of the lighting installations in all air-conditioned public areas, as follows:

$$AEC = AEC_{AC} + AEC_{TENANT} + AEC_{LACPA} \quad (3)$$

$$MED = MED_{AC} + MED_{TENANT} + MED_{LACPA} \quad (4)$$

Where:

AEC = the annual electricity consumption of the central air-conditioning system, the lighting and equipment in tenants' premises and the lighting installations in air-conditioned public areas in the building per square meter gross floor area of the entire building (kWh/m²-yr)

AEC_{LACPA}= the annual energy consumption of lighting in air-conditioned public areas in the building per square meter gross floor area of the entire building (kWh/m²-yr)

AEC_{TENANT}= the annual electricity consumption of lighting and equipment in tenants' premises in the building per square meter gross floor area of the entire building (kWh/m²-yr)

MED = the maximum electricity demand of the central air-conditioning system, the lighting and equipment in tenants' premises and the lighting installations in air-conditioned public areas in the building in the year per square meter gross floor area of the entire building (VA/m²)

MED_{LACPA} = the maximum electricity demand of lighting in air-conditioned public areas in the building in the year per square meter gross floor area of the entire building (VA/m²)

MED_{TENANT} = the maximum electricity demand of lighting and equipment in tenants' premises in the building in the year per square meter gross floor area of the entire building (VA/m²)

AEC_{TENANT}, MED_{TENANT}, AEC_{LACPA} and MED_{LACPA} are evaluated as described in Section 8.5.3.

8.5.2 COMMERCIAL COMPLEXES

The regression models shown in equations (1) and (2) are for predicting the annual electricity consumption (AEC) and the maximum electricity demand (MED) of the Baseline building model for a commercial complex that accommodates only offices, restaurants and retail shops, or any one or two of these premises types. These models are to be used to determine the respective zero credit benchmarks for the Assessed Building complex, which may be either a new or an existing commercial complex. However, the models CANNOT be used for predicting the annual electricity consumption and the maximum electricity demand in the assessed complex; these energy performance indicators are to be evaluated by computer simulation for a new commercial complex or be ascertained from billing records for an existing commercial complex.

The AEC and MED values predicted by the regression models cover the entire range of landlord's services systems in the building complex and the electricity end-uses in the tenants' premises. The last term in each equation (AEC_{TENANT} or MED_{TENANT}), however, can be ignored (set to zero) when applied to assess a multi-tenanted existing commercial complex, in which case the predicted AEC and MED values will only be those of the landlord's services systems and, where applicable, the air-side equipment within tenants' premises in the complex.

$$AEC = a_0 + a_1(WWRSC) + a_2(U_{BLD}) + a_3(RPR) + a_4(SPR) + a_5(HRS) + AEC_{TENANT} \quad (1)$$

$$MED = b_0 + b_1(WWRSC) + b_2(U_{BLD}) + b_3(RPR) + b_4(SPR) + b_5(HRS) + MED_{TENANT} \quad (2)$$

Where:

AEC = the annual electricity consumption per square meter gross floor area of the building (kWh/m²)

AEC_{TENANT} = the annual electricity consumption of lighting and equipment in premises occupied by the tenants/premises owners per square meter gross floor area of the building (kWh/m²)

a_i & b_i = coefficients in the models shown in equations (1) and (2) (see Table 8.9) for values of the coefficients for buildings with different area mixes of office, retail shop and restaurant premises in the building)

HRS = type of heat rejection system used in the chiller plant; = 1 for air-cooled; = 0 for water cooled

MED = the maximum electricity demand in the year per square meter gross floor area of the building (VA/m²)

MED_{TENANT}= the maximum electricity demand of lighting and equipment in premises occupied by the tenants/premises owners per square meter gross floor area of the building (VA/m²)

RPR = faction of the gross floor area of the building occupied by restaurants

SPR = faction of the gross floor area in the building occupied by retail shops

U_{BLD} = envelope thermal transmittance factor as defined in equation (3)

WWRSC = window performance factor as defined in equation (4)

