HK - BEAM

Version 4/04

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

New Buildings

HK-BEAM Society

HK-BEAM 4/04 ‘New Buildings’

An environmental assessment for new buildings Version 4/04

HK-BEAM Society

c/o Business Environment Council
77 Tat Chee Avenue,
Kowloon,
Hong Kong.
Telephone (852) 2784-3900
Facsimile (852) 2784-6699

Copies of this document are available free of charge from:

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

OVERVIEW

HONG KONG BUILDING ENVIRONMENTAL ASSESSMENT METHOD

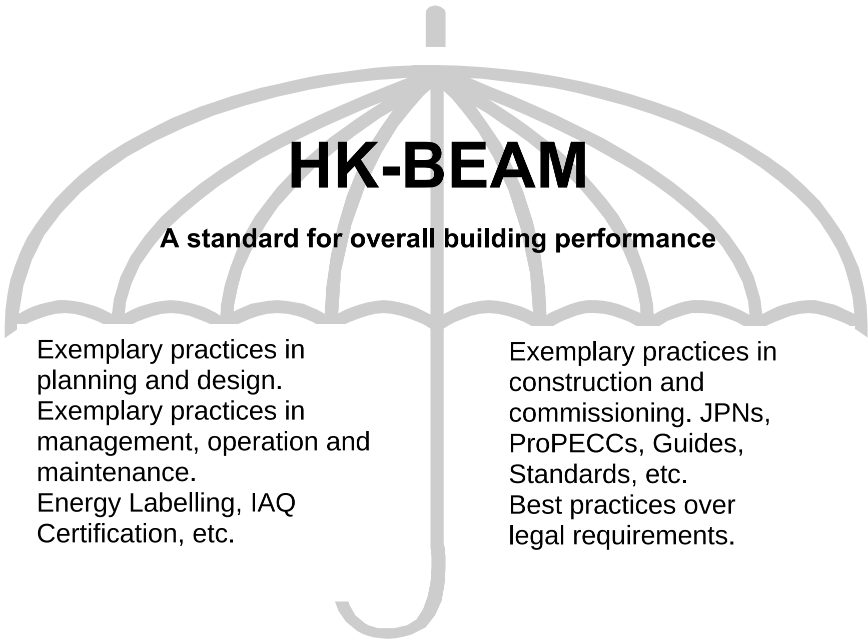
A STANDARD THAT DEFINES BUILDING QUALITY

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

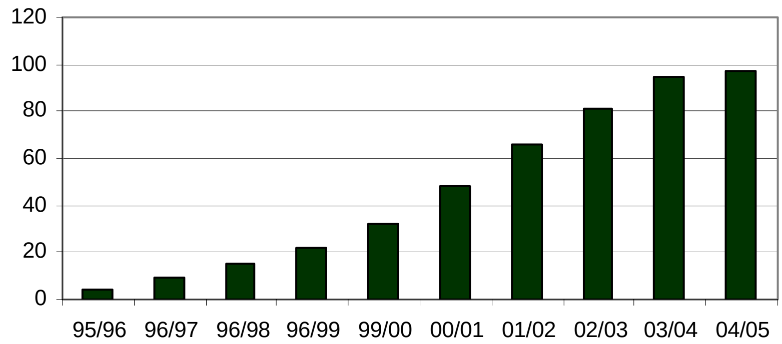
HK-BEAM is owned and operated by the HK-BEAM Society [8], an independent not-for-profit organisation whose membership is drawn from the many professional and interest groups that are part of Hong Kong’s building construction and real estate sectors. Following initial funding from The Real Estate Developers 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

TECHNICAL REVIEW PANEL VERSION 4/03

Agnes Ng - Chair, Andrew Wong , Benny Au, Reuben Chu, Charles Chu, C. K. Chau, C. K. Wong, John Burnett, K.S. Wong, Kenneth Li, Peter Chan , S.C. Tse, T. W. Fung, W. K. Pau

TECHNICAL REVIEW PANEL VERSION 5/03

Cary Chan - Chair, Ben Ridley, Benny Au, Bernard Hui, Reuben Chu, Charles Chu, Deanna Li, Gary Yeung, Greg Powell, John Burnett, Joseph Lai, Joseph Pereira, K.S. Wong, Keith Chung, Kelvin Law, Kevin Edmunds, Peter Chan, Peter Shaw, Victor Cheung, Wolfgang Peck, Y.C. Lam

DEVELOPMENT TEAM VERSION 4/04

Research and development for versions 4/04 and 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), Chung Tse Ming, Hilda Cheung (Lighting), Alice Tang (Site, Materials)

Contributions from Philip Jones, C K Chau S K Tang, D W T Chan, K T Chan, Stephen S Y Lau, Martin Fung 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 4/04

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 4/04 for new buildings. This version can also be used where building have undergone a major refurbishment. Assessment of existing buildings is carried out using version 5/04. 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 4/04 covers the planning, design, construction (and demolition) and commissioning of a building and should be initiated at the early stages of project development. HK-BEAM 4/04 aims to reduce the environmental impacts of new 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

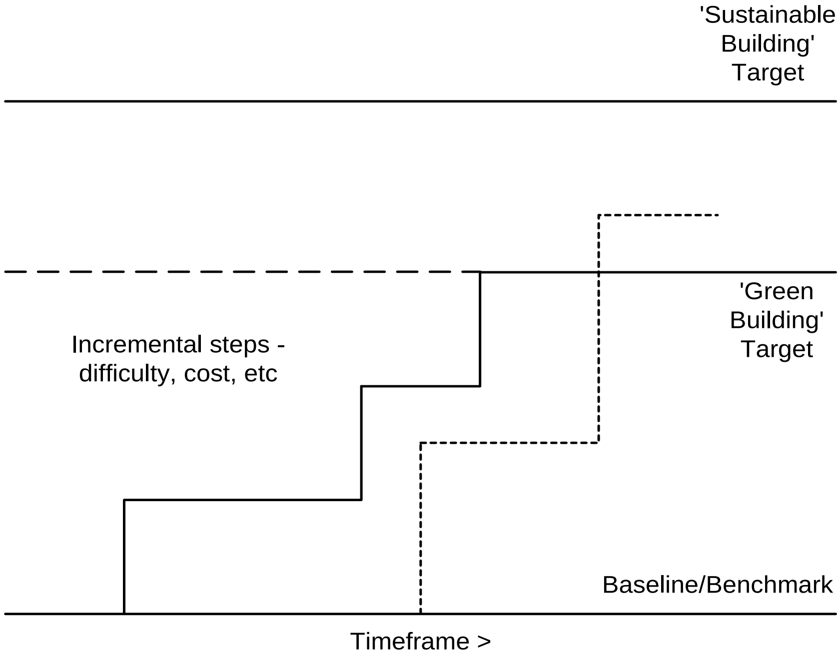
HK-BEAM recognises the need to include social and economic dimensions when assessing building performance. Where there is

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.

A notable attribute of HK-BEAM 4/04, as compared to most schemes in use elsewhere is that an assessment for new building is not finalised until a building is completed, ensuring that 'green' and 'sustainable' design features are actually implemented and construction practice meets the required performance standards. Besides being in the interests of the Client in certifying the actual performance of the finished product, this approach also serves to 'dovetail' assessment with that used for existing buildings. It would be expected that a building graded under HK-BEAM 4/04 and suitably operated and maintained would achieve a similar grade under HK-BEAM 5/04 some years later.

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 NEW BUILDINGS

HK-BEAM 4/04 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 development, and may involve premises that are only a 'shell' or are fitted-out. Whatever the circumstances, assessment focuses on what the designer, builder and commissioning agent achieves. Assessment of some aspects of performance may be type dependent, or not feasible for various reasons, so the number of applicable credits and their aggregation will vary. This is taken into account in determining the performance grade.

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 building developments may not be fully embraced by the criteria currently presented in HK-BEAM 4/04, 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 building developments, 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

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

developer. In HK-BEAM the various performance aspects covered are 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 development. 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 development 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. HK-BEAM 4/04 adopts 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 4/04 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 4/04. 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 new and recently refurbished buildings are eligible for certification under HK-BEAM 4/04, 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 developments will seek certification under this assessment method, the method is sufficiently flexible to embrace all types of building developments.

INITIATION

Whilst buildings can be assessed at any stage in the production process, the greatest benefit is derived if the assessment process begins at the planning stage, allowing designers to make changes that will improve the building's overall performance.

GUIDANCE

The HK-BEAM Assessor will issue a questionnaire to the Client which details the information required for assessment. The Assessor will arrange to meet the design team to discuss the details of the design. The 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, those that are likely to be achieved, and outline changes necessary to obtain further credits. At this stage the client may wish to make changes to the design or specification of the building.

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

CERTIFICATION

Given that a significant number of credits under HK-BEAM are based on actions taken during construction and upon completion, certification can only be issued upon building completion.

When a building development 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.

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 developments, 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**				
2.1.1	**LAND USE**	1 credit where the building development uses reclaimed land. 2 credits where the building development uses a previously developed site.	None.	**2**	
2.1.2	**CONTAMINATED LAND**	1 credit for conducting a site contamination assessment on developed or reclaimed land and implementing measures for rehabilitation as necessary, and/or proper preparation of sites and structures adjacent to landfill sites.	Building developments on Greenfield sites.	**1**	
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 existing recreational facilities and open space is adequate and available for building users.		**1**	
		1 credit if recreational facilities and open space provided within the development that is open to the public.		**1**	
2.2.1	**SITE DESIGN APPRAISAL**	1 credit for a site design appraisal report which demonstrates a proactive approach to achieve greater integration of site planning issues.	None.	**1**	
2.2.2	**ECOLOGICAL IMPACT**	1 credit for designs that demonstrate how landscaping and other site design strategies minimises ecological impact for Greenfield sites, or contributes positively to the ecological value of Brownfield sites.	None.	**1**	
2.2.3	**CULTURAL HERITAGE**	1 credit where development does not have a negative impact on sites of cultural heritage.	None.	**1**	
2.2.4	**LANDSCAPING AND PLANTERS**	1 credit for using pervious materials for a minimum of 50% of hard landscaped areas.	None.	**1**	
		1 credit for providing appropriate planting on site equivalent to at least 30% of the site area.		**1**	

2.2.5	MICROCLIMATE AROUND BUILDINGS	1 credit for demonstrating that no pedestrian areas will be subject to excessive wind velocities caused by amplification due to the site layout and/or 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
2.2.6	OVERSHADOWING AND VIEWS	1 credit for designs for which the access to daylight of neighbouring sensitive buildings is maintained to the prescribed level, OR 2 credits where the building development has no negative impact on neighbouring buildings in respect of access to daylight, views and natural breezes.	Buildings where daylight and views are of no value to neighbouring properties.	2
2.2.7	VEHICULAR ACCESS	1 credit for providing safe and efficient access for vehicles entering and leaving the site and buildings.	None.	1
2.2.8	DEMOLITION/ CONSTRUCTION MANAGEMENT PLAN	1 credit for a Demolition/Construction Management Plan including provisions for Environmental Monitoring and Auditing.	None.	1
2.3.1	AIR POLLUTION DURING CONSTRUCTION	1 credit for applying adequate mitigation measures for dust and air emissions during the construction as the recommended by the Environmental Protection Department; and demonstrating compliance with the air quality management guidelines as detailed in the Environmental Monitoring and Audit Manual.	None.	1
2.3.2	NOISE DURING CONSTRUCTION	1 credit for demonstrating and confirming that the criteria and requirements laid down in ProPECC PN 2/93 has been achieved, for all Noise Sensitive Receivers.	None.	1
2.3.3	WATER POLLUTION DURING CONSTRUCTION	1 credit for undertaking measures to reduce water pollution during construction as outlined in ProPECC PN 1/94.	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 obtrusive light from exterior lighting meets the specified performance for the environmental zone in which the building development is located.	None.	1

3	MATERIALS ASPECTS				
3.1.1	BUILDING REUSE	1 credit for the reuse of 15% or more of the existing building sub-structure or shell. 2 credits for the reuse of 30% or more of the existing building sub-structure or shell.	Buildings on reclaimed land or Greenfield sites.	2	
3.1.2	MODULAR AND STANDARDISED DESIGN	1 credit for demonstrating the application of modular and standardized design in buildings.	None.	1	
3.1.3	OFF-SITE FABRICATION	1 credit when the manufacture of 50% of listed building elements has been off-site. 1 additional credit where the manufacture of 80% of listed building elements has been off-site.	None.	2	
3.1.4	ADAPTABILITY AND DECONSTRUCTION	1 credit for designs providing flexibility through the choice of building structural system that allows for change in future use, and which is coordinated with interior planning modules.	None.	1	
		1 credit for designs providing spatial flexibility that can adapt spaces for different uses, and allows for expansion to permit additor more ional spatial requirements to be accommodated.		1	
3.1.5	ENVELOPE DURABILITY	1 credit for demonstrating the integration of building envelope systems which optimises the integrity of the envelope over the building life.	None.	1	
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 in the building.	None.	1	
3.2.2	SUSTAINABLE FOREST PRODUCTS	1 credit where virgin forest products are not used for temporary works during construction.	None.	1	
		1 credit for sourcing timber and composite timber products which are from well managed sources, including reuse of salvaged timber.		1	
3.2.3	RECYCLED MATERIALS	1 credit for use 50% of recycled materials in site exterior surfacing work, structures and features.	None.	1	
		1 credit for: using 5% of recycled materials, other than PFA, in the construction of the building; and maximising use of PFA or similar in concrete.		1	
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.	None	1	
		1 credit for the use of products in the building fabric and services that avoids the use of ozone depleting substances in their manufacture, composition or use.		1	

3.3.1	**DEMOLITION WASTE**	1 credit for implementation of a waste management system that provides for the sorting and proper disposal of inert and non-inert demolition materials.	Projects where demolition is not required or is not under the Client's control.	**1**	
		1 credit sorting and recycling specified demolition waste.		**1**	
		1 credit for demonstrating that at least 50% of demolition waste is recycled. 2 credits for demonstrating that at least 75% of demolition waste is recycled.		**2**	
3.3.2	**CONSTRUCTION WASTE**	1 credit for implementation of a waste management system that provides for the sorting and proper disposal of inert and non-inert construction materials.	None	**1**	
		1 credit sorting and recycling specified construction waste.		**1**	
		1 credit for demonstrating that at least 50% of construction waste is recycled.		**1**	
3.3.3	**WASTE DISPOSAL AND RECYCLING FACILITIES**	1 credit for providing facilities for the collection, sorting, storage and disposal of waste and recovered materials.	None	**1**	
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% to 45%.	Other types of buildings.	**10**	
		1 to 3 credits for a reduction in the maximum electricity demand by 15% to 30%.		**3**	
4.1.2	**ANNUAL ENERGY USE IN HOTEL BUILDINGS**	1 to 10 credits for a reduction in the annual energy consumption by 10% to 45%.	Other types of buildings.	**10**	
		1 to 3 credits for a reduction in the maximum electricity demand by 15% to 30%.		**3**	
4.1.3	**ANNUAL ENERGY USE IN EDUCATIONAL BUILDINGS**	1 to 8 credits for a reduction in the annual energy consumption by 5% to 30%.	Other types of buildings.	**8**	
		1 to 3 credits for a reduction in the maximum electricity demand by 8% to 15%.		**3**	
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**	
		1 to 3 credits for a reduction in the maximum electricity demand by 8% to 15%.		**3**	
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**	
4.2.1	**EMBODIED ENERGY IN BUILDING STRUCTURAL ELEMENTS**	1 credit for demonstrating the embodied energy in the major elements of the building structure of the assessed building is reduced by 10%. 2 credits for demonstrating a reduction by 15%.	None.	**2**	

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**
4.2.4	**HOT WATER SUPPLY SYSTEMS**	1 credit for installing energy efficient hot water supply system(s) and equipment that can save 20% or more energy.	Buildings where the energy used for supplying hot water is less than 10% of total.	**1**
4.2.5	**LIFT AND ESCALATOR SYSTEMS**	1 credit for complying with the Code of Practice for Energy Efficiency of Lift and Escalator Installations.	Building with one or no elevators.	**1**
4.2.6	**ELECTRICAL SYSTEMS**	1 credit for complying with the Code of Practice for Energy Efficiency of Electrical Installations.	None.	**1**
4.2.7	**RENEWABLE ENERGY SYSTEMS**	1 credit where 2%/4% or more 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 credit for complying with the items listed in the assessment check-list.		**1**
4.3.2	**CLOTHES DRYING FACILITIES**	1 credit for providing suitable clothes drying facilities which utilise the natural environment for the majority of residential units.	Buildings other than residential buildings.	**1**
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**

4.3.4	HEAT RECLAIM	1 credit for using heat reclaim chillers or heat pumps for: pre-heating domestic hot water supply; or pre-heating hot water supply for winter space heating.	Building other than hotels or similar.	1	
4.3.5	MECHANICAL VENTILATION IN HOTEL BUILDINGS	1 credit for using energy efficient ventilation fans that will consume less electricity than those meeting the zero credit requirements by 15% or more.	Buildings other than hotels or similar.	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 provision of appropriate specifications and cost provisions in contract documents detailing the commissioning requirements for all systems and equipment that impact on energy use and indoor environmental quality.	All 4 credits applicable to buildings with central HVAC/services. For residential and similar buildings only the last 2 credits apply.	1	
		1 credit for the appointment of a commissioning authority and provision of a detailed commissioning plan that embraces all specified commissioning work.		1	
		1 credit for ensuring full and complete commissioning of all systems, equipment and components that impact on energy use and indoor environmental quality.		1	
		1 credit for providing fully detailed commissioning reports for all systems, equipment and components that impact on energy use and indoor environmental quality.		1	
4.4.2	OPERATION AND MAINTENANCE	1 credit for providing a fully documented operations and maintenance manual to the minimum specified.	All 3 credits applicable to buildings with central/HVAC services.	3	
		1 credit for providing fully documented instructions that enables systems to operate at a high level of energy efficiency.			
		1 credit for: providing training for operations and maintenance staff to the minimum specified; and demonstrating that adequate maintenance facilities are provided for operations and maintenance work.	Only the 3rd credit applicable to residential buildings.		
4.4.3	METERING AND MONITORING	1 credit for installation of: metering that allows monitoring of electricity use by the main chiller plant and auxiliaries; instruments for monitoring building cooling load and operating parameters central chiller plant; metering that allows separate monitoring of electricity use by the air side of the HVAC system; and metering for landlord's electricity consumption in common space/public areas.	None.	1	

5	WATER USE			
5.1.1	WATER QUALITY	1 credit where fresh water plumbing installations comply with the referenced good practice guides.	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 to 3 credits for demonstrating that the use of water saving devices leads to an estimated aggregate annual saving of 15% to 35%.	None.	3
5.2.2	MONITORING AND CONTROL	1 credit for installations of any two features: 2 credits for installation of all three features: automatic shut-off of devices for the purposes of water conservation; monitoring water leakage within the fresh water distribution system; monitoring of water flow at main supply branches for audit purposes.	None.	2
5.2.3	WATER EFFICIENT IRRIGATION	1 credit for the use of an irrigation system which does not require the use of municipal potable water supply after a period of establishment is complete.	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 of rainwater will lead to a reduction of 10% or more in the consumption of fresh water.	None.	1 + 2B
		1 credit for the provision of plumbing and drainage systems that provide for separation of grey water from black water.		
		1 additional credit where harvested or recycled water will lead to a reduction of 10% or more in the consumption of fresh water.		
5.2.5	WATER EFFICIENT FACILITIES AND APPLIANCES	1 credit for demonstrating that installed water facilities are more efficient than otherwise.	Buildings in which facilities and/or devices are not installed by the developer.	1
		1 credit for installing water efficient appliances that are at least 20% more efficient than otherwise.		1
5.3.1	EFFLUENT DISCHARGE TO FOUL SEWERS	1 credit for demonstrating an estimated reduction in annual sewage volumes by 25%.	None.	1

6	INDOOR ENVIRONMENTAL QUALITY				
6.1.1	FIRE SAFETY	1 credit for demonstrating design integration between fire services systems, communication systems, and non-fire services systems.	None.	1	
		1 credit for provision of a fire safety 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 for designs that 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 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	
6.3.1	CONSTRUCTION IAQ MANAGEMENT	1 credit for implementing a Construction IAQ Management Plan.	Residential and similar buildings.	1	
		1 credit for: a building 'flush out' or 'bake out'; and replacement of all filters prior to occupancy.		1	
6.3.2	OUTDOOR SOURCES OF AIR POLLUTION	1 credit for demonstrating compliance with appropriate criteria for carbon monoxide.	None.	1	
		1 credit for demonstrating compliance with the appropriate criteria for nitrogen dioxide.		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 corrected design ventilation rate meets the design intent for normally occupied spaces, and the corresponding outdoor air flow rate is achieved.	Residential and similar buildings not centrally air-conditioned.	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 can be achieved by natural means.	Buildings with central air-conditioning.	2	
6.4.3	UNCONTROLLED VENTILATION	1 credit for undertaking tests in multi-zone buildings using a non-balanced test method on a representative sample of units, to demonstrate that the air tightness is within recognized limits, OR 2 credits for undertaking tests using either a whole building test method or, in the case of multi-zone buildings (e.g. apartment blocks) a 'guarded cell' (or balanced) test method, on a representative sample of units, to demonstrate that the air tightness is within recognized limits.	Air-conditioned buildings.	2B	
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.	2nd credit not applicable to residential and similar buildings.	1	
		1 credit for the provision of a system of local exhaust of premises undergoing fit-out and redecoration.		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. 2 credits for demonstrating indoor operative temperatures in occupied/habitable rooms meet the 90% acceptability limits.	Buildings that are not designed to utilise natural ventilation.	2
		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
		1 credit where fluorescent and other lamps with modulating (fluctuating) output are fitted with dimmable high-frequency ballasts in all work areas.		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**	
6.7.4	**INDOOR VIBRATION**	1 credit for demonstrating vibration levels shall not exceed the prescribed criteria.	None.	**1B**	
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 amenity features that enhance the quality and functionality of a building to the benefit of building users.	None.	**1**	
		1 credit for providing amenity features that allow for greater flexibility in building use and improved operation and maintenance of the building and its engineering services.		**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

INTRODUCTION

This section focuses on the site upon which the building is to be built; the land used and its location with respect to local transport and amenities, planning and design for the site to take account of both beneficial and negative impacts on neighbours and the development itself, mitigation of ecological impacts and emissions from the site over the building's lifetime, and aspects of site management. Obviously, there will be significant differences between large scale developments, such as estates, as compared to single buildings, which needs to be reflected in the assessment criteria and weighting of credits.

2.1 SITE LOCATION

BACKGROUND

Due to the shortage of land on which to build the choices for building location are limited. However, from an environmental perspective credit should be given where new buildings make use of sites that have already been developed or reclaimed, thereby preserving natural environments and reducing habitat encroachment. Additional credit should be awarded when contaminated land and land adjacent to landfill sites are put to use, provided that appropriate steps are taken to reduce environmental and health hazards to users of the building and to neighbouring properties. Site 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 PLANNING AND DESIGN

BACKGROUND

The planning and design issues which affect the environmental performance of a site and master layout planning should include:

- disposition of individual buildings within the site;
- spatial relationship of the building(s) to the immediate built and natural environment;
- relationship of the building(s) to the site topography and ground conditions;
- overall massing of the proposed development;
- built form of the buildings;
- orientation of buildings in relationship to view factors and ambient forces;

- balance of built-up and landscaped/open area;
- environmental enhancement to the surroundings of the site; and
- master landscaping strategy.

Greenfield site development should seek to minimise disturbance, including the ecology of the site and impacts on cultural heritage. The aim is to ensure that appropriate landscape treatment is provided on site to ameliorate visual impact, and conserve natural features. For Brownfield sites the emphasis should be on restoration of the local ecology and local environment.

Planning and design needs to take into account and allow for the adverse impacts that inevitably arise during construction, with high quality construction management the key to minimising the impacts.

2.3 EMISSIONS FROM THE SITE

2.3.1 AIR POLLUTION DURING CONSTRUCTION

2.3.2 NOISE DURING CONSTRUCTION

2.3.3 WATER POLLUTION DURING CONSTRUCTION

2.3.4 EMISSION FROM COOLING TOWERS

2.3.5 NOISE FROM BUILDING EQUIPMENT

2.3.6 LIGHT POLLUTION

BACKGROUND

The various discharges and emissions from the site should be considered over a building's lifetime.

Construction site activities can be a source of significant environmental degradation, unless appropriate steps are taken to reduce the emissions to air, land and waters, and to reduce the often considerable annoyance from construction related noise. It is the responsibility on contractors to do all in their power to employ appropriate construction methods that reduce air pollution, noise and water pollution.

It is the responsibility of the project team to consider emissions from the site, primarily the buildings on the site, as they may affect neighbouring properties, especially noise sensitive receivers such as hospitals, schools, residential buildings, etc., which will be affected for the life of the building development. 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

These issues are covered in HK-BEAM 5/04.

2 SITE ASPECTS

2.1 SITE LOCATION

2.1.1 LAND USE

EXCLUSIONS

None.

OBJECTIVE

Encourage building development on land that was previously developed or has been reclaimed in order to preserve habitat and natural resources.

CREDITS ATTAINABLE

2

PRE-REQUISITES

None.

CREDIT REQUIREMENT

1 credit where the building development uses reclaimed land.

2 credits where the building development uses a previously developed site (Brownfield site).

ASSESSMENT

Credit is not obtained if the building development is on a Greenfield site (virgin land).

The Client shall provide evidence in the form of a report by a suitably qualified person as to the previous uses of the land prior to the construction of the building development. Where the development uses previously developed land (Brownfield site), or where use is made of reclaimed land the credit shall be awarded.

BACKGROUND

Land is a precious commodity in a densely populated territory like Hong Kong. The land not only meets the housing and social needs of the community, but also sustains a rich biodiversity of animal and plant species. However, these natural resources are currently under considerable threat due to the encroachment of urbanization. If the present trend continues it reduces the ability of future generations to access this natural heritage.

The use of land in Hong Kong is very efficient, but to take account of the depletion of natural resources preference is given to previously developed sites. A less desirable alternative in this regard is the use of land reclaimed from public filling areas or marine reclamations. The use of reclaimed land helps to reduce the pressure on undeveloped land (Greenfield sites), and thereby conserving the natural habitats.

2 SITE ASPECTS

2.1 SITE LOCATION

2.1.2 CONTAMINATED LAND

EXCLUSIONS

Building developments on Greenfield sites.

OBJECTIVE

Ensure proper investigation and remediation of potential contamination of redevelopment sites, or proper precautions for sites adjacent to landfill sites.

CREDITS ATTAINABLE

1

PRE-REQUISITES

None.

CREDIT REQUIREMENT

1 credit for;

conducting a site contamination assessment on developed or reclaimed land and implementing measures for rehabilitation as necessary, and/or

proper preparation of sites and structures adjacent to landfill sites.

