VGBC | Vietnam Green Building Council

Hội đồng Công trình xanh Việt Nam

LOTUS Multi-family Residential Pilot

Technical Manual

October 2015

LOTUS CERTIFIED

LOTUS SILVER

LOTUS GOLD

LOTUS PLATINUM

Acknowledgements

In researching and developing the LOTUS assessment system, the Vietnam Green Building Council (VGBC) conducted a survey of all the world's significant green building rating systems. Several became focal points from which the VGBC has borrowed heavily in constructing this system. These are Australia's Green Star, the USA's LEED and Malaysia's GBI rating systems and to a lesser extent, Britain's BREEAM, Indonesia's Greenship and Singapore's Green Mark systems.

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LOTUS Rating Tool Authors and contributors

Lead Authors MFR Pilot / NR V2.0

Xavier Leulliette, Trần Văn Thành

Supporting Authors MFR Pilot / NR V2.0

Alexandre Duverger, Đỗ Ngọc Diệp, Heloise Pelen, Nguyễn Thị Mai, Melissa Merryweather, Vũ Hồng Phong

Contributors MFR Pilot / NR V2.0

Andrew Crouch, Anna-Carina Wallisch, Arsy Adiguna Christensen, Benjamin Raux, Claudia Weissman, Dang Hoang Anh, Dominik Pfaffenbichler, Hugo Fontourcy, Jens Leibold, Soo Kim, Tahiana Ratsimba, Yannick Millet

Lead Authors NR V1.0 and V1.1

Alberto Perez Ortiz, Andrea Archanco Astorga, Andrew Crouch, Darren O'Dea (LEED AP), Do Ngoc Diep, Nguyễn Trung Kiên, Melissa Merryweather (LEED AP), Timothy Middleton, Tuan Anh Phan, Xavier Leulliette, Yannick Millet.

Supporting Authors NR V1.0 and V1.1

Aaron May, Alan Williams, Andrea Archanco, Andrew Benham, Aurore Juliard, Celine Pilain Panetta, Clara James Diane Goetz, Dương Bình (LEED AP), Đoàn Quang Hưng, Franck Jung, Graham Horne (BREEAM AP), Jalel Sager, Jérôme Botta, Joan Bennett, John Calloway (LEED AP), John Kilgallon, Jordan Colomb, Kevin Caille, Lê Kiên, Lê Vũ Cường, Liam Lafferty, Lương Thanh Thư, Manuel Valcárcel Rodríguez, Mark Edwards, Nancy Tran, Ngô Mai Hoa, Nguyễn Hữu Dũng, Nguyễn Quang Hiếu, Nguyễn Văn Muôn, Nguyễn Việt Anh, Oliver John Kerr, Phan Thị Quyên, Phạm Đức Nguyên, Phạm Ngọc Đăng, Sheldon de Wit (LEED AP), Rory Martin (Greenstar AP), Sarah Herrou, Tamsin McCabe, Trần Ngọc Chấn, Trương Thanh Vân, Victor Sandoval, Vincent Mazens.

Authors LOTUS NR Pilot Version

Mateusz Bogdan, Lê Vũ Cường, Sheldon de Wit, Đỗ Ngọc Diệp, Tanguy Fabre, Marion Floret, Ngô Mai Hoa, Molly Hicks, Geoff Lewis, Natalie Mady, Mellissa Merryweather, Yannick Millet, Darren O'Dea, Phan Thị Quyên, Philip Sarn, Jalel Sager, Luke Smith, Mitchell Swann, Milena Tadini

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Contents

VGBC Background Information

The Vietnam Green Building Council (VGBC) is a project of the Green Cities Fund, Inc. (GCF), an international non-profit organisation 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 recognised 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 tools (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 tools developed by the Vietnam Green Building Council specifically for the Vietnamese built environment.

LOTUS Rating Tools 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 Tools 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 Tools currently include:

- LOTUS Non-Residential (LOTUS NR)
- LOTUS Building in Operation (LOTUS BIO)
- LOTUS Multi-family Residential (LOTUS MFR)

Further tools now in development include:

- LOTUS for Single Family Homes (LOTUS Homes)
- LOTUS Interiors
- LOTUS for Neighbourhoods

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 Rating Tool philosophy, structure and practical application within the lifecycle of a building project. LOTUS APs are listed on the VGBC website.

LOTUS MFR – Scope

LOTUS Multi-family Residential can be used for any residential building of more than 4 floors and with multiple separate dwelling units.

LOTUS MFR – Eligibility

1. Whole distinct building

For a project to be eligible for LOTUS MFR assessment, it must be a whole distinct building. A portion of a building that has clear separation from other building components may be eligible for assessment under guidance from the VGBC.

2. Mixed-use buildings

In addition to the above, LOTUS MFR has also been developed for mixed-use buildings. The Non-Residential component of a mixed-use building should not exceed 30% of the gross floor area (not including car parking) to be eligible for assessment under LOTUS MFR.

If a project is intended to have a residential component of between 30% and 70% of the gross floor area, please contact the VGBC for guidance on the application of LOTUS rating tools.

3. Major refurbishment

Major refurbishment projects are eligible for assessment under LOTUS MFR when any of the following eligibility requirements are complied with:

- An alteration affects more than 50% of the Gross Floor Area (GFA) of the building at any one time
- An alteration disrupts the operations or relocates more than 50% of the building occupants
- An addition increases the GFA of the building by more than 30%

LOTUS MFR Categories

LOTUS MFR is composed of 9 categories (plus "Innovation"*)*, each containing a varying number of credits. Against each credit, specific criteria have been set carrying individual scoring points.

It is important to note that prerequisite criteria have been set for many credits. All of these prerequisites are therefore mandatory and must be achieved in order to obtain a LOTUS rating.

Energy (E) **-** To monitor and reduce the energy consumption of a building through proper insulation, the use of natural ventilation and the installation of energy efficient equipment (HVAC, lighting, water heater etc.).

Water (W) **-** To reduce the water consumption of a building through the use of water-efficient fixtures, rain water harvesting, water reuse/recycling and associated water saving measures.

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

Ecology (Eco) **-** To protect the ecology of the site of the building and surrounding area, assure the preservation of topsoil and maximise biodiversity.

Waste and Pollution (WP) **-** To promote the reduction of waste during the construction and operation of the building, as well as encourage extensive recycling practices.

Health and Comfort (H) **-** To ensure high indoor environmental quality, through maximising daylight, open views and the optimisation of the indoor air quality.

Adaptation and Mitigation (A) **-** In view of forecasts placing Vietnam amongst one of the five countries most affected by climate change, to ensure that all necessary adaptation and mitigation strategies are integrated at the design and management stages of a building (flood risk, strong wind protection, drought, etc.).

Community (CY) **-** To promote the social integration of a building within its neighbourhood, through public consultation, public space, local jobs and to facilitate access for persons with disabilities.

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

In addition to the above Categories, an "Innovation" (Inn) category rewards exceptional performance or initiatives which are above or not specifically addressed by LOTUS. This category carries additional "bonus" points.

LOTUS MFR Prerequisites

The following table presents all prerequisites included in LOTUS MFR. Each prerequisite, whether stand-alone or included inside a credit, must be carried out as a minimum requirement for all projects applying for LOTUS MFR.

In a building project with unique constraints or certain building typologies, the VGBC recognises that some prerequisites and/or credits in LOTUS may not be attainable. Where it can be demonstrated that all reasonable strategies have been considered and a building is still not able to meet these prerequisites and/or credits, or alternately that the pre-requisite is patently unsuitable for that building, the VGBC reserves the right to waive those requirements. Such decisions will only be made through careful consideration by the VGBC.

Table 1: LOTUS MFR Prerequisites

Credit	Criteria	Prerequisite
E-PR-1 Passive Design	Conduct Passive Design Analysis	Energy Pre 1
E-1 Building Total Energy Use	Project complies with all mandatory requirements of VBEEC	Energy Pre 2
E-1 Building Total Energy Use	Demonstrate a 10% reduction of the total building energy use compared to the baseline	Energy Pre 3
W-1 Water Efficient Fixtures	Reduce total building domestic water consumption through fixtures by 10% in comparison to a baseline model	Water Pre 1

Eco-PR-1 Environment	Prepare an Environmental Impact Assessment (EIA) or an Environmental Protection Commitment	Ecology Pre 1
WP-PR-1 Wastewater Treatment	Building must comply with QCVN 14:2008/BTNMT National technical regulation on domestic wastewater	Waste & Pollution Pre 1
WP-2 Demolition and Construction Waste	Develop and implement a demolition and construction waste management plan	Waste & Pollution Pre 2
WP-4 Light Pollution Minimisation	Implement automatic lighting shutoff strategies for exterior lighting fixtures and interior lighting fixtures with lumens striking windows to the outside	Waste & Pollution Pre 3
H-PR-1 Indoor Smoking	Prohibit smoking in all the common areas of the building in accordance with Decision 1315/QĐ-TTg	Health & Comfort Pre 1
A-1 Flooding Resistance	Prepare a local flood risk report for the site	Adaptation & Mitigation Pre 1
A-4 Green Transportation	Provide and display building occupants with information on the different collective transportation means to travel to and from the site	Adaptation & Mitigation Pre 2
CY-PR-1 Access for People with Disabilities	Building must meet the QCVN 10:2014/BXD requirements	Community Pre 1
Man-1 Design Stage	Perform an Eco-Charrette	Management Pre 1
Man-2 Construction Stage	Produce a safety policy and safety plan	Management Pre 2
Man-4 Maintenance	Provide a Building Operation & Maintenance Manual	Management Pre 3
Man-5 Green Management Practice	Provide a Building User's Guide to all dwelling units	Management Pre 4

LOTUS MFR 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, Overview, 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).

Codes and Standards Referenced in LOTUS

LOTUS MFR references 16 Vietnamese and 4 International Codes and Standards. These references are included in LOTUS for their relevance to green building construction. Those which are legislated are mandatory for any construction project to follow in Vietnam. The VGBC recognises that it has a responsibility to ensure that LOTUS certified buildings meet these mandatory minimum requirements as well as raise awareness of such codes in Vietnam. LOTUS achieves this by including many codes in prerequisite criteria, meaning evidence must be given of compliance with such codes in order for a building to be LOTUS certified.

Where a Vietnamese standard exists, LOTUS references or uses it as part of credit criteria, however, the construction sector in Vietnam often relies on International standards as well. VGBC has consciously prioritised the use and awareness of local standards wherever possible.

This list is intended to highlight the different codes and standards that LOTUS expects Applicants to consider as a minimum. This is by no means a comprehensive list of all codes and standards to be applied to Residential Construction. As such, the VGBC does not intend this list to be used as a checklist for construction projects. Whilst every care has been taken to provide the most current codes and standards at the time of publishing, it is the responsibility of the project team to source the most current codes and standards for their project. When a code or standard becomes out dated in LOTUS, the Applicant will be expected to apply the most current version.

Table 2: Codes and Standards Referenced in LOTUS

Category	Vietnamese/ International	Legislation or Standard
General	Vietnamese	Decree 209/2004/ND-CP - Quality management of construction works
		QCVN 02:2009/BXD - Vietnam Building Code Natural Physical & Climatic Data for Construction
Energy	Vietnamese	QCVN 09:2013/BXD - Vietnam Building Energy Efficiency Code (VBEEC)
Water	Vietnamese	TCVN 5502:2003 - Domestic Supply Water - Quality Requirements
Ecology	Vietnamese	Decree 175/1994/NĐ-CP dated 18-10-1994 on Guidance of Enforcing Environmental Protection Law - Decree 143/2004/NĐ-CP amended Article 14
		Decree 21/2008/NĐ-CP amends and supplements a number of articles in Decree No. 80/2006/NĐ-CP with regard to regulations detailing and guiding the implementation of the following articles of Law on Environmental protection: articles 4, 5, 11, 17, clause 1 article 6, clause 3 article 22 and supplements articles 6a, clause 1b article 13, articles 17a, 17b, 17c, 17d, 21a, 23a.
		TCVN 7538-5:2007 Soil quality - Sampling - Part 5: Guidance on the procedure for the investigation of urban and industrial sites with regard to soil contamination
		TCVN 7629:2007 Hazardous waste thresholds
		TCVN 6647:2007 Soil quality - Pre-treatment of samples for physic-chemical analysis
		TCVN 7370-2:2007 Soil quality - Dissolution for the determination of total element content - Part 2: Dissolution by alkaline fusion
Waste and Pollution	Vietnamese	QCVN 14:2008/BTNMT National technical regulation on domestic wastewater
Health and Comfort	Vietnamese	TCVN 5687:2010 Ventilation - Air conditioning - Design standards
		TCXDVN 277-2002 - Sound insulation standards of building elements between rooms
	International	ASHRAE Standard 62.1 – 2007, 2010 and 2013
		Australian Standard, AS 1668.2
		CIBSE Guide B - Heating, Ventilating, Air conditioning and Refrigerant
		ASHRAE Standard 55-2004
Adaptation and Mitigation	Vietnamese	TCVN 7957:2008 Drainage and sewerage - External Networks and Facilities - Design Standard
Community	Vietnamese	QCVN 10:2014/BXD National Technical Regulation on Construction for Disabled Access to Buildings and Facilities”
Management	Vietnamese	Circular No. 22/2010/TT-BXD on Labour Safety in Work Construction

LOTUS MFR Weighting

The weighting of categories within LOTUS MFR (Table 3) has been carefully considered through analysis of other green building rating tools and in response to the environmental issues specific to the construction practices, development and the changing climate of Vietnam.

Table 3: LOTUS MFR Weighting

Categories	Weight (%)	Max Points
Energy	28%	31
Water	12%	13
Materials	8%	9
Ecology	8%	9
Waste & Pollution	6%	7
Health & Comfort	12%	13
Adaptation & Mitigation	9%	10
Community	6%	6
Management	11%	12
Total	100 %	110

The number of points available per credit, and as a result per category, has been set up to reflect this weighting.

LOTUS MFR Certification Levels

There are 110 points available in LOTUS MFR, plus up to 8 bonus points available within the Innovation category. The thresholds for Certification (Figure1) have been set up after a survey of several rating systems including; LEED (US) NC v3, Green Star (Australia) Office V.3, GBI (Malaysia) RNC V.1, BEAM Plus (Hong-Kong) NB V1.2.

As a consequence of this research, the first certification level for LOTUS MFR Pilot 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.

0-43 points	44-60 points	61-71 points	72-82 points	83-118 points
Uncertified	**Certified**	**Silver**	**Gold**	**Platinum**

Figure 1: Certification System & Performance levels

LOTUS Multi-family Residential Pilot: Updates from LOTUS R Pilot

Compared to LOTUS R Pilot, LOTUS MFR Pilot maintains the general structure of the tool and focuses mainly on updating the LOTUS categories with modifications on the content of the prerequisites and credits. The overall approach was to simplify LOTUS, not in terms of the sustainable performance achieved by projects, but in terms of keeping the most relevant prerequisites and credits and increasing their applicability to a maximum number of projects.

The main changes between LOTUS R Pilot and LOTUS MFR Pilot are detailed as follows:

1. Platinum certification level has been introduced to recognize more effectively the higher performance reached by some projects.
2. Thresholds for achieving each Certification Level have been modified accordingly.
3. The number of prerequisites has been decreased from 22 to 16 and the number of points from 150 (+8 bonus) to 110 (+8 bonus).
4. A number of credits and prerequisites have been modified to offer multiple compliance methods and to reflect more appropriately current industry best practice in Vietnam.
5. The LOTUS Provisional Certification stage is clearly made optional and certification levels (silver, gold or platinum) will no longer be awarded at this stage to match most international certification systems.

LOTUS MFR Certification

LOTUS certification is a formal process to independently validate that a project has achieved the environmental performance specified in LOTUS Rating Tools. Documentation-based submissions are provided to the VGBC 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 not only will improve the project´s overall performance, but will also achieve a better LOTUS certification level.

LOTUS MFR certification happens in 2 steps:

- LOTUS Provisional Certification
- LOTUS (Full) Certification

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

LOTUS Provisional Certification is valid for a maximum of 18 months after the completion of construction. Provisional Certification allows for marketing opportunities (refer to marketing package).

LOTUS (Full) Certification assesses the performance of the as-built building. LOTUS (Full) Certification can be applied for as soon as handover is completed and must be completed before 18 months of the completion of construction. It demonstrates that all green building strategies and attributes defined at the design stage are incorporated and achieved at the construction 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. LOTUS (Full) Certification is valid for 3 years and certified projects are required to provide monthly energy and water consumption data for the building each year during these 3 years.

The validity period of LOTUS (Full) Certification may be extended for an additional 2 years based on the submission of energy and water consumption data. Projects will only be eligible for Certification extension if operational data has been provided during the initial 3 year certification validity period.

The following sections outline the timeline to attain LOTUS certification:

1. Application and Registration
2. LOTUS Provisional Certification
3. LOTUS (Full) Certification

LOTUS Timeline

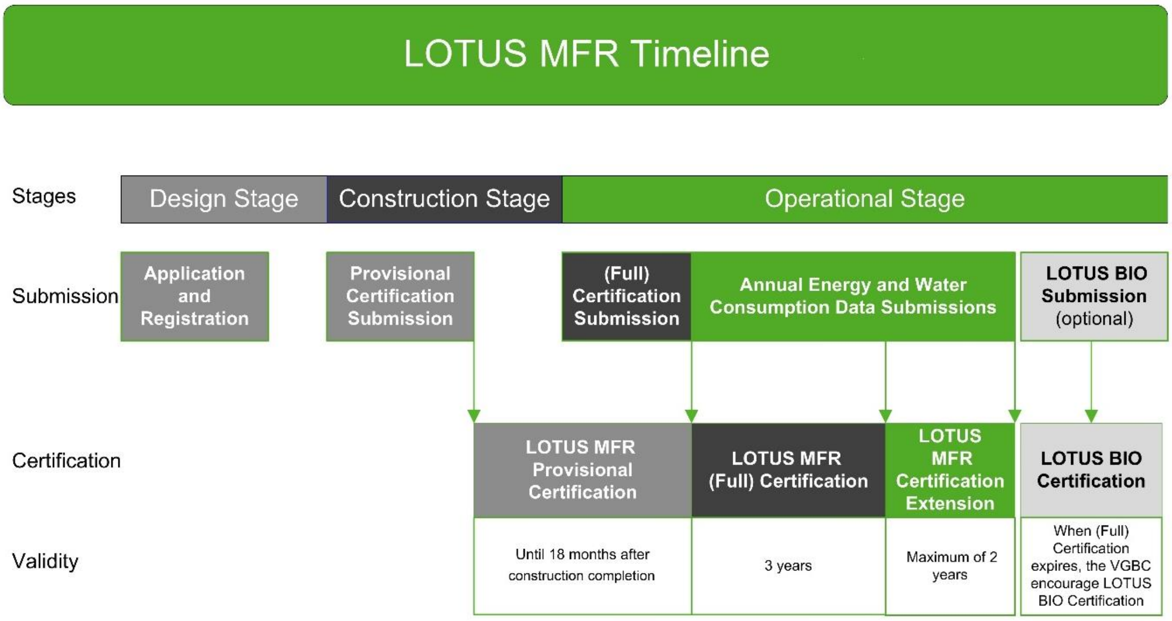

Figure 2: LOTUS Timeline

The first step to gain LOTUS certification is to apply and register the project with the VGBC. This should be done at the earliest stage possible as the implementation of “green” strategies is most effective when they are considered early in the planning and design stage.

During the design stage the Applicant should prepare the Provisional Certification Submission, which should be submitted at the completion of the design stage. Based on the results of the assessment of the Provisional Certification Submission a LOTUS MFR Provisional Certificate will be issued with a validity of up to 18 months after the completion of construction.

At the completion of the construction stage the Applicant should make a (Full) Certification Submission. To be eligible for (Full) Certification, this submission must be made within 18 months of the completion of construction. In case that the submission is made more than 6 months after the completion of construction, energy and water consumption data should also be submitted as part of the (Full) Certification Submission.

Based on the results of the assessment of the (Full) Certification Submission a LOTUS MFR (Full) Certificate will be issued. The (Full) Certificate is valid for 3 years from the issue date. During this validity period the Applicant is required to submit energy and water consumption data annually. Provided that energy and water consumption data has been submitted annually a Certification Extension of a further 2 years may be granted. During this period the Applicant is required to continue to submit energy and water consumption data.

Application and Registration

Registering a project with the VGBC declares the intent to pursue LOTUS certification using a LOTUS Rating Tool and is the first step in the certification process.

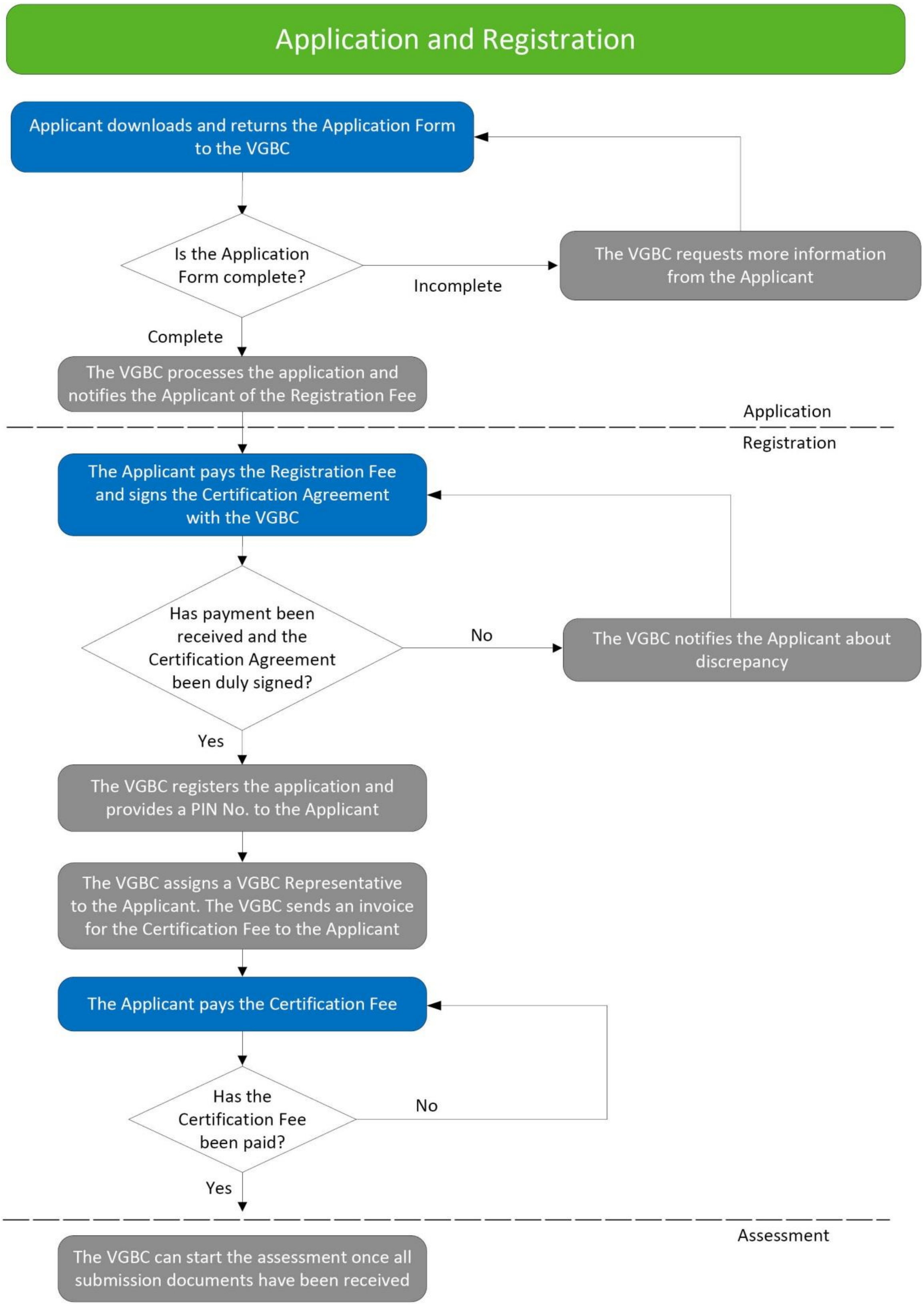

Figure 3: Application and Registration

For any building to go through the certification process, all eligibility criteria must be fulfilled. It is the Applicant Representative's responsibility to ensure that only eligible projects are registered for certification. The VGBC 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 the VGBC.

Applicants must complete an application form and submit it to the VGBC. On receipt of the application form the VGBC 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.

Once the application form has been confirmed as complete, the VGBC will request payment of the registration fee. In addition, a VGBC certification agreement with all necessary terms and conditions will be signed by both the Applicant and the VGBC.

On receipt of the registration fee and a signed copy of the VGBC certification agreement, the project registration is complete. The Applicant will then be issued with a Project Identification Number (PIN) and assigned a VGBC Representative for the certification process. 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 VGBC. A certification fee will be invoiced and must be paid prior to any submission of documentation.