The factors U_{BLD} and WWRSC are to be evaluated as follows:

$$U_{BLD} = \left(\sum_{i=1}^{n} U_{W,i} \cdot (1 - WWR_i) \cdot A_{W,i} + \sum_{i=1}^{n} U_{F,i} \cdot WWR_i \cdot A_{W,i} \right) \Big/ GFA \quad (3)$$

$$WWRSC = \left(\sum_{i=1}^{n} SC_i \cdot WWR_i \cdot A_{W,i} \right) \Big/ GFA \quad (4)$$

Where:

$A_{W,i}$ = area of the i^{th} wall or roof in the building envelope (m²)

GFA = gross floor area of the entire building (m²)

n = number of external wall and roof in the building envelope

SC_i = shading coefficient of fenestration at the i^{th} wall or roof in the building envelope (m²)

$U_{F,i}$ = U-value of the fenestration of the i^{th} wall or roof in the building envelope (W/m²K)

$U_{W,i}$ = U-value of the opaque part of the i^{th} wall or roof in the building envelope (W/m²K)

WWR_i = fenestration to wall area ratio of the i^{th} wall or roof in the building envelope

AEC_{TENANT} and MED_{TENANT} are to be evaluated as described in Section 8.5.3.

TABLE 8.9 COEFFICIENTS IN EQUATIONS (1) AND (2)

a) For a commercial building with less than 50% of its GFA occupied by restaurants and retail shops (RPR+SPR < 0.5)

Coefficients	i	a_i	b_i
	0	93.44	55.58
	1	102.3	44.41
	2	4.404	4.158
	3	241.9	31.96
	4	93.72	5.606
	5	26.46	22.32

b) For a commercial building with 50% or more of its GFA occupied by restaurants and retail shops (RPR+SPR ≥ 0.5)

Coefficients	i	a_i	b_i
	0	127.4	60.72
	1	81.48	31.24
	2	7.104	4.196
	3	157.4	30.71
	4	55.68	6.658
	5	31.21	25.64

c) For commercial buildings with a mix of restaurants and retail shops but no offices (RPR+SPR = 1.0)

Coefficients	i	a_i	b_i
	0	226.2	78.94
	1	81.94	26.61
	2	10.67	5.597
	3	0	0
	4	0	0
	5	49.26	33.22

d) For a commercial building with 100% of its GFA occupied by retail shops (SPR = 1.0)

Coefficients	i	a_i	b_i
	0	169.2	68.24
	1	97.57	38.26
	2	9.348	5.493
	3	0	0
	4	0	0
	5	34.13	26.24

e) For a commercial building with 100% of its GFA occupied by restaurants (RPR = 1.0)

Coefficients	i	a_i	b_i
	0	285.1	95.17
	1	132.89	36.19
	2	14.62	5.499
	3	0	0
	4	0	0
	5	63.37	39.82

EVALUATION OF AEC_{TENANT}, MED_{TENANT}, AEC_{LACPA} AND MED_{LACPA} FOR COMMERCIAL BUILDINGS

$$AEC_{TENANT} = \left(\sum_{i=1}^{nT} GFA_i \cdot (AEC_{LGT,i} + AEC_{EQP,i}) \right) \Big/ GFA \tag{1}$$

$$MED_{TENANT} = \left(\sum_{i=1}^{nT} GFA_i \cdot (MED_{LGT,i} + MED_{EQP,i}) \right) \Big/ GFA \tag{2}$$

Where:

$AEC_{EQP,i}$ = the annual electricity consumption of equipment per square meter gross floor area of the i^{th} premises in the building (kWh/m²)

$AEC_{LGT,i}$ = the annual electricity consumption of lighting per square meter gross floor area of the i^{th} premises in the building (kWh/m²)

GFA_i = gross floor area of the i^{th} premises in the building (m²)

$MED_{EQP,i}$ = the maximum electricity demand of equipment in the year per square meter gross floor area of the i^{th} premises in the building (VA/m²)