ASSESSMENT

a) Contaminated sites

The Client shall submit evidence in the form of a report prepared by a suitably qualified person that demonstrates through a site contamination assessment that the issues and requirements outlined in ProPECC PN 3/94 [1] have been addressed and that the immediate environs are free from any hazardous contamination. The report shall confirm that the required remedial measures, other than excavation and transfer to land fill (which is not regarded as an environmentally sound solution), have been completed to restore the land to an acceptable condition for use for the building redevelopment.

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 has been properly assessed and all issues and requirements outlined in ProPECC PN 3/96 [2] have been adequately addressed. Due consideration to gas hazards that may arise during the construction phase shall be included.

BACKGROUND

Derelict land and sites previously used as factories, shipyards, for chemical manufacturing or processing, oil deports, car repair workshops, waste treatment, etc, might be contaminated by hazardous substances such as oil, heavy metals and organic substances. Most of these sites are targeted for renewal in the Urban Renewal Strategy Study. Such land can pose risks to users, the adjacent environment or even the building materials, possibly undermining the integrity of the building. Special attention and rehabilitation may be required. Reclaimed land constructed with soil dredged from seabed or construction and demolition material can also be contaminated.

ProPECC PN3/94 sets out requirements for proper assessment and management of potentially contaminated sites, and suggests 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

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

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. Detailed guidelines are available for conducting contaminated land assessments and remediation work for sites previously used for purposes such as petrol filling stations, boatyards and vehicle repair/dismantling workshops [3].

Hong Kong is running out of landfill space due to the continued growth of waste. Excavating the contaminated soil and disposing it of at landfills is not considered as an environmentally responsible measure. On-site or off-site remediation should be employed to restore the site to an acceptable condition for the proposed use, or to put the treated soil to good use elsewhere.

It is recognised that building developments on land adjacent to landfill sites may be affected by migrating landfill gas and/or leachate unless specific precautions are taken to control the potential hazards. 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 [4] 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.

3 Environmental Protection Department. Guidance Notes for Investigation and Remediation of Contaminated Sites of Petrol Filling Stations, Boatyards, and Car Repair/Dismantling Workshops. http://www.epd.gov.hk/epd/textonly/english/environmentinhk/waste/guide_ref/guide_contamsite.html

4 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 design plans or completed site will 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, the provision of a shuttle bus service which links to a main stream mass transport interchange may be deemed to satisfy the criteria. The onus is on the Client to demonstrate that the service is of adequate capacity and frequency to meet the needs of building users.

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 building. 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.

The adequacy of a shuttle bus service may be demonstrated by data showing capacity, frequency, service hours, and the percentage of building users that can be transported during peak periods of commuting.

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

3

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 credit if recreational facilities and open space provided within the development that is 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 will be made available for public use, including details of any restrictions or conditions of access that will be 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.

To enhance the quality of a neighbourhood a development can bring additional recreational facilities and open space that is accessible by the public within reasonable restrictions on time of use, etc.

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

2.2.1 Site Design Appraisal

Exclusions

None.

Objective

Encourage a proactive approach in order to achieve greater integration of site planning issues.

Credits Attainable

1

Pre-requisites

None.

Credit Requirement

1 credit for a site design appraisal report which demonstrates a proactive approach to achieve greater integration of site planning issues.

Assessment

The onus is on the Client to demonstrate that site planning and design have taken into full account the physical and environmental aspects of the immediate site surroundings and neighbourhood. A report shall be submitted that explains and details the design team's efforts in achieving integration of the development with the immediate surroundings, covering as a minimum the negative, neutral or positive impacts associated with:

- building scale (height, skyline and massing) in relation to adjoining streets and roads, existing view corridors (to harbour, mountains, etc) and surrounding topography;
- access to daylight and views for neighbouring properties;
- impact on breezeways and corridors providing natural ventilation and flushing of pollutants;
- wind amplification adjacent to the site;
- building and surface materials and finishes as they affect reflected solar energy and sunlight onto adjacent buildings, public areas, roads, etc;
- green and open space provisions and connecting corridors;
- disturbances with respect to traffic and pedestrian flows during and after construction;
- integration with neighbouring low-rise and recreational areas;
- harmonisation with the local setting (rural, new town, or urban);
- integration of pre-existing site features;
- mixed–use development for regeneration of urban fabric;
- shading for buildings on site to mitigate noise, optimise daylighting and natural ventilation, minimise solar heat gains, etc.

Background

HK-BEAM seeks to encourage the Client and the design team to adopt a more integrated and proactive approach to the site planning matters. A site design appraisal report is to demonstrate how the various aspects of site and architectural planning issues can collectively contribute to the enhancement of the site and its surrounding neighbourhood. Investigations should include:

- a detailed assessment of the climatic conditions and topographic conditions immediate to the site;
- examination of the orientation of the buildings with respect to environmental conditions, overshadowing and views;

- planning of building form in response to local environmental conditions, such as variation of heights and distances among buildings and breaks in and between buildings, to achieve better natural ventilation and daylighting;

The ratio between the area of a site covered by buildings, and the open ground area without buildings within the site, affects the resistance that the wind encounters in the particular site and the access of sun and daylight in the site and subsequently affects pollutant concentration. Site layout should seek to minimise any negative aspects relating to microclimate, solar heat gain, wind, and loss of natural daylight to the neighbouring buildings and pubic areas, as well as the development itself.

2 SITE ASPECTS — 2.2 SITE PLANNING AND DESIGN

2.2.2 ECOLOGICAL IMPACT

EXCLUSIONS

None.

OBJECTIVE

Encourage planning and design of Greenfield sites that minimises damage to the local ecology or areas of natural beauty, and where feasible, improve the ecological value of Brownfield sites.

CREDITS ATTAINABLE

1

PRE-REQUISITES

For designated project (DP) as specified under the Environmental Impact Assessment Ordinance (EIA), Environmental Permit shall be obtained by following the statutory Environmental Impact Assessment Process, unless exempted.

CREDIT REQUIREMENT

1 credit for designs that demonstrate how landscaping and other site design strategies minimises ecological impact for Greenfield sites, or contributes positively to the ecological value of Brownfield sites.

ASSESSMENT

The Client shall provide a master landscape plan prepared by an appropriately qualified person which illustrates the various design strategies in relation to the ecological value of the site. Details of the impact on the flora, fauna and other components of the ecological habitats within and immediately adjacent to the development area shall be provided. The report shall also detail the means adopted to protect, maintain or rehabilitate the natural environment. In particular, it shall be demonstrated that development had no negative impacts on recognised sites of conservation importance, and on other ecological sensitive areas.

Where it can be demonstrated that all practical measures have been taken to conserve the ecology of a Greenfield site or to increase the ecological value of a Brownfield site, the credit shall be awarded.

The criterion for evaluating ecological impacts is given in the EIA Technical Memorandum [1]. EIAO Guidance Note 6/2002 [2] provides the basis of a check list of items to be addressed.

BACKGROUND

Ecological impact refers to a habitat or species being affected directly or indirectly due to changes in the environment brought about by a development. Besides magnitude and scale, the significance of an ecological impact is also related to the asserted importance of the habitat or species affected. The principle is first to minimise damage to the existing local ecology, and then to enhance it as far as practicable. Damage can be minimised either by selecting a site of low ecological value or by developing the site in a manner that protects salient ecological attributes.

The Technical Memorandum to the Environmental Impact Assessment Process [3] describes a general approach and methodology for assessment of ecological impact arising from a development. The objective of an ecological assessment is to provide sufficient data to allow a complete identification, prediction and evaluation of the potential ecological impacts, and/or opportunities to restore or improve matters.

1 Technical Memorandum. Annex 8 : Criteria for Evaluating Ecological Impact http://www.epd.gov.hk/eia/english/legis/memorandum/annex8.html
2 Environmental Impact Assessment Ordinance, Cap.499 Guidance Note No. 6/2002. Some Observations on Ecological Assessment From the Environmental Impact Assessment Ordinance Perspective. http://www.epd.gov.hk/epd/eia/hb/materials/GN6.doc
3 Environmental Protection Department. Technical Memorandum on Environmental Impact Assessment Process. http://www.info.gov.hk/epd/eia/legis/index3.htm

The methodology adopted will vary from site to site depending on the natural environment affected, the scale of building, and the opportunities to improve on the local ecology.

It is expected that the project team will undertake a survey of the ecological impacts arising from the development, with appropriate requirements specified in design and construction to minimise the change in ecological value. The assessment should identify and quantify as far as possible the potential ecological impacts associated with the proposed development. Both on-site and off-site impacts shall have been evaluated. Off-site mitigation measures shall only be considered when the potential for providing on-site mitigation has been exhausted [4].

Landscaping offers a major opportunity for the protection of, or improvements to, the existing site ecology, such as restoring as far as possible natural ecology - existing water courses and drainage, connections to adjacent habitats, establishment of biodiversity, supplementing natural vegetation with native species, plant protection from wind and sun, etc.

NOTE Preserving or reinstating wildlife corridors, sustaining or creating wildlife habitats, and creation of low maintenance soft landscaping are significant steps to restore the ecology of Hong Kong's built up areas. Where significant effort has been made in this regard, Client's are encouraged to seek additional credits under this aspect of performance (refer Section 7).

4 Guidelines for Implementing the Policy on Off-site Ecological Mitigation Measures. Planning, Environment & Lands Technical Circular No. 1/97. Works Branch Technical Circular No. 4/97. February 1997. http://www.etwb.gov.hk/UtilManager/tc/97/wpe0497.doc

2 SITE ASPECTS

2.2 SITE PLANNING AND DESIGN

2.2.3 CULTURAL HERITAGE

EXCLUSIONS

None.

OBJECTIVE

Conserve and protect archaeological remains, historic buildings and monuments so as to maintain the local and regional cultural heritage.

CREDITS ATTAINABLE

1

PRE-REQUISITES

Compliance with the Antiquities and Monuments Ordinance, and where applicable to the development, the Environmental Impact Assessment Ordinance

CREDIT REQUIREMENT

1 credit where development does not have a negative impact on sites of cultural heritage.

ASSESSMENT

The Client shall conduct a site survey and desktop study to identify if there are any sites of cultural heritage on or in the near vicinity of the development site. The information of the identified sites of cultural heritage shall be assembled from the Antiquities and Monuments Office [1], public libraries and archives and tertiary institutions. The guidelines and criteria for the assessment of sites of cultural interest shall follow Annex 10 and Annex 19 of Technical Memorandum to the Environmental Impact Assessment Process [2]. The guidelines on conservation of historical buildings contained in the Chapter 10 of Hong Kong Planning and Standards Guidelines [3] shall be followed.

Credit shall be awarded where evidence in the form of report by a suitably qualified person is provided detailing the findings and confirming that site preparation (including the process of reclamation), construction and building commissioning has had no adverse impacts on these sites.

BACKGROUND

Hong Kong has a long history which probably dates back to 6,000 years ago and possesses rich cultural heritage resources. SUSDEV 21 Study has defined heritage resources as those sites which contain archaeological, historical and religious value. Cultural heritage provides a means of knowing and interpreting social, cultural and economic changes and enhancing our understanding of the past. It also provides a focus for community identity, from which a sense of belonging to Hong Kong can be fostered among the community [4].

Preservation of cultural heritage resources is important. Besides the declared monuments that are protected under the Antiquities and Monuments Ordinance and the Environmental Impact Assessment Ordinance there are over 450 historic buildings have been accorded a grading, but which have no statutory protection. There remains thousands of historic buildings which are yet to be fully assessed and categorized, and are outside the protected areas. As such, special attention and measures must be given taken to ensure that any cultural heritage features on site and in the vicinity are properly retained and protected to maintain our cultural sustainability [5].

1 Antiquities and Monuments Office. http://www.lcsd.gov.hk/CE/Museum/Monument/en/index.php
2 Environmental Protection Department. Technical Memorandum on Environmental Impact Assessment Process. http://www.epd.gov.hk/eia/legis/index3.htm
3 Hong Kong Planning and Standards Guidelines. http://www.info.gov.hk/planning/tech_doc/hkpsg/english/e_index.htm
4 HK2030 Study. Working Paper No. 9. Built Heritage Preservation. http://www.info.gov.hk/hk2030/hk2030content/wpapers/wpaper_9/e_wpaper_9.htm
5 Environmental Protection Department. Assessment of Impact on Sites of Cultural Heritage in Environmental Impact Assessment Studies. http://www.epd.gov.hk/eia/english/guid/index5.html

The definition of sites of cultural heritage is shown in Schedule 1 of the Environmental Impact Assessment Ordinance. They generally cover archaeological sites and structures, historical buildings, paleontological sites and other cultural heritage features in a wide variety of forms (e.g.old street furniture, lime kilns, graves, trackways, salt-pans, etc.).

Relics fashioned before 1800 (and discovered after 1976) belong to the Government under the Antiquities and Monuments Ordinance. The excavation and search for such relics require a licence from the Authority.

2 SITE ASPECTS — 2.2 SITE PLANNING AND DESIGN

2.2.4 LANDSCAPING AND PLANTERS

EXCLUSIONS

None.

OBJECTIVE

Encourage building development to preserve or expand 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

Management of any trees on or immediately adjacent to the site follow Government stipulated requirements.

CREDIT REQUIREMENT

a) Hard landscaping

1 credit for using pervious materials for a minimum of 50% of hard landscaped areas.

b) Soft landscaping

1 credit for providing appropriate planting on site equivalent to at least 30% of the site area.

ASSESSMENT

The Client shall provide a report prepared by a suitably qualified person that outlines the Master Landscape Plan for the site and provides a dialogue that demonstrates how soft landscaping has addressed the guidelines and recommendations provided in the Hong Kong Planning Standards and Guidelines Chapter 4 Section 2 Greenery [1], appropriate to the type and scale of the building development and the immediate surroundings. The report shall detail the landscape treatment of the development including the planting and hard finishes of all landscaped areas, slopes and retaining structures, 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 both during construction and permanently;
- site formation with specific details of slope treatment;
- the choice of finishes in qualitative terms for all hardwork elements, indicating any perceived or quantifiable environmental benefits;
- planting plans with the character and planting densities for all softworks elements, 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
- future maintenance provisions.

a) Hard landscaping

Where it can be demonstrated that a minimum 50% of hard landscaped area (roadways, surface parking, plazas, pathways, etc), are pervious and measures are taken to restrict the contamination of ground waters

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

by oil and similar contaminants, the credit shall be awarded.

b) Soft landscaping

It is expected that due account shall be taken of the plant type and planter designs to minimise watering and maintenance requirements. The species, density, topsoil, fertiliser, pesticide, planting maintenance, etc. should comply with the General Specification for Building Section 25: Landscape, or at least equal equivalent.

The Client shall demonstrate compliance through quantification of the areas of greenery on the site and any 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 the construction of green and innovative buildings has identified communal sky gardens and communal podium gardens [2,3].

Water pollution in Hong Kong remains a problem. Measures that mitigate against pollution will help reduce the environmental loading. Criteria for protection of the aquatic environment against water pollution include consideration of all the aquatic components: water quality, hydrology, bottom sediments, and ecology.

2 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

3 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 been adequately considered, and where appropriate, suitable mitigation measures are provided.

CREDITS ATTAINABLE

2

PRE-REQUISITES

None.

CREDIT REQUIREMENT

a) Wind amplification

1 credit for demonstrating that no pedestrian areas will be subject to excessive wind velocities caused by amplification due to the site layout and/or 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 around buildings shall be assessed by placing a suitable scale model of the building and surrounding large structures within 500m radius from the development site in a boundary layer wind tunnel. Profiles of relative wind flow can be predicted at pedestrian levels. Measurement may be through multiple point measurement or through erosion techniques. The wind amplification factor, the developed site ground wind speed relative to the open ground site wind speed, can be estimated at pedestrian areas. These include entrances and exits to buildings, car parks, pedestrian routes, play areas, etc.

Alternatively, wind flow around the estate can be simulated using computer airflow modelling (CFD), and areas of relative wind speed predicted. Tests should be carried out for average wind speed for the site and the main prevailing wind directions. It should be demonstrated that under prevailing wind conditions

- no pedestrian areas on or immediately adjacent to the site shall have local wind speeds accelerated by factors greater than 2; and
- there are no stagnant areas which has a wind speed of less than 1.5 ms^{-1} and not 'flushed' by breezes.

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 should be designed with 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

2.2.6 OVERSHADOWING AND VIEWS

EXCLUSIONS

Buildings where daylight and views are of no value to neighbouring properties.

OBJECTIVE

Encourage building development which is sensitive to the needs of neighbours in respect of preserving daylight and views.

CREDITS ATTAINABLE

2

PRE-REQUISITES

Compliance with Building (Planning) Regulation (CAP 123F) Regulation 37.

CREDIT REQUIREMENT

a) Minimum daylight

1 credit for designs for which the access to daylight of neighbouring sensitive buildings is maintained to the prescribed level.

b) Negative impacts

2 credits where the building development has no negative impact on neighbouring buildings in respect of access to daylight, views and natural breezes.

ASSESSMENT

Neighbouring buildings and public spaces (i.e. active and passive recreational spaces), both existing and planned, shall be assessed to determine the value of daylight (and to some extent sunlight), view corridors, and breezeways to sensitive buildings and spaces. Assessment shall be by appropriate computer and/or physical modelling.

The Client shall submit a report prepared by a suitably qualified person containing a comprehensive analysis (calculations and drawings) that qualifies and quantifies the extent to which the building development will impact on the sensitive neighbouring buildings and public spaces in respect of access to daylight, view corridors and breezeways.

Change in the access to daylight may be objectively assessed in terms of the change in Vertical Daylight Factor (VDF) on the façades of sensitive receivers, or change in viewing angle, whichever is deemed most appropriate. Change of views and natural breezes, being more subjective, can be assessed in qualitative terms.

Where the VDF on the façade of the lowest floor of the sensitive receiver most affected is either unchanged or is no less than 12%, or the viewing angle is reduced by less than 5%, the first credit shall be awarded.

Where it is demonstrated that there is no impact on neighbouring sensitive receivers two credits shall be awarded.

BACKGROUND

Tall buildings can cause substantial overshadowing of neighbouring developments and amenities, affecting both direct and indirect sunlight and light from the sky. The profile of a building and its layout with respect to neighbouring buildings impacts on beneficial views, such as to the harbour or to mountains and open spaces, as well as affecting natural breezeways around the development.

The impact of a new building on all existing or planned neighbouring buildings where daylight, sunlight, views and natural ventilation is of value, such as residential buildings, hospitals, schools, etc should be assessed. Wherever possible the access to these beneficial natural elements should be safeguarded. This issue reinforces the concept of 'good neighbour buildings'.

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.

Refer also to Section 6 in respect of indoor environmental quality where vehicles enter enclosed and/or semi-enclosed premises and areas.

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

2.2 Site Planning and Design

2.2.8 Demolition/Construction Management Plan

Exclusions

None.

Objective

Encourage a higher standard of environmental management during construction.

Credits Attainable

1

Pre-requisites

A prerequisite for credit is compliance with all relevant environmental protection and pollution control ordinances. Any evidence of non-compliance shall nullify the award of any credits. The relevant enacted ordinances and their regulations are summarised in the Recommended pollution control clauses for construction contracts by the Environmental Protection Department.

Credit Requirement

1 credit for a Demolition/Construction Management Plan including provisions for Environmental Monitoring and Auditing.

Assessment

The Client shall provide copies of relevant contract documents highlighting the clauses appropriate to the construction activities for the building development in accordance with recommendations set out by the Environmental Protection Department. The Demolition/Construction Management Plan should be submitted which takes into account the Checklist and practical advice given in PNRC 17 Appendix A [1]. The Client shall confirm through a report derived from appropriate site management and monitoring that environmental management practices on site are such as to comply with legislative requirements and to minimise nuisance. Appendix A of PNRC 17 should be used as a point of reference in reporting on implementation of the environmental management on site.

Where it can be demonstrated that contract documents, specifications and cost provisions provide for a Management Plan conforming to the guidelines, and the plan has been proprely executed, the credit shall be awarded.

Background

The environmental impacts arising during demolition and construction are often very significant, affecting site ecology, air, noise and water quality as well as nuisance from waste within and outside the site. The appointment of contractors who are environmentally aware and who are able to implement good environmental practices on site should make a significant contribution to reducing environmental pollution and waste. Appropriate pollution control clauses should be included in demolition and construction contracts in accordance with recommendations by the Environmental Protection Department [2]. Contractors should take appropriate steps to minimise the impacts of demolition and construction activities on the surrounding environment.

1 Buildings Department. Practice Note for Registered Contractors PNRC 17. Control of Environmental Nuisance from Construction Sites. August 1997. http://www.info.gov.hk/bd/english/documents/pnrc/Pnrc17.pdf

2 Environmental Protection Department. Recommended Pollution Control Clauses for Construction Contracts. http://www.epd.gov.hk/epd/english/environmentinhk/eia_planning/guide_ref/rpc.html

2 Site Aspects

2.3 Emissions from the Site

2.3.1 Air Pollution During Construction

Exclusions

None

Objective

Minimise air pollution during the construction of buildings and the infrastructure serving buildings.

Credits Attainable

1

Pre-requisites

Observance and compliance with the Air Pollution Control Ordinance and its subsidiary regulations, particularly the Air Pollution Control (Open Burning) Regulation and Air Pollution Control (Construction Dust) Regulation and Air Pollution Control (Smoke) Regulation.

Credit Requirement

1 credit:

for applying adequate mitigation measures for dust and air emissions during the construction as the recommended by the Environmental Protection Department; and

demonstrating compliance with the air quality management guidelines as detailed in the Environmental Monitoring and Audit Manual.

Assessment

Where demolition is included as part of the works it shall be included in the assessment.

The Client shall submit confirmation in the form of a report from suitably qualified person that the works have been carried out without violation of the Air Pollution Control Ordinance and no conviction or complaint about air pollution from the site has been upheld by the Environmental Protection Department.

The Client shall present evidence in the form of specifications and contract documents detailing the requirements to control dust and air emissions generated by construction activities. The Client's representative on site shall be responsible for monitoring and reporting on the execution of the instructions. The representative shall confirm in writing to the Assessor that the control of dust on site followed the requirements as laid down in the specifications and contract documents.

The Client shall also present evidence in the form of a report prepared by a suitably qualified person that the monitoring and audit of Respirable Suspended Particulates (RSP) and Total Suspended Particulates (TSP) has been satisfactory for the scale of the works involved.

For major projects compliance with EPD's Environmental Monitoring and Audit Manual [1] is required. For those projects for which this it is not a requirement the frequency of the monitoring can be reduced, and/or monitoring undertaken during key phases of construction. For instance, 1-hour TSP monitoring should be undertaken with a sampling frequency of at least three times in every six days, and when the highest dust impact occurs.

Background

The Air Pollution Control Ordinance (APCO) is the main legislative framework governing the control of air pollution activities. Air pollution control regulations are enacted under the APCO for specific air pollution control purposes. Under the APCO, air pollution emissions from construction activities are subject to control under five regulations:

Construction Dust Regulation
Specified Processes Regulation

Smoke Regulation
Fuel Restriction Regulation
Open Burning Regulation

Dust generated by various construction site activities can make a significant contribution to local air pollution. High levels of dust, combined with other outdoor air pollutants, can cause respiratory problems. Inhaled particles may aggravate asthma and bronchitis, and very small particles may cause cancer. Dust also reduces visibility, dirties clothing and buildings, and increases the rate of corrosion. All these effects decrease the quality of life and cost money. Good site practices are the major mitigation measures for prevention or minimisation of air pollution from construction activities. Practical guidance on the control of air pollution during construction is available from the Environmental Protection Department. Measures include:

- effective water spays to be used to water exposed working areas that can generate dust;
- fine particle materials on site to be enclosed and covered;
- wheel washing facilities shall be installed and used by all vehicles leaving the site; and
- at the end of the works, all bare surface to be hydroseeded as soon as possible.

A Guide, published by the Hong Kong Construction Association (HKCA) [2], aims to enhance the environmental awareness of the construction industry and to provide steps and practical solutions to identify and mitigate environmental problems which are often encountered on construction sites.

The Guide can assist project/environmental managers and engineers to implement environmental protection on construction sites, starting from the project planning stage (e.g. tender bidding) to implementation, with detailed descriptions of environmental impacts and mitigation measures. Particular attention has been focused on environmental issues and mitigation measures with regard to various construction activities including piling and civil and building works.

1 Environmental Protection Department, Generic Environmental Monitoring and Audit Manual, Chapter 2, Air Quality.
2 Hong Kong Construction Association (HKCA). Best Practice Guide for Environmental Protection on Construction Sites. November 2002.

2 SITE ASPECTS

2.3 EMISSIONS FROM THE SITE

2.3.2 NOISE DURING CONSTRUCTION

EXCLUSIONS

None

OBJECTIVE

Minimise nuisance to the immediate neighbourhood caused by noise during the construction of buildings and the infrastructure serving buildings.

CREDITS ATTAINABLE

1

PRE-REQUISITES

Observance and compliance with the Noise Control Ordinance.

CREDIT REQUIREMENT

1 credit for demonstrating and confirming that the criteria and requirements laid down in ProPECC PN 2/93 has been achieved, for all Noise Sensitive Receivers.

ASSESSMENT

Where demolition is included as part of the works it shall be included in the assessment.

The Client shall submit confirmation in the form of a report from suitably qualified person that the works have been carried out without violation of the Noise Control Ordinance, and that no complaint about noise form the site has been upheld by the Authority (Environmental Protection Department) or the Police leading to the issue of a fine or prosecution.

The Client's representative on site, who shall be a suitably qualified person, shall be responsible for monitoring and shall submit monthly reports confirming that the control of noise on site has met the requirements laid down in ProPECC PN 2/93 [1] in respect of all Noise Sensitive Receivers as defined in Annex 13 of the Technical Memorandum under the Environmental Impact Assessment Ordinance [2].

BACKGROUND

Due to the high density of buildings, traffic and people, Hong Kong is perhaps one of the noisier cities in the world. The Government's policy objective for controlling noise pollution is to ensure that a satisfactory noise environment is maintained to safeguard the quality of life of the population. Noise caused by construction activity is a major target for attention. Noise related to construction activities is controlled under the Noise Control Ordinance (NCO) Chapter 400. Despite the introduction of controls under the NCO [3] and general tightening of the controls, construction noise remains a problem.

Guidance is given practice notes issued by EPD and the Buildings Department [4,5]. A Guide, published by the Hong Kong Construction Association (HKCA) [6], aims to enhance the environmental awareness of the construction industry and to provide steps and practical solutions

1 Environmental Protection Department. Practice Note for professional Persons. ProPECC PN 2/93. Noise from Construction Activities – Non-statutory Controls. http://www.epd.gov.hk/epd/english/resources_pub/publications/files/pn93_2.pdf
2 Environmental Protection Department. EIA Technical Memorandum. Annex 13 Guidelines for Noise Assessment. http://www.epd.gov.hk/eia/english/legis/memorandum/annex13.html
3 A Concise Guide to the Noise Control Ordinance. Environmental Protection Department. 8th Ed. July 2000. http://www.epd.gov.hk/epd/english/environmentinhk/noise/guide_ref/guide_nco.html
4 Buildings Department. Practice Note for Authorized Persons and Registered Structural Engineers. PNAP 144. Control of Environmental Nuisance from Construction Sites. August 1997. http://www.info.gov.hk/bd/english/documents/pnap/Pnap144.pdf
5 Environmental Protection Department. Environmental Noise. http://www.epd.gov.hk/epd/noise_education/web/ENG_EPD_HTML/index/index.html
6 Hong Kong Construction Association (HKCA). Best Practice Guide for Environmental Protection on Construction Sites. November 2002.

to identify and mitigate environmental problems which are often encountered on construction sites.