LOTUS Provisional Certification

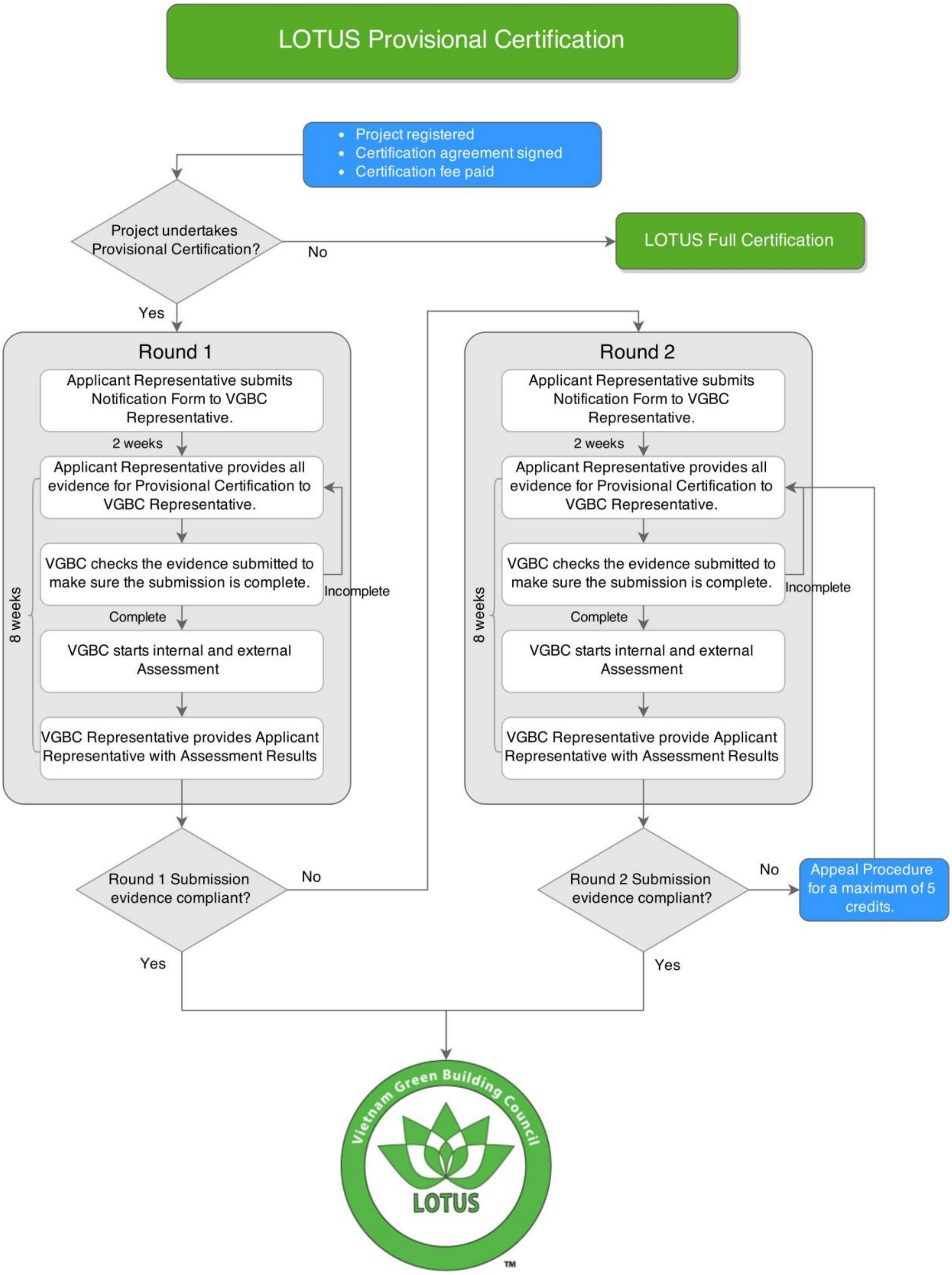

Figure 4: LOTUS MFR Provisional Certification

The project design team will need to identify which level of performance they aim to achieve at the beginning of the design stage.

Following registration, the project design team must prepare all of the evidence required by the LOTUS Rating Tool being used 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.

Round 1

Notification Form Submission

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

Submission

The Applicant Representative submits all required evidence for Provisional Certification Assessment. The VGBC recommends that all evidence is provided before the beginning of construction 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 VGBC Representative will be checked to make sure it is complete. In case documentation is missing, the VGBC Representative will request the Applicant Representative to promptly provide the missing data.

Assessment

The data supplied to the VGBC Representative will be assessed by the VGBC Project Assessment Committee. This committee is led by a VGBC project manager and consists of VGBC and external experts. Results of the assessment will be provided to the Applicant Representative within 8 weeks of the submission date.

Results

An assessment report detailing the results of the round will be issued to the Applicant Representative by the VGBC.

Round 2

If Round 1 submission for any credit submitted for LOTUS Provisional Certification is denied, or the Applicant would like the opportunity to score higher for that credit, a second round of submissions for re-assessment is available for projects. This round will give the possibility to provide further evidence to demonstrate to the VGBC Primary Assessment Committee that pending Credits 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.

Results of the assessment 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, 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 18 months after the completion of construction at which point Final Certification must be submitted.

LOTUS Full Certification

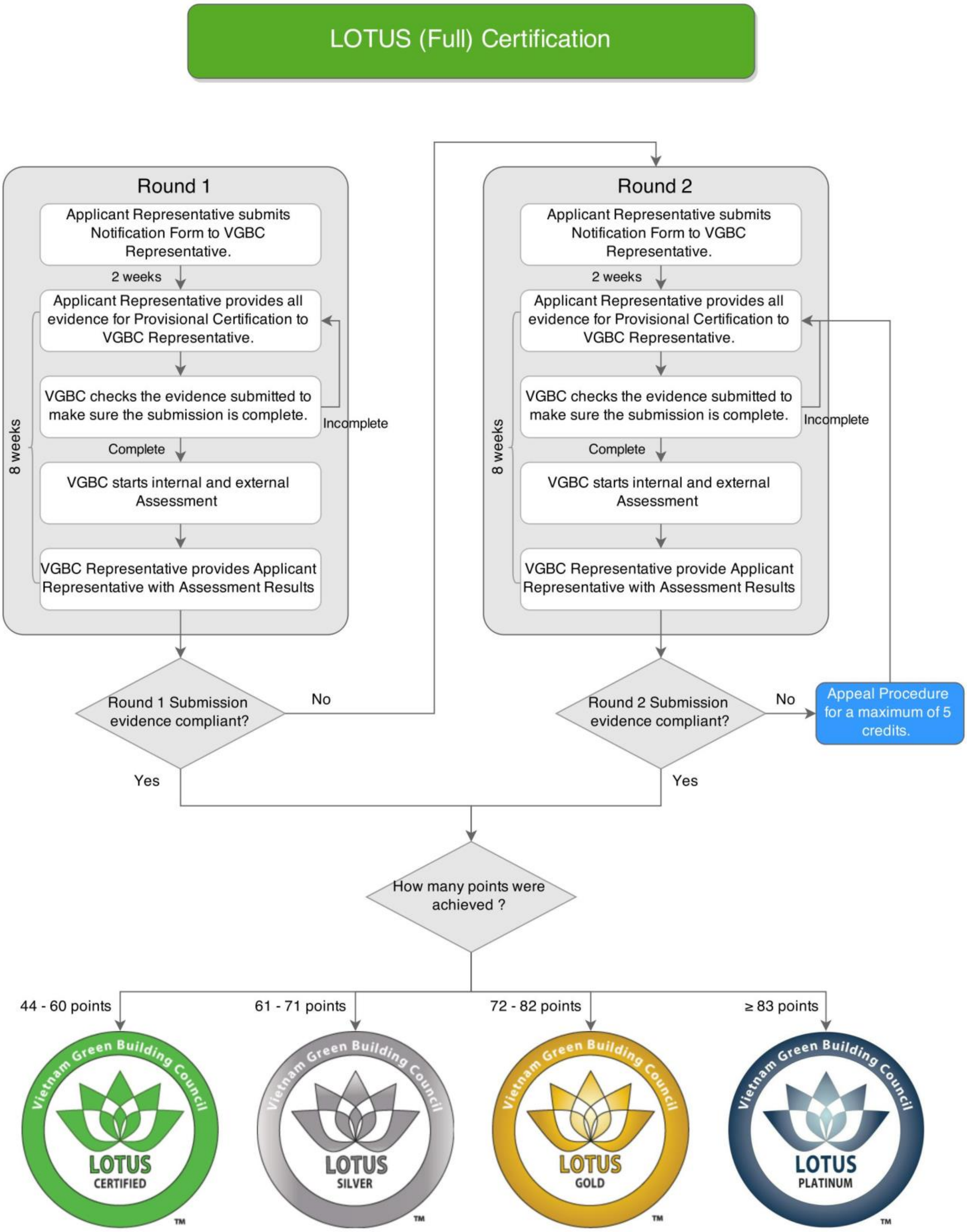

Figure 5: LOTUS MFR (Full) Certification

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 18 months of the completion of construction.

Full Certificate

The LOTUS (Full) Certificate will be issued by the VGBC upon successful completion of this final assessment. Building 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 building owner provides monthly energy and water consumption data on a yearly basis, for the duration of the LOTUS MFR (Full) Certification (3 years). An extension of a further 2 years may be granted based on the annual submission of energy and water consumption data over that extension period.

LOTUS Submissions

There are two different types of submissions:

- Design stage submissions, which are required for LOTUS Provisional Certification
- As-built stage submissions, which are required for LOTUS (Full) Certification

At each round of both types of submissions, a complete portfolio of evidence is submitted at one time, demonstrating that a project meets the requirements. The list of all submittals to be provided is given at the end of each prerequisite and credit. The following sections detail the structure of this submission.

Project Submission Folder

Once payment for registration fee has been received and the certification agreement has been duly signed, the VGBC Representative provides the Applicant Representative with the following pre-arranged 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 12 sub-folders for the LOTUS MFR Pilot Categories, a General Information Folder and a Resources Folder.

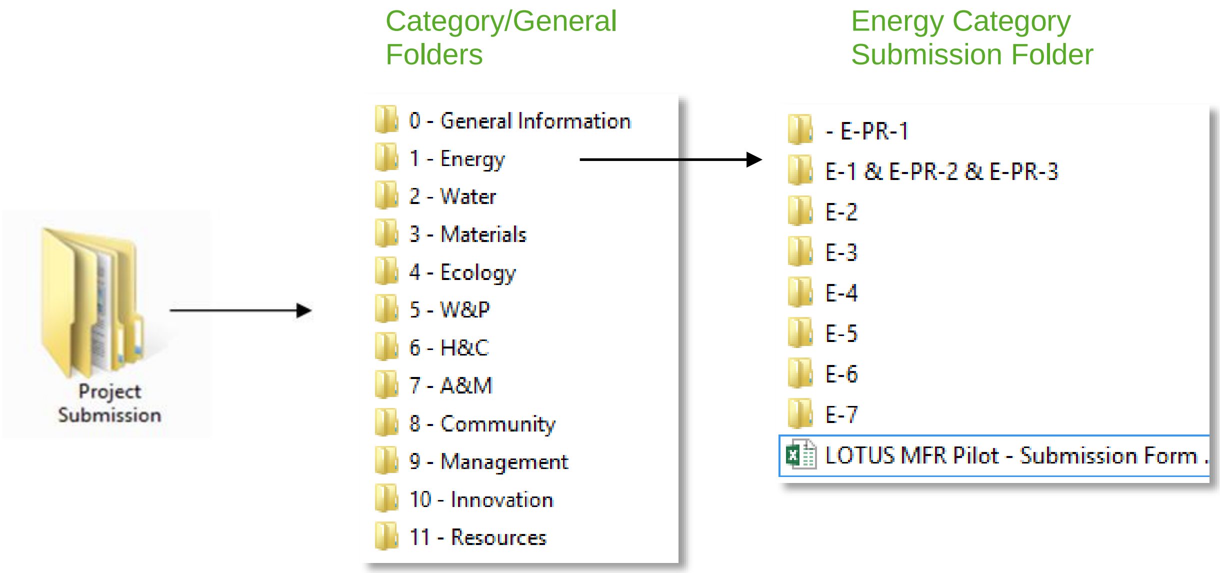

Figure 6: Project Submission Folder

The Applicant Representative must use the folder structure detailed in Figure 6. More information about the different sub-folders is given in the following.

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. The completed LOTUS MFR Pilot Project General Information spreadsheet. This file provides VGBC with important information about the project, including:
   - Project location
   - Construction/completion dates
   - List of consultants involved in the building construction and/or certification
   - General information on building and site including a breakdown of spaces
   - Summary of all of the credits targeted by the project and the status of the submittals

2. Any critical correspondence between the Applicant Representative and the VGBC Representative that may impact the project assessment.

3. A full set of project documentation including design drawings and specifications (where available) for all architectural, civil, structural, mechanical, electrical, hydraulic and building controls (VGBC recommends files are provided in .PDF format).

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

Category Folder

Within each of the 10 category folders, include the Submission Template file and a credit folder for each individual credit or prerequisite for that category.

Credit Folder

Credit folders should be submitted for each of the credits targeted. Each credit folder should contain all supporting evidence for the credit.

Category Submission Template

The Category Submission Template summarises how a project has achieved the credit requirements and links all applicable documentation as evidence. Its aim is to introduce the credit criteria, ensure all the required documentation is submitted and serve as the format for the VGBC to provide assessment feedback on each of the credits.

In order to make the assessment easier and quicker, Category Submission Templates for all Categories have been supplied and formatted to directly refer to the submissions section of each credit. The sections for each credit being targeted, including all mandatory prerequisites, must be completed for Submission.

Each Credit Cover Sheet contains the following sections that must be completed for Submission:

- General Information: Complete for each category to identify the project and certification stage of the submission
- Points: Tick the right box for the number of points claimed for the credit
- Approach and Implementation: Insert a detailed summary to explain how the credit requirements have been complied with intent, solutions found, methodology used, main features and results (maximum of 2000 characters). If appropriate, submitter may provide further information such a description of the challenges of realizing the credit. Summary may be very detailed or simple depending on what is required to give a complete understanding of the credit solution.
- Specific Information: Complete this section when applicable to the requirements of the credit
- Documents submitted: Complete the table by:
    - Adding the exact name of the electronic file in “Document Name”

- Briefly explaining within the "Document Intent" the reason for providing the document
- Adding a "Reference" which will be used to guide the reviewer when assessing long or complicated documents which only partly address credit requirements (e.g. page 10, section 3.4, table 4.3)

Resources Folder

This folder contains a few documents that are provided to the Applicant Representative:

- LOTUS MFR Pilot Management tool: a tool that can be helpful to manage the project, select appropriate pathways, track progression, set targets, etc. The Applicant Representative can use this tool at their own discretion.
- LOTUS Water Calculation Tool: a tool that can perform all the calculations necessary for the Water credits. VGBC strongly encourages the use of this tool as a submission document for the calculations of the Water Credits
- LOTUS Water Calculation Tool - User Manual.
- 'E-1 Energy Performance Calculation Method'. This document provides all the guidelines that have to be followed to realise the simulations required in the scope of E-PR-3 and E-1 Total Building Energy Use.
- 'E-1 Energy modelling Input tables'. This file has to be completed and submitted for compliance with E-PR-3 and E-1 Total Building Energy Use.
- 'OTTV Calculator'. VGBC strongly encourages the use of this tool to perform the OTTV calculations necessary for E-2 Building Envelope Option A.

Full Certification stage Submissions

- Credits not impacted by any deviation or addition from the design stage submission:

Unless specifically stated in the final assessment report of the Provisional Certification, credits that have been validated at Provisional Certification only require the submission of as-built drawings, as-built documentation and as-built evidence for the Full Certificate assessment. Calculations, reports or any other document validated at Provisional Certification are not required to be re-submitted.

- Credits impacted by any deviation or addition from the design stage submission:

In this case, project applicants should re-submit all required evidence for the Full Certification Assessment including evidence already submitted for Provisional Stage. A description of the modifications should be provided and the documents submitted (drawings, calculations, etc.) should clearly highlight the changes.

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, the LOTUS rating tools rewards efforts taken to reduce the building energy consumption through passive design and an iterative design process, utilizing energy modelling software and techniques. Sharing this common end goal all credits within this Energy category of LOTUS encourages the reduction of a building's energy use through optimized thermal performance, incorporating natural ventilation and energy efficient technologies, as well as utilizing sustainable energy sources.

Energy		31 points
Item	**Criteria**	**Points**
E-PR-1	Passive Design	PR
	Conduct a Passive Design Analysis	Energy Prerequisite 1
E-1	Total Building Energy Use	14 points
	Project complies with all mandatory requirements of VBEEC	Energy Prerequisite 2
	Demonstrate a 10% reduction of the total building energy use compared to the baseline	Energy Prerequisite 3
	1 point for every additional 2.5% reduction of total building energy use compared to the baseline (Up to 45%)	14
E-2	Building Envelope	4 points
	Option A: Overall Thermal Transfer Value (Available for all types of project)	
	Building's average OTTV surpasses VBEEC requirements by 10%	1
	1 point for every additional 10% reduction of building's average OTTV compared to VBEEC requirements (Up to 40%)	4
	Option B: Building Envelope Design (Available for projects with more than 50% of dwelling units with a building layout design meeting requirements of strategy A3 of credit E-3)	
	Strategy A: Solar radiation For 1 point, Implement strategies to reduce the solar radiation absorbed by opaque surfaces.	4
	Strategy B: West facing façade For 1 point, West facing facade area lower than 20% of total facade area For 2 points, West facing facade area lower than 10% of total facade area For 3 points, No west facing façade	
	Strategy C: Window to Wall Ratio on West and East facing facades For 1 point, Window to Wall Ratio of the West and East facing facades lower than 30% For 2 points, Window to Wall Ratio of the West and East facing facade lower than 15%	
	Strategy D: Effective external shadings For 1 point, Install proper external shadings on all windows	

E-3	Natural ventilation and Air-conditioning	6 points
	Strategy A: Natural Ventilation	
	Strategy A1: Building layout design 1 point for every 20% of units with window openings facing prevailing wind directions (up to 4 points) Strategy A2: Dwelling unit design 1 point for every 20% of living rooms and bedrooms with effective cross ventilation (up to 4 points) Strategy A3: Common areas 1 point if 80% of the lobby, corridor and staircase areas are designed to be naturally ventilated	6
	Strategy B: Air-conditioning	
	Use energy efficient HVAC systems by implementing the following strategies: A. 1 point for every 10% improvement of COP for direct electric air-conditioners AND 5% improvement of COP for water-chilling systems in comparison to VBEEC requirements (up to 5 points) B. 1 point for using variable controls on all the HVAC systems	6
E-4	Artificial Lighting	3 points
	Installed LPD surpasses VBEEC requirements by 15%	1
	1 additional point for every 15% of reduction of the installed LPD compared to VBEEC requirements (up to 45%)	3
E-5	Energy Monitors	1 point
	Provide each dwelling unit with a home energy monitor to record electricity consumption	1
E-6	Lifts	1 point
	Option A: No Lift installed	
	No lift is installed in the building	1
	Option B: Use of energy efficient lifts	
	All lifts installed in the building shall either: • Reach energy efficiency class A or class B following the certification guideline VDI 4707 Part 1 – Lifts Energy Efficiency -OR- • Follow at least 4 ways to reduce energy consumption among the following: 1) efficient hoisting 2) efficient lighting system 3) standby mode 4) energy regeneration 5) controls	1
E-7	Renewable Energy	2 points
	0.5% of the total energy used in the building is produced from renewable sources -OR- Install a renewable electricity generation system with a power output of more than 5 kW	1
	1.5% of the total energy used in the building is produced from renewable sources -OR- Install a renewable electricity generation system with a power output of more than 15 kW	2

E-PR-1 Passive Design

Intent

To identify, analyze and incorporate design techniques that take advantage of the natural climate and site to minimize mechanical cooling and heating in the building, while ensuring comfort for all occupants

Requirements

Criteria	Points
Conduct a Passive Design Analysis	Energy Prerequisite 1

Overview

Passive Design Analysis (Energy Prerequisite 1)

Passive design analysis evaluates the site location, surroundings and topography, as well as the orientation of the proposed building. The study allows for analysis of solar paths, wind modelling, thermal performance modelling and shadowing assessment. The main purpose of passive design analysis is to demonstrate natural energy flows to optimize building performance and reduce reliance on energy intensive systems. As such, careful attention must be paid to adapting the design to the local climate while designers must demonstrate how the proposed building integrates/considers passive design measures.

Approach & Implementation

Passive Design Analysis (Energy Prerequisite 1)

The following factors should be considered in a passive design strategy:

Climatic Data

- Providing monthly data of the site for the following climatic parameters: temperature, humidity, irradiation, rainfall, wind speed and direction

Orientation

- A well-positioned building delivers significant life-style and environmental benefits
- Appropriate orientation assists passive cooling by minimizing its exposure to the sun and maximizing the effect of trade winds, resulting in improved comfort and decreased energy consumption (Figure E.1)

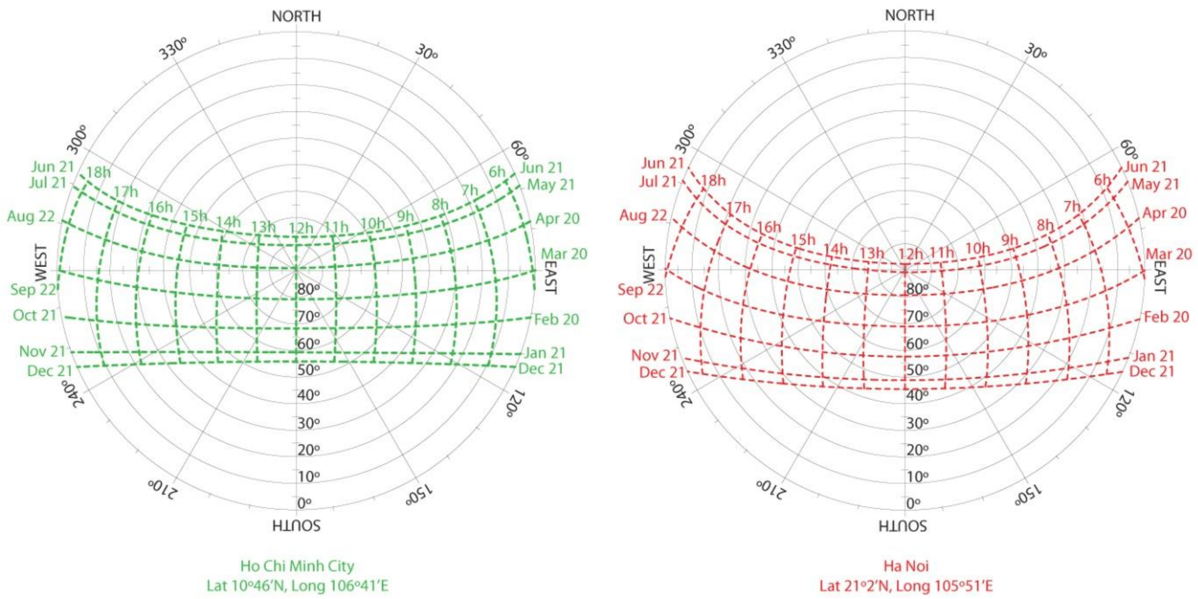

Figure E.1: Sun-paths for Hanoi and Ho Chi Minh City

Glazing

- Sizing, positioning and detailing of windows avoids overheating in summer and heat loss in winter
- The positioning and design of the windows can facilitate air movement and cooling in the summer and protect from cold winter winds
- Specifying glazing which has proper insulation levels and light transmittance to reduce unwanted heat losses and gains

Material and Construction

- Specifying proper levels of insulation to reduce unwanted heat loss or heat gains through the roof, walls, doors, windows and floors
- Specifying high mass materials increases the thermal mass of a building, providing thermal damping
- Applying construction methods which result in an air-tight envelope reducing infiltration and loss of energy and moisture

Natural Ventilation

- Designing robustly controlled air flows through buildings for daytime and night time cooling

Zoning

- Providing thoughtful zoning to allow different thermal requirements to be compartmentalized to reduce wasted energy

Shading

- Reducing solar gains at openings, outdoor spaces and building elevations can dramatically improve comfort and save energy
- Utilizing of overhangs, louvers and planting which are effective means for shading a building from excessive solar gains (Figure E.1)

Landscaping

- Using the landscape for shading, wind channeling and passive cooling of the surroundings

VGBC strongly encourages the use of thermal simulation to assess the effectiveness of the passive design strategies. The passive design report can then quantify the energy performance of the strategies implemented

Submissions

Design stage

Passive Design Analysis (Energy Prerequisite 1)

- Passive design analysis report considering all the factors described in Approach & Implementation and indicating the steps taken by the design team to address these factors.

As-built stage

Passive Design Analysis (Energy Prerequisite 1)

- If not provided at design stage, submit a passive design analysis report considering all the factors described in Approach & Implementation and indicating the steps taken by the design team to address these factors.

