VGBC | Vietnam Green Building Council
Hội đồng Công trình xanh Việt Nam ®

LOTUS Interiors V1

Technical Manual

August 2017

Vietnam Green Building Council LOTUS CERTIFIED ™

Vietnam Green Building Council LOTUS SILVER ™

Vietnam Green Building Council LOTUS GOLD ™

Vietnam Green Building Council LOTUS PLATINUM ™

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VGBC Members

The VGBC would also like to thank its generous and valuable members (as of August 2017):

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Preface

VGBC Background Information

The Vietnam Green Building Council (VGBC) is a project of the Green Cities Fund, Inc. (GCF), an international non-profit organization based in Oakland, California, USA. The VGBC's aim is to be the focal point for academia, government and the private sector in order to promote a more sustainable and adaptive built environment in the context of climate change.

The VGBC has been officially recognized by the Ministry of Construction of the Socialist Republic of Vietnam (March 2009) and also took part in the establishment of the WGBC Asia Pacific Network (September 2009).

The VGBC has set the following objectives:

Raise awareness and advocate for the development of green buildings:

- Enhance awareness of green building practice through workshops and online resources
- Support the government in defining green building development policies and codes
- Strengthen ties with academia, government and private sector partners

Build capacity:

- Develop and implement training curricula for academia and government
- Define and implement an official Green Consultant training and examination program (LOTUS Accredited Professional)

Define green building metrics for Vietnam:

- Develop a set of green building rating systems (LOTUS)
- Create a Green Database (products and services)
- Continue long-term research on climate change resilience for the built environment

LOTUS General Information

LOTUS includes a set of market-based green building rating systems developed by the Vietnam Green Building Council specifically for the Vietnamese built environment.

LOTUS Rating Systems share the same goal with existing international green building rating systems (LEED, Green Star, BREEAM, GBI, Green Mark, Greenship, etc.) and aim at establishing standards and benchmarks to guide the local construction industry towards more efficient use of natural resources and more environmentally friendly practices.

LOTUS Rating Systems have been developed through long-term research, with the expert advice of specialists giving particular consideration to Vietnam's economic and natural characteristics and existing Vietnamese standards and policy.

The LOTUS Rating Systems currently include:

- LOTUS Non-Residential (LOTUS NR)
- LOTUS Multi-family Residential (LOTUS MFR)
- LOTUS Building in Operation (LOTUS BIO)
- LOTUS Homes
- LOTUS Small Buildings (LOTUS SB)
- LOTUS Interiors
- LOTUS Small Interiors (LOTUS SI)

LOTUS Accreditation for Professional Practitioners

One of the key roles of VGBC is to educate and update practitioners about "green building" design and implementation issues. The core of VGBC's educational offering is the LOTUS Accredited Professional Training Course which allows candidates to undertake an exam in order to achieve the qualification of LOTUS Accredited Professional (LOTUS AP).

LOTUS APs are practitioners within the construction industry who have comprehensive knowledge of the LOTUS Certification System philosophy, structure and practical application within the lifecycle of a building project. LOTUS APs are listed on the VGBC website.

LOTUS Interiors Rating System

LOTUS Interiors Scope

LOTUS Interiors can be used for single use or mixed-use fit-out project including the following:

- office spaces
- retail spaces (supermarkets, shops, etc.) and restaurants
- hotels and hospitality spaces (spaces dedicated to businesses within the service industry that provide transitional or short-term lodging)
- educational facilities including classrooms, libraries
- health facilities including clinics, etc.
- dwelling-units in apartment buildings

LOTUS Interiors Eligibility Rules

To be eligible for LOTUS Interiors, projects must meet the following Eligibility Rules:

1. Fit-out project

The project must be a fit-out project within a building. It may involve the design, construction and commissioning of a new fit-out or the renovation and refurbishment of an existing fit-out.

2. Distinct boundary

The project must be clearly distinct from other spaces within the same building with regards to at least one of the following characteristics: ownership, management, lease, or party wall separation. The owner of the project (tenant) must be different from the owner of the building.

3. Complete interior fit-out project

The project must include a complete interior fit-out. Project components are not eligible.

4. Length of Occupancy

Project should show a 3-years lease contract or commit that the area will be used as the same function for a minimum of 3-years period starting from the achievement of LOTUS Certification.

5. Occupancy rates

The space must have at least one full-time employee working for a year or one resident.

LOTUS Interiors or LOTUS Small Interiors?

If one of two the following statements is true, then the project can follow LOTUS Small Interiors instead of LOTUS Interiors:

- The project has a gross floor area lower than 1,000 m^2
- The project fit-out activities include no more than 2 of the following categories:
    - Installation of artificial lighting fixtures (task lighting should not be considered),
    - Installation of water fixtures or water appliances (water dispensers should not be considered)
    - Installation of HVAC systems (split-units should not be considered),
    - Installation of commercial refrigeration systems such as walk-in refrigerators, walk-in freezers or refrigerated casework,
    - Installation of partitions, floorings and/or ceilings

Categories

LOTUS Interiors is composed of 7 Categories (plus "Innovation"), each containing a varying number of Credits.

Energy (E) - To monitor and reduce the energy consumption through the use of natural ventilation and the installation of energy efficient equipment (HVAC, lighting, appliances, etc.).

Water (W) - To reduce the water consumption through the use of water-efficient fixtures and to reduce consumption of bottled drinking water.

Materials (M) - To reduce the use of high embodied energy materials, maximize the use of re-used and/or recycled materials and encourage a wider use of sustainable materials.

Waste and Pollution (WP) - To promote the reduction and recycling of waste during the construction and the operation of a building, as well as limiting the atmospheric impact due to the use of refrigerants.

Health and Comfort (H) - To ensure high indoor environmental quality, through the optimization of the indoor air quality, daylighting and views, and occupant comfort.

Location & Transportation (LT) - To encourage the selection of a base building and lease types that will help to improve the sustainability performance of the project, as well as developing green transportation and providing access to facilities and amenities for the occupants.

Management (Man) - To ensure that, throughout the project, all targets set up for the various stages (design, construction, commissioning, and operation) are effectively managed.

In addition, an Innovation (Inn) category rewards additional "bonus" points for exceptional performance and initiatives which are above or not specifically addressed by LOTUS.

Prerequisites

Table 1 presents all the prerequisites included in LOTUS Interiors. Each prerequisite, whether stand-alone or included inside a credit, must be carried out as a minimum requirement for all projects applying for LOTUS Interiors.

Table 1: LOTUS Interiors Prerequisites

Prerequisite	Criteria
W-PR-1 Water Efficient Fixtures	Reduce building domestic water consumption through fixtures by 10% in comparison to a baseline model
WP-PR-1 Fit-out Waste	Develop and implement a fit-out waste management plan
H-PR-1 Indoor Smoking	Prohibit smoking in the project space
LT-PR-1 Green Transportation	Provide and display space occupants with information on the different collective transportation means to travel to and from the building

In an interior project space with unique constraints, the VGBC recognizes that some prerequisites in LOTUS may not be attainable. Where it can be demonstrated that all reasonable strategies have been considered and a project is still not able to meet these prerequisites, or alternately that the prerequisite is patently unsuitable for that project, the VGBC reserves the right to waive those requirements after careful consideration.

Credits

LOTUS is a point based system where projects obtain points for complying with criteria set in the LOTUS Credits. Credits are built on the following structure: Intent, Requirements, Approach & Implementation, Calculations (optional) and Submissions. For a project to be compliant with a credit, the intent of the credit has to be met, the requirements have to be achieved and the required submission documents have to be provided.

For some credits, requirements can encompass different options or strategies. A project can only select one of the proposed options to comply with a credit but it can implement any of the proposed strategies and cumulate points for the credit (while being restricted by the maximum number of points available for the credit).

Weighting

The current weighting of categories within LOTUS Interiors (Table 2) has been carefully considered through analysis of other green building rating systems and in response to the environmental issues specific to the construction practices, development and the changing climate of Vietnam.

Table 2: LOTUS Interiors Weighting

Categories	Weight	Points
Energy	22.5%	18
Water	7.5%	6
Materials	17.5%	14
Waste & Pollution	6.25%	5
Health & Comfort	25%	20
Location & Transportation	10%	8
Management	11.25%	9
Innovation	0%	6 bonus points
Total	100 %	80

Certification Levels

There will be 80 points available in LOTUS Interiors, plus up to 6 bonus points available within the Innovation category. The thresholds for Certification have been kept similar to the recently released LOTUS rating systems.

The first certification level for LOTUS Interiors has been benchmarked at 40% (LOTUS Certified) of the total amount of points. This value reflects a good first level of performance and the minimum required for certification. The following thresholds correspond to 55% (LOTUS Silver), 65% (LOTUS Gold) and 75% (LOTUS Platinum) of the total number of points as shown in Figure 1.

Figure 1: Certification System & Performance levels

LOTUS Interiors Certification Process

Introduction

LOTUS Certification is a formal process to independently validate that a project has achieved the environmental performance specified in LOTUS Rating Systems. Documentation-based submissions need to be provided as evidence of this achievement.

The VGBC recommends that LOTUS Certification is planned at the earliest possible stage of the project, ideally before the design stage even begins. This allows designers to make changes that will improve the project´s overall performance and help to achieve a better LOTUS Certification level.

LOTUS Interiors Certification happens in 3 steps:

- Application and Registration
- LOTUS Provisional Certification (optional)
- LOTUS Full Certification

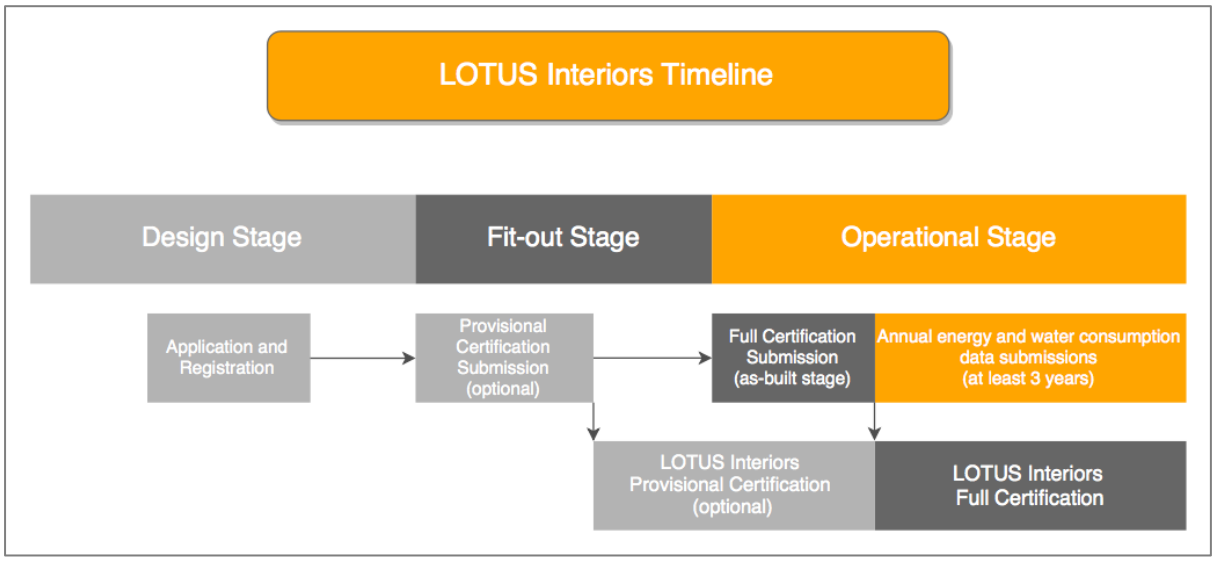

Figure 2: LOTUS Interiors Timeline

Application and Registration

Applicants must complete an Application Form included in the User Tool (described below in *Submissions*) and submit it to the VGBC. On receipt of the Application form, the Assessment Organization will check that it is complete and all supporting information has been provided. In the event of there being some missing or inadequate documentation, the Applicant will be notified and will have the opportunity to provide the missing information

For any project to go through the certification process, all eligibility rules must be fulfilled. It is the Applicant's responsibility to ensure that only eligible projects apply for certification. The Assessment Organization reserves the right to refuse certification of ineligible projects. If you are in any doubt as to whether a project meets the eligibility requirements, please contact VGBC.

Once the application form has been confirmed as complete, a Registration Fee will be invoiced and a Certification Agreement with all necessary terms and conditions will be signed by both the Applicant and the Assessment Organization. At this point, the Applicant is to nominate an Applicant Representative for the duration of the project that will be the primary contact for the Assessment Organization.

On receipt of the Registration Fee and a signed copy of the Certification Agreement, project registration is complete. The Applicant will then be issued with a Project Identification Number (PIN), receive the Project submission folder and be assigned an Assessment Organization's Representative for the certification process.

Following registration, the project team will have to prepare all of the evidence required by LOTUS Interiors to demonstrate that all prerequisites and selected credits are achieved. This evidence includes all calculations and documentation as listed in the Submission Section for each prerequisite and credit.

Then, the project should request the Assessment Organization's Representative to invoice the Assessment Fee that has to be paid prior to any submission for Provisional or Full Certification.

LOTUS Provisional Certification stage

LOTUS Provisional Certification is an optional stage awarded after the completion of the design stage of a project. It certifies that the necessary requirements and strategies are in place for the project to be constructed “green”.

The LOTUS Provisional Certification process happens in 2 rounds of submissions and assessment as described below.

Round 1

Notification Form Submission

Once the design team has compiled all evidence to be verified by the VGBC, the Applicant Representative submits to the Assessment Organization Representative a Notification Form. This contains the date when all evidence will be submitted to the Assessment Organization. A minimum of a two week notice must be provided.

Submission

The Applicant Representative submits the fully completed User Tool along with all required evidence for Provisional Certification Assessment.

It is recommended that all evidence is provided before the beginning of fit-out work to ensure the most efficient management of the project.

Further information regarding the content of submissions can be found in the Submissions section.

Scan of the submission

The data supplied to the Assessment Organization Representative will be checked to make sure it is complete. In case documentation is missing, the Assessment Organization Representative will request the Applicant Representative to promptly provide the missing data.

Assessment

The data supplied to the Assessment Organization Representative will be assessed by the Project Assessment Committee (PAC). This committee is led the Assessment Organization’s project manager and consists of experts from the Assessment Organization and from external independent experts.

Results

An assessment report detailing the results of the round will be issued to the Applicant Representative by the Assessment Organization within 8 weeks of the submission date.

Round 2

If Round 1 submissions for any prerequisite is denied, or if the number of points achieved is not sufficient to be awarded LOTUS Provisional Certification, or if the Applicant would like the opportunity to score higher for some credits, a second round of submissions for re-assessment is available for projects.

Round 2, that should follow the same process as in Round 1, gives the possibility for the project to provide further evidence to demonstrate to the PAC that pending credits and/or prerequisites have finally been achieved. There is no limit to the number of credits that may be re-submitted, and the applicant is encouraged to re-submit all queried credits so long as they can provide new submittal information.

An assessment report detailing the results of the round will be provided to the Applicant Representative within 8 weeks of the submission date. In special cases further appeals and/or applications may be permitted, however these may generate additional fees.

Provisional Certificate

At the end of the Round 1 or Round 2 or after the appeal procedure, if all necessary evidence is compliant with LOTUS requirements, LOTUS Provisional Certification can be awarded.

A Provisional Certification allows for marketing opportunities prior to construction completion. The Provisional Certification of a project represents the intention of the project to be certified at Full Certification stage and shows that the project is on-track to achieve an anticipated level of certification at Full Certification stage. As such, no certification levels will be given to projects at Provisional Certification stage.

LOTUS Provisional Certification is valid for a maximum of one year after the completion of the fit-out at which point Full Certification must be submitted.

LOTUS Full Certification stage

LOTUS Full Certification assesses the performance of the as-built interior space. LOTUS Full Certification can be applied for as soon as handover is completed and must be completed before 1 year of the completion of the fit-out. It demonstrates that all green building strategies and attributes defined at the design stage are incorporated and achieved at the fit-out stage. At this stage, points can be lost or gained. Where the construction or installation differs from that which is specified within the LOTUS Provisional Certification, projects must justify how these changes provide an equal or greater environmental benefit for the points to be awarded.

The assessment process for LOTUS Full Certificate is the same as the LOTUS Provisional Certificate and consists also of two rounds of assessment and one potential appeal procedure. The difference is that instead of verifying design documentation, the LOTUS Full Certificate assessment verifies as-built and as-installed evidence. At the Full Certificate assessment, in case of deviation or addition from the design stage, it is possible for a project to lose credits that were gained in the Provisional Certificate stage but also to gain extra credits for which evidence can be provided.

The assessment for LOTUS Full Certification is to be undertaken within 1 year of the completion of the fit-out.

Full Certificate

The LOTUS Full Certificate will be issued by the VGBC upon successful completion of this final assessment. Projects will be issued with LOTUS Certified, LOTUS Silver, LOTUS Gold or LOTUS Platinum certificates depending on the number of points achieved.

After Full certification, VGBC request that the interior space tenant provides monthly energy and water consumption data on a yearly basis, for the duration of the LOTUS Interiors Full Certification.

LOTUS Interiors Submissions

Types of Submissions

There are two different types of submissions:

- Provisional Certification stage submissions, happening at the design/tender stage and which are required for LOTUS Provisional Certification
- Full Certification stage submissions, happening at the as-built stage and which are required for LOTUS Full Certification

Provisional Certification stage submissions

The list of all submittals to be provided for Provisional Certification stage is given at the end of each prerequisite and credit. Submittals mostly include tender and design documents showing the project is on-line to meet LOTUS requirements at the end of fit-out.

The structure of the submissions should follow the description provided in section Submission Structure.

Full Certification stage submissions

The list of all submittals to be provided for Full Certification stage is given at the end of each prerequisite and credit.

The structure of the submissions should follow the description provided in section Submission Structure.

Where the sentence “If it was not approved at Provisional Certification or if there is any change” is written, all the submittals listed below this sentence do not need to be submitted for Full Certification if all of the following is true:

- The submittals have been provided for Provisional Certification
- The assessment report at Provisional Certification shows that the submittals have been approved by the Assessment Organization
- No change (deviation or addition) impacting the credit has occurred since the submittals have been provided to the Assessment Organization

This means that, for some credits that have been awarded by the Assessment Organization at Provisional Certification, no submission may be required for Full Certification.

Submission Process

At each round of both types of submissions, a complete portfolio of evidence should be submitted at one time, demonstrating that a project meets the requirements of all the prerequisites and all the credits targeted.

Once payment for Registration Fee has been received and the Certification Agreement has been duly signed, the Assessment Organization Representative provides the Applicant Representative with a complete package of documentation that includes a pre-arranged submission folder and a resources folder.

Project Submission Folder

The Project Submission Folder is the main folder provided that, upon completion, will be returned to the VGBC Representative for assessment. The Project Submission Folder contains 9 sub-folders for the LOTUS Interiors Categories and a General Information Folder.

General Information Folder

All general project information should be provided in the General Information Folder. If information is not provided, this could cause problems validating evidence when assessing individual credits.

This folder should include:

1. Any critical correspondence between the Applicant Representative and the Assessment Organization Representative that may impact the project assessment.
2. A full set of project documentation including design drawings and specifications (where available) for all architectural, mechanical, electrical, plumbing and building controls (It is recommended to provide files in .PDF format).

The General Information Folder should be updated with latest information and included in each submission from the Applicant Representative.

Category Folders

Within each of the 8 category folders, include the supporting evidence for the prerequisites and/or credits of the category that are pursued by the project.

Resources Folder

This folder contains the LOTUS Interiors User Tool and the LOTUS Water Calculation Tool which is necessary to perform the calculations of water savings.

User Tool

The main material to LOTUS Interiors Submissions is the LOTUS Interiors User Tool. This tool is a template for the applicant to:

- have a complete overview of LOTUS Interiors
- complete all the information and perform all the calculations required in the credits

The User Tool has been developed in such a way that the users only need to fill in some relevant information about the project and all the results are computed automatically.

LOTUS Interiors Credit List

Credit	Title	Points
ENERGY		18 points
E-1	Space Cooling	6
E-2	Artificial Lighting	6
E-3	Energy Efficient Appliances	4
E-4	Energy Monitoring	2
WATER		6 points
W-PR-1	Water Efficient Fixtures	Water Prerequisite 1
W-1	Water Efficient Fixtures	5
W-2	Drinking Water	1
MATERIALS		14 points
M-1	Sustainable Materials	10
M-2	Sustainable Furniture Products	4
WASTE & POLLUTION		5 points
WP-1	Refrigerants	1
WP-PR-1	Fit-out Waste	W&P Prerequisite 1
WP-2	Fit-out Waste	2
WP-3	Operation Waste Management	2
HEALTH & COMFORT		20 points
H-PR-1	Indoor Smoking	Health & Comfort Prerequisite 1
H-1	Fresh Air Supply	2
H-2	CO2 monitoring	1
H-3	Low-VOC Emissions	4
H-4	Pre-occupancy removal of pollutants	1
H-5	Interior Plants	1
H-6	Green Cleaning	1
H-7	Daylighting	2
H-8	External Views	2
H-9	Lighting comfort	2
H-10	Thermal comfort	2
H-11	Acoustic comfort	1
H-12	Post-occupancy comfort	1

LOCATION & TRANSPORTATION		8 points
LT-1	Base building green attributes	3
LT-2	Tenancy lease	1
LT-PR-1	Green Transportation	L&T Prerequisite 1
LT-3	Green Transportation	3
LT-4	Facilities and amenities for occupants	1
MANAGEMENT		9 points
Man-1	LOTUS AP	1
Man-2	Construction Stage	2
Man-3	Commissioning	2
Man-4	Maintenance	2
Man-5	Green Awareness and Behavior	2
INNOVATION		6 bonus points
Inn-1	Exceptional Performance Enhancement	6
Inn-2	Innovative techniques/initiative	

Energy

As urbanization is speeding all over the world, buildings have been described as a hidden culprit, responsible for 20% to 40% of global energy consumption and more than 30% of global greenhouse gas emission.

For developing countries like Vietnam, while fast economic growth and urbanization rates are improving living conditions, they are also leading to an increasing energy demand. It is expected that between 2010 and 2025 there will be a 10% increase in energy demand each year and that by 2025 the demand will be triple the current demand and that 8 times the amount of electricity will be required to cope with the fast urbanization and construction rate.

Moreover, as Vietnam's energy is mainly generated from non-renewable fossil fuels which are the main sources of greenhouse gas emissions, increased energy demand also means worsening global warming.

However, since buildings, especially in urban areas, consume the majority of the energy produced annually in Vietnam, there is potential for mitigating climate change and energy insecurity through integrating energy efficiency measures into buildings. With energy efficient designs, buildings can potentially reduce their energy consumption up to 50%, thus climate change improvement can be realized.

With this target in mind, LOTUS Interiors rewards efforts taken to reduce the building energy consumption through the incorporation of natural ventilation, the optimization of the design and the use of energy efficient technologies, as well as the monitoring of energy.

Energy		18 Points
Item	Criteria	Points
E-1	Natural Ventilation and Air-conditioning	6 points
	Strategy A: Natural Ventilation	
	10 % of occupied areas are naturally ventilated	1
	1 point for every additional 15% of occupied areas that are naturally ventilated (up to 85%)	6
	Strategy B: COP improvement	
	10% improvement of COP for direct electric air-conditioners AND 5% improvement of COP for water-chilling systems in comparison to QCVN 09:2013 requirements	1
	1 point for every further 10% improvement of COP for direct electric air-conditioners AND further 5% improvement of COP for water-chilling systems in comparison to QCVN 09:2013 requirements	4
	Strategy C: HVAC Zoning	
	Provide separate control zones for each solar exposure and for areas with different usage/occupancy needs	1
	Strategy D: HVAC Controls	
	1 point for each of the following strategies implemented: - Use variable speed controls on all the air-conditioning systems - Install a demand control ventilation system for spaces with special occupancies	2
	Strategy E: Alternative strategies	
	1 point for each of the following strategies implemented: - Install enthalpy recovery systems on all air handling units - Use a radiant cooling system - Install mounted fans in 50% of occupied areas	2
E-2	Artificial Lighting	6 points
	Strategy A: Lighting power density reduction	
	Lighting power density surpasses VBEEC requirements by 10 %	1
	1 point for every additional 10% improvement of the lighting power density compared to VBEEC requirements (up to 60%)	6
	Strategy B: Lighting controls for separate spaces	
	Project meet VBEEC requirements on Lighting controls for separate spaces	1
	Strategy C: Lighting controls for daylit areas	
	Install lighting control devices for the lighting fixtures located in potentially daylit areas	1
	Strategy D: Other lighting controls	
	Implement the following strategies: - task lighting - main switch or scheduling	1

E-3	Energy Efficient Appliances	4 points
	Strategy A: Appliances with Energy Efficiency labels	
	30% of appliances and equipment installed have an energy efficiency label	1
	1 point for every additional 20% of appliances and equipment installed that have an energy efficiency label (up to 90%)	4
	Strategy B: Plug load controls	
	Install plug load controls for 50% of plug points	1
E-4	Energy Monitoring	2 points
	Option A: Sub metering and Power monitoring system	
	Sub-metering: Install individual meters to monitor the consumption of all major electrical energy uses	1
	Power monitoring system: Install a power monitoring system to monitor the consumption of all major electrical energy uses	2
	Option B: Energy monitor	
	Install an energy monitor to record electricity consumption	1

E-1 Space Cooling

Intent

To reduce the need for cooling by increasing natural air flow and to encourage the installation of energy efficient HVAC systems.