General requirements [7] and practical guidance [8] on meeting the requirements is available from EPD. The police are also authorized to enforce the sections of product noise and construction noise under the NCO. Construction activities are grouped into two main categories:

- general works (e.g. excavation and concreting); and
- percussive piling (e.g. piling by means of a hydraulic hammer or a drop hammer).

A Technical Memorandum [9] details the procedures for determining any permitted hours of operation for percussive piling. Control of construction noise for general works can be further categorised into:

- control in the whole territory - the use of all Powered Mechanical Equipment (PME) requires a Construction Noise Permit (CNP) during restricted hours; and
- control in Designated Areas - stricter control is imposed on construction sites within Designated Areas (DA). Most of the built-up residential areas are within designated areas. The use of Specified Powered Mechanical Equipment and the carrying out of Prescribed Construction Work (PCW) during restricted hours requires a CNP.

For construction work other than percussive piling other technical memoranda [10,11] detail the procedures for determining (on the basis of equipment used, distance separation, and the calculated noise level) whether a CNP for general works should be granted. The noise impacts on nearby Noise Sensitive Receivers (NSRs, e.g. dwellings, school) are assessed in accordance with the Technical Memoranda. Under the Noise Control Ordinance, there is no statutory control on the noise from general works during the unrestricted hours (i.e. 7 am - 7 pm on weekdays).

Examples of 'good practices' in respect of further reducing noise nuisance from construction activities, erection of barriers and use of enclosures, and use of appropriate equipment such as:

- hydraulic piling hammers;
- hydraulic crushers instead of conventional excavator mounted breakers;
- wire saw for concrete cutting rather than excavator mounted breakers
- acoustic enclosures for hand-held breakers and generators;
- acoustic barriers for large equipment;
- disposal of rubble through plastic chutes; or
- providing temporary solutions to reduce noise at adjacent noise sensitive receivers, such as the provision of acoustic insulation.

7 Environmental Protection Department. EIA & Planning: guidelines & references, section 3 Noise Control.
8 http://www.epd.gov.hk/epd/english/news_events/current_issue/files/enoise2002.ppt
9 Environmental Protection Department. Technical Memorandum on Noise from Percussive Piling. http://www.epd.gov.hk/epd/english/environmentinhk/noise/guide_ref/tm_pp.html
10 Environmental Protection Department. Technical Memorandum on Noise from Construction Work other than Percussive Piling. http://www.epd.gov.hk/epd/english/environmentinhk/noise/guide_ref/tm_nonpp.html
11 Environmental Protection Department. Technical Memorandum on Noise from Construction Work in Designated Areas. http://www.epd.gov.hk/epd/english/environmentinhk/noise/guide_ref/tm_des_area.html

2 SITE ASPECTS

2.3 EMISSIONS FROM THE SITE

2.3.3 WATER POLLUTION DURING CONSTRUCTION

EXCLUSIONS

None

OBJECTIVE

Ensure the proper management of construction site discharges.

CREDITS ATTAINABLE

1

PRE-REQUISITES

Observance and compliance with the Water Pollution Control Ordinance and its subsidiary regulation.

CREDIT REQUIREMENT

1 credit for undertaking measures to reduce water pollution during construction as outlined in ProPECC PN 1/94.

ASSESSMENT

Where demolition is included as part of the works it shall be included in the assessment.

The Client shall submit confirmation in the form of a report from suitably qualified person that the works have been carried out without violation of the Water Pollution Control Ordinance and no conviction or complaint about air pollution from the site has been upheld by the Environmental Protection Department.

The Client shall present evidence in the form of specifications and contract documents detailing the requirements to undertake measures to reduce water pollution during construction, as laid down in ProPECC PN 1/94 [1].

The Client's representative on site shall be responsible for monitoring and reporting the execution of the instructions. The Client shall confirm in writing that the works were conducted in accordance with the recommendations given in ProPECC PN 1/94 as appropriate to the particular circumstances of the site.

BACKGROUND

Construction activity can pose a major pollution threat to the environment if discharges from construction sites are not properly handled. Such discharges are subject to control under the Water Pollution Control Ordinance [2]. The major types of discharges have been identified as follows:

- muddy underground water and bentonite slurries from excavation work and/or bore piling activities;
- run-off from site watering and wheel washing effluent as a result of adopting dust control measures;
- domestic sewage generated from canteen and toilet facilities on site; and
- contaminated surface run-off during wet weather.

Construction site wastewater contains mainly silt, sand and gravel. Indiscriminate discharge of untreated or partially treated wastewater will have a major impact on the receiving water bodies. Common pollution threats include:

- siltation in drainage pipes which may lead to blockage and eventually flooding risks;
- visual nuisance and hazard to the aquatic life e.g. fish gills blocked

1 Environmental Protection Department. Practice Note for Professional Persons. ProPECC PN 1/94. Construction site drainage. http://www.epd.gov.hk/epd/english/resources_pub/publications/files/pn94_1.pdf

2 Environmental Protection Department. A Guide to the Water Pollution Control Ordinance. May 2001. http://www.epd.gov.hk/epd/english/environmentinhk/water/guide_ref/files/guide_wpc_wpco.pdf

up causing suffocation to death;

- increase in turbidity of the receiving water which may adversely affect the ecosystem.

Prior to making a discharge, the responsible person for the discharge should submit an application to EPD for a discharge licence. Under the Water Pollution Control Ordinance, it is an offence to discharge polluting matter in a water control zone without a valid license, or to discharge effluent in breach of the terms and conditions specified in the discharge license granted by the Authority. The contractor has the responsibility to ensure compliance with all legislative control requirements. Apart from obtaining a valid discharge license before the commencement of any discharge, the contractor must take all necessary steps to comply with the terms and conditions of the license. This requires due consideration be given at the planning stage of a construction project. Attention should be paid to the wastewater characteristics, minimize the quantity of pollution loads (both in terms of flow and concentration), plan and install proper site drainage to intercept stormwater run-off from outside the side and collect silt carrying site run-off to silt removal facilities; design and construct appropriate wastewater treatment facilities, provide the necessary training to the site personnel as well as constant on-site supervision and monitoring of the environmental performance. All wastewater treatment facilities should be well maintained to achieve the desired performance.

ProPECC PN 1/94 provides guidance on good practice for dealing with discharges from construction sites. A Guide, published by the Hong Kong Construction Association (HKCA) [3], aims to enhance the environmental awareness of the construction industry and to provide steps and practical solutions to identify and mitigate environmental problems which are often encountered on construction sites.

3 Hong Kong Construction Association (HKCA). Best Practice Guide for Environmental Protection on Construction Sites. November 2002.

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 to be specified and do not use seawater they shall be designed to the specifications outlined in the Code of Practice Prevention of Legionnaires Disease. The Client shall submit details of the installation and confirm compliance with the Code of Practice. Any deviations from the specifications given in the CoP shall be identified together with confirmation that there is no increased risk of dispersal of airborne droplets or mists.

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

Encourage proactive design techniques intended to 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

On the basis of promoting good environmental design assessment shall assume that a noise sensitive development already exists or has the potential to exist and be affected by the building. Ideally, therefore, assessment should be made at the façade of the nearest or most affected adjacent building, or site boundary.

The noise assessments shall be conducted in accordance with the Technical Memorandum [1]. This lays down statutory Acceptable Noise Levels (ANL). However, in order to plan for a better environment, all fixed noise sources should be so located and designed that 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.

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

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

served. Non-compliance with such a notice will be an offence. The Technical Memorandum [1] contains the technical procedures that 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.

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 construction, 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 improved design, choice of materials, and installation methods. Of concern are:

- pollutants arising from manufacturing and transportation; and
- waste generated and recycled.

There are opportunities to reduce material use through modular designs allowing off-site prefabrication, lean construction methods, etc. Improved materials management and on-site sorting can achieve significant reductions in waste generation and reduce construction costs.

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, such as foundations, main structures, facades, etc. Flexibility in design allows for change in use and layout of the premises within a building development. High standards of design detailing permits off-site fabrication of major building components, allows for deconstruction, and improves durability and longevity of buildings.

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 at the earliest stages of planning and design of building developments, and carried over to fit-out and subsequent redecoration.

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

BACKGROUND

Hong Kong is running out of land for waste disposal, and without concerted effort the existing landfill sites could be exhausted by 2015. In 2003, about 19 million tonnes of construction waste materials were generated in Hong Kong, 20% increase from 2002. Of this quantity, 87% was inert material suitable for reuse as public fill in land formation projects. The remaining 13% (approx. 2.5 million tonnes), comprises mostly non-inert materials, was disposed of at landfills; this accounts for

38% of the total waste intake at the landfills. 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 the inert material.

3 MATERIALS ASPECTS

3.1 EFFICIENT USE OF MATERIALS

3.1.1 BUILDING REUSE

EXCLUSIONS

Buildings on reclaimed land or Greenfield sites.

OBJECTIVE

Encourage the reuse of major elements of existing buildings, to reduce demolition waste, conserve resources and reduce environmental impacts during construction.

CREDITS ATTAINABLE

2

PRE-REQUISITES

The reuse of major elements from existing building structure or shell shall comply with Building (Construction) Regulations Chapter 123B Regulation 90 Fire resisting construction and other relevant Building regulations.

CREDIT REQUIREMENT

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

2 credits for the reuse of 30% 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 existing building were used in the 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 new development.

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

BACKGROUND

With greater flexibility in planning approvals opportunities exist to rehabilitate existing buildings. 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 need to be critically reviewed to determine the advantages and feasibility of reuse as opposed to demolition.

3 MATERIALS ASPECTS

3.1 EFFICIENT USE OF MATERIALS

3.1.2 MODULAR AND STANDARDISED DESIGN

EXCLUSIONS

None.

OBJECTIVE

Encourage increased use of modular and standardised components in building design in order to enhance buildability and reduce waste.

PRE-REQUISITES

Full compliance with the Building (Construction) Regulations.

CREDITS ATTAINABLE

1

CREDIT REQUIREMENT

1 credit for demonstrating the application 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
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. 1983.
2 International Standard Organization. ISO 2848 Building Construction – Modular coordination – Principles and rules. 1984.
3 British Standards Institution. British Standard BS 6750. Specification for Modular coordination in building. 1986.
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

3.1.3 OFF-SITE FABRICATION

EXCLUSIONS

None.

OBJECTIVE

Encourage off-site fabrication of building elements in order to reduce wastage of materials and quantities of on-site waste.

CREDITS ATTAINABLE

2

PRE-REQUISITE

None.

CREDIT REQUIREMENT

1 credit when the manufacture of 50% of listed building elements has been off-site.

1 additional credit where the manufacture of 80% of listed building elements has been off-site.

ASSESSMENT

The listed building elements includes:

- facades;
- staircases;
- slabs;
- external elements;
- balcony/utility platform;
- bridge-decks;
- footbridges;
- pavement paving;
- partition walls; and
- internal fittings.

Additional or alternative elements may be included, which the Client believes to demonstrate a significant contribution to the assessment criteria. Off-site in this context means a factory or similar purpose built facility but not a temporary site set up for the purpose of producing said elements.

The Client shall demonstrate through the submission of contract specifications, drawings and other supporting documents the quantities (by weight or volume) of those building elements fabricated off-site in accordance with the Code of Practice for Pre-cast Construction 2003. The assessment shall take into account the number and quantities of building elements in the building development that can be fabricated off-site and award credits where the assessment criteria have been met.

BACKGROUND

Off-site fabrication is the manufacture of sections of a building at the factory so they can be easily and rapidly assembled at the building site, improving the buildability of the building. Since the factory fabrication of building elements are produced under controlled conditions, it allows for more efficient disposal of debris and waste. Noise, dust, site traffic and other environmental nuisances can also be reduced. Interior millwork and custom metalwork should be detailed to be shop-finished and installed to the highest degree to limit the need for on-site painting and finishing work.

The Hong Kong construction industry is under continual stringent pressure to raise productivity, reduce costs and improve the quality levels of constructed facilities. All these requirements are the key drivers for change in the industry [1]. A new research agenda has therefore been embarked by the Construction Industry Institute, Hong Kong (CII-HK) to explore the existing state of implementation of prefabrication and preassembly, and how they could be successfully applied to construction services. This paper provides a succinct review of the application of prefabrication and preassembly in the local public housing construction industry, followed by the significant ingredients of the captioned research agenda. A wider use of prefabrication would help overcome many of the hurdles inherent in traditional in-situ construction, and engender more technically feasible and cost-effective installations.

Prefabricated components are widely used in the construction of public housing blocks [2] for better workmanship and quality control and to maximize construction efficiency. Please click on the links below to view the application of prefabrication in a New Harmony 1 block, the latest standard block of today's public rental housing. The Code of Practice [3] provides guidance on the design, construction and quality control of precast structural and non-structural elements.

1 Yeung N S Y, Chan A P C, Chan D W M. Application of Prefabrication in Construction – A New Research Agenda for Reform by CII-HK. http://www.ciihk.org.hk/sheet/26112002_apc.pdf

2 Housing Department. Prefabrication in Housing Blocks. http://www.housingauthority.gov.hk/en/businesspartners/prefabrication/0%2C%2C%2C00.html

3 Building Department, Code of Practice for Pre-cast Concrete Construction. http://www.info.gov.hk/bd/english/documents/code/cppcc2003.pdf

3 MATERIALS ASPECTS

3.1 EFFICIENT USE OF MATERIALS

3.1.4 ADAPTABILITY AND DECONSTRUCTION

EXCLUSIONS

None.

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

PRE-REQUISITES

None.

CREDIT REQUIREMENT

a) Structural adaptability

1 credit for designs providing flexibility through the choice of building structural system that allows for change in future use, and which is coordinated with interior planning modules.

b) Spatial adaptability

1 credit for designs providing spatial flexibility that can adapt spaces for different uses, and allows for expansion to permit additional spatial requirements to be accommodated.

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 specific design strategies that provide for the intended outcome.

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 applicable good practices in respect of structural and/or spatial flexibility, and/or flexibility in servicing have been adopted whenever feasible, the credit(s) shall be awarded.

ADAPTABILITY CHECK-LIST

Reference may be made to various publications [e.g. 1]. Key points include:

- design of foundations to allow for potential vertical expansion of the building (rational analysis should be done to arrive at a reasonable estimate for possible future expansion);
- installation of isolation joints or other features that avoid the potential for differential settlements and for progressive collapse due to accidental loading;
- reliance on a central core for lateral load resistance, to allow local modifications to the structure while maintaining complete structural integrity;
- use a wide structural grids, upward of 6m (the redundancy in structural strength that a wide grid introduces can increase adaptability considerably);
- design the lower few floors for heavier (e.g. 4.8 kPa) live load (the increased capacity will enable the building to easily accommodate all of the likely conversions with no structural modification0;

1 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

- add sufficient height to lower floors to enable a range of uses;
- use of a structural floor system that accommodates a number of mechanical and electrical service distribution schemes based on different occupancies;
- design the building envelope independent of the structure (i.e., functionally discrete systems, with the interfaces designed for separation);
- provide means for access to the exterior wall system from inside the building and from outside;
- design a versatile envelope capable of accommodating changes to the interior space plan;
- where possible using hybrid HVAC systems, with a balance between centralised components and distributed components (designed to provide the flexibility of changing the central system fuel and capacity, while allowing for easy upgrading of localised conditioning units and distribution network);
- spaces designed for a loose fit rather than tight fit;
- inclusion of multifunctional spaces;
- use of interior partitions that are demountable, reusable and recyclable;
- provision of more than the minimum spatial areas and floor heights; and
- use of adaptable floor plans, including large grids that can be subdivided.

SERVICEABILITY CHECKLIST

ASTM provides guidance for various types of buildings and uses [e.g. 2, 3,4].

- spaces designed such that minimum disruption will be caused to occupants due to physical change;
- luminaires are easily relocated within ceiling grid or uplighting is 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;
- easy relocation of partition walls that causes minimum damage to flooring or ceiling systems; and
- partition walls are easily removed and fully salvageable.

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

2 ASTM International. Designation E1692-95a Standard Classification for Serviceability of an Office for Change and Churn by Occupants.

3 ASTM International. Designation E1679-95 Standard Practice for Setting the Requirements for the Serviceability of a Building or Building-Related Facility

4 ASTM International. Designation E1334-95 Standard Practice for Rating the Serviceability of a Building or Building-Related Facility

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. Examples include:

- foundations that allow for potential vertical expansion of the building;
- superstructures that rely on a central core for lateral load resistance to allows local modifications to the structure without affecting the building's structural integrity;
- reducing the use of embedded infrastructure for power, data and HVAC systems;
- the use of building systems that isolate structural and building enclosure systems used for housing building services components;
- the provision of lightweight partitions that can be moved to change layout;
- design that allows interior fitting-out to use modular and pre-fabricated components; and
- 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.

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

3.1 EFFICIENT USE OF MATERIALS

3.1.5 ENVELOPE DURABILITY

EXCLUSIONS

None.

OBJECTIVE

Encourage good design detailing and use of materials to promote longevity of the building envelope.

CREDITS ATTAINABLE

1

PRE-REQUISITES

Full compliance with the specific requirements set out in Building (Construction) regulation.

CREDIT REQUIREMENT

1 credit for demonstrating the integration of building envelope systems which optimises the integrity of the envelope over the building life.

ASSESSMENT

The Client shall submit a report prepared by a suitably qualified person detailing the design of the building envelope and providing supporting drawings and specification documents that demonstrates how the design and materials used in the building envelope can achieve the projected life with low maintenance, thereby minimising the consumption of resources over the life of the building. The adequacy of construction methods that provide effective protection against building failure should also be considered in the report.

For the purposes of assessment reference shall be made to the check-list included herein. A similar checklist detailing how the prerequisites and listed good practices should be submitted by the Client. Where it can be demonstrated that applicable good practices have been adopted whenever feasible, the credit shall be awarded.

CHECK-LIST

- Where cladding is affixed to the external walls of building, it is a prerequisite to comply with the performance requirements stipulated in the Building (Construction) Regulation 39 in respect of material type, fixings, strength and durability. PNAP 59 [1] should be followed for the testing of anchors and cladding panels to ensure that they are corrosion resistant and properly affixed.
- Where curtain wall system is used to form the external walls of a building, it is a prerequisite to comply with the specific requirements set out in Building (Construction) Regulation 43 in curtain walls. PNAP 106 [2] should be followed which details the design requirements, maintenance and repair inspection requirements, and safety test requirements for curtain wall system with a history of previously accepted test.
- Where cantilevered projecting structures, including canopies, balconies, bay windows, air-conditioner platforms, windows flower boxes, etc, are constructed, it is a prerequisite to comply with the specific requirements set out in Building (Construction) Regulation 4. PNAP 173 [3] should be followed for the loading carrying capacity of the structural elements and the durability of concrete to ensure public safety.
- It is a prerequisite that all windows and window walls should satisfy the performance requirements stipulated in the Building

1 Buildings Department, Practice Note for Authorized Persons and Registered Structural Engineers, PNAP 59. Cladding. http://www.info.gov.hk/bd/english/documents/pnap/Pnap059.pdf

2 Buildings Department, Practice Note for Authorized Persons and Registered Structural Engineers, PNAP 106. Curtain Wall Systems. http://www.info.gov.hk/bd/english/documents/pnap/Pnap106.pdf

3 Buildings Department, Practice Note for Authorized Persons and Registered Structural Engineers, PNAP173. Safe Design and Construction of Cantilevered Projecting Structures. http://www.info.gov.hk/bd/english/documents/pnap/Pnap173.pdf

(Construction) Regulations.

- It is a prerequisite that all roofs should be weatherproof in compliance with Building (Construction) Regulation 48.
- Fixing of Reinforcement of Concrete Works should follow the good practice recommenced in PNAP 221 [4].
- Design of window and window wall should take into account the following practice as suggested in PNAP 239 [5].
- Where aluminium window is installed, design should follow the good practice as suggested in PNAP 248 [6].
- Where pre-cast concrete elements are adopted, the Code of Practice for Pre-cast Concrete Construction 2003 [7].
- All doors to outside and windows should resist the effects of repeated use without impairment of their performance over their expected service lives [e.g. 8 or equivalent standard].
- Roofs should resist the degradation factors likely to act upon them during their service lives [8].
- All joints and all joint sealants should be of the best service life to prevent high cost of replacement and the potential for building damage [8].

BACKGROUND

In general, durability is a building's ability to maintain its performance over its lifetime. The advantages are well-known: durable materials and building systems are long lasting, can reduce maintenance and repair costs, and are often cost-effective from a life-cycle perspective. Additional benefits include minimized disruption of building operations due to repairs and maintenance, and environmental benefits resulting from the reduced disposal and replacement of materials

Provision of good detail design in constructive protection measure are significant to promote longer life of a building, the measures may include preservation treatments, choice of suitable material specifications, 'breathing' wall detailing, condensation control, etc. Material products with compatible maintenance requirements should be chosen to optimize building life. Materials requiring dry maintenance should have adequate separation from materials requiring wet maintenance.

4 Buildings Department, Practice Note for Authorized Persons and Registered Structural Engineers PNAP 221. Fixing of Reinforcement for Concrete Works. http://www.info.gov.hk/bd/english/documents/pnap/Pnap221.pdf

5 Buildings Department, Practice Note for Authorized Persons and Registered Structural Engineers PNAP 239. Window and Window Wall. http://www.info.gov.hk/bd/english/documents/pnap/Pnap239.pdf

6 Buildings Department, Practice Note for Authorized Persons and Registered Structural Engineers PNAP 248. Aluminium Windows. http://www.info.gov.hk/bd/english/documents/pnap/Pnap248.pdf

7 Buildings Department. Code of Practice for Precast Concrete Construction. 2003. http://www.info.gov.hk/bd/english/documents/code/cppcc2003.pdf

8 ASTM International. ASTM E2136-01, Standard Guide for Specifying and Evaluating Performance of Single Family Attached and Detached Dwellings – Durability.

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 in the building.

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, and where they have been used to replace other more commonly used materials. 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.

Designers should establish objectives for the use of rapidly renewable materials and identify where such materials can be applied as substitutes for more commonly used resource intensive materials. The use of materials such as bamboo flooring, strawboard, cotton insulation, natural linoleum flooring, etc. should be considered as a minimum.

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

2

PRE-REQUISITES

None.

CREDIT REQUIREMENT

a) Timber used for temporary works

1 credit where virgin forest products are not used for temporary works during construction.

b) Forest products used in the building

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

ASSESSMENT

a) Timber used for temporary works

The Client shall provide a report prepared by a suitably qualified person demonstrating that no virgin forest products were used for temporary works, unless exceptional circumstances required such use. The report should highlight how contract documents and specifications precluded such use in form work, hoardings, walkways, etc., together with evidence such as site photos and records to demonstrate that no new timber or timber products were used. Where circumstances required the use of new timber products the reasons, details and quantities used shall be reported. The reuse of timber and timber products is allowed, but shall also be identified in the report.

The Client's representative on site shall be responsible for monitoring and reporting on construction activities, and shall confirm in writing that the works were conducted in accordance with the specifications and contract documents, and that all details regarding the use of timber contained in the report are correct.

The Assessor may carry out site inspections during construction.

Where it can be demonstrated that all practical steps have been taken to avoid the use of virgin forest products the credit shall be awarded.

b) Forest products used in the building

The Client shall provide a report prepared by a suitably qualified person demonstrating that reasonable effort has been made to secure forest products 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], that is by seeking:

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

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 the building projects.

A Works Bureau Technical Circular (WBTC) [5] establishes the revised policy requiring the use of metallic site hoardings and signboards, in order to reduce the amount of timber used on construction sites. This Circular supersedes WBTC 19/99 and shall be read in conjunction with WBTC 32/92 [6], the purpose of which is to reduce the amount of hardwood timber used on construction sites.

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
5 Works Bureau. Technical Circular No. 19/2001. Metallic Site Hoardings and Signboards. http://www.etwb.gov.hk/UtilManager/tc/1992/wb3292.doc
6 Works Bureau. Technical Circular No. 32/92. The Use of Tropical Hardwood on Construction Sites. http://www.etwb.gov.hk/UtilManager/tc/2001/wb1901.doc

3 MATERIALS ASPECTS **3.2 SELECTION OF MATERIALS**

3.2.3 RECYCLED MATERIALS

EXCLUSIONS

None.

OBJECTIVE

Promote use of recycled materials in order to reduce the consumption of virgin resources.

CREDITS ATTAINABLE

2

PRE-REQUISITES

Compliance with the Building (Construction) Regulations, Chapter 123B Regulation 3.

CREDIT REQUIREMENT

a) Outside surface works and structures

1 credit for use 50% of recycled materials in site exterior surfacing work, structures and features.

b) Building structure

1 credit for:

using 5% of recycled materials, other than PFA, in the construction of the building; and

maximising use of PFA or similar in concrete.

ASSESSMENT

a) Surface work and structures

The Client shall submit a report prepared by a suitably qualified person detailing the recycled materials used (minerals, plastics, etc), their quantities by weight, percentage and/or volume as compared to the total amount of materials used in exterior surfacing works and structures (structures and features, which include paths, surfaces for recreational areas, structures such as seating, playground features, etc), and technical and/or economic reasons for not using elements made from recycled materials. Credit will be awarded where there is sufficient evidence that the use of recycled materials is no less than 50% by weight or volume.

b) Building structure

The Client shall submit a report prepared by a suitably qualified person detailing the use of recycled materials in the building, such as foundations, structural elements, etc., but excluding PFA. Also, the use of existing structural elements in situ shall not be counted.

The report shall also detail the use of PFA or similar as cementitious content, and as an admixture or as fine aggregate.

Where recycled material other than PFA accounts for no less than 5% by weight or volume, and the use of PFA is maximised to extent permitted by design codes, the credit shall be awarded.

BACKGROUND

Waste materials and industrial by-products can be used in building construction in an unprocessed form, e.g. as fill material, or processed to a limited degree for use as aggregates in concrete, or used as raw material for manufacturing building products. This reduces the extraction of virgin materials. The basic properties required for technical acceptance are that they can perform their intended functions throughout the design life without being deleterious on the environment or associated constructional features.

There are many opportunities for using recycled materials in structural and non-structural elements of a building and the surrounding site works. For large sections, high strengths, where shrinkage and cracking are critical, where resistance to sulphate attack is required, and where surface finish is particularly important, PFA concrete should be specified. Crushed concrete aggregate complying with the quality and grading requirements of British Standard BS 882 [1] or similar for use in concrete for foundations. The fills in foundations and for over-site use of recycled materials should comply with the requirements of BS 6543 [2] or similar specification.