E-1 Total Building Energy Use

Intent

To reduce the total building energy use through energy modelling, allowing the identification of strategies to reduce energy consumption and the evaluation of their effectiveness

Requirements

Criteria	14 Points
Project complies with all mandatory requirements of VBEEC	Energy Prerequisite 2
Demonstrate a 10% reduction of the total building energy use compared to the baseline	Energy Prerequisite 3
1 point for every additional 2.5 % reduction of energy use from the baseline (Up to 45%)	14

Overview

Total Building Energy Use (Energy Prerequisite 2 and Energy Credit 1)

Energy consumption within buildings is a major source of energy demand in Vietnam. Unabated, Vietnam's energy consumption stands to outweigh production and may result in more frequent energy shortages. Additionally, this escalating consumption will have an increasing contribution to climate change as a large portion of energy produced in Vietnam is derived from coal and gas.

VBEEC (QCVN 09:2013/BXD) is the Vietnamese National Technical Code providing mandatory technical standards to achieve energy efficiency in the design and construction or retrofit of civil engineering buildings (offices, hotels, hospitals, schools, retails, services, residential, etc.) with a gross floor area of 2,500 m^2 or larger.

Energy modelling is a design strategy which encompasses building geometry, spatial relationships, geographic information, quantities and properties of building components and systems. A building model helps designers make informed decisions regarding the potential benefits of specific measures, materials, systems and techniques employed in the final construction.

Approach & Implementation

Total Building Energy Use (Energy Prerequisite 2)

VBEEC includes mandatory requirements on:

- Building envelope
- Interior lighting
- Ventilation and air conditioning
- Water heating
- Energy management equipment, and
- Elevators and escalators

Projects should comply with all these mandatory requirements. More specifically, projects will have to submit evidence demonstrating compliance with requirements on U-value, SHGC, COP of HVAC systems, lighting power density and sub-metering.

Total Building Energy Use (Energy Prerequisite 3 and Energy Credit 1)

Energy simulations using high resolution modelling need to be performed in order to estimate the energy use of the design and baseline buildings. These simulations have to be conducted in accordance with the E-1 Energy performance calculation method set by the VGBC which will be provided to registered projects. In these guidelines is described all the necessary information to realize the modelling for the design and baseline buildings.

Submissions

Design stage

Total Building Energy Use (Energy Prerequisite 2)

Tender stage documents demonstrating compliance with VBEEC requirements on:

- U-values:
  - Tender stage specification extracts -OR- Manufacturer’s data indicating the thermal conductivity of the materials used for external walls and roof
  - U-values calculations
- SHGC:
  - Tender stage specification extracts -OR- Manufacturer’s data indicating SHGC values of glazing
- COP of HVAC systems:
  - Tender schedule of all HVAC equipment

- Tender stage specification extracts -OR- Manufacturer's published data on all HVAC equipment, indicating cooling capacity and COP calculated at the appropriate rating conditions

- Lighting power density:
  - Tender stage schedule of all devices proposed for artificial lighting
  - Tender stage interior lighting drawings
  - Tender stage specification extracts -OR- manufacturer's published data for all lamps and ballasts used in the interior of the building and in roofed exterior spaces
- Sub-metering:
  - Tender electrical schematic drawings showing location, type and number of energy meters showing the usage served by those meters

Total Building Energy Use (Energy Prerequisite 3 and Credit 1)

- Energy simulations to be documented in accordance with section 1.3 of the E-1 Energy Performance Calculation Method given by the VGBC.

<u>As-built stage</u>

Total Building Energy Use (Energy Prerequisite 2)

Evidence demonstrating compliance with VBEEC requirements on:

- U-values:
  - Manufacturer's data indicating the thermal conductivity of the materials used for external walls and roof
  - U-values calculations
- SHGC:
  - Manufacturer's data of the glazing indicating the SHGC value of glazing
- COP of HVAC systems:
  - Final schedule of all HVAC equipment
  - Manufacturer's published data on all HVAC equipment, indicating cooling capacity and COP calculated at the appropriate rating conditions
  - Evidence showing all HVAC equipment installed such as photographs, invoices, receipts, commissioning report, etc.

- Lighting power density:
  - Final schedule of all devices installed for artificial lighting

- As-built lighting drawings
- Manufacturer's published data of all lamps and ballasts used in the interior of the building and in roofed exterior spaces
- Evidence showing all devices installed for artificial lighting such as photographs, invoices, receipts, commissioning report, etc.

- Sub-metering:
  - As-built electrical schematic drawings showing location, type and number of energy meters showing the usage served by those meters
  - Evidence of the meters installed such as photographs, invoices, receipts, etc

Total Building Energy Use (Energy Prerequisite 3 and Credit 1)

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission
- Final energy simulations to be documented in accordance with section 1.3 of the E-1 Energy Performance Calculation Method given by the VGBC.

If the building construction has been completed for more than 6 months at the time of submission:

- Submit documents indicating monthly building energy consumption

E-2 Building Envelope

Intent

To ensure proper application of materials and techniques to the construction of the building envelope to optimise the thermal performance of the building

Requirements

Option A: Overall Thermal Transfer Value (Available for all projects)

Criteria	4 points
Building's average OTTV surpasses VBEEC requirements by 10%	1
1 point for every additional 10% reduction of building's average OTTV compared to VBEEC requirements (Up to 40%)	4

Option B: Building Envelope Design (Available for projects with more than 50% of dwelling units with a building layout design meeting requirements of strategy A1 of credit E-3)

Criteria	4 points
Strategy A: Solar radiation	
Implement strategies to reduce the solar radiation absorbed by opaque surfaces.	1
Strategy B: West facing façade*	
West facing facade area lower than 20% of total facade area	1
West facing facade area lower than 10% of total facade area	2
No west facing facade	3
Strategy C: Window to Wall Ratio on West and East facing facades	
Window to Wall Ratio of the West and East facing facades lower than 30%	1
Window to Wall Ratio of the West and East facing facade lower than 15%	2
Strategy D: Effective external shadings	
Install proper external shadings on all windows	1

* The west facing facade is defined as the facades oriented within the range of 22.5 degrees North of West and 22.5 degrees South of West. East facing facade is defined similarly. Core walls for lifts or staircases and toilets that are located within this range should be deducted in the calculation.

Overview

Building Envelope (Energy Credit 2)

A building envelope is the physical separation between the interior and the exterior environments of a building.

For air-conditioned buildings, where indoor climate is controlled by HVAC systems, it is essential to maintain a proper thermal separation between the interior and the exterior of the building. A good method to assess the overall performance of the building envelope involves the calculation of the Overall Thermal Transfer Value (OTTV).This factor determines the maximum thermal transfer permissible into the building through its walls, roof and windows due to solar heat gain and outdoor-indoor temperature difference (Figure E.2).

A well designed building envelope with a low OTTV value will minimise external heat gain and humidity gain while reducing the load on mechanical systems.

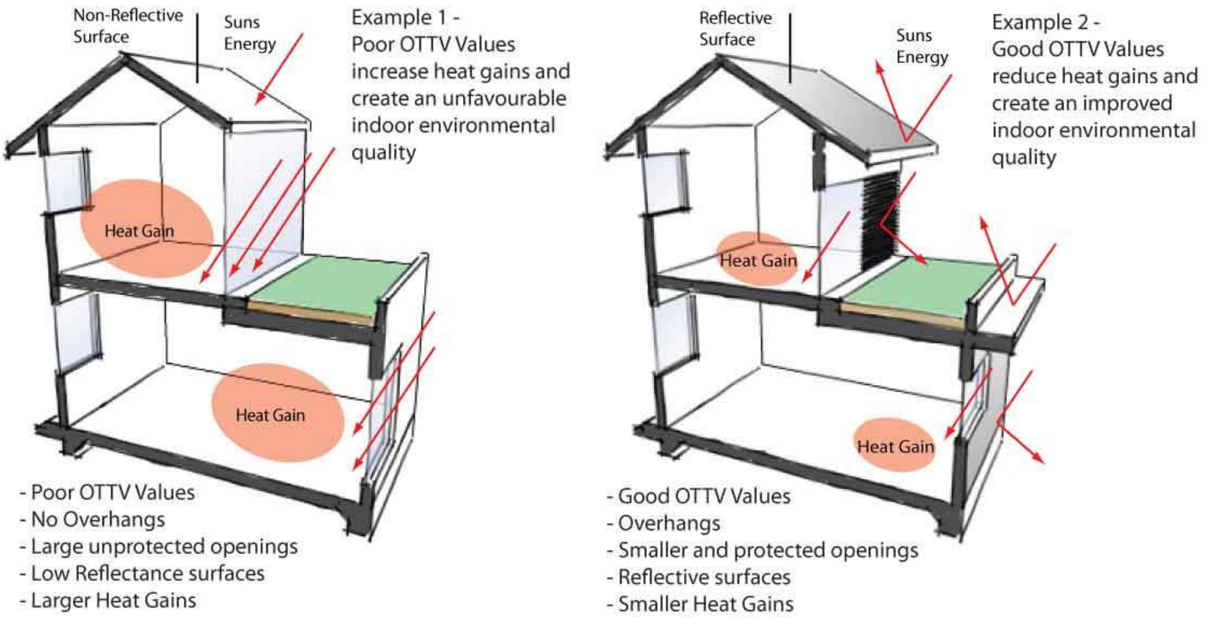

Figure E.2: OTTV to assess the overall performance of the building envelope

For naturally ventilated buildings, the insulation (limiting the heat transfer due to the indoor-outdoor temperature difference) is of much less importance since the openings will let the warm air from outdoors penetrate the building. Such buildings should mainly focus on limiting the direct solar heat gains through optimised orientation, proper fenestration layout, the use of external shadings and the use of materials with high solar reflectance.

Approach & Implementation

Building Envelope (Energy Credit 2)

Option A: Overall Thermal Transfer Value

Maximum OTTV values required by the VBEEC are 60 W/m^2 for walls and 25 W/m^2 for roofs.

To improve the performance of the building envelope and reduce the external heat gains, projects should consider the following strategies and technologies:

- Specification of materials with high thermal insulation for opaque walls and roofs
- Specification of proper techniques for the construction of the building envelope
- Optimised positioning and orientation of the building to reduce loads
- Proper sealing of windows, doors, mechanical openings and other assemblies within or penetrating the building envelope
- Provision of external shading to reduce unnecessary heat gains from solar irradiation
- Specification of glazing with low SHGC (solar heat gain coefficient)
- Specification of surface materials with a high solar reflectance

Option B: Building Envelope Design

Strategies to implement should aim to limit the solar heat gains:

- Reduction of the solar radiation on opaque roof and wall surfaces (strategy A)
- Optimised orientation of the building to limit the west-facing facade (strategy B)
- Reduction of the fenestration area on east and west-facing facades (strategy C)
- Provision of effective external shading to reduce unnecessary heat gains from solar irradiation. The effectiveness of the shadings installed will have to be demonstrated in link with the passive design analysis realised for the prerequisite E-PR-1. (strategy D)

To limit solar radiation on opaque roof AND walls of the building, LOTUS requires that 90% of the opaque roof and wall surface meet any or any combination of the following:

- Have a roof solar reflectivity> 0.7 or have a wall solar reflectivity> 0.4
- Be a green roof or be green walls
- Have external shadings. For roofs, fixed shading structure must be ventilated by spacing out at least 0.3m from the roof surface. PV panels and solar collectors can be considered external shadings for opaque roofs.

In the tropical climates, solar radiation should be kept off the opaque solid elements of the building's envelope where possible to reduce incoming heat. External balconies and corridors are multifunctional and have numerous OTTV and passive benefits, including shading effect. An opaque wall can have external shadings by the appropriate arrangement of balconies and external corridors. Surrounding buildings, topography, landscaping can also be considered as providing shading, when their effectiveness is sufficiently supported by evidence such as sunshading software showing shading at key points during the day.

Calculation

Building Envelope (Energy Credit 2)

Option A: Overall Thermal Transfer Value

Use the OTTV calculation tool provided by VGBC or follow the below steps to calculate OTTV:

- Step 1. Calculations of the OTTV values for each facade and roof

Calculations must be undertaken for each wall and roof assembly according to the normative reference of the VBEEC.

$$\mathrm{OTTV}\ [\mathrm{W/m^2}] = (1-\mathrm{WWR}) \times \mathrm{U_w} \times \alpha \times \left(\mathrm{TD_{eq}} - \Delta\mathrm{T}\right) + (1-\mathrm{WWR}) \times \mathrm{U_w} \times \Delta\mathrm{T} + \mathrm{WWR} \times \mathrm{K_{cs}} \times \mathrm{I_o} \times \beta + \mathrm{WWR} \times \mathrm{U_f} \times \Delta\mathrm{T}$$

Where:

WWR = Window-to-wall area ratio for the gross exterior wall being considered. The ratio of window area over the general area of the wall concerned or the ratio of skylight over the general area of roof (non-dimensional)

U_w = Thermal transmittance of the opaque wall/roof [W/m^2.K]

α= Coefficient of solar absorbance for the surface of the materials of opaque wall/roof

TD_{eq}= Equivalent indoor-outdoor temperature difference, in °C, which incorporates the effects of solar radiation onto the surface of opaque wall or roof

ΔT =Temperature difference, in ˚C, between indoor and outdoor temperatures

I_o= Average irradiation on wall and glazed area. Average hourly value of the solar energy incident on the windows for the i^{th} orientation, to account for the variation in the available solar, due to the orientation of the window [W/m^2]

β = External shading multiplier – non-dimensional. To consider the influence of external shading devices on solar heat gains through the fenestration

K_{cs}= Solar heat gain coefficient (SHGC), non-dimensional

U_f = Thermal transmittance of fenestration system [W/m^2.K]

K_{cs} and U_f values shall be calculated under NFRC (National Fenestration Rating Council) procedures

- Step 2. Calculation of the building's average OTTV (all facades and roofs included)

Building's average OTTV shall be calculated with the following formula:

$$\mathrm{OTTV_{average}} = \frac{\mathrm{OTTV_1} \times \mathrm{A_1} + \ldots + \mathrm{OTTV_n} \times \mathrm{A_n}}{\mathrm{A_1} + \ \ldots + \ \mathrm{A_n}}$$

Where n is the number of facades and roofs, $OTTV_n$ is the OTTV value of the nth facade/roof and A_n is the area of the nth facade/roof.

- Step 3. Calculations of the maximum VBEEC compliant average building OTTV

$$\mathrm{OTTV_{VBEEC}} = \frac{60 \times \mathrm{A_W} + \ 25 \times \mathrm{A_R}}{\mathrm{A_W} + \ \mathrm{A_R}}$$

- Step 4. Calculation of the improvement compared to the VBEEC

$$\text{Improvement [\%]} = \frac{\mathrm{OTTV_{VBEEC}} - \mathrm{OTTV_{average}}}{\mathrm{OTTV_{VBEEC}}}$$

Option B:

Calculations are relatively simple and will be illustrated under the form of an example.

A building with a 2000 m^2 total building façade area, a 5000 m^2 roof area, and a 300 m^2 west-facing facade with 60 m^2 of fenestration has 60% of the dwelling-units complying with strategy A1 of credit E-3.

The building has effective external shadings on all glazing with west and east orientations. Also, the building has a roof solar reflectivity of 0.75 and a wall solar reflectivity of 0.35 while no external shadings are installed.

The passive design analysis has shown via modelling that solar heat gains through glazing will be very important on the southern facade as well as on east and west facades.

- This building can apply Option B as more than 50% of the dwelling-units comply with strategy A1 of credit E-3.

- Strategy A: The roof solar reflectivity is higher than 0.7 but the wall solar reflectivity is lower than 0.4 as required in the credit. No shadings, green roofs or green walls are installed. As less than 90% of the opaque roof and wall surface is limiting solar radiation, no points can be achieved.

- Strategy B: Calculate the percentage of west-facing façade area

$$\text{\% of west facing facade } = \frac{300\ \mathrm{m^2}}{2000\ \mathrm{m^2}} = 15\ \%$$

The percentage of west-facing façade area is under 20% of the total building façade area, so 1 point can be granted.

- Strategy C: Calculate the WWR of the west and east-facing facades

$$\text{WWR of west facing facade } = \frac{60 \text{ m}^2}{300 \text{ m}^2} = 20\ \%$$

$$\text{WWR of east facing facade } = \frac{72 \text{ m}^2}{300 \text{ m}^2} = 24\ \%$$

The WWR of the west and east-facing facades are both under 30%, so 1 point can be granted.

- Strategy D: Effective external shadings have been implemented only on West and East orientations; according to the passive design analysis the southern facade requires horizontal shading but none is provided; therefore it is considered not suitable and the project is not awarded with 1 point for external shadings.

Conclusion: This building can be awarded 2 points under Option B.

Submissions

Design stage

Building Envelope (Energy Credit 2)

- Tender stage elevations, sections and annotated indicating materials drawings of all external walls and roof

Option A: Overall Thermal Transfer Value

- Glazing: Tender stage specification extracts -OR- Manufacturer's data indicating U-values and solar heat gain coefficients (SHGC)
- Opaque walls and roofs: Tender stage specification extracts -OR- Manufacturer's data indicating the solar reflectivity coefficients of the materials used for external walls and roof -OR- Justification for any values used solar reflectivity coefficients (when tender specifications or manufacturer's values are not available)
- Calculations of the OTTV values of the building and of the percentage of improvement compared to VBEEC requirements.

Option B:

- Strategy A: Tender stage specification extracts -OR- Manufacturer's data indicating the solar reflectivity coefficients of opaque walls and roof surfaces -OR- Justification for any values used for solar reflectivity coefficients (when manufacturer's values are not available)
- Strategy A: Tender stage roof plan indicating areas of all green roofs (if any) and/or tender stage elevation indicating areas of all green walls (if any)
- Strategy A and D: Report explaining how the passive design strategies, for instance shading, are implemented in order for demonstrating compliance with the requirements. The report may include reference to the specific sections of the passive design report.
- Strategy B: Calculations of the percentage of west-facing facade area
- Strategy C: Calculations of the WWR of west and east-facing facades

<u>As-built stage</u>

Building Envelope (Energy Credit 2)

- As-built elevations, sections and annotated indicating materials drawings of all external walls and roof
- Evidence showing how all the external walls and roofs are built and shaded, such as photographs, commissioning report, etc.

Option A: Overall Thermal Transfer Value

- Glazing: Manufacturer's data indicating U-values and SHGC values
- Opaque walls and roofs: Manufacturer's data indicating the solar reflectivity coefficients of the materials used for external walls and roof -OR- Justification for any values used for solar reflectivity coefficients (when manufacturer's values are not available)

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission
- Final calculations of the OTTV values of the building and of the percentage of improvement compared to VBEEC requirements.

Option B:

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission

- Strategy A: Manufacturer’s data indicating the solar reflectivity coefficients of opaque walls and roof surfaces -OR- Justification for any values used for solar reflectivity coefficients (when manufacturer’s values are not available)
- Strategy A: As-built stage roof plan indicating areas of all green roofs (if any) and/or as-built stage elevation indicating areas of all green walls (if any)
- Strategy A and D: Final report explaining how the passive design strategies, for instance shading, are implemented in order for demonstrating compliance with the requirements
- Strategy B: Final calculations of the percentage of west-facing facade area
- Strategy C: Final calculations of the WWR of west and east-facing facades

E-3 Natural Ventilation and Air-conditioning

Intent

To reduce the need for HVAC systems and increase natural air flow and to encourage the installation of energy efficient HVAC systems

Requirements

Criteria	6 points
Strategy A: Natural Ventilation	
Strategy A1: Building layout design 1 point for every 20% of units with window openings facing prevailing wind directions (up to 4 points)	6
Strategy A2: Dwelling unit design 1 point for every 20% of living rooms and bedrooms with effective cross ventilation (up to 4 points)	
Strategy A3: Common areas 1 point if 80% of the lobby, corridor and staircase areas are designed to be naturally ventilated	
Strategy B: Air-conditioning	
Use energy efficient HVAC systems by implementing the following strategies: A. 1 point for every 10% improvement of COP for direct electric air-conditioners AND 5% improvement of COP for water-chilling systems in comparison to VBEEC requirements (up to 5 points) B. 1 point for using variable controls on all the HVAC systems	6

Overview

Natural Ventilation and Air-conditioning (Energy Credit 3)

Space cooling usually accounts for the largest portion of a building's energy consumption in Vietnam. By improving the building envelope, it is possible to reduce the cooling load to a certain extent but solutions like natural ventilation or air-conditioning need to be implemented to provide comfortable spaces.

Naturally ventilated buildings take advantage of local wind patterns and building orientation to provide a supply of fresh air to occupants. This practice reduces the energy consumption of HVAC systems, while increasing Indoor Air Quality (IAQ). Buildings cannot wholly rely on natural means of ventilation but both intelligent building and system design are critical in minimizing HVAC demand.

There are two distinct ways of providing natural ventilation within buildings:

The first method, wind driven ventilation, involves the use of natural air flows as the primary means of ventilating spaces and providing thermal comfort. This method involves proper building orientation, as well as the correct design of size, number and placement of wall and roof opening.

The second method, stack ventilation, depends on the density differences between air of different temperatures. As air is warmed, either by internal heat loads, or within a thermal chimney, it begins to rise due to its lower relative density. In a structure designed to take advantage of the stack effect, this buoyancy causes the warm air to rise and leave the building via openings positioned at high elevations. This generates a pressure difference between the interior of the building and the exterior, which causes cooler, denser air to enter at lower elevations.

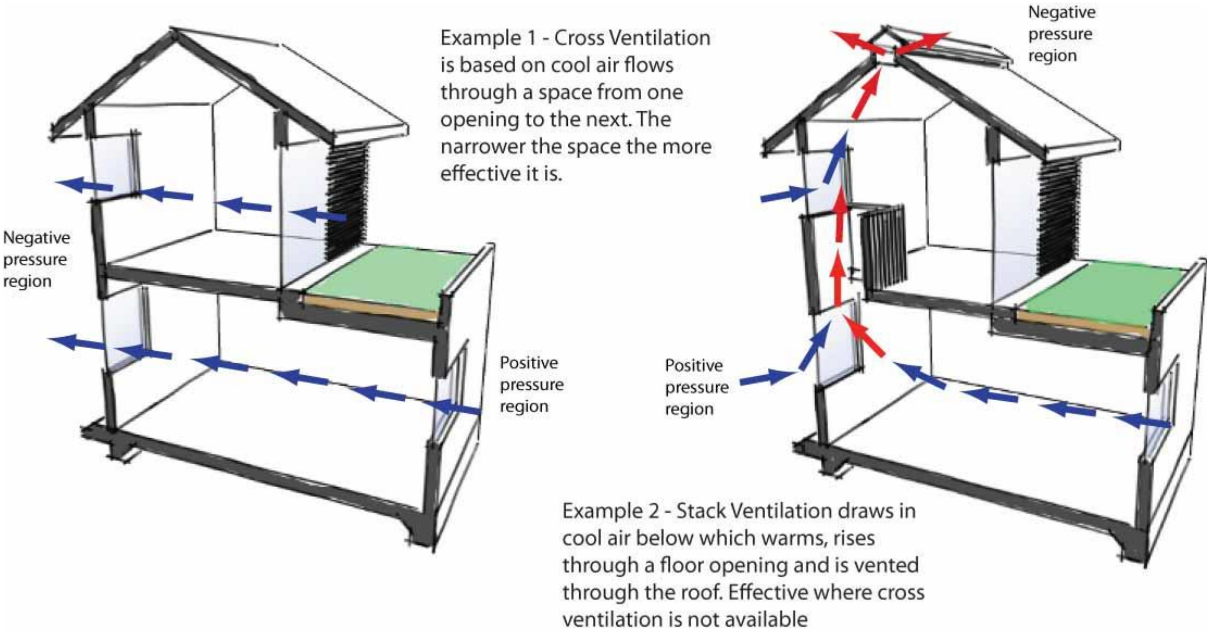

Figure E.3: Natural ventilation can be provided in a building through two methods: wind driven ventilation and stack ventilation

As for air-conditioning systems, relying on a refrigeration cycle, they are designed to change the air temperature and humidity within a space to bring more comfortable conditions.
A properly installed and well-designed cooling system along with reductions in HVAC loads can result in energy and financial savings over the life of a building. Selecting energy efficient equipment that is properly commissioned will improve system efficiency and will lengthen the life of the equipment. Changing filters, cleaning evaporators and condensers and having them checked on a regular (monthly) basis will reduce HVAC maintenance and even replacement costs.

Approach & Implementation

Natural Ventilation and Air-conditioning (Energy Credit 3)

Strategy A: Natural Ventilation

The inclusion of natural ventilation as a major source of ventilation and cooling must be investigated early in the design stage. Technologies and strategies which promote natural ventilation include:

- Proper building layout and orientation which utilises 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

To avoid compromising aesthetic intent or liability issues associated with operable windows in high rise buildings this requirement may be met by other means of induced natural airflow. Alternatives may include trickle vents, wing walls, or a thermal chimney.

Strategy A1: Building layout design

To improve natural ventilation, building layout should be designed to utilize prevailing wind conditions and achieve cross ventilation.

Prevailing wind direction is defined as the direction with the highest percent of frequency. It should be determined for the hottest months of the year using Table 2.16 of QCVN 02:2009/BXD (Vietnam Building Code Natural Physical & Climatic Data for Construction) or using meteorological data.

In the table of QCVN 02:2009/BXD is given information on wind directions and average wind speeds for all the weather stations of Vietnam. PL (%) is the frequency of time that there is no wind blowing while P (%) is the frequency of time that the wind is blowing from one direction. V (m/s) defines the average wind speed.