$MED_{LGT,i}$ = the maximum electricity demand of lighting in the year per square meter gross floor area of the i^{th} premises in the building (VA/m²)

nT = number of tenants in the building

The electricity consumption and maximum electricity demand of lighting and equipment in individual tenants' premises shall be determined as follows:

$$AEC_{EQP,i} = \left(\sum_{j=1}^{nEQP} N_{EQP,j} \cdot W_{EQP,j} \cdot UF_{EQP,j} \cdot OPH_{EQP,j} \right) \Big/ GFA_i \tag{3}$$

$$AEC_{LGT,i} = \left(\sum_{j=1}^{nLGT} N_{LGT,j} \cdot W_{LGT,j} \cdot UF_{LGT,j} \cdot OPH_{LGT,j} \right) \Big/ GFA_i \tag{4}$$

$$MED_{EQP,i} = \left(\sum_{j=1}^{nEQP} N_{EQP,j} \cdot VI_{EQP,j} \cdot UF_{EQP,j} \right) \Big/ GFA_i \tag{5}$$

$$MED_{LGT,i} = \left(\sum_{j=1}^{nLGT} N_{LGT,j} \cdot VI_{LGT,j} \cdot UF_{LGT,j} \right) \Big/ GFA_i \tag{6}$$

Where:

nEQP = number of equipment types in premises i

$N_{EQP,j}$ = number of the j^{th} type of equipment in premises i

nLGT = number of lamp types in premises i

$N_{LGT,j}$ = number of the j^{th} type of lamps in premises i

$OPH_{EQP,j}$= annual operating hours of the j^{th} type of equipment in premises i (hr/yr)

$OPH_{LGT,j}$= annual operating hours of the j^{th} type of lamps in premises i (hr/yr)

$UF_{EQP,j}$ = utilisation factor of the j^{th} type of equipment in premises i

$UF_{LGT,j}$ = utilisation factor of the j^{th} type of lamps (including the control gears where applicable) in premises i

$VI_{EQP,j}$ = maximum electricity demand of the j^{th} type of equipment in premises i (VA)

$VI_{LGT,j}$ = maximum electricity demand of the j^{th} type of lamp (including the control gear where applicable) in premises i (VA)

$W_{EQP,j}$ = installed power of the j^{th} type of equipment in premises i (W)

$W_{LGT,j}$ = installed power of the j^{th} type of lamp (including the control gear where applicable) in premises i (W)

The electricity consumption and maximum electricity demand of lighting in air-conditioned public areas shall be determined as follows:

$$AEC_{LACPA} = \left(\sum_{j=1}^{nLACPA} N_{LACPA,j} \cdot W_{LACPA,j} \cdot UF_{LACPA,j} \cdot OPH_{LACPA,j} \right) \Big/ GFA \qquad (7)$$

$$MED_{LACPA} = \left(\sum_{j=1}^{nLACPA} N_{LACPA,j} \cdot VI_{LACPA,j} \cdot UF_{LACPA,j} \right) \Big/ GFA \qquad (8)$$

Where:

nLACPA= number of lamp types in air-conditioned public areas in the building

$N_{LACPA,j}$ = number of the j^{th} type of lamps in air-conditioned public areas in the building

$OPH_{LACPA,j}$= annual operating hours of the j^{th} type of lamps in air-conditioned public areas in the building (hr/yr)

$UF_{LACPA,j}$= utilisation factor of the j^{th} type of lamps in air-conditioned public areas in the building

$VI_{LACPA,j}$= maximum electricity demand of the j^{th} type of lamps in air-conditioned public areas in the building (W)

$W_{LACPA,j}$= installed power of the j^{th} type of lamps (including the control gears where applicable) in air-conditioned public areas in the building (W)

8.6 INSTALLATION OF AIR-CONDITIONERS

The temperature and flow rate of ambient air available to air-conditioners for rejection of condenser heat affects the energy performance of the air-conditioners. The ambient air flow rate and temperature is dependent on the positions of the air-conditioners relative to the building envelope elements and other air-conditioners. For instance, if the condenser side of an air-conditioner is too close to an opposing wall, condenser air discharge will be affected, which may lead to insufficient condenser airflow, or the discharged hot air being re-circulated back into the condenser. Also, an air-conditioner should not be too close to a solid wall or to another air-conditioner at either side, as such conditions would limit the amount of air that can be drawn through the condenser coil. In the situation of a high rise residential building, the ambient air temperature around the air-conditioners at the top floors could be higher than the outdoor air temperature due to heat rejection from other air-conditioners below. This problem will be particularly acute if the air-conditioners are situated inside a recessed space with limited open area at the side.