A list of Recycled Construction Products is available from the Environmental Protection Department [3]. Works Branch Technical Circular 14/90 [4] and.2/97 [5] discusses the quantities of PFA that can be used. PNAP 90 [6] sets out the conditions in which the use of PFA as a partial cement replacement in concrete is permitted. PNAP 275 [7] sets out the technical guidelines for using recycled aggregates in prescribed mix concrete of specified grade strength of 20P and designed mix concrete of specified grade strengths of 25D to 35D.

1 British Standards Institution. Specification for aggregates from natural sources for concrete. British Standard BS 882:1992.
2 British Standards Institution. Guide to use of industrial by-products and waste materials in building and civil engineering. British Standard BS 6543: 1985.
3 Environmental Protection Department. http://sc.info.gov.hk/gb/www.epd.gov.hk/epd/misc/cdm/en_products_list.html
4 Works Branch Technical Circular No. 14/90. The Use of PFA in Structural Concrete. http://www.etwb.gov.hk/UtilManager/tc/90/wb1490.doc, http://www.etwb.gov.hk/UtilManager/tc/90/wb14901.doc
5 Works Branch Technical Circular No. 2/97. The Use of PFA in Concrete Pile Caps and Substructures http://www.etwb.gov.hk/UtilManager/tc/97/wb0297.doc
6 Building Department, Practice Note for Authorized Persons and Registered Structural Engineers, PNAP 90. Pulverised Fuel Ash in Concrete. http://www.info.gov.hk/bd/english/documents/pnap/Pnap090.pdf
7 Building Department, Practice Note for Authorized Persons and Registered Structural Engineers, PNAP 275, Use of Recycled Aggregates in Concrete. http://www.info.gov.hk/bd/english/documents/pnap/Pnap275.pdf

3 MATERIALS ASPECTS

3.2 SELECTION OF MATERIALS

3.2.4 OZONE DEPLETING SUBSTANCES

EXCLUSIONS

None.

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.

b) Ozone depleting materials

1 credit for the use of products in the building fabric and services 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.

b) Ozone depleting materials

The Client shall provide a full description and specifications of all major thermal insulation and fire retardant materials specified in roof constructions, walls, chilled water pipes, refrigerant pipes, ductwork, etc., advising the presence or otherwise of ozone depleting agents. Where there is any doubt as to the ozone depletion potential of a material or product, the Client shall ascertain details from the supplier. Credit shall be awarded where it can be demonstrated that reasonable effort has been made to avoid the use of products that have significant ozone depletion potential.

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 Kongs 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.

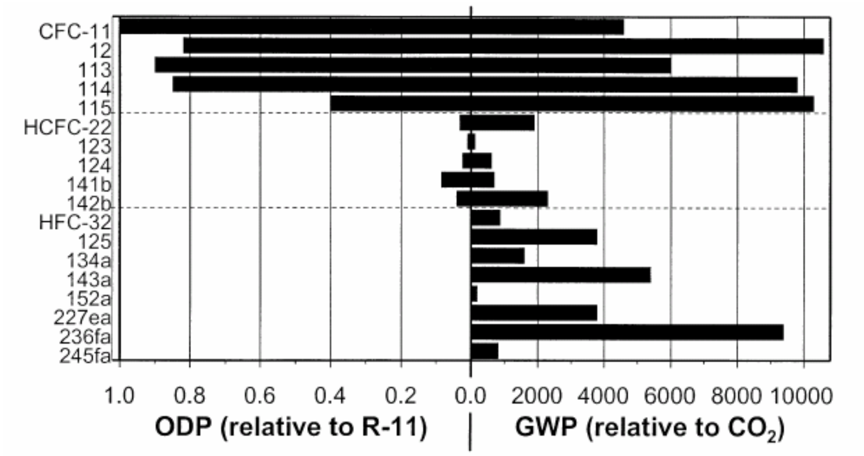
1 Environmental Protection Department. A Concise Guide to the Ozone Layer Protection Ozone Layer Protection Ordinance. http://www.epd.gov.hk/epd/english/laws_regulations/comp_guides/files/cgto_olpo_eng.pdf

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

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 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.

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

3 **MATERIALS ASPECTS**

3.3 WASTE MANAGEMENT

3.3.1 DEMOLITION WASTE

EXCLUSIONS

Projects where demolition is not required or is not under the Client's control.

OBJECTIVE

Encourage best practices in the management of waste, including sorting, recycling and disposal of demolition waste.

CREDITS ATTAINABLE

4

PRE-REQUISITES

Compliance with the Waste Disposal (Chemical Waste) (General) Regulation.

CREDIT REQUIREMENT

a) Waste Management

1 credit for implementation of a waste management system that provides for the sorting and proper disposal of inert and non-inert demolition materials.

b) Sorting and recycling of waste

1 credit sorting and recycling specified demolition waste.

c) Quantity of recycled waste

1 credit for demonstrating that at least 50% of demolition waste is recycled.

2 credits for demonstrating that at least 75% of demolition waste is recycled.

ASSESSMENT

The Client shall present evidence in the form a report by a suitably qualified person that the carrying out of the demolition works complied with all the requirements specified.

a) Waste Management

The Client shall submit tender documents, contract conditions and specifications to demonstrate that the contractor was required and able to prepare and implement a waste management system essentially in accordance with the guidelines provided in Environment, Transport and Works Bureau (ETWB) Technical Circular 15/2003 [1].

Where it can be demonstrated that the waste management system covered the items listed in the Buildings Department's PNAP 243 [2] and that all materials arising from or in connection with the works were separated into inert and non-inert materials, and disposed of in accordance with the WBTC No. 21/2002 [3], as they apply to the nature of the development work, the credit shall be awarded.

b) Sorting and recycling of waste

The following shall guide the assessment:

- how metals, including reinforcement bars, mechanical and electrical fittings, other building services fittings/materials are recovered for collection by recycling contractors; and
- how waste from demolition works is sorted to recover broken concrete and other inert non-metallic materials.

1 Environment, Transport and Works Bureau Technical Circular (Works) 15/2003, Waste Management on Construction Sites. http://www.etwb.gov.hk/utilmanager/tc/2003/c-2003-15-0-1.pdf

2 Buildings Department. Practice Note for Authorized Persons and Registered Structural Engineers 243. Construction and Demolition Waste. June 2000. http://www.info.gov.hk/bd/english/documents/pnap/Pnap243.pdf

3 Works Bureau Technical Circular 21/2002. Trip-ticket System for Disposal of Construction and Demolition Material. June 2002. http://www.etwb.gov.hk/UtilManager/tc/2002/wb2102.doc

Where it can be demonstrated through appropriate record keeping that sorting for the items of construction waste items specified in WTBC TWC 15.2003 has been carried out, the credit shall be awarded.

c) Quantity of recycled waste

Where at least 50% (by weight or by volume) of all waste generated on site can be shown to have been recycled the credit shall be awarded. Where the percentage is 75% the second credit shall be awarded.

The Client's representative on site shall be responsible for monitoring and reporting on the execution of the instructions and shall confirm through monthly reports the extent to which recycling and sorting has been achieved. WTBC TWC 15/2003 should be used as a guide to the nature of reporting and recording keeping.

The HK-BEAM Assessor may undertake site inspections during demolition.

BACKGROUND

To ensure public safety, the control of demolition works has been strengthened with the enactment of the Buildings (Amendment) Ordinance 1996, Building (Administration) (Amendment) (No.4) Regulation 1997 and Building (Demolition Works) (Amendment) Regulation 1997, which impose new requirements for:

- application for approval of plans for demolition works;
- application for consent to commence the works;
- site safety supervision;
- appointment of Technically Competent Person to supervise demolition works and operator of powered mechanical plant or equipment; and
- certification of completion of works.

PNAP 71 [4] sets out the procedures to be followed by authorized persons (AP) and registered structural engineers (RSE) in meeting these requirements. Some points for practical application are also clarified.

Refer also to Section 3.3.2.

4 Buildings Department. Practice Note for Authorized Persons and Registered Structural Engineers. PNAP 71. Demolition Works Measures for Public Safety. http://www.info.gov.hk/bd/english/documents/pnap/Pnap071.pdf

3 MATERIALS ASPECTS **3.3 WASTE MANAGEMENT**

3.3.2 CONSTRUCTION WASTE

EXCLUSIONS None.

OBJECTIVE Encourage best practices in the management of waste, including sorting, recycling and disposal of construction waste.

CREDITS ATTAINABLE 3

PRE-REQUISITES Compliance with the Waste Disposal (Chemical Waste) (General) Regulation.

CREDIT REQUIREMENT

a) Waste Management

1 credit for implementation of a waste management system that provides for the sorting and proper disposal of inert and non-inert construction materials.

b) Sorting and recycling of waste

1 credit sorting and recycling specified construction waste.

c) Quantity of recycled waste

1 credit for demonstrating that at least 50% of construction waste is recycled.

ASSESSMENT The Client shall present evidence in the form a report by a suitably qualified person that the carrying out of the construction works complied with all the requirements specified.

a) Waste Management

The Client shall demonstrate through the submission of tender documents, contract conditions and specifications to demonstrate that the contractor was able and required to prepare and implement a waste management plan essentially in accordance with the guidelines provided in Environment, Transport and Works Bureau (ETWB) Technical Circular 15/2003 [1].

Where it can be demonstrated that the waste management system covered the items listed in the Buildings Department's PNAP 243 [2] and that all materials arising from or in connection with the works were separated into inert and non-inert materials, and disposed of in accordance with the WBTC No. 21/2002 [3], as they apply to the nature of the development work, the credit shall be awarded.

b) Sorting and recycling of waste

The following shall guide the assessment:

- how excavated materials are sorted to recover the inert portions for reuse on site or disposal (not as landfill);
- how metals are recovered for collection by recycling contractors; and
- the extent to which cardboard and paper packaging recovered, properly stockpiled and recycled.

Where it can be demonstrated through appropriate record keeping that sorting for the items of construction waste items specified in WTBC TWC

1 Environment, Transport and Works Bureau Technical Circular (Works) 15/2003, Waste Management on Construction Sites. http://www.etwb.gov.hk/utilmanager/tc/2003/c-2003-15-0-1.pdf

2 Buildings Department. Practice Note for Authorized Persons and Registered Structural Engineers 243. Construction and Demolition Waste. June 2000. http://www.info.gov.hk/bd/english/documents/pnap/Pnap243.pdf

3 Works Bureau Technical Circular 21/2002. Trip-ticket System for Disposal of Construction and Demolition Material. June 2002. http://www.etwb.gov.hk/UtilManager/tc/2002/wb2102.doc

15.2003 has been carried out, the credit shall be awarded.

c) Quantity of recycled waste

Where at least 50% (by weight or by volume) of all waste generated on site can be shown to have been recycled the credit shall be awarded.

The Client's representative on site shall be responsible for monitoring and reporting on the execution of the instructions and shall confirm through monthly reports the extent to which recycling and sorting has been achieved. WTBC TWC 15/2003 should be used as a guide to the nature of reporting and recording keeping.

The HK-BEAM Assessor may undertake site inspections during construction.

BACKGROUND

Chemical wastes are liquid, semi-solid and solid wastes which are hazardous in nature or constitute a risk of pollution to the environment. Chemical waste is defined by reference to a list of chemicals which forms Schedule 1 of the Waste Disposal (Chemical Waste) (General) Regulation. The Regulation provides for the definition of chemical waste, the registration of persons producing chemical waste and the control of the possession, storage, collection, transport and disposal of chemical waste.

At present, there is no charge to disposal of construction waste. While many waste reduction initiatives are being promoted, implementation of these initiatives is not widely practiced. In late 2003, the government submitted to the Legislative Council a proposal on 'Construction Waste Disposal Charging Scheme' which proposes that construction waste disposed of at different facilities will be charged at prescribed rates.

In May 2003 ETWB issued technical circular No.15/2003 requiring contractor to prepare and implement the Waste Management Plan (WMP) for all capital works projects tendered on or after 1 July 2003. Dedicated payment is allocated under the contract for preparation and implementation. This sets out the procedures for preparation and implementation of an enhanced WMP to encourage on-site sorting of Construction and Demolition (C&D) materials and to minimize their generation during the course of construction. The requirements apply to capital works contracts, including electrical and mechanical (E&M) contracts and Design and Build (D&B) contracts but excluding term contracts. C&D material means both inert and non-inert C&D materials.

Inert construction waste means waste that does not undergo any significant physical, chemical or biological transformations. It will not dissolve burn or otherwise physically or chemically react, biodegrade or adversely affect other matter with which it comes into contact in a way likely to give rise to environmental pollution or harm human health. The total leachability and pollutant content of the waste and the ecotoxicity of the leachate must be insignificant, and in particular not endanger the quality of surface water and/or groundwater. Soil, sand/aggregates, bricks, concrete, cement and plaster are regarded as inert, whereas general debris, plastics, paper, Styrofoam, timber, etc., are not.

On-site sorting of surplus construction and demolition (C&D) material is desirable so that inert material can be disposed of at public filling areas, and the remainder at landfills. Dumping Licences require that material to be disposed of at public filling areas must comprise only earth, building debris, broken rock and concrete. Such materials shall be free from marine mud, household refuse, plastic, metal, industrial and chemical waste, animal and vegetable matter etc. The materials considered unsuitable for disposal at public filling areas should go to a landfill.

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

Compliance with the Building (Refuse Storage and Material Recovery Chambers and Refuse Chutes) Regulations.

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 waste steams and estimated 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, that will encourage and facilitate waste recycling.

The assessment shall take into account how a system of 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 scrutinise designs and specifications for the waste management facilities and may carry out inspections to check compliance.

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 designed with the provision of 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.

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

4 ENERGY USE

4.1 ANNUAL ENERGY USE

4.2 ENERGY EFFICIENT SYSTEMS

4.3 ENERGY EFFICIENT EQUIPMENT

4.4 PROVISIONS FOR ENERGY MANAGEMENT

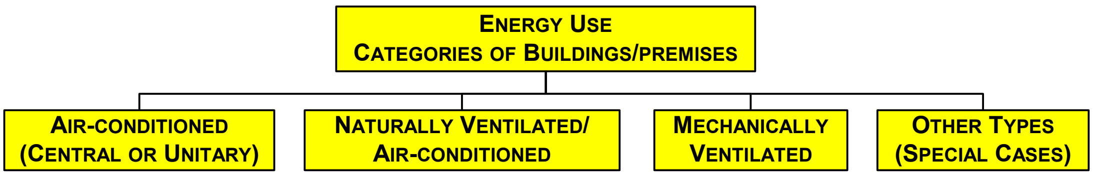
INTRODUCTION

HK-BEAM encourages detailed design of buildings and systems, and provisions that enhance energy efficiency and energy conservation. Credits are awarded on the basis of enhanced energy performance, the provision of energy efficient systems and equipment, and the provisions for energy management.

The number of Annual 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.

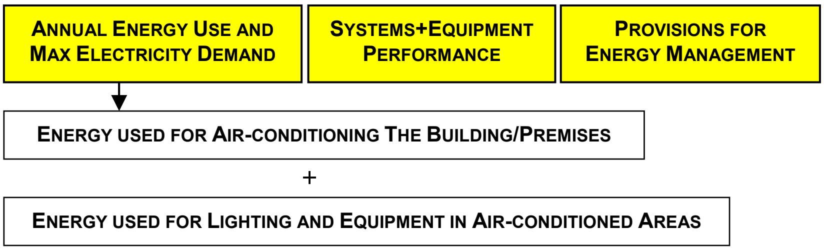
ASSESSMENTS

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.



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 designed for 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 new building developments 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 data defining internal heat gains and patterns of use for the various types of equipment in 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

The Energy Budget approach used for assessing the Annual Energy Use and Maximum Electricity Demand is described in detail in Section 8, together with the relevant data for use in the assessment.

SPECIFICATION FOR SIMULATION TOOLS

The assessment of energy performance is based on estimations obtained from computer simulations. The criteria for the award of credits have been established using a detailed building heat transfer simulation program HTB2 [1] and an air-conditioning system simulation program BECON [2]. BECON has been developed to ensure that system design and equipment sizing can better match cooling load demand profiles, thereby improving efficiency and enabling better control of indoor environmental conditions. Notwithstanding, for the purpose of assessment, building energy use predictions may be performed with the use of any suitable building energy simulation program.

A building energy simulation program will be recognised as a suitable tool for use in the building energy performance assessment 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 development being assessed and that the stated requirements are met. Evidence demonstrating fulfilment of requirement 1 above 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.

ALIGNMENT WITH THE PERFORMANCE-BASED BUILDING ENERGY CODE

Assessment of annual energy use in HK-BEAM is very similar to that used in the Performance-based Building Energy Code (PBEC) [4]. However, an assessment under the PBEC is a pass/fail assessment, whereas a HK-BEAM assessment quantifies the level of performance improvement (and also includes estimation of electricity maximum demand within the simulation). Certification under the PBEC automatically qualifies for one credit under HK-BEAM, irrespective of the simulation software and default values. For a HK-BEAM assessment the simulation software and default values used must meet the requirements stipulated in HK-BEAM. Where an assessment under HK-BEAM uses software approved under the PBEC then the outcome of the assessment can also be used in a submission for certification under the PBEC.

ENERGY USES INCLUDED IN SIMULATIONS

The Energy Budget is assessment includes the following energy uses:

- air-conditioning energy use for the entire building development; and
- lighting and equipment energy use in air-conditioned spaces.

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 Insitute/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.
4 Electrical and Mechanical Services Department. Performance-based Building Energy Code. http://www.emsd.gov.hk/emsd/e_download/pee/pb-bec.pdf

These energy uses are interrelated and together dominate the overall energy use in an air-conditioned building. Computer simulation is taken as the generic method for the prediction of the energy use and maximum electricity demand for air-conditioning. The performance of the building envelope design will be indirectly assessed as the air-conditioning energy use is dependent on the heat gains from the envelope. The energy use and maximum electricity demand for lighting and equipment will be predicted based on the installed power, the operating hours and the pattern of use for each.

An 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. The Energy Budget is then the sum of the energy use, and the maximum electricity demand, for the air-conditioning and these systems and equipment.

ENERGY USES EXCLUDED FROM SIMULATIONS

Other energy uses in buildings that do not have an impact on the air-conditioning energy use, such as for lighting installations in non-air-conditioned public areas and services plant rooms, for lift and escalator installations, hot water supply, etc., and energy losses in the electrical installations are assessed under features and performance of systems and equipment.

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 will be taken into account in the prediction of the annual energy use and maximum electricity demand for air-conditioning in the Assessed Building, allowing higher credits commensurate with the enhanced performance likely to be achieved. 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;
- 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.

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 account design improvements to the building envelop and 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. The use of robust automatic controls has sown to provide for energy conservation through 'switching-off' or 'turn down'.

4.4 PROVISIONS FOR ENERGY MANAGEMENT

4.4.1 TESTING AND COMMISSIONING

4.4.2 OPERATION AND MAINTENANCE

4.4.3 METERING AND MONITORING

4.4.4 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 Client should implement and execute a commissioning process that starts with performance requirements and ends with commissioning records for all energy related systems and equipment. The details of all systems, equipment and components, operating instructions, set points and results of all testing and commissioning should be provided to the building operator in a comprehensive and well organised operation and maintenance manual.

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

Refer Section 8.1.2.

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%.

ASSESSMENT

The number of credits to be 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 the Baseline Building model.

a) Estimated annual energy use

A new 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 prediction of the annual energy use and maximum electricity demand will be based on the design lighting power densities for various premises in the building, as ascertained from the lighting installation designs.
- Where the lighting installations will be provided by tenants or sub-owners, the default lighting power densities will also apply to the assessed building, unless the developer can confirm that the prospective tenants or owners of premises will not install lighting that exceeds the design lighting power intensities. In this case, the design values used and the evidence that such values will not be exceeded, such as given in a 'Tenants Fitting-out Specification', shall be

included in the submission.

- Likewise, the default equipment power densities will be used to assess the energy performance of the building, but design values provided by the building owner will be used instead if sufficient details are provided.

b) Estimated maximum electricity demand

The assessment is included within the assessment of annual energy use for commercial buildings.

ALTERNATIVE

a) Estimated annual energy use

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

Certification under the Performance-based Building Energy Code [1] automatically qualifies for one credit under HK-BEAM, irrespective of the simulation software and default values used. Likewise, certification covering the energy efficiency of air-conditioning and lighting installations under the Energy Efficiency Registration Scheme for Buildings [2] automatically qualifies for one credit.

1 Electrical and Mechanical Services Department. Performance-based Building Energy Code. http://www.emsd.gov.hk/emsd/e_download/pee/pb-bec.pdf

2 Electrical and Mechanical Services Department. Energy Efficiency Registration Scheme for Buildings. http://www.emsd.gov.hk/emsd/e_download/pee/sch_c_v19.pdf

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

13

PRE-REQUISITES

Refer Section 8.1.2.

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%.

ASSESSMENT

The number of credits to be 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 the Baseline Building model.

a) Estimated annual energy consumption

A standalone hotel building or hotel that is part of a complex will be assessed based on the method for air-conditioned buildings, as described in Section 8. This does not cover the energy used for other purposes, such as for winter space heating, water heating, cooking, kitchen ventilation, or energy use in a laundry.

The Code of Practice for Energy Efficiency of Air Conditioning Installations (Clause 7.4.2) 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 a mandatory requirement, the effect of equipping guestrooms with such control devices will be taken into consideration in the prediction of the energy use for the assessed hotel, but not for the Baseline Building model.

In predicting the annual energy use in the Baseline Building model, the patterns of occupation, lighting load and equipment load, as given in Table 8.5.4(a), shall be used. The assumption made in the energy use prediction is that all the guestrooms will be air-conditioned 24 hours a day keeping indoor temperatures steadily at 22ºC throughout the year.

For the hotel being assessed, patterns given in Table 8.5.4(b) shall be used if the guestrooms in the hotel are equipped with master switches that control the air-conditioning, lighting and equipment inside the guestrooms. The effects of the 'as-installed' control actions will be considered when rooms become unoccupied, such as turning off lights, temperature reset, fan speed reset or fan on/off cycling, shall be included in predicting the energy use in the assessed hotel. Three groups of patterns of use are defined for:

- rented rooms that will not be occupied during day time;
- rented rooms that will be occupied all day long; and
- vacant rooms.

The assumption made in the energy use prediction is that 75% of the rooms belong to the first group, 20% to the second group and 5% to the third group. However, if the guestrooms in the assessed hotel are not equipped with such master control switches the patterns set for the Baseline Building model in Table A.5.4 a) shall be used in conjunction with the 'as-designed' installed lighting and equipment load intensities.

b) Estimated maximum electricity demand

The assessment is included within the assessment of annual energy use for hotel buildings.

ALTERNATIVE Certification under the Performance-based Building Energy Code [1] automatically qualifies for one credit under HK-BEAM, irrespective of the simulation software and default values. Likewise, a certification covering the energy efficiency of air-conditioning and lighting under the Energy Efficiency Registration Scheme for Buildings [2] automatically qualifies for one credit.

NOTE Refer also to Sections 4.2 and 4.3, and in particular 4.2.4, 4.3.4 and 4.3.5.

1 Electrical and Mechanical Services Department. Performance-based Building Energy Code. http://www.emsd.gov.hk/emsd/e_download/pee/pb-bec.pdf

2 Electrical and Mechanical Services Department. Energy Efficiency Registration Scheme for Buildings. http://www.emsd.gov.hk/emsd/e_download/pee/sch_c_v19.pdf

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

11

PRE-REQUISITES

Refer Section 8.1.2

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) Estimated maximum electricity demand

1 credit for a reduction in the maximum electricity demand by 8%.

2 credits for a reduction in the maximum electricity demand by 12%

3 credits for a reduction in the maximum electricity demand by 15%.

ASSESSMENT

The number of credits to be 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 the Baseline Building model.

a) Estimated annual energy consumption

Assessment of the energy performance of an air-conditioned educational establishment follows generally the method for buildings accommodating predominantly air-conditioned premises, as described in Section 8 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, indoor design conditions, 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 (zero credit benchmark). 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 (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) Estimated maximum electricity demand

The assessment is included within the assessment of annual energy use for educational buildings.

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

11

PRE-REQUISITES

Refer Section 8.

CREDIT REQUIREMENT

a) Estimated annual energy consumption

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%.

b) Estimated maximum electricity demand

1 credit for a reduction in the maximum electricity demand by 8%.

2 credits for a reduction in the maximum electricity demand by 12%

3 credits for a reduction in the maximum electricity demand by 15%.

ASSESSMENT

This assessment method is intended to allow good layout designs of flats to be reflected in the assessment outcome.

The number of credits to be 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 the Baseline Building model.

a) Estimated annual energy use

The assessment method for standalone residential building or the residential part of a complex will follow generally the method used for assessing buildings accommodating predominantly air-conditioned premises, as described in Section 8.

Where a residential 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.

There are specific conditions that apply to residential buildings, such as the method for quantifying the building envelope performance of the Baseline Building model (Section 8.2) and the use of standardised internal load intensities.

For the prediction of annual energy use for air-conditioning in a residential building the months in the year that air-conditioners serving living rooms and bedrooms (the air-conditioned spaces) operate is taken to be April to October inclusive, and that air-conditioning will not be needed outside this period. The predicted annual energy use for lighting and equipment in these rooms shall be their total energy use throughout the year. The patterns of occupancy and operation of air-conditioners, lighting and equipment shall be as given in Tables 8.5.5 and 8.5.6.

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, only four simulation calculations will need to be carried out for a N-storey building, i.e. 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.

b) Estimated maximum electricity demand

The assessment is included within the assessment of annual energy use for 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

Refer to Section 8.

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, such as multi-storey car parks, bus terminus, platform concourses in rail stations, factories, warehouses, cargo handling facilities, etc., the dominant energy end-uses will include the mechanical ventilation systems, the lighting installations, and the various types of equipment and appliances. Except where equipment/machines for production purposes are present (e.g. an industrial building), such buildings will typically consume much less energy per unit floor area compared to air-conditioned buildings.

Since the range of equipment and appliances that may be found in this category of buildings can vary significantly from one building to another, the assessment will be limited to the energy performance of the mechanical ventilation and lighting installations. The assessment will 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.

NOTE

The assessment of energy use in this category of buildings/premises is given in Sections 4.2 to 4.3, with Sections 4.2.2 to 4.2.3 particular to this category.

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

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

Refer to Section 8.

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 covered will be assessed on individual basis. For buildings that are pre-dominantly air-conditioned, the method shall follow generally that described in Section 8.1 while the method described in Section 4.2.5 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 requirements of relevant regulations and codes are barely met, or design is only on a par with local basic practice.

Where a comparison with the performance of a baseline building model is involved but default values for defining the baseline building model are unavailable, suitable criteria will be established for the assessed building based on the above-mentioned principle. 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 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 worked out and agreed upon between the Client and the HK-BEAM Society Executive Committee prior to commencement of the assessment.

4 ENERGY USE

4.2 ENERGY EFFICIENT SYSTEMS

4.2.1 EMBODIED ENERGY IN BUILDING STRUCTURAL ELEMENTS

EXCLUSIONS

None.