To comply with strategy A1, a dwelling unit must have:

- Some window openings facing prevailing wind direction (based on the hottest months of the year); and
- Some window openings located on the opposite direction of the prevailing wind

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.

In case of a building with 6 or less storeys located in a dense urban area, it is not necessary to be oriented in such a way to face prevailing wind direction.

Strategy A2: Dwelling unit design

Dwelling units should be designed to achieve effective cross ventilation in the living rooms and bedrooms. Cross ventilation in a room is considered as effective when:

- There is a continuous (unobstructed) air flow path between 2 window openings either within the room or from the room to another. One opening can be used as supply for up to two air flow paths.
- Window openings are located either in opposite or adjacent external walls. If the openings are on adjacent walls, they must be at least 3 meters apart at their closest point.
- Distance between the supply and exhaust openings is not more than 15 meters
- There is no more than one doorway or opening smaller than 2 m^2 between the ventilation openings
- Window openings have an openable area of at least 1 m^2.

For this requirement, the main entrance of the dwelling unit is assumed to be closed and all the windows / internal doors are assumed to be opened. Exception: when a gate door (with an opened area of at least 1 m^2) is covering the main entry door of the dwelling unit, the door can be considered as an exhaust opening.

Strategy A3: Common areas

Lobby, corridor and staircase areas should be designed to be naturally ventilated:

- For each space, the openable area of windows must be 5% or more of the net floor area of the space.
- Spaces equipped with air-conditioning system are not considered as naturally ventilated.

Strategy B: Air-conditioning

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

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 < 223 kW	2.78	
	≥ 223 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	ARI 550/590
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	

- All HVAC systems in the building should be designed to ensure better part-load systems efficiency. This can be achieved by implementing some of the following strategies:
  - VRV/VRF systems
  - VAV systems
  - VSD on chiller plant equipment like chilled-water pumps (VBEEC requirement) and/or cooling tower fans
  - Variable speed compressors for chillers, rooftop-units and split-units (inverters)

Calculations

Natural Ventilation and Air-conditioning (Energy Credit 3)

Strategy A: Natural Ventilation

Strategy A1: Building layout design

$$\text{Compliant Units } [\%] = \frac{\sum \text{Units facing prevailing wind}}{\sum \text{Units}} \times 100$$

Strategy A2: Dwelling unit design

$$\text{Living rooms and bedrooms with effective cross ventilation } [\%] = \frac{\sum \text{Living rooms and bedrooms with cross ventilation}}{\sum \text{living rooms and bedrooms}} \times 100$$

Strategy A3: Common areas

$$\text{Naturally ventilated common areas } [\%] = \frac{\sum \text{common areas with natural ventilation}}{\sum \text{common areas}} \times 100$$

Strategy B: Air-conditioning

All air conditioning units and water chilling packages in the building 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

Design stage

Natural Ventilation and Air-conditioning (Energy Credit 3)

Strategy A: Natural Ventilation

- Tender stage elevations, sections and plans marking all operable wall and roof openings
- Tender stage window schedule indicating the number, location and size of all operable wall and roof openings or room data sheets that indicate floor area and window specifications (glazing type, size and whether the window is operable).

Strategy A1: Building layout design

- Calculations demonstrating the percentage of units with openings facing prevailing wind direction and achieving cross ventilation.

Strategy A2: Dwelling unit design

- Schedule showing the number of living rooms and bedrooms in the building and highlighting those designed with effective cross ventilation
- Calculations demonstrating the percentage of the living rooms and bedrooms which are designed with effective cross ventilation

Strategy A3: Common areas

- Schedule showing the number of common spacesin the building and highlighting those designed with natural ventilation
- Calculations demonstrating the percentage of naturally ventilated common areas

Strategy B: Air-conditioning

- Tender schedule of all HVAC equipment including equipment ensuring better part-load systems efficiency
- Tender stage schematic drawings of the HVAC systems
- Calculations demonstrating improvement on the VBEEC requirements

<u>As-built stage</u>

Natural Ventilation and Air-conditioning (Energy Credit 3)

Strategy A: Natural Ventilation

- As-built plans, elevations and sections marking all operable wall and roof openings
- As-built window schedule indicating the number, location and size of all operable wall and roof openings

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission
- Strategy A1: Building layout design: Final as-built calculations demonstrating the percentage of units with openings facing prevailing wind direction and achieving cross ventilation.
- Strategy A2: Dwelling unit design: Final as-built calculations demonstrating the percentage of the living rooms and bedrooms which are designed with effective cross ventilation
- Strategy A2: Dwelling unit design: Final schedule showing the number of living rooms and bedrooms in the building and highlighting those designed with effective cross ventilation
- Strategy A3: Common areas: Final as-built calculations demonstrating the percentage of naturally ventilated common areas

Strategy B: Air-conditioning

- Final schedule of all the HVAC equipment installed including equipment ensuring better part-load systems efficiency
- As-built schematic drawings of the HVAC system indicating location of all the equipment

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission
- Final as-installed calculations demonstrating improvement on the VBEEC requirements

E-4 Artificial Lighting

Intent

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

Requirements

Criteria	3 Points
Installed LPD surpasses VBEEC requirements by 15%	1
1 additional point for every 15% of reduction of the installed LPD compared to VBEEC requirements (up to 45%)	3

Overview

Artificial Lighting (Energy Credit 4)

Artificial lighting contributes significantly to a building overall energy consumption. The application of appropriate levels of lighting contributes to occupant well-being, worker performance and building aesthetics. Reducing the amount of energy used to meet the lighting requirements of a building and its occupants is a strategy which can lower overall operating costs. Natural lighting can be applied, where possible, to reduce the electrical load associated with lighting requirements. Using natural lighting and specifying high grade materials and equipment also leads to reduced costs in maintenance.

Lighting systems can be included in a building management system that may be present in the building or as a standalone lighting control system. This allows tight control of the lighting fixtures in order to deliver the right lighting levels at the right time. Depending on many factors such as occupancy, natural lighting levels, task undertaken, time of the day, the lighting will be adjusted appropriately.

Approach & Implementation

Artificial Lighting (Energy Credit 4)

VBEEC stipulates maximum light power densities for different building types (Table E.4). 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 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.4: Maximum LPD Values for different types of building (VBEEC Table 2.12)

Type of Buildings	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 buildings	13

Calculation

Artificial Lighting (Energy Credit 4)

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

- Prepare a model of the building 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 building including parking spaces. 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 building [W/m^2]

P_L = Total power required to provide artificial lighting in the building (including indoor parking spaces and outdoor/open parking spaces with roof) [W]

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

- Calculate the average baseline LPD for the building including parking spaces with the following formula:

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

I_E = Maximum Lighting Power Density for the building [W/m^2]

$I_{E\,i}$ = Maximum Lighting Power Density for the building type i from the VBEEC [W/m^2]

$GFA_{L\,i}$ = total gross floor area of lighted spaces in the building 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 multi-family residential building includes the following areas and lighting power installed (Table E.5):

Table E.5: Example of LPD reduction calculation for a mixed-use project

Building types	GFA of lighted spaces [m^2]	Total artificial lighting power installed [W]	Maximum LPD for the building type (VBEEC) [W/m2]
Residential	11,000	55,000	8
Enclosed car parks	2,000	6,000	3
Total	GFA_L = 13,000 m^2	P_L = 61,000 W	

Thus:

$$I_D[W/m2] = \frac{P_L}{GFA_L} = \frac{61{,}000}{13{,}000} = 4.7\ W/m2$$

And:

$$I_E\left[\frac{W}{m2}\right] = \frac{\sum_i (I_{E\,i} \times GFA_{L\,i})}{\sum_i GFA_{L\,i}} = \frac{11{,}000*8+2{,}000*3}{13{,}000} = 7.2\ W/m2$$

Finally:

$$Reduction\ [\%] = \left(1 - \frac{I_D}{I_E}\right) \times 100 = 34.7\ \%$$

This retail building can be granted 2 points with more than 30 % of LPD reduction achieved.

Submissions

Design stage

Artificial Lighting (Energy Credit 4)

- Calculations demonstrating the percentage of LPD reduction achieved

As-built stage

Artificial Lighting (Energy Credit 4)

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission
- Final as-built calculations demonstrating the percentage of LPD reduction achieved

E-5 Energy Monitors

Intent

To ensure continuous monitoring and control of all building's energy consuming systems

Requirement

Criteria	1 Point
Provide each dwelling unit with a home energy monitor to record electricity consumption	1

Overview

Energy Monitors (Energy Credit 5)

Power sub-metering involves the installation of measurement equipment to meter building energy use. It helps to track energy consumption of major building uses and other end-use applications (e.g. by building systems or individual floors). As indicated in section 2.5 of VBEEC, it is required to install separate metering to monitor all major power uses (over 100 kVA) and tenancies of the building.

A home energy monitor is an electronic device that provides feedback on electricity consumption. Most monitors allow to view real-time electricity usage in units of energy used (kWh), cost or carbon emissions. As shown in various studies, real-time data helps homeowners to change their behaviour and leads to a reduction of the household energy use. Most advanced home energy monitors may also provide information on the usage of specific rooms and appliances.

Approach & Implementation

Energy Monitoring and Management (Energy Credit 5)

A permanent home energy monitor should be installed in each unit. It should:

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

Submissions

Design stage

Energy Monitors (Energy Credit 5)

- Description of the type of home energy monitors to be used (accessibility to unit owners, ability to display real-time information and to analyse data at regular intervals)
- Tender plans showing the location of the visual displays in the different units - OR - description of the monitor's ability to communicate the information to a remote location (e.g., computer).

As-built stage

Energy Monitors (Energy Credit 5)

- Evidence of the equipment installed such as photographs, invoices, receipts, etc.
- As-built plans showing the location of the visual displays in the different units - OR - description of the monitor's ability to communicate the information to a remote location (e.g., computer).

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission
- Description of the type of home energy monitors used (accessibility to unit owners, ability to display real-time information and to analyse data at regular intervals)

E-6 Lifts

Intent

To reduce energy consumption associated with the use of lifts.

Requirement

Criteria	1 Point
Option A: No Lift installed	
No lift is installed in the building	1
Option B: Use of energy efficient lifts	
All lifts installed in the building shall either: • Reach energy efficiency class A following the certification guideline VDI 4707 Part 1 – Lifts Energy Efficiency -OR- • Follow at least 4 ways to reduce energy consumption among the following: 1) efficient hoisting 2) efficient lighting system 3) standby mode 4) energy regeneration 5) efficient controls	1

Overview

Lifts (Energy Credit 6)

Energy consumption of lifts may be relatively low compared to cooling, home appliances and even lighting but it is far from being negligible and lift installations possess a high potential for saving energy. LOTUS encourages the use of lifts incorporating energy efficiency solutions such as VVVF (Variable Voltage, Variable Frequency), LED lighting, controls, etc.

VDI 4707 standard is an elevator energy efficiency classification guideline established by the Association of German Engineers. It provides a method to assess elevator energy performance taking into account factors such as load, speed, frequency of use and travel height – both during travel and standby modes.

Approach & Implementation

Lifts (Energy Credit 6)

All lifts installed in the building shall be compliant with at least one of the 2 following options:

- Reach energy efficiency class A following the certification guideline VDI 4707 Part 1 – Lifts Energy Efficiency.
  As described in the guideline, the ratings are influenced by travel height, speed, load and usage frequency (Table E.6). Depending on these factors, measurements of both standby and travel energy are considered separately to form the Energy Efficiency Class of the lift (ranging from 'A' to 'G' with 'A' being the best-in-class system.)

Table E.6: Usage categories according to VDI 4707 Part 1

Usage category	1	2	3	4	5
Usage intensity/frequency	Very low / very seldom	Low / seldom	Medium / occasionally	High / frequently	Very high / very frequently
Average travel time in hours/day	0.2 (≤0.3)	0.5 (>0.3 – 1)	1.5 (>1 – 2)	3 (>2 – 4.5)	6 (>4.5)
Average standby time in hours/day	23.8	23.5	22.5	21	18
Typical types of residential buildings	- Residential building with up to 6 units	Residential building with up to 20 units	Residential building with up to 50 units	Residential building with more than 50 units	/

- Follow at least 4 ways to reduce energy consumption among the following:
  1) Efficient hoisting
     Use AC Variable-Voltage Variable-Frequency (VVVF) drives.
  2) Efficient lighting system
     Use LED lamps for car lighting and display lighting
  3) Standby mode
     When the lift is not in use, the power stage of the drive should be set to sleep mode, and car lighting and ventilation fans should be switched off.
  4) Energy regeneration
     Use regenerative drive to recover potential energy contained in the car when it is descending with a heavy load or ascending with a light load.
  5) Controls
     Use control systems such as:
     - Intelligent controller to ensure that the entire elevator goes in standby mode when not in use
     - Destination selection control (when users select their destination before they enter the car, and the system directs them to the elevator that will get them to their destination soonest).

Submissions

Design stage

Lifts (Energy Credit 6)

- Tender schedule of the lift systems to be used in the building
- Tender specifications indicating the types of lifts and the energy efficient features to be incorporated
  - OR -
- Tender specifications indicating the VDI 4707 Energy Efficiency class to be reached.

As-built stage

Lifts (Energy Credit 6)

- Manufacturer's data indicating the types of lifts and the energy efficient features incorporated
  - OR -
- Manufacturer's data or energy efficiency certificate indicating the VDI 4707 Energy Efficiency class reached.

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission
- As-built schedule of the lift systems used in the building

E-7 Renewable Energy

Intent

To promote the use of renewable sources of energy and encourage their use in the built environment

Requirements

Criteria	2 Points
0.5% of the total energy used in the building is produced from renewable sources -OR- Install a renewable electricity generation system with a power output of more than 5 kW	1
1.5% of the total energy used in the building is produced from renewable sources -OR- Install a renewable electricity generation system with a power output of more than 15 kW	2

Overview

Renewable Energy (Energy Credit 7)

The use of renewable energy will serve to reduce the need for traditional power, and promote low carbon energy use. It will also serve to reduce the environmental impact due to emission of CO_2. The term renewable energy generally refers to electricity supplied from renewable energy sources, such as wind and solar power, geothermal, hydropower and various forms of biomass. These energy sources are considered renewable sources because their fuel sources are continuously replenished. Using renewable energy sources can help to reduce the overall energy consumption, environmental impacts and CO_2 emissions of a building. The application of renewable energy strategies in buildings are presently uncommon in Vietnam and should be promoted in the interest of sustainable development.

Approach & Implementation

Renewable Energy (Energy Credit 7)

Specifying sources of power which produce energy on-site from a renewable source can achieve points within this credit.

Valid forms of renewable energy include:

- Biomass, subject to VGBC approval
- Photovoltaic (PV) & Solar Thermal (including solar water heating)
- Fuel cells
- Geothermal
- Wind
- Micro-hydro

When following the option based on the power output of the renewable electricity generation system with a solar photovoltaic systems, the number of kWp installed should be considered instead of the power output.

Calculation

Renewable Energy (Energy Credit 7)

Calculation of the total energy used in the building produced from renewable sources:

Energy modelling shall be undertaken according to the procedure and data outlined in Energy Credit E-1. The following calculation shall be performed to indicate the total contribution to the building's energy use from renewable sources

$$\text{Renewable Energy Contribution } [\%] = \frac{\text{Renewable Energy Produced}}{\text{Energy Consumption (Proposed Design)}} \times 100$$

Submissions

Design stage

Renewable Energy (Energy Credit 7)

- Report outlining:
  - renewable energy sources proposed
  - explanation of the reasons for its selection, including basis for any further calculations as required
  - calculations showing estimated annual energy harvest
  - calculations demonstrating compliance with the requirements
- Description of simulation methodology/software used
- Tender stage schedule of all the energy production equipment

- Tender stage electrical schematic drawings indicating location within the site and required area
- Tender stage specification extracts -OR- Manufacturer´s published technical data of all the energy production equipment

<u>As-built stage</u>

Renewable Energy (Energy Credit 7)

- Final as-installed schedule of all the energy production equipment
- As-built electrical schematic drawings indicating location within the site and required area
- Manufacturer’s technical data of all energy production equipment installed
- Evidence showing the renewable energy equipment installed such as photographs, invoices, receipts, commissioning report, etc.

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission
- Final report outlining:
  - renewable energy sources proposed
  - explanation of the reasons for its selection, including basis for any further calculations as required calculations showing estimated annual energy harvest
  - as-built calculations demonstrating compliance with the requirements

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 recently 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 prioritises the reduction of water consumption and emphasizes this in the requirements of the Water Category. Credits within this category encourage strict monitoring of water consumption, water-efficient equipment and design, as well as other water recovering solutions such as water reuse/recycle, and finally rain water collection.

Water		13 Points
Item	Criteria	Points
W-1	Water Efficient Fixtures	5 points
	Reduce building domestic water consumption through fixtures by 10% in comparison to a baseline model	Water Prerequisite 1
	Reduce building 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
W-2	Water Efficient Landscaping	2 points
	Reduce the amount of domestic water used for landscaping by 50% compared to benchmark consumption	1
	Reduce the amount of domestic water used for landscaping by 80% compared to benchmark consumption	2
W-3	Water Monitoring	1 point
	Provide water meters for all major water uses	1
W-4	Sustainable Water Solutions	5 points
	Strategy A: Water recycling/reuse/harvest	
	Recycled water, reused water or harvested rainwater contributes to 10% of the building's total water consumption	1
	1 point for every additional 10% contribution of recycled water, reused water or harvested rainwater to the building's total water consumption (Up to 50%)	5
	Strategy B: Swimming Pool Water Efficiency	
	Implementing strategies to reduce water use for swimming pools	1

W-1 Water Efficient Fixtures

Intent

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

Requirements

Criteria	5 Points
Reduce building domestic water consumption through fixtures by 10% in comparison to a baseline model	Water Prerequisite 1
Reduce building 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

Overview

Water Efficient Fixtures (Water Prerequisite 1 and Credit 1)

The world's fresh water is a finite resource that is becoming ever more increasingly polluted. It is inevitable that the total amount of clean water accessible to populations will be further reduced as a consequence of climate change and as these water resources become scarcer, the cost of domestic water will increase. Incorporating water use reduction measures into building designs can reduce this dependency on the ever diminishing water supplies while reduce the operational costs.

Domestic water refers to treated water supplied to the building from municipal water supply systems, according to QCVN 02:2009/BYT (National technical regulation on domestic water quality).

LOTUS considers both municipal water and groundwater as domestic water.

Approach & Implementation

Water Efficient Fixtures (Water Prerequisite 1 and Credit 1)

The following strategies can be used to reduce the demand for domestic water 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

Calculation

Water Efficient Fixtures (Water Prerequisite 1 and Credit 1)

The aim of this calculation is to compare the building's water consumption through fixtures to a baseline model. The baseline annual water use should be calculated using values in tables W.1 and W.2 below. The LOTUS Water Calculation Tool contains these calculations embedded into the tool and can be used instead of manually performing the calculations.

Table W.1: 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.2: 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 building 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.1 and W.2
- In case no urinals are available in the building, daily uses values for WCs (female) shall be considered for the male occupants.
- Full-time occupants are employees/staff in the building 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 building per day divided by 8
- In buildings with multiple shifts, use the number of full-time occupants from all shifts.

Water fixtures do not include water-cooled HVAC and irrigation systems. Therefore water consumption of these systems is not considered in this calculation

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 building 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 Calculation:

A building with 150 dwelling-units and an occupancy of 500 residents (gender ratio: 1 to 1) is equipped with the water fixtures in Table W.3. The building's number of operation days during the year is O = 365 days.

Table W.3: Example calculation - building fixtures quantities and flow/flush rates

Fixtures Present in the Building	Quantities of Fixtures	Fixtures Water Use
WC Dual flush	100	3.0 - 4.5 Lpf
WC Single flush	50	5 Lpf
Faucet	80	0.12 L/s
Showerheads	150	0.15 L/s
Clothes washer	150	100 L/load

Table W.4: 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)
WC	1	6 Lpf	4	500	12,000
Faucet	1	0.14 L/s (60 sec)	7	500	29,400
Showerheads	1	0.16 L/s (480 sec)	1	500	38,400
Clothes washer	1	120 L/load	1	150	18,000
Total daily water use through fixtures (litres)					97,800
Baseline total annual water use through fixtures (m^3)					35,697

Table W.5: 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)
WC Dual flush	100/150	$\left(\frac{3}{4} \times 3 + \frac{1}{4} \times 4.5\right)$ Lpf	4	500	4,500
WC Single flush	50/150	5 Lpf	4	500	3,333
Faucet	1	0.12 L/s (60 sec)	7	500	25,200
Showerheads	1	0.15 L/s (480 sec)	1	500	36,000
Clothes washer	1	100 L/load	1	150	15,000
Total daily water use through fixtures (litres)					84,033
Design total annual water use through fixtures (m^3)					30,673

$$\text{Water Consumption Through Fixtures Reduction [\%]} = \left(1 - \frac{30{,}673}{35{,}697}\right) \times 100 = 14.1\%$$

The building finally achieves a 14.1% reduction of the domestic water consumption through fixtures in comparison to a baseline model so no point is awarded but the prerequisite is met.

Submissions

Design stage

Water Efficient Fixtures (Water Prerequisite 1 and Credit 1)

- Tender schedule of all water fixtures proposed indicating their flush/flow rates
- Tender stage hydraulic plans and schematics indicating types of water fixtures
- Tender stage specification extracts -OR- Manufacturer's published data of all water fixtures proposed indicating their flush/flow rates
- Calculations demonstrating compliance with the requirements

As-built stage

Water Efficient Fixtures (Water Prerequisite 1 and Credit 1)

- Final schedule of all water fixtures installed indicating their flush/flow rates
- As-built hydraulic plans and schematics indicating types of water fixtures
- Manufacturer's published data of all water fixtures installed indicating their flush/flow rates
- Evidence of water fixtures installed such as photographs, invoices, receipts, commissioning report, etc.

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission
- Final as-installed calculations demonstrating compliance with the requirements

If the building construction has been completed for more than 6 months at the time of submission:

- Submit documents indicating monthly building water consumption

W-2 Water Efficient Landscaping

Intent

To promote landscape designs which incorporate native species and limit the use of domestic water for irrigation

Requirements

Criteria	2 Points
Reduce the amount domestic water used for landscaping by 50% compared to benchmark consumption	1
Reduce the amount domestic water used for landscaping by 80% compared to benchmark consumption	2

Only sites with a landscaped area which is greater than 100m^2 are eligible for this credit.

Overview

Water Efficient Landscaping (Water Credit 2)

Irrigation can be a significant consumer of water on building sites. By reducing the irrigation requirements of landscape areas, the total water consumption of a building can be significantly reduced. Irrigation demand can be reduced by installing a xeriscape landscape and planting native species that are adapted to the local climate. Where irrigation is necessary, efficient irrigation techniques and technologies can be used. Alternatively, non-domestic water sources such as recycled water and harvested rainwater can be used for irrigation.

Xeriscaping is the preferred approach and has the following advantages:

- Reduced consumption of domestic or ground water
- Less maintenance required (irrigation not necessary, lawns don't need to be cut)
- Xeriscape plants take full advantage of rainfall and thus reduce quantity of stormwater leaving the site
- Stormwater leaving the site can be of a higher quality

Approach & Implementation

Water Efficient Landscaping (Water Credit 2)

The amount of domestic water used for irrigation can be reduced through a number of different strategies. In this credit applicants can demonstrate their reduction through any combination of the methods outlined in this section.

Xeriscape Landscape and Planting Native Species

Practices in this area can include:

- Plant native and/or climate adapted plants to reduce irrigation requirements. Some examples of drought resistant plants are:
  - Succulent plants: Cactus, Aloe, Euphorbiaceae family, etc.
  - Plants of Acacia genus: Acacia auriculiformis and Acacia mangiumare the two most popular species of the Acacia genus in Vietnam.
- Reduce lawn areas since lawn is usually a high consumer of water
- Mulch regularly. Mulching is an important part of xeriscaping as it helps the soil to retain moisture. Cover the surface around plants with composted leaves, coarse compost, bark, wood chips or gravel. Mulch also helps to stabilise soil temperature to protect the roots of plants from excessive heat
- Fertilise wisely
- Use the least toxic method of insect and disease control

Water Efficient Irrigation

Water efficient irrigation systems should be installed where possible; these can make significant water savings. Examples include:

- Drip or bubble irrigation systems that apply water directly to the roots of plants. This strategy uses 30% to 50% less water than common sprinkler irrigation systems
- Irrigation systems fitted with either:
  - A manual timer with a maximum range of two hours; or
  - An automated timer, used with a soil moisture sensor or rain sensor to prevent the system operating during rain or where the soil already holds adequate moisture to sustain plant growth

The following irrigation management principles should also be followed:

- Conduct a vegetation survey for the building site (Ecology PR-1). Based on the outcomes of the survey and knowledge of all plants' properties, a watering plan can be developed in order to reduce the amount of water used in irrigation. A precise watering schedule will help to reduce total water consumption

- Water at a rate so that it does not pond, pool or run off
- Do not water when the soil is already adequately moist to sustain plant growth, whether as a result of rain or other watering
- Water in such a manner so that it does not fall on buildings or hard surfaces
- Do not water in windy conditions where the distribution pattern of the irrigation systems will be affected
- Only water gardens that are sufficiently mulched to reduce evaporation

Irrigation with Recycled/Reused Water and/or Harvested Rainwater

- Recycled/reused water and/or rainwater collection systems can also be integrated in the building water system, thus recycled/reused water/rainwater can then be used for irrigation of the building landscape. However, before using recycled/reused water and rainwater to water plants, toxic contaminants should be filtered out. Soap and other cleaning substances should be carefully chosen; they should be environmentally friendly, biodegradable and cause no damage to plants

Calculation

Water Efficient Landscaping (Water Credit 2)

The irrigation demand of the landscape area can be demonstrated using irrigation demand calculations.