Requirements

Criteria	6 points
Strategy A: Natural Ventilation	
10 % of occupied areas are naturally ventilated	1
1 point for every additional 15% of occupied areas that are naturally ventilated (up to 85%)	6
Strategy B: COP improvement	
10% improvement of COP for direct electric air-conditioners AND 5% improvement of COP for water-chilling systems in comparison to QCVN 09:2013 requirements	1
1 point for every further 10% improvement of COP for direct electric air-conditioners AND further 5% improvement of COP for water-chilling systems in comparison to QCVN 09:2013 requirements	4
Strategy C: HVAC Zoning	
Provide separate HVAC control zones for each solar exposure and for areas with different usage/occupancy needs	1
Strategy D: HVAC Controls	
1 point for each of the following strategies implemented: - Use variable speed controls on all the air-conditioning systems - Install a demand control ventilation system for spaces with special occupancies	2
Strategy E: Alternative strategies	
1 point for each of the following strategies implemented: - Install energy recovery ventilation systems on all air handling units - Use a radiant cooling system - Install mounted fans in 50% of occupied areas	2

Approach & Implementation

For this credit, HVAC systems installed and managed by the base building can be used for compliance as long as they serve the project space.

Strategy A: Natural Ventilation

Select an interior space with a good potential for natural ventilation and properly design the space layout.

Technologies and strategies which promote natural ventilation include:

- Proper building layout and orientation which utilizes prevailing wind conditions to achieve adequate flow of outside air
- Computational Fluid Dynamic (CFD) modelling to identify airflows and to increase the efficiency of the layout to promote natural ventilation
- Properly located windows and ventilation openings to ensure natural airflows do not produce uncomfortable drafts or stagnant areas
- Means of induced natural airflow (trickle vents, wing walls, or a thermal chimney)

Strategy B: COP improvement

Select and install HVAC equipment whose COP values meet the minimum requirement values of tables E.1 and E.2. Increasing COP Values result in an improvement of the efficiency of HVAC systems.

Table E.1: Minimum COP requirements for direct electric air conditioners (VBEEC Table 2.6)

Equipment Type	Capacity	Minimum COP	Test procedures
Unitary air-conditioner	-	2.30	TCVN 7830:2012 and TCVN 6307:1997
Split air-conditioner	<4.5 kW	2.60	
	≥ 4.5 kW and < 7.0 kW	2.50	
	≥ 7.0 kW and < 14.0 kW	2.40	
Air conditioners, air cooled	≥ 14.0 kW and < 19 kW	2.93	TCVN 6307:1997 or ARI 210/240
	≥ 19 kW to < 40 kW	3.02	ARI 340/360
	≥ 40 kW to < 70 kW	2.84	
	≥ 70 kW to < 117 kW	2.78	
	≥ 117 kW	2.70	
Air conditioners, water and evaporatively cooled	< 19 kW	3.35	ARI 210/240
	≥ 19 kW to < 40 kW	3.37	ARI 340/360
	≥ 40 kW to < 70 kW	3.32	
	≥ 70 kW	2.70	
Condensing Units, Air-Cooled	≥ 40 kW	2.96	ARI 365
Condensing Units, Water or evaporatively cooled	≥ 40 kW	3.84	

Table E.2: Minimum COP Requirements for chillers (VBEEC Table 2.7)

Equipment Type	Capacity	Minimum COP	Test procedures
Air cooled, with or without condenser, electrically operated	All Capacities	3.10	ARI 550/590
Water cooled, electrically operated, positive displacement (reciprocating)	All capacities	4.20	
Water cooled, electrically operated, positive displacement (rotary screw and scroll)	< 528 kW	4.45	
	≥ 528 kW to <1055 kW	4.90	
	≥ 1055 kW	5.50	
Water Cooled, Electrically Operated, Centrifugal	< 528 kW	5.00	
	≥ 528 kW to <1055 kW	5.55	
	≥ 1055 kW	6.10	

Strategy C: HVAC Zoning

Provide separate HVAC control zones for each solar exposure and for areas with different usage/occupancy needs.
In case the interior project space has only one or no solar exposures, only provide control zones for areas with different usage/occupancy needs.

HVAC zone controls are defined as equipment specially designed to automatically control the amount of air-conditioning and ventilation that is supplied to defined areas within a building, known as control zones, in an energy efficient manner. They allow the environmental conditions in the control zones to be independently controlled to meet the desired conditions (internal air temperature and ventilation).
A HVAC zone control system always contains a central module (control panel) and may include sensors (temperature, humidity, occupancy), schedule control, actuators to drive valves or dampers, etc.

Strategy D: HVAC Controls

- Install at least one type of variable control on each HVAC system used in the building to ensure better part-load efficiency. This can be achieved by using the following variable control systems:
    - VRV/VRF systems
    - VSD on chiller plant equipment like chilled-water pumps and cooling tower fans
    - Variable speed compressors for chillers, roof top-units and split-units (inverters)
    - High-performance VAV (Variable air volume) systems. To qualify as a high-performance, the VAV system controls should be optimized with:

- Optimal start / stop
- Fan-pressure optimization
- Supply-air-temperature reset
- Ventilation optimization

- Install a demand control ventilation system to control the fresh air intake and/or the temperature setpoints of spaces with special occupancy.

  These spaces can be conference rooms, break rooms, classrooms, gymnasiums with variable use patterns, cafeterias, hotel guest rooms, and other occupied spaces where energy savings can be achieved when the space is unoccupied.

  Also, these spaces can be densely occupied spaces where energy savings can be achieved by adjusting the amount of fresh air supplied to the space when the space is partially occupied.

  Occupancy can be measured/estimated in one of several ways: space CO_2 sensing, occupancy counting (turnstile, ticket sales, etc.), occupancy sensing or scheduled occupancy.

Strategy E: Alternative strategies

- All air handling units should include energy recovery ventilation systems.
- Use a radiant cooling system to meet the cooling demand or a part of the cooling demand of the project space.

  A radiant cooling system cools surfaces (floor or ceiling) rather than air like typical HVAC systems do. With radiant cooling systems, most of the cooling comes from removing sensible heat through radiant exchange with people and objects. This way, occupant thermal comfort can be achieved with warmer interior air temperatures than with air based cooling systems.
- Mounted fans should be installed in 50% of the occupied areas of the project. For one occupied space to be considered as compliant, a minimum of one mounted fan should be installed for every 20 m^2 or some high-volume low-speed (HVLS) fans should be installed.

Calculations

Strategy A: Natural Ventilation

Only occupied spaces are to be included and must be applied consistently across all calculations for this credit.

For locations where the average maximum temperature during the hottest month is below 30°C (Sapa, Đà Lạt, Tam Đảo), a space shall be considered naturally ventilated where the total operable opening area is no less than 4% of the floor area.

For locations where the hottest month average maximum temperature is above 30°C, a space shall be considered to be naturally ventilated if it meets the following specifications (based on QCXDVN 09:2005 requirements):

- Ventilation inlet: Inlet openings shall be placed on the windward side of the building. The total effective area of operable openings to the outside (inlet area) shall be no less than 5% of the floor area. These openings shall be readily accessible to occupants. The effective area of a window is defined as the physical area of the window open to the outdoors (this can be calculated using simple geometry).
- Ventilation outlet: Outlet openings shall be placed on the leeward side of the building. The total effective area of operable openings through the ceiling or the opposite wall from the ventilation inlet (outlet area) shall be no less than the inlet area.
- There should be a direct and unobstructed route between the windward inlet and leeward outlet openings (direct path to the outside).
- All area within any naturally-ventilated space shall be within 8 meters of (and permanently open to) an operable wall or roof opening.
- Plan depth of the occupied space shall not be greater than 15m
- Outlet openings shall be located not lower than inlet openings

The windward side of the building is determined based on the prevailing wind direction during the hottest period of the year.
The prevailing wind is the wind that blows the most frequently during this period. Information on the frequency of wind direction of the proposed site location can be found in table 2.16 of QCVN 02:2009/BXD - Vietnam Building Code Natural Physical & Climatic Data for Construction or can come from meteorological data.

The windward side of the building should not necessarily be located perpendicularly to the prevailing wind direction, oblique angles are acceptable. It is also possible to use architectural features to steer the wind such as casement windows, wing walls, fences, or even strategically-planted vegetation.

Mixed-mode ventilated spaces also have to follow these requirements but in order to be considered as naturally ventilated spaces, projects should provide information on the type of mixed-mode system used and how it is implemented in order to reduce energy consumption for HVAC.

The total naturally ventilated occupied area of the building is calculated using the following formula:

$$\text{Naturally Ventilated Occupied Area } [\%] = \frac{\sum \text{Area of Naturally Ventilated Spaces}}{\text{Total Net Occupied Area}} \times 100$$

Strategy B: COP improvement

All air conditioning units and water chilling packages serving the interior space should be included in the calculation. Cooling capacity and COP values should be calculated using the rating conditions in accordance with the test procedures listed in tables E.1 and E.2.

The calculation of increased HVAC efficiencies for air conditioned spaces for average COP values should be calculated using the following formulas:

$$\text{Direct electric AC COP Improvement Compared to VBEEC } [\%] = \left(\frac{\sum_i (P_i \times Y_i)}{\sum_i (P_i \times Y_{Ei})} - 1\right) \times 100$$

P_i = Capacity of the direct electric air-conditioning unit i

Y_i = COP of the direct electric air-conditioning unit i

Y_{Ei} = VBEEC minimum COP for a unit of the same type and capacity as the proposed unit i

$$\text{Chiller COP Improvement Compared to VBEEC } [\%] = \left(\frac{\sum_c (P_c \times Y_c)}{\sum_c (P_c \times Y_{Ec})} - 1\right) \times 100$$

P_c = Capacity of the chiller unit c

Y_c = COP of the chiller unit c

Y_{Ec} = VBEEC minimum COP for a unit of the same type and capacity as the proposed unit c

Submissions

Provisional Certification Stage
Strategy A: Natural Ventilation
• Elevations and plans marking all operable wall and roof openings • Window schedule indicating the number, location and size of all operable wall and roof openings
Strategy B: Efficiency of HVAC equipment
• Schematic drawings of the HVAC system indicating location of all the equipment • Schedule of all the HVAC equipment indicating COP values - OR - Tender specifications of the HVAC equipment indicating minimum specified COP values
Strategy C: HVAC Zoning
• Schematic drawings of the HVAC system indicating location of thermostats and diffusers
Strategy D: HVAC Controls
For variable controls: • Schematic drawings of the HVAC system showing location of variable controls • Evidence showing that variable controls will be installed such as schedule of all the HVAC equipment, tender specifications, design document, etc.
For demand control ventilation: • Evidence indicating how demand control ventilation will work and indicating the sensors/controls to be installed (if any) such as design document, tender specifications, etc.
Strategy E: Alternative strategies
For energy recovery ventilation systems: • Schematic drawings of the HVAC system indicating location of the energy recovery systems
For radiant cooling system: • Schematic drawings of the HVAC system showing the radiant cooling system
For mounted fans: • Evidence indicating the location and number of fans to be installed such as schematic drawings, design document, tender specifications, etc.

Full Certification Stage
Strategy A: Natural Ventilation
• As-built plans and elevations marking all operable wall and roof openings • As-built window schedule indicating the number, location and size of all operable wall and roof openings

Strategy B: Efficiency of HVAC equipment
• Final schedule of all the HVAC equipment installed indicating COP values • As-installed schematic drawings of the HVAC system indicating location of all the equipment • Manufacturer's data of the HVAC equipment installed indicating COP values
Strategy C: HVAC Zoning
• As- built schematic drawings of the HVAC system indicating location of thermostats and diffusers
Strategy D: HVAC Controls
For variable controls: • As- built schematic drawings of the HVAC system showing location of variable controls • Final schedule of all the HVAC equipment installed indicating variable controls installed • Manufacturer's data of the variable control systems
For demand control ventilation: • Extract of an operation and maintenance manual indicating the procedures for operation, adjustment and maintenance of the demand control ventilation system If any sensors/controls have been installed for the demand control ventilation system: • As- built schematic drawings of the HVAC system indicating all the demand sensors/controls
Strategy E: Alternative strategies
For energy recovery ventilation systems: • As- built schematic drawings of the HVAC system indicating location of the energy recovery systems
For radiant cooling system: • As- built schematic drawings of the HVAC system showing the radiant cooling system
For mounted fans: • Evidence showing the installation of the fans such as as-built drawings, photographs, receipts, etc.

E-2 Artificial Lighting

Intent

To reduce energy consumption associated with the use of interior artificial lighting systems.

Requirements

Criteria	6 points
Strategy A: Lighting power density reduction	
Lighting power density surpasses VBEEC requirements by 10 %	1
1 point for every additional 10% improvement of the lighting power density compared to VBEEC requirements (up to 50%)	5
Strategy B: Lighting controls for separate spaces	
Project meet VBEEC requirements on Lighting controls for separate spaces	1
Strategy C: Lighting controls for daylit areas	
Install lighting control devices for the lighting fixtures located in potentially daylit areas	1
Strategy D: Other lighting controls	
Implement the following strategies: - task lighting - main switch or scheduling	1

Approach & Implementation

Strategy A: Lighting power density reduction

The VBEEC stipulates maximum light power densities for different building types (Table E.3). Lighting power associated with the use of artificial lighting systems can be reduced in the following way:

- Specifying high efficiency lighting fixtures (fluorescent T5, LED...) and lighting ballasts
- Design the lighting so as to have the proper illuminance levels
- Select interior walls and ceilings with high reflective qualities
- Use reflector lamps or build reflectors into luminaires

Table E.3: Maximum LPD Values for different types of interior spaces (VBEEC Table 2.12)

Type of interior space	Maximum LPD (W/m^2)
Office	11
Hotel	11
Hospital	13
School	13
Retail	16
Residential	8
Enclosed, in-house, basement car parks	3
Outdoor or open (roofed only) car parks	1.6
Other types of interior spaces	13

Strategy B: Lighting controls for separate spaces

Follow requirements of QCVN 09:2013/BXD Section 2.3.3 Lighting controls 1) Lighting controls for different building spaces.

Every space enclosed with ceiling-height partitions is a separate space.

- All separate spaces must have at least one lighting control device (actuated manually or by automatic sensor).
- Each control device must cover a maximum floor area of 100 m^2
- Conference rooms and passageways in office buildings, hotels, schools and residential buildings must have occupancy or vacancy sensors to control the lighting system.

Strategy C: Lighting controls for daylit areas

Install lighting control devices for the lighting fixtures located in potentially day-lit areas.

For each potentially daylit area, comply with at least one of the three following requirements:

- install photosensors to automatically dim lights depending on the level of natural illuminance received.
- install photosensors to automatically switch lights off when natural light measured by the sensors is beyond the standard preset level for the occupant space (e.g. 300 lux for offices)
- install a manual switch to control the lights independently of the general area lighting

Potentially daylit areas are the sidelit daylit areas and skylit daylit areas as defined below.

- Sidelit daylit area is the area on a plan directly adjacent to each vertical glazing, two window head height deep into the area, and window width plus 0.5 times window head height wide on each side of the rough opening of the window, minus any area on a plan beyond a permanent obstruction that is 1.5 meters or taller as measured from the floor.

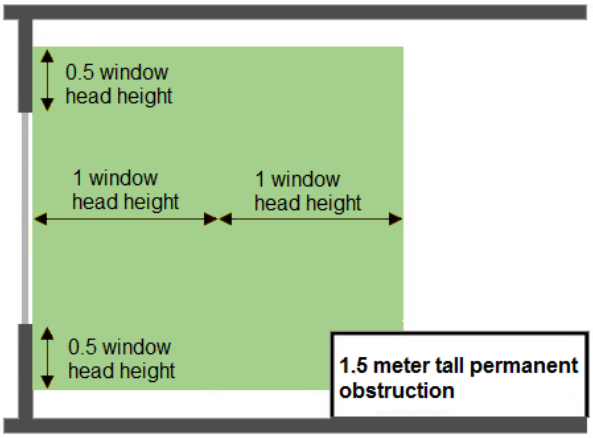

Figure E.2: Measurement of the sidelit daylit area (top view)

- Skylit daylit area is the rough area in plan view under each skylight, plus 0.7 times the average ceiling height in each direction from the edge of the rough opening of the skylight, minus any area on a plan beyond a permanent obstruction that is taller than one - half the distance from the floor to the bottom of the skylight.

  The bottom of the skylight is measured from the bottom of the skylight well for skylights having wells, or the bottom of the skylight if no skylight well exist

  For the purpose of determining the skylit daylit zone, the geometric shape of the skylit daylit zone shall be identical to the plan view geometric shape of the rough opening of the skylight (e.g. for a rectangular skylight the skylit daylit zone plan area shall be rectangular).

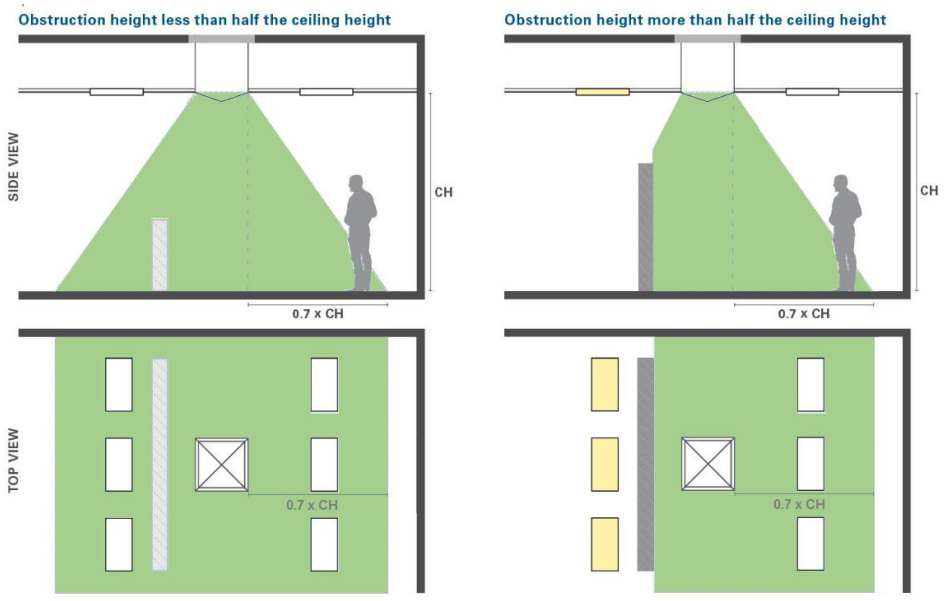

Figure E.3: Measurement of the skylit daylit area

Strategy D: Other lighting controls

Implement the task lighting strategy and either the main switch or the scheduling strategy.

- Task lighting

Task lights provide local lighting of a specific area by bringing the light source closer to the task. For every desk or workstation, supplementary task lighting luminaires should be provided and they should allow the occupant some degree of control, both of light output and position. Control of light output can be provided either by switching or dimming. The position of the luminaire should be limited so as to ensure that it cannot become a source of discomfort to others.

- Main switch

A master main switch located adjacent to the main staff entry for the premises (not necessarily the main entrance) should be installed. With this main switch, the last person can turn off all the lighting systems when leaving the premises.

- Scheduling

Scheduling with a timer control to switch on and/or off the lightings with some localized override control where lighting is needed beyond the scheduled period.

Calculation

Strategy A: Reduction of Light Power Density:

Designers must demonstrate that the light power density in the project space surpasses the requirements of the VBEEC with the following method:

- Prepare a model of the project space indicating illuminance levels throughout the entire artificially lit area
- Calculate the average LPD (as the ratio of the power required to provide artificial lighting to the gross floor area of lighted spaces) of the project space. The calculation must include the power used by lamps, ballasts, current regulators and control devices.

$$I_D[\mathrm{W/m2}] = \frac{P_L}{GFA_L}$$

I_D = Design Lighting Power Density of the project space [W/m^2]

P_L = Total power required to provide artificial lighting in the project space [W]

GFA_L= total gross floor area of lighted spaces in the project space [m^2]

- Calculate the average baseline LPD for the project space with the following formula:

$$I_E[\mathrm{W/m2}] = \frac{\sum_i (I_{E\,i} \times GFA_{L\,i})}{\sum_i GFA_{L\,i}}$$

IE = Maximum Lighting Power Density for the project space [W/m^2]

IE i = Maximum Lighting Power Density for the space type i from VBEEC requirements [W/m^2]

$GFA_{L\,i}$ = total gross floor area of lighted spaces in the project space corresponding to the building type i [m^2]

- Calculate the average reduction in Lighting Power Density with the following formula:

$$Reduction\,[\%] = \left(1 - \frac{I_D}{I_E}\right) \times 100$$

Example of calculation:

A retail building includes the following areas and power installed (Table E.4):

Table E.4: Example of LPD reduction calculation for a mixed-use project

Interior space types	GFA of lighted spaces [m^2]	Total artificial lighting power installed [W]	Maximum Lighting Power Density for the space type (VBEEC) [W/m2]
Retail	5,000	52,000	16
Office	300	1,800	11
Total	GFA_L = 5,300 m2	P_L = 53,800 W	

Thus:

$$I_D[W/m2] = \frac{P_L}{GFA_L} = \frac{53{,}800}{5{,}300} = 10.15\ W/m2$$

And:

$$I_E\left[\frac{W}{m2}\right] = \frac{\sum_i (I_{E\,i} \times GFA_{L\,i})}{\sum_i GFA_{L\,i}} = \frac{5{,}000 * 16 + 300 * 11}{5{,}300} = 15.7\ W/m2$$

Finally:

$$Reduction\,[\%] = \left(1 - \frac{I_D}{I_E}\right) \times 100 = 35.3\%$$

This interior project space can be granted 3 points with more than 30% of LPD reduction achieved.

Submissions

Provisional Certification Stage
Strategy A: Lighting power density reduction
• Electrical lighting drawings showing all the lighting fixtures to be installed in the interior space • Lighting schedule showing all the lighting fixtures to be installed in the interior space
Strategy B: Lighting controls for separate spaces
• Electrical lighting drawings showing the location of all the lighting sensors and controls for separate spaces to be installed
Strategy C: Lighting controls for daylit areas
• Electrical lighting drawings showing the location of all sensors and controls for daylit areas to be installed
Strategy D: Other lighting controls
• Electrical lighting drawings showing the location of task lights and master main switch or timer control to be installed

Full Certification Stage
Strategy A: Lighting power density reduction
• As-built electrical lighting drawings showing all the lighting fixtures installed in the interior space • As-built lighting schedule showing all the lighting fixtures installed in the interior space • Manufacturer's published data of all the lighting fixtures installed in the project interior space
Strategy B: Lighting controls for separate spaces
• As-built electrical lighting drawings showing the location of all the lighting sensors and controls for separate spaces installed If any occupancy or vacancy sensor has been installed: • Evidence showing that the sensors have been installed such as invoices, receipts, delivery notes, commissioning records, photographs, etc.
Strategy C: Lighting controls for daylit areas
• As-built electrical lighting drawings showing the location of all the lighting sensors and controls for daylit areas installed If any photosensor has been installed: • Evidence showing that the photosensors have been installed such as invoices, receipts, delivery notes, commissioning records, photographs, etc.
Strategy D: Other lighting controls
• As-built electrical lighting drawings showing the location of task lights and master main switch or timer control installed • Evidence of the task lights and master main switch or timer control that have been installed such as invoices, delivery notes, photographs, etc.

E-3 Energy Efficient Appliances

Intent

To reduce the energy consumption of equipment and appliances

Requirements

Criteria	4 points
Strategy A: Appliances with Energy Efficiency labels	
30% of appliances and equipment installed have an energy efficiency label	1
1 point for every additional 20% of appliances and equipment installed that have an energy efficiency label (up to 90%)	4
Strategy B: Plug load controls	
Install plug load controls for 50% of plug points	1

Approach & Implementation

Strategy A: Appliances with Energy Efficiency labels

Install energy efficient equipment and appliances.

All the following types of appliances and equipment should be considered in the credit: washing machines, refrigerators and freezers, dishwashers, fans, televisions, computers (desktops and laptops), displays (computer monitors), and rice cookers.

LOTUS will consider as energy efficient appliances, all the appliances that are certified (or can demonstrate equivalent performance with the minimum requirements of the labels):

- Energy Star
- VNEEP energy label with 4 or 5 stars
- European Union Energy Label with class A label or better
- EMSD (Hong Kong) Energy Efficiency Labelling Scheme with Grade 1 or Grade 2 labels
- EMSD's Voluntary Energy Efficiency Labelling Scheme with Recognition type label
- Australian Energy Rating Label Program with 3 stars or higher for Appliances that carry an energy label
- Australian Energy Rating Label Program MEPS for Products registered for MEPS.
- Other labels may be accepted under VGBC approval.

Strategy B: Plug load controls

Install plug load controls for at least 50% of plug points.

The general concept for plug load control is to provide two separate sets of receptacles:

- The first set of receptacles is called controlled receptacles. Controllable plug loads are connected to controlled receptacles so that they can automatically be switched off when they are not in use. Controllable plug loads may include water dispensers, portable fans, televisions, video projectors, monitors, task lighting, etc. Controlled receptacles should be marked differently from other receptacles.
- The other set of receptacles is called un-controlled receptacles. Non-controllable plug loads are connected to this set of receptacles so that their services will not be disrupted. Non-controllable plug loads include refrigerators, faxes, computers, etc.

As required in ASHRAE 90.1-2010, plug load controls should be automatic control devices that function on:

- a scheduled basis using a time-of-day operated control device that turns receptacles off at specific programmed times (an independent program schedule shall be provided for areas of no more than 2,320 m2 but not more than one floor), or
- an occupant sensor that shall turn receptacles off within 30 minutes of all occupants leaving a space, or
- a signal from another control or alarm system that indicates the area is unoccupied

Similar to general lighting shut off controls, building occupants should have easy access to manual switches to override the shut off controls.

For hotel and motel rooms, key card systems that switch off electricity automatically can also be used as plug load controls.