OBJECTIVES

Encourage the design of structural elements and choice of materials that results in lower embodied energy.

CREDITS ATTAINABLE

2

PRE-REQUISITES

None.

CREDIT REQUIREMENT

1 credit for demonstrating the embodied energy in the major elements of the building structure of the assessed building is reduced by 10%.

2 credits for demonstrating a reduction by 20%.

ASSESSMENT

The assessment covers only the elements and materials used in the building foundations, building core, walls, etc, i.e., the main elements that comprise the building structure, façade, and the roof. Interior services and fit-out components are not included.

The Client shall provide a report detailing where changes in the design of the main structural elements, for example the use of less materials or alternative constructions, etc., that provide for a reduction in embodied energy beyond that which would result if the enhancements were not included.

The method to estimate reduction in embodied energy should follow a well-established Life Cycle Assessment (LCA) approach. Given the variability of approaches and the potential use of different software tools for estimating embodied energy HK-BEAM does not prescribe which approach shall be adopted, nor the data to be used in the analysis.

Where the Client can demonstrate through appropriate analysis that the construction of the main elements of the assessed building reduces the embodied energy by the percentages specified then credit(s) shall be awarded.

BACKGROUND

The energy used in the extraction, processing and transportation of materials used in building construction can be a significant part of the total energy used over the life cycle of a building, particularly buildings that utilise natural ventilation where operating energy for cooling and ventilation are significantly less than for air-conditioned buildings. Estimations for Hong Kong residential buildings suggest that embodied energy amounts to 20-40% of total energy used over a 40-60 year lifetime [1,2,3].

Heightened awareness of the importance of environmental protection, and the possible impacts associated with products manufactured and consumed, has increased the interest in the development of methods to better comprehend and reduce these impacts. One of the techniques being developed for this purpose is Life Cycle Assessment (LCA). ISO 14040 [4] describes the principles and framework for conducting and reporting LCA studies, and includes certain minimal requirements. LCA

1 Cole R J, Wong K S. Minimising environmental impact of high-rise residential buildings. Proc. Housing for millions: The challenge ahead. Hong Kong: Housing Authority, 1996, pp 262–5.
2 Humphrey S, Amato A, Frewer R. Whole Life Comparison of High Rise Residential Blocks in Hong Kong. International Housing Conference - Housing in the 21st Century: Challenges and Commitments. 2-4 February 2004.
3 Chen T Y, Burnett J, Chau C K. Analysis of embodied energy use in residential building of Hong Kong. Energy 26, 2001. pp 323-340.
4 International Organization for Standardization. EN ISO 14040:1997. Environmental management – Life cycle assessment – Principles and framework.

is a technique for assessing the environmental aspects and potential impacts associated with a product, by:

- compiling an inventory of relevant inputs and outputs of a product system;
- evaluating the potential environmental impacts associated with those inputs and outputs; and
- interpreting the results of the inventory analysis and impact assessment phases in relation to the objectives of the study.

ASTM E 1991 [5] is a general guide for the application of environmental Life Cycle Assessment (LCA) as a tool for evaluating the environmental aspects of materials/products, processes, and services produced and used in buildings and the built environment.

With the availability of more reliable and relevant data for use in Life Cycle Assessment (LCA) methods designers are better able to quantify embodied energy in buildings elements and structures.

5 American Society for Testing and Materials. ASTM E 1991-98. Standard Guide for Environmental Life Cycle Assessment of Building Materials/Products.

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 15% or more.

2 credits where the consumption is reduced by 25% 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

4.2.4 HOT WATER SUPPLY SYSTEMS

EXCLUSIONS

Buildings where the estimated energy used for supplying hot water is less than 10% of total estimated building annual energy use.

OBJECTIVES

Promote the use of energy efficient hot water supply systems to conserve energy.

CREDITS ATTAINABLE

1

PRE-REQUISITES

Design of systems shall comply with recommendations in respect of the control of legionella bacteria.

CREDIT REQUIREMENT

1 credit for installing energy efficient hot water supply system(s) and equipment that can save 20% or more energy.

ASSESSMENT

Design of systems shall comply with the local Code of Practice [1] where applicable.

The Client shall provide evidence in the form of detailed calculations demonstrating the energy saving potential of the installed equipment when compared to systems/equipment not designed for energy efficiency/conservation, i.e., the baseline/benchmark.

The submission shall include specifications of both the installed systems/equipment and the equipment representing the baseline/ benchmark systems/equipment, with justification for the selected baseline/benchmark data used in the analysis.

The gains may be demonstrated in terms of conversion efficiency, reduced energy losses, and/or energy conserving controls. However, the estimates of energy saving shall be independent of the quantity of hot water produced.

Where it can be demonstrated that the hot water supply equipment/systems installed demonstrate a saving of 20% over the applicable and appropriate baseline/benchmark the credit shall be awarded.

BACKGROUND

Estimations of annual energy use for the various building types do not include energy use for water heating. Where this is likely to be a substantial energy requirement then this additional credit applies.

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. http://www.emsd.gov.hk/emsd/e_download/pps/code.doc

4 ENERGY USE

4.2 ENERGY EFFICIENT SYSTEMS

4.2.5 LIFT AND ESCALATOR SYSTEMS

EXCLUSIONS

Building with one or no elevators.

OBJECTIVES

Encourage the use of energy efficient lift and escalator installations in buildings with significant provisions for vertical transportation.

CREDITS ATTAINABLE

1

PRE-REQUISITES

Compliance with the Building (Construction) Regulations Chapter 123b Regulation 9a.

CREDIT REQUIREMENT

1 credit for complying with the Code of Practice for Energy Efficiency of Lift and Escalator Installations.

ASSESSMENT

To qualify for the credit the Client shall provide a report prepared by a suitably qualified person detailing the systems and equipment installed and confirming compliance with the code [1]. Certification under EMSD's Energy Efficiency Registration Scheme for Buildings [2] will also satisfy the requirement.

ALTERNATIVE

Where the lift and/or escalator systems are not in strict compliance with the Code but it can be demonstrated that energy performance (though conversion efficiency or intelligent controls) is enhanced to a similar degree the credit shall be awarded.

BACKGROUND

In Hong Kong buildings are usually high-rise and/or large scale developments. Vertical and horizontal transportation can consume up to 8% of total electrical energy consumption. Consequently, the Electrical & Mechanical Services Department issued a code of practice for the energy efficiency of lift and escalators. Compliance with the code, and for using feature specific criteria in the assessment, is endorsed by HK-BEAM because the:

- the code is not yet regulatory requirements;
- the code provides for good practices that are worth promoting; and
- alignment between the energy assessments using the building energy codes and HK-BEAM is thereby established.

However, for consistency with the philosophy of HK-BEAM, should this Code of Practice become a regulatory requirement, no credit shall be given for compliance. The requirements therein would then become either 'basic' or 'baseline' criteria in HK-BEAM.

1 Electrical and Mechanical Services Department. Code of Practice for Energy Efficiency of Lift and Escalator Installations. 1998. http://www.emsd.gov.hk/emsd/e_download/pee/lift_esccop.pdf

2 Electrical and Mechanical Services Department. Energy Efficiency Registration Scheme for Buildings. http://www.emsd.gov.hk/emsd/e_download/pee/sch_c_v19.pdf

4	**ENERGY USE**	**4.2**	**ENERGY EFFICIENT SYSTEMS**
		4.2.6	**ELECTRICAL SYSTEMS**

EXCLUSIONS

None.

OBJECTIVES

Encourage the design of energy efficient electrical installations in high-rise buildings.

CREDITS ATTAINABLE

1

PRE-REQUISITES

Compliance with the Electricity (Wiring) Regulations Chapter 406E.

CREDIT REQUIREMENT

1 credit for complying with the Code of Practice for Energy Efficiency of Electrical Installations.

ASSESSMENT

To qualify for the credit the Client shall provide a report prepared by a suitably qualified person detailing the systems and equipment installed and confirming compliance with the code [1]. Certification under EMSD's Energy Efficiency Registration Scheme for Buildings [2] will also satisfy the requirement.

BACKGROUND

As Hong Kong buildings are usually high-rise and/or large scale developments, distribution of large amounts of electrical energy also involves distribution losses, which are often not insignificant. Consequently, the Electrical and Mechanical Services Department issued a code of practice for the energy efficiency for electrical installations.

Compliance with the code is endorsed in HK-BEAM for the same reasons, and with the same caveat as for lift and escalator installation.

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 Electrical and Mechanical Services Department. Energy Efficiency Registration Scheme for Buildings. http://www.emsd.gov.hk/emsd/e_download/pee/sch_c_v19.pdf

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

3

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 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 located;

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

- 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

4.3.2 CLOTHES DRYING FACILITIES

EXCLUSIONS

Buildings other than residential buildings.

OBJECTIVES

Encourage greater use of natural resources in place of gas or electrical energy for clothes drying purposes.

CREDITS ATTAINABLE

1

PRE-REQUISITES

None.

CREDIT REQUIREMENT

1 credit for providing suitable clothes drying facilities which utilise the natural environment for the majority of residential units.

ASSESSMENT

The Client shall demonstrate the adequacy of the clothes drying facilities for efficient drying by sun and breeze, which is adequately protected from water droplets and debris falling from higher levels, and not adversely affected by smoke, fumes and pollutants emitted from water heaters, cooking exhausts, discharges from air-conditioning units, etc.

BACKGROUND

Provisions of clothes drying facilities in many existing residential buildings are inadequate such that people tend not to use them and resort to gas or electric drying machines, increasing energy consumption.

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 such spaces will reduce the air-conditioning load and increase the number of credits that can be obtained. 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

4.3.4 HEAT RECLAIM

EXCLUSIONS

Buildings other than those housing hotel accommodation and/or apartments.

OBJECTIVES

Promote energy conservation.

CREDITS ATTAINABLE

1

PRE-REQUISITES

None.

CREDIT REQUIREMENT

1 credit for using heat reclaim chillers or heat pumps for:

pre-heating domestic hot water supply; or

pre-heating hot water supply for winter space heating.

ASSESSMENT

The Client shall provide details of the equipment installed quantifying the improvements in energy performance of the chosen equipment when compared to that when heat reclaim is not used in the designs.

The reclaimed energy produced can be considered in the evaluation of annual energy use in hotel and similar buildings, provided that the energy use for preheating hot water is included in the determination of the respective benchmark (zero-credit) criteria, and an appropriate calculation method to the satisfaction of the HK-BEAM Society is used to estimate the reduction in annual energy consumption.

BACKGROUND

In a building used as a hotel hot water supply is maintained throughout the year for bathrooms, kitchens and any laundry. Inclusive mall shops and restaurants will require air-conditioning throughout the year while some guestrooms may call for heating in winter. Utilising the condenser heat chillers reject for pre-heating the hot water supply to guestrooms or for winter space heating can significantly reduce the energy use for such purposes. Therefore, in addition to using energy efficient equipment or solar energy for hot water supply a credit is given for the use of heat reclaim chillers and/or heat pumps for pre-heating hot water for space heating or domestic hot water supply.

4 ENERGY USE

4.3 ENERGY EFFICIENT EQUIPMENT

4.3.5 MECHANICAL VENTILATION IN HOTEL BUILDINGS

EXCLUSIONS

Buildings other than hotels and apartment buildings.

OBJECTIVES

Promote energy conservation.

CREDITS ATTAINABLE

1

PRE-REQUISITES

None.

CREDIT REQUIREMENT

1 credit for using energy efficient ventilation fans that will consume less electricity than those meeting the zero credit requirements by 15% or more.

ASSESSMENT

Fans of mechanical ventilation systems serving the bathrooms in guestrooms, the kitchens, and other utilities and plant rooms will be assessed based on component-performance criteria.

The 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.

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

- 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.

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

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 PROVISIONS FOR 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

4

PRE-REQUISITES

None.

CREDIT REQUIREMENT

a) Commissioning specifications

1 credit for provision of appropriate specifications and cost provisions in contract documents detailing the commissioning requirements for all systems and equipment that impact on energy use and indoor environmental quality.

b) Commissioning plan

1 credit for the appointment of a commissioning authority and provision of a detailed commissioning plan that embraces all specified commissioning work.

c) Commissioning

1 credit for ensuring full and complete commissioning of all systems, equipment and components that impact on energy use and indoor environmental quality.

d) Commissioning report

1 credit for providing fully detailed commissioning reports for all systems, equipment and components that impact on energy use and indoor environmental quality.

ASSESSMENT

a) Commissioning specifications

The Client shall submit copies of specifications detailing the commissioning requirements for each system and equipment, and details of the cost provisions for the commissioning work.

Where it can be shown that the specifications meet the requirements given in Section 8.7.1 as a minimum, and cost provisions are sufficient to carry out the intended work the credit shall be awarded.

b) Commissioning plan

There shall be appropriate cost provisions for the appointment of an independent commissioning authority and for the commissioning processes. The commissioning authority shall be a Registered Professional Engineer with adequate expertise in the commissioning or electrical and mechanical systems, equipment and components. A suitably qualified member of the organisation that performed the design may act as the commissioning authority; however, such an individual must not be responsible for any aspect of the project design, or construction management or supervision for the subject building. In addition, reporting of all conditions and findings must be immediate and direct from the commissioning authority to the Client. The commissioning authority shall be responsible for:

- review and approval of commissioning specifications;
- the development of a commissioning plan;

- determining and documenting whether systems, equipment and components are functioning in accordance with the design intent and in accordance with the construction documents.

Where the Client can provide evidence that the commissioning plan meets the requirements detailed in Section 8.7.2 as a minimum the credit shall be awarded.

c) Commissioning

Where the Client appoints a commissioning agent to be responsible for performing the functional testing of systems and equipment, as documented by the commissioning authority, using forms approved by the commissioning authority, and all of which meet the requirements of Section 8.7.3 as a minimum, the credit shall be awarded.

d) Commissioning report

Where the Client demonstrates that after all commissioning tasks, except seasonally deferred testing have been completed, and a commissioning report is provided covering as a minimum the items given in Section 8.7.4, the credit shall be awarded.

BACKGROUND

Commissioning is a quality assurance process for buildings from pre-design through design, construction, and operations. 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 [e.g. 5] publications provide guidance on commissioning requirements and procedures, such as management, design for commissioning, access, testing, measurements and tolerances, installed transducers, specification for portable measuring equipment, etc. Locally Architectural Services Department publishes commissioning procedures for Government buildings [e.g. 6].

Effective 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, including:

- chillers;
- cooling towers;
- controls for central plant and for HVAC, including, if present, the energy management system or building automation system (BAS);

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/
5 ASHRAE. New Building Commissioning. http://www.ashrae.org/
6 Architectural Services Department, Building Services Branch. Testing and Commissioning Procedure No. 1 for Air-conditioning, Refrigeration, Ventilation and Control System in Government Buildings. http://www.archsd.gov.hk/english/publications/publication_pdf/e70.pdf

- unitary and split-air conditioners;
- fans;
- pumps;
- heat exchangers;
- boilers;
- domestic hot water and hot water heaters;
- ducts and associated dampers;
- piping and associated valves;
- waste heat recovery, thermal storage, etc.

4 ENERGY USE

4.4 PROVISIONS FOR ENERGY MANAGEMENT

4.4.2 OPERATION AND MAINTENANCE

EXCLUSIONS

None.

OBJECTIVES

Enable building operators to implement the design intent, be able to monitor the performance of the building, and maintain the performance.

CREDITS ATTAINABLE

3

PRE-REQUISITES

None.

CREDIT REQUIREMENT

a) Operations and maintenance manual

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

b) Energy management

1 credit for providing fully documented instructions that enables systems to operate at a high level of energy efficiency.

c) Operator training and operation and maintenance facilities

1 credit for:

providing training for operations and maintenance staff to the minimum specified; and

demonstrating that adequate maintenance facilities are provided for operations and maintenance work.

ASSESSMENT

The Client shall submit details of the provisions for operation and maintenance as outlined below.

a) Operations and maintenance manual

The design intent and basis of design shall be included as a defining part of the operations and maintenance manual and the energy management manual. The manual shall include the details given in Section 8.7.5 as a minimum.

Where an adequate contract sum was provided for the preparation of comprehensive operations and maintenance manual, and the manual covers adequately the major energy consuming building services systems and equipment the credit shall be awarded.

b) Energy management

Where the operations and maintenance manual, or a dedicated energy management manual is provided, and meets the requirements of Section 8.7.6 as a minimum, the credit shall be awarded.

c) Operator training and operation and maintenance facilities

The training program shall cover as a minimum the items listed in Section 8.7.7. Details of the facilities for operation and maintenance, such as the workshop(s), office accommodation, computing facilities etc., shall be provided, and the case made to demonstrate the adequacy of the facilities in relation to the size and complexity of the building served.

Where the Client can verify that training of the building's operations and maintenance staff was undertaken for all commissioned systems and major equipment, using the operations and maintenance manual, and the energy management manual as the basis for the training, and demonstrate that the provided operation and maintenance facilities are adequate, the credit shall be awarded.

BACKGROUND

Facilities to carry out basic maintenance and equipment for monitoring consumption can help improve operating efficiency and environmental performance of a building. ASHRAE [1] and BSRIA [2] provide advice on the preparations for operation and maintenance to ensure the safe and efficient operation of each system and major item of plant, including a description of the operating modes, a recommended strategy for operation and control, control data and set points, interlocks between plant items, etc.

1 American Society of Heating, Air-conditioning, and Refrigerating Engineers. Preparation of Operating and Maintenance Documentation for Building Systems. ASHRAE Guideline 4. Atlanta.

2 J H Armstrong. Building Services Research and Information Association. Operating and Maintenance Manuals for Building Services Installations. Application Guide 1/87. Dec. 1990.

4 ENERGY USE

4.4 PROVISIONS FOR ENERGY MANAGEMENT

4.4.3 METERING AND MONITORING

EXCLUSIONS

None.

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

1

PRE-REQUISITES

As a prerequisite metering provisions shall meet the requirements of the Government's energy codes.

CREDIT REQUIREMENT

1 credit for installation of:

metering that allows monitoring of electricity use by the main chiller plant and auxiliaries;

instruments for monitoring building cooling load and operating parameters central chiller plant;

metering that allows separate monitoring of electricity use by the air side of the HVAC system; and

metering for landlord's electricity consumption in common space/public areas.

ASSESSMENT

The Owner/Operator shall provide details of the measuring and monitoring equipment installed and commissioning records of consumption and chiller plant performance, to demonstrate that electricity use and performance can be monitored as stipulated.

Monitoring of central chiller plant will be assessed on the basis of BSRIA Technical Note TN 7/94 [1] 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.

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 [2] 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 [3] or similar equivalent.

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

Metering provision shall identify the electricity use pattern for each major system fed from the Owner/Operator'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.

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

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

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

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.

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 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.

5 WATER USE

5.1 WATER QUALITY

5.2 WATER CONSERVATION

5.3 EFFLUENT

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

5.1.1 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

5.2.1 ANNUAL WATER USE

5.2.2 MONITORING AND CONTROL

5.2.3 WATER EFFICIENT IRRIGATION

5.2.4 WATER RECYCLING

5.2.5 WATER EFFICIENT FACILITIES AND APPLIANCES

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. 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. Effort will be made to bring sea water to more places, including the Peak, part of Southern District, Sai Kung, the outlying islands, Tin Shui Wai and Yuen Long [2]. 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

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. Annual Report. http://www.info.gov.hk/wsd/en/html/pdf/rpt0203/pdf/09_water_supply.pdf

at 0.66 million cubic metres [3]. Total freshwater consumption was 974 million cubic metres, with domestic consumption accounting for over 50%, and 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. 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.

3 Water Supplies Department. Facts About Water. http://www.info.gov.hk/wsd/en/html/pdf/w_facts.pdf

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

Buildings shall be complied with the Waterworks Ordinance (Cap 102) and the Waterworks Regulations (Cap 102 Subsidiary Legislation), the Hong Kong Waterworks Standard Requirements for Plumbing Installation in Building, and relevant Water Supplies Department Circular Letters issued to Licensed Plumbers and Authorized Persons.

CREDIT REQUIREMENT

a) Fresh water plumbing

1 credit where fresh water plumbing installations comply with the referenced good practice guides.

b) Water quality survey

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 Client shall submit a report by a suitably qualified person confirming that the plumbing installations comply with all requirements set down by the Water Supplies Department (WSD) that are applicable to the particular installations in the building, and that due account has been taken into account of the design, and future operation and maintenance requirements of the Code of Practice for the Prevention of Legionnaire Disease [1] and the Fresh Water Plumbing Quality Maintenance Recognition Scheme [2], or equal equivalent guidance.

Where it can be demonstrated that the plumbing system installations comply with the recommendations in the cited documents, or where equal of better solutions are provided, the credit shall be awarded.

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 [3], 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. If water quality at all sample points meets with the World Health Organization (WHO) Guidelines [4] the credit shall be awarded.

BACKGROUND

According to the agreement between Guangdong and Hong Kong, "all water supplies to Hong Kong will meet the water quality standard of Guangdong Province currently in force and will not be inferior to the Class II water quality standard stipulated in the Environmental Quality

1 Prevention of Legionnaires' Disease Committee, Hong Kong Government. Code of Practice for the Prevention of Legionnaires' Disease in Hong Kong. http://www.emsd.gov.hk/emsd/
2 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
3 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.
4 World Health Organization. Guidelines for Drinking-water Quality. Vol. 1 - Recommendations 1993. http://www.who.int/water_sanitation_health/dwq/gdwq2v1/en/index.html

Standard for Surface Water GB 3838-83 published by the People's Republic of China in 1983" [5].

QUALITY OF WATER SUPPLIED FROM THE MAINLAND

It is closely monitored by WSD on entering Hong Kong at reception points at Muk Wu Pumping Stations at the border and again at all treatment works receiving the raw water. Laboratory tests are performed daily with ammonia and manganese selected for monitoring because their levels in the raw water are useful reference for dosing of treatment chemicals. The sampling and testing frequencies of individual parameters vary from 4-monthly to three times per day, and if necessary as frequently as hourly. All raw water is delivered to water treatment works where it is treated to comply chemically and bacteriologically with the WHO Guidelines for Drinking-water Quality (1993) before being supplied to consumers.

SUPPLY QUALITY

According to WSD [6] Hong Kong's water is of the safest quality and among the best in the world. However, it is affected in some instances by the inadequate maintenance of internal plumbing systems before it reaches customers' taps and this can cause discolouration of the water. To strengthen public confidence in drinking water from their taps, WSD launched the voluntary Fresh Water Plumbing Quality Maintenance Recognition Scheme [2]. This scheme aims to give recognition to responsible building owners or their agents for proper maintenance of their internal plumbing systems.

PLUMBING INSTALLATIONS

Section 14(3) of the Waterworks Ordinance (Chapter 102) empowers the Water Authority to prescribe the manner of construction or installation and the nature, size and quality of the pipes and fittings of an inside service or fire service for water supplies. All plumbing proposals for inside service and fire service are therefore subject to the approval of the Water Authority [7]. The Hong Kong Waterworks Standard Requirements is a set of normal requirements which are applicable to the installation of inside service and fire service in addition to the requirements that are set out in Schedule 2 of the Waterworks Regulations (Chapter 102) or modified under Regulation 25(1). Where necessary, additional requirements may also be imposed on individual application for water supply depending on the nature and type of the plumbing installations.

SAMPLING

Part 6 of ISO 5667 [3] 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 Supplies Department. ACQWS Paper No. 5. Raw Water Quality Monitoring in Hong Kong.
6 Water Supplies Department. Annual Report. http://www.info.gov.hk/wsd/en/html/pdf/rpt0203/pdf/08_water_quality.pdf
7 Water Supplies Department. Hong Kong Waterworks Standards for Plumbing Installations in Buildings. http://www.info.gov.hk/wsd/en/html/pdf/hkwsre.pdf

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

Compliance with relevant section of the Waterworks Ordinance.

CREDIT REQUIREMENT

1 credit for demonstrating that the use of water efficient devices leads to an estimated aggregate annual saving of 15%.

2 credits for demonstrating an estimated annual saving of 25%.

3 credits for demonstrating an estimated annual saving of 35%.

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.

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.

BACKGROUND

Demand for flushing and potable water should be assessed with regard to Building (Standards of Sanitary Fitments, Plumbing, Drainage Works and Latrines) Regulation 10A(4). "Potable water" refers to a supply of water for the purposes of Regulation 10A(2). Where mains (fresh water is used for flushing purposes reference may be made to Section 5.3.1 which provides further details on flushing volumes permitted under local regulations.

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].

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

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

4 Cheng C L. Evaluating water conservation measures for Green Building in Taiwan. Building and Environment 38 (2003) 369 – 379.
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

2

PRE-REQUISITES

Compliance with Waterworks Regulation Chapter 102A Regulation 32.

CREDIT REQUIREMENT

1 credit for installations of any two features

2 credits for installation of all three features:

automatic shut-off of devices for the purposes of water conservation;

monitoring water leakage within the fresh water distribution system;

monitoring of water flow at main supply branches for audit purposes.

ASSESSMENT

The assessment will seek to establish if means are in place that can effectively limit the wastage of water by shutting off fixtures automatically when left open, and the ability to detect water leaks in buried pipework Various approaches are available and HK-BEAM is not intended to be prescriptive as to which should be used.

The Client shall submit a report prepared by a suitably qualified person that details:

- devices installed to reduce the potential wastage of water due to unnecessary operation of taps, etc;
- details of any system for monitoring water leaks within internal plumbing installations; and
- evidence to demonstrate that water use is capable of being fully monitored by the building operator.

The provision of water flow measuring devices to measure consumption by the Owner/Operator for each of the major water-using sectors (excluding the provisions required for metering individual users) shall be identified by a review of drawings and specifications, or other evidence provided by the Client.

Where it can be demonstrated that the provisions of equipment meets the intent, the credit(s) shall be awarded.

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. Detection of water leaks in service pipework also presents an opportunity to save water, and perhaps more importantly, reduce the potential for structural damage as well as the creation of unhygienic conditions.

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.

PRIVATE CHECK METER

- A private check meter may, with the permission in writing of the Water Authority, be installed on any part of an inside service.
- The Water Authority may at any time require a private check meter

installed under subregulation (1) to be tested, and the consumer shall, on payment of the charge prescribed in Part I of Schedule 1, get the meter tested by the Water Authority.

- The Water Authority shall, in assessing consumption at any inside service, take no account of the readings of a private check meter.
- The Water Authority shall not be responsible for the accuracy of a private check meter and where such meter is found to be operating unsatisfactorily or restricting the supply to any premises the consumer shall, if so required by the Water Authority, remove the meter.

WATER SEEPAGE

Water seepage has been a cause for concern to a number of Government departments including the Buildings Department [1]. Causes of seepage are many and varied but one of the common sources of seepage relates to water-borne piping embedded in the structural members of a building.