At the indoor side, the location of air-conditioners will affect the thermal environmental conditions in the indoor space, and may give rise to condensation on wall or floor surfaces in adjacent spaces. For maintaining uniform space air conditions inside an air-conditioned space, air-conditioners should be installed at high level. This would also avoid discomfort caused by the cold air stream discharged by the air-conditioner blowing against the occupants. Furthermore, the air-conditioner should not be too close to the ceiling slab or to a partition wall to avoid contact of the slab or wall with the cold air. Otherwise, the temperature at the other side of the slab or wall may become lower than the dew point of the air in the adjacent spaces and may thus give rise to condensation.

For the purpose of avoiding deterioration of air-conditioner performance and maintenance of satisfactory indoor thermal environmental conditions, the installation locations of air-conditioners are assessed in HK-BEAM. Credits will be awarded for buildings designed to provide air-conditioner installation locations that comply with the minimum dimensions specified in Tables 8.10 and 8.11. Minimum dimensions specified in this table are as shown in Figures 8.3 and 8.4.

TABLE 8.10 MINIMUM DISTANCES FROM AIR-CONDITIONERS

Dimension	A	B	C	E	F	G	J	K	M
Minimum value (m)	1.5	0.75	1.5	0.75	2.0	See Table 8.11	0.3	1.7	0.6

TABLE 8.11 MINIMUM WIDTH (G) OF RECESSED SPACE FOR HEAT REJECTION

Depth of recessed space (D) (m)	No. of Storey (S)	Minimum width (G) (m)	
		2 A/C units per storey	4 A/C units per storey
D < 6 m	S ≤ 5	2.0	3.5
	5 < S ≤ 10	2.5	Undesirable
	10 < S ≤ 25	3.0	Undesirable
	S > 25	3.5	Undesirable
10m > D ≥ 6m	S ≤ 5	2.0	2.5
	5 < S ≤ 10	2.0	3.0
	10 < S ≤ 20	2.0	3.5
	20 < S ≤ 60	2.5	Undesirable
D ≥ 10m	S ≤ 20	2.0	2.5
	20 < S ≤ 35	2.0	3.0
	35< S ≤ 60	2.0	3.5