Calculations

Strategy A: Appliances with Energy Efficiency labels

Projects must calculate the percentage of energy efficient appliances and equipment with the following method:

- Identify and calculate the total rated-power of all the appliances and equipment that are considered as energy efficient under LOTUS
- Identify and calculate the total rated-power of all the appliances and equipment eligible
- Calculate the percentage of energy efficient appliances and equipment installed using the following formula:

$$\text{Percentage of Energy efficient appliances } [\%] = \frac{P_{EE}}{P_T}$$

P_{EE} = Total rated-power of all the energy efficient appliances and equipment [W]

P_T = Total rated-power of all the appliances and equipment eligible under the scope of Energy Star [W]

Strategy B: Plug load controls

- Calculate the total number of plug points in the project space (N_T)
- Calculate the number of plug points where plug load controls are used (N_{PLC})
- Calculate the number of plug points designated for equipment requiring 24 hour operation or situated in spaces where an automatic shutoff would endanger the safety or security of the room or building occupants (N_E)
- Compliance should be demonstrated with the following formula:

$$\frac{N_{PLC}}{N_T - N_E} \geq 50\ \%$$

Submissions

Provisional Certification Stage
Strategy A: Appliances with Energy Efficiency labels
• Evidence indicating the future installation of energy efficient appliances such as tender specifications, schedule of appliances, etc.
Strategy B: Plug load controls
• Electrical drawings showing the location of all the plug points and plug load controls • Evidence indicating the future installation of plug load controls such as tender specifications, design document, etc.

Full Certification Stage
Strategy A: Appliances with Energy Efficiency labels
• Evidence showing that the appliances installed are energy efficient such as manufacturer's published data, energy efficiency certificate, etc. • Evidence showing that the energy efficient appliances have been installed such as invoices, receipts, delivery notes, photographs, etc.
Strategy B: Plug load controls
• As-built electrical drawings showing the location of all the plug points and plug load controls • Manufacturer's published data of the plug load controls • Evidence showing that the plug load controls have been installed such as invoices, receipts, delivery notes, photographs, etc.

E-4 Energy Monitoring

Intent

To ensure continuous monitoring of the energy consuming systems of the project space.

Requirements

Criteria	2 points
Option A: Sub metering and Power monitoring system	
Sub-metering: Install individual meters to monitor the consumption of all major electrical energy uses	1
Power monitoring system: Install a power monitoring system to monitor the consumption of all major electrical energy uses	2
Option B: Energy monitor	
Install an energy monitor to record electricity consumption	1

Approach & Implementation

Option A: Sub metering and Power monitoring system

Sub-metering:

Individual meters should be permanently installed to monitor the energy consumption of separate floors and of the following energy end-uses:

- HVAC equipment
- Lifts and escalators
- Artificial lighting
- Any equipment/system which carries an energy use greater than 100 kVA

Power monitoring system:

The power monitoring system should meet the following requirements:

- Include individual meters as required above for sub-metering
- Centralize the data from all meters at a remote location using a communication infrastructure
- Meters are able to record data at intervals of one hour or less
- Meters are able to record both energy consumption and energy demand

Option B: Energy Monitor

A permanent energy monitor should be installed and should:

- Have an in-house visual display located conveniently for owners - OR - have the ability to communicate the information to a personal computer
- Provide real-time feedback on energy consumption
- Provide a function to analyze data at regular intervals (daily, weekly, monthly or yearly)

Submissions

Provisional Certification Stage
Option A: Sub metering and Power monitoring system
Sub-metering: • Electrical drawings showing location, type and number of energy meters and showing the usage served by those meters
Power Monitoring System: • Schematics of the communication interface between the software and the meters
Option B: Energy Monitor
• Evidence indicating the future installation of an energy monitor such as drawings, tender specifications, design document, signed letter, etc.

Full Certification Stage
Option A: Sub metering and Power monitoring system
Sub-metering: • As-built electrical drawings showing location, type and number of energy meters and showing the usage served by those meters • Evidence of the meters installed such as photographs, invoices, receipts, etc.
Power Monitoring System: • As-built schematics of the communication interface between the software and the meters • Report indicating how the monitoring system is employed, including: - Responsible staff and training provided - Outputs generated such as daily/monthly electricity consumption report
Option B: Energy Monitor
• Evidence showing that an energy monitor has been installed such as photographs, invoice, etc. • Evidence showing that the energy monitor installed can analyze data at regular intervals and can provide the data to a visual display or to a PC such as photographs, technical data, etc.

Water

Water scarcity - including poor availability and quality- is a growing risk threatening both food and energy security of many countries in Southeast Asia. Several river basins in the country are expected to face acute stress or shortage by 2025, and groundwater sources are rapidly declining.

In Vietnam, even though the country was considered one with high water availability with intensive river systems, the government has announced that Vietnam is a country with poor clean water resource, which has only enough water to provide 4000m^3/year/person, compared to the global average of 7000m^3/year/person. Moreover, seasonal shortages have already worsened, especially around major metropolitan areas such as the Red river delta or big rice-producing areas like the Mekong delta due to high demand, water pollution and climate change impacts. Since these two river deltas are the country's premier rice-growing regions, water shortage threatens the nation’s food security.

As clean water becomes less readily available within Vietnam, the cost of this service is bound to increase in near future. Therefore, a water-efficient building not only ensures consistency in operation and production but also saves building owners money in operational costs. Furthermore, such building improvements will also help reduce the load on many of the antiquated sewage systems in urban areas of Vietnam.

Understanding the circumstance, LOTUS prioritizes the reduction of water consumption and emphasizes this in the requirements of the Water Category. Credits within this category encourage the use of water-efficient equipment.

Water		6 Points
Item	Criteria	Points
W-1	Water Efficient Fixtures	5 points
	Option A: Projects with provision of bathroom water fixtures	
	All the bathroom water fixtures installed by the project are water-efficient fixtures	W-PR-1
	Strategy A1: Space Water Use For 1 point, reduce domestic water consumption through fixtures by 20% in comparison to a baseline model 1 point for every additional 5% reduction of the domestic water consumption through fixtures	5
	Strategy A2: Upgrade of base building water fixtures Replace or alter the base building water fixtures associated with the interior project	1
	Strategy A3: Process Water Use Install water efficient appliances to reduce process water use	1
	Option B: Projects with no provision of bathroom water fixtures	
	Strategy B1: Building Water Use For 1 point, domestic water consumption through base building water fixtures associated with the interior project is reduced by 20% in comparison to a baseline model 1 point for every additional 10% reduction of the domestic water consumption through base building water fixtures (Up to 40%)	3
	Strategy B2: Upgrade of base building water fixtures Replace or alter the base building water fixtures associated with the interior project	5
	Strategy B3: Process Water Use Install water efficient appliances to reduce process water use	1
W-2	Drinking Water	1 point
	Provide drinking water filtration system to avoid the use of plastic bottled water	1

W-PR-1 & W-1 Water Efficient Fixtures

Intent

To reduce the consumption of water in buildings by means of water efficient fixtures.

Requirements

Option A: Projects with provision of bathroom water fixtures

To follow Option A, a project needs to install within the tenant spaces at least the following fixtures: water closets and bathroom taps.

Criteria	5 Points
All the bathroom water fixtures installed by the project are water-efficient fixtures	Water Prerequisite 1
Strategy A1: Space Water Use	
Reduce domestic water consumption through fixtures by 20% in comparison to a baseline model	1
1 point for every additional 5% reduction of the building domestic water consumption through fixtures (Up to 40%)	5
Strategy A2: Upgrade of base building water fixtures	
Replace or alter the base building water fixtures associated with the interior project	1
Strategy A3: Process Water Use (only available for projects using process water appliances)	
Replace or alter the base building water fixtures associated with the interior project	1

Option B: Projects with no provision of bathroom water fixtures

Criteria	5 Points
Strategy B1: Building Water Use	
Domestic water consumption through base building water fixtures associated with the interior project is reduced by 20% in comparison to a baseline model	1
1 point for every additional 10% reduction of the domestic water consumption through base building water fixtures (Up to 40%)	3
Strategy B2: Upgrade of base building water fixtures	
Replace or alter the base building water fixtures associated with the interior project	1
Strategy B3: Process Water Use (only available for projects using process water appliances)	
Install water efficient appliances to reduce process water use	1

Approach & Implementation

Water Prerequisite 1

Projects where fixtures are not within the tenant spaces are exempt from this prerequisite.

Projects with provision of bathroom water fixtures should install:

- Dual flush WCs with flush rates lower than (or equal to) 3 / 6 liters per flush
- Urinals with flush rates lower than (or equal to) 3.79 liters per flush
- Shower heads with flowrates lower than (or equal to) 0.14 liters per second
- Bathroom and kitchen taps with flowrates lower than (or equal to) 0.12 liters per second

Strategy A1: Space Water Use & Strategy B1: Building Water Use

The following strategies can be used to reduce the water demand within a building:

- Dual flush low flow WCs
- Low flow or waterless urinals
- Low flow aerated shower heads
- Low flow aerated kitchen and bathroom taps
- Standard low flow (not aerated) shower heads, kitchen and bathroom taps

Strategy A2 & B2: Upgrade of base building water fixtures

Project can earn one point for replacing or altering the water fixtures of the base building associated with the interior project (i.e. project occupants need to use these fixtures) to reduce building domestic water consumption through fixtures by an additional 10% in comparison to a baseline model.

The following strategies can be used:

- Replace existing fixtures with water efficient fixtures
- Install flow aerators or flow restrictors to taps

Strategy A3 & B3: Process Water Use

Projects using process water appliances can earn one point by selecting water efficient appliances that meet the requirements listed in Table W.1.

Table W.1: Requirements for water efficient appliances (Source: LEED ID+C v4)

Type of appliance		Requirement
Residential equipment		
Residential dishwashers		ENERGY STAR or performance equivalent
Residential Clothes washer		120 l per load
Commercial equipment		
Commercial Clothes washer		1000 l per cubic meter of laundry
Commercial Prerinse Spray Valves		≤ 4.9 l per minute
Ice machine		ENERGY STAR or performance equivalent and use either air-cooled or closed-loop cooling, such as chilled or condenser water system
Kitchen equipment		
Dishwasher	Undercounter	≤ 6.0 liters/rack
	Stationary, single tank, door	≤ 5.3 liters/rack
	Single tank, conveyor	≤ 3.8 liters/rack
	Multiple tank, conveyor	≤ 3.4 liters/rack
	Flight machine	≤ 680 liters/hour
Food steamer	batch	≤ 23 liters/hour/pan
	Cook-to-order	≤ 38 liters/hour/pan
Combination oven	Countertop or stand	≤ 13 liters/hour/pan
	Roll-in	≤ 13 liters/hour/pan

Calculations

Strategy A1: Space Water Use & Strategy B1: Building Water Use

This calculation aims to compare the project's water consumption through fixtures to a baseline model. The baseline annual water use should be calculated using values in Tables W.2 to W.6.

If the project doesn't feature all the fixtures necessary to meet the needs of the occupants, include the water fixtures of the base building associated with the tenancy in the calculation.

Table W.2: Baseline daily fixture uses for office, hospitals & factory buildings (Source: Default Fixture Uses, LEED Reference Guide for Green Building and Construction, 2009)

Fixture	Daily Fixture Uses		Duration of Use (flow fixtures)
	Full Time Occupants	Visitors	
WC - Single Flush (female)	3	0.5	-
WC - Dual flush (female)	1 full-flush / 2 half-flushes	0.1 full-flush / 0.4 half-flush	
WC - Single Flush (male)	1	0.1	-
WC - Dual flush (male)	1 full-flush	0.1 full-flush	
Urinal (male)	2	0.4	-
Lavatory Faucet	3	0.5	15 sec; 12 sec with auto-control
Shower	0.1	0	300 sec
Kitchen Sink	1	0	15 sec

Table W.3: Baseline daily fixture uses for residential & hotel buildings (Source: Default Fixture Uses, LEED Reference Guide for Green Building and Construction, 2009)

Fixture	Daily Fixture Uses Per Occupant			Duration of Use (flow fixtures)
	Residents / Hotel Guests	Full Time Occupants	Visitors	
WC - Single Flush (female)	4	3	0.5	-
WC - Dual flush (female)	1 full-flush / 3 half-flushes	1 full-flush / 2 half-flushes	0.1 full-flush / 0.4 half-flush	
WC - Single Flush (male)	4	1	0.1	-
WC - Dual flush (male)	1 full-flush / 3 half-flushes	1 full-flush	0.1 full-flush	
Urinal (male)	0	2	0.4	-
Lavatory Faucet	7	3	0.5	Residents: 60 sec. Others: 15 sec or 12 sec with auto-control
Shower	1	0.1	0	Residents: 480 sec. Others: 300 sec
Kitchen Sink	4	1	0	Residents: 60 sec. Others: 15 sec
Clothes washer	1 / living unit	0	0	

Table W.4: Baseline daily fixture uses for educational buildings (Source: Default Fixture Uses, LEED Reference Guide for Green Building and Construction, 2009)

Fixtures	Daily Fixture Uses Per Occupant				Duration of Use (flow fixtures)
	Students (kindergarten and primary education	Students (secondary & post/secondary education)	Full Time Occupants	Visitors	
WC - Single Flush (female)	3	1.5	3	0.5	-
WC - Dual flush (female)	1 full-flush / 2 half-flushes	0.5 full-flush / 1 half-flush	1 full-flush / 2 half-flushes	0.1 full-flush / 0.4 half-flush	
WC - Single Flush (male)	1	0.5	1	0.1	-
WC - Dual flush (male)	1 full-flush	0.5 full-flush	1 full-flush	0.1 full-flush	
Urinal (male)	2	1	2	0.4	-
Lavatory Faucet	3	1.5	3	0.5	15 sec; 12 sec with auto-control
Shower	0	0	0.1	0	300 sec
Kitchen Sink	0	0	1	0	15 sec

Table W.5: Baseline daily fixture uses for retail buildings (Source: Default Fixture Uses, LEED Reference Guide for Green Building and Construction, 2009)

Fixture	Daily Fixture Uses Per Occupant			Duration of Use (flow fixtures)
	Retail Customers	Full Time Occupants	Visitors	
WC - Single Flush (female)	0.2	3	0.5	-
WC - Dual flush (female)	0.1 full-flush / 0.1 half-flush	1 full-flush / 2 half-flushes	0.1 full-flush / 0.4 half-flush	
WC - Single Flush (male)	0.1	1	0.1	-
WC - Dual flush (male)	0.1 full-flush	1 full-flush	0.1 full-flush	
Urinal (male)	0.1	2	0.4	-
Lavatory Faucet	0.2	3	0.5	15 sec; 12 sec with auto-control
Shower	0	0.1	0	300 sec
Kitchen Sink	0	1	0	15 sec

Table W.6: Baseline fixtures water use (Source: UPC and IPC Standards)

Fixture	Fixtures Water Use
WC (single/dual flush)	6.0 L per flush (Lpf)
Urinal (flush)	3.79 Lpf
Faucet (conventional)	0.14 L/s
Showerheads	0.16 L/s
Kitchen faucet	0.14 L/s
Clothes washer	120 L/load

The following assumptions should be made when making the calculations of both baseline and design water uses:

- The gender ratio should be representative of the project occupancy, if this is not available, a ratio of one to one should be used
- The number of daily fixture uses and flow fixture use durations (in baseline case) should follow values in tables W.2 to W.5 according to the interior space type
- In case no urinals are available for the project occupants, daily uses values for WCs (female) shall be considered for the male occupants.
- Full-time occupants are employees/staff in the interior space and their number should be calculated based on a daily occupancy of 8 hours. Part-time occupants should be given an equivalent 'full-time occupants' value based on the number of hours they spend in the interior space per day divided by 8
- In interior spaces with multiple shifts, use the number of full-time occupants from all shifts.

Calculation of annual water consumption through fixtures:

$$\text{Annual Water Consumption Through Fixtures [L/year]} = [\sum(F \times Q_{flush} \times n \times P) + \sum(F \times Q_{flow} \times t_{flow} \times n \times P)] \times O$$

F = Proportion of fixtures

$$F = \frac{\text{Number of Fixtures with a Specific Flush/Flow Rate}}{\text{Total Number of Fixture of This Type}}$$

n = Number of daily uses per person per fixture type

P = Number of project occupants

Q_{flush} = Water used per flush for each type of flush fixture [L]

Q_{flow} = Flow rate per type of flow fixture [L/s]

t_{flow} = Duration of use per type of flow fixture [s]

O = Number of operation days per year

$$\text{Water Consumption Through Fixtures Reduction [\%]} = \left(1 - \frac{\text{Annual Water Consumption Through Fixtures (Design Case)}}{\text{Annual Water Consumption Through Fixtures (Baseline Case)}}\right) \times 100$$

Example of Calculation:

An interior space with an occupancy of 50 full-time occupants (gender ratio: 1 to 1) is equipped with the water fixtures in Table W.7. The interior space's number of operation days during the year is O = 290 days.

Table W.7: Example calculation - building fixtures quantities and flow/flush rates

Fixtures Present in the Building	Quantities of Fixtures	Fixtures Water Use
Urinal (flush)	3	3 Lpf
WC Dual flush (male)	15	3.0 - 4.5 Lpf
WC Single flush (male)	5	5 Lpf
WC Dual flush (female)	18	3.0 - 4.5 Lpf
WC Single flush (female)	6	5 Lpf
Faucet	20	0.12 L/s
Faucet with auto-control	5	0.12 L/s
Showerheads	1	0.15 L/s

Table W.8: Example calculation - daily water use through fixtures calculation for baseline case

Fixtures Present in the Building	F	Q Flush/Flow	Number of Daily Uses (n)	Number of Occupants (P)	Daily Water Use Through Fixtures (L)
Urinal (flush)	1	3.79 Lpf	2	25	189.5
WC (male)	1	6 Lpf	1	25	150
WC (female)	1	6 Lpf	3	25	450
Faucet	20/25	0.14 L/s (15 sec)	3	50	252
Faucet with auto-control	5/25	0.14 L/s (12 sec)	3	50	50.4
Showerheads	1	0.16 L/s (300 sec)	0.1	50	240
Total daily water use through fixtures					1,332
Baseline total annual water use through fixtures					386,251

Table W.9: Example calculation - daily water use through fixtures calculation for the design case

Fixtures Present in the Building	F	Q Flush/Flow	Number of Daily Uses (n)	Number of Occupants (P)	Daily Water use Through Fixtures (L)
Urinal (Flush)	1	3 Lpf	2	25	150
WC Dual flush (male)	15/20	4.5 Lpf	1	25	84
WC Single flush (male)	5/20	5 Lpf	1	25	31
WC Dual flush (female)	18/24	$\left(\frac{2}{3}\times 3+\frac{1}{3}\times 4.5\right)$Lpf	3	25	197
WC Single flush (female)	6/24	5 Lpf	3	25	93.8
Faucet	20/25	0.12 L/s (15 sec)	3	50	216
Faucet with auto-control	5/25	0.12 L/s (12 sec)	3	50	43
Showerheads	1	0.15 L/s (300 sec)	0.1	50	225
Total daily water use through fixtures					1,040
Design total annual water use through fixtures					301,745

$$\text{Water Consumption Through Fixtures Reduction [\%]} = \left(1-\frac{301{,}745}{386{,}251}\right)\times 100 = 22\%$$

The interior space finally achieves a 22% reduction of the domestic water consumption through fixtures in comparison to a baseline model so one point can be awarded.

Submissions

Provisional Certification Stage
Water Prerequisite 1 and Strategy A1: Space Water Use
• Plumbing drawings showing all the water fixtures to be installed • Evidence showing the water usage (flow rates or flush volumes) of all the water fixtures such as tender specifications, design document, schedule of water fixtures, manufacturer's data, etc.
Strategy B1: Building Water Use
• Evidence showing the water usage (flow rates or flush volumes) of all the water fixtures already installed (or to be replaced or altered) in the base building and associated with the interior project such as manufacturer's data, audit report, tender specifications, design document, etc.
Strategy A2 & B2: Upgrade of base building water fixtures
• Evidence showing the water usage (flow rates or flush volumes) of all the existing water fixtures installed in the base building and associated with the interior project such as manufacturer's data, audit report, photographs, etc. • Evidence showing the water usage (flow rates or flush volumes) of all the water fixtures to be installed to replace or alter the existing fixtures such as tender specifications, design document, schedule of water fixtures, manufacturer's published data, etc.

Strategy A3 & B3: Process Water Use
• Evidence showing the water usage of all the water appliances to be installed such as tender specifications, design document, schedule of water appliances, manufacturer's published data, etc.

Full Certification Stage
Water Prerequisite 1 and Strategy A1: Space Water Use
• As-built plumbing drawings showing all the water fixtures installed • Manufacturer's published data showing the water usage (flow rates or flush volumes) of all the water fixtures installed • Evidence showing that the water efficient fixtures have been installed such as receipts, invoices, delivery notes, etc.
Strategy B1: Building Water Use
If it had not been approved at Provisional Certification or if there is any change: • Evidence showing the water usage (flow rates or flush volumes) of all the water fixtures installed in the base building and associated with the interior project such as manufacturer's published data, audit report, etc.
Strategy A2 & B2: Upgrade of base building water fixtures
• Manufacturer's published data showing the water usage (flow rates or flush volumes) of all the water fixtures installed to replace or alter the existing fixtures. • Evidence showing that the water efficient fixtures to replace or alter the existing fixtures have been installed such as receipts, invoices, delivery notes, etc.
If it had not been approved at Provisional Certification or if there is any change: • Evidence showing the water usage (flow rates or flush volumes) of all the existing water fixtures installed in the base building and associated with the interior project such as manufacturer's data, audit report, photographs, etc.
Strategy A3 & B3: Process Water Use
• Manufacturer’s published data of all water appliances installed indicating the water usage of the appliances installed • Evidence showing that the water efficient appliances have been installed such as receipts, invoices, delivery notes, etc.

W-2 Drinking Water

Intent

To reduce the use of plastic water bottles and the environmental impact associated to their production and transportation.

Requirements

Criteria	1 Point
Provide drinking water filtration system to avoid the use of plastic bottled water	1

Approach & Implementation

Municipal tap water can contain many kind of contaminants such as dissolved metals (including lead and iron), nitrates, chlorine and mineral salts. It can also contain other undesirable substances such as sulfates, mercury, asbestos and arsenic.

Install a proper drinking water filtration system to get clean drinking water. As a minimum the filtration system should contain filters that can remove:

- dust, particles, and rust
- heavy metals
- chlorine
- bacteria

A drinking water filtration system including filters such as sediment filters, reverse-osmosis filters and activated carbon filters is advised.

Submissions

Provisional Certification Stage
• Evidence showing the future installation of a drinking water filtration system such as tender specifications, signed supply and installation contract, design document, etc.

Full Certification Stage
• Manufacturer's published data showing the types of filters contained in the water filtration system • Evidence showing that the water filtration system has been installed such as photographs, invoices, receipts, etc.

Materials

During the lifecycle of any construction material, its extraction, processing, transportation, use and disposal can have negative effects on the environment. Especially, the acquisition of virgin material destroys natural habitats, pollutes air and water, and depletes energy and natural resources. Therefore, to mitigate the negative impacts of construction on the natural environment, usage of materials produced from virgin sources must be limited.

With the fast urbanization rate reaching 28% (Vietnam Ministry of Construction), construction sites are rising in all corners of Vietnam. Along with this, the demand of construction materials is expected to rise by 10% annually (Vietnam Association of Building Materials). However, this growth will not be sustainable as the production of those construction materials mostly relies on the exploitation of virgin materials. Moreover, since materials exploitation in Vietnam is usually small-scaled and processing technologies are often outdated, natural resources are being wasted and serious damages are being done to the environment.

By setting a common goal of construction materials conservation, the Materials Category of LOTUS encourages strategies and materials which are not only re-used or recycled, but also sustainable and accessible. By responsibly specifying materials and construction processes, the impact of any project on the natural environment can be significantly reduced.

The Material Category of LOTUS includes two main goals which are to reduce the amount of virgin natural resources used, and to promote the use of low-energy sustainable materials.

Materials		14 Points
Item	Criteria	Points
M-1	Sustainable Materials	10 points
	15% of the total value of materials installed on the project are sustainable materials	1
	1 point for every additional 5% of the total value of materials installed on the project that are sustainable materials (up to 60%)	10
M-2	Sustainable Furniture Products	4 points
	15% of the total value of furniture installed on the project are sustainable products	1
	1 point for every additional 15% of the total value of furniture installed on the project that are sustainable products (up to 60%)	4

M-1 Sustainable Materials

Intent

To encourage the use of sustainable materials.

Requirements

Criteria	10 Points
15% of the total value of materials installed on the project are sustainable materials	1
1 point for every additional 5% of the total value of materials installed on the project that are sustainable materials (up to 60%)	10

Approach & Implementation

This credit takes into account all the following materials:

- Walls and partitions (non-load bearing space dividers)
- Ceilings and floorings
- Toilet partitions; shower partitions including shower screens
- Internal stairs
- Wall coverings, such as ceramic tiles.
- Skirting

Select sustainable materials among the following list:

- Reused materials. These include materials:
    - purchased from a second-hand retailer
    - that were used on the current site by a previous occupant or installed by a building owner as part of make good processes prior to fit-out works by the tenant.
    - relocated to the site from the project's previous fit-out or building.
- Materials with reused components which are materials composed with some reused components (following the above definition).
- Materials with recycled content which are materials with a post-consumer or pre-consumer recycled content.
    - A pre-consumer material is a material diverted from waste stream during a manufacturing process. Excluded is reutilization of materials such as rework,

regrind or scrap generated in a process and capable of being reclaimed within the same process that generated it.

- A post-consumer material is a material generated by households or by commercial, industrial and institutional facilities in their role as end-users of the product, which can no longer be used for its intended purpose. This includes returns of material from the distribution chain.