Water seepage arising from embedded piping causes not only nuisance but also deterioration to the structural member of a building if unattended for a prolonged period. Designers are strongly advised to design the routing of all water-borne piping off structural elements to facilitate the indispensable need for repair and replacement of such piping during the design life of the building, which would normally outlast the design life of the piping. The huge benefit to the consumers and the public that this will bring about in terms of easy maintenance of the building for its entire design life will certainly outweigh the efforts at the design stage of a building project.

1 Buildings Department. Practice Note for Authorised Persons and Registered Structural Engineers, PNAP 230. Water Seepage. http://www.info.gov.hk/bd/english/documents/pnap/Pnap230.pdf

5 WATER USE

5.2 WATER CONSERVATION

5.2.3 WATER EFFICIENT 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

PRE-REQUISITES

None.

CREDIT REQUIREMENT

1 credit for the use of an irrigation system which does not require the use of municipal fresh water after a period of establishment is complete.

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.

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.

There is the potential to use well water, but due consideration must be made in respect of the requirements of the Water Authority. Normally, wells may not be sunk on government land [1]. Permission under Building (Construction) Regulation 85 to sink a well in private land will be given only where the:

- well yield is adequate; and
- water abstraction will not adversely affect nearby services buildings, structures or land.

1 Buildings Department. Practice Note for Authorized Persons and Registered Structural Engineers. PNAP 17. Water Supply and Wells. http://www.info.gov.hk/bd/english/documents/pnap/Pnap017.pdf.

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+2 BONUS

PRE-REQUISITES

Compliance with the water quality standards appropriate to the use of the recycled water.

CREDIT REQUIREMENT

a) Harvested rainwater

1 credit for harvesting of rainwater which will lead to a reduction of 10% or more in the consumption of fresh water.

b) Provisions for grey water recycling

1 credit for the provision of plumbing and drainage systems that provide for separation of grey water from black water.

c) Recycled water

1 additional credit where recycled grey water will lead to a reduction of 10% 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.

a) Harvested rainwater

The Client shall provide a report detailing the system or systems installed for the purpose of harvesting rainwater, the details of the expectations in respect of savings in the consumption of fresh water, and shall demonstrate that the rainwater is of a quality appropriate to the end use. Where it can be demonstrated that the expected savings in fresh water use will be 10% or more, either based on baseline building estimates (see Section 5.2.1) or any other appropriate estimation, the credit shall be awarded.

b) Provisions for grey water recycling

Where there is provision for separating grey and black water the credit shall be awarded.

c) Recycled water

The Client shall provide a report detailing system or systems installed for the purpose of recycling grey water, details of the expectations in respect of savings in the consumption of potable water and shall demonstrate that the treated grey water is of a quality appropriate to the end use. Where it can be demonstrated that the expected savings in fresh water use will be 10% or more, either based on baseline building estimates (see Section 5.2.1) or any other appropriate estimation, the 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.

Water quality should meet appropriate criteria, such as that outlined by ACQWS [1], the Building Research and Information Association [2], or similar authoritative guidance.

Due consideration has to be made for the amounts of water that can be generated, and how this matches with the amounts that can be put to use; else there is little incentive to recycle.

The problem for Hong Kong's high-rise dense built environments is that the potential for collecting rainwater is limited. Yang et al [3] 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.

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.

1 Water Supplies Department. ACQWS Paper No. 14 – Treated Effluent Reuse at Ngong Ping.
2 BSRIA, Greywater and Rainwater Systems: Recommended UK Requirements, The Building Services Research and Information Association, Final Report 13034/1, March 1997.
3 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.

5 WATER USE

5.2 WATER CONSERVATION

5.2.5 WATER EFFICIENT FACILITIES AND APPLIANCES

EXCLUSIONS

Buildings in which facilities and/or appliances are not installed by the developer.

OBJECTIVES

Encourage the wider use of water efficient facilities and appliances.

CREDITS ATTAINABLE

2

PRE-REQUISITES

None.

CREDIT REQUIREMENT

a) Water efficient facilities (pools, spas, fountains, etc)

1 credit for demonstrating that installed water facilities are more efficient than otherwise.

b) Water efficient appliances

1 credit for installing water efficient appliances that are at least 20% more efficient than otherwise.

ASSESSMENT

a) Water efficient facilities (pools, spas, etc)

The Client shall provide details of all the facilities installed on site or in the building and evidence as to how fresh water use is reduced through design innovations.

Where it can be demonstrated that water savings for pools, spas and other water features is 20% or better than the case when water conservation measures are not included, the credit shall be awarded.

b) Water efficient appliances

The Client shall provide details of all the appliances installed in the building and evidence as to the water use ratings of each type and size of appliance. Where it can be demonstrated that water use efficiency is high, typically 20% better than appliances not marketed as water efficient, the credit shall be awarded.

BACKGROUND

Water use in washing machines, dishwashers in homes, in hotel laundries, etc., can be a substantial part of consumption of fresh water. Likewise there is opportunity for reduce water loss from water features and recreational facilities. HK-BEAM encourages attention to the selection of water efficient equipment and design of water using facilities that include means to save water.

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, and the Building (Standards of sanitary fitments, plumbing, drainage works and latrines) Regulations Chapter 123 Regulation 17.

CREDIT REQUIREMENT

1 credit for demonstrating a reduction in annual sewage volumes by 25% or more.

ASSESSMENT

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.

Confirmation of the award of credit shall take into account the appropriateness of the data used and the estimated percentage of effluent reduction.

BACKGROUND

Demand for flushing and potable water should be assessed with regard to Building (Standards of Sanitary Fitments, Plumbing, Drainage Works and Latrines) Regulation 10A(4). "Potable water" refers to a supply of water for the purposes of Regulation 10A(2). The quantity of flushing water required is given in PNAP 17 [1].

Regulation 19 of the Building (Standards of Sanitary Fitments, Plumbing, Drainage Works and Latrines) Regulations (Drainage Regulations) requires flushing cisterns of water closet fitments to have a discharge between 9 and 14 litres. Under the current Waterworks Regulations, flushing cisterns shall be of the valveless syphonic type and the flushing volume shall be within the range of 7.5 and 15 litres [2].

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. Therefore, to conserve our valuable water resources, both the Building Authority (BA) and Water Authority would have no objection to relaxing the use of syphonic flushing cisterns with discharge less than that required by the current regulations provided that the associated toilet bowls are compatible with the cisterns and the syphonic action is sufficient for the wastes in the toilet bowls to be cleared effectively by a single flush. WSD has relaxed the requirements in respect of the flushing mechanism and minimum flushing volume as follows:

- the use of valve type flushing devices (mechanical or sensor type with single flush or dual flush) in addition to valveless syphonic type flushing apparatuses; and
- the use of flushing devices which are capable to give a single flushing volume of less than 7.5 litres.

The capacity of the flushing cistern in the case of trough water-closets and urinals shall be approved by the Water Authority subject to the discharge in the case of trough water-closets being not less than 9 litres of water for every metre of the channel and the discharge in the case of urinals being not less than 4.5 litres of water for every basin or stall, or in the case of a trough urinal, every metre thereof.

Accordingly, for the purposes of determining the number of persons for whom sanitary fitments should be provided in shops and department stores the determination shall be at the rate of 1 person for every 15 square metres of usable floor area [3].

1 Buildings Department. Practice Note for Authorized Persons and Registered Structural Engineers. PNAP 17. Water Supply and Wells. http://www.info.gov.hk/bd/english/documents/pnap/Pnap017.pdf.

2 Buildings Department. Practice Note for Authorized Persons and Registered Structural Engineers. PNAP 220. Flushing Volume for Flushing Cisterns. http://www.info.gov.hk/bd/english/documents/pnap/Pnap220.pdf

3 Buildings Department. Practice Note for Authorized Persons and Registered Structural Engineers. PNAP 41. Shops and Department Stores Building Regulation 5. http://www.info.gov.hk/bd/english/documents/pnap/Pnap041.pdf

6 INDOOR ENVIRONMENTAL QUALITY

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 performance specifications at the commissioning stage before handover and occupancy. 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 the negative impacts from the user of premises, and it is clear that a building that is not yet fully fitted-out, furnished and occupied cannot be fully tested for compliance to all possible performance specifications. HK-BEAM 4/04 seeks to ensure that buildings and systems are tested are far as possible to ensure that intended performance is likely to 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 in different buildings/premises, for the purposes of assessment HK-BEAM considers buildings as follows:

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.

- 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 for the design, 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 development, and is a basic performance specification.

HK-BEAM 4/04 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 for cooling 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

Design proposals to improve the performance of buildings should not compromise safety, and the performance of safety systems, particularly for fire safety, need to be integrated in order to achieve the highest level of performance. For example, whilst current legislation and codes dealing with fire safety are quite comprehensive, an integrated fire engineering approach in design and management of premises will reduce risks to life and property. In some more complex buildings electromagnetic interference can compromise safety, and provisions for security should be integrated with those for fire 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

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

and drainage systems, are likely to have contributed to health problems. Proper provisions for inspection, cleaning and maintenance allows for 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. The design of the building envelope should consider moisture and vapour penetration, and infiltration. 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

5 American Society of Heating, Refrigeration and Air-conditioning Engineers. ASHRAE 62-2001: Ventilation for Acceptable Indoor Air Quality. Atlanta 2001.

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 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 standards of performance for air-conditioned buildings, as the performance 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

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.

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 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 developments. Good planning and design is especially important to mitigate external noise. Noise mitigation measures such as appropriate road surface design, screening by non-noise sensitive building structures, podium structures or purpose built barriers, orientation, or disposition and internal layout of buildings should be explored in an effort to minimise rail and road traffic noise.

The design of a building façade, including windows, balconies, openings for air-conditioning and ventilation, etc., is important in further reducing the propagation of noise into noise sensitive premises, particularly where external noise levels exceed the limits given in the Hong Kong Planning Standards and Guidelines. Even where external sources of noise and/or noise mitigation measures are such as to satisfy the guidelines, further attention to noise attenuation is warranted on the grounds of comfort and privacy.

The selection and erection of 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

6.1.1 FIRE SAFETY

EXCLUSIONS

None

OBJECTIVE

Ensure that the designs of fire safety systems are integrated with other building systems 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 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].

CREDIT REQUIREMENT

a) Design integration

1 credit for demonstrating design integration between fire services systems, and non-fire services systems.

b) Fire safety manual

1 credit for provision of a fire safety manual based on a fire risk assessment for the building.

ASSESSMENT

a) Design integration

The Client shall submit a report detailing the provision of passive and active fire safety systems provided for the building:

- highlighting compliance with the relevant regulations;
- interaction with non-fire systems in the event of an alarm or fire event;
- interaction with security and communications systems that will support safe egress of occupants in the event of a fire.

The credit shall be awarded where it can be demonstrated that the following aspects of whole building performance and fire safety design have been taken into account:

- the stability of the structure will be maintained under all assumed uses of the building (i.e. adequate fire resistance period);
- integration between security and fire safety;
- the extent that any provisions for natural ventilation, or the degree of air-tightness, will influence the movement of smoke;
- the interactions between air handling and smoke movement;
- air quality in refuges during a fire event;
- adequacy of emergency warning systems in the acoustical environment;
- signage and way finding in the event of poor visibility due to smoke, including provisions for the visibility impaired and disabled;
- door opening where pressurisation systems are employed;
- durability of fire safety systems, equipment and components.

1 Building Authority. The Provision of Means of Escape in Case of Fire 1996. 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. 1995. http://www.info.gov.hk/bd/english/documents/code/moa_code1995.PDF
3 Building Authority. Fire Resisting Construction. 1996. http://www.info.gov.hk/bd/english/documents/code/e_frc.htm

b) Fire safety manual

The Client shall submit a fire safety manual, written in appropriate language for the end-user, 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 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 [4]. Design of fire services installations (FSI) [5] 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 [6,7,8]. The assessment should take into account the nature of the building structure, the use of the building, the processes

4 Eric W. Marchant. Fire safety systems - interaction and integration. Facilities. Vol. 16, No. 4. 1998. pp 229-235.

5 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

6 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

7 British Standards Institution. BS PD 9754. Application of fire safety engineering principles to the design of buildings — Part 7: Probabilistic risk assessment.

8 British Standards Institution. BS 7899. Code of practice for Assessment of hazard to life and health from fire - Part 1. General guidance.

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:

- 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 [4].

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' [9,10].

9 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).

10 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].

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 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

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

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.

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.

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, the ability of systems to carry infections, and 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 for designs that reduce the potential for transmission of harmful bacteria viruses, and odours.

ASSESSMENT

The Client shall submit details in the form of drawings and specifications for the plumbing and drainage systems, and confirmation that installation of the systems was carried out according to the specifications. A summary report shall be submitted highlighting where appropriate means have been included to allow for safe and hygienic operation over the expected lifespan 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 the pattern of demand;
- design of drainage stacks of adequate capacity for peak loading;
- venting of stacks;
- access to pipework and ducts for maintenance purposes;
- installation of buried pipework that pays attention to leaks at joints, seals, etc. for the expected life of the installation;
- design of floor drains; and
- maintenance of water seals.

Where it can be demonstrated that the design and installation of the plumbing and drainage systems, 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 was 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 design and installation 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. Self priming type drainage traps or drainage pipe connections which ensure trap priming may be considered, e.g. connection of washbasin discharge to the pipe between the floor drain grating and its U-trap. Care should also be taken to prevent back-flowing at the floor drain.

Any provision requiring modification of the relevant Building (Standards of Sanitary Fitments, Plumbing, Drainage Works and Latrines) Regulations may be considered by the Building Authority on the merits of individual case upon application.

TWO-PIPE SYSTEM

According to regulations [2] waste pipes must be connected to a soil pipe. Use of two pipes for drainage, one for foul water and one for greywater, may also be a consideration (note that such an arrangement can allow for greywater recycling). Separation of soil and waste pipes can reduce the chance of cross contamination between systems, the connection of wash basin; bath and floor drain to the same waste stack can still permit cross contamination within the waste system. A more effective measure is to provide an independent stack for floor drains.

However, the use of a one-pipe system of combined soil and waste stack has been commonly used in Hong Kong for decades. Many local designers do not regard the adoption of separate stacks for soil and waste a practical and cost-effective solution because it does not resolve the problem of drying out U-traps. The amount of drainage pipework will be doubled and, besides extra cost, can impose spatial constraints [3].

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.

MAINTENANCE

A common problem is the difficulty in gaining access to systems from public or common areas. Locating pipework on the exterior of a building has the advantage that maintenance can be carried out with minimal disturbance to users; however, locating pipework internally is acceptable if adequate duct space is provided with proper access from a public area, such as a common corridor.

As drainage and other service pipes are often placed in lightwells and re-entrants, when designing these designers should pay special attention to access for repair and maintenance [4]. The lowest level of re-entrants and lightwells housing soil and waste pipes or stacks should be designated as common areas with access, including access through cat-ladder where appropriate, to facilitate maintenance and clearance of any refuse.

2 Regulation 12. Hong Kong Building (Standards of sanitary Fitments, Plumbing, Drainage Works and Latrines) Regulations.
3 Ma Y Y, Lee HV. Institute of Plumbing Hong Kong. Preventing Infection of Virus from Drainage System. August 2003.
4 Buildings Department. Practice Note for Authorized Persons and Registered Structural Engineers, PNAP 218. Facilities for External Inspection and Maintenance of Buildings. http://www.info.gov.hk/bd/english/documents/pnap/Pnap218.pdf

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 [5]. 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.

5 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 design and installation 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 designed and installed in compliance with the Code or Practice.

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 newly completed building are unlikely to reveal problems with biological contamination caused by either air-conditioning and ventilation systems, or water systems. Consequently, HK-BEAM seeks confirmation that the design and installation of systems and equipment will reduce the possibility of problems arising during use of the building.

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. 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 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.

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 development.

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.

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

6.3 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 ventilation systems are not contaminated as a result of residuals left over from construction activities.

CREDITS ATTAINABLE

2

PRE-REQUISITES

None.

CREDIT REQUIREMENT

a) Construction IAQ management

1 credit for implementing a Construction IAQ Management Plan.

b) Filter replacement and flush-out

1 credit for:

a building 'flush out' or 'bake out'; and

replacement of all filters prior to occupancy.

ASSESSMENT

a) Construction IAQ management

To demonstrate compliance the Client shall submit a report prepared by a suitably qualified person documenting effective implementation of a Construction IAQ Management Plan appropriate to the scale and extent of the development including, but not limited to, the following:

- a copy of the Plan;
- evidence of measures showing protection of ducts, on-site storage or protection of installed absorptive materials, etc;
- checklists, worksheets, notifications, deficiencies, resolutions, etc., related to construction IAQ issues;
- documentation that demonstrates implementation of construction IAQ management measures during construction;
- details of filtration media used during construction and installed immediately prior to occupancy; and
- documentation for duct cleaning and testing.

Where due attention has been paid to construction IAQ management as detailed in the check-list below, the credit shall be awarded.

b) Filter replacement and flush-out

The Client shall submit a report prepared by a suitably qualified person detailing the technical information for the filtration media used during construction and installed immediately prior to occupancy. The report shall also detail building flush-out procedures including actual dates of the flush-out.

Where it can be demonstrated that filtration media used had a Minimum Efficiency Reporting Value (MERV) of 13 as determined by ANSI/ASHRAE 52.2-1999(1) or equivalent performance specification, and a minimum one-week building flush-out with new filtration media at 50% outside air was carried out after construction ended and prior to occupancy, the credit shall be awarded.

1 American Society of Heating, Refrigerating and Air-conditioning Engineers. ANSI/ASHRAE Standard 52.2-1999. Method of Testing General Ventilation Air-cleaning Devices for Removal Efficiency by Particle Size. Atlanta, 1999. www.ashrae.org.

CHECK LIST

Contract conditions for the project specifications should require a written Construction IAQ Management Plan which includes procedures meeting or exceeding the minimum requirements, as follows:

- measures to protect the ventilation system components and air pathways against contamination during construction;
- 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;
- control measures for HVAC system and component protection;
- contaminant source control; and
- interruption of moisture/pollutant pathways;

Events shall be scheduled to protect indoor air quality by:

- permitting adequate airing-out of new materials;
- sequencing the installation of finish materials; and
- proper curing of concrete before covering.

The Plan should specify the location, type, amount, sequence and timing of the various control measures, including emergency procedures, and the labour, materials and time required to implement them. The project construction documents should address the following:

- an overview of tasks to be executed;
- a list of reference documents, including specifications, drawing list, and submittal drawings;
- a list of participants in the process and their responsibilities;
- a plan for management, communication and documentation;
- an outline of the scope of the IAQ Management Plan, including submittal review, inspection, and enforcement;
- the expected written work products, including checklists and worksheets; and
- a schedule of activities.

The project construction documents should require the contractor to:

- designate a representative with daily responsibility for IAQ issues;
- include procedures related to the IAQ Management Plan on the agenda during regularly scheduled meetings;
- store building materials in a weather tight, clean area protected from dust, debris and moisture damage;
- keep 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 to protect HVAC systems from contamination;
- submit a construction schedule to prevent materials from acting as sinks for storage and subsequent release of contaminants emitted from finishes which have the potential for short-term off-gassing. In the schedule, the contractor should include appropriate allowances for drying or curing times before installation of materials that have a fibrous or porous nature that tend to adsorb contaminants;
- provide adequate outside air continuously during installation of

materials and finishes;

- replace all construction-related filtration media used on permanent HVAC equipment at substantial completion of the work;
- confirm that all air filters, casing, coils, fans and ducts are clean, before air quality testing.
- ensure air ducts clean by coordinating duct testing and cleaning procedures with the commissioning requirements.

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 construction, followed by cleaning and replacement strategies can significantly reduce air pollution caused by construction. Designers should specify containment control strategies including protecting the HVAC systems, controlling pollutant sources, interrupting pathways for contamination, enforcing proper housekeeping and coordinating schedules to minimize disruption. The construction sequencing to install absorptive materials after the prescribed dry or cure time of wet finishes should be specified to minimize adverse impacts on indoor air quality. 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 None.

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.

In the case of occupied/habitable rooms in air-conditioned/naturally

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.

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 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.

BACKGROUND

This section deals with pollutants found in indoor air which are mainly attributable to outdoor sources. 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 outdoor 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.

Survey data for Hong Kong buildings shows that if design and construction is adequate it should be possible to meet the Excellent Class of the Guidance Note for CO, NO_2, O_3 and RSP in new air-conditioned buildings.

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

None.

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.

a) Measurement method

Where compliance is 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

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.

and doors closed.

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.

b) Design method

As an alternative to measurements on the completed building the Client shall provide a report prepared by the suitably qualified person detailing how indoor air pollution has been taken into account through detailed design. The report shall detail the computations and data used in the design approach used, especially the assumption in respect of . Where it can be demonstrated that compliance with Good Class in Table 1 of the scheme Guide based on the 'Indoor Air Quality Procedure given in ASHRAE 62-1999 [3] or the methodology outlined in CEN Report CR 1752 [4], the relevant credits shall be awarded.

BACKGROUND

This section deals with pollutants found in indoor air which are mainly attributable to indoor sources. 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.

3 American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc. ASHRAE 62-1999. Ventilation for Acceptable Indoor Air Quality.

4 European Committee for Standardization. CEN Report CR 1752. Ventilation for buildings – Design criteria for the indoor environment. December 1998.

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 None.

Credit Requirement 1 credit for compliance with the design requirements 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.

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. 1996.

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 design requirements 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.

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. 1998.

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 corrected design ventilation rate meets the design intent for normally occupied spaces, and the corresponding outdoor air flow rate 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 design criteria that has been adopted for each category of premises included in the development, and the results of calculations, simulations and/or measurements in the specified sample of premises to demonstrate compliance with the assessment criteria.

a) Outdoor air ventilation rate

The calculations/simulations shall cover at least one representative sample of each type of premises (normally occupied spaces). Calculations should be based on guidance from recognised authorities such as ASHRAE 62 [1] or equivalent that take into account ventilation required to provide adequate indoor air quality for odour comfort.

The outcome of 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 [2], or by tracer gas techniques in accordance with ASTM E 741 [3] or equivalent.

Where the corrected ventilation rate is achieved in a minimum of 90% of premises, and the design ventilation rate is achieved in a sample of each type of premises the credit shall be awarded

b) Air change effectiveness

Compliance may be demonstrated either through measurement of the completed building in accordance with ASHRAE 129 (RA 2002) [4] or equivalent, or in cases where measurement may be difficult using CFD simulations produced by a suitable airflow model.

The measurement locations shall include at least one representative sample of each type of premises (normally occupied spaces) as defined

1 American Society of Heating Refrigeration and Air Conditioning Engineers. ASHRAE Standard 62. Ventilation for Acceptable Indoor Air Quality, Atlanta 2001.
2 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
3 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.
4 American Society of Heating Refrigeration and Air Conditioning Engineers. ANSI/ASHRAE Standard 129 (RA 2002). Measuring Air-change Effectiveness. Atlanta 1997.

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 in accordance with ASHRAE 129. The measurements shall be undertaken under simulated full occupancy conditions. All airstreams of the air-side system serving the test space 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.

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 [5]. 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 [4] 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. Approximate values of ACE that can be used at the design stage can be found in CR1752 [6]. 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 [7] and manometer to perform a pitot tube traverse in accordance with ASHRAE 111-98 [2] or ASHRAE Handbook [8] or

5 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

6 European Committee for standardization. CEN Report CR 1752. Ventilation for buildings – Design Criteria for the indoor environment. Brussels. 1998.

7 International Organization for Standardization. ISO 3966-1977. Measurement of fluid flow in closed circuits - Velocity area method using Pitot static tubes.

8 American Society of Heating Refrigeration and Air Conditioning Engineers. ASHRAE Handbook Fundamentals. Atlanta 2001.

- 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 [3] describes the required properties of tracer gases and discusses procedures for tracer decay, tracer step up and constant concentration measurements.

A CFD (Computational Fluids Dynamics) model would typically be used to perform the simulation and to compute the air change effectiveness although alternative modelling methods may be proposed. Modelling should take into account:

- HVAC system type, supply and exhaust dimensions, supply temperature etc;
- climatic variations;
- air leakage of building envelope; and
- presence of expected furniture/fittings.

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 can be 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 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 minimum ventilation rate required to maintain known contaminants below recognised limits can be calculated using recognised procedures, for example, Appendix D of BS 5925 [1] or similar.

Ventilation performance may be simulated using wind tunnel tests, computational fluid dynamics (CFD) or other appropriate modelling techniques [2,3].

The modelling technique shall show a boundary layer as appropriate for the site, and the model will include any significant buildings and site obstructions within a distance of approximately 6 building heights. The pressure data will be used with recognised calculation procedures (e.g. BS 5925) to estimate flows through the habitable areas. Buoyancy or turbulence driven flows need not be considered. Ventilation rates can be predicted using either CFD or approaches that range in complexity from simple single zone models to elaborate multi-zone models [2]. Principles of model operation are discussed in the ASHRAE Handbook [4].

Alternatively, a suitable commissioning test may be performed, for example a tracer gas decay test [5]. The test should be carried out in representative units as defined above and performed under average wind conditions with windows closed and purposely designed ventilators open.

1 BS 5925:1991 (Inc. Amendment No 1), Code of Practice for Ventilation principles and designing for natural ventilation. British Standards Institute, London. December 1995.
2 American Society for Testing Materials. ASTM E 2267-03. Specifying and Evaluating Performances of Single Family Attached and detached Dwellings – Indoor Air Quality. 2003.
3 American Society of Heating, Refrigerating and Air Conditioning Engineers. ASHRAE Fundamentals Handbook Chapter 26. Atlanta 2001.
4 American Society of Heating, Refrigerating and Air Conditioning Engineers. ASHRAE Fundamentals Handbook Chapter 26. Atlanta 2001.
5 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.

Where it can be demonstrate 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 the credit shall be awarded. 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 [6]. Local research on residential buildings suggests that 0.5 to 1 Ach would be sufficient to maintain radon below the target level.

For domestic buildings the Building Authority (BA) is prepared to accept the following alternative performance standards on the provision of natural ventilation in habitable rooms [7]:

Room of domestic building	Air Change per Hour (ACH)
Habitable Room	1.5 (natural means)
Kitchen	1.5 (natural means) plus 5 (mechanical means)

6 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

7 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

6.4.3 UNCONTROLLED VENTILATION

EXCLUSIONS

Air-conditioned and mechanically ventilated buildings.

OBJECTIVE

Reduce uncontrolled air movement in or out of premises, thereby provide better control over background ventilation through purposely provided openings and reduce infiltration of contaminated air.

CREDITS ATTAINABLE

2 BONUS

PRE-REQUISITES

None.

CREDIT REQUIREMENT

1 credit for undertaking tests in multi-zone buildings using a non-balanced test method on a representative sample of units, to demonstrate that the air tightness is within recognized limits.

OR

2 credits for undertaking tests using either a whole building test method or, in the case of multi-zone buildings (e.g. apartment blocks) a 'guarded cell' (or balanced) test method, on a representative sample of units, to demonstrate that the air tightness is within recognized limits.

ASSESSMENT

The Client shall provide evidence in the form of a report prepared by a suitably qualified person that defines the targets for air leakage rate for the various types of premises in the development, demonstrating that the appropriate testing and analysis has been undertaken, and that the outcomes demonstrate compliance.