The total irrigation demand for the landscaped area can be calculated using the following equation. The demand should be calculated for each different type of vegetation within the landscape (e.g. lawn, shrubs, trees etc.) and then summed together. The LOTUS Water Calculation Tool contains these calculations embedded into the tool and can be used instead of manually performing the calculations.

$$\text{Total Irrigation Demand}\left[\frac{\text{m}^3}{\text{year}}\right] = \sum_{i=1}^{n} \text{Irrigation Demand}_i$$

$$\text{Irrigation Demand}_i{}^{*}\left[\frac{\text{m}^3}{\text{year}}\right] = \text{Area}_i \times \sum_{m=1}^{12}\left(\frac{\text{ET}_{0\,m} \times \text{Ks}_i \times \text{Kd}_i \times \text{Km}_i}{1000 \times \text{IE}_i} - \frac{\text{E}_{\text{rain}\,m}}{1000}\right)$$

* If the irrigation demand for any area or any month is less than zero, it must be taken as zero in the total irrigation demand calculation.

Where:

Total landscaped area is split into *n* different sub-areas each with different landscape characteristics

Irrigation demand $_i$ = Irrigation demand for the soft landscape *i*

Area $_i$ = Area of the soft landscape *i* (m^2),

$ET_{0\,m}$ = Average monthly reference evapotranspiration value (mm/month) of the month m

Ks_i = Species factor specific for sub-area *i* (for the purposes of this calculation *Ks* for all native species can be considered as "low")

Kd_i = Density factor specific for sub-area *i*

Km_i = Microclimate factor specific for sub-area *i* (e.g. well shaded and sheltered area *Km* - "low", area next to pavement or on roof - "high")

IE_i = Irrigation efficiency factor specific for sub-area *i* (e.g. drip irrigation IE = 0.9, sprinkler IE = 0.625, xeriscape garden with no irrigation IE = 1)

$E_{rain\,m}$ = Monthly effective rainfall of the month *m* (mm). The effective rainfall refers to the percentage of rainfall which becomes available to plants and can be calculated with the following formula:

$$\text{Monthly effective rainfall of the month } m \text{ (mm)} = \sum_d (Daily\ rainfall_d - 5) \times 0.75$$

Daily $rainfall_d$ is the rainfall of the day d.
Where daily rainfall data is unavailable, monthly rainfall data can be divided by the number of rainy days to give an average daily rainfall to be used in this equation.
If the landscape *i* is sheltered or partly sheltered from rainfall, apply a percentage to lower the amount of effective rainfall for the landscape *i*.

Typical values for these parameters are included in Table W.6.

Table W.6: Standard values for species, density and microclimate factors of vegetated areas (Source: LEED Reference Guide for Green Building and Construction, 2009)

Vegetation Type	Species Factor (Ks)			Density Factor (Kd)			Microclimate Factor (Km)		
	Low	Average	High	Low	Average	High	Low	Average	High
Trees	0.2	0.5	0.9	0.5	1.0	1.3	0.5	1.0	1.4
Shrubs	0.2	0.5	0.7	0.5	1.0	1.1	0.5	1.0	1.3
Groundcover	0.2	0.5	0.7	0.5	1.0	1.1	0.5	1.0	1.2
Lawn	0.55	0.7	0.8	0.6	1.0	1.0	0.8	1.0	1.2

The irrigation demand should then be converted to a demand per square metre of landscaped area using the following equation:

$$\text{Irrigation Demand per m}^2\text{ per Year} = \frac{\text{Irrigation Demand (m}^3\text{/year)}}{\text{Soft Landscape Area (m}^2\text{)}}$$

The soft landscape (excluding hard areas) water demand benchmark for Vietnam is = 1.1 m^3/m^2/year.

Soft landscape water consumption can then be compared to this benchmark value by using the following steps.

1. Determine soft landscape area
2. Determine annual irrigation demand per square metre of soft landscaped area, this can be demonstrated either by sub-metering or the irrigation demand calculation method
3. Calculate irrigation demand savings using the following equation:

$$\text{Irrigation Demand Reduction [\%]} = \left(1 - \frac{\text{Annual Irrigaton Demand/m}^2}{1.1\text{ m}^3\text{/m}^2\text{/year}}\right) \times 100$$

<u>Example Calculation</u>

A building's landscape in Ho Chi Minh City (ET_0 and E_{rain} values as per Table W.7) includes a 60 m^2 area of native trees, a 60 m^2 area of native shrubs, a 40 m^2 area of native groundcover and a 40 m^2 of a non-native lawn with an average species factor. All the vegetation areas are irrigated by a drip system. For Ho Chi Minh City the annual effective rainfall is 854 mm.

Table W.7: Monthly ET_0 and E_{rain} values for Ho Chi Minh City

Ho Chi Minh City	Mth 1	Mth 2	Mth 3	Mth 4	Mth 5	Mth 6	Mth 7	Mth 8	Mth 9	Mth 10	Mth 11	Mth 12
ET_0 (mm)	120	135	145	147	136	120	118	114	112	107	106	104
E_{rain} (mm)	0.0	0.0	2.6	18.0	88.5	137.3	144.4	126.8	141.0	139.9	55.9	0.0

Table W.8: Example calculation - standard values for species, density and microclimate factors of vegetated areas

Vegetation Type	Landscape Area (m^2)	Species Factor (Ks) *low except lawn (average)*	Density Factor (Kd) *average*	Microclimate Factor (Km) *average*	Irrigation Efficiency (IE) *drip on lawn*	Annual Irrigation Demand (m^3)
Trees	60	0.2	1.0	1.0	0.9	7.44
Shrubs	60	0.2	1.0	1.0	0.9	7.44
Groundcover	40	0.2	1.0	1.0	0.9	4.96
Lawn	40	0.7	1.0	1.0	0.9	21.18
Total	200					41.03

$$\text{Irrigation Demand per m}^2\text{ per Year} = \frac{41.03\ \text{m}^3/\text{year}}{200\ \text{m}^2} = 0.205\ \text{m}^3/\text{m}^2/\text{year}$$

$$\text{Irrigation Demand Reduction [\%]} = \left(1 - \frac{0.205\ \text{m}^3/\text{m}^2/\text{year}}{1.1\ \text{m}^3/\text{m}^2/\text{year}}\right) \times 100\% = 81.4\%$$

Based on this calculation, 2 points are awarded for an 81.4%reduction in landscape irrigation consumption compared to the baseline.

Submissions

Design Stage

Water Efficient Landscaping (Water Credit 2)

- Landscape plan outlining the proposed landscape design with a list of all plants (with picture/photo, Latin name, Vietnamese name, information about whether species is native, locally adapted or introduced and estimated number of individuals per species (trees) and/or coverage (grasses - m^2), this can be taken from the vegetation survey in Ecology PR-1) and irrigated areas
- Submit the LOTUS Water Calculation Tool filled in to include irrigation demand calculation and water recycling, reuse or rainwater harvesting
- If the project followed an alternative calculation method, provide the calculations estimating landscape irrigation demand

If using water efficient irrigation equipment:

- Description of all proposed water saving irrigation fixtures and drawings showing location.

If using water recycling, reuse or rainwater harvesting:

- Schematic drawings of proposed reticulation network

As-built Stage

Water Efficient Landscaping (Water Credit 2)

- As-built landscape plan outlining the landscape design with a list of all plants (with detailed descriptions of each species characteristics, watering patterns and estimated number of individuals per species this can be taken from the vegetation survey in Ecology PR-1) and irrigated areas

If using water efficient irrigation equipment:

- Evidence such as photographs, invoices, receipts, commissioning report, etc. showing installation and location of all installed water saving irrigation fixtures

If using water recycling, reuse or rainwater harvesting:

- As-built drawings of proposed reticulation network
- Evidence of all water efficient irrigation fixtures installed such as photographs, invoices, receipts, etc.

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission
- Submit the LOTUS Water Calculation Tool filled in to include irrigation demand calculation and water recycling, reuse or rainwater harvesting
- If the project followed an alternative calculation method, provide the final as-built calculations estimating landscape irrigation demand

W-3 Water Monitoring

Intent

To monitor and control water uses so that water consumption can be regulated and water leaks can be detected

Requirements

Criteria	1 Point
Provide water meters for all major water uses	1

Overview

Water Monitoring (Water Credit 3)

Sub-monitoring water system includes installation of water meters for all major water uses in the project. Major water uses are described as each floor or major occupancy.

Central water monitoring system refers to an effective mechanism for water monitoring inside the project (i.e. all sub water meters are connected to a centre automated monitoring system)

Water monitoring and/or leakage monitoring systems are able to calculate total water consumption of all water based appliances. Such systems can allow for high precision operation of the entire building's water use either automatically or manually. In addition, the prompt detection of water leakage can prevent structural damages and the generation of unhygienic conditions.

Approach & Implementation

Water Monitoring (Water Credit 3)

Some examples of the water monitoring system:

- Water meter connected to automated monitoring system (e.g. BMS)
- Design sub-metering of tenancies, plant and landscape use

Submissions

Design stage

Water Monitoring (Water Credit 3)

- Report detailing the Water Monitoring strategy
- Tender stage hydraulic plans and schematic drawings showing location, type and number of water meters/water metering system as well as the usage served by those meters

As-built stage

Water Monitoring (Water Credit 3)

- As-built hydraulic plans and schematic drawings showing location, type and number of water meters/water metering system as well as the usage served by those meters
- Evidence of all meters installed such as photographs, invoices, receipts, commissioning report, etc.

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission
- Final report detailing the strategy of Water Monitoring

If the building construction has been completed for more than 6 months at the time of submission:

- Submit water meter readings indicating monthly building water consumption for each sub-metered area/tenancy

W-4 Sustainable Water Use Solutions

Intent

To encourage water recycling, reuse and rainwater harvesting as a means to reduce domestic water consumption

Requirements

Criteria	5 Points
Strategy A: Water recycling/reuse/harvest	
Recycled water, reused water or harvested rainwater contributes 10% of the building's total water consumption	1
1 point for every additional 10% contribution of recycled water, reused water or harvested rainwater to the building's total water consumption (Up to 50%)	5
Strategy B: Swimming Pool Water Efficiency	
Implement strategies to reduce water use for swimming pools	1

Overview

Sustainable Water Use Solutions (Water Credit 4)

Strategy A: Water recycling/reuse/harvest

Black water is the untreated wastewater coming from toilets, kitchen taps or industrial waste, while gray water corresponds to all the other forms of wastewater. Gray water includes used water discharged from bathtubs, showers, wash basins and laundries (Figure W.1). This water has the potential to be reused or recycled within a building and its site.

Water recycling saves the amount of domestic water used for toilet flushing or irrigation and reduces the amount of wastewater delivered to water treatment facilities. The importance of using non-domestic water is that it reduces demand for domestic water, which should be saved for drinking and bathing.

Rainwater harvesting refers to the collection and storage of rain. Collection is usually from rooftops and channelled to storage tanks (Figure W.2). Stored water can be used for non-potable purposes such as irrigation, washing or toilet flushing. Rainwater harvesting systems can range from a simple barrel at the bottom of a down pipe to multiple tanks with pumps and controls.

Strategy B: Swimming Pool Water Efficiency

Swimming pools can be major water users. Indeed, big amounts of water are required to fill the volume of a pool and water loss can be substantial because of evaporation, splashing, leaks or filtering.

Approach & Implementation

Sustainable Water Use Solutions (Water Credit 4)

Strategy A: Water recycling/reuse/harvest

Water Recycling and Reuse

Gray water reuse can occur with or without purification. When the gray water is being collected but is not subject to purification, the following strategies can be used to capture and reuse gray water:

- Install a gray water diversion system directing water from shower drains, bathtubs and laundries to gardens for irrigation or to WCs for flushing. A simple filter is needed to remove suspended solids
- Install a gray water diversion system which directs wastewater through a filtration system (to remove suspended solids and contaminants) to a storage tank. Gray water is recommended not to stay in the storage tank longer than 24 hours to avoid damaging storage equipment

If gray water is to be purified for use in domestic water systems, the following strategies can be applied:

- Mechanical treatments: sand filtration, activated carbon filtration, ultraviolet light or ozone disinfection techniques can be implemented to remove pathogens
- Biological treatments: plant systems (e.g. treatment ponds, constructed wetlands, living walls, biofiltration swales) and compact systems (e.g. activated sludge systems, aerobic and anaerobic bio-filters, submerged aerated filters)

Any basic gray water system should ensure that gray water is tightly controlled and not mixed with clean/domestic water and black water. Measures such as storage tanks, colour-coded piping, filters, pumps, valves, and controls should be clearly defined.

To ensure that the uses associated with treated gray water are always supplied (e.g. so that the tanks can continuously discharge) the system should be complemented by another source of water supply.

Review and control of sanitary risk must be conducted at appropriate intervals to avoid the generation of pathogenic micro-organisms.

Recycled or reused water must comply at the point of delivery with minimum quality requirements of national or international standards.

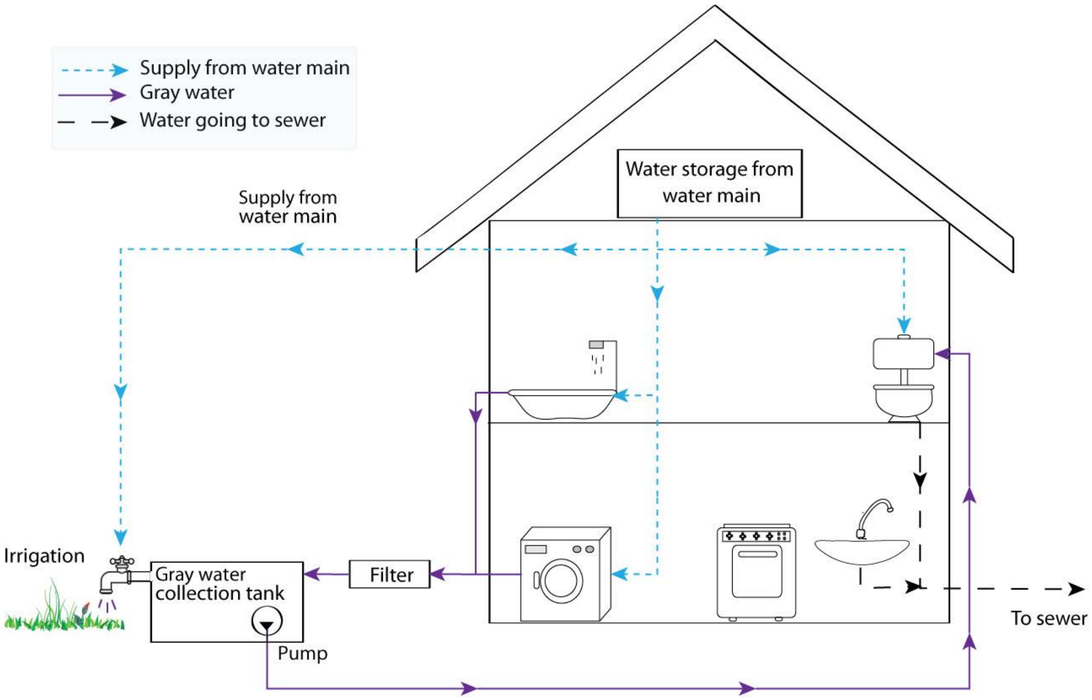

Figure W.1: Gray water collection system

Black water is more difficult to process as it requires a combination of physical, biological and chemical treatment and disinfection before use. A normal black water treatment would require four stages:

- Removal of large solid objects, sand, gravel, and other heavy material from the water
- Primary treatment separating solids and greases
- Secondary treatment removing dissolved organic material from wastewater
- Tertiary disinfection to kill harmful micro-organisms

<u>Rainwater Harvesting</u>

Rainwater can be collected from impervious surfaces to reduce rainwater runoff and control infrastructure demands. Rainwater can be stored in storage tank(s) for non-potable use. Air pollution can contaminate rainwater with pollutants which can potentially damage storage tanks and plumbing systems. In this case, rainwater should be filtered before entering the tanks. Instead of a filtration system, a mechanism where the initial water flow is sent to waste by a diverter can be used to minimise contamination of storage supply, since airborne pollutants and pollutants on the collection surface are usually washed away by the initial rainfall. In such case, simple but regular inspection and maintenance of the mechanism is necessary.

Harvested rainwater can only be reused if there is sufficient storage available. Designers are encouraged to undertake a water balance based on daily or monthly rainfall and demand data for a period of at least one year to appropriately size the storage tank.

Rainwater must comply at the point of delivery with minimum quality requirements of national or international standards.

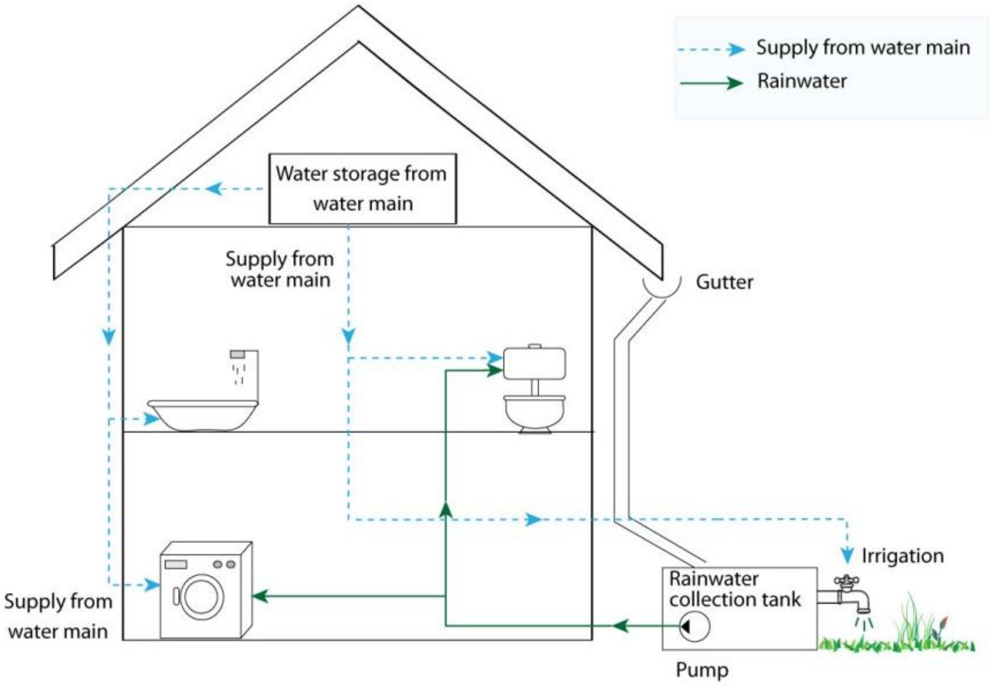

Figure W.2: Rainwater harvesting system

Strategy B: Swimming Pool Water Efficiency

Implement 2 of the following strategies to reduce water consumption for swimming pools:

- Reduce evaporation with the installation of a pool cover. The pool should be covered anytime it is not being used.
- Use more water efficient filter systems such as cartridge filters which do not need backwashing. If sand filter is used, a pressure drop sensor should be installed in order to know when backwash is needed, and the backwash water should be reused to water plants or for any other beneficial use.
- Monitor pool filling to be able to detect leaks (when a sharp increase of the amount of water needed to fill the pool is noticed.)
- Other strategies may be applied but shall be subject to VGBC approval

Also, to be awarded points with Strategy B, projects must meet following requirements:

- Maximum depth of swimming pool for adults: 2 meters
- Maximum depth of swimming pool for kids: 1.3 meters

Calculations

Sustainable Water Use Solutions (Water Credit 4)

Strategy A: Water recycling/reuse/harvest

The volume of harvested rainwater, recycled water and reused water can either be measured by metering or estimated using reasonable assumptions. The LOTUS Water Calculation Tool contains these calculations embedded into the tool and can be used instead of manually performing the calculations.

Water Recycling and Reuse

If the volume of recycled and reused water is estimated, the calculation should be the same as the calculation of the annual domestic water use in Credit W-1, except that only the fixtures connected to gray or black water collection system are included in the calculation.

To use the following equation, projects should demonstrate that the storage tank is properly sized to provide a balance between supply and demand.

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

F = Proportion of fixtures

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

n = Number of daily uses per person per each fixture type

P = Number of building occupants

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

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

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

O = Number of operation days during the year

** Fixtures concerned in this calculation must be connected to a gray/black water collection system*

The water collected will have to pass through different treatment systems, from simple filtration to comprehensive treatment, depending on where it will be used. During the treatment process some water will be lost, therefore, the amount of water collected that will be actually used should be calculated using the coefficient of water efficiency of the treatment method.

$$\text{Annual Water Collected Actually Used for a Demand [L/year]} \\ = E_t \times \text{Annual Water Collected Distributed Towards a Demand [L/year]}$$

E_t = Water efficiency of the treatment system (amount of water out/amount of water in)

Rainwater Harvesting

As not all collected rainwater is reused due to storage limitations, it is necessary to determine the amount of rainwater that is actually used. This should be done by calculating a water balance for the building’s collection and consumption for at least 12 months based on the storage volume and average or recorded rainfall data.

To estimate the amount of harvested rainwater that will be reused, applicants can use either the VGBC Water Calculator or their own method that shall be subject to VGBC approval.

Water recycled, reused or harvested:

In order to calculate the proportion of total water consumption supplied by harvested rainwater, recycled water or reused water this value should be compared to the total water consumption of the building based on baseline water consumption through fixtures (as calculated for W-1) plus all other water needs.

$$\text{Water recycled, reused or harvested [\%]} \\ = \frac{\text{Annual Recycled, Reused and Harvested Rainwater Used}}{\text{Annual Water Consumption}} \times 100$$

Where Annual Water Consumption equals:

$$\text{Annual Water Consumption [L/year]} = \\ = \text{Annual Water Use through fixtures} + \text{Water Used for irrigation} \\ + \text{Water used for the HVAC system} + \text{Water used for other needs}$$

Submissions

Design Stage

Sustainable Water Use Solutions (Water Credit 4)

Strategy A: Water recycling/reuse/harvest

- Report describing and detailing the proposed strategy of gray/black water recycling/reuse and/or rainwater harvesting system including collection, distribution and storage
- Hydraulic plans and schematics of the proposed gray and black water system and/or rainwater harvesting system, including collection distribution and storage
- Submit the LOTUS Water Calculation Tool filled in to include water recycling, reuse or rainwater harvesting

Strategy B: Swimming Pool Water Efficiency

- Report describing the strategies to be implemented to reduce water use for swimming pool and showing the depth of swimming pools.

Depending on the strategies implemented:

- Tender stage specifications showing the type of filter to be installed or showing that a pressure drop sensor is to be installed
- Tender stage hydraulic plans and schematic drawings showing location and type of water meter for the monitoring of the water used for swimming pool.

As-built Stage

Sustainable Water Use Solutions (Water Credit 4)

Strategy A: Water recycling/reuse/harvest

- As-built hydraulic plans and schematics of the gray and black water system and/or rainwater harvesting system, including collection distribution and storage
- Evidence showing main equipment and components installed such as photographs, invoices, etc.

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission
- Final report describing and detailing the strategy of gray/black water recycling/reuse and/or rainwater harvesting system including collection, distribution and storage

- Submit the LOTUS Water Calculation Tool filled in to include water recycling, reuse or rainwater harvesting

Strategy B: Swimming Pool Water Efficiency

- Evidence showing equipment installed (pool cover and/or filters and/or pressure drop sensor and/or water meter) and the depth of swimming pools such as photographs, invoices, material approval requests, etc.
- As-built stage hydraulic plans showing location and type of water meter for the monitoring of the water used for swimming pool.

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission
- Final report describing the strategies implemented to reduce water use for swimming pool.

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 urbanisation rate reaching 28% and urban area expected to double by 2020 (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 out-dated, 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 three main goals which are to reduce the amount of virgin natural resources used, to promote the use of low-energy sustainable materials, and to reduce the amount of construction waste generated. To achieve the goals, credits within this category encourage onsite reuse of building materials and structure, consumption of recycled materials, materials from sustainable sources and unbaked materials.