- Rapidly renewable materials, which are natural building materials planted and harvested within a 10 year cycle. The following is a partial list of rapidly renewable materials which can be used: Bamboo, Cork, Coconut, Reed, Straw board, etc.
- Sustainable timber which is timber coming from sustainable sources, preferably accredited by the Forest Stewardship Council in Vietnam (FSC), Programme for the Endorsement of Forest Certification (PEFC), Malaysia Tiber Certification Council (MTCC) or other.
- Non-baked materials (also called non-fired materials) which are building materials that solidify and meet all required physical properties (compressive strength, bending strength, water absorption, etc.) without undergoing the firing process as traditional baked bricks do. Non-baked materials include: concrete bricks, gypsum panels, AAC blocks, etc.
- Materials from an ISO 14001 certified manufacturer which are materials that have been manufactured in an ISO 14001 certified facility. In order to comply, 80% of the mass of the product or materials must be sourced from manufacturing facilities that are certified to ISO 14001.
- Materials certified under third party ecolabels considering whole lifecycle analysis (LCA) such as Global GreenTag LCARate, Cradle to Cradle, NSF Sustainability Assessment, etc.
- Materials certified under third party ecolabels (not considering whole LCA) such as Global GreenTag GreenRate, Singapore Green Building Product, Singapore Green Labelling Scheme (SGLS), etc.
- Materials with an environmental product declaration (EPD) which are materials for which an environmental product declaration has been produced by the manufacturer.
- Local Materials which represents the materials:
    - that are manufactured locally in Vietnam (within a 500 km radius of the project site or 500 km total transportation distance); and
    - materials that are extracted, harvested and manufactured locally in Vietnam (within a 500 km radius of the project site or 500 km total transportation distance).

- Materials designed for disassembly which are materials easy to dismantle, to disassemble and to remove from the building for future reuse or recycling.

Calculations

- Calculation of the recycled content of materials:

$$\text{Recycled Content } [\%] = \%\ \text{Post (i)} + 0.5\ \times \%\ \text{Pre (i)}$$

% Post (i) = percentage of post-consumer recycled content by weight of material (i)

% Pre (i) = percentage of pre-consumer recycled content by weight of material (i)

- Calculation of the total transportation distance for local materials:

Total transportation distance should include all the travel distances and should be calculated with the following formula:

$$(\text{Distance by rail}/3)\ +\ (\text{Distance by inland waterway}/2)\ +\ (\text{Distance by sea}/15) + (\text{Distance by all other means})\ \leq\ 500\ \text{km}$$

- Calculation of the percentage of sustainable materials:

Only materials installed by the interiors project should be considered and the percentage of sustainable materials should be calculated using the following formula:

$$\text{Sustainable materials } [\%] = \sum_{\text{i}} \frac{M_{\text{i}} \times \text{C}_{\text{i}}}{\text{C}_{\text{tot}}}$$

M_i = sustainability factor of material (i) (values from Table M.1)

C_i = cost of material (i)

C_{tot} = Total cost of materials in the project [VND]

Table M.1: Sustainability factors of the different types of sustainable materials

Criteria	Materials sustainability factors
Reused materials	100 %
Materials with reused components	% of reused components (by mass)
Materials with recycled content	% of recycled content (calculated in accordance with the method above)
Rapidly renewable material	% of rapidly renewable materials (by mass)
Sustainable timber	0.5 x % of timber from sustainable sources (by mass)

Materials third-party certified based on whole lifecycle analysis	• Platinum & Gold (or equivalent): 100% • Silver (or equivalent): 80% • Bronze (or equivalent): 60% • Basic (or equivalent): 40%
Other third-party certified materials	20 %
Non-baked materials (for non-structural walls only)	20 %
Manufacturer ISO 14001 certification	20 %
Materials with an Environmental Product Declaration	20 %
Materials designed for disassembly	20 %
Materials extracted, harvested and manufactured locally	20%
Materials manufactured locally	10 %

When a material have more than one sustainable feature, use a sustainability factor for this material as equal to the sum of the different sustainability factor (a maximum of 3 features can be considered).

Submissions

Provisional Certification Stage
• Bill of quantities -OR- estimated costing highlighting all materials to be installed • For each sustainable material, evidence showing that the material is sustainable such as manufacturer's data, certificate, test report, signed and stamped letter from manufacturer, tender specification extracts, etc.

Full Certification Stage
• Final bill of quantities detailing the cost of all materials installed in the project • Evidence showing that the materials have been installed such as invoices, receipts, delivery notes, photographs (if appropriate), etc.
If it had not been approved at Provisional Certification or if there is any change: • For each sustainable material, evidence showing that the material is sustainable such as manufacturer's data, certificate, test report, signed and stamped letter from manufacturer, tender specification extracts, etc.

M-2 Sustainable Furniture Products

Intent

To encourage the use of sustainable furniture products to reduce demand for virgin materials and reduce waste.

Requirements

Criteria	4 Points
15% of the total value of furniture installed on the project are sustainable products	1
1 point for every additional 15% of the total value of furniture installed on the project that are sustainable products (up to 60%)	4

Approach & Implementation

The following types of furniture products are included in the scope of this credit:

- Seatings (chairs, stools, benches, etc.)
- Surfaces (tables, desks, etc.)
- Storage units (cabinets, lockers, dressers, closets, chess, bookcases, pantries, etc.)
- Work settings (workbench or workstation). Storage, shelving and screening elements which form part of the work setting, cannot be dissociated from the work setting.

Select sustainable furniture products among the following list:

- Reused products. These include products:
    - purchased from a second-hand retailer
    - that were used on the current site by a previous occupant or installed by a building owner as part of make good processes prior to fit-out works by the tenant.
    - relocated to the site from the project's previous fit-out or building.
- Products with reused components which are products composed with some reused components (following the above definition).
- Products with recycled content which are materials with a post-consumer or pre-consumer recycled content (c.f. definition given in credit M-1)
- Products made from rapidly renewable materials, which are natural building materials planted and harvested within a 10 year cycle. The following is a partial list of rapidly renewable materials which can be used: Bamboo, Cork, Coconut, Reed, Straw board, etc.

- Products made with timber coming from sustainable sources, preferably accredited by the Forest Stewardship Council in Vietnam (FSC), Programme for the Endorsement of Forest Certification (PEFC), Malaysia Tiber Certification Council (MTCC) or other.
- Products from an ISO 14001 certified manufacturer which are materials that have been manufactured in an ISO 14001 certified facility. In order to comply, 80% of the mass of the product must be sourced from manufacturing facilities that are certified to ISO 14001.
- Products certified under third party ecolabels considering whole lifecycle analysis (LCA) such as Global GreenTag LCARate, Cradle to Cradle, NSF Sustainability Assessment, etc.
- Products certified under third party ecolabels (not considering whole LCA) such as Global GreenTag GreenRate, Singapore Green Building Product, Singapore Green Labelling Scheme (SGLS), etc.
- Products with an environmental product declaration which are materials for which an environmental product declaration (EPD) has been produced by the manufacturer.
- Local products which represents the products:
    - that are manufactured locally in Vietnam (within a 500 km radius of the project site or 500 km total transportation distance); and
    - that are extracted, harvested and manufactured locally in Vietnam (within a 500 km radius of the project site or 500 km total transportation distance).

Calculations

- Calculation of the recycled content of products:

$$\text{Recycled Content } [\%] = \%\ \text{Post (i)} + 0.5\ \times \%\ \text{Pre (i)}$$

% Post (i) = percentage of post-consumer recycled content by weight of product (i)
% Pre (i) = percentage of pre-consumer recycled content by weight of product (i)

- Calculation of the total transportation distance for local materials:

Total transportation distance should include all the travel distances and should be calculated with the following formula:

$$(\text{Distance by rail}/3)\ +\ (\text{Distance by inland waterway}/2)\ +\ (\text{Distance by sea}/15)$$
$$+\ (\text{Distance by all other means})\ \leq\ 500\ \text{km}$$

- Calculation of the percentage of sustainable materials:

Only materials installed by the interiors project should be considered and the percentage of sustainable materials should be calculated using the following formula:

$$\text{Sustainable materials } [\%] = \sum_{\mathrm{i}} \frac{M_{\mathrm{i}} \times \mathrm{C_i}}{\mathrm{C_{tot}}}$$

M_i = sustainability factor of material (i) (values from Table M.2)

C_i = cost of material (i)

C_{tot} = Total cost of materials in the project [VND]

Table M.2: Sustainability factors of the different types of sustainable furniture products

Criteria	Products sustainability factors
Reused products	100 %
Products with reused components	% of reused components (by mass)
Products with recycled content	% of recycled content (calculated in accordance with the method above)
Products made with rapidly renewable materials	% of rapidly renewable materials (by mass)
Products made of timber coming from sustainable sources	0.5 x % of timber from sustainable sources (by mass)
Manufacturer ISO 14001 certification	20 %
Products third-party certified based on whole lifecycle analysis	• Platinum & Gold (or equivalent): 100% • Silver (or equivalent): 80% • Bronze (or equivalent): 60% • Basic (or equivalent): 40%
Other third-party certified products	20 %
Products with an Environmental Product Declaration	20 %
Locally manufactured products with locally extracted and harvested materials	20%
Locally manufactured products	10 %

When a material have more than one sustainable feature, use a sustainability value for this material as equal to the sum of the different sustainability values (a maximum of 3 features can be considered).

Submissions

Provisional Certification Stage
• Bill of quantities -OR- estimated costing highlighting all the furniture products to be installed • For each sustainable furniture product, evidence showing that the furniture product is sustainable such as manufacturer's data, certificate, test report, signed and stamped letter from manufacturer, tender specification extracts, etc.

Full Certification Stage
• Final bill of quantities detailing the cost of all furniture products installed in the project • Evidence showing that the aforementioned furniture products have been installed such as invoices, receipts, delivery notes, photographs (if appropriate), etc.
If it had not been approved at Provisional Certification or if there is any change: • For each sustainable furniture product, evidence showing that the furniture product is sustainable such as manufacturer's data, certificate, test report, signed and stamped letter from manufacturer, tender specification extracts, etc.

Waste & Pollution

An interior space and its occupants produce various forms of waste and pollution. These include solid waste, water pollution, and atmospheric pollution (through ozone depleting chemical and Greenhouse Gases). Reducing waste generation and pollution emission should be a key aim of any green interior space, as pollution prevention is always preferable to remediation, which is costly and inefficient.

The credits within the Waste & Pollution Category of LOTUS Interiors encourage strategies and technologies which minimize the generation, and hence minimize the negative effects of a wide range of waste and pollutants. Proper equipment and specification for building systems, as well as good management procedures throughout the lifespan of the building, can reduce the overall waste and pollution generated by the built environment. In addition to reducing waste generation, systematic reuse and recycling programs can also have a significant impact on waste and pollution discharge.

Waste & Pollution		5 Points
Item	Criteria	Points
WP-1	Refrigerants	1 point
	Option A: No Refrigerants or Low-Impact Refrigerants	
	Do not use refrigerants or use only low-impact refrigerants	1
	Option B: Refrigerant Atmospheric Impact of HVAC systems	
	The average Refrigerant Atmospheric Impact of all the air-conditioning systems installed in the building is below 11	1
	Option C: Strategies to limit the Atmospheric Impact of the refrigerants in the project (only applicable for projects with commercial refrigeration systems)	
	Implement 2 strategies to limit the atmospheric impact of the refrigerants used in air-conditioning, heat pump and commercial refrigeration systems	1
WP-2	Fit-out Waste	2 points
	Develop and implement a fit-out waste management plan	WP-PR 1
	Strategy A: Waste Diversion	
	Reuse, salvage and/or recycle 30% of fit-out waste	1
	Reuse, salvage and/or recycle 60% of fit-out waste	2
	Strategy B: Reduction of Waste Generation	
	Implement 2 strategies to reduce the waste generation during fit-out	1
WP-3	Operation Waste Management	2 points
	Strategy A: Environmentally friendly waste management system	
	Implement an environmentally friendly waste management system	1
	Strategy B: Dedicated recycling storage area	
	Provide a dedicated recycling storage area for use by all project occupants	1

WP-1 Refrigerants

Intent

To encourage the installation of systems that limit the atmospheric impact due to the use of refrigerants.

Requirements

Criteria	1 Point
Option A: No Refrigerants or Low-Impact Refrigerants	
Do not use refrigerants or use only low-impact refrigerants	1
Option B: Refrigerant Atmospheric Impact of HVAC systems	
The average Refrigerant Atmospheric Impact of all the air-conditioning systems serving the project space is below 11	1
Option C: Strategies to limit the atmospheric impact from refrigerants (only applicable for projects with commercial refrigeration systems)	
Implement 2 strategies to limit the atmospheric impact of the refrigerants used in air-conditioning, heat pump and commercial refrigeration systems	1

Approach & Implementation

For all options

- No CFC refrigerant or refrigerants with an ODP higher or equal to 0.05 should be installed in the building to be eligible for the credit.
- Systems using less than 250 grams of refrigerant should not be considered in the credit.

Option A: No Refrigerants or Low-Impact Refrigerants

The project should comply with either of the following requirements:

- No systems using refrigerants are serving the interior project space
- All the refrigerants in systems serving the interior project space are low-impact refrigerants which are refrigerant with ozone depletion potential (ODP) of zero and a global warming potential (GWP_{100}) of less than 50.

Option B: Refrigerant Atmospheric Impact of Air-conditioning systems

Projects with commercial refrigeration systems shall meet the requirements of at least one strategy of the Option C to be eligible for points under option B.

Refrigerants that have a limited atmospheric impact such as those in Table WP.1 should be selected. In general, such refrigerants should have both low GWP_{100} values (under 2000) and ODP values of 0.

The atmospheric impact of refrigerants can also be limited by using equipment which use a low refrigerant charge (centralized direct expansion systems to be avoided) and which can ensure a lower leakage rate of the refrigerant (under 2% per year).

Table WP.1: List of some selected refrigerants that have a limited atmospheric impact (values from IPCC Fifth Assessment Report 2013)

Refrigerant	ODP	GWP_{100}
R134a	0	1,300
R32	0	675
CO_2	0	1

Option C: Strategies to limit the atmospheric impact from refrigerants

This option is only applicable for projects with commercial refrigeration systems. Commercial refrigeration equipment includes the following:

- Walk-in refrigerators
- Walk-in freezers
- Refrigerated casework

To reduce the refrigerant atmospheric impact of air-conditioning, commercial refrigeration and heat pump systems, different strategies can be implemented:

- Centralized direct expansion systems shouldn't be used as such systems have high refrigerant charge and high leakage rate.
- All the refrigerants should have a GWP_{100} below 2000 and an ODP ≤ 0.02. Refrigerants like the R404A, still commonly used and with a high GWP_{100} (3943 under IPCC fifth assessment) should be discouraged as many alternatives from other HFCs (such as R134a, R407A...) to HFOs exist.
- Natural refrigerants should be used in as many systems as possible; they have extremely low GWP_{100} values and can be used efficiently for heat pumps (with CO_2) and for commercial refrigeration in configurations such as cascade or indirect systems (with CO_2, propane, etc.).
- Indirect (also called secondary loop) systems are systems that use a chiller to cool a secondary fluid that is then circulated throughout the building to the cases and coolers. With a much lower refrigerant charge, these systems are effective to limit the warming impact of commercial refrigeration.

Calculation

Option B: Refrigerant Atmospheric Impact of Air-conditioning systems

Using the following equation, the Refrigerant Atmospheric Impact of all the air-conditioning equipment using more than 250 grams of refrigerant in the building should be calculated.

$$\text{Refrigerant Atmospheric Impact} = \frac{\sum_{\text{unit}} [(\text{LCGWP} + \text{LCODP} \times 10^5) \times \text{Q}_{\text{unit}}]}{\text{Q}_{\text{total}}}$$

Where:

Q_{unit} = Cooling capacity of an individual air-conditioning equipment (kW)

Q_{total} = Total cooling capacity of all air-conditioning equipment (kW)

LCGWP, the Lifecycle Global Warming Potential (kg CO_2/kW/Year) and LCODP, the Lifecycle Ozone Depletion Potential (kg CFC 11/kW/Year) are calculated as follows:

LCGWP = [GWPr × (Lr ×Life + Mr) × Rc] / Life

LCODP = [ODPr × (Lr ×Life + Mr) × Rc] / Life

GWPr = Global Warming Potential of Refrigerant (0 to 12,000 kg CO_2/kg r) coming from the IPCC Fifth Assessment Report (AR5) in 2013.

ODPr = Ozone Depletion Potential of Refrigerant (0 to 0.2 kg CFC 11/kg r) coming from the stratospheric ozone protection regulations at 40 CFR Part 82

Lr = Refrigerant Leakage Rate (0.5% to 2.0%; default of 2% unless otherwise demonstrated)

Mr = End-of-life Refrigerant Loss (2% to 10%; default of 10% unless otherwise demonstrated)

Rc = Refrigerant Charge (0.2 to 2.3 kg of refrigerant per kW of rated cooling capacity)

Life = Equipment Life (default based on Table WP.2, unless otherwise demonstrated)

Table WP.2: Recommended Lifetime values for different types of equipment (Source: ASHRAE Applications Handbook, 2007)

Equipment type	Recommended Lifetime (years)
Window air-conditioning units and heat pumps	10
Unitary, split, and packaged air-conditioning units and heat pumps	15
Reciprocating compressors, scroll compressors and reciprocating chillers	20
Absorption chiller	23
Water cooled packaged air-conditioners	24
Centrifugal and screw chillers	25

Submissions

Provisional Certification Stage
Option A: No Refrigerants or Low-Impact Refrigerants
If no systems using refrigerants are serving the interior project space: No evidence required at this submission stage
If only low-impact refrigerants are used: • Evidence showing that the proposed types of systems will be using low-impact refrigerants such as tender specifications, mechanical drawings of the HVAC systems, manufacturer's published data, etc.
Option B and Option C
• Mechanical drawings of the HVAC/R systems showing location and type of all the systems using refrigerants • Evidence showing the HVAC/R systems to be installed with the type and volume of refrigerants used such as tender specifications, schedule, manufacturer´s published data, etc.

Full Certification Stage
Option A: No Refrigerants or Low-Impact Refrigerants
If no systems using refrigerants are serving the interior project space: If it had not been approved at Provisional Certification or if there is any change: • Signed letter from the tenant committing that no system using refrigerants is serving the interior project space.
If only low-impact refrigerants are used: • Manufacturer's published data showing that the systems are using low-impact refrigerants • Evidence showing that the systems using low-impact refrigerants have been installed such as invoices, receipts, commissioning report, photographs, etc.
Option B and Option C
• As-built mechanical drawings of the HVAC/R systems showing location and type of all the systems using refrigerants • Manufacturer’s published data of the systems installed indicating the type and volume of refrigerants used • Evidence showing the HVAC/R systems installed such as invoices, receipts, commissioning report, photographs, etc.

WP-PR-1 & WP-2 Fit-out Waste

Intent

To encourage the reuse, salvage and recycling of fit-out waste and to minimize disposal in landfill.

Requirements

Criteria	2 Points
Develop and implement a fit-out waste management plan	W&P Prerequisite 1
Strategy A: Waste Diversion	
Reuse, salvage and/or recycle 30% of fit-out waste	1
Reuse, salvage and/or recycle 60% of fit-out waste	2
Strategy B: Reduction of Waste Generation	
Implement 2 strategies to reduce the waste generation during fit-out	1

Approach & Implementation

W&P Prerequisite 1

A Fit-out Waste Management Plan must be developed and implemented. This plan must consider all fit-out wastes (including demolition) and must specify the following:

- Goals of waste management: percentage of fit-out waste to be diverted from landfill
- Strategies to reduce the generation of waste on site
- Estimated volumes/tonnages of each type of waste
- For each material, strategies to reuse, salvage or recycle waste
- Parties responsible for carrying out various aspects of the WMP: recycling coordinator, recycling contractor, licensed haulers and processors, etc.
- Description of disposal methods, handling procedures and monitoring of wastes

Strategy A: Waste Diversion

Provide a waste storage area on the fit-out site for collection and separation of reusable and recyclable fit-out waste.

Recycle or reuse typical fit-out waste such as: brick, concrete, metals, plastic, glass, ceramic tiles, ceiling panels, corrugated cardboard, drywall, etc.

Strategy B: Reduction of Waste Generation

Consider and implement 2 of the strategies below to reduce waste generation during fit-out:

- Design solutions for resource efficiency (design to use fewer materials, optimization of the design such as matching building and product dimensions, etc.)
- Material Procurement (order only the amount of materials needed, use standard sizes and plan ahead to reduce offcuts)
- Construction Logistics (make sure materials are delivered, handled and stored properly to avoid damage)
- Offsite prefabrication (use pre-fabricated systems)
- Packaging reduction (buy materials with less packaging, reduce the use of adhesives in favor of interlocking tabs, have items such as sand and aggregate delivered in bulk and not in multiple bags, ask suppliers to take back packaging, etc.)

Calculation

Strategy A: Waste Diversion

Calculation is based on volume or weight. Units selected must be applied consistently across the entire credit. The percentage of waste diverted from landfill (e.g. reused, salvaged and recycled waste) must be calculated by the following method:

- Quantify amount of all waste generated by fit-out activities
- Quantify waste diverted from landfill disposal using the following formula:

$$Fit-out\ Waste\ Diverted\ [\%] = \frac{W_D}{W_G} \times 100$$

W_D = Waste diverted from landfill [kilograms, tons or m^3]

W_G = Total waste generated by fit-out activities [kilograms, tons or m^3]

Table WP.3: Example calculation of demolition and construction waste reused or recycled

Materials	Quantity (kgs)	Disposal Option	Where/Construction haulers & recyclers
Concrete	150	Recycle	Recycling Facility
Glass	6	Recycle	Recycling Facility
Cardboard	3	Recycle	Recycling Facility
Carpet, ceiling and floor tiles	9	Reuse	Reuse or recycle with manufacturer
All other wastes	63	Landfill	Landfill
Total fit-out waste	231		
Total fit-out waste diverted	168		

$$Fit - out\ Waste\ Diverted\ [\%] = \left(\frac{168}{231}\right) \times 100 = 73\%$$

This interior project space can be granted 2 points with more than 60% of fit-out waste diverted from landfill.

Submissions

Provisional Certification Stage
Waste & Pollution Prerequisite 1 and Strategy A: Waste Diversion
• Evidence showing that a fit-out waste management plan will be implemented such as tender specifications, signed letter from the tenant, etc.
Strategy B: Reduction of Waste Generation
• Evidence showing that strategies to reduce waste generation during fit-out will be implemented such as tender specifications, signed letter from the tenant, etc.

Full Certification Stage
Waste & Pollution Prerequisite 1 and Strategy A: Waste Diversion
• Evidence showing the waste storage area during fit-out such as execution plans, photographs, etc. • Evidence showing all the waste generated and all the waste diverted from landfill such as removal contracts, sales/trade documents, receipts, etc.
Strategy B: Reduction of Waste Generation
• Evidence showing that the strategies to reduce the waste generation have been implemented such as drawings, receipts, report, photographs, etc.

WP-3 Operation Waste Management

Intent

To encourage and facilitate the recycling of wastes generated during occupancy.

Requirements

Criteria	2 Points
Strategy A: Environmentally friendly waste management system	
Implement an environmentally friendly waste management system	1
Strategy B: Dedicated recycling storage area	
Provide a dedicated recycling storage area for use by all project occupants	1

Approach & Implementation

Strategy A: Environmentally friendly waste management system

An environmentally friendly waste management system should be developed and include the following aspects:

- Is pro-active in the management of potentially hazardous waste (such as batteries, light fittings, etc.)
- Is pro-active in increasing reuse and recycling of waste
- Is pro-active in reducing the disposal of waste in landfills or incineration facilities
- Is pro-active in reducing incoming waste streams (packaging, etc.)
- Is pro-active in educating, advising and facilitating building users to adopt environmentally friendly waste management practices

The environmentally friendly waste management system should be an ongoing commitment for which adequate resources are allocated.

Strategy B: Dedicated recycling storage area

Incorporate into the design a dedicated recycling storage area with recycling bins for the collection, separation and storage of recyclable wastes.

The storage area may be provided in the interior project design or provided in the base building but the following requirements must be met:

- The recycling storage area and the bins for each material must be clearly marked.

- The recycling storage area should be sized in accordance with Calculations section
- The recycling storage area should allocate storage space for at least the following recyclable materials:
    - Paper (including newspaper)
    - Corrugated cardboard
    - Plastics
    - Metals
    - Glass

Calculation

Strategy B: Dedicated recycling storage area

The recycling storage area shall be sized based on the total gross floor area of the project space (if located in the interior project space) or on the total gross floor area of the base building (if located in the base building) in accordance with Table WP.4.

Projects with a GFA less than 500 m^2 shall have a minimum area of 7.5 m^2 and projects with a GFA more than 20,000 m^2 shall use 0.15%. For projects with a dedicated recycling storage area over 50 m^2, a smaller percentage may be justified depending on the type of building and frequency of recycling pick-up, and can be judged on a case-by-case basis.

Table WP.4: Dedicated Recycling Storage Area Size Requirements
(*Source: GREEN STAR office version 3-2008, Materials, Mat-1 Recycling Waste Storage*)

Gross Floor Area (m^2)	Dedicated Recycling Area (% of GFA)
500	1.5%
1,000	0.80%
5,000	0.35%
10,000	0.25%
20,000	0.15%

Submissions

Provisional Certification Stage
Strategy A: Environmentally friendly waste management system
No evidence required at this submission stage
Strategy B: Dedicated recycling storage area
• Plans indicating the location and size of the dedicated recycling storage area

Full Certification Stage
Strategy A: Environmentally friendly waste management system
• Copy of the environmentally friendly solid waste management system manual • Signed letter from the tenant committing to implement and maintain the environmentally friendly solid waste management system
Strategy B: Dedicated recycling storage area
• As-built plans indicating the location and size of dedicated recycling storage area • Photographs showing the recycling storage area.