The defined air leakage rates should conform to recognised good practice targets [e.g.1].

Fan pressurisation measurements can be based on a whole building test such as described in ASTM E 779 [2], or a method demonstrating similar rigour. In the case of high rise multi zone (or multi unit) buildings it is permissible to pressurise individual units using a guarded cell technique [3,4].

A less stringent test is to perform an un-balanced test on individual units, i.e. pressurise individual units in isolation. These tests are influenced by the degree of cross leakage by neighbouring units (to the sides, above and below) and therefore the air leakage rate measured is not only the air leakage through the building envelope.

For all test methods, the arithmetic mean of the air leakage rates measured under pressurisation and depressurisation at 50 Pa should be normalised to the external surface area of the whole building or unit to give the air leakage rate in $m^3\,m^{-2}\,h^{-1}$ of external envelope.

Where the tests and analysis have been properly undertaken in a sample of each type of premises and the air leakage rate(s) conform to recognised good practice/standards then the appropriate bonus credit(s) shall be awarded.

BACKGROUND

Air movement between indoors and outdoors occurs as a result of differentials between indoor and outdoor air pressure caused by winds and stack effect. Poor building detailing, services penetrations and gaps around windows in a building envelope will result in air leakage, either

1 Chartered Institute of Building Services Engineers. TM23:2000. Testing Buildings for Air Leakage, London. 2000.
2 ASTM International. E 779. Standard Test Method for Determining Air Leakage Rate by Fan Pressurization. 1999.
3 International Energy Agency. Air Infiltration and Ventilation Centre (AIVC. Guarded Cell Pressurisation Measurements.
4 Bahnfleth W P, Yuill G K, Lee B W. Protocol for field testing of tall buildings to determine air leakage rate. ASHRAE Transactions. 1999. pp 27-38.

infiltration or ex-filtration. This results in a loss of conditioned air or an unwanted gain of unconditioned air, and resultant heat losses or heat gains in occupied rooms. These losses reduce the user's control over ventilation through purposely provided ventilators. Infiltration can increase the levels of outdoor pollutants that enter indoors. Infiltration can be reduced through good detail design, sealing of services penetrations and properly installed high-quality window systems with effective sealing of cracks and joints [5].

The air tightness of the building envelope can be investigated using a fan (or fans) mounted in a suitable aperture such as a door or window to create an induced pressure difference across the building envelope. The test should be carried out under low wind and stack conditions so that the induced pressure difference is uniformly distributed over the building envelope.

Whole building tests are straight forward for small buildings e.g. new territories style housing, but for tall buildings large fan equipment, usually on a mobile rig, need to be used.

In the case of apartment buildings, individual apartments may be tested using a guarded cell method [3]. During this test, the units above, below and to each side of the tested apartment are tested simultaneously. This would however entail the need for 5 blower door test fans in order to perform the measurement.

ASHRAE RP 935 [4] details several methods for testing tall buildings. A modification to one test method (floor by floor method) is to simultaneously pressurise the floors above and below the test floor, i.e. simultaneously pressurise 3 adjacent floors. If the flow rates are adjusted so that there is no differential pressure between the middle and the upper and lower floors there will be no cross leakage from the middle floor. The measured air leakage rate will therefore be the envelope leakage for that floor.

Some example good practice target values (at 50 Pa) are [4]:

Dwellings	15 $m^3 m^{-2} h^{-1}$
Dwellings (mechanically ventilated)	8 $m^3 m^{-2} h^{-1}$
Air-conditioned offices	5 $m^3 m^{-2} h^{-1}$
Naturally Ventilated offices	10 $m^3 m^{-2} h^{-1}$
Superstores	5 $m^3 m^{-2} h^{-1}$
Industrial Buildings	15 $m^3 m^{-2} h^{-1}$

The measured value quoted are the arithmetic mean of the air leakage rates measured for pressurisation and depressurisation tests. It follows that the air leakage rate measured under unbalanced conditions will be an over estimate of the air leakage through external envelope by an amount depending on the degree of leakage to neighbouring units.

5 The American Institute of Architects. Glazing Design: Handbook for Energy Efficiency. AIA.

6 IEQ

6.4 VENTILATION

6.4.4 LOCALISED VENTILATION

EXCLUSIONS

Item b) is excluded for residential buildings.

OBJECTIVE

Prevent exposure of building occupants to concentrated indoor sources of pollutants.

CREDITS ATTAINABLE

2

PRE-REQUISITES

Compliance with CAP 123J Building (Ventilating Systems) Regulations

CREDIT REQUIREMENT

a) Source control

1 credit for the provision of an adequate ventilation system for rooms/areas where significant indoor pollution sources are generated.

b) Local exhaust

1 credit for the provision of a system of local exhaust of premises undergoing fit-out and redecoration.

ASSESSMENT

a) Source control

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 designs providing 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.

b) Local exhaust

The report shall provide technical details to demonstrate how the ventilation system design(s) may be temporarily adapted so that air from any areas undergoing fit out or renovation can be exhausted to the outside without re-circulation or entrainment to occupied areas. The ventilation provisions shall be adequate to exhaust to outside air any material off-gassing, combustion products, excess moisture, etc., and the exhaust is discharged such that it does not re-enter the premises or enter adjacent premises under typical wind conditions. Compliance may be demonstrated by conducting appropriate tests in a sample of units.

Where it can be demonstrated that source control measures can meet the performance requirements the credit(s) shall be awarded.

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. It is also appropriate to provide a system that allows for localised exhaust of premises during fit-out and redecoration, to avoid entrainment to occupied areas. It could be part of the fixed ventilation system, or a simple approach that allows temporary exhaust provisions. 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.

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

The Building Authority will give favourable consideration to an application for modification of Building (Planning) Regulation 36 in respect of bathrooms and lavatories in domestic buildings [4] where the following criteria are met :

- the room is part of a unit of accommodation for domestic use;
- the room is of a reasonable size; and
- the modification to be granted is unlikely to result in standards of public health and safety being compromised.

Upon the grant of a modification of the Regulation, the Building Authority will impose the following conditions:

- mechanical ventilation producing 5 air changes per hour (Ach) is in operation at any time when the room is in use. The change of air shall be with the outside of the building and to achieve this, the use of ventilation ducting is acceptable;
- there is permanent ventilation to the 'open air', the 'external air' or with another room which is provided with a window meeting the area requirement for the combined windows. The permanent ventilation may be in the form of an air duct, an aperture in a wall or a door suitably located and permanently open or protected with louvers having a minimum size of 1/20 of the floor area of the room; and
- the requirements of Building (Planning) Regulation 35A and PNAP 82 [5] regarding water heaters are complied with, where applicable.

Where mechanical ventilation in the form of extractor fan is provided in bathrooms and lavatories, care should be taken to ensure that plumbing

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.
3 Singapore Standard SS CP13. Code of Practice for Mechanical Ventilation and Air Conditioning in Buildings. 1999.
4 Buildings Department. Practice Note for Authorized Persons and Registered Structural Engineers, PNAP 219. Lighting and Ventilation for Bathrooms and Lavatories in Domestic Buildings. http://www.info.gov.hk/bd/english/documents/pnap/Pnap219.pdf
5 Buildings Department. Practice Note for Authorized Persons and Registered Structural Engineers, PNAP 82. Gas Water Heaters - Building (Planning) Regulation 35A. http://www.info.gov.hk/bd/english/documents/pnap/Pnap082.pdf

seals are intact and operate according to the design intent [6]. 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.

UTILITY AND LAUNDRY ROOMS

ASHRAE 62.2 makes no requirement for mechanical ventilation although it stipulates an opening not less than 4% of the room floor area nor less than 0.15 m^2. However it does stipulate that clothes dryers must be directly exhausted to outside.

REFUSE AREAS

Exhaust from refuse storage areas and material recovery centres (RS & MRC) should follow the principles of PNAP 98 [7]. 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 to 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.

DOMESTIC GARAGES

ASHRAE 62.2 states that for low rise residential buildings where air handlers or return ducts are in an attached garage the ductwork should be tested for air tightness. A ductwork air leakage test conforming to test procedure DW 143 [8] or similar authority should be performed.

CHIMNEYS AND FLUES

The siting and height of chimneys and flues should follow PNAP 45 [9]. In particular, chimneys and flues should be situated so that products of combustion cannot enter windows, ventilation openings, supply air intakes.

6 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

7 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

8 DW 143. A practical guide to Ductwork Leakage Testing. Heating and Ventilating Contractors Association. 1994.

9 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 design criteria that has been adopted for each type of common area included in the development, and the results of calculations, simulations and/or 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, or by appropriate modelling techniques, such as wind tunnel test, CFD or other computer models [4, 5].

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 The Buildings Department seeks to improve building design in the context of environmental hygiene. Designers are recommended to consider the provision of ventilation to common areas, such as corridors,

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 ASTM International. ASTM E 2267-03. Specifying and Evaluating Performances of Single Family Attached and detached Dwellings – Indoor Air Quality. 2003.
5 American Society of Heating, Refrigerating and Air Conditioning Engineers. ASHRAE Fundamentals Handbook Chapter 26. Atlanta 2001.

lift lobbies, entrance lobbies, etc. [6]. 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 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.

Cross ventilation of common and circulation areas not provided with mechanical cooling or ventilation is important to control temperatures and to dilute pollutants and odours. Recommended practice is to place ventilation openings so that cross ventilation can occur. However, wind driven cross ventilation can only happen when there is a reliable higher pressure on one side of openings than on the other. For an isolated building this may be easily achieved by simple consideration of prevailing winds and the building form. For buildings within dense groupings, however, local wind direction may be less apparent, turbulence high, and cross-ventilation decreased. A more sophisticated analysis of the behaviour of the wind is necessary to ensure beneficial cross flows.

MEASUREMENT APPROACH

A suitable commissioning test may be performed. The test should be carried out in representative sample, including worst case spaces as defined above and performed under average wind conditions. In the case of naturally ventilated spaces, measurements should be made under conditions when windows are closed and purpose designed ventilators are open.

MODELLING APPROACH

Boundary layer wind tunnel modelling may be used for wind pressure analysis. Wind pressure coefficients at inlet/outlet areas for common areas shall be measured for at least one representative floor, including worst case, for each type of occupied premise in the assessed building. These may be site specific depending on the building's height in relation to nearby buildings and local terrain. The measurements will be taken for at least the prevailing wind conditions which are likely to be site specific and therefore should be determined case by case.

The modelling technique shall show a boundary layer as appropriate for the site, and the model will include any significant buildings and site obstructions within a distance of approximately 6 building heights. The pressure data will be used with standard calculation procedures to estimate flows through the common areas, arising from an average wind condition. Buoyancy or turbulence driven flows need not be considered.

ASTM 2267 [4] states that building ventilation rates can be predicted using approaches that range in complexity from simple single zone models to elaborate multi-zone models. The underlying principles of model operation are discussed in the ASHRAE Handbook [5]. The modelling should take into account average wind speed conditions. In the case of naturally ventilated premises, the simulation should be performed for windows are closed and purpose designed ventilators are open.

6 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

6 IEQ

6.5 THERMAL COMFORT

6.5.1 THERMAL COMFORT IN AIR-CONDITIONED PREMISES

EXCLUSIONS

Buildings 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 design 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 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.

b) Room air distribution

The measurement locations shall be as for a). The assessment of performance shall be in accordance with ASHRAE 113 [3] 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

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 American Society of Heating, Refrigerating and Air-conditioning Engineers. ASHRAE 113-1990: Method of Testing for Room Air Diffusion. Atlanta, 1990.

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.

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

3

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.

2 credits for demonstrating indoor operative temperatures in occupied/habitable rooms meet the 90% 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 design of the building envelope can mitigate the effects of external heat gains. Based on the output from a suitable thermal simulation model of the building the predicted 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.

The thermal analysis shall be undertaken using dynamic thermal modelling software. The thermal performance within the occupied or habitable space of each type of premises most affected by solar gains shall be determined. The modelling shall be undertaken full annual simulation using standard Hong Kong weather data. The modelling will include the effect of installed solar control features, e.g. glazing, internal or external shading components, fabric and infiltration specifications, and site obstructions. The modelling need not include any internal gains, i.e., simulations for unoccupied premises are required.

Alternatively, compliance may be demonstrated under appropriate summer and winter 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

1 American Society of Heating, Refrigeration and Air-conditioning Engineers. ASHRAE 55-2004: Thermal Environmental Conditions for Human Occupancy. Atlanta 2004.

(solar) heat gains, the specification and details of the thermal simulation software used in the analysis, and the results of the simulations.

Where compliance is demonstrated by measurements the details of measuring equipment, sampling locations, sampling time, time of measurements, external temperature and prevailing weather conditions shall be provided.

Where it can be demonstrated that the predicted indoor temperature lies within the 80% acceptability limits given in ASHRAE 55-2004 a credit shall be awarded. Where the predicted indoor temperature lies within the 90% acceptability limits both credits 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 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. Derived from laboratory experiments using a thermal-balance model of the human body these standards have attempted to provide an objective criterion for thermal comfort, specifying combinations of personal and environmental factors that will produce interior thermal environments acceptable to at least 80% of a building's occupants. The heat-balance models, on which the standards are based were developed in tightly controlled conditions. The people involved were considered passive subjects of climate change in artificial settings, and little consideration was given to the broad ways they might naturally adapt to a more wide ranging thermal environments in realistic settings.

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

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.

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. Mechanical cooling for the space should not be available, although mechanical ventilation with unconditioned air may be utilized. The method applies only to spaces where the occupants are engaged in near sedentary physical activities, with metabolic rates ranging from 1.0 met to 1.3 met, and may freely adapt their clothing to the indoor and/or outdoor thermal conditions.

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 90% acceptability limits may be used when a higher standard of thermal comfort is desired.

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.

It is most likely that some of the premises within a building development will be subject to higher than average external heat gains, with consequent higher internal temperatures during summer months. Those premises at more exposed facades will suffer from adverse winter conditions. It is appropriate to examine the detailed thermal performance of the most susceptible premises, and based on detailed analysis employ mitigation measures, such as changes in fabric design and other solar control strategies.

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.

SIMULATION SOFTWARE

For the purposes of simulating thermal conditions (and in estimating energy use) previous HK-BEAM assessments have employed the simulation software HTB2 [6]. Any software meeting the requirements of ASHRAE standard 140 [7] would be acceptable.

6 Alexander D K. HTB2 User Manual Version 2.0. Welsh School of Architecture, Cardiff University.

7 American National Standards Insitute/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

6 IEQ

6.6 LIGHTING QUALITY

6.6.1 NATURAL LIGHTING

EXCLUSIONS

None.

OBJECTIVE

Encourage a holistic examination of site layout, building design, and fenestration design, such as to 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.

c) Estimation of VDF

The CIE standard overcast sky shall be used in computer simulations.

Compliance with the VDF criteria can be demonstrated using the method

1 The Chartered Institution of Building Services Engineers. Applications Manual – Window design.

given in PNAP 278 [2], provided application of the method takes account of the limitations stated in the Appendix A. The alternative is to use the HK-BEAM preferred method developed by Cheung and Chung [3] which can be applied without restrictions. (Details of this method with supporting calculation spreadsheet are available from the authors upon request).

d) Estimation of DF

The average daylight factor (DF) shall be estimated according to the preferred method [3], that given in the CIBSE design guide [4], or similar equivalent method. Alternatively, daylighting design software such as Radiance [5] can be used to calculate the average DF provided it can be demonstrated that the method of computation employed by the software used is not inconsistent with the preferred calculation method.

The report submitted shall identify the key parameters used in the computations/modelling, especially with regard to glazing transmittance, and the reflectance's of external and internal surfaces. The values of the parameters shall reflect the nature and type of surfaces on the external vertical obstructions and horizontal surfaces, and likely internal finishes.

The room dimensions shall be taken to be a typical perimeter room for the building, be it a habitable room, office, classroom , etc.

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:

- 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. It is possible to take into account the overshadowing by adjacent buildings using appropriate design tools.

VERTICAL DAYLIGHT FACTOR

In Hong Kong, Building (Planning) Regulations CAP123 - Lighting and Ventilation sets out prescriptive requirements of a minimum window to floor area ratio of 10% and a maximum obstruction angle of 71.5° for habitable rooms. On a trial basis the Building Authority (BA) is prepared to accept an alternative performance standard on the provision of natural lighting in habitable rooms and domestic kitchens for the purpose of Building (Planning) Regulations (B(P)Reg.) 30, 31 and 32:

Vertical Daylight Factor (VDF) (measurement taken on the centre of the window pane):

Habitable Room 8%   Kitchen 4%

To assist designers in adopting the above performance-based approach in design, guidelines with a simplified assessment method are given in

2 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

3 Cheung H D, Chung T M. Calculation fo Mean Daylight Factor in a Building Interior Within a Dense Urban Environment. Department of Building Services Engineering, Hong Kong Polytechnic University.

4 The Chartered Institution of Building Services Engineers. Lighting Guide LG10. daylighting and window design. CIBSE.

5 Ward Larson, G. and Shakespeare, R. Rendering with RADIANCE. Morgan Kaufmann. San Francisco.

Appendix A of PNAP 278.

The Practice Note recommends the use of the "Unobstructed Vision Area" (UVA) method as a reliable tool to demonstrate compliance with the performance requirements. However, the correlation between VDF and UVA is not entirely convincing. In fact, VDF assesses only one factor determining the indoor daylight environment, namely the external daylight availability. The internal daylight levels depend also on the window size and configuration and the transmission property of the window glazing. The total daylight environment of a room depends also on the depth of the room. Daylight penetration in side lit rooms is limited to a shallow perimeter area adjacent to the window. For deep rooms, the back of the room looks gloomy unless some advanced daylight redistribution systems such as light shelves exist in the room. For these reasons, HK-BEAM gives credit for building designs that provide for the use of sufficient daylight.

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 or 3 depending on type of building/premises.

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.

1 credit where fluorescent and other lamps with modulating (fluctuating) output are fitted with dimmable high-frequency ballasts in all work areas.

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 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 by adjacent air-conditioning or ventilation fixtures, and the 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 yet to be fitted-out, the technical details of the proposed lighting systems for each type of normally occupied space within the development. The report shall detail the design criteria and the results of measurements or other means demonstrating compliance. For premises to be fitted out by

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.

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 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'.

Air diffusers located near to fluorescent luminaires with open lamp compartments may result in cool air blowing over the lamps directly causing decrease light output and lamp efficacy. The design details should demonstrate that the cool air from diffusers will not adversely impact on lamp performance.

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

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.

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. Besides the energy conservation, power quality and control benefits offered by dimmable high-frequency electronic ballasts, the high frequency modulation avoids the problem of 'flicker' that can occur when using mains frequency ballasts.

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

A first step in architectural acoustic design is to identify appropriate values of reverberation time for the intended use of a room and then to specify materials to be used in the construction which will achieve the desired value of the reverberation time for a given space and use.

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. Guidance on the design of walls and floors, and guidelines for assessing performance is available in the literature (e.g. [9]).

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).
9 British Standards Institution BS8233 – Sound insulation and noise reduction for buildings – Code of Practice.

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. Predictions should take into consideration future as well as existing land uses. Estimation of road traffic noise can be made using the UK Department of Transport's prediction method [5]. For railway noise, calculations shall be made in terms of $L_{Aeq,T}$ using the UK Department of Transport's prediction method [6]. For noise from industry which are more or less of steady level, $L_{Aeq,T}$ is estimated according to British Standard BS 4142 [7]. T in the case can be 1 hr or 30 minutes.

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 [8], and for planning residential developments against road traffic noise [9]. The Environmental Protection Department also provides guidelines on practical noise control measures for ventilation systems [10], and for pumping systems [11].

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 UK Department of Transport. The Calculation of Road Traffic Noise. HM Stationary Office.
6 UK Department of Transport. The Calculation of Railway Noise. HM Stationary Office.
7 British Standards Institution. Method for rating industrial noise affecting mixed residential and industrial areas. British Standard BS 4142:1990. London, BSI, 1990.
8 Environmental Protection Department. Practice Note for Professional Persons. ProPECC PN 4/93. Planning and Designing Noise Sensitive Developments.
9 Environmental Protection Department. Practice Note for Professional Persons. ProPECC PN 1/97. Streamlined Approach for the Planning of Residential Developments Against Road Traffic Noise.
10 Environmental Protection Department. Good Practices on Ventilation System Noise Control.
11 Environmental Protection Department. Good Practices on Pumping System Noise Control.

6 IEQ

6.7 ACOUSTICS AND NOISE

6.7.4 INDOOR VIBRATION

EXCLUSIONS None

OBJECTIVE Avoidance of excessive vibration from building services equipment and external sources.

CREDITS ATTAINABLE 1 BONUS

PRE-REQUISITES None.

CREDIT REQUIREMENT 1 credit for demonstrating vibration levels shall not exceed the prescribed criteria.

ASSESSMENT The Client shall provide evidence of the investigation in the form of a report prepared by a suitably qualified person demonstrating compliance with the criteria given in ISO 2631-2 [1].

BACKGROUND Excessive vibration is buildings can also be a source of annoyance to users. It is possible to mitigate against vibration caused external sources, such as traffic, and internal sources, such as building services equipment, through good design.

1 International Standard Organization.. ISO2631-2. Evaluation of human exposure to whole-body vibration – Part 2 : Continuous and shock-induced vibration in buildings (1 to 80Hz)

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 designs to demonstrate full compliance with the pre-requisites, and demonstrate how they provide for enhanced levels of access for disabled persons.

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.

As the advice provided cannot be exhaustive, developers and designers should exercise forethought and creativity to cater for the well-being of disabled persons when designing buildings, allowing greater independence of disabled persons, the elderly, and other less physically able persons using the facilities.

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

a) Amenities for the benefit of building users.

1 credit for providing amenity features that enhance the quality and functionality of a building to the benefit of building users.

b) Amenities for improved operation and maintenance.

1 credit for providing amenity features that allow for improved operation and maintenance of the building and its engineering services.

ASSESSMENT

a) Amenities for the benefit of building users.

The Client shall submit a report prepared by a suitably qualified person detailing the amenity features provided within the building for the purposes of improving the living and/or working experience of building users. The report shall identify the exempted percentage GFA obtained under regulations, and the additional percentage of GFA provided for the amenities for which no exemption has been allowed.

Where it can be demonstrated that passive and active recreational facilities, balconies, mail rooms, lift lobbies, common areas, etc., are provided, to at least to the extent described in the referenced documents (see below), and where the Client has included a number of such facilities beyond those giving exemptions in the gross floor area calculations, then the credit shall be awarded.

b) Amenities for improved operation and maintenance.

The Client shall submit a report prepared by a suitably qualified person detailing the amenity features provided within the building for the purposes of improving the flexibility in use and operation and maintenance of the building. The report shall identify the exempted percentage GFA obtained under regulations, and the additional percentage of GFA provided for the amenities for which no exemption has been allowed.

Where it can be demonstrated that provisions that serve to enhance operation and maintenance exist, to at least to the extent described in the referenced documents (see below), and where the Client has included a number of such facilities beyond those giving exemptions in the gross floor area calculations, then the credit shall be awarded.

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.

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 [1].

To encourage these features, the Building Authority is prepared to consider modification and exemption, under the Buildings Ordinance and

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

Regulations, for the provision of new amenities in both new developments and existing buildings. To justify favourable consideration for modification or exemption, such proposals should meet one or a combination of the following objectives :

- encouraging efficient and effective building management;
- enhancing the quality of life for residents and users;
- obviating the desire or temptation for unauthorized building works; and
- improving environmental compatibility with the neighbourhood.

The amenity features identified 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.

GREEN AND INNOVATIVE BUILDINGS

To protect and improve the built and natural environment, the Buildings Department (BD), the Lands Department (LandsD) and the Planning Department (PlanD) promote the construction of green and innovative buildings. The objective is to encourage the design and construction of buildings that encompass the following features:

(a) Adopting a holistic life cycle approach to planning, design, construction and maintenance;

(b) Maximizing the use of natural renewable resources and recycled/green building material;

(c) Minimizing the consumption of energy, in particular those nonrenewable types; and

(d) Reducing construction and demolition waste.

Joint Practice Note No. 1 [2] sets out the incentives provided to encourage the incorporation of certain features in building development, including:

- balconies;
- wider common corridors and lift lobbies;
- communal sky gardens; and
- communal podium gardens.

Criteria and conditions for exempting the above green features are listed in the JPN. To contain the effect on the building bulk resulting from the provision of these incentives, the cumulative GFA exemption for all the green features, excluding sky and podium gardens, should not exceed 8% of the total permitted GFA for the development.

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

Joint Practice Note No. 2 [3] includes:

- mail delivery rooms with mailboxes; and
- communal sky gardens for non-residential buildings.

OPEN SPACE AND RECREATIONAL AREAS

PNAP 280 [4] describes the factors that the Building Authority may take into account in considering applications for flexibility in determining site coverage and open space to facilitate innovative design. PNAP 233 [5] sets out the general guidelines on proposals to dedicate land or area within a building for use as public passage and the concessions which the Building Authority (BA) may grant upon acceptance of such dedication.

The provision of podium roof gardens and play areas is encouraged. Where these are under and within the perimeter of a domestic building a modification would be granted provided the area is of open design and not encumbered with structural elements. Certain other recreational facilities such as squash courts, indoor swimming pools, etc., for active or passive recreational activities can be considered for exclusion from GFA calculations [1]. Lands Department provides details of the recreational facilities commonly allowed in residential developments [6].

Applications for exclusion of floor areas for recreational use from GFA calculations must be accompanied by information substantiating the need for the areas with justification on overall size of the facilities, the headroom requirements, etc., [7]. In normal circumstances the Building Authority would not expect the GFA of such facilities to exceed 5% of the domestic floor area. Open-sided covered landscaped area/children play areas provided under the footprint of the domestic tower would not be subject to the 5% limitation.

ENTRANCES

Prestige entrances such as large voids in front of cinema and theatre balconies, in banking halls and shopping arcades, entrance lobbies, etc., may be exempted from GFA calculations [8].

BUILDING SERVICES FACILITIES

Non-accountable GFA applies to basic building services facilities such as water tanks, meter rooms, pump rooms, cable riser duct rooms, etc., are exempt providing the size and location are appropriate to the layout and size of the main building. Particular designs of building services facilities such as chimney shafts, fire refuge areas, swimming pool filtration plant rooms, pipe-ducts, etc., can also be exempt [8]. The area of refuse container chambers, hopper rooms, chutes, and storage chambers planed to suit factors listed in PNAP 98 [9] may also be discounted.

For residential buildings, projections such as wall boxes or platforms, window cills, flower boxes, etc., of prescribed dimensions may be excluded from site coverage considerations [10]. Notwithstanding,

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 280. Site Coverage and Open Space Provision. http://www.info.gov.hk/bd/english/documents/pnap/Pnap280.pdf

5 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

6 Lands Administration Office, Lands Department. Practice Note 4/2000. Recreational Facilities in Domestic Development.

7 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

8 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

9 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

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.

canopies, balconies, air-conditioner platforms, etc., need to be properly designed and constructed [11].