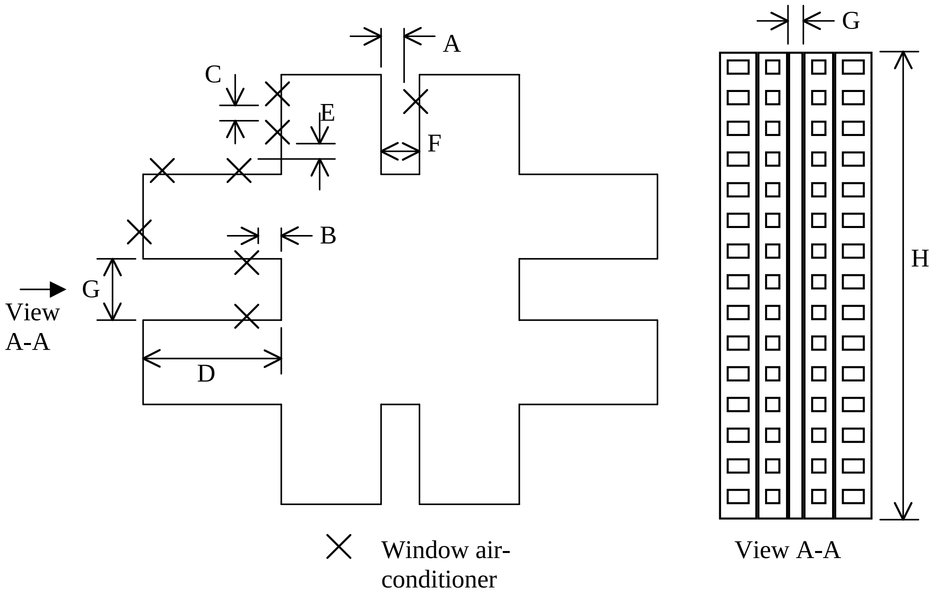

Figure 8.3 Layout plan and elevation of building

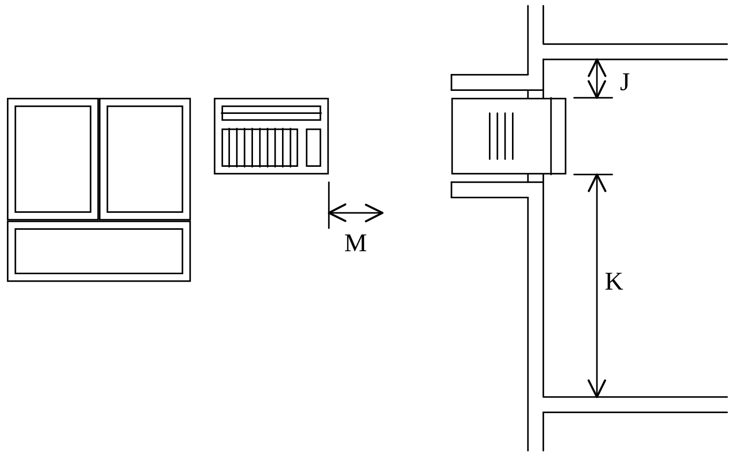

Figure 8.4 Elevation and section of a room in a residential building

LEGEND FOR FIGURES 8.3 AND 8.4:

A	Distance between window air-conditioner and nearest obstructing wall at the condenser side
B	Distance between window air-conditioner and nearest obstructing wall at either side
C	Distance between two adjacent window air-conditioners side-by-side
D	Depth of a recessed space into which air-conditioners reject heat
E	Distance between two window air-conditioners perpendicular to each other
F	Distance between two opposite walls with one window air-conditioner installed per storey at one wall
G	Distance between two opposite walls with two to 4 window air-conditioners installed at either or both walls
H	Height of building
J	Distance of top side of air-conditioner from ceiling slab
K	Distance of bottom side of air-conditioner from finished floor level
M	Distance of side of air-conditioner from nearest wall surface

8.7 OPERATIONS & MAINTENANCE AND ENERGY MANAGEMENT

8.7.1 COMMISSIONING SPECIFICATIONS

Functional performance testing procedures shall be defined and must be used to functionally test systems, equipment, components, and modes of operation. Test procedures must be documented to describe the individual test procedure, the expected system response, and acceptance criteria for each procedure. Testing documentation must identify the actual system response and must provide any pertinent observations.

Commissioning specifications shall be included in the construction documents and embrace:

- scope and details of the commissioning process;
- qualifications and skills required by the commissioning agent;
- detailed description of the responsibilities of all parties included in the commissioning process;
- systems, equipment and components to be commissioned;
- requirements for functional checklists and start-up;
- the functional performance testing process;
- specific functional performance test requirements, including testing conditions and acceptance criteria for each piece of equipment being commissioned;
- provisions for resolving deficiencies;
- requirements for reporting and documentation for commissioning;
- requirements for training;
- requirements for an operations and maintenance manual, and for systems and an energy management manual.

8.7.2 COMMISSIONING PLAN

To execute commissioning in a comprehensive and orderly manner a commissioning plan, covering a given system, equipment or component shall be prepared. The plan shall include:

- start-up and inspection checklists and procedures;
- functional performance testing procedures and checklists;
- testing, adjusting, and balancing;
- development of a comprehensive operations and maintenance manual and energy management manual; and
- completion of the commissioning report.

For each system commissioned the plan shall provide:

- an overview of the tasks to be executed during commissioning;
- a list of all features to be commissioned;
- a list of reference documents related to commissioning, including

specification references, drawing list, and submittal drawings;

- a list of primary participants in the commissioning process and their responsibilities;
- a plan for management, communication and documentation;
- description of checklists and tests to be performed, with reference to specific
- pre-start and start-up checklists;
- list of the functional performance tests to be performed; and
- description of the training to be provided to the operations and maintenance personnel

8.7.3 COMMISSIONING

Start-up and inspection checklist should comprise the checks and tests to determine that all components, equipment, subsystems, systems, and interfaces between systems operate in accordance with specifications and construction documents, including all modes and sequences of control operation, interlocks and conditional control responses, and specified responses to abnormal or emergency conditions.

The results of the start-up and check-out should be documented and must be performed according to the manufacturer's written instructions for the systems and equipment being commissioned, and the as-fitted construction documents.