Health & Comfort

The World Health Organization reported in its Air Quality Guidelines (2nd Edition) that most of an individual's exposure to air pollutants comes from inhalation of indoor air. Besides air quality, the amount of noise and light pollution can also affect occupants as well as the surrounding communities. As the population of Vietnam is increasingly urbanized, it is estimated by the Ministry of Construction that urban population will increase by 45% within the next 20 years. This urban migration results in an increasing number of people spending an increasing amount of their time within the built environment. As a result, building occupants quality of life depends greatly on the indoor environment quality (IEQ).

Ensuring occupants' health and comfort is done most effectively by maintaining and increasing the building's IEQ. Improving the IEQ results in reduced cases of asthma, allergies, respiratory disease and other occupant ailments described as "sick building syndrome".

All credits within the Health & Comfort Category of LOTUS Interiors targets the overall improvement of the indoor environment in buildings. The improvements aim exactly at four different aspects of the indoor environment. First and most important aspect is the quality of indoor air. The building has to ensure fresh, clean air free of toxic chemicals for occupants. Moreover, a healthy indoor environment in a building has to be comfortable visually, acoustically and thermally for most of the occupants of the building.

Health & Comfort		20 Points
Item	Criteria	Points
H-PR-1	Indoor Smoking	PR
	Prohibit smoking in the project space	H-PR-1
H-1	Fresh Air Supply	2 points
	Provide sufficient fresh air supply to a minimum of 95% of the total net occupied area of the space	2
H-2	CO2 Monitoring	1 point
	Specify and install a CO_2 monitoring system	1
H-3	Low-VOC Emissions Products	4 points
	Strategy A: Paints and coatings	
	Specify and install low-VOC emission paints and coatings	1
	Strategy B: Adhesives and sealants	
	Specify and install low-VOC emission adhesives and sealants	1
	Strategy C: Floorings	
	Specify and install low-VOC emission floorings	1
	Strategy D: Composite wood	
	Specify and install low-formaldehyde emission composite wood	1
	Strategy E: Ceilings, partitions and insulation	
	Specify and install low-VOC emission ceilings, partitions and insulation	1
H-4	Pre-occupancy removal of pollutants	1 point
	Option A: Flush-out	
	Perform a flush-out procedure prior to occupancy	1
	Option B: Clean air supply ductwork	
	Ensure that all the air supply ductworks are cleaned prior to occupancy	1
H-5	Interior Plants	1 point
	Install a sufficient amount of carefully selected interior plants in the project space	1
H-6	Green Cleaning	1 point
	Use Environmentally friendly cleaning products	1
H-7	Daylighting	2 points
	60% of all occupied spaces have an average daylight factor between 1.5% and 3.5%	1
	80% of all occupied spaces have an average daylight factor between 1.5% and 3.5%	2

H-8	External Views	2 points
	Strategy A : Percentage of occupied areas providing external views	
	60% of the net occupied area achieves a direct line of sight to the outdoor environment via vision glazing	1
	80% of the net occupied area achieves a direct line of sight to the outdoor environment via vision glazing	2
	Strategy B : Quality views	
	60% of the net occupied area has quality views	1
H-9	Lighting Comfort	2 points
	For 1 point, meet requirements of at least 2 strategies to improve lighting comfort.	1
	For 2 points, meet requirements of at least 3 strategies to improve lighting comfort.	2
H-10	Thermal Comfort	2 points
	Strategy A: Thermal Comfort Design	
	95% of the occupied spaces shall be designed to avoid overheating under hot summer conditions	1
	Strategy B: Thermal Controls (only for air-conditioned spaces and mixed-mode ventilated spaces)	
	Provide individual thermal controls for at least 90% of individual occupant spaces - AND- Provide group thermal controls for all shared multi-occupant spaces	1
	Strategy C: Thermal Comfort Measurement (only for air-conditioned spaces and mixed-mode ventilated spaces)	
	95% of the occupied spaces shall meet with the following requirements: A. Air temperature within spaces is ±1.5°C of the set temperature when the air side system is operating at steady state under normal occupied periods. B. Relative humidity within spaces is less than 70%. C. Air movement within spaces is less than 0.3 m/s	1
H-11	Acoustic Comfort	1 point
	Option A: Internal Noise Levels	
	Spaces of the project comply with the requirements of TCXDVN 175:2005 - Maximum Permitted Noise Levels for Public Buildings – Design Standard	1
	Option B: Reverberation Time	
	Average reverberation time (T_{60}) in the spaces of the project meet requirements of the Performance Measurement Protocols for Commercial Buildings	1
H-12	Post-occupancy Comfort	1 point
	Conduct yearly post-occupancy survey to assess comfort and living conditions of the occupants of the interior space - AND - If occupants' average overall satisfaction score from the post-occupancy survey is less than 3 out of 5, develop an action plan based on the responses.	1

H-PR-1 Indoor Smoking

Intent

To minimise the effect of passive smoking.

Requirements

Criteria	PR
Prohibit smoking in the project space	Health & Comfort Prerequisite 1

Approach & Implementation

Smoking should be banned inside the whole project space and projects should ensure all building users are aware of the smoking ban by displaying “No Smoking” signs near the space entrance and in area of prominence that may be frequented by smokers.

Exception: Projects that are listed in Decision 1315/QĐ-TTg such as exhibition centers, sporting halls, hotels, etc. may allow smoking in designated areas inside the project space but these areas must have a separated ventilation system.

Submissions

Provisional Certification Stage
For all projects:
• Signed letter from the tenant committing to prohibit smoking in the project space
For projects where designated smoking areas are to be provided in the project space:
• Plans indicating the location of designated smoking areas • Mechanical drawings showing the ventilation system for the designated smoking areas

Full Certification Stage
For all projects:
• Photographs showing the “no smoking” signs
If it had not been approved at Provisional Certification or if there is any change: • Signed letter from the tenant committing to prohibit smoking in the project space

For projects where designated smoking areas are provided in the project space:
• Photographs showing the designated smoking areas • As-built plans indicating the location of designated smoking areas • As-built mechanical drawings showing the ventilation system for the designated smoking areas

H-1 Fresh Air Supply

Intent

To ensure the provision of enough fresh air to maintain good indoor air quality during occupancy.

Requirements

Criteria	2 Points
Provide sufficient fresh air supply to a minimum of 95% of the total net occupied area of the interior project space	2

Approach & Implementation

This credit applies to all occupied spaces in the project space in order to provide good air quality for all occupants. A minimum of 95% of the total net occupied area should meet with the following requirements depending on the ventilation type.

Mechanically ventilated spaces:

HVAC systems and distribution ductwork must meet or surpass the requirements of one of the following international standards:

- TCVN 5687:2010 - Ventilation- Air Conditioning, Design Standards
- ASHRAE Standard 62.1 - Ventilation for Acceptable Indoor Air Quality (version 2007, 2010, 2013 or 2016)
- CIBSE Guide A - Environmental Design
- CIBSE Guide B - Heating, Ventilating, Air Conditioning and Refrigerant
- Australian Standard AS1668.2

These standards determine the minimum fresh air volumetric flow rate to be supplied to occupied spaces as a function of the space type and occupancy.

In mechanical ventilation systems, air supply and exhaust in the different spaces should be designed carefully to avoid any short circuiting of the supplied air and ensure well mixed air within the space, with a particular focus on fresh air reaching the breathing zone.

Naturally ventilated spaces:

Naturally ventilated spaces (or mechanically assisted naturally ventilated spaces) must meet the following requirements (taken from section 5.1.1 of ASHRAE 62.1-2007):

- All spaces shall be within 8 meters of (and permanently open to) an operable wall or roof opening
- The total area of wall or roof openings shall be at least 4% of the floor area of the space

Exceptions:

- A space without direct openings to the outdoors can be naturally ventilated through adjoining rooms if the unobstructed openings between the rooms are at least 8% of the floor area (with a minimum of 2.3 m2)
- In the case that a project follows a prescriptive design procedure from a different code or standard, or if a project implements an engineered natural ventilation system, the project must provide all necessary information to demonstrate that the provision of fresh air will ensure a good air quality for all occupants. This shall be subject to VGBC approval.
- A space served by a cooling equipment cannot be considered as naturally ventilated space. Such a space should adopt a mixed-mode ventilation system to be compliant.

Mixed-mode ventilated occupied spaces:

Mixed-mode ventilated spaces (combination of natural ventilation from operable window, and mechanical systems that include air distribution equipment and HVAC) must meet both the above requirements for HVAC systems and for natural ventilation.

Calculations

Mechanically ventilated and mixed-mode ventilated occupied spaces:

For each of these occupied spaces, calculate minimum ventilation rates (fresh air supply) in accordance to one of the standards from the above list and demonstrate that designed ventilation rates meet the requirements of the selected standard.

Naturally ventilated and mixed-mode ventilated occupied spaces:

For each of these occupied spaces, perform calculations to show compliance with the above requirements adapted from section 5.1.1 of ASHRAE 62.1-2007.

Submissions

Provisional Certification Stage
For mechanically ventilated spaces and mixed-mode ventilated spaces:
• Mechanical drawings showing fresh air supply rates of AHUs and fans • Calculations demonstrating that the mechanical ventilation system designed meet the requirements of the standard selected for compliance
For naturally ventilated spaces and mixed-mode ventilated spaces:
• Plans and elevations indicating all operable wall and roof openings with their size

Full Certification Stage
For mechanically ventilated spaces and mixed-mode ventilated spaces:
• As-built mechanical drawings showing fresh air supply rates of AHUs and fans • Evidence of the HVAC equipment installed, such as invoices, receipts, commissioning records, etc.
If it had not been approved at Provisional Certification or if there is any change: • Calculations demonstrating that the mechanical ventilation system installed meet the requirements of the standard selected for compliance
For naturally ventilated spaces and mixed-mode ventilated spaces:
• As-built plans and elevations marking all operable wall and roof openings with their size • Photographs showing operable wall and roof openings

H-2 CO_2 Monitoring

Intent

To regulate indoor air quality via CO_2 monitoring.

Requirements

Criteria	1 Point
Specify and install a CO_2 monitoring system	1

Approach & Implementation

One of the two following techniques should be applied to high density occupied areas (at least 1 person for 3 m^2) of buildings to meet the requirements:

- Install permanent CO_2 sensors integrated with building automation systems to ensure continuous adjustments of the fresh air supply
- Monitor CO_2 concentrations and manually amend the operation schedules of ventilation systems accordingly. Configure all monitoring systems to generate an alarm when the CO_2 concentration gets higher than a CO_{2max} concentration set for each space. The alarm should be able to alert either the building operator through building automation system or the building occupants through visible or audible alerts. The CO_{2max} concentration, at which fresh air supply must be increased, shall be set at 1000 ppm or appropriately calculated for each different high density occupied area. Designers can refer to the Appendix A CO_2-Based Demand Controlled Ventilation of ASHRAE 62.1 User's Manual (2007 or 2010) for more details.

For both techniques, CO_2 sensors should be installed in a sufficient number and located between 1 and 2 meters above the finished floor (breathing zone). When monitoring large open spaces with largely uniform concentration levels, it is also acceptable to mount sensors in return air ducts.

In the case that hazardous gas risks (carbon monoxide, hydrogen sulphide, nitrogen dioxide etc.) are identified for a project, continuous monitoring systems to warn of dangerous conditions can be designed. Such a strategy may be eligible for an Innovation credit.

Submissions

Provisional Certification Stage
• Mechanical drawings showing location of the CO_2 sensors • Evidence showing technique that will be applied for the CO2 monitoring system such as tender specifications, design document, etc.

Full Certification Stage
• Extract of an operation and maintenance manual indicating the procedures for operation, adjustment and maintenance of the CO_2 monitoring system • Evidence showing that the CO_2 monitoring system has been installed, such as invoices, receipts, commissioning records, photographs, etc.

H-3 Low-VOC Emissions Products

Intent

To minimize the negative impacts of volatile organic compounds (VOCs) & formaldehydes from building materials on occupant's health.

Requirements

Criteria	4 Points
Strategy A: Paints and coatings	
Specify and install low-VOC emission paints and coatings	1
Strategy B: Adhesives and sealants	
Specify and install low-VOC emission adhesives and sealants	1
Strategy C: Floorings	
Specify and install low-VOC emission floorings	1
Strategy D: Composite wood	
Specify and install low-formaldehyde emission composite wood	1
Strategy E: Ceilings, partitions and insulation	
Specify and install low-VOC emission ceilings, partitions and insulation	1

Approach & Implementation

Specify and install low-VOC emission and low-formaldehyde emission products.

Are considered low-VOC emission products, the products which either:

- are certified as low-VOC emission products by any internationally or regionally recognized authorities/labels (e.g. Singapore Green Label, GreenGuard, Global Green Tag, etc.);
- or, have a VOC content lower than the limits set by any internationally or regionally recognized authorities/labels. The VOC content of the products should appear either on manufacturer's published data or on laboratory test results following relevant test methods such as: US EPA Reference Method 24, EN 16516, ASTM D6886, etc.;
- or, are inherently non-emitting VOC (stone, ceramics, powder-coated metals, plated metals or anodized metals, glass, concrete, clay brick, and unfinished/untreated solid wood)

Are considered as low-formaldehyde emission products, the products which either:

- do not exceed a concentration limit of 0.05 ppm of formaldehyde (0.06 mg/m2.h when expressed as emission rate) as tested following an internationally recognized standard
- or, do not contain any added urea-formaldehyde (UF) resin and phenol-formaldehyde (PF) resin
- or, are classified as U.L.E.F. (ultra-low-emitting formaldehyde) or N.A.F. (no added formaldehyde)

Strategy A: Paints and coatings

Install only low-VOC emission interior paints and coatings.

Strategy B: Adhesives and sealants

Install only low-VOC emission interior adhesives and sealants.

Strategy C: Floorings

Install only low-VOC emission flooring products and systems.
For floorings with inherently non-emitting products (ceramic tiles, solid timber, stone, polished concrete, etc.), if finishing products are used, they must be low-VOC products.

Strategy D: Composite wood

Install only products which are low-formaldehyde emission products.

Strategy E: Ceilings, partitions and insulation

Install only low-VOC emission ceiling, partition and insulation (including thermal and acoustic insulation but not HVAC ductwork insulation) products and systems.

Submissions

Provisional Certification Stage
Strategy A, Strategy B, Strategy C and Strategy E
• Evidence showing that the products to be installed are low-VOC products such as tender specifications, manufacturer's published data, certificate, test reports, etc.
Strategy D: Composite wood products
• Evidence showing that the products that will be installed are low-formaldehyde products such as tender specifications, manufacturer's published data, certificate, test reports, etc.

Full Certification Stage
Strategy A, Strategy B, Strategy C and Strategy E
• For each low-VOC product, evidence showing that the products installed are low-VOC products such as manufacturer's published data, certificate, test reports, etc. • Evidence showing that the low-VOC products have been installed such as invoices, receipts, delivery notes, etc.
Strategy D: Composite wood products
• For each low-formaldehyde product, evidence showing that the products installed are low-formaldehyde products such as manufacturer's published data, certificate, test reports, etc. • Evidence showing that the low-formaldehyde products have been installed such as invoices, receipts, delivery notes, etc.

H-4 Pre-occupancy removal of pollutants

Intent

To reduce the potential for indoor air quality problems resulting from the construction.

Requirements

Criteria	1 point
Option A: Flush-out	
Perform a flush-out procedure prior to occupancy	1
Option B: Clean air supply ductwork	
Ensure that all the air supply ductworks have been cleaned prior to occupancy	1

Approach & Implementation

Option A: Flush-out

The flush-out procedure that should be performed is based on ASHRAE 189.1 section 10.3.1.4 Indoor Air Quality (IAQ) Construction Management of Management.

A flush-out should be realized in all the occupied spaces of the interior project by supplying a minimum volume of fresh air in total air changes (TAC) prior to occupancy. The TAC value is calculated as the minimum fresh air supply rate (cf credit H-1) during a period of 14 days, refer to the formula in the Calculation section for more details.

To meet LOTUS requirements, project should comply with one of the two following options:

- Continuous Post-construction, Pre-occupancy Flush-out

The flush-out shall be continuous with a minimum fresh air supply rate no less than the design minimum (as calculated in credit H-1). The TAC required shall be supplied prior to occupancy.

- Continuous Post-construction, Pre-occupancy/Post-occupancy Flush -out

When occupancy is desired prior completion of the TAC, it is allowed for a space to be occupied after half of the TAC have been supplied to the space. Then, the space shall have a minimum fresh air supply rate of 1.5 L/s per m^2 or the minimum design rate calculated in the H-1 credit, whichever is greater. These conditions shall be maintained until the TAC required have been supplied to the space. The flush-out shall be continuous.

Option B: Clean air supply ductwork

All accessible supply air ductwork has to be cleaned to remove dust, dirt and mold prior to occupancy.

For a new building, the operational test and the cleaning of HVAC system should not be carried out until all construction work that produces dust ambient air has been completed.

This option is not applicable for projects that are not served by supply air ductwork.

Calculation

Option A: Flush-out

The total air changes (TAC) value shall be calculated for all spaces with the following formula:

$$\mathrm{TAC} = \mathrm{V} \times 1\mathrm{m}^3/1000\ \mathrm{L} \times 1/\mathrm{A} \times 1/\mathrm{H} \times 3600\ \mathrm{s/h} \times 24\mathrm{h/day} \times 14\ \mathrm{days}$$

With:

V = minimum fresh air supply rate of the space as determined in credit H-1 (L/s)

A = floor area (m^2)

H = ceiling height (m)

Submissions

Provisional Certification Stage
Option A: Flush-out
• Evidence showing that a flush-out procedure will be implemented before occupancy such as tender specifications, design document, etc.
Option B: Clean air supply ductwork
• Evidence showing that the ductwork will be cleaned prior to occupancy such as tender specifications, signed cleaning contract, etc.

Full Certification Stage
Option A: Flush-out
• Flush-out report including a description of the flush-out procedure implemented and a logbook with date, outdoor delivery rates, flushing duration, internal temperature, humidity.
Option B: Clean air supply ductwork
• Evidence that dust, dirt and mold have been removed from all accessible supply air ductwork prior to occupancy, such as ductwork inspection records, photographs (if appropriate), etc.

H-5 Interior Plants

Intent

To encourage the installation of interior plants that will improve indoor air quality and enhance the productivity.

Requirements

Criteria	1 point
Install a sufficient amount of carefully selected interior plants in the project space.	1

Approach & Implementation

Interior plants should be incorporated in the project space to improve the indoor environmental quality. The installation of interior plants should comply with the following requirements:

- Plants species should be suited for indoor environment
- The density of plants should be higher than one plant unit for 2 full time occupants and higher than one plant unit for every 50 m^2 of occupied area.
- No herbicides and pesticides should be applied to the plants

Calculation

The number of pot plant units should be calculated based on the width at the opening of the pot in accordance with Table H.1.

Table H.1: Equivalence between plant unit number and width at the opening of the pot

Width at the opening of the pot (mm)	Plant unit number
< 100	0.2
≥ 100 and < 200	0.33
≥ 200 and < 250	0.5
≥ 250 and < 320	1
≥ 320 and < 400	2
≥ 400 and < 550	3
≥ 550	4
Bed & Vertical Planting	Determine number of equivalent pots based on a width of 250mm.

Submissions

Provisional Certification Stage
• Evidence showing the number and the species of plants that will be installed such as tender layout plans, schedule of plants, letter from the tenant, etc.

Full Certification Stage
• Evidence showing that the plants installed are suitable to indoor environments such as letter of confirmation from the plant supplier, published document, etc. • Evidence showing the number and species of plants that have been installed such as receipts, invoices, etc.

H-6 Green Cleaning

Intent

To encourage the use of environmentally friendly cleaning products and procedures.

Requirements

Criteria	1 Point
Use Environmentally friendly cleaning products	1

Approach & Implementation

Green cleaning procedures should be implemented to clean each area of the project space with environmentally friendly products. The cleaning can be realized in-house or by appointing cleaning service providers.

Environmentally friendly cleaning products are less hazardous and less toxic cleaning products. Such products should be natural products (baking soda, lemon, apple cider, etc.) or should be products certified by recognized green labelling scheme such as:

- Green Seal
- Singapore Green Labelling Scheme
- Global Green Tag
- Safer Choice (US EPA)
- Green Specifications from EPD Hong Kong

Products which are not certified by a recognized green labelling scheme but can justify compliance with the Green Specifications of a recognized green labelling scheme will be considered as environmentally friendly cleaning products under LOTUS.

Submissions

Provisional Certification Stage
• Evidence showing that Environmentally friendly products will be used for cleaning such as tender specifications, signed cleaning contract, etc.

Full Certification Stage
If it had not been approved at Provisional Certification or if there is any change: • Evidence showing that Environmentally friendly products will be used for cleaning during the operations of the project such as letter from the tenant, cleaning contract, etc.

H-7 Daylighting

Intent

To encourage building designs which maximize the use of daylight.

Requirements

Criteria	2 Points
60% of all occupied spaces have an average daylight factor between 1.5% and 3.5%	1
80% of all occupied spaces have an average daylight factor between 1.5% and 3.5%	2

Approach & Implementation

Natural light promoting designs strategies include:

- Window arrangement
- Skylights
- Interior light shelves
- Open plan design

Calculations

The prediction of daylight factor (DF) requires knowledge of the proposed building and its surroundings. DF must be calculated for all occupied spaces (spaces included in the net occupied area). In order to simplify calculations, spaces within a building which present same orientation and glazing distribution can be grouped, but this has to be justified.

Calculations for this credit can be done using a daylight modelling software or using a spreadsheet. Spreadsheet calculations are suitable for simple, rectilinear buildings. More complicated buildings, such as curved or faceted buildings, cannot be assessed with this methodology and should be assessed using daylight modelling software.

Daylight modelling software

Use daylight factor outputs from a daylight modelling software to justify average daylight factor values in the occupied spaces. The design day used for daylight factor calculations should be on the 21st of September at 12:00pm.

Spreadsheet calculations

The average DF for each occupied space is calculated as follows (methodology developed by the Building Research Establishment in the UK):

$$DF = \frac{A_g \times \alpha \times M \times t \times 100}{A_{total} * (1 - \rho^2)}$$

DF = Average Daylight Factor [%]

A_g = Glazed area of windows in the zone studied (excluding frames or obstructions) [m^2]

A_{total} = Total internal surface area of the space [m^2]

α = Angle of visible sky from the mid-point of the window [Rad]. Angle of visible sky is determined as per the below figure (Figure H.1).

M = Maintenance factor. This factor considers the dirt on the exterior surface of the glass and takes into account the location of the building, the use of the room and the slope of the glazing (Table H.2)

t = Visible light transmission (Values of Table H.3 can be used if manufacturer's data is not available)

ρ = Average reflectance of surrounding room surfaces (recommended values in Table H.4 can be used)

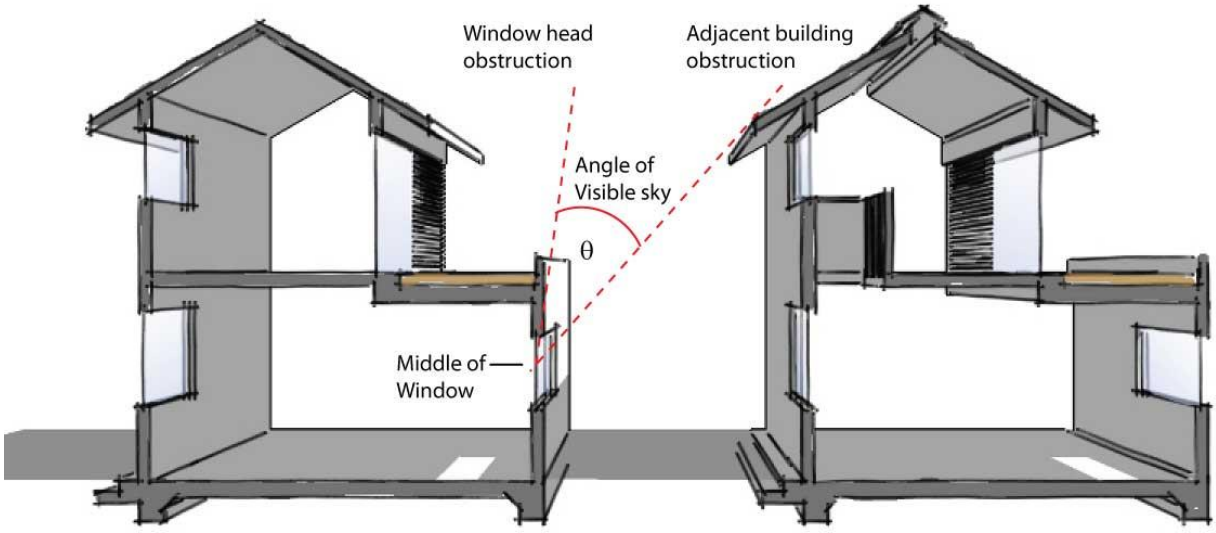

Figure H.1: Angle of visible sky from the mid-point of the window

Table H.2: Maintenance factors (*Source: Introduction to Architectural Science. Steven V. Szokolay*)

Location	Slope	Window Condition	
		Clean	Dirty
Non-Industrial Area	Vertical	0.9	0.8
	Sloping	0.8	0.7
	Horizontal	0.7	0.6
Dirty Industrial Area	Vertical	0.8	0.7
	Sloping	0.7	0.6
	Horizontal	0.6	0.5

Table H.3: Visible light transmission (*Source: Efficient Windows Collaborative*)

Glazing Type		Glazing Transmission
Single-Glazed	Clear	0.90
	Tinted	0.68
	Reflective	0.27
Double-Glazed	Clear	0.81
	Tinted	0.62
	Reflective	0.10
	High-solar-gain low-E	0.75
	Low-solar-gain low-E	0.64

Table H.4: Recommended average reflectance for ceiling, walls and floor (*Source: CIBSE Guide F Energy Efficiency in Buildings*)

Room Surface	Recommended Reflectance
Ceiling	0.7
Walls	0.5
Floor	0.2

In both calculations methods, the suggested method shall be followed:

- Calculate the average DF in all the rooms part of the net occupied area
- Identify all the rooms that have an average DF value between 1.5% and 3.5%
- All these rooms are considered as compliant for the daylighting credit (rooms with a DF above 3.5% can also be considered compliant but only if manual shadings are provided)
- Sum the areas of all these rooms and compare them to the net occupied area of the building using the following formula:

$$\text{Compliant Area Percentage } [\%] = \frac{A_C}{A_O} \times 100$$

A_C = Compliant occupied area (sum of the areas of the compliant rooms) [m^2]

A_O = Net occupied area [m^2]

Note: Projects using Climate Based Daylight modelling (CBDM) to optimize their daylight design may use methods such as daylight Autonomy (DA) or useful daylight illuminance (UDI) to demonstrate compliance with the credit. This shall be performed under VGBC guidance and might help to achieve an innovation credit.