For commercial and industrial buildings, a centralized air-conditioning system should be provided or suitable internal areas set aside for this purpose at the design stage, with allowance made for adequate ducting and trunking, recesses, etc. In accordance with Regulation 23(3)(b), any floor space genuinely intended for air-conditioning may be excluded from gross floor area (GFA) calculations. Air-conditioning plant rooms not exceeding 1% of the total floor area of a building, or air handling units not exceeding 4% of the GFA of each floor, are considered reasonable [1].

The lift service in a building has been the subject of complaints from time to time. The Building Authority (BA) accepts that occupants of the building may have legitimate cause for concern in some cases. PNAP 207 [12] introduces guidelines on the provision of lifts in buildings for domestic and office use with a view to enhancing standards of lift services, thereby improving the quality of life for the occupants of domestic and office buildings.

PNAP 201 [13] specifies the BA's requirements other provisions for communications systems. It would also be appropriate to make provisions for accommodating satellite dishes [1].

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

12 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

13 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

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 4-03.

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 4-03.

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 ENERGY BUDGET APPROACH

8.1.2 PRE-REQUISITES

ASSESSMENT FRAMEWORK

The assessment framework described herein applies to all types of new building developments:

- those that are air-conditioned throughout the year, including standalone buildings accommodating a single type or a mix of premises;
- buildings/premises in the same development served by a central air-conditioning plant; and
- buildings/premises that also utilise natural ventilation.

8.1.1 ENERGY BUDGET APPROACH

Buildings accommodating predominantly air-conditioned premises, such as malls, offices, hotels and high-rise apartments, are the dominant electricity consumers in Hong Kong. In order to allow designers flexibility in achieving the energy performance target for a building development, the assessment of Annual Energy use is based primarily on the 'Energy Budget' approach, supplemented by a range of basic requirements.

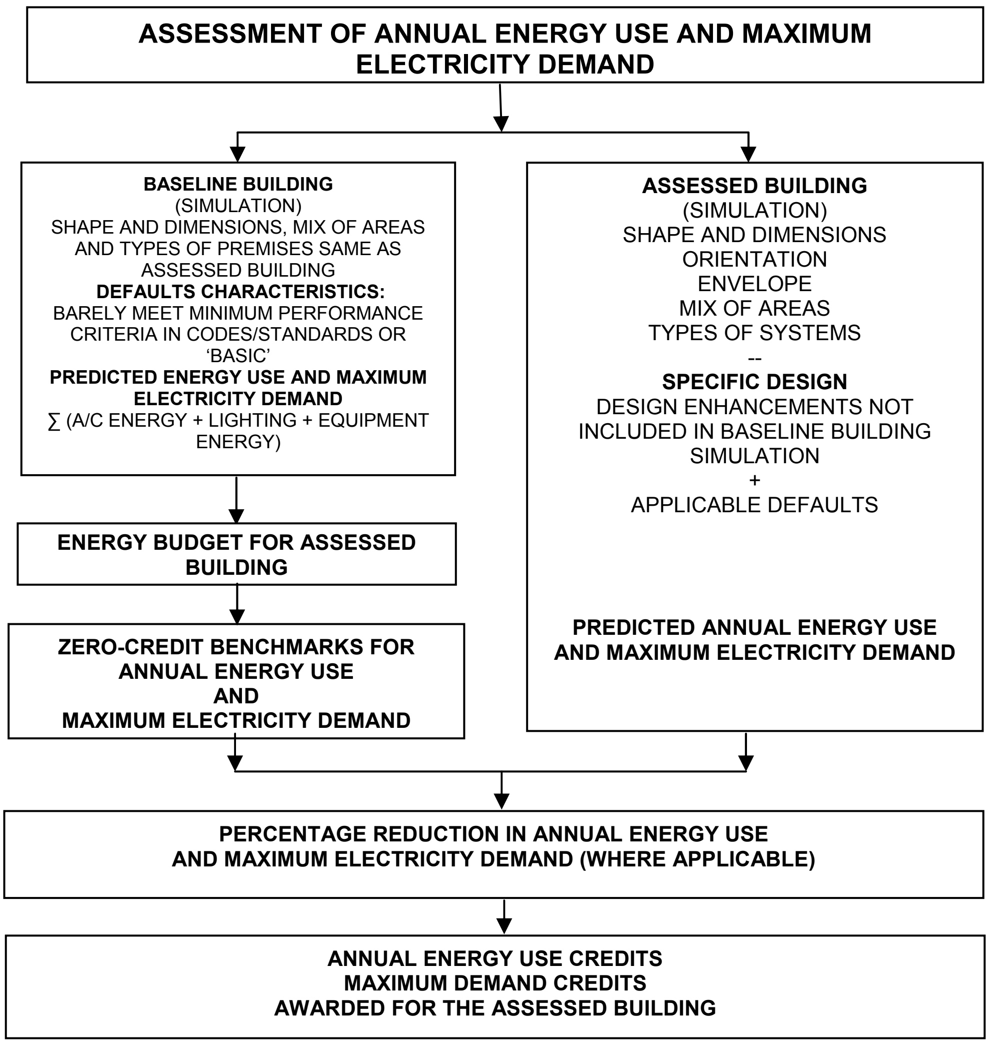


Figure 8.1 Building energy performance assessment

KEY FEATURES

The key features of the assessment framework are as follows.

- the 'Energy Budget' for an ASSESSED BUILDING is the predicted Annual Energy Use for a BASELINE BUILDING (zero-credit benchmark);
- the BASELINE BUILDING model has the same shape and dimensions, comprises the same mix of areas and types of premises as the ASSESSED BUILDING (except for window-to-wall ratio adjustment to meet the relevant regulatory requirement);
- the BASELINE BUILDING model will incorporate a range of standard (default) characteristics such that the model represents a building whose energy performance barely meets the relevant regulatory requirements or meets only 'basic' design quality ;
- as far as possible the predicted Annual Energy Use of the ASSESSED BUILDING will be based on its specific design characteristics (except for some parameters for which default values are specified - see Section 8.2); and
- the number of credits awarded is determined by the percentage reduction in the predicted Annual Energy Use of the ASSESSED BUILDING relative to the BASELINE BUILDING.

The assessment of Maximum Electricity Demand is conducted in a similar manner, as follows:

- the zero-credit benchmark for Maximum Electricity Demand will be that of the BASELINE BUILDING model; and
- the number of credits awarded is determined by the percentage reduction in the predicted Maximum Electricity Demand of the ASSESSED BUILDING relative to the BASELINE BUILDING.

8.1.2 PRE-REQUISITES

A pre-requisite for obtaining credits for Annual Energy Use under the Energy Budget assessment 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.

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 8.1 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.

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	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 DESIGN FEATURES

The characteristics to be incorporated into the Baseline Building model include:

- envelope design features;
- indoor design conditions, ventilation rates, occupation densities and usage patterns;
- internal load intensities and usage patterns, and
- performance of air-conditioning systems and equipment.

The Baseline Building model shall satisfy the minimum requirement of relevant regulations, code of practice, or those that are regarded in local practice as the basic requirements.

The Baseline Building model will not be incorporated with skylights even if there are skylights in the Assessed Building.

COMMERCIAL BUILDINGS/HOTEL BUILDINGS

The regulatory control over the overall thermal transfer value (OTTV) of new commercial and hotel buildings is taken as the benchmark envelope design for these two types of building. The envelope of the Baseline Building model will be assigned with characteristics that barely comply with the OTTV requirement as stipulated in Buildings Department's Practice Note 172 [1]. Calculation of OTTV shall be based on the method and data given in the Code of Practice for Overall Thermal Transfer Value in Buildings [2]. Since, according to this OTTV calculation method, the heat gain from fenestration dominates the OTTV of a building, adjustment of the envelope characteristics from the 'as designed' condition to the baseline condition shall be made by varying the fenestration area at the external walls or roofs.

The modification of the envelope design of the Assessed Building into that of the Baseline Building model shall preferably be made through adjusting the window-to-wall area ratio (WWR, the ratio of the total window area in the building façade to the total façade area). The WWR shall be adjusted such that the OTTV of the envelope of the Baseline Building model will just meet the relevant regulatory requirement (30 W/m² for a building tower and 70 W/m² for a podium).

STANDARDISED METHOD FOR ADJUSTING WWR

Because many different ways can be used to adjust the envelope WWR, a standardised method is needed to allow consistence assessments. The standardised method that shall be used in devising the Baseline Building model is described below. This will ensure that when the window areas are enlarged, the degree of enlargement shall be the same for all orientations, i.e. the ratio of the area of the opaque part of each external wall to the total opaque surface area of the envelope (Equation 8.2) will remain unchanged.

1 Buildings Department. PNAP 172. Energy Efficiency of Buildings Building (Energy Efficiency) Regulation. june 2000. http://www.info.gov.hk/bd/english/documents/pnap/Pnap172.pdf
2 Buildings Department. Code of Practice for Overall Thermal Transfer Value in Buildings 1995. http://www.info.gov.hk/bd/english/documents/index_pnap.html

Assuming that a floor or flat in the Assessed Building is enclosed by N external walls, and let:

$AWIN_i$ = area of the window on the i^{th} wall on the floor or in the flat, m^2

$AOPW_i$ = opaque wall area of the i^{th} wall on the floor or in the flat, m^2

The total area of the i^{th} external wall, $AWAL_i$, would be:

$$AWAL_i = AWIN_i + AOPW_i \qquad (1)$$

The ratio of the opaque area of the i^{th} external wall to the total opaque area of all external walls of the room, $ROPW_i$, would be:

$$ROPW_i = AOPW_i \Big/ \sum_{i=1}^{N} AOPW_i \qquad (2)$$

The overall window-to-wall area ratio of the room, $WWR_{overall}$, would then be:

$$WWR_{overall} = \sum_{i=1}^{N} AWIN_i \Big/ \sum_{i=1}^{N} AWAL_i \qquad (3)$$

To meet the regulatory requirements on OTTV, the $WWR_{overall}$ shall first be adjusted by trial-and-error method. Upon the required value (WWR_{Req}) is determined, the new window area and opaque area of the i^{th} wall, denoted by $AWIN_i$' & $AOPW_i$', which would be the window and opaque areas of the corresponding wall in the Baseline Building model, would bear the following relation:

$$AWAL_i = AWIN_i' + AOPW_i'$$

It follows that:

$$AWIN_i' = AWAL_i - AOPW_i' \qquad (4)$$

Note that:

$$WWR_{Req} = \sum_{i=1}^{N} AWIN_i' \Big/ \sum_{i=1}^{N} AWAL_i$$

Hence:

$$\sum_{i=1}^{N} AWIN_i' = WWR_{Req} \cdot \sum_{i=1}^{N} AWAL_i \qquad (5)$$

Substitute equation (4) into equation (5):

$$\sum_{i=1}^{N} \left[AWAL_i - AOPW_i'\right] = WWR_{Req} \cdot \sum_{i=1}^{N} AWAL_i$$

It follows that:

$$\sum_{i=1}^{N} AOPW_i' = (1 - WWR_{Req}) \cdot \sum_{i=1}^{N} AWAL_i \qquad (6)$$

Assuming the ratio of the opaque area of the i^{th} wall to the total opaque area of all the external walls on the floor or in a flat in the Baseline Building model ($ROPW_i$, equation (2)) would be identical to that in the Assessed Building, then:

$$ROPW_i = AOPW_i' \Big/ \sum_{i=1}^{N} AOPW_i'$$

Hence:

$$AOPW_i' = ROPW_i \cdot \sum_{i=1}^{N} AOPW_i' \qquad (7)$$

Equations (2), (6), (7) and then (4) can be used to determine the opaque and window areas of each of the external walls in the Baseline Building model.

8.2.2 OTHER BUILDING TYPES

The default WWR area ratio of the Baseline Building model shall be 0.65.

For other types of new buildings, the Baseline Building model will be assumed to have envelope components (windows, walls, roofs, etc.) of construction characteristics as summarised in Table 8.3.

The method described under 'Standardised Method for Adjusting WWR' shall apply in setting the envelope characteristics of the Baseline Building model.

TABLE 8.3 DEFAULT CHARACTERISTICS FOR THE BUILDING ENVELOPE (1)

External walls	Thickness (m)	Material	k (W/mK)	ρ (kg/m³)	Cp (J/kgK)	α (-)
Layer 1	0.005	Mosaic Tiles	1.5	2500	840	0.58
Layer 2	0.01	Cement/Sand Plastering	0.72	1860	840	
Layer 3	0.1	Heavy Concrete	2.16	2400	840	
Layer 4	0.01	Gypsum Plastering	0.38	1120	840	0.65
Roofs						
Layer 1	0.025	Concrete Tiles	1.1	2100	920	0.65
Layer 2	0.02	Asphalt	1.15	2350	1200	
Layer 3	0.05	Cement/Sand Screed	0.72	1860	840	
Layer 4	0.05	Expanded Polystyrene	0.034	25	1380	
Layer 5	0.15	Heavy Concrete	2.16	2400	840	
Layer 6	0.01	Gypsum Plaster	0.38	1120	840	0.65
Windows						
Layer 1	0.006	Tinted Glass	1.05	2500	840	0.65
Window to wall area ratio		0.65				

Symbols:

- k Thermal conductivity
- ρ Density
- Cp Specific heat
- α Solar absorptivity of exposed surface
- SC Shading coefficient of glazing

(1) This applies to all types of buildings except commercial and hotel buildings. The envelope of the Baseline Building model for such buildings will be set to achieve an OTTV that barely meets the threshold value stipulated in the OTTV Code.

8.2.3 RESIDENTIAL BUILDINGS

In devising the Baseline Building model for a new residential building, the major façade of each flat in the building will be identified, which will be the group of external walls that are exposed to the same direction in which the aggregate window area is the largest amongst all groups of external walls (grouping determined with reference to the orientation of walls). Only external walls that enclose air-conditioned rooms in the flats shall be considered. In predicting the annual energy use and maximum electricity demand for the Baseline Building model, each flat in the building model will be rotated such that its major façade will be facing west, the worst orientation in respect of solar heat gain in the flats. However, the layout design of flats in the building, including their respective orientations, will be modelled 'as designed' in the prediction of the annual energy use of the Assessed Building.

8.2.4 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 shall be as given 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 found from surveys 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 either a new or an existing building shall be as summarised in Tables 8.4 and 8.5.

Prediction of the energy use in the Assessed Building shall be based on the corresponding equipment densities, occupation densities and ventilation rates adopted for the air-conditioning system design, but the default indoor conditions and occupancy pattern still apply (Although the use of design ventilation rates that are lower than the default values will lead to a better outcome in the energy performance assessment, it is not advisable as it will lead to a worse outcome in the indoor air quality assessment).

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.

8.2.5 INTERNAL LOADS

The lighting power intensities to be used for various types of premises in the Baseline Building model shall be the threshold compliance values as stipulated in the Code of Practice for Energy Efficiency of Lighting Installations applicable to the types of premises. For those types of premises that the lighting energy code does not cover, default values established from building surveys are 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 8.4 will be applied to the Baseline Building model.

For both the Assessed Building and its Baseline Building model, the default utilisation patterns of lighting and equipment, as summarised in Table 8.5, shall be used in the Energy Use and Maximum Electricity Demand predictions.

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.

8.2.6 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. Design values will be adopted in predicting the annual energy use in the Assessed Building.

Where unitary, window- or split-type air-conditioners of capacities falling 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 and the Assessed Building. If the developer can provide evidence that air-conditioners of better performance will be adopted in the Assessed Building, the annual energy use prediction for the Assessed Building will be based on such performance.

Where a central air-conditioning plant is used to serve multiple types of premises in the same building, prediction of the annual energy use and the maximum electricity demand of the central air-conditioning plant will be based on the simultaneous total cooling load on the plant from all the served premises, taking into account also the periods of air-conditioning provisions for different types of premises, and the sequencing control strategy that will be applied to control the operation of the chillers and pumps in the plant.

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 complex 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 air-conditioning plant (as illustrated in Figure 8.2), each part will be assessed according to the building type to which it belongs.

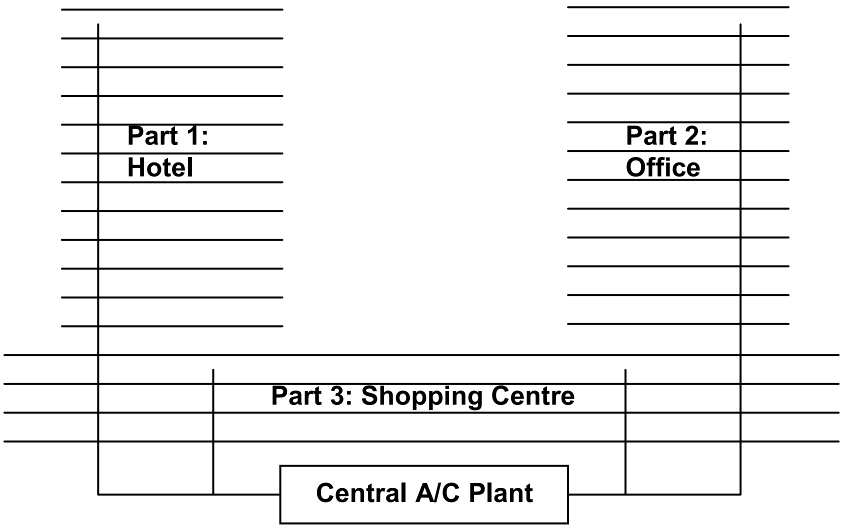


Figure 8.2 A building complex served by a central air-conditioning plant

METHODOLOGY The method to determine annual energy use assessment for a new building complex

STEP 1 A Baseline Building model is established for each Part of the complex, based on the minimum performance specifications and default values appropriate to the Part. Each Part shall be assumed to have its own chiller plant, which is of the same type as the central plant (e.g. heat rejection method) and can meet the design cooling load of the Part it serves.

STEP 2 The annual electricity use for air-conditioning ($AEU_{BAC}(i)$) and maximum electricity demand ($MED_{BAC}(i)$) of the individual Baseline Building models shall then be predicted. In the prediction, the electricity use and maximum demand of the air-side ($AEU_{BAS}(i)$, $MED_{BAS}(i)$) and water-side systems ($AEU_{BWS}(i)$, $MED_{BWS}(i)$) shall be determined separately.

For example, for a complex comprising N Parts, the following shall be determined:

$AEU_{BAC}(i) = AEU_{BAS}(i) + AEU_{BWS}(i)$ for i = 1, 2, …, N

$MED_{BAC}(i) = MED_{BAS}(i) + MED_{BWS}(i)$ for i = 1, 2, …, N

STEP 3 The annual electricity use and maximum electricity demand of the lighting and equipment in the Baseline Building (in air-conditioned areas only) for each Part (denoted as $AEU_{BNAC}(i)$ and $MED_{BNAC}(i)$) should be determined, based on default intensities and use patterns.

STEP 4 The zero-credit benchmark for each Part ($AEU_B(i)$ for electricity use and $MED_B(i)$ for maximum electricity demand) shall then be:

$AEU_B(i) = AEU_{BAC}(i) + AEU_{BNAC}(i)$

$MED_B(i) = MED_{BAC}(i) + MED_{BNAC}(i)$

STEP 5

The annual electricity use and maximum electricity demand of the air-side air-conditioning system and the lighting and equipment of the assessed complex shall be determined, based on the actual intensity and the default patterns. These are denoted as:

$AEU_{AAS}(i)$ = annual electricity use of air-side system in Part i of the assessed complex

$MED_{AAS}(i)$ = maximum electricity demand of air-side system in Part i of the assessed complex

$AEU_{ANAC}(i)$ = annual electricity use of non-air-conditioning systems in Part i of the assessed complex

$MED_{ANAC}(i)$ = maximum electricity demand of non-air-conditioning systems in Part i of the assessed complex.

STEP 6

The annual electricity use (AEU_c) and maximum electricity demand (MD_c) of the central plant shall be determined based on the simultaneous cooling load on the plant from all the served premises and the actual designs of the assessed complex. These values shall then be apportioned to individual Parts of the assessed complex according to the corresponding ratio determined for the Baseline Building Model as follows:

$$AEU_{AWS}(i) = AEU_C \frac{AEU_{BWS}(i)}{\sum_{i=1}^{N} AEU_{BWS}(i)}$$

$$MD_{AWS}(i) = MD_C \frac{MD_{BWS}(i)}{\sum_{i=1}^{N} MD_{BWS}(i)}$$

STEP 7

The total annual electricity use and maximum electricity demand of each Part of the complex shall then be:

$AEU_A(i) = AEU_{AAS}(i) + AEU_{AWS}(i) + AEU_{ANAC}(i)$

$MED_A(i) = MED_{AAS}(i) + MED_{AWS}(i) + MED_{ANAC}(i)$

STEP 8

The percentage reduction values, which are the basis for determining the number of credits to be awarded for each Part, shall be calculated as follows:

$\Delta AEU_A(i) = 100 \times [AEU_B(i) - AEU_A(i)] / AEU_B(i)$

$\Delta MED_A(i) = 100 \times [MED_B(i) - MED_A(i)] / MED_B(i)$

RESIDENTIAL DEVELOPMENTS

For residential developments that include residential towers located 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 shall first be separately assessed, according to the assessment methods that apply to the respective types of premises, and a 'area' weighted overall score will then be determined for the overall development.

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

8.5.2 COMMERCIAL COMPLEXES

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 NEW 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.

$$AEC_{AC} = a_0 + a_1(AG \times UG \times Ta / COP) + a_2(AG \times UG / COP) + a_3(VR / COP) + a_4(W_{LGT} / COP) + a_5(W_{EQP} / COP) + a_6(CPP \times PP) + a_7(CFP \times FP) \quad (1)$$

$$MED_{AC} = b_0 + b_1(AG \times SC / COP) + b_2(VR / COP) + b_3(VR \times Wa / COP) + b_4(W_{LGT} / COP) + b_5(W_{EQP} / COP) + b_6(FP) \quad (2)$$

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

$$AEC_{TENANT} = \left(\sum_{i=1}^{nT} GFA_i \cdot (AEC_{LGT,i} + AEC_{EQP,i}) \right) \Big/ GFA \quad (1)$$

$$MED_{TENANT} = \left(\sum_{i=1}^{nT} GFA_i \cdot (MED_{LGT,i} + MED_{EQP,i}) \right) \Big/ GFA \quad (2)$$

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:

$$AEC_{EQP,i} = \left(\sum_{j=1}^{nEQP} N_{EQP,j} \cdot W_{EQP,j} \cdot UF_{EQP,j} \cdot OPH_{EQP,j} \right) \Big/ GFA_i \quad (3)$$

$$AEC_{LGT,i} = \left(\sum_{j=1}^{nLGT} N_{LGT,j} \cdot W_{LGT,j} \cdot UF_{LGT,j} \cdot OPH_{LGT,j} \right) \Big/ GFA_i \quad (4)$$

$$MED_{EQP,i} = \left(\sum_{j=1}^{nEQP} N_{EQP,j} \cdot VI_{EQP,j} \cdot UF_{EQP,j} \right) \Big/ GFA_i \quad (5)$$

$$MED_{LGT,i} = \left(\sum_{j=1}^{nLGT} N_{LGT,j} \cdot VI_{LGT,j} \cdot UF_{LGT,j} \right) \Big/ GFA_i \quad (6)$$

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

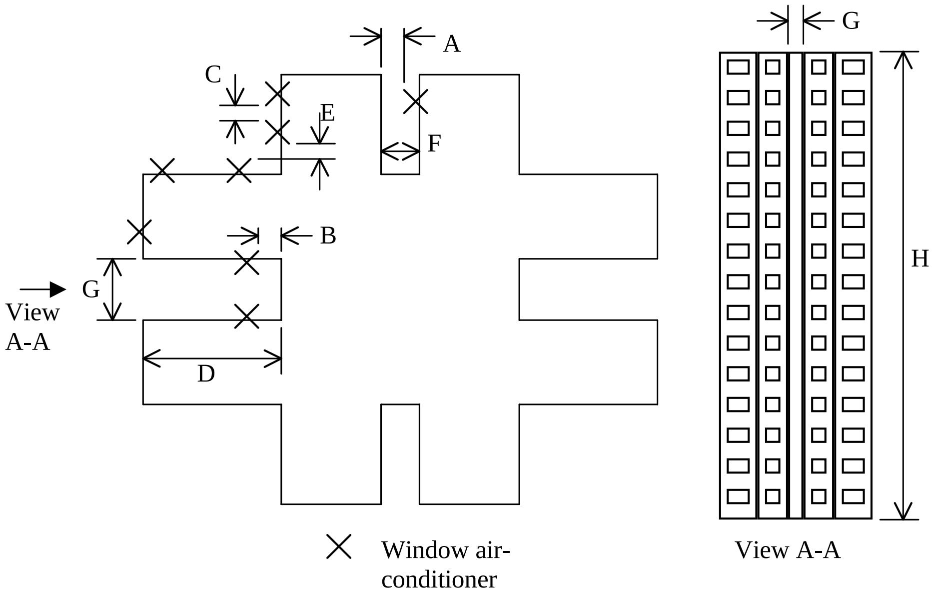


Figure 8.3 Layout plan and elevation of building

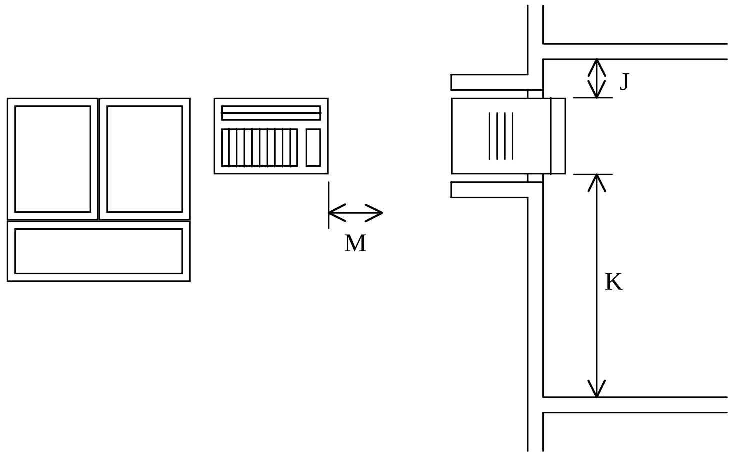


Figure 8.4 Elevation and section of a room in a residential building

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 PROVISIONS FOR ENERGY MANAGEMENT

8.7.1 COMMISSIONING SPECIFICATIONS
8.7.2 COMMISSIONING PLAN
8.7.3 COMMISSIONING
8.7.4 COMMISSIONING REPORT
8.7.5 OPERATIONS AND MAINTENANCE MANUAL
8.7.6 ENERGY MANAGEMENT MANUAL
8.7.7 OPERATOR TRAINING AND FACILITIES

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 5/04
Existing Buildings

Further information on how to participate in the HK-BEAM scheme is available from:
HK-BEAM Society
c/o Business Environment Council
77 Tat Chee Avenue,
Kowloon,
Hong Kong
Telephone (852) 2784-3900
Facsimile (852) 2784-6699