Certificates of readiness should be prepared by the commissioning agent verifying that start-up and inspections have been successfully completed and that all equipment, systems, and controls are complete and ready for functional performance testing.

After initial inspection and checking has been verified each sequence in the sequence of operations shall be tested, including the following:

- start-up;
- shutdown;
- unoccupied and manual modes;
- modulation up and down the unit's range of capacity, if applicable;
- staging, if applicable;
- power failure/power down;
- alarms;
- backup upon failure; and
- interlocks with other equipment.

The commissioning authority shall verify that:

- initial inspections, start-up and checking were successfully completed;
- every point of the control system has been checked and that a minimum sample of each type of control point is commanding, reporting and controlling as specified in the as-fitted construction documents;
- if any control point in the sample is not functioning as specified, then an additional sample shall be checked, until all control points in the sample are found to be performing as specified;
- a minimum sample of each type of sensor has been calibrated so that the value reported in the control system represents the actual local value;

- if any sensor in the sample is out of calibration, then an additional sample shall be re-calibrated, until all sensors in a the sample are found to be in calibration;
- a minimum sample of each type actuators have been adjusted and observed to fully close and open dampers and valves, and that the reported values in the control system are correct;
- if any actuator, valve, or damper in the sample does not operate as required, then an additional sample of each type of actuator, valve, or damper shall be checked until all actuators, valves, or dampers in the sample are found to be to be operating as required;
- testing, adjusting and balancing by re-measuring a minimum sample of values reported for each type of component, equipment, subsystem, or system in the testing, adjusting and balancing reports;
- if any re-measured value in the sample deviates from requirements by more than 10 percent, then an additional samples shall be re-measured for each type part for which there is a deviation;
- any chimneys, chimney connectors and stacks are free of cracks, blockages and leaks;
- ensure that proper combustion air is provided to equipment; and
- ensure that all appliances are installed in accordance with applicable fire safety and local building codes.

The functional performance of each type of system, equipment, and component shall be tested based on a minimum sample for each type. If any part is found not to operate as required then additional samples shall be tested to ensure satisfactory performance has been achieved.

As far as practicable equipment shall be tested to demonstrate performance at near-design conditions (details of seasonally deferred testing can be submitted as an alternative).

The efficiency of central plant shall be recorded for reference by operations staff.

Functional performance testing can carried out using manual methods, control system trend logs, stand-alone data loggers, etc, as considered appropriate.

8.7.4 COMMISSIONING REPORT

The report shall contain:

- an executive summary;
- list of participants and their respective roles;
- a brief building description;
- an overview of the scope of commissioning and testing;
- a general description of testing and verification methods; and
- a list of each feature or system commissioned.
- for each piece of commissioned equipment, the determination of the commissioning authority regarding the adequacy of the equipment, documentation and training.

The commissioning report shall address the following areas:

- adequacy of equipment with respect to construction documents and design intent;
- equipment installation;
- functional performance and efficiency;

- equipment documentation;
- operations and maintenance review and recommendations; and
- operator training.

The functional performance and efficiency section for each piece of equipment shall identify the verification method used observations and conclusions from the testing.

The report must also include a list of outstanding commissioning issues and any testing that is scheduled for a later date.

All outstanding deficiencies identified during or as a result of commissioning activities shall have been corrected or must be separately listed and highlighted in the commissioning report.

Each non-compliance issue must be referenced to where the deficiency is documented.

Verification and documentation of installation of systems, equipment and components shall ensure:

- that they are installed according to construction documents and manufacturer's instructions;
- or any differences between the final installation and the original construction documents are documented;
- that other building systems or components are not compromising the efficiency of the systems or features being commissioned;
- the start-up and inspection ckeck-lists were completed and performed as required;
- that functional performance tests are completed as required.
- that HVAC piping testing and duct testing is completed and documentation is included in operations and maintenance manuals.
- sufficient functional testing of any control systems.
- that testing record include any deficiencies and corrections;
- final testing outcomes are included in the commissioning report and in operations and maintenance manuals;
- documentation of any seasonally deferred testing and corrections of any deficiencies;
- the operations and maintenance manual and energy management manual are complete for all components, equipment, subsystems, and systems that have been commissioned; and
- adequacy of training provided for the Owner's management, operations and maintenance personnel.