Submissions

Provisional Certification Stage
• Floor plans and elevations indicating the occupied spaces and all glazed areas If daylight factor calculations have been done using a daylight modelling software: • Report indicating the inputs and outputs (average daylight factor values of all the occupied rooms) of the modelling

Full Certification Stage
• As-built floor plans and elevations
If it had not been approved at Provisional Certification or if there is any change: • Floor plans and elevations indicating the occupied spaces and all glazed areas • If daylight factor calculations have been done using a daylight modelling software, report indicating the inputs and outputs of the modelling

H-8 External Views

Intent

To increase the occupants connection to the outdoors by ensuring direct line of sight to the exterior.

Requirements

Criteria	2 Points
Strategy A : Percentage of occupied areas providing external views	
60% of the net occupied area achieves a direct line of sight to the outdoor environment via vision glazing	1
80% of the net occupied area achieves a direct line of sight to the outdoor environment via vision glazing	2
Strategy B : Quality views	
60% of the net occupied area has quality views	1

Approach & Implementation

For this credit, a glazing can be considered as an external view only if:

- It is present between 0.8 m and 2.2 m above the finished floor
- And it provides a clear image of the exterior, not obstructed by frits, fibers, patterned glazing, or added tints that distort color balance.

Strategy A: Percentage of occupied areas providing external views

Many strategies should be considered to offer occupants a connection to the outdoors, including:

- Locating open areas near the perimeter of the building
- Locating unoccupied spaces within the core of the building
- Application of glazing for internal partitions

The occupied area achieving a direct line of sight to the outdoor environment via vision glazing should be measured as follows:

- The lines of sight begin at 45 degrees from the edge of each external view.
- Lines of sight can pass through 2 interior glazing surfaces, but not a doorway with a solid door. Moveable partitions and non-fixed furniture shall not be taken into account

Strategy B: Quality views

To comply with this strategy, 60% of the net occupied area must have quality views.

To qualify as an area with quality views, the area must at least meet two of the following requirements:

- have a direct line of sight to an external view that is unobstructed for at least 8 meters from the exterior of the glazing;
- have a direct line of sight to an external view that includes vegetation, fauna or sky;
- have a direct line of sight to an external view that includes movement;
- have multiple lines of sight to the outdoors via vision glazing in different directions at least 90 degrees apart.

Calculations

Strategy A: Percentage of occupied areas providing external views

Compliant areas shall be calculated using the following procedure:

- Identify all occupied spaces and their areas
- Identify all areas within these occupied spaces that have a direct line of sight to the exterior.
- If at least 75% of a room's floor area has a direct line of sight to the outdoor, the entire floor area shall be counted towards having a view to the outdoors. If less than 75% of the area has a view, calculate/estimate the total area with a direct line of sight to the outdoors
- Calculate the percentage of the floor space that is compliant using the following formula:

$$\text{Compliant Area } [\%] = \frac{\text{Total compliant floor space}}{\text{Net occupied area}} \times 100$$

Figure H.2 and Table H.5 give an example of the calculation method.

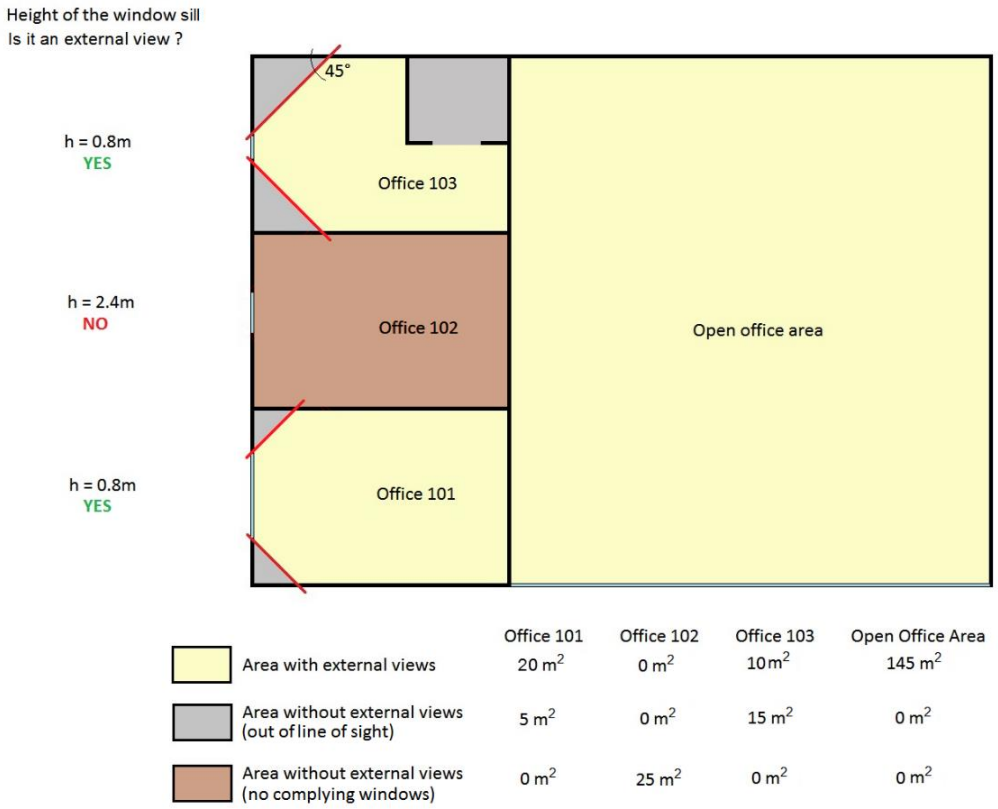

Figure H.2: Example of Calculation Method for External Views

Table H.5: Example of Calculation Method for External Views

Room	Total Occupied Area [m²]	External View? [Y or N]	Area with External View (measured) [m²]	Compliant Area [m²]
Office 101	25	Y	20	25
Office 102	25	N	/	0
Office 103	25	Y	10	10
Open Office Area	145	Y	145	145
TOTAL	220	-	175	180

In this example, it can be shown that 82% of the net occupied area is compliant, leading to the award of 2 credit points.

Strategy B: Quality views

Compliant areas shall be calculated using the following procedure:

- Identify all occupied spaces and their areas
- Identify all areas within these occupied spaces that have quality views (areas where at least 2 of the requirements listed in Approach & Implementation are met)

- If at least 75% of a room's floor area has quality views, the entire room floor area shall be counted towards having quality views. If less than 75% of the area has a quality view, calculate/estimate the total area with quality views
- Calculate the percentage of the floor space that is compliant using the following formula:

$$\text{Compliant Area } [\%] = \frac{\text{Total compliant floor space}}{\text{Net occupied area}} \times 100$$

For each occupied space, it is possible to have different areas with different types of quality views. For example, in one room, a part of the room may have a direct line of sight with a view including both vegetation and movement while another part of the room may have multiple lines of sight to the outdoors including a line of sight to an unobstructed external view.

Submissions

Provisional Certification Stage
Strategy A: External views
• Floor plans indicating the occupied spaces and the areas with direct line of sight to outdoors • Sections and elevations showing the height and location of external views and the height of solid internal partitions (if any)
Strategy B: Quality views
• Floor plans indicating the occupied spaces and the areas with quality views

Full Certification Stage
For both strategies:
• As-built floor plans, sections and elevations
Strategy A: External views
If it had not been approved at Provisional Certification or if there is any change: • Floor plans indicating the occupied spaces and the areas with direct line of sight to outdoors • Sections and elevations showing the height and location of external views and the height of solid internal partitions (if any)
Strategy B: Quality views
• Photographs showing the different types of quality views
If it had not been approved at Provisional Certification or if there is any change: • Floor plans indicating the occupied spaces and the areas with quality views

H-9 Lighting Comfort

Intent

To encourage the provision of high quality lighting that provides good comfort to occupants.

Requirements

Criteria	2 points
For 1 point, meet requirements of 2 of the following strategies: • Strategy A: General Illuminance Average illuminance in 95% of the occupied spaces meet recommendations of QCXDVN 09:2005 (EEBC 2005). • Strategy B: Light Distribution 95% of the occupied spaces meet recommendations on illuminance uniformity • Strategy C: Color rendering index 95% of interior artificial light sources have a color rendering index (CRI) of 80 or higher • Strategy D: Glare Design lighting installations to limit glare and excessive reflection in all occupied areas. • Strategy E: Lighting level controls Give occupants the ability to control the lighting level in their immediate environment.	1
For 2 points, meet requirements of 3 of the above strategies.	2

Approach & Implementation

Strategy A: General Illuminance

Ensure sufficient light levels in the spaces by meeting recommendations on average illuminance of QCXDVN 09:2005. Other internationally recognized systems may be used to demonstrate compliance on average illuminance (SLL Code for Lighting from CIBSE, AS/NZS 1680.1:2006, EN12464-1, etc.)

Following QCXDVN 09:2005 recommendations in Table H.6, for a given space function, the corresponding average illuminance in the space shall not be less than the value listed in the “low” column. If no value is listed in the “Low” column, then the average illuminance for the space shall not be less than the value listed in the “general and task” column.

Table H.6: Minimum required illuminance levels
(Adapted from Table 12 of the Guidelines for Building Energy Code QCVN 09:2013/BXD)

Lighting purpose	Minimum lux level	Application
Lighting for rooms and common areas used infrequently and/or performing simple observation tasks	20	Minimum illuminance outside of pathway, outdoor shops, yard
	50	Outdoor pathway or yard
	70	Boiler house
	100	Transformer station, boiler area…
	150	Pathway inside industrial factories, shops, storage.
Normal indoor lighting	200	Minimum illuminance to perform work
	300	Average precision level work, general process in chemical industry and food processing, reading
	450	Checking work, drawing room, detailed part assembly, high precision of drawing work and color required
	1500	High precision machinery operating work, electronic part assembly and small tools required high precision level, meter and check complicated parts (task light can be used)
High precision level tasks	3000	Working with detailed, precision and particular e.g. small items or parts

Strategy B: Light Distribution

Illuminance uniformity is the ratio of the minimum illuminance to average illuminance.
The minimum illuminance uniformity is required on a given plane (i.e. work plane for offices) and may consider all types of lighting (general, accent, task, display).

The project should meet recommendations on illuminance uniformity from a recognized standard or from the SLL Handbook 2009 published by CIBSE as shown in Table H.7.

Table H.7: Summary of recommendations on illuminance uniformity
(Adapted from SLL Lighting Handbook 2009)

Building type	Space function	Minimum illuminance uniformity	Lighting types considered	Plane	Exceptions
Office	Work space	0.7	All	individual work surface	
Industrial	Workshop space	0.8	General lighting	working plane	
Retail	All	0.7	General lighting	Illuminance to be provided on the merchandise	where accent and display lighting is used
Hospital	Corridors	0.2	General lighting	Floor level	
	Wards	0.5	Combination of general and task lighting	General area of the bed	

Educational premises	Classroom, lecture hall	0.8	General lighting	plane of the desks	
	IT room	0.8	General lighting	plane of the desks	
	Arts room	0.8	General lighting	relevant plane	
	Science laboratory	0.8	General lighting	plane of the desks	
	Seminar room	0.7	All	task area	
	Library	0.7	All	task area	
	Assembly hall	0.8	General lighting	relevant plane	
	Music room	0.7	All	task area	
	Drama studio	0.7	All	task area	

Strategy C: Color rendering index

Select artificial light sources with a color rendering index (CRI) of 80 or higher.
Color rendering index (CRI) is a quantitative measure of the ability of a light source to reveal the colors of various objects faithfully in comparison with an ideal or natural light source.

Light sources located in areas where the activity is not impeded by a lower CRI (storage areas, mechanical rooms, etc.) or light sources specifically designed to provide colored lighting for effect, site lighting, or other special use may have a CRI lower than 80.

Strategy D: Glare

Glare is the sensation produced by excessively bright areas or excessively marked differences in luminance within an observer's field of view. Glare, which is found disturbing and impairs our sense of wellbeing, is known as discomfort glare.

To limit glare and excessive reflection in occupied areas, lighting fixtures must comply with one of the 2 following approaches.

- Prescriptive approach: Light fixtures must comply with either one of the following:
    - Light fixtures with low luminance: use light fixtures with a luminance of less than 2,500cd/m2 between 45 and 90 degrees from nadir (Exceptions include wallwash fixtures properly aimed at walls, indirect uplighting fixtures, provided there is no view down into these uplights from an occupied space above, and adjustable fixtures)
    - Obscured light sources: All bare light sources have been fitted with baffles, louvers, translucent diffusers, ceiling design, or other means that directly obscure the light source from all viewing angles by occupants, including looking directly upwards.
    -

- Unified glare rating approach:

  Unified glare rating (UGR) of the lighting installations must not exceed the maximum values recommended in internationally recognized standards (such as AS1680.1, EN 12464, CIBSE Glare Index, etc.). UGR is a general formula for assessing glare that takes account of all the luminaires in a room that contribute to the sensation of glare.

  It should be determined based on CIE 117-1995 - Discomfort Glare in Interior Lighting using:

  - a tabular method and respecting the proportions (width-to-length ratios) of the rooms;
  - or, a CAD software method
  - or, the UGR value provided by manufacturers (tabular value of the reference room UGRR (4H x 8H) based on a spacing-to-height ratio of 0.25 and ceiling/walls/floor reflectances of 0.7/0.5/0.2) may also be used.

Strategy E: Lighting level controls

Give occupants the ability to control the lighting level in their immediate environment by:

- Providing individual lighting level controls for at least 90% of occupants in individual occupant spaces
- Providing a lighting level control system in all shared multi-occupant spaces

Individual occupant spaces are spaces where occupants perform distinct tasks from one another and multi-occupant spaces are places of congregation, or where occupants pursue overlapping or collaborative tasks (e.g. conference rooms, classrooms, cafeteria, etc.). Only spaces where an occupant is expected to work or remain for an extended period of time should be considered in this credit.

The following lighting level controls/systems are considered as compliant for the individual occupant spaces:

- two component lighting system (for example, a background lighting system and a separate task lighting component)
- individual desk lamps
- digital dimmable lighting control system (through a manual dimming switch or a computer interface linked to a digital lighting control system)

For shared multi-occupant spaces, the following must be provided:

- A lighting control system that enable occupants to adjust the lighting to meet group needs and preferences, with at least three lighting levels or scenes (on, off, midlevel).
- Separate lighting controls for any presentation or projection wall

Submissions

Provisional Certification Stage
For all strategies
• Electrical lighting drawings showing all the lighting fixtures and/or lighting controls that will be installed in the project interior space
Strategy A: General illuminance
• Evidence showing the lumen output of the lighting fixtures that will be installed such as tender specifications, lighting schedule, design document, etc.
Strategy B: Light Distribution
• Evidence showing the lumen output of the lighting fixtures that will be installed such as tender specifications, lighting schedule, design document, etc. • Report indicating the inputs and outputs of the simulation realized to calculate expected values of illuminance uniformity
Strategy C: Color rendering index
• Evidence showing the color rendering index (CRI) of the lighting fixtures that will be installed such as tender specifications, lighting schedule, design document, etc.
Strategy D: Glare
If light fixtures with low luminance approach is followed: • Evidence showing that the lighting fixtures to be installed will be compliant such as tender specifications, lighting schedule, design document, manufacturer's published data, etc.
If obscured light sources approach is followed: • Evidence showing that the lighting fixtures to be installed will be obscured light sources such as tender specifications, lighting schedule, design document, manufacturer's published data, etc.
If unified glare rating approach is followed: • Evidence showing that the lighting fixtures to be installed will be compliant with unified glare rating such as tender specifications, design document, manufacturer's published data, etc.
Strategy E: Lighting level controls
• Evidence showing the lighting level control strategies that will be provided to occupants and indicating how they will work such as tender specifications, design document, etc.

Full Certification Stage
For all strategies:
• As-built electrical lighting drawings showing all the lighting fixtures and lighting controls that have been installed in the project interior space • Evidence showing that the lighting fixtures have been installed such as invoices, receipts, delivery notes, photographs, etc.
Strategy A: General illuminance
• Manufacturer's published data showing the lumen output of the lighting fixtures that have been installed

Strategy B: Light Distribution
• Manufacturer's published data showing the lumen output of the lighting fixtures that have been installed
If it had not been approved at Provisional Certification or if there is any change: • Final report indicating the inputs and outputs of the simulation realized to calculate expected values of illuminance uniformity
Strategy C: Color rendering index
• Manufacturer's data of all artificial lighting sources showing the CRI values
Strategy D: Glare
If light fixtures with low luminance approach is followed: • Manufacturer's published data showing luminance of the light fixtures with low luminance
If obscured light sources approach is followed: • Evidence showing that the lighting fixtures installed are obscured light sources such as manufacturer's published data, photographs, etc.
If unified glare rating approach is followed: • Results of UGR calculations or manufacturer’s published data showing UGR values
Strategy E: Lighting level controls
• As-built electrical lighting drawings showing all the lighting level controls and/or task lights installed in the project interior space • Evidence showing that the lighting level controls/systems have been installed such as invoices, receipts, delivery notes, photographs, etc.

H-10 Thermal Comfort

Intent

To encourage designs which achieve comfortable thermal conditions for occupants.

Requirements

Criteria	2 Points
Strategy A: Thermal Comfort Design	
95% of the occupied spaces shall be designed to avoid overheating under hot summer conditions	2
Strategy B: Thermal Controls (only for air-conditioned spaces and mixed-mode ventilated spaces)	
Provide individual thermal controls for at least 90% of individual occupant spaces - AND- Provide group thermal controls for all shared multi-occupant spaces	1
Strategy C: Thermal Comfort Measurement (only for air-conditioned spaces and mixed-mode ventilated spaces)	
95% of the occupied spaces shall meet with the following requirements: A. Air temperature within spaces is ±1.5°C of the set temperature when the air side system is operating at steady state under normal occupied periods. B. Relative humidity within spaces is less than 70%. C. Air movement within spaces is less than 0.3 m/s	1

Approach & Implementation

Air-conditioned spaces and mixed-mode ventilated spaces:

To achieve this credit, the project should design a properly sized air-conditioning system with appropriate thermal zoning.

Non-air-conditioned spaces:

In non-air-conditioned spaces, to avoid overheating during the hottest days of the year, it is necessary to provide appropriate air velocity in the space and to limit to a minimum all types of external and internal heat gain (solar gains, artificial lighting, equipment, occupancy, etc.).

The following strategies will help to achieve the credit for non-air-conditioned spaces:

- Enhance indoor air velocity using fans or through carefully designed natural ventilation
- Limit solar radiation on glazing by installing effective external shadings on windows
- Limit solar radiation on opaque walls and roofs
- Limit internal heat gains (from artificial lighting and equipment)
- Optimize daylighting (and thus limit the use of internal artificial lighting)

Strategy A: Thermal Comfort Design

Air-conditioned spaces and mixed-mode ventilated spaces:

During cooling period, air-conditioning systems shall be designed to maintain consistent indoor conditions with an operative temperature set between 24° to 26°C and a relative humidity set below 70%.

A building energy simulation should be performed to demonstrate that the selected indoor conditions will be maintained consistently and that the number of unmet load hours (hour in which one or more zones is outside of the thermostat setpoint range) will not exceed 2% of the occupied hours during the cooling period.

Non-air-conditioned spaces:

Method 1: Spaces shall meet the requirements of Section 5.3 of ASHRAE 55-2004. In particular, at design conditions, indoor operative temperature of the spaces should be within the 80% acceptability limits given in Figure 5.3 of ASHRAE 55-2004.

Method 2: Spaces comply with at least 1 strategy in each of the three following categories:

A. Indoor air velocity
   - requirements of credit E-3 on natural ventilation are met
   - or, ceiling or wall fans are installed with at least one fan for every 20 m^2
   - or, high-volume low-speed (HVLS) fans are installed

B. Reduction of external (solar) heat gains
   - effective external shadings are installed on all the windows of the space
   - exterior walls and roofs surrounding the space have a solar reflectivity> 0.7 or are vegetated or have external shadings

C. Reduction of internal heat gains
   - Lighting Power Density of the space is reduced by more than 30%
   - 50% of all the equipment installed have an energy label
   - average daylight factor is between 1.5% and 3.5%

Strategy B: Thermal Controls

This strategy can only be applied for air-conditioned spaces and mixed-mode ventilated spaces.

Thermal controls allow occupants, whether in individual spaces or shared multi-occupant spaces, to adjust at least one of the following in their local environment: air temperature, radiant temperature, air speed, and humidity.

Strategy C: Thermal Comfort Measurement

This strategy can only be applied for air-conditioned spaces and mixed-mode ventilated spaces.

The measurements should be carried in accordance with requirements set in sections 6 and 7 of TCXVN 306:2004 - Dwellings and Public Buildings - Parameters for Microclimates in Rooms.

Calculations

Strategy A: Thermal Comfort Design

Non-air-conditioned spaces:

For Method 2, the following calculations should be realized for each occupied space:

A. Indoor air velocity

- Calculations in accordance with strategy A of credit E-1,

  - OR -

- Density of ceiling or wall fans in the space should be calculated as the number of fans divided by the area of the space. At least one ceiling or wall fans per 20 m^2 should be installed (QCVN 09:2005 requirement).

C. Reduction of internal heat gains

- LPD reduction: LPD value of the space should be calculated following explanations in strategy A of credit E-2. This value should be compared with the LPD value of the same space type in Table A.1 (in Appendix section) in order to calculate the percentage of LPD reduction.

  - OR -

- Calculate the percentage of equipment installed (based on power ratings) that meet the requirements of any recognized energy label: Energy Star, VNEEP (minimum 4 stars), etc.

  - OR -

- Calculations in accordance with credit H-7 on daylighting to demonstrate the daylight factor of the space is between 1.5% and 3.5%. Unlike in credit H-7, spaces with a daylight factor higher than 3.5% and using internal manual shadings are not compliant for this credit.

Submissions

Provisional Certification Stage
Strategy A: Thermal Comfort Design
For all the air-conditioned spaces and mixed-mode ventilated spaces: • Mechanical drawings showing all the HVAC systems that will serve the interior project space • Report of a building energy simulation showing inputs/outputs of the simulation, the temperature and humidity setpoints used and the number of unmet load hours.
For all the non-air-conditioned spaces: • If method 1 is followed, report showing calculation of the maximum indoor operative temperature during design day • If method 2 is followed, calculations showing compliance with the strategies pursued to limit heat gains and to enhance air velocity.
Strategy B: Thermal Controls
• Evidence showing all the thermal controls that will be installed such as tender specifications, mechanical drawings, schedule of all thermal controls, design document, etc.
Strategy C: Thermal Comfort Measurement
Strategy not available at Provisional Certification stage

Full Certification Stage
Strategy A: Thermal Comfort Design
For all the air-conditioned spaces and mixed-mode ventilated spaces: • As-built mechanical drawings showing all the HVAC systems serving the interior project space If it had not been approved at Provisional Certification or if there is any change: • Final report of a building energy simulation showing inputs/outputs of the simulation, the temperature and humidity setpoints used and the number of unmet load hours.
For all the non-air-conditioned spaces: If it had not been approved at Provisional Certification or if there is any change: • If method 1 is followed, final report showing calculation of the maximum indoor operative temperature during design day and demonstrating compliance with Section 5.3 of ASHRAE 55-2004. • If method 2 is followed, final calculations showing compliance with the strategies pursued to limit heat gains and to enhance air velocity.
Strategy B: Thermal Controls
• As-built mechanical drawings indicating the location of thermal controls • Evidence showing that the thermal controls have been installed such as invoices, receipts, delivery notes, photographs, etc.
Strategy C: Thermal Comfort Measurement
• Thermal Comfort measurements showing compliance with requirements

H-11 Acoustic Comfort

Intent

To provide a comfortable acoustic environment for occupants.

Requirements

Criteria	1 Point
Option A: Internal Noise Levels	
Spaces of the project comply with the requirements of TCXDVN 175:2005 - Maximum Permitted Noise Levels for Public Buildings – Design Standard	1
Option B: Reverberation Time	
Average reverberation time (T_{60}) in the spaces of the project meet requirements of the Performance Measurement Protocols for Commercial Buildings	1

Approach & Implementation

Option A: Internal noise levels

TCXDVN 175:2005 and related standards outline many strategies which can be applied to reduce noise levels. Reduction of noise inside and outside of the building should include but not be limited to the following strategies:

- Use wall, window and roof materials which provide good acoustic insulation properties
- Install wall and roof insulation with good acoustic insulation properties
- Locate noise-sensitive areas away from noise-producing areas
- Place acoustic buffers, such as corridors, lobbies, stairwells, electrical/janitorial closets and storage rooms, between noise-producing and noise-sensitive spaces
- Proper slab construction between floors
- Screens to reduce the impact of noise from external sources
- Consider acoustic properties when selecting surface finishes
- Avoid locating outside air intakes or exhaust-air-discharge openings near windows, doors, or vents where noise can re-enter the building
- Wrapping or enclosing rectangular ducts with insulation materials and use sound attenuators and acoustic plenums to reduce noise in ductwork

The maximum allowable noise level is the maximum noise level in the room that must not be exceeded, in order to ensure acoustic comfort suitable for the activity in the room.