Materials		9 points
Item	Criteria	Points
M-1	Materials Reuse	2 points
	Option A: Major refurbishment	
	25% of total value of construction material used in the project is from reused items	1
	50% of total value of construction material used in the project is from reused items	2
	Option B: New construction	
	2% of total value of construction material used in the project is from reused items	1
	5% of total value of construction material used in the project is from reused items	2
M-2	Materials with Recycled Content	3 points
	10% of the total value of the materials in the project is from recycled materials	1
	1 point for every additional 10% of the total value of the materials from recycled materials (up to 30%)	3
M-3	Non-Baked Materials	2 points
	50% (by volume) of all non-structural walls are made up of non-baked materials	1
	70% (by volume) of all non-structural walls are made up of non-baked materials	2
M-4	Sustainable Timber and Rapidly Renewable Materials	2 points
	Strategy A: Rapidly renewable materials	
	1% of the total value of the materials in the project is from rapidly renewable materials	1
	2% of the total value of the materials in the project is from rapidly renewable materials	2
	Strategy B: Timber from sustainable sources (not applicable if the total cost of all timber in the project represents less than 1% of the total material cost)	
	25% (based on cost) of all timber used is from a sustainable source	1
	50% (based on cost) of all timber used is from a sustainable source	2

M-1 Material Reuse

Intent

To encourage and recognise developments that reuse building materials in order to minimise the use of virgin materials.

Requirements

Criteria	2 Points
Option A: Major refurbishment	
25% of total value of construction material used in the project is from reused items	1
50% of total value of construction material used in the project is from reused items	2
Option B: New construction	
2% of total value of construction material used in the project is from reused items	1
5% of total value of construction material used in the project is from reused items	2

Overview

Material Reuse (Materials Credit 1)

Reuse of materials can significantly reduce the demand for new construction materials thus reducing environmental burdens resulting from the development.

Approach & Implementation

Material Reuse (Materials Credit 1)

All building materials or products are considered, excluding mechanical, electrical and plumbing equipment such as HVAC systems, water fixtures, elevator systems, etc.

Building materials can be reused in two ways:

a) Structural materials/components existing on-site in their original form and function can be reused for their original purpose. The following are examples of structures which can be reused:

- Foundations
- Columns
- Beams

- Structural roof components
- Floors and subfloors

b) Materials can be salvaged to be used in the construction for their original or a new purpose. All on-site or off-site reused materials or products, excluding building services and mechanical equipment are eligible. The following list suggests some materials or products which can be reused:

- Bricks
- Doors
- Siding
- Windows
- Flooring materials
- Ceiling tiles
- Internal partition & non-structural wall framing

Calculation

Material Reuse (Materials Credit 1)

Calculation is based on cost. The selected units must be applied consistently for all materials throughout the calculations.

Use the following method to determine the percentage of reused materials:

- Quantify the total cost of the materials required in the project
- Quantify the total cost of the reused materials in the project. Cost for a reused material can be determined in two ways:
    - the actual cost paid by the project for a material
    - or, in case the material was existing on-site, the replacement value determined by pricing a comparable material in the local market.
- Present costs in table form (Table M.1) and demonstrate the percentage of reused material with the following formula:

$$\text{Material Reuse [\%]} = \frac{S_r}{S_{tot}} \times 100$$

S_r = Total cost of reused materials [VND]

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

Table M.1: Example of Reused Material Calculation

Building Materials	Cost of Required Material [VND]	Cost of Reused Material [VND]
Concrete	500,000,000	300,000,000
Steel	100,000,000	100,000,000
Bricks	40,000,000	30,000,000
Windows	40,000,000	0
Total	680,000,000	430,000,000
Reused material	63%	

Submissions

Design stage

Material Reuse (Materials Credit 1)

- Report detailing existing materials to be reused and whether the materials are reused in their original form or not
- Bill of quantities -OR- Estimated cost detailing the cost of all materials required in the project and the cost of all reused materials
- Tender stage plans indicating existing materials to be reused
- Calculations demonstrating compliance with the requirements

As-built stage

Material Reuse (Materials Credit 1)

- Bill of quantities detailing the cost of all materials installed in the project and the cost of all reused materials
- As-built plans indicating where existing materials were reused
- Evidence that the aforementioned materials were reused such as photographs during the construction stage, commissioning report, etc.

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission
- Final report detailing existing materials reused and whether the materials were reused in their original form or not
- Final as-built calculations demonstrating compliance with the requirements

M-2 Materials with Recycled Content

Intent

To promote the use of recycled materials in construction

Requirements

Criteria	3 Points
10% of the total value of the materials in the project is from recycled materials	1
1 point for every additional 10% of the total value of the materials from recycled materials (up to 30%)	3

Overview

Materials with Recycled Content Materials Credit 2)

Products with a high fraction of recycled content reduce the demand for virgin materials and reduce creation of waste. This serves to reduce environmental impacts associated with extraction and processing of virgin resources. In the case of concrete, industrial waste products, such as fly ash, blast furnace slag or silica fume, can be recycled and used as a substitute to Portland clinker in cement. Their quality should be strictly controlled within a Quality Assurance System to guarantee its structural integrity for usage. These practices are encouraged because the production of Portland clinker is responsible for approximately 90% of the greenhouse gas emissions associated with concrete production. Replacing a portion of Portland clinker with industrial waste products reduces the mining of natural resources and greenhouse gas emissions associated with cement production, while disposing of a waste material previously destined for landfill.

Approach & Implementation

Materials with Recycled Content (Materials Credit 2)

All building materials or products are considered, excluding mechanical, electrical and plumbing equipment such as HVAC systems, water fixtures, elevator systems, etc.

Specify materials with high recycled content used in the building and provide manufacturer's published technical data indicating percentage of recycled content.

ISO 14021 defines recycled content as "the proportion, by mass, of recycled materials in a product or packing". Only pre-consumer and post-consumer materials shall be considered as recycled content where:

- 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.

Calculation

Material with Recycled Content (Materials Credit 2)

Calculation is based on cost. Percentage of recycled content materials used on a project can be calculated by the following method:

- Quantify the total cost of the materials required in the project
- Quantify the cost of the materials with recycled content in the project
- Quantify the percentages of pre-consumer and post-consumer content in the materials with recycled content
- Half of the value of the percentage of pre-consumer content value will be considered in calculation.
- Percentage of recycled content for the materials other than steel and cement should be multiplied by 2 before being used in the formula below.
- Present materials in table form (Table M.2) and demonstrate the percentage of recycled content in materials by using the following formula:

$$\text{Recycled Content } [\%] = \sum_i \frac{\%\,\text{Post (i)} \times C_i + 0.5\ \times \%\,\text{Pre(i)} \times C_i}{C_{tot}}$$

% 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)

C_i = cost of material (i)

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

Table M.2: Example of Recycled Content Calculation

Building materials	Recycled content (%)		Cost of Materials (1000 VND)	Recycled content value (1000 VND)
	Post-consumer	Pre-consumer		
Steel	0%	60%	300,000	0.5 x 60% x 300,000 = 90,000
Cement	0%	15%	400,000	0.5 x 15% x 400,000 = 30,000
Carpet	10%	30%	50,000	(10% x 50,000 + 0.5 x 30% x 50,000) x 2 =25,000
Others	0%	0%	250,000	0
Total			1,000,000	145,000
Percentage of Recycled Content			14.5%	

Submissions

Design stage

Materials with Recycled Content (Materials Credit 2)

- Report detailing the recycled content materials to be installed, indicating location
- Bill of quantities -OR- estimated costing highlighting all materials including those with recycled content
- Tender stage specification extracts -OR- Manufacturer's published data indicating recycled content -OR- Signed and stamped letter from the manufacturer indicating recycled content
- Calculations demonstrating compliance with the requirements

As-built stage

Materials with Recycled Content (Materials Credit 2)

- Bill of quantities detailing the cost of all materials installed in the project and the cost of all materials with recycled content
- Manufacturer's published data indicating recycled content -OR- signed and stamped letter from the manufacturer indicating recycled content
- Evidence that the aforementioned materials were installed such as photographs, invoices, receipts, commissioning report, etc.

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission
- Final report detailing the recycled content materials installed, indicating location
- Final as-built calculations demonstrating compliance with the requirements

M-3 Non-baked Materials

Intent

To reduce the use of baked materials and replace them with non-baked materials

Requirements

Criteria	2 Points
50% (by volume) of all non-structural walls are made up of non-baked materials	1
70% (by volume) of all non-structural walls are made up of non-baked materials	2

Overview

Non-baked Materials (Materials Credit 3)

A non-structural wall is a wall that only bears the load of itself. Typical construction practices in Vietnam involve a post and beam structure with non-structural internal and external walls constructed from bricks. As a result, most of the building envelope is constructed by bricks, which are mainly baked.

In Vietnam, about 20 billion bricks are consumed every year and this number is estimated to reach 40 billion by 2020. This factor results in the exploitation of billions of cubic meter of clay annually and thousands of agricultural-cultivated area are exploited for improper purposes, which leads to instability of national food security. Moreover, the exploiting and manufacturing processes in Vietnamese brick-kilns, which are mostly small and technically-underdeveloped, have resulted in material inefficiency and a higher amount of toxic smoke causing serious impacts on the environment.

Recently, the technologies for producing non-baked materials have been adopted worldwide, which yields many positive results such as taking full advantage of many inexpensive material resources which are available locally and thus, producing low-cost building materials. In April 2010, Decision No.567/QĐ-TTg about the “Developing Program for Non-baked Material up to 2020” was approved by the Prime Minister. It forces all building projects having more than 9 floors to use non-baked materials by at least 30% out of total material usage. Other constructions are also encouraged to use this type of materials by specific solutions in terms of policy, scientific engineering and information dissemination – all included in this Decision.

Approach & Implementation

Non-baked Materials (Materials Credit 3)

Non-baked building materials include, but are not limited to, the following:

- Concrete bricks
- Gypsum panels
- Pre-cast concrete panels
- Polymerized bricks
- Aerated Autoclaved Concrete (AAC)

Calculation

Non-baked Materials (Materials Credit 3)

Calculation is based on volume (m^3). Percentage of non-baked material can be calculated by the following method:

- Quantify the volume of non-structural walls required in the project
- Quantify the volume of non-baked material used in non-structural walls in the project
- Present materials in table form (Table M.3) and demonstrate the percentage of non-baked material with the following formula:

$$\text{Non} - \text{Baked Materials Use } [\%] = \left(\frac{W_b}{W_{tot}}\right) \times 100$$

W_b = Non-structural walls made up of non-baked materials in the building [m^3]

W_{tot}= Total non-structural walls in the project [m^3]

Table M.3: Example of Non-Baked Materials Percentage Calculation

Project Materials	Total Volume of Non-Structural Walls [m^3]	Volume of Non-Baked Material [m^3]	Percentage of Non-Baked materials [%]
Total	475	285	60%

Submissions

Design stage

Non-baked Materials (Materials Credit 3)

- Report detailing all non-baked materials of non-structural walls to be installed, indicating location
- Tender stage detail drawings of all non-baked materials proposed for the non-structural walls
- Tender stage plans and elevations indicating location and volume of all non-structural walls and highlighting non-structural walls made from non-baked materials (not required for projects with no brick walls)
- Calculations demonstrating compliance with the requirements

As-built stage

Non-baked Materials (Materials Credit 3)

- As-built detail drawings of all non-baked materials installed for the non-structural walls
- As-built plans and elevations indicating the location and volume of all non-structural walls and highlighting non-structural walls made from non-baked materials (not required for projects with no brick walls)
- Evidence showing that the aforementioned materials were installed, such as photographs, invoices, receipts, commissioning report, etc.

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission
- Final report detailing all non-baked materials of non-structural walls installed, indicating location
- Final as-built calculations demonstrating compliance with the requirements

M-4 Sustainable Timber and Rapidly Renewable Materials

Intent

To promote the use of timber produced from sustainable sources and the use of rapidly renewable materials

Requirements

Criteria	2 Points
Strategy A: Rapidly renewable materials	
1% of the total value of the materials in the project is from rapidly renewable materials	1
2% of the total value of the materials in the project is from rapidly renewable materials	2
Strategy B: Timber from sustainable sources*	
25% (based on cost) of all timber used is from a sustainable source	1
50% (based on cost) of all timber used is from a sustainable source	2

* Strategy B is not applicable if the total cost of all timber in the project represents less than 1% of the total material cost

Overview

Sustainable Timber and Rapidly renewable materials (Materials Credit 4)

Strategy A: Rapidly renewable materials

Traditional natural building materials, such as wood, typically require large amounts of land, capital and time to produce. Poor forestry practices degrade natural ecosystems, destroy habitats, erode soil and pollute water systems. To produce petroleum-based plastics fossil fuels are required.

Rapidly renewable materials are natural building materials, such as cork or bamboo, which are planted and harvested within a 10 year cycle. These materials require less land, resources and capital to produce the same total non-renewable quantity of material which would be otherwise needed.

Strategy B: Timber from sustainable sources

Timber should be reused, recycled or 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. These certification schemes provide a credible guarantee that the product comes from a well-managed forest that has been independently certified for its timber resource sustainability, forest ecosystem maintenance and financial and socioeconomic viability.

Using timber from certified sustainable sources can help maintain viable and healthy forests throughout Vietnam.

Approach & Implementation

Sustainable Timber and Rapidly renewable materials (Materials Credit 4)

Non-fixed partitions and furniture cannot be considered for this credit.

Strategy A: Rapidly renewable materials

Specify materials which are produced entirely or in part from rapidly renewable materials. The following is a partial list of rapidly renewable materials which can be used (additional or alternative materials may be used):

- Bamboo
- Cork
- Coconut
- Reed
- Straw board

Strategy B: Timber from sustainable sources

Building components able to utilise timber from sustainable forests include, but are not limited to, the following:

- Structural framing
- Flooring, wall, ceiling
- Finishes
- Fitted furnishings
- Internal and external joinery including window, doors, and the other timber fixtures

Calculation

Sustainable Timber and Rapidly renewable materials (Materials Credit 4)

Strategy A: Rapidly renewable materials

Calculation is based on cost. Percentage of rapidly renewable materials can be calculated by the following method:

- Quantify the total cost of rapidly renewable materials used in the project
- Quantify the total cost of the materials required in the project
- Present materials in table form (Table M.4) and demonstrate the percentage of rapidly renewable materials with the following formula:

$$\text{Rapidly Renewable Material [\%]} = \frac{MC_{rr}}{MC_{tot}} \times 100$$

MC_{rr}= Cost of rapidly renewable building materials [VND]

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

Table M.4: Example of Rapidly Renewable Percentage Calculation

Building Materials	Total Cost of Project Material [VND]	Cost of Rapidly Renewable Material [VND]	Percentage of Rapidly Renewable Material [%]
Total	100,000,000	11,000,000	1%

Strategy B: Timber from sustainable sources

Calculation is based on cost. Percentage of timber from a sustainable source can be calculated by the following method:

- Quantify the value of timber required in the project
- Quantify the value of sustainably sourced timber in the project
- Present materials in table form (Table M.5) and demonstrate amount of sustainably sourced timber with the following formula:

$$\text{Sustainably Sourced Timber [\%]} = \frac{T_s}{T_{tot}} \times 100$$

T_s = Sustainably sourced timber used in the project [VND]

T_{tot} = Total timber required in the project [VND]

Table M.5: Example of Sustainably Sourced Timber Percentage Calculation

Building Materials	Total Cost of Timber [VND]	Total Cost of Sustainably Sourced Timber [VND]	Percentage of Sustainably Sourced Timber [%]
Total	20,000,000	10,000,000	50%

Submissions

Design stage

Sustainable Timber and Rapidly renewable materials (Materials Credit 4)

Strategy A: Rapidly renewable materials

- Report detailing the rapidly renewable materials to be installed, indicating location
- Bill of quantities -OR- Estimated cost detailing the cost of all materials required in the project and the cost of all rapidly renewable materials
- Any tender plans, door schedules, or joinery drawings that describe the rapidly renewable materials to be installed
- Tender stage specification extracts -OR- Manufacturer's published data indicating the content of rapidly renewable materials in a product -OR- A letter from the manufacturer indicating the content of rapidly renewable materials in a product
- Calculations demonstrating compliance with the requirements

Strategy B: Timber from sustainable sources

- Report detailing the proposed use of sustainably sourced timber as well as the proposed use of all timber in the project
- Bill of quantities -OR- Estimated cost detailing the cost of sustainably sourced timber to be installed as well as the total cost of all timber to be installed
- Any tender plans, door schedules, or joinery drawings that describe the sustainably sourced timber to be installed
- Tender stage specification extracts -OR- manufacturer's published data indicating the timber to be installed are from a source certified by the FSC or holding another internationally recognised accreditation
- Calculations demonstrating compliance with the requirements

As-built stage

Sustainable Timber and Rapidly renewable materials (Materials Credit 4)

Strategy A: Rapidly renewable materials

- Bill of quantities detailing the cost of all materials installed in the project and the cost of all rapidly renewable materials
- Any as-built plans, door schedules, or joinery drawings that describe the rapidly renewable materials to be installed
- Manufacturer's published data indicating the content of rapidly renewable materials in a product -OR- A letter from the manufacturer indicating the content of rapidly renewable materials in a product
- Evidence that the aforementioned materials were installed such as photographs, invoices, receipts, commissioning report, etc.

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission
- Final report detailing the rapidly renewable materials installed, indicating location
- Final as-built calculations demonstrating compliance with the requirements

Strategy B: Timber from sustainable sources

- Describe any deviation or addition to the design stage submission
- Bill of quantities detailing the cost of sustainably sourced timber installed as well as the total cost of all timber installed
- Any as-built plans, door schedules, or joinery drawings that describe the sustainably sourced timber to be installed
- Manufacturer's published data indicating that the timber installed are from a source certified by the FSC or holding another internationally recognised accreditation
- Evidence that the aforementioned timber were installed such as photographs, invoices, receipts, commissioning report, etc.

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission
- Final report detailing the use of sustainably sourced timber as well as the use of all timber in the project
- Final as-built calculations demonstrating compliance with the requirements

Ecology

In the 21st century, the world has witnessed the bloom of increasingly large cities across Asia, with populations of over 10 million. Following this trend, Vietnam's urbanisation rate is rapidly increasing together with a rise in the country's GDP. While this raises the general standard of living, the fast but difficult to manage rate of urbanisation poses a great threat to the existence of various ecosystems. As virgin land quickly turns into construction sites, habitats are disappearing together with the species living within them.

Therefore, to reduce the impacts of development on the natural environment, construction projects should be contained within already developed areas instead of encroaching on areas with high ecological-value. Moreover, for large-scale construction projects, all possible negative impacts on the environment have to be carefully assessed and minimised wherever possible. Proper redevelopment of a contaminated site can improve its conditions, reversing some of the negative impacts of the previous development.

Apart from site selection, green buildings also promote the preservation of existing natural environments through careful construction planning. The rich top soil and vegetation of a project site can be preserved and existing ecosystems can be protected from the disturbances caused by construction activities. In addition, the introduction of local species and green roofing to project sites will increase biodiversity and improve the onsite habitats.

Ecology		9 points
Item	Criteria	Points
Eco-PR-1	Environment	PR
	Prepare an Environmental Impact Assessment (EIA) or an Environmental Protection Commitment	Ecology Prerequisite 1
Eco-1	Construction Environmental Management Plan	2 points
	Mandate strategies which limit site disturbance during the construction process	2
Eco-2	Habitat Restoration	3 points
	Strategy A: Space restoration	
	15% of the total site area (including roof) is restored with native or adapted vegetation	1
	30% of the total site area (including roof) is restored with native or adapted vegetation	2
	Strategy B: Landscape management plan (Not applicable if the area restored represents less than 10% of the total site area)	
	Establish and implement a landscape management plan	1
Eco-3	Development footprint	2 points
	Reduce the development footprint and/or provide open space within the project boundary to exceed the local open space requirement for the site by 10%	1
	Reduce the development footprint and/or provide open space within the project boundary to exceed the local open space requirement for the site by 20%	2
Eco-4	Green Roof	2 points
	30% of the roof area is covered with a green roof	1
	50% of the roof area is covered with a green roof	2

Eco-PR-1 Environment

Intent

To limit the negative impacts of development on the environment.

Requirements

Criteria	PR
Prepare an Environmental Impact Assessment (EIA) or an Environmental Protection Commitment	Ecology Prerequisite 1

Overview

Environment (Ecology Prerequisite 1)

Environmental impacts refer to the effects of human activities or natural phenomenon on living organisms as well as the physical environments they live in. The consequences of these impacts are often lasting, hard to predict, to measure or recover from.

An Environmental Impact Assessment (EIA) is a document which qualifies and quantifies all potential environmental impacts that a construction project will have. The document provides the information required by the decision makers and authorities which have jurisdiction on how to responsibly proceed with the project.

Depending on their type and scale, projects might be asked to submit an EIA report (refer to Appendix II, Decree 29/2011/NĐ-CP) or a Strategic Environmental Assessment (SEA) – an analysis and forecast of impacts on the environment to be exerted by draft development strategies, planning and plan before they are approved in order to attain sustainable development (refer to Appendix I, Decree 29/2011/NĐ-CP).

Other projects not included in the Appendix I or II of Decree 29/2011/NĐ-CP or identified by the authorities might have to complete an Environmental Protection Commitment (EPC). The form of an EPC is defined by the Vietnam Ministry of Natural Resources and Environment (MoNRE). Similarly as EIA, EPC was created to clarify the positive and negative impacts of the project on the natural and social environment.

Approach & Implementation

Environment (Ecology Prerequisite 1)

An EIA is necessary to calculate any potential environmental disturbances before the selection of project site. Site ecological evaluation should be done to prove that the land neither has value as agricultural land nor as habitat for native species. The evaluation must comply with:

- TCVN 7538-5:2007"Soil quality. Sampling" - Part 5: Guidance on the procedure for the investigation of urban and industrial sites with regard to soil contamination
- TCVN 7629:2007"Hazardous waste thresholds"
- TCVN 6647:2007"Soil quality. Pre-treatment of samples for physic-chemical analysis"
- TCVN 7370-2:2007"Soil quality. Dissolution for the determination of total element content." - Part 2: Dissolution by alkaline fusion

The EIA shall be conducted during the feasibility study phase of the project to avoid unwanted impacts on the site's ecology. EIA structure and content shall be regulated by the local authorities having jurisdiction, Decree 175-CP, Decree ND-80 and the "Law on Environmental Protection" and shall include, as a minimum, the following sections:

- Introduction
  - Objective of the report
  - Document, data status of the report
  - Selection of the assessment method
  - Organisation, members, method and the process used in preparing the report
- Brief Description of the Report
  - Name of the project
  - Name of the owner and of the agency implementing the feasibility study
  - Socio-economic objective and political significance of the project
  - Main contents of the project and the socio-economic benefit that the project can provide
  - Project progress, plan for project implementation
  - Project cost and cost process
- Environmental status at the project location
  - General description of the geographical and physical conditions (e.g. conditions of soil, air, water, etc.) of the project site. This part includes:
    - Biodiversity survey
    - Vegetation survey

    - Contamination survey
    - Socio-economic conditions related to the project location
    - Heritage Survey
    - Forecast of conditions if the project is not implemented

- Impacts of the project implementation on the environment and natural resources
    - Description of the impacts of the project implementation to each environmental factor at the project location. Present the characteristics, degree and occurrence for each of the impacts. Compare to the case of not implementing the project
    - Impact of the physical environmental water quality and air quality
    - Impact on aquatic and terrestrial biological resources and ecosystems
    - Impact on natural resources and the environment, including water supply, transportation, agriculture, irrigation, energy, exploration, industry, small industry, healthcare and entertainment, other land uses

- Impact on the quality of life of local people
    - Socio-economic condition
    - Cultural condition
    - Aesthetic

- General environmental assessment for the case of project implementation.
    - Analysis of the environmental development for each alternative project implementation case.
    - The damages to the natural resources and environment resulting from each alternative.
    - The measures for overcoming impacts discussed
    - Material inputs to production
    - Waste from production
    - Products
    - Impacts forecasted of the above items
    - The mitigating measures implemented to limit the negative impacts on the environment caused by the project. Presenting in a detailed manner the techniques, technologies and management structure for overcoming the negative impact on the environment caused by the project
    - General assessment of the document, including a critical review of the reliability of the EIA

- Recommendations on the alternatives for project implementation
  - Recommendation for the alternative selection to implement the project based on the environmental point of view
  - Recommendation for the environmental protection measures associated with the approved alternative

Submissions

Design stage

Environment (Ecology Prerequisite 1)

- Submit an environmental impact assessment. The EIA shall also contain the following information:
  - Site vegetation survey
  - Biodiversity report
  - Contamination survey
  - Heritage survey

- OR -

- Submit an environmental protection commitment appraised and approved by relevant authority. The EPC shall follow the valid form defined and issued by the Ministry of Natural Resource and Environment.

As-built stage

Environment (Ecology Prerequisite 1)

If not submitted at design stage, submit an environmental impact assessment or an environmental protection commitment as per above requirements.

Eco-1 Construction Environmental Management Plan

Intent

To limit the negative impacts of construction on the environment.

Requirements

Criteria	2 Points
Prepare a Construction Environmental Management Plan to implement strategies which limit site disturbance during the construction process	2

Overview

Construction Environmental Management Plan (Ecology Credit 1)

Site disturbance is the disruption of the sites ecosystem, causing the site eco-value to decrease dramatically. Ecological disturbance may cause the collapse of the whole ecosystem's structure and functions. The effects of the disturbance generally last for time periods longer than a single seasonal growing cycle for natural vegetation cover.