If components, equipment, subsystems, or controls, or sequences of operations as-built are differ from the original construction documents, the report shall detail these differences.

If seasonally deferred testing is completed to be under the original contract, the commissioning authority shall issue an addendum to the report, arranged in the same manner as in the initial report.

8.7.5 OPERATIONS AND MAINTENANCE MANUAL

The parties responsible for the design each system to be commissioned shall provide in writing:

- the design intent;
- the basis of design; and

- full sequences of operation for all equipment and systems, all of which must meet the legal requirements and industry wide standards.

The description of the design intent should include as a minimum:

- space temperature and humidity criteria (refer also to the section on IEQ);
- levels operator and/or occupant control over HVAC systems;
- ventilation requirements and related indoor air quality criteria (refer also to the section on IAQ);
- performance criteria related to energy efficiency;
- environmental responsiveness of the facility; and
- commissioning criteria.

The basis of design shall include at a minimum:

- details of occupancy;
- space activity and any process requirements;
- applicable regulations, codes, and standards;
- design assumptions;
- performance standards and benchmarks; and
- control system appropriate for the skill of the operations and maintenance staff.

The operations and maintenance manual must include for each piece of equipment and each system:

- the name and contact information of the manufacturer or vendor and installing contractor;
- submittal data; and
- operations and maintenance instructions with the models and features for the subject site clearly marked.

The manual shall include only data for equipment that is actually installed, and include the following:

- instructions for installation, maintenance, replacement, start-up;
- special maintenance requirements and sources for replacement parts/equipment;
- parts list and details of and special tooling requirements;
- performance data; and
- warranty information.

The manual shall include an as-built documentation package for controls covering the following:

- control drawings and schematics;
- normal operation;
- shutdown;
- unoccupied operation;
- seasonal changeover;
- manual operation;
- controls set-up and programming;

- troubleshooting;
- alarms; and
- final sequences of operation.

8.7.6 ENERGY MANAGEMENT MANUAL

The details shall include:

- descriptions of the final design intent and basis of design, including brief descriptions of each system;
- final sequences of operations for all equipment;
- procedures for seasonal start-up and shutdown, manual and restart operation;
- as-built control drawings;
- for all energy-saving features and strategies, rationale description, operating instructions, and caveats about their function and maintenance relative to energy use;
- recommendations and brief method for appropriate accounting of energy use of the whole building.
- specifications for re-calibration frequency of sensors and actuators by type and use;
- recommendations for continuous commissioning or recommended frequency for re-commissioning by equipment type, with reference to tests conducted during initial commissioning;
- recommendations regarding seasonal operational issues affecting energy use;
- list of all user-adjustable set points and reset schedules, with a discussion of the purpose of each and the range of reasonable adjustments with energy implications;
- schedules of frequency for reviewing the various set points and reset schedules to ensure they still are near optimum;
- list of time-of-day schedules and a frequency to review them for relevance and efficiency;
- guidelines for establishing and tracking benchmarks for building energy use and primary plant equipment efficiencies;
- guidelines for ensuring that future renovations and equipment upgrades will not result in decreased energy efficiency and will maintain the design intent;
- list of diagnostic tools, with a description of their use, that will assist facility staff for the building in operating equipment more efficiently; and
- a copy of the commissioning report; and
- index of all commissioning documents with notation as to their location.

8.7.7 OPERATOR TRAINING AND FACILITIES

The training program shall cover the following:

- general purpose of each building system including basic theory of operation, capabilities and limitations, and modes of control and sequences of operation;
- review of control drawings and schematics;
- procedures for start-up, shutdown, seasonal changeover, normal operation, unoccupied operation, and manual operation;

- controls set-up and programming;
- troubleshooting;
- alarms;
- interactions with other systems;
- operational monitoring and record keeping requirements, and the use of data for analyzing system performance;
- adjustments and optimizing methods for energy conservation;
- any relevant health and safety issues;
- inspection, service, and maintenance requirements for each system, including any need for specialized services;
- sources for replacement parts/equipment; and
- any tenant interaction issues.

The demonstration portion of the training program shall include at least the following:

- operation typical examples of each system;
- start-up and shutdown procedures;
- operation under all specified modes of control and sequences of operation;
- procedures under emergency or abnormal conditions; and
- procedures for effective operational monitoring.