Maximum allowable noise levels are specified in two ways depending on the acoustic quality requirements of rooms. Table H.8 reflects the specifications applicable to spaces that do not require high acoustic quality. More information and guidance can be found within the standard for spaces that require high acoustic quality.

Table H.8: Maximum allowable noise level for public buildings *(Source: Extract from Table 2 - TCXDVN 175:2005 - Maximum permitted noise levels for public buildings – Design standard)*

Space type	Time (hr)	Maximum noise level (dB,A)
EDUCATION FACILITIES		
1 - Kindergarten, nursery, boarding primary schools		
Bed rooms in kindergarten, boarding primary schools	6 - 22	45
	22 - 6	35
Class room	-	50
Playground (outside)	-	55
Areas around schools (outside)	-	60
2 - Secondary or tertiary schools, universities, colleges, vocational schools		
Conference hall	-	45
Lecture hall, class rooms	-	50
Labs	-	50
Offices in schools	-	50
Staff rest rooms	-	55
OFFICES		
3 - Office buildings, Design and Research facilities		
Working spaces, with office equipment, computers	-	50
Reception rooms	-	50
4 - Court		
Court room	-	45
Working spaces	-	50
COMMERCIAL & SERVICE FACILITIES		
5 - Shops, malls, supermarkets	-	60
6 - Restaurants, beverage shops	-	55
7 - Public service centers: laundry, clothes tailor, equipment and electronics repair, hairdresser, bath	-	60
8 - Central market (with or without roofs)	-	60

Internal noise levels should be measured in accordance with TCVN 5964 - 1995: Description and measurement of environmental noise.

Option B: Reverberation Time

Average reverberation time (T_{60}) in the spaces of the project must meet values in Table H.9.

A reverberation is the overall effect of reflected sound and the time required for reflected sound to become inaudible. The reverberation time (T_{60}) measures the reflectivity of a room and consequently a room's absorbance to sound waves. The higher the reflectivity of a room, the longer the reverberation time will be. The reverberation time is proportional to the volume of the space, and inversely proportional to the amount of sound absorbing material within the space.

The reflectivity is dependent on the following factors:

- Geometry
- Room fittings
- Nature of sound source

Table H.9: Reverberation time requirements (*Source: Adapted from ASHRAE (2007d), ASA (2008), ANSI (2002), and CEN (2007)*)

Space type	Application	T_{60} (sec)
Apartment and condominium	-	< 0.6
Hotel/motel	Individual room or suite	< 0.6
	Meeting or banquet room	< 0.8
Office building	Executive or private office	< 0.6
	Conference or Teleconference room	< 0.6
	Open-plan office	< 0.8
Hospital & Clinic	Private rooms	< 0.6
	Wards	< 0.6
Courtroom	Unamplified speech	< 0.7
	Amplified speech	< 1.0
Performing arts space	Drama theaters, concert and recital halls	Varies by application
Laboratories	Testing or research with minimal speech communication	< 1.0
	Extensive phone use and speech communication	< 0.6
Library	-	< 1.0
Indoor stadium, gymnasium	Gymnasium and natatorium	< 2.0
	Large-capacity space with speech amplification	< 1.5
School	Classroom	< 0.6
	Large lecture room with speech amplification	< 0.7
	Large lecture room without speech amplification	< 1.0

Calculation

Option B: Reverberation Time

Reverberation time values can be found through measurements in accordance with ISO 3382 Acoustics - Measurement of the reverberation time for rooms with reference to other acoustical parameters.

Also, reverberation time can be calculated theoretically using a modelling software that includes an acoustic component or with a calculator.

Submissions

Provisional Certification Stage
Option A: Internal Noise Levels
Strategy not available at Provisional Certification stage
Option B: Reverberation Time
• Signed letter from the tenant committing to perform noise levels measurements of the interior project space

Full Certification Stage
Option A: Internal Noise Levels
• Noise levels measurements showing compliance with TCXDVN 175:2005
Option B: Reverberation Time
• Results of the calculations or measurements of reverberation time If calculations of reverberation time have been performed: • Evidence showing that the materials used in the calculations have been installed such as as-built plans, receipts, invoices, etc.

H-12 Post-occupancy Comfort

Intent

To ensure comfort for occupants during operation.

Requirements

Criteria	1 Point
Conduct a post-occupancy comfort survey of building occupants within 3 to 6 months after occupancy - AND - Develop a corrective action plan based on the responses	1

Approach & Implementation

Conduct a post-occupancy comfort survey of building occupants within 3 to 6 months after occupancy. This survey should use Table H.10 as a template and collect anonymous responses about thermal comfort, air quality, visual comfort and acoustic comfort in the interior project space. Responses should be collected from a significant and representative sample of occupants.

Table H.10: Post-occupancy survey table

Comfort Category	1 Very Bad	2 Bad	3 Satisfactory	4 Good	5 Excellent
Thermal Comfort					
Air Temperature					
Humidity					
Air speed					
Air quality					
Air odor					
Visual Comfort					
Natural light					
Artificial light					
Acoustic Comfort					
Exterior noise					
Interior noise					
Overall Comfort					
Overall comfort					

Occupants' average overall satisfaction score should be calculated as the average score given by the occupants in the survey for all the comfort categories.

If the survey results indicate an average score of less than 3 out of 5 for any of the comfort categories, a corrective action plan should be developed and implemented.

This plan should first aim to identify precisely each problem and determine the root cause by doing inspections, more detailed occupant survey and/or measuring relevant environmental variables including:

- Thermal comfort: air temperature, relative humidity and air speed,
- Air quality: odor problem, CO_2 level, VOCs and particulate concentration
- Visual comfort: lighting level (lux), glare problem
- Acoustic comfort: background noise level.

Then, appropriate corrective actions should be implemented to fix the problem and prevent the problem happening again.

Submissions

Provisional Certification Stage
No evidence required at this submission stage

Full Certification Stage
• Results of the post-occupancy comfort survey
• Evidence that the measurements and corrective actions have been undertaken

Location & Transportation

To make sure that an interior space is really sustainable, not only fit-out activities, interior architecture, selection of equipment and systems should be considered but also the proper integration of the project with the surroundings.

Interior projects being located inside existing base buildings can be positively or negatively impacted from the performance of the base building. A well-selected interior space in a base building with green attributes and with adequate facilities and amenities can improve the sustainable performance of the project and the well-being of the project occupants. Also, through a long-term lease or a green lease, interior project can help further to conserve resources and reduce environmental impacts.

Sustainable interior projects should also contribute to the development of green transportation in Vietnam in order to reduce the consumption of fossil fuels required for the transport of the occupants. Projects should raise awareness of the different green transport means available to occupants and implement policies to ensure a significant proportion of occupant trips are made by green transport.

The Location and Transportation category rewards projects which select a base building and a lease type that will help to improve the sustainability performance of the project as well as projects which help developing green transportation.

Location & Transportation		8 Points
Item	Criteria	
LT-1	Green base building	3 points
	Option A: LOTUS certified base building	
	Base building is certified under a recognized green building certification system with a rating equivalent to LOTUS Certified or Silver Certified	2
	Base building is certified under a recognized green building certification system with a rating equivalent to LOTUS Gold or Platinum Certified	3
	Option B: Base building with green attributes	
	2 green attributes are met by the base building	1
	4 green attributes are met by the base building	2
LT -2	Tenancy lease	1 point
	Option A: Long-term lease	
	The fixed term period of the lease is at least 6 years	1
	Option B: Green lease	
	A green lease is signed with the landlord	1
LT -3	Green Transportation	3 points
	Provide and display occupants with information on the different collective transportation means to travel to and from the building	LT-PR-1
	Strategy A: Bicycle friendly	
	Project occupants have access to covered and secured bicycle parking spaces, shower facilities and lockers/personal storage space	1
	Strategy B: Public transportation	
	Project space is located within a 500 m walking distance from one public transportation route OR within a 700 m walking distance of 2 different public transportation routes	1
	Strategy C: Private buses	
	Provide private buses that are able to transport 10% of total project occupants	1
	Strategy D: Electric vehicle charging stations	
	Install electric vehicle charging stations for 3% of the full-time occupants of the project	1
	Strategy E: Green transportation program	
	Set up a green transportation program	1
LT-4	Facilities and amenities for occupants	1 point
	Provide an access to at least 3 facilities/amenities for the project occupants	1

LT-1 Green base building

Intent

To encourage the selection of green certified base buildings or base buildings that feature green attributes.

Requirements

Criteria	3 Points
Option A: Green building certified base building	
Base building is certified under a recognized green building certification system with a rating equivalent to LOTUS Certified or Silver Certified	2
Base building is certified under a recognized green building certification system with a rating equivalent to LOTUS Gold or Platinum Certified	3
Option B: Base building with green attributes	
2 green attributes are met by the base building	1
4 green attributes are met by the base building	2

Approach & Implementation

Option A: Green building certified base building

Install your interior project in a base building which is certified under LOTUS or certified under another green building certification system that is recognized by the Ministry of Construction of Vietnam and/or by the World Green Building Council, such as LEED or BCA Green Mark.

Option B: Base building with green attributes

Install your interior project in a base building which meets the following requirements:

- Community connectivity: at least 10 different basic services are located within a 500m walking distance from the site
- Water recycling/reuse: Recycled water, reused water or harvested rainwater contributes to the building's water consumption
- Renewable energy: at least 0.5% of the total energy used in the base building is produced on-site from a renewable energy source
- Access for people with disabilities: Base building and fit-out project meet the QCXDVN 01:2002 requirements by following a recognized Barrier Free Environment standard in public areas of the building

- Vegetation: 10% of the total site area (including roof) is vegetated

Submissions

Provisional Certification Stage
Option A: LOTUS certified base building
• Copy of the certificate showing that the base building is certified under a recognized green building certification system
Option B: Base building with green attributes
• Evidence showing that the base building complies with the requirements such as plans, photographs, signed letters of confirmation from base building owner, etc.

Full Certification Stage
Option A: LOTUS certified base building
If it had not been approved at Provisional Certification or if there is any change: • Copy of the certificate showing that the base building is certified under a recognized green building certification system
Option B: Base building with green attributes
If it had not been approved at Provisional Certification or if there is any change: • Evidence showing that the base building complies with the requirements such as plans, photographs, signed letters of confirmation from base building owner, etc.

LT-2 Tenancy lease

Intent

To encourage lease types that will help to conserve resources and reduce environmental impacts.

Requirements

Criteria	1 Point
Option A: Long-term lease	
The fixed term period of the lease is at least 6 years	1
Option B: Green lease	
A green lease is signed with the landlord	1

Approach & Implementation

Option A: Long-term lease

The tenant should sign a lease agreement with the building owner/landlord with a fixed term period of at least 6 years.

Option B: Green lease

A Green lease is a lease between the landlord and tenant which aims to ensure that the ongoing use and operation of the building minimizes environmental impacts.

The tenant should sign a Green lease with the building owner/landlord to commit to on-going performance.

The Green lease should include the following:

- Energy and water metering and data reporting requirements: tenants should report energy and water usage to the building owner/landlord.
- Environmental Management Plan: the tenant together with the landlord should prepare an environmental management plan including requirements for ongoing sustainable building management and operation on energy, water and waste reduction/recycling.

Submissions

Provisional Certification Stage
Option A: Long-term lease
• Copy (or extracts) of the lease agreement showing the fixed term period of the lease
Option B: Green lease
• Copy (or extracts) of the lease agreement showing the elements specific to a Green lease - OR - • Copy of a signed agreement between the landlord and tenant following LOTUS requirements

Full Certification Stage
Option A: Long-term lease
If it had not been approved at Provisional Certification or if there is any change: • Copy (or extracts) of the lease agreement showing the fixed term period of the lease
Option B: Green lease
If it had not been approved at Provisional Certification or if there is any change: • Copy (or extracts) of the lease agreement showing the elements specific to a Green lease - OR - • Copy of a signed agreement between the landlord and tenant following LOTUS requirements

LT-PR-1 & LT-3 Green Transportation

Intent

To raise awareness of the different collective transport means available to occupants and implement policies to ensure a significant proportion of occupant trips are made by green transport.

Requirements

Criteria	3 Points
Provide and display occupants with information on the different collective transportation means to travel to and from the building	LT Prerequisite 1
Strategy A: Bicycle friendly	
Project occupants have access to covered and secured bicycle parking spaces, shower facilities and lockers/personal storage space	1
Strategy B: Public transportation	
Project space is located within a 500 m walking distance from one public transportation route OR within a 700 m walking distance of 2 different public transportation routes	1
Strategy C: Private buses	
Provide private buses that are able to transport 10% of total project occupants	1
Strategy D: Electric vehicle charging stations	
Install electric vehicle charging stations for 3% of the full-time occupants of the project	1
Strategy E: Green transportation program	
Set up a green transportation program	1

Approach & Implementation

Location & Transportation Prerequisite 1

Provide and display collective transportation information for occupants including routes and schedules in an obvious and accessible location. This service must be regularly maintained.

Strategy A: Bicycle friendly

Provide occupants with access to covered and secured bicycle parking spaces, shower facilities and lockers/personal storage space

Strategy B: Public transportation

Project space is located within a 500 m walking distance from one public transportation route OR within a 700 m walking distance of 2 different public transportation routes

Strategy C: Private buses

Provide private buses that are able to accommodate 10% of total project occupants

Strategy D: Electric vehicle charging stations

Install electric vehicle charging stations for 3% of the full-time occupants of the project space.

Strategy E: Green transportation program

Set up a green transportation program. In association with any of the above strategies, provide at least 2 other services/incentives to encourage occupants to use a green mode of transport. Such services and incentives include (but are not limited to): organizing a vehicle sharing program, providing shuttle busses for events, covering taxi fares in exceptional circumstances, providing rides to occupants, providing electric vehicles for employee business use, etc.

Calculations

Strategy C: Private buses

Calculation is based on the total number of building occupants of one day. For each day, private buses shall be provided with the capacity to transport 10% or more of the total number of building occupants (full-time occupants or transients). The number of buses circulating at a given time shall be based on the occupancy with more buses available during peak travel periods. Minimum number of bus seats per day shall be calculated as follows:

$$\text{Number of bus seats} = N_T \times 0.1$$

N_T = Total number of building occupants of the day (this number should include all full-time occupants and transients).

Strategy D: Electric vehicle charging stations

Calculation is based on number of full-time occupants. The minimum number of electric vehicle charging stations required shall be calculated with the following formula:

$$\text{Number of electric vehicle charging stations} = F \times 0.03$$

F = number of full-time occupants

Submissions

Provisional Certification Stage
Location & Transportation Prerequisite 1
• Plans indicating the location where collective transport information will be displayed
Strategy A: Bicycle friendly
• Plans indicating location, size and capacity of bicycle parking spaces and showering facilities
Strategy B: Public transportation
• Maps indicating location of public transport stops within a 500 m or a 700 m walking distance of the site.
Strategy C: Private buses
• Plans and maps indicating location of private buses stops on the site and proposed routes of private collective transport systems • Signed letter from the tenant committing to provide private buses for occupants
Strategy D: Electric vehicle charging stations
• Plans indicating location of the electric vehicle charging stations
Strategy E: Green transportation program
• Signed letter from the tenant committing to implement and maintain the green transportation program

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Full Certification Stage
Location & Transportation Prerequisite 1
• Photographs showing that the collective transport information is displayed in the interior space
Strategy A: Bicycle friendly
• Photographs of the bicycle parking spaces and showering facilities
If it had not been approved at Provisional Certification or if there is any change: • Plans indicating location, size and capacity of bicycle parking spaces and showering facilities
Strategy B: Public transportation
If it had not been approved at Provisional Certification or if there is any change: • Maps indicating location of public transport stops within a 500 m or a 700 m walking distance of the site.

Strategy C: Private buses
If it had not been approved at Provisional Certification or if there is any change: • Plans and maps indicating location of private buses stops on the site and proposed routes of private collective transport systems • Signed letter showing commitment from the tenant to provide private buses for occupants
Strategy D: Electric vehicle charging stations
• Photographs of the electric vehicle charging stations in the parking
If it had not been approved at Provisional Certification or if there is any change: • Plans indicating location of the electric vehicle charging stations
Strategy E: Green transportation program
• Evidence showing the implementation of the green transportation program, such as receipts, contracts, photographs, etc.
If it had not been approved at Provisional Certification or if there is any change: • Signed letter from the tenant committing to implement and maintain the green transportation program

LT-4 Facilities and amenities for occupants

Intent

To provide access to facilities and amenities for the occupants and increase their well-being, satisfaction and enjoyment.

Requirements

Criteria	1 Point
Provide an access to at least 3 facilities/amenities for the project occupants	1

Approach & Implementation

Project occupants should have access to facilities and amenities such as the following (non-exhaustive list):

- Recreational facilities (e.g. sleeping/rest room, fitness room, library, etc.);
- Nursery provisions / Child care rooms;
- Medical room with First-Aid-Kit Facility;
- Garden with seats (can be a sky garden or a roof garden);
- Fully equipped pantries;
- Dry-cleaning facilities

Facilities and amenities may be located in the project space or in the base building.

Submissions

Provisional Certification Stage
For the facilities and amenities located in the project space:
• Floor plans showing the location of facilities and amenities that will be provided to occupants
For the facilities and amenities located in the base building:
• Evidence showing that the facilities and amenities will be accessible to the occupants of the project space such as lease agreement, letter of confirmation from the base building owner, etc.

Full Certification Stage
• Photographs showing the facilities and amenities
For the facilities and amenities located in the project space:
If it had not been approved at Provisional Certification or if there is any change: • Floor plans showing the location of the facilities and amenities provided to occupants
For the facilities and amenities located in the base building:
If it had not been approved at Provisional Certification or if there is any change: • Evidence showing that the facilities and amenities are accessible to the occupants of the project space such as lease agreement, letter of confirmation from the base building owner, etc.

Management

To attain the standards expected of a LOTUS Interiors certified building, high levels of communication and coordination between all parties involved is vital. It is extremely important that the entire project team works together towards adopting all appropriate environmental principals at the projects inception. It is also vital that this information is passed on to occupants so that the design features are understood and used, ensuring the intended performance goals are met during the operation of the project space.

During the construction phase, it is necessary to limit the impacts of construction works (air quality, noise, safety, etc.) that affect the workers and the building occupants.

At completion of construction, different important measures to ensure a good performance of the project during operation should be implemented: performing commissioning will make sure that the building systems are well installed and perform up to the design intent, producing a building operation and maintenance manual (O&M manual) and a preventative maintenance plan will make sure that systems and equipment are well-maintained and operate efficiently and having a green awareness program will make sure that occupants have access the information necessary to properly operate the space.

Management		9 Points
Item	Criteria	Points
Man-1	Design Stage	1 point
	Involve a LOTUS AP as a green consultant of the project team	1
Man-2	Construction Stage	2 points
	Strategy A: Air quality management	
	Implement adequate mitigation measures to reduce indoor air quality (IAQ) impacts arising from fit-out activities	1
	Strategy B: Environmental Management	
	The main contractor has valid ISO14001 accreditation	1
	Strategy C: Construction Noise	
	Implement measures to reduce noise level arising from fit-out activities	1
	Strategy D: Site safety and welfare	
	Implement measures to provide safety and welfare for construction workers	1
Man-3	Commissioning	2 points
	Strategy A: Commissioning Activities	
	Perform commissioning of the systems installed by the project	1
	Prepare an on-going commissioning plan including post-occupancy analysis	2
	Strategy B: Independent Commissioning Agent (only available if one point is achieved in Strategy A)	
	The commissioning agent supervising the commissioning activities is qualified and independent from the project.	1
Man-4	Maintenance	2 points
	Provide an Operation & Maintenance Manual for the interior space	1
	Produce a preventative maintenance plan	2
Man-5	Green Awareness and Behavior	2 points
	Strategy A: User guide	
	Produce a User guide for occupants	1
	Strategy B: Green Training for occupants	
	Develop a training program for occupants on the topic of sustainability	1
	Strategy C: Green Awareness	
	Implement a permanent green-awareness campaign	1

Man-1 LOTUS AP

Intent

To encourage the involvement of a LOTUS AP to manage the sustainable aspects of the project through the design process and maintained during the construction stage.

Requirements

Criteria	1 Point
Involve a LOTUS AP as a green consultant of the project team	1

Approach & Implementation

A qualified individual, internal or external should be appointed with direct responsibility to ensure that all sustainable aspects of the project are met and best practice is achieved throughout the project lifecycle. This individual will be known as a 'green consultant' and should be a LOTUS Accredited Professional (LOTUS AP) who has successfully passed the LOTUS AP Exam provided by the VGBC. The primary objective of the LOTUS AP is to ensure that reliable analysis tools are introduced early into the design process to enable integrated design decisions.

Submissions

Provisional Certification Stage
• Evidence showing the involvement of a LOTUS AP in the design stage such as minutes of meeting, etc. • Copy of the LOTUS AP certificate

Full Certification Stage
• Evidence showing the involvement of a LOTUS AP until completion of fit-out such as minutes of meeting, etc.
If it had not been approved at Provisional Certification or if there is any change: • Copy of the LOTUS AP certificate

Man-2 Construction Stage

Intent

To encourage sustainable and environmentally friendly construction activities.

Requirements

Criteria	2 Points
Strategy A: Air quality management	
Implement adequate mitigation measures to reduce indoor air quality (IAQ) impacts arising from fit-out activities	1
Strategy B: Environmental Management	
The main contractor has valid ISO14001 accreditation	1
Strategy C: Construction Noise	
Implement measures to reduce noise level arising from fit-out activities	1
Strategy D: Site safety and welfare	
Implement measures to provide safety and welfare for construction workers	1

Approach & Implementation

Strategy A: Air quality management

At least one mitigation measure in 4 of the 5 following categories must be implemented:

- HVAC protection measures, such as:
  - Protect all HVAC equipment from both dust and odors and seal all duct and equipment openings
  - Avoid using permanently installed HVAC systems during construction if possible
- Contaminant source control and pathway interruption measures, such as:
  - Isolate areas of work to prevent contamination of clean or occupied spaces (with temporary barriers or by maintaining negative pressure relative to other spaces)
- Housekeeping measures, such as:
  - Clean dust by using wetting agents
  - Use efficient cleaning methods (wet mops, Vacuum cleaners with high efficiency particle filters, etc.)
  - Select cleaning measures and frequency according to the pollutants generated

- Scheduling measures, such as:
  - Conduct activities with high pollution potential (odorous or dust generating activities) during off hours to allow time for new materials to air out.
- Moisture and mold control measures, such as:
  - Protect stored on-site and installed absorptive materials from moisture damage

Strategy B: Environmental Management

The main contractor has valid ISO14001 Environmental Management System (EMS) accreditation throughout the construction phase of the project.

Strategy C: Construction Noise

Propose a plan with measures to reduce noise and/or reschedule the fit-out activities to avoid nuisance to base building occupants and neighboring occupants.
As a minimum, one measure shall be implemented to reduce structure-borne noise and one measure shall be implemented to reduce airborne noise.

- Reduce structure-borne noise:

Where the work takes place in circumstances when other parts of the building are normally occupied, noise and vibration transmitted via the building structure (with demotion, drilling, cutting chases, scrabbling, coring, etc.) shall be avoided between 8 a.m. and 6 p.m. (or other hours in accordance with the base building activities).

- Reduce airborne noise:

Where the noise is transmitted as airborne noise, one of the following steps shall be taken to mitigate the noise impacts:

- Modify a noisy process or equipment to eliminate or reduce the noise and vibration output (e.g. adding new mufflers, or sound absorbing material).
- Regularly maintain machinery and equipment, so equipment in disrepair is not contributing to total noise (simple maintenance can reduce noise level by 50%).
- Use noise absorption material to reduce reflected noise inside a room or enclosure, and transmitted outside (e.g. plywood with sound absorbing).

Strategy D: Site safety and welfare

Implement measures to provide safety and welfare for construction workers:

- Provide toilets, washing facilities and/or any other site amenities (accommodation, drinking water, changing rooms, rest facilities, etc.) deemed applicable for construction works

- Implement strategies to meet the safety requirements outlined in Circular No. 22/2010/TT-BXD on Labor Safety in Work Construction (such as: provide safety training, personal safety equipment, first aid kits, ensure fire safety, etc.)

Submissions

Provisional Certification Stage
Strategy A: Air quality management
• Evidence showing that measures to reduce IAQ impacts arising from fit-out activities will be implemented such as tender specifications, IAQ management plan, etc.
Strategy B: Environmental Management
• Copy of the ISO 14001 certificate of the main contractor
Strategy C: Construction Noise
• Evidence showing that measures to limit construction noise will be implemented such as tender specifications, Construction Noise Mitigation plan, etc.
Strategy D: Site safety and welfare
• Evidence showing that measures to provide safety and welfare for construction workers during fit-out activities will be implemented such as tender specifications, signed Health and Safety plan, etc.

Full Certification Stage
Strategy A: Air quality management
• Evidence showing all the mitigation measures that have been implemented to reduce IAQ impacts during fit-out such as records, photographs, etc.
Strategy B: Environmental Management
If it had not been approved at Provisional Certification or if there is any change: • Copy of the ISO 14001 certificate of the main contractor
Strategy C: Construction Noise
• Evidence showing all the measures that have been implemented to limit noise during fit-out such as records, photographs, etc.
Strategy D: Site safety and welfare
• Evidence showing all the measures that have been implemented to provide safety and welfare for construction workers during fit-out activities such as records, photographs, etc.