Approach & Implementation

Construction Environmental Management Plan (Ecology Credit 1)

Construction activities onsite must follow all safety regulations and standards issued by the government of Vietnam in accordance with Circular 22/2010/TT-BXD on Labour safety during construction work. In addition, a Construction Management Plan shall be prepared showing that there have been efforts made to limit the negative effects of the construction process on the site ecosystem.

The Construction Management Plan should at least include the following contents:

- Construction zone:
    - Site information (site location on local area map, fenced area, construction time schedule, responsible parties)
    - Estimate site to be excavated (estimate average run-off coefficient before and after construction).

    - Potential source of pollution (list all potential sources of sediment/ non-sediment, which may reasonably be expected to affect the quality of stormwater discharges, soil, air, underground/surface water, any ecological forms from the construction site.)
- Location of:
    - neighbouring buildings (including setbacks)
    - surrounding street network
    - waterways
    - site access points
    - surface water drainage
    - native vegetation/trees
        - ✓ on site/off site
        - ✓ to be retained and protected
        - ✓ to be removed or lopped
- Proximity to areas such as:
    - rare or threatened species habitat (can refer to EIA/EPC if available)
    - soil and geotechnical hazards
    - any other significant sensitive natural features (slope, tree, soil components)
    - Historic preservation
- Existing service locations and protection measures
- Storage areas for:
    - construction vehicles
    - construction materials
    - waste
    - stockpiles
- Location of any temporary site offices/lunchrooms (if applicable)
- Topography/slope of the land
- Sediment control measures
- Storm water drainage measures
- Staging of works (if applicable)
- Location of onsite green waste storage
- Location of onsite vehicle wash down location

Evaluation of the site environment must be done after the construction of the building to justify the effectiveness of those plans.

The following strategies should be considered:

- Efforts to restore the site ecosystem after construction
- Operational procedures should be put in place to provide guidance and prevent actions that would negatively affect site ecology during construction

Submissions

Design stage

Construction Environmental Management Plan (Ecology Credit 1)

- Provide a construction plan -OR- Tender stage specification extracts indicating measures which will be implemented to reduce the impact to the site during the construction process

As-built stage

Construction Environmental Management Plan (Ecology Credit 1)

- Provide the construction plan indicating the measures that has been implemented to reduce the impact on the site during the construction process
- Summary log showing implementation and maintenance of all measures used on site to comply with credit requirements
- Evidence that the provided construction plan was followed and all measures implemented, such as photographs

Eco-2 Habitat Restoration

Intent

To restore site areas into habitat that can nourish and sustain biodiversity

Requirements

Criteria	3 points
Strategy A: Space restoration	
15% of the total site area (including roof) is restored with native or adapted vegetation	1
30% of the total site area (including roof) is restored with native or adapted vegetation	2
Strategy B: Landscape management plan (Not applicable if the area restored represents less than 10% of the total site area)	
Establish and implement a landscape management plan	1

Overview

Habitat Restoration (Ecology Credit 2)

Site vegetation greatly contributes to the improvement of the sites microclimate, ventilation and scenery. Moreover, vegetation can lead to the restoration of topsoil and prevent erosion. Site vegetation preservation is considered as conserving natural resources. The purpose is to enhance the native plant communities and wildlife habitat on the site while limiting the disturbance and damage to ecosystems.

Vegetation preservation should take priority as to avoid the loss of native species. Conservation actions have to be carried through construction to operation phrase, and a carefully plotted vegetation management plan is encouraged to enhance biodiversity onsite. The process of restoration should consider re-plantation and reestablishment.

To increase the area covered by vegetation is to increase not only the improvement in biodiversity but also the size of the carbon sink and the ability of the area to absorb greenhouse gases. Vegetation of any sort helps mitigate the effects of emissions from the construction and operation of the site. For this reason, maximising the area covered by the vegetation is encouraged; however, introduced species (non-native species) must be avoided as they risk changing an entire habitat, placing ecosystems at risk, crowding out or replacing native species that are beneficial to a habitat and damaging undeveloped habitats.

Once vegetation preservation/ restoration is achieved, focused efforts and planning should be made to maintain the landscape to ensure a healthy habitat whilst minimising the use of water and chemical fertilisers.

Approach & Implementation

Habitat Restoration (Ecology Credit 2)

The following techniques of vegetation preservation/restoration and biodiversity enhancement should be considered:

- Plant native species as they are better adapted to the regional climate and local conditions
- Consider the light and water demands of species when deciding where to plant them (particularly for shaded areas)
- Re-vegetate damaged areas; this will help to improve soil quality and reduce erosion and sediment runoff
- When undertaking any construction, renovations or major maintenance install temporary fencing to the extent of the determined tree protection zone around any vegetation potentially affected by the activities. Fencing should be constructed of at least 1.2 m tall metal posts and bunting
- Restoration/Improvement of the site's physical environment (i.e. abiotic factors)
- Restoration/Improvement of the site’s native species (i.e. community)
- Directly introduce new species to the site, but where possible only those native/endemic to Vietnam and the surrounding region of Indochina
- Introducing structures and species that themselves further promote a native community. (e.g. bird boxes, trees/shrubs that are a natural feeding/nesting site for native birds or a habitat for invertebrates)

Strategy A: Space restoration

The quantity and quality of the site vegetation shall be outlined in a Vegetation Survey. The vegetation survey should cover the whole site and shall include any green roofs present. This Vegetation Survey can be a part of the EIA or EPC of the project (refer to Ecology Prerequisite 1) or an independent comprehensive report on vegetation onsite.

The vegetation survey must include the following information:

- List of species name (Latin and Vietnamese name), number of individuals or coverage (m^2) per species, region of origin and explanation as to why each species was chosen

- Landscape plan showing the position on the site of each plant except grass and small vascular plants (for sites less than or equal to 2 ha), or each plant cluster of the same species (for sites greater than 2 ha)
- List of plants greater than 50 years old
- List of plants of particular ecological and/or spiritual value
- Photos showing existing site vegetation

Strategy B: Landscape management plan

Specifically the landscape management plan shall at a minimum address the following points:

- Vegetation map and list of species: A framework and commitment to maintain the same vegetation patterns for at least 5 years
- Inspection and records: A framework and commitment to maintain records of maintenance activities
- Sustainable landscape maintenance: Details of the landscape's maintenance needs and appropriate landscape practices. A commitment and schedule for actions such as mulching, composting, weeding, sweeping, pruning and removal of diseased plants
- Water conservation: Details of the landscape's irrigation methods and needs and a commitment to water only when necessary
- Chemical fertilisers and pesticides: Details of the landscape's chemical fertiliser needs (if any) and a commitment to prioritise the use of organic fertilisers and/or minimise the use of chemical fertilisers and pesticides
- Native plant species selection: A commitment to plant native species wherever practical

Calculation

Habitat Restoration (Ecology Credit 2)

Strategy A: Space restoration

Percentage of preserved/restored vegetation can be calculated by the following method:

- Quantify area of vegetated area preserved/restored/improved using the following classifiers (using definitions of vegetation as outlined in the EIA):
  - Grasses and small vascular plants that have colonised naturally have low/negligible value and so cannot be counted towards vegetative coverage
  - Low lying vegetation and shrubs: overall vegetative area coverage as if seen from above.
  - Trees: standard set coverage of $1m^2$, applied to all species, shape and size

- If a green roof is installed then the area of this can be included in the vegetated area, regardless of what species or type of vegetation is planted

- Demonstrate amount of preserved/restored vegetated area with the following formula:

$$\text{Vegetation Preserved/Restored/Improved [\%]} = \left(\frac{A_V}{A_S}\right) \times 100$$

A_V= Area of vegetation [m^2]

A_S= Site area [m^2]

Submissions

Design stage

Habitat Restoration (Ecology Credit 2)

Strategy A: Space restoration

- If the site was previously vegetated, submit a Vegetation survey
- A report indicating how on-site preservation will be undertaken -OR- a report indicating how on-site revitalisation will be undertaken
- Tender landscape plans and schedules showing all planting types on the site
- Calculations demonstrating compliance with the requirements

Strategy B: Landscape management plan

- Landscape management plan

As-built stage

Habitat Restoration (Ecology Credit 2)

Strategy A: Space restoration

- Final vegetation survey including required information
- As-built landscape plan showing each plant (not including grass and small vascular plants) (if site is less than or equal to 2 ha), or each plant cluster of the same species (if site is greater than 2 ha), position on site
- Evidence showing on-site preservation was undertaken -OR- evidence showing on-site revitalisation was undertaken, such as photographs, commissioning report, etc.

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission
- Final calculations demonstrating compliance with the requirements

Strategy B: Landscape management plan

- Final landscape management plan
- Evidence showing that the landscape management plan was included in specification for the building/ landscape management team and showing that the plan is implemented.

Eco-3 Development Footprint

Intent

To minimize the area affected by any development activity.

Requirements

Criteria	2 Points
Reduce the development footprint and/or provide open space within the project boundary to exceed the local open space requirement for the site by 10%	1
Reduce the development footprint and/or provide open space within the project boundary to exceed the local open space requirement for the site by 20%	2

Overview

Development Footprint (Ecology Credit 3)

Minimizing the development footprint helps conserve the existing natural areas and restore damaged areas to provide habitat and promote biodiversity. Providing open space can contribute to the mitigation of environmental impacts including land consumption and rainwater runoff, and create physiological as well as psychological benefits for building occupants and the community.

Approach & Implementation

Development Footprint (Ecology Credit 3)

The development footprint is the total area of the building footprint and areas affected by the development or by project site activity. Building footprint is the area used by the building structure and defined by the perimeter of the building. Parking lots, parking garages, access roads and other non-building facilities are not included in the building footprint, but they are included in the development footprint (Figure G1 of the Glossary).

In Vietnamese setting, open space is the space not used for the purpose of construction of buildings and facilities, adjacent to the space used for residential or non-residential buildings.

Building footprint, construction density and open space are governed by local departments of planning and architecture in accordance with a master plan. Projects however can adopt effective strategies for the site design to remain compliant and better than the mandatory requirements while creating environmental benefits and improving building functionality.

Strategies that can be considered include but are not limited to:

- Making provision for more dense development
- Ensuring the efficient use of land by designing blocks, lots and buildings together
- Increasing setback distances to protect natural areas
- Design responding to the environmental constraints of the location
- Retain existing vegetation and ecology
- Enhance natural and heritage features and views
- Reinforce and continue existing open-space networks and greenbelts, through and between settlements

Submissions

Design stage

Development Footprint (Ecology Credit 3)

- Documents provided by local planning and architecture department with instructions based on 1:2000 detailed urban construction plan on building heights, number of stories, GFA, construction density, land-use ratio;
- Planning and Architectural Certificate, issued to the project by local department of planning and architecture;
- 1:500 urban construction plan prepared by the project owner;
- Narrative report showing criteria compliance of the site planning. In order to be awarded with points, the reduction of development footprint, building footprint and increase of open space must be calculated.

As-built stage

Development Footprint (Ecology Credit 3)

- As-built drawings showing the project has been constructed as previously intended.

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission
- Submit all the final documentation with the submittals required at design stage

Eco-4 Green Roof

Intent

To encourage the use of green roofs which improves the outdoor environmental quality and the overall performance of a building

Requirements

Criteria	2 Points
30% of the roof area is covered with a green roof	1
50% of the roof area is covered with a green roof	2

Overview

Green Roof (Ecology Credit 4)

Green roof refers to a building roof that is partially or completely covered with vegetation and soil, or a growing medium, planted over a waterproofing membrane along with appropriate additional layers such as a root barrier and drainage and irrigation systems (see Figure Eco.1). The term does not refer to roofs which are merely coloured/painted green, as with green roof shingles, or decorated with pot plants.

Approach & Implementation

Green Roof (Ecology Credit 4)

Incorporate in the design any of the following features:

- Extensive green roofs: lightweight, narrow plant range and require low maintenance
- Semi-intensive green roofs: include features of both intensive and extensive green roofs. While the roof features a range of extensive plantings and is designed to be low-maintenance, it is also accessible to occupants
- Intensive green roofs: deep topsoil (depth ≥ 50cm), wide plant choice and are geared for recreational use by human beings. Intensive green roofs should allow a wider range of plants to be chosen and hence develop the biodiversity.

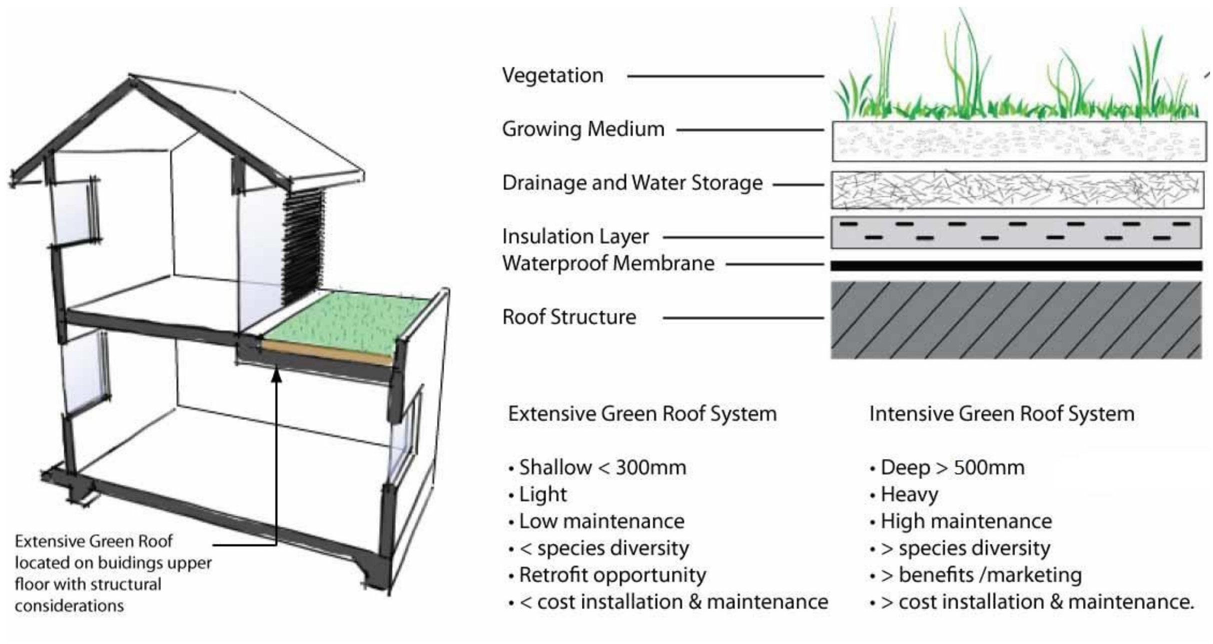

Figure Eco.1: Green roof layers

Calculations

Green Roof (Ecology Credit 4)

Calculation is based on area. Percentage of green roof area can be calculated by the following method:

- Quantify total roof area
- Quantify area of intensive green roof
- Quantify area of semi-intensive or extensive green roof
- Demonstrate amount of green roof with the following formula:

$$\text{Green Roof [\%]} = \left(\frac{R_{gi} + R_{ge} * 70\%}{R_{tot}}\right) \times 100$$

R_{gi} = Area of intensive green roof [m²]

R_{ge} = Area of semi-intensive or extensive green roof [m²]

R_{tot} = Total area of roof [m²]

Submissions

Design stage

Green Roof (Ecology Credit 4)

- Report on green roof design and implementation
- Tender stage detail drawings of the construction system of all green roofs
- Tender stage roof plan indicating areas of all green roofs
- Calculations demonstrating compliance with the requirements

As-built stage

Green Roof (Ecology Credit 4)

- As-built detail drawings of the construction system of all green roofs
- As-built roof plan indicating areas of all green roofs
- Evidence showing all green roofs built such as photographs, commissioning report, etc.

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission
- Final report on green roof design and implementation
- Final calculations demonstrating compliance with the requirements

Waste & Pollution

A building and its occupants produce various forms of waste and pollution. These include sewer discharge, water pollution, light pollution and ozone depleting chemicals, as well as Greenhouse Gases. Reducing these emissions should be a key aim of any green building.

Infrastructure is required to move sewage from its building of origin to be processed at treatment plants. Limiting the amount of sewage generated by a building reduces the strain on existing infrastructure, reducing the need for additional infrastructure projects and the energy requirements involved with the removal and treatment of sewage. This matter is particularly important for Vietnam, where the three largest cities have a combined domestic waste water discharge of 1.9 million m^3 per day less than 10% of which is treated. This is due to urban treatment plants which are outdated and have a capacity which is greatly insufficient. Inadequate sewerage infrastructure is causing industrial as well as domestic waste water to escape into the natural environment. This is a major concern as Vietnam's natural aquifers are becoming increasingly polluted.

Vietnam's urban areas generate over 8 million tonnes of solid waste per year, of which only about 70% is collected and treated. This means almost 2.5 million tonnes of untreated solid waste is released into the environment each year.

Mitigating these trends is extremely important, as pollution prevention is always preferable to remediation, which is costly and inefficient. The credits within the Waste & Pollution Category of LOTUS MFR encourage strategies and technologies which minimise the generation, and hence minimise 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		7 Points
Item	Criteria	Points
WP-PR-1	Wastewater Treatment	
	Building must comply with QCVN 14:2008/BTNMT National technical regulation on domestic wastewater	W&P Prerequisite 1
WP-1	Refrigerants	1 point
	Option A: No air-conditioning system in dwelling-units (only applicable for projects with effective natural ventilation)	
	No air-conditioning system is installed in dwelling-units	1
	Option B: Refrigerant Atmospheric Impact of Air-conditioning systems	
	Provide air-conditioning for all the dwelling units in the building and the average Refrigerant Atmospheric Impact of the air-conditioning systems is below 13	1
WP-2	Demolition and Construction Waste	2 points
	Develop and implement a demolition and construction waste management plan	W&P Prerequisite 2
	Reuse, salvage and/or recycle 50% of the demolition and construction waste	1
	Reuse, salvage and/or recycle 70% of the demolition and construction waste	2
WP-3	Waste Management	3 points
	1 point for every of the following types of waste being managed and sorted: A. recyclables B. organics C. bulky waste	3
WP-4	Light Pollution Minimisation	1 point
	Implement automatic lighting shutoff strategies for exterior lighting fixtures and interior lighting fixtures with a direct line of sight to any openings in the envelope	W&P Prerequisite 3
	Option A: Light trespass	
	Exterior lighting fixtures and interior ones with a direct line of sight to any openings in the envelope	1
	Option B: Fully-shielded luminaires	
	All exterior lighting fixtures are fully-shielded	1

WP-PR-1 Wastewater Treatment

Intent

To encourage appropriate treatment of wastewater prior to discharge from the site.

Requirements

Criteria	Points
Building must comply with QCVN 14:2008/BTNMT National technical regulation on domestic wastewater	WP Prerequisite 1

Overview

Wastewater Treatment (Waste and Pollution Prerequisite 1)

The on-site treatment of wastewater is particularly important in Vietnam as only 10% of wastewater is treated at downstream wastewater treatment plants. On-site treatment in Vietnam typically involves a septic tank however, more advanced technologies such as filtration, biological treatment and disinfection can achieve superior results.

Approach & Implementation

Wastewater Treatment (Waste and Pollution Prerequisite 1)

Design wastewater system to comply with QCVN 14:2008/BTNMT National technical regulation on domestic wastewater.

Submissions

Design stage

Wastewater Treatment (Waste and Pollution Prerequisite 1)

- Report describing how the wastewater system meets the requirements of QCVN 14:2008/BTNMT
- Tender stage hydraulic plans and schematics of the wastewater system

As-built stage

Wastewater Treatment (Waste and Pollution Prerequisite 1)

- As-built hydraulic plans and schematics of the wastewater system

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission
- Final report describing how the wastewater system meets the requirements of applicable wastewater regulations and standards

WP-1 Refrigerants

Intent

To encourage the selection and use of refrigerants that do not increase global warming nor damage the ozone layer

Requirements

Criteria	1 point
Option A: No air-conditioning system in dwelling-units (only applicable for projects with effective natural ventilation*)	
No air-conditioning system is installed in dwelling-units	1
Option B: Refrigerant Atmospheric Impact of Air-conditioning systems	
Provide air-conditioning for all the dwelling units in the building and the average Refrigerant Atmospheric Impact of the air-conditioning systems is below 13	1

* To be considered as a project with effective natural ventilation, a project needs to achieve at least 4 points in the strategies A1 and A2 of the credit E-3.

Overview

Refrigerants (Waste and Pollution Credit 1)

Common chemical refrigerants used in buildings such as Chlorofluorocarbons (CFCs) and Hydrochloroflourocarbons (HCFCs) are Ozone Depleting Substances (ODS). These refrigerants have significant Ozone Depleting Potential (ODP) and Global Warming Potential (GWP), thus they contribute to ozone depletion and global warming when emitted to the atmosphere.

HCFCs are being used as a transition chemical to aid the phase out of CFC's due to lower ODP compared to CFCs. These refrigerants are considered as an interim medium term alternatives and not long term replacements. Under the 2007 Montreal Adjustment on Production and Consumption of HCFCs, Vietnam (Article 5 (developing country) Parties) committed to phase out HCFCs (including R-22) with 10% reduction by 2015, 35% reduction by 2020, 67.5% reduction by 2025, and 100% reduction by 2030. In addition, the annual average of 2.5% is restricted to the refrigeration and air conditioning equipment existing on 1 January 2030 for the 10 year period (2030-2040) and subject to review in 2015.

Other refrigerants such as HFCs have zero ODP (as they do not contain chlorine), thus they are the current favourable replacements. However, HFCs may have a high GWP (up to

12240). In selecting an ideal refrigerant a trade-off should be sought between ODP and GWP. The VGBC is aware that refrigerants with lower GWP such as HFOs are beginning to come onto the market. Innovation points may be awarded for the use of such refrigerants.

Approach & Implementation

Refrigerants (Waste and Pollution Credit 1)

Option A: No air-conditioning system in dwelling-units

This option is only applicable for projects with effective natural ventilation, which are projects achieving at least 4 points in the strategies A1 and A2 of the credit E-3 Natural Ventilation and Air-conditioning.

No air-conditioning system shall be installed in the dwelling-units and some information indicating that the building is effectively naturally ventilated and that the use of air-conditioning might not be necessary shall be included in the Building User's Guide.

Option B: Refrigerant Atmospheric Impact of Air-conditioning systems

No CFC refrigerant or refrigerants with an ODP higher or equal to 0.05 should be installed in the building to be eligible for 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 uses a low refrigerant charge (centralised 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
R407A	0	1,923
R407C	0	1,624
R410A	0	1,924
CO_2	0	1

Calculations

Refrigerants (Waste and Pollution Credit 1)

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.

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

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

Design stage

Refrigerants (Waste and Pollution Credit 1)

Option B: Refrigerant Atmospheric Impact of Air-conditioning systems

- Tender schedule of all HVAC systems proposed indicating the type, volume and weight of refrigerants used
- Tender stage specification extracts -OR- manufacturer´s published data indicating the proposed types of systems with the type and volume of refrigerants used
- Tender mechanical drawings of the HVAC systems showing location and type of all the systems using refrigerants
- Calculations demonstrating compliance with the requirements

As-built stage

Refrigerants (Waste and Pollution Credit 1)

Option A: No air-conditioning system in dwelling-units

- Extract of the Building User's Guide showing that some information indicating that the use of air-conditioning can be reduced have been included.

Option B: Refrigerant Atmospheric Impact of Air-conditioning systems

- As-built schedule of all HVAC equipment installed proposed indicating the type and volume of refrigerants used
- Manufacturer’s published data indicating the proposed types of systems with the type and volume of refrigerants used
- As-built mechanical drawings of the HVAC systems showing location and type of all the systems using refrigerants
- Evidence of the equipment installed, such as photographs, invoices, receipts, commissioning report, etc.

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission
- Final calculations demonstrating compliance with the requirements

WP-2 Demolition and Construction Waste

Intent

To encourage the reuse, salvage and recycling of demolition and construction waste and to minimise disposal in landfill

Requirements

Criteria	2 Points
Develop and implement a demolition and construction waste management plan	WP prerequisite 2
Reuse, salvage and/or recycle 50% of the demolition and construction waste	1
Reuse, salvage and/or recycle 70% of the demolition and construction waste	2

Overview

Demolition and Construction Waste (Waste and Pollution Prerequisite 2 and Credit 2)

Demolition and construction waste can be considered a valuable resource for reuse and recycling. By replacing the demand for virgin resources, demolition and construction waste reuse and/or recycling can significantly reduce the environmental impacts resulting from new material exploitation and production.

Approach & Implementation

Demolition and Construction Waste (Waste and Pollution Prerequisite 2)

A Waste Management Plan (WMP) must be developed and implemented. The WMP must specify:

- Goals of waste management: percentage demolition and construction wastes 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

Demolition and Construction Waste (Waste and Pollution Credit 2)

Provide a recycling waste storage area on the construction site for collection and separation of recyclable demolition and construction waste. Recycle or reuse typical demolition and construction waste such as:

- Brick
- Concrete
- Metals
- Plastic
- Glass
- Lumber
- Roofing materials
- Corrugated cardboard
- Drywall

Excavated soil and land-clearing debris shall not be considered in this credit.