The Client shall submit details in the form of drawings and a report demonstrating:

- that proper maintenance facilities are provided for operations and maintenance work in the form of workshop(s), office accommodation and control room;
- adequate provision of chemical storage and mixing areas for housekeeping products (central storage facilities and janitors closets, where appropriate) to allow for adequate and secure product storage with water in the space for mixing concentrated chemicals; and
- adequate provision of drains plumbed for the appropriate disposal of liquid waste products, equipped with separate outside venting, and operated under negative pressure.

8.8 SAMPLING PROTOCOL FOR IAQ ASSESSMENTS

As an alternative to the sampling protocol described in the Guidance Notes, the sampling method can be simplified based on the following rationale. This protocol seeks to reduce the number of sampling points and sampling parameters without significantly reducing the representation of IAQ.

PRINCIPLE 1: DETERMINING THE POPULATION OF MEASUREMENT POINTS

Before sampling is undertaken, the population of IAQ zone has to be defined. A sampling zone is defined as a region of indoor space, whether it is confined by partitions providing a physical barrier to another zones, or a part of an open indoor space within which every physical location (preferably the workstations) has the same quality of ventilating air, the same distribution of the ventilating air and the same emission characteristics of all significant pollutants. Within a zone, the pollutant concentrations of a set of pollutants are expected to be unchanged within any location in the zone, within the accuracy of the measuring instruments used.

Air sampling zones can be defined by a suitably experienced person during an initial walkthrough survey of all spaces. The total number of zones forms the population of the representative air quality zones.

PRINCIPLE 2: DETERMINING THE NUMBER OF SAMPLING POINTS

If the zones within a building are viewed as the total population, once this is defined, the number of sampling points can be computed using classic statistical sampling theory. Determination of the number of sampling points is done using two procedures. The first procedure involves in grouping of similar zones into 'categories'. When zones have the same three factors as defined in Principle 1, they will be grouped together to form 'category'. In a given category, zones are expected to have similar pollutant profiles. For example, zones within a building where the activities are the same, such as typical offices with sedentary workers and non-smoking, served with typical air conditioning systems, and with the same pollutant inventories within the zones, can be grouped together to form a category.

The second procedure follows the definition of all the categories. The classic statistical sampling comes into effect the number of sampling points can be reduced to provide a more economical and viable monitoring schedule. Typically, the number of sampling points (N) in a category can be computed by equation (1).

$$N = \frac{t^2 S^2}{d^2} \qquad (1)$$

where t = number of standard deviations that account for the confidence level

S = standard deviation for the variable to be estimated

d = the margin of error (e.g. 10% of the mean value).

PRINCIPLE 3:

REDUCING THE NUMBER OF SAMPLING PARAMETERS IN EACH SAMPLING POINT

Either if the pollutant comes from outdoor sources and its concentration at the intake point is below the prescribed criteria at all times, or if the pollutant is known to have a constant emission rate and its profile relative to the ventilation rate is known and is under control at all times, this pollutant can be discounted in IAQ sampling program.

PRINCIPLE 4:

REDUCING THE SAMPLING TIME FOR EACH PARAMETER IN EACH SAMPLING POINT

The reduction of sampling time is based on the assumption that when a building enters into its routine operation that including the activities of the occupancy and the operation of ventilation system, the function of the zone or the pollutant inventory are ever changing, it is reasonable to assume that the pollution profiles of the target pollutants would remain similar with small changes of magnitude. When the pollutant profile is known, a snapshot of measurement at any time can be used to determine the equivalent 8-hour exposure, and to check if any abnormal built up of the pollutant has occurred. This is particularly useful when availability of instrumentation is a problem.

PRINCIPLE 5:

CHOICE OF ALTERNATIVE INSTRUMENTATION

If the simpler measuring instrument using in the sampling is different from the requirement mentioned in the Guidance Notes for any reason, the calibration of this measuring instrument against the standard should be undertaken in order to prove that the measuring instrument is suitable for the sampling. Therefore, the cost of sampling can be reduced if the Client's representative already has an instrument that is not specified in the Guidance Note.

Also available:
HK-BEAM Version 4/04
New Buildings

Further information on how to participate in the HK-BEAM scheme is available from:
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