Man-3 Commissioning

Intent

To ensure all the building's equipment is installed, calibrated and performing up to the design intent.

Requirements

Criteria	2 Points
Strategy A: Commissioning	
Perform commissioning of the systems installed by the project	1
Hire a qualified and independent commissioning agent to supervise the commissioning activities	2
Strategy B: On-going commissioning	
Prepare an on-going commissioning plan including post-occupancy analysis	1

Approach & Implementation

Strategy A: Commissioning

Commissioning:

Interiors projects are responsible for completing commissioning tasks for all systems and equipment included in their scope, including items furnished by the base building, but modified or relocated as part of tenant fit-out.

Information such as sequences of operations, schedules, equipment setpoints, and outside air requirements for tenant equipment and spaces must be coordinated with base building requirements.

The systems to be commissioned shall encompass energy intensive and water systems:

- Heating, ventilating, air conditioning and refrigeration (HVAC & R) systems
- Artificial lighting systems
- Hot water systems
- Metering and monitoring systems
- Control systems
- Plumbing systems
- Renewable energy systems (for instance, wind, solar)

For each equipment/system, the following commissioning steps must be performed:

- Verify proper installation: correct equipment/system are installed at the correct location in accordance with design criteria and manufacturer's specifications.
- Verify proper operation: startup, shutdown, and sequence of operation.

An installation checklist must be completed to include the results of these 2 verification tests.

Also, for HVAC systems, Testing, Adjusting and Balancing (TAB) should be performed.

Commissioning agent:

For an additional point, hire a commissioning agent and meet the following:

- some owner's project requirements (OPR) and basis of design (BOD) documents must be produced and handed to the commissioning agent;
- the commissioning agent must be:
  - independent of any consultant, contractor or sub-contractor that has been involved in the installation of the commissioned systems; and
  - a registered professional engineer or qualified technician with demonstrated knowledge on nominated systems commissioning, and has previous experience with the commissioning process of projects similar in scope.

Strategy B: Independent Commissioning Agent

Prepare an on-going commissioning plan ensuring that the following steps will be performed as a minimum (from 6 to 18 months of occupation):

- Fine-tuning of all the commissioned systems is undertaken. All these fine-tuning activities should be clearly documented and signed by the responsible person.
- Conducting measurement and physical monitoring of several physical systems such as light levels, noise levels, CO_2 levels, air flow rates and energy & water consumption. Methods and results of the analysis must be clearly noted down.
- Carrying out interviews and/or surveys with all concerned parties (such as project manager, contractors, architects, engineers, technicians) and occupants regarding the building performance and end-user satisfaction after commissioning.

Submissions

Provisional Certification Stage
Strategy A: Commissioning
Commissioning: • Evidence showing that the project will perform commissioning according to LOTUS requirements such as tender specifications, signed letter from the tenant, commissioning plan, etc.
Commissioning agent: • Evidence showing that the project will hire a commissioning agent according to LOTUS requirements such as tender specifications, signed letter from the tenant, commissioning plan, etc.
Strategy B: On-going Commissioning
No evidence required at this submission stage

Full Certification Stage
Strategy A: Commissioning Activities
Commissioning: • Commissioning report including: - List of equipment/system commissioned - Completed installation checklists - If any, TAB report summarizing the TAB work showing the measurements, the adjustments made, the deficiencies found during the TAB work, etc.
Commissioning agent: • Copy of the resume of the commissioning agent • Copy of the owner's project requirements and basis of design documents • Evidence showing the involvement of the commissioning agent such as contract, minutes of meeting, etc.
Strategy B: On-going Commissioning
• Copy of the on-going commissioning plan • Signed letter from the tenant committing to implement the on-going commissioning plan during the operations of the project space

Man-4 Maintenance

Intent

To make sure systems and equipment are well-maintained and operate efficiently.

Requirements

Criteria	2 Points
Strategy A: Operation & Maintenance Manual	
Provide an Operation & Maintenance Manual	1
Strategy B: Preventative Maintenance Plan	
Produce a Preventative Maintenance Plan	1

Approach & Implementation

Strategy A: Operation & Maintenance Manual

The operation and maintenance manual (O&M manual) includes the necessary information for the operation and maintenance of the interior project space. The operation and maintenance manual should include:

- A description of the main design principles
- As-built drawings and specifications
- Instructions for building operation and maintenance (including health and safety information, general instructions for efficient operation and periodical maintenance)
- Schedule of all equipment
- Commissioning and testing results (if any)
- Guarantees, warranties and certificates

Strategy B: Preventative maintenance plan

Produce a preventative maintenance plan for the building's major services and equipment which shall encompass energy intensive and water systems:

- Heating, ventilating, air conditioning and refrigeration (HVAC & R) systems
- Artificial lighting systems
- Hot water systems
- Metering, monitoring and control systems
- Hydraulic systems
- Renewable energy systems (for instance, wind, solar)

The preventative maintenance plan shall include, as a minimum, the following information:

- List of all equipment requiring maintenance
- Timeline for maintenance for all listed equipment
- Schedule indicating when each maintenance operation must be conducted

Submissions

Provisional Certification Stage
Strategy A: Operation & Maintenance Manual
No evidence required at this submission stage
Strategy B: Preventative maintenance plan
No evidence required at this submission stage

Full Certification Stage
Strategy A: Operation & Maintenance Manual
• Evidence showing the operation and maintenance manual which can be either: - photographs or scans showing front cover, table of contents, and at least 3 key sheets of the building operation and maintenance manual, - or, if available, full electronic version of the manual
Strategy B: Preventative maintenance plan
• Copy of the Preventative Maintenance Plan • Signed letter from the tenant committing to implement the Preventative Maintenance Plan during the operations of the project space

Man-5 Green Awareness and Behavior

Intent

To ensure that occupants will have access to all the required information to properly operate the space and to increase green awareness of both occupants and visitors.

Requirements

Criteria	2 Points
Strategy A: User guide	
Produce a User guide for occupants	1
Strategy B: Green Training for occupants	
Implement a green training program for occupants on the topic of sustainability	1
Strategy C: Green Awareness	
Implement a permanent green-awareness campaign	1

Approach & Implementation

Strategy A: User guide

Provide a user guide for occupants. It should be a non-technical, easy to understand guide with information for users about:

- Design specifications of the interior space and how these affect its operation
- Energy efficiency and water-saving features
- Correct operation of HVAC and lighting systems
- Access, security and safety systems
- Evacuation/disaster response plan
- Methods for reporting problems
- Information on parking, public transportation, car sharing schemes, etc.
- Waste recycling procedures

Strategy B: Green Training for occupants

Develop and implement an educational program for occupants on the topic of sustainability. This program should educate the occupants on the interior space and their relationship to the interior space and should include, as a minimum, the following information:

- Green features of the space/building,

- Impacts of occupant behavior on the performance of the space/building
- Ways to improve occupant behavior.

Also, the educational program should educate occupants about the topics of resource conservation, health issues, climate change, etc.

Strategy C: Green Awareness

A permanent green awareness campaign should be implemented. It can be executed by displaying posters or screens in the most frequented areas of the interior space. This campaign should be maintained permanently.

As a minimum, the following information should be shown:

- The impacts of buildings on the environment
- One sustainability feature of the project related to Energy Conservation or Energy Efficiency
- One sustainability feature of the project related to Water Conservation or Water Efficiency
- One sustainability feature of the project related to Health & Comfort

Submissions

Provisional Certification Stage
Strategy A: User guide
No evidence required at this submission stage
Strategy B: Green Training for occupants
No evidence required at this submission stage
Strategy C: Green Awareness
No evidence required at this submission stage

Full Certification Stage
Strategy A: User guide
• Copy of the User guide (scans, photographs or electronic version)

Strategy B: Green Training for occupants
• Green Training program showing the topics of the training, schedule and participants • Evidence showing that occupants of the interior space attended the Green Training such as signed attendance sheets, photographs, etc.
Strategy C: Green Awareness
• Photographs showing that the green awareness campaign is implemented • Signed letter from the tenant committing to maintain the green awareness campaign.

Innovation

The purpose of this category is to reward innovative techniques/initiatives, as well as exceptional performance enhancement.

There are up to 6 bonus points available over the 2 credits, but these points are not specifically allocated to one or the other credit.

Innovation		6 Bonus Points
Item	Criteria	Points
Inn-1	Exceptional Performance Enhancement	6
	Exceed significantly the credit requirements of LOTUS credits	
Inn-2	Innovative techniques / initiatives	
	Implement innovative and environmentally friendly solutions that are not considered in the scope of LOTUS Interiors	

Inn-1 Exceptional Performance Enhancement

Intent

To encourage the involvement of a LOTUS AP to manage the sustainable aspects of the project through the design process and maintained during the construction stage.

Requirements

Criteria	6 Points
Exceed significantly the credit requirements of LOTUS credits	1-6

Approach & Implementation

Innovation credits are considered on a case by case basis. Up to 6 Exceptional Performance Enhancement Innovation credits may be targeted (1 point each) out of a maximum of 6 points available in the Innovation category. In special cases, the VGBC may consider awarding more than 1 Innovation point for a single initiative.

There are three different cases where Exceptional Performance Enhancement points can be awarded:

Case 1: In a credit with two or more performance increments, the building performance exceeds the maximum credit requirement by an additional increment.

Example: Credit WP-2 Demolition and Construction Waste
Requirement (Level 1) – Reuse, salvage and/or recycle 30% of demolition and construction waste

- Requirement (Level 2) – Reuse, salvage and/or recycle 60% of demolition and construction waste
- Surpass by the next increment – Reuse, salvage and/or recycle 90% of demolition and construction waste. Project is eligible for one Innovation point

Case 2: In a credit with only one performance threshold, the building performance significantly exceeds the credit requirement.

Example: Credit H-1 Fresh Air Supply

- Requirement - Provide sufficient fresh air supply to all occupied spaces in accordance with national or international standard
- A building that exceeds the fresh air supply requirement of a national or international standard by 30% may be eligible for an Innovation point

Case 3: In a credit with different strategies available, the building performance reaches a higher number of points than what is available in the credit.

Example: Credit E-2 Artificial Lighting (6 points available)

- Strategy A – The project space has a lighting power density surpassing VBEEC requirements by more than 50% and 5 points can be earned.
- Strategy B – The project has installed space lighting controls and 1 point can be earned.
- Strategy D – The project has implemented task lighting and 1 point can be earned.
- This building can be awarded 6 points in Credit E-2 Artificial Lighting and 1 point in credit Inn-1.

Calculation

The calculation of each exceeded benchmark has to be done exactly the same way as the given credit specifies it.

Submissions

Certification Stage
For each Exceptional Performance Enhancement of a credit: • Submissions as per initial credit requirements

Inn-2 Innovative Techniques/Initiatives

Intent

To promote techniques and/or initiatives that are out of the scope of the current LOTUS Interiors Rating System.

Requirements

Criteria	6 Points
Implement innovative and environmentally friendly solutions that are not considered in the scope of LOTUS Interiors	1-6

Approach & Implementation

Innovation credits are considered on a case by case basis. Points will only be awarded where adequate justification for the innovative nature and the environmental benefits of the solutions are provided. For this reason it is advisable to confirm the proposed innovation credit nature, with the Assessment Organization at any time prior to submissions.

Submissions

Provisional Certification Stage
For each Innovative Technique/Initiative:
• Evidence showing the expected performance of the innovative technique/initiative such as manufacturer's data, calculations, report, etc.

Full Certification Stage
For each Innovative Technique/Initiative:
• Evidence showing that the innovative technique/initiative has been installed/implemented such as receipts, delivery notes, photographs, etc.
If it had not been approved at Provisional Certification or if there is any change: • Evidence showing the performance of the innovative technique/initiative such as manufacturer's data, calculations, report, etc.

Glossary

Specific LOTUS Terms

Applicant - The person/organization applying for LOTUS Certification of a project.

Applicant Representative - The Applicant Representative is responsible for all elements of the certification and submission process within LOTUS Rating Systems. The Applicant Representative will directly liaise with the VGBC Representative throughout all stages of LOTUS Certification.

Application Form - The Application Form is the first step in registering a project with the VGBC. Once completed, the VGBC will check to see that all relevant information is present and correct, register the project and request the payment of a Registration Fee.

Assessment Fee - The Assessment Fee is a one off charge by for the total administration process of LOTUS Certification and is bound by the Certification Agreement.

Assessment Organization – The organization that performs the assessment of the projects applying for LOTUS Certification.

Assessment Organization Representative - The Assessment Organization Representative is nominated within the Registration Process and will be the Assessment Organization primary representative that liaises with the Applicant Representative throughout the duration of the project.

Base building - The building which houses the interior project space.

Category - A Category is a grouping of Credits that have a similar area of focus and perceived environmental impact.

Certification Agreement - The Certification Agreement is the legally binding contract signed between the Applicant and the Assessment Organization upon registration.

Credit - Each Credit has a specific intent that, if followed and achieved, allows the user to gain points within a LOTUS Rating System.

LOTUS Accredited Professional - The LOTUS Accredited Professional or LOTUS AP has undergone training and successfully passed the LOTUS Rating System examination. Upon Accreditation, the LOTUS AP is then deemed qualified to work either as an internal or external resource within a LOTUS project.

LOTUS Certified Rating - The LOTUS Certified Rating is the result obtained after Submission has been assessed at Certification stage by the VGBC Representative. A project can achieved 4 levels of certification, LOTUS Certified, LOTUS Silver, LOTUS Gold or LOTUS Platinum.

LOTUS Technical Manual - The LOTUS Technical Manual is a user's guide to attaining the LOTUS Certificate. It provides technical guidance for all LOTUS Credits in order for users to understand intents, requirements, approaches and implementations, calculations and submissions.

Notification Form - The Notification Form is submitted by the Applicant Representative to notify the Assessment Organization that the Applicant is ready to provide ALL submissions in order to be assessed for LOTUS Certification. The Notification Form must be submitted a minimum of 2 weeks prior to the main Submissions in order for the Assessment Organization to organize the period in which the project will be assessed.

Prerequisite *or* LOTUS Prerequisite - Indicates the minimum requirements in a LOTUS Rating System. Projects that apply for LOTUS certification are obliged to fulfil all prerequisites. Each prerequisite is organized in a standard format, similar to credit format. A list of all prerequisites is provided at the beginning of the LOTUS Technical Manual.

Project Identification Number (PIN) - The Project Identification Number (PIN) is a unique reference number issued at the Registration Confirmation. This reference number must be protected and is for the use of the Applicant Representative when providing submissions to the VGBC.

Registration Fee - The Registration Fee is a one off charge by the VGBC for the administration process of registration to a LOTUS Rating System.

Submission - The Submission is the process where all documents are provided to the VGBC Representative for assessment.

Submission Section – In each Credit, the Submission Section details all requirements that will be assessed for LOTUS Certification.

LOTUS Submission Terms

Bill Of Quantity (BOQ) - A document drawn up by a quantity surveyor providing details of the prices, dimensions, etc., of the materials required to build a project. A BOQ is a document used in tendering in the construction industry in which materials, parts, and labor and their costs are itemized. It may also detail the terms and conditions of the construction or repair contract and itemize all work to enable a contractor to price the work for which he or she is bidding.

Commissioning Records - Documents that record the activities and results of the Commissioning Process, including inspection reports, testing reports, etc.

Contract - A binding legal agreement of an exchange of promises between two or more parties.

Delivery note - A document accompanying a shipment of goods that lists the description, and quantity of the goods delivered.

Drawings - Two dimensional technical diagrams of a place or object.

Elevation - An elevation is a view of a building seen from one side, a 2D drawing of one facade of the building.

Inventory / Schedule - A complete list of specific items or contents within a project space.

Invoice / Receipt - A proof of purchase given from a supplier to a consumer.

Plan - A floor plan is the most fundamental architectural diagram, a view from above showing the arrangement of spaces in building in the same way as a map, but showing the arrangement at a particular level of a building. Technically it is a horizontal section cut though a building (conventionally at three feet/one meter above floor level), showing walls, window and door openings and other features at that level.

Record - Document that memorializes and provides objective evidence of activities performed, events occurred, results achieved, or statements made.

Report - A written document that describes how the project satisfies the requirements of a certain LOTUS credit.

Schedule - A complete list of specific items or contents within a project.

Site Plan - An accurate drawing or picture of a planned or completed development site, which has a scale of size for reference (to determine relative sizes and distances). Site plans often show, but are not limited to, boundaries, building locations, landscaping, topography, vegetation, drainage, floodplains, zoning, routes/streets, sidewalks and other site features.

Technical Terms

ASHRAE - The American Society of Heating, Refrigerating and Air Conditioning Engineers is an international technical society for all individuals and organizations interested in heating, ventilation, air-conditioning, and refrigeration. The society publications include handbook, journal as well as series of HVAC relating standards and guidelines. These standards are often referenced in green building assessment reference guide/technical manual and are considered useful guide for consulting engineers, mechanical contractors, architects, and government agencies.

Basis of Design - It is a document that records the concepts, calculations, decisions, and product selections used to meet the Owner's Project Requirements and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and specific assumptions made by the designers.

Climate change - In modern terms, climate change refers to the changes of the Earth climate mainly due to the uncharacteristic increase of greenhouse gases concentration in the atmosphere, resulting from human activities.

Coefficient of performance (COP) - The ratio of the rate of heat removal to the rate of energy input in consistent units, for a complete cooling system or factory assembled equipment, as tested under a nationally recognized standard or designated operating conditions. COP for air-cooled electrically driven air conditioners includes compressor, evaporator, and condenser. COP for water chilling packages does not include chilled water or condenser water pumps or cooling tower fans.

Computational Fluid Dynamic (CFD) Analysis - A modelling technique that can be used to calculate fluid properties such as temperature, heat flow, wind velocity and air flow of a building.

Daylight factor (DF) - DF is the ratio of the light level inside a room to the light level outdoors. It is used to assess the internal natural lighting levels as perceived on working planes or surfaces.

Environmental Product Declaration (EPD) – It is a standardized way of quantifying the environmental impact of a product or system. Declarations include information on the environmental impact of raw material acquisition, energy use and efficiency, content of materials and chemical substances, emissions to air, soil and water and waste generation. Product and company information is also included.

Global Warming Potential (GWP_{100}) - A value assigned to a refrigerant based on scientific measurements showing how much that refrigerant will contribute to global warming if released into the atmosphere. The reference datum is based on the effect of CO_2 in the atmosphere, which is assigned a GWP of 1. GWP is usually measure over a 100-year period and the lower the GWP of a refrigerant is the better or less harmful the refrigerant is for the environment.

Gross Floor Area (GFA) - The sum of the fully enclosed covered floor area and the unenclosed covered floor area of a building or a project space at all floor levels. Some commercial and public authorities use variants of this definition. Car parks are not to be included as GFA.

HVAC (Heating, Ventilating and Air Conditioning) - The equipment, distribution network, and terminals that provides either collectively or individually the processes of heating, ventilating, or air conditioning to a building.

Illuminance - The density of the luminous flux incident on a surface. It is measured in lux or lm/m^2 and is equal to the luminous flux (lumen) divided by the area (m^2) of the surface when the latter is uniformly illuminated.

Interior fit-out - The installation of ceilings, floors, furnishings, and partitions of a building, as well as the installation of all required building services.

Lighting Ballast - A device used to obtain the necessary circuit conditions (voltage, current, and wave form) for starting and operating an electric-discharge lamp.

Natural lighting (or Daylighting) - Technologies or design strategies used to provide lighting to buildings without power consumption. Although maximizing natural lighting will minimize electricity consumption used for lighting, too much solar irradiation will heat up the building and increase cooling load.

Natural ventilation - Technologies or design features used to ventilate buildings without power consumption. Natural ventilation, unlike fan-forced ventilation, uses the natural forces of wind and buoyancy to deliver fresh air into buildings.

Net Occupied Area (NOA) - The sum of the areas of all the occupied spaces of the project.

Non-baked materials - Also called Non-fired materials. They are building materials that solidify and meet all required physical properties (compressive strength, bending strength, water absorption, etc.) without undergoing the firing process. In the Decision No. 567/QD-TTg of April 28, 2010 (Approving the Program on development of non-baked building materials through 2020), the Vietnamese government has officially supported the development of non-baked materials to replace traditionally baked bricks, a main cause of pollution and energy waste.

Occupied spaces - Enclosed spaces that can accommodate human activities. They include work spaces (offices, meeting rooms, laboratories, etc.), event spaces (halls, sales areas, libraries, gyms, etc.), common areas (receptions, waiting rooms, lounges, lobbies, etc.), and learning spaces (classrooms). They exclude corridors, staircases, storage areas, toilets, changing facilities, IT equipment rooms and mechanical rooms.

Owner's Project Requirements (OPR) - It is a written document that details the functional requirements of a project and the expectations of how it will be used and operated. This includes project and design goals, measurable performance criteria, budgets, schedules, success criteria, owner's directives, and supporting information.

Ozone depletion potential (ODP) - A value assigned to a refrigerant based on scientific measurements that show how destructive a refrigerant is to the ozone layer if released into the atmosphere. The reference datum is based on the effect of refrigerant R11, which is assigned an ODP of 1. The lower the value of ODP the better or less harmful the refrigerant is for the ozone layer and therefore the environment.

Rapidly renewable materials - A rapidly renewable material is a source that can regenerate what has once been harvested within 10 years or less.

Reflectance - The ratio of light reflected by a surface to the light incident upon it.

Refrigerant - A refrigerant is a compound used in a heat cycle that reversibly undergoes a phase change from a gas to a liquid in a process of converting thermal energy to mechanical output.

Renewable energy - Energy generated from sources (sunlight, wind, rain, tides, and geothermal heat) that are replenished naturally and continually.

Tenant - Entity (person, company, etc.) that occupies a property rented from a landlord (the property owner) through a lease or tenancy agreement.

Testing, Adjusting and Balancing (TAB) - They are the three major steps used to achieve proper operation of HVAC systems. Testing is the use of specialized and calibrated instruments to measure temperatures, pressures, rotational speeds, electrical characteristics, velocities, and air and water quantities for an evaluation of equipment and system performance. Balancing is the methodical regulation of system fluid flows (air or water) through the use of acceptable procedures to achieve the desired or specified airflow or water flow. Adjusting is the final setting of balancing devices such as dampers and valves, adjusting fan speeds and pump impeller sizes, in addition to automatic control devices such as thermostats

and pressure controllers to achieve maximum specified system performance and efficiency during normal operation

VAV (variable air volume) - Type of HVAC system which has the ability to vary the airflow of cooled supply air (maintained at a constant temperature) to the different air-conditioned spaces in order to meet precisely the thermal setpoint.

VBEEC (Vietnam Building Energy Efficiency Code) – The Vietnam Building Energy Efficiency Code QCXDVN 09:2013/BXD is issued by the Ministry of Construction and is mandatory in Vietnam in order to help meet energy saving goals.

Ventilation - The process of supplying fresh air and removing vitiated air by natural or mechanical means to and from a space. Such air may or may not have been conditioned.

Volatile Organic Compound (VOC) - An organic chemical compound that enters gaseous phase under normal room conditions due to its high vapor pressures. Some VOCs have negative effects on human health when concentrated in poorly ventilated indoor spaces.

VRV/VRF (variable refrigerant volume/flow) - Type of direct (one refrigerant only) air-conditioning system with variable speed compressors, several air handlers (indoor units) on the same refrigerant loop/circuit.

VSD (variable-speed drive) - Equipment used to control the speed of a pump or fan to adjust to the demand.

Water efficient fixture - Water-based fixture that requires less amount of water to complete a designed task than most average fixtures

Appendix

Table A.1: Lighting Power Density Requirements
(Sources: QCXDVN 09:2005, ASHRAE 90.1 – 2007 & 2010, ECBC – 2007)

Building Categories	Space types	LPD (W/m^2)
Typical of all buildings	Corridor	6
	Lobby	12
	Restrooms	10
	Food Preparation	13
	Storage, Active	8
	Storage, Inactive	3
	Electrical/Mechanical	14
	Dressing/Locker/Fitting Room	7
Apartments	Apartments / Condos (Public spaces)	9
Banks	Lobby, General	9
	Lobby, Writing area	13
	Tellers' stations	16
Hotels	Bathrooms	14
	Guest/ Bed Rooms, General	13
	Guest/ Bed Rooms, Reading	16
	Corridors, elevators and stairs	8
	Banquet and Exhibit	16
	Lobby, Front Desk, Reading	12
	Lobby, General Lighting	10
Hospitals	Consulting areas, General	12
	Consulting areas, Examination	12
	Corridors, General, Waiting Rooms	8
	Ward Corridors, Day / Night	9
	Laboratories, General	15
	Laboratories, Examination	20

	Nurses Stations	12
	Ward Bed Head, Reading	14
	Surgeries, General	17
Offices	Accounting	12
	Audio Visual areas	12
	Conference areas	13
	General and private offices	12
Printing	Off-set printing and duplicating area	13
Restaurants	Fast Food/ Cafeteria	15
	Leisure Dining	14
	Bar/ Lounge	12
Retail, shops, stores	Conventional with counters	15
	Conventional with wall display	15
	Self Service	14
	Supermarkets	17
	Mall concourse/ multi-store service	8
Libraries	Libraries	14
Nursing Homes	Nursing Homes	12
Schools	Pre/elementary	13
	High/ Tech/ University	13
Worship	Temples/ Churches/ Synagogues	14
Manufacturing	Low Bay (<25 ft Floor to Ceiling Height)	13
	High Bay (≥25 ft Floor to Ceiling Height)	15
	Detailed Manufacturing	16
	Equipment Room	11
	Control Room	5
Parking - Garage	Garage area	2
Convention center	Exhibit Space	14
Dormitory	Living Quarters	10
Warehouse	Fine Material Storage	14
	Medium/Bulky Material Storage	9