Calculation

Demolition and Construction Waste (Waste and Pollution Credit 2)

Calculation is based on volume or weight. Units selected must be applied consistently across the entire credit. Reused/salvaged/recycled wastes must be calculated by the following method:

- Quantify amount of all demolition and construction waste
- Indicate disposal method for each material
- Quantify waste diverted from landfill disposal using the following formula and present data in table form (example below):

$$C\&D\ Waste\ Reused\ or\ Recycled\ [\%] = \frac{\mathrm{W_D}}{\mathrm{W_G}} \times 100$$

W_D = Waste diverted from landfill [tonnes or m^3]

W_G = Total waste generated by construction activities [tonnes or m^3]

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

Materials	Quantity (tonnes)	Disposal Option	Where/Construction haulers & recyclers	Handling Procedure
Asphalt from parking lot	2	Reused as fill	On site	Ground on site
Concrete	3	Recycle	Recycling Facility	Keep separated in "Container for Concrete" in designated areas on site.
Scrap Metal	2	Recycle	Recycling Facility	Keep separated in "Container for Metal" in designated areas on site.
Glass	1	Recycle	Recycling Facility	Keep separated in "Container for Glass" in designated areas on site.
Plastics	1	Recycle	Recycling Facility	Keep separated in "Container for Plastic" in designated areas on site.
Cardboard	1	Recycle	Recycling Facility	Keep separated in "Container for Cardboard" in designated areas on site.
Carpet, ceiling and floor tiles	2	Reuse or recycle	Reuse or recycle with manufacturer	Keep separated in designated areas on site.
All other wastes	10	Landfill	Landfill	Dispose of in "Container for Trash" in designated areas on site.
Total C&D Waste	22			
Total C&D Waste sent to landfill	10			
Total C&D Waste reused/recycled (diverted from landfill)	12			
% of C&D Waste reused/recycled (diverted from landfill)	55%			

$$C\&D\ Waste\ Reused\ or\ Recycled\ [\%] = \left(\frac{12}{22}\right) \times 100 = 55\%$$

Submissions

Design stage

Demolition and Construction Waste (Waste and Pollution Prerequisite 2)

- Submit a demolition and construction waste management plan -OR- Tender stage specification extracts and signed letter from the owner/developer indicating that the demolition and construction waste management plan will be produced and followed

Demolition and Construction Waste (Waste and Pollution Credit 2)

- Based on the information in the demolition and construction waste management plan (Estimated volumes/tonnages of each type of waste and the strategies to reuse, salvage or recycle waste), provide an estimate of the percentage of waste that will be reused, salvaged or recycled.

As-built stage

Demolition and Construction Waste (Waste and Pollution Prerequisite 2)

- Summary log of all construction waste generated by type, the quantities of each type that were diverted and landfilled
- Removal contracts and/or sales/trade documents covering all recycled waste removal compiled month by month
- Evidence that the demolition and construction waste management plan was followed such as photographs, receipts, etc.

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission
- Final Demolition and construction waste management plan that has been implemented

Demolition and Construction Waste (Waste and Pollution Credit 2)

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission
- Final calculations demonstrating compliance with the requirements

WP-3 Waste Management

Intent

To implement waste sorting and facilitate the recycling and reuse of waste

Requirements

Criteria	3 Points
1 point for every of the following types of waste being managed and sorted: A. recyclables B. organics C. bulky waste	3

Overview

Waste Management (Waste and Pollution Credit 3)

Operational buildings will produce a considerable amount of wastes that should be diverted from landfill for recycling or reuse. Good practice and the provision of separation facilities to allow for recycling and reuse is a simple way to reduce the amount of waste generated once the building is occupied.

Approach & Implementation

Waste Management (Waste and Pollution Credit 3)

General strategies to implement:

- Display signs in the whole building to indicate the storage areas in which are present the different waste containers: normal garbage bins and the bins dedicated to each type of waste that is managed and sorted by the building.
- If the building is higher than 7 floors, provide on each floor a space for interim storage of all the types of waste that are managed and sorted by the building.

A. Management and sorting of recyclables

Implement the following strategies to manage and sort recyclables:

- Provide a storage place in each dwelling with a bin for recyclable wastes
- Put signs in the space (or include a description in the Building User's Guide in the Management Prerequisite 4) explaining which types of waste should be recycled.

- Incorporate into the design a dedicated recycling storage area with recycling bins for the collection, separation and storage of recyclables. The storage area must allocate storage space for at least the following recyclable materials:
  - Paper (including newspaper)
  - Corrugated cardboard
  - Plastic
  - Metal
  - Glass

The dedicated recycling storage area must be located in the basement or at the ground level for convenient access by occupants and collection vehicles. The recycling area and the bins for each material should be clearly marked.

The dedicated recycling storage area shall be sized based on the total gross floor area of the building in accordance with Table WP.4. Where the GFA of the building falls between the figures in the table, linear interpolation shall be used to determine the appropriate percentage area for the dedicated recycling storage. 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%

Example:

The minimum dedicated recycling storage area of a building with a GFA of 17,000 m^2 should be calculated as follows:

- 10,000m^2 with 0.25 % equals 25 m^2
- 20,000m^2 with 0.15 % equals 30 m^2
- $\text{Minimum area } [\text{m}^2] = 25 + (30 - 25) \times \frac{17{,}000 - 10{,}000}{20{,}000 - 10{,}000} = 28.5$

B. Management and sorting of organic wastes

Implement the following strategies to manage and sort organic wastes:

- Provide a storage place in each dwelling with a bin for organic wastes
- Put signs in the space (or include a description in the Building User's Guide in the Management Prerequisite 4) explaining which types of waste should go in the bin for organic wastes.
- Provide bins for organic wastes in the interim and common storage areas of the building
- Provide compost bins and have one staff responsible of the following:
  - Facilitate compost start by putting some compost already done before the first use of the container
  - Put some branches in the bottom before you start to fill it up in order to have a good base aeration.
  - Mix frequently the compost in order to have the new organic wastes are in contact with the ones in fermentation.

Also, the compost shall either be used onsite or made available for people to use it.

C. Management and sorting of bulky wastes

Implement the following strategies to manage and sort bulky wastes:

- Provide a space big enough for bulky wastes (considering the intended frequency of collection) in the common waste area
- Provide space for bulky wastes in all the waste storage areas of the building

Submissions

Design stage

Waste Management (Waste and Pollution Credit 3)

- Report indicating that the project will provide a space in each dwelling unit with different bins for each type of waste managed and sorted by the building and describing how waste separation and location of waste storage areas will be explained to residents.
- Tender stage plans showing location of all the waste storage areas and showing the spaces reserved for the different types of waste managed and sorted by the building

A. Management and sorting of recyclables

- Report indicating that the design provides adequate space for recyclable materials storage, how recycling materials will be sorted and which materials will be recycled

- Site plan indicating the location and size of the dedicated recycling storage area and access routes to the recycling storage area(s) for building occupants and recycling contractors

B. Management and sorting of organic wastes

- Report indicating that the design provides a space to put the compost bin(s) and that a staff will be appointed to take care of the composting.

C. Management and sorting of bulky wastes

- Report indicating that the design provides adequate space for bulky wastes.

<u>As-built stage</u>

Waste Management (Waste and Pollution Credit 3)

- Evidence that the project has provided a space in each dwelling unit with different bins for each type of waste managed and sorted by the building and that signs (or a description in the Building User's Guide in the Management Prerequisite 4) explain how to properly recycle, and which type of waste goes in which bin.
- Evidence that signs showing the location of storage areas are displayed all over the building.
- As-built stage plans showing location of the different waste storage areas and showing the spaces reserved for the different types of waste managed and sorted by the building

A. Management and sorting of recyclables

- As-built site plan indicating the location and size of dedicated recycling storage area and access routes to the dedicated recycling storage area for recycling contractors
- Evidence such as photographs, receipts, narratives, etc., showing:
    - The recyclable materials storage space
    - How recycling materials are sorted
    - Materials which are recycled

B. Management and sorting of organic wastes

- Photographs showing the compost bin(s)
- Evidence showing that a staff member is taking care of the composting

C. Management and sorting of bulky wastes:

- Photographs showing the different bulky storage areas.

WP-4 Light Pollution Minimisation

Intent

To minimise light pollution into the night sky

Requirements

Criteria	1 point
Implement automatic lighting shutoff strategies for exterior lighting fixtures and interior lighting fixtures in common areas with a direct line of sight to any openings in the envelope	WP Prerequisite 3
Option A: Light trespass	
Exterior lighting fixtures and interior ones in common areas with a direct line of sight to any openings in the envelope	1
Option B: Fully-shielded luminaires	
All exterior lighting fixtures are fully-shielded	1

Overview

Light Pollution Minimisation (Waste and Pollution Prerequisite 3 and Credit 4)

Light pollution is excessive or obtrusive artificial light, causing adverse effects such as sky glow, glare, light trespass, light clutter, decreased visibility at night and energy waste. Like any forms of pollution (such as water, air, and noise pollution) light pollution also causes damage to the environment. It affects human health and psychology, disrupts ecosystems and impinges on astronomical observation.

Approach & Implementation

Light Pollution Minimisation (Waste and Pollution Prerequisite 3)

Implement automatic lighting shutoff strategies (using scheduling, photosensors or occupancy sensors) to switch off exterior lighting fixtures and interior lighting fixtures in common areas with a direct line of sight to any openings in the envelope during the non-operational period.
Exceptions: The following shall not require an automatic control device:

- Lighting intended for 24-hour operation.
- Lighting in spaces where patient care is rendered.
- Lighting in spaces where an automatic shutoff would endanger the safety or security of the room or building occupant(s).

Light Pollution Minimisation (Waste and Pollution Credit 4)

Option A: Light trespass

Light trespass occurs when unwanted light enters property from a light source outside the property, for instance, a light shining over a neighbour's fence (Fig. WP.1). Light trespass reduction is achieved with a combination of the following factors: fixture shielding, directional control designed into the fixture, fixture location, fixture height, fixture aim.

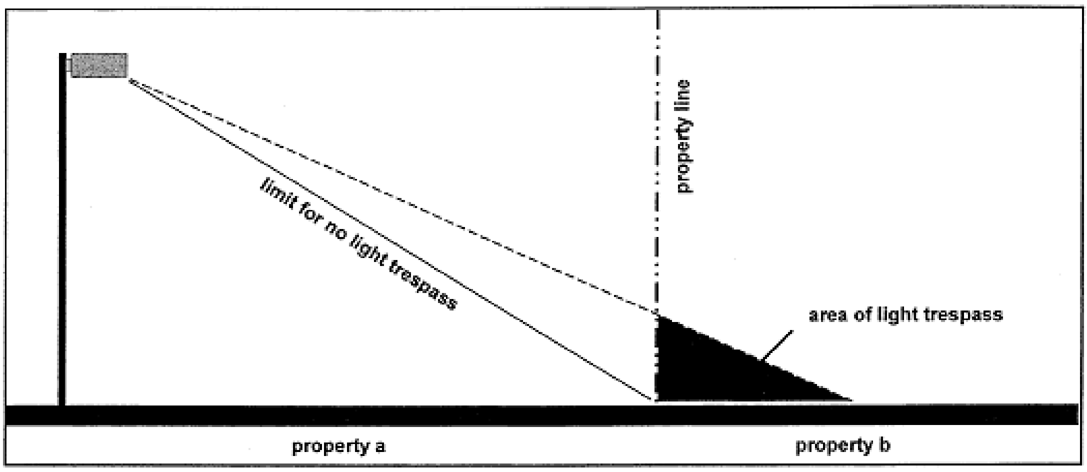

Figure WP.1: Example of light trespass

Option B: Fully shielded fixtures

Exterior lighting fixtures must all be fully-shielded.
Shielding is used to block the lamp's rays from traveling upward (causing sky glow) or sideways (and off your property–potentially causing a nuisance to your neighbour).
Fully shielded luminaires emit no direct uplight (no light emitted above horizontal), but have no limitation on the intensity in the region between 80° and 90° unlike the full cutoff classification.
Photometric distribution of luminaires should be used to justify that they are fully-shielded.

Calculations

Light Pollution Minimisation (Waste and Pollution Credit 4)

Option A: Light trespass

Calculations must be undertaken for each exterior lighting fixture and interior lighting fixture with a direct line of sight to any openings in the envelope.

First, it is needed to classify the project under one of the following zones, as recommended by IDA (International Dark-Sky Association):

Table WP.5: Environmental zones

Zone	Lighting Environment	Description
LZ0	No ambient lighting	Areas where the natural environment will be seriously and adversely affected by lighting
LZ1	Low ambient lighting	Areas where lighting might adversely affect flora and fauna or disturb the character of the area.
LZ2	Moderate ambient lighting	Areas of human activity where the vision of human residents and users is adapted to moderate light levels.
LZ3	Moderately high ambient lighting	Areas of human activity where the vision of human residents and users is adapted to moderately high light levels.
LZ4	High ambient lighting	Areas of human activity where the vision of human residents and users is adapted to high light levels.

During night-time hours (i.e. between 9 p.m. and 9 a.m.), it is required to limit the horizontal and vertical illuminance (E_H and E_V) at the side boundary to comply with the following table:

Table WP.6: Obtrusive light limitations

Zone	Horizontal and Vertical Illuminance
LZ0	0 lux
LZ1	1 lux
LZ2	4 luxes
LZ3	5 luxes
LZ4	6 luxes

The point of measurement shall be located at 1 meter above the surface, and at 1.5 meters inside an adjacent residential parcel or public right-of-way, and 3 meters inside an adjacent commercial or industrial parcel or a public roadway.

Horizontal and Vertical illuminances must be calculated with the following formulas:

$$E_H = \frac{I}{D^2}\cos(\alpha)$$

$$E_V = \frac{I}{D^2}\cos(\beta)$$

Where:

E_H and E_V = Horizontal and Vertical illuminance (lx).

I = Intensity towards the point (cd); this information is given in manufacturer's photometric data (candlepower distribution curve*).

$D =$ Direct distance (meters) between the lamp and the closest point located 1.5 or 3 meters beyond the site boundary.

α and β = Angles of incidence (°), as shown below:

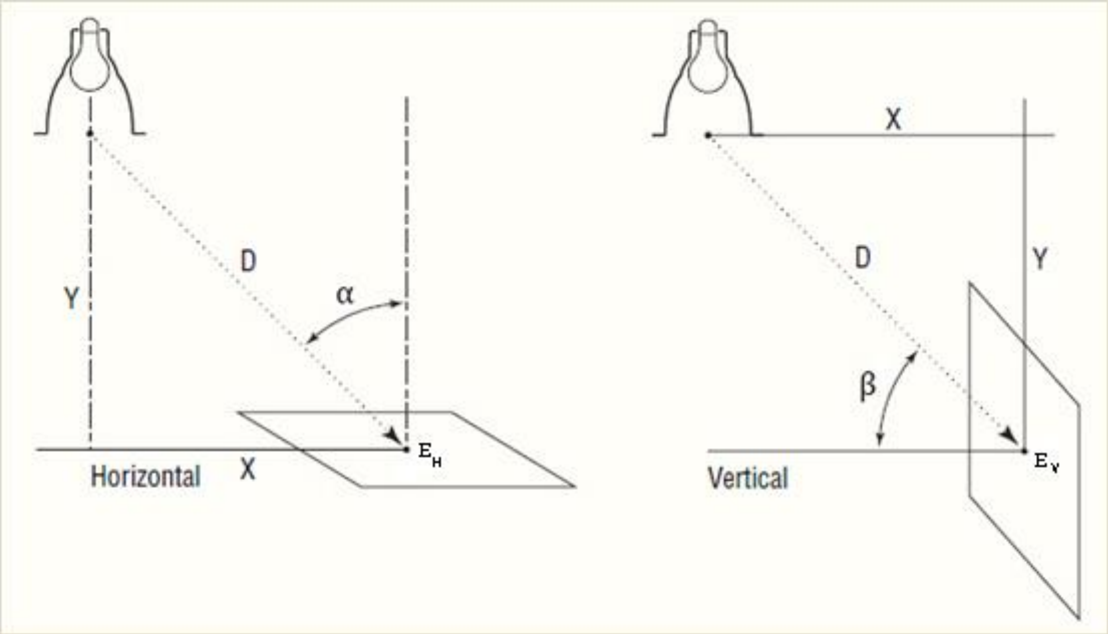

Figure WP.2: Angles of incidence

*The candlepower distribution curve is a cross-sectional “map” of intensity (candelas) measured at many different vertical angles. It is a two-dimensional representation and therefore shows data for one plane only. If the distribution of the unit is symmetric, the curve in one plane is sufficient for all calculations. If asymmetric, such as with street lighting and fluorescent units, three or more planes are required. In general, incandescent and HID reflector units are described by a single vertical plane of photometry. Fluorescent luminaires require a minimum of one plane along the lamp axis, one across the lamp axis and one at a 45° angle. The greater the departure from symmetry, the more planes needed for accurate calculations.

Submissions

Design stage

Light Pollution Minimisation (Waste and Pollution Prerequisite 3)

- Tender stage lighting drawings outlining the lighting fixtures concerned by lighting schedule

Light Pollution Minimisation (Waste and Pollution Credit 4)

Option A: Light trespass

- E_H and E_V calculations demonstrating compliance with the requirements.
- Plans of project area including neighbouring areas with their types and calculated light trespass.

Option B: Fully shielded fixtures

- Tender stage specification extracts -OR- Manufacturer´s published data of all the proposed exterior lighting fixtures indicating the fully-shielded classification

As-built stage

Light Pollution Minimisation (Waste and Pollution Prerequisite 3)

- As-built lighting drawings outlining the lighting fixtures concerned by lighting schedule
- Schedule of all the installed lighting schedule controls

Light Pollution Minimisation (Waste and Pollution Credit 4)

Option A: Light trespass

- E_H and E_V values obtained with measurements demonstrating compliance with the requirements.
- As-built plans of project area including neighbouring areas with their types and calculated light trespass.
- Evidence showing all the exterior lighting fixtures and lighting schedule controls installed such as photographs, invoices, receipts, commissioning report, etc.

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission

Option B: Fully shielded fixtures

- Schedule of all the installed lighting schedule controls and lighting fixtures indicating the fully-shielded classification.
- Evidence showing how all the concerned lighting fixtures are build, such as photographs, commissioning report, etc.

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission

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 urbanised, 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 workers' productivity 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". Reduced absenteeism and increased productivity can translate into reduced costs and increased savings for building owners and operators. Proper IEQ also increase the resale value of any building.

All credits within the Health & Comfort Category of LOTUS MFR 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 and dust for occupants. Moreover, a healthy indoor environment in a building has to be comfortable visually and thermally for most of the occupants of the building.

Health & Comfort		13 Points
Item	Criteria	Points
H-PR-1	Indoor Smoking	PR
	Prohibit smoking in all the common areas of the building in accordance with Decision 1315/QĐ-TTg	H&C Prerequisite 1
H-1	Fresh Air Supply	2 points
	Provide sufficient fresh air supply to a minimum of 95% of the net occupied area of the building	2
H-2	Ventilation in Wet Areas	1 point
	Install a local exhaust system in wet areas to remove moisture and odours from wet areas	1
H-3	Hazardous Materials	4 points
	Specify and install products with low VOC and formaldehyde content. Choose one type of products from the following: 1) All flooring systems 2) all interior paint and coatings 3) all adhesives and sealants 4) all composite wood products	1
	1 point for every additional type of product chosen with low VOC and formaldehyde content (Up to 4 types of product)	4
H-4	Daylighting	3 points
	50% of the net occupied area have an average daylight factor between 1.5% and 3.5%	1
	1 point for every additional 15% of the net occupied area has an average daylight factor between 1.5% and 3.5% (Up to 80%)	3
H-5	Thermal comfort	2 points
	To avoid overheating under hot summer conditions, 95% of the occupied spaces shall meet one of the following requirements: • Air-conditioned and mixed-mode ventilated spaces: Air-conditioning system is designed to maintain an indoor operative temperature between 24°C to 26°C and a relative humidity below 70% during occupied hours. • Non air-conditioned spaces: Method 1: Spaces meet the requirements of Section 5.3 of ASHRAE 55-2004 with indoor operative temperature at design conditions in the 80% acceptability limits. -OR- Method 2: Spaces comply with at least 1 strategy in each of the three following categories: A. Indoor air velocity B. Reduction of external (solar) heat gains C. Reduction of internal heat gains	2
H-6	Noise Insulation	1 point
	Design all walls and floors to comply with the requirements of TCXDVN 277:2002 on airborne and impact sound insulation for all classes	1

H-PR-1 Indoor Smoking

Intent

To minimise the effect of passive smoking

Requirements

Criteria	Points
Prohibit smoking in all the common areas of the building in accordance with Decision 1315/QĐ-TTg	Health & Comfort Prerequisite 1

Overview

Indoor Smoking (Health and Comfort Prerequisite 1)

Second-hand smoking/Passive smoking is the inhalation of smoke from tobacco products used by others. It occurs when tobacco smoke permeates any environment, causing its inhalation by people within that environment. Scientific evidence shows that health effects of exposure to second-hand smoke include lung cancer, nasal sinus cancer, respiratory tract infections and heart disease.

Approach & Implementation

Indoor Smoking (Health and Comfort Prerequisite 1)

Smoking should be banned inside the whole building and projects should ensure all building users are aware of the smoking ban by:

- Including information regarding indoor smoking ban in Building User's Guide
- Displaying "No Smoking" signs (in area of prominence that may be frequented by smokers)

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

All projects are encouraged to install smoking corners outside the building. They should be located 8 meters away from building entrances, outdoor intakes and operable windows and should be equipped with individual firefighting equipment.

Submissions

Design stage

Indoor Smoking (Health and Comfort Prerequisite 1)

If any designated smoking areas:

- Tender stage site plan indicating the location of designated smoking areas
- Tender stage mechanical drawings showing the ventilation system for the designated smoking areas inside the building

As-built stage

Indoor Smoking (Health and Comfort Prerequisite 1)

- Photographs showing the “no smoking” signs
- As-built stage site plan annotated to indicate the location of “no smoking” signs

If any designated smoking areas:

- Photographs showing the designated smoking areas
- As-built stage site plan annotated to indicate the location of designated smoking areas
- As-built stage mechanical drawings showing the ventilation system for the designated smoking areas inside the building (if any)

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission

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 net occupied area of the building	2

Overview

Fresh Air Supply (Health and Comfort Credit 1)

Fresh air supply refers to the volumetric flow rate of fresh air (outdoor air) being introduced to an occupied space. Fresh air is assumed to be free of contaminates (investigation of the fresh air quality is advised, especially in dense urban areas) and increased fresh air supply can help decrease respiratory illnesses and associated absenteeism. Reduced instances of sick building syndrome symptoms and improved productivity are also results of high fresh air intake rates.

Approach & Implementation

Fresh Air Supply (Health and Comfort Credit 1)

This credit applies to all occupied spaces in the building 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.

- 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
  - CIBSE Guide A - Environmental Design
  - CIBSE Guide B - Heating, Ventilating, Air Conditioning and Refrigerant
  - ASHRAE Standard 62.1 - Ventilation for Acceptable Indoor Air Quality (versions 2007, 2010 or 2013)

- Australian Standard, AS1668.2 - The Use of Ventilation and Air-conditioning in Buildings - Ventilation Design for Indoor Air Contaminant Control

- 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 naturally ventilated 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 naturally ventilated spaces' floor area
  - Interior spaces 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 m^2)

  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.
- 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.

For 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.

Calculation

Fresh Air Supply (Health and Comfort Credit 1)

- Mechanically ventilated, air conditioned 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 section 5.1.1 of ASHRAE 62.1-2007.

Submissions

Design Stage

Fresh Air Supply (Health and Comfort Credit 1)

For spaces with mechanical ventilation:

- Table outlining every occupied space along with each space's ventilation type, fresh air supply rate and AHUs or fans serving the space.
- Calculations demonstrating that the requirements of the national or international standard selected are met
- Tender schematic mechanical drawings showing fresh air supply rates of AHUs and fans
- Inventory of proposed HVAC equipment

For spaces with natural ventilation:

- Tender stage elevations and plans marking all operable wall and roof openings
- Tender stage window schedule indicating the number, location and size of all operable wall and roof openings or room data sheets that indicate area and window specifications (glazing type, size and whether the window is operable).
- Calculations demonstrating that naturally ventilated occupied spaces conform to the requirements

As-built Stage

Fresh Air Supply (Health and Comfort Credit 1)

For spaces with mechanical ventilation:

- Final schedule outlining every occupied space along with each space's ventilation type, fresh air supply rate and AHU’s or fans serving the space
- As-built schematic mechanical drawings showing fresh air supply rates of AHUs and fans
- Final inventory of HVAC equipment
- Evidence of the HVAC equipment installed, such as photographs, invoices, receipts, commissioning report, etc.

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission
- Final as-built calculations demonstrating that the requirements of the national or international standard selected are met

For spaces with natural ventilation:

- As-built stage elevations and plans marking all operable wall and roof openings
- As-built stage window schedule indicating the number, location and size of all operable wall and roof openings or room data sheets that indicate area and window specifications (glazing type, size and whether the window is operable).

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission
- Final calculations demonstrating that naturally ventilated occupied spaces conform to the requirements

H-2 Ventilation in Wet Areas

Intent

To reduce moisture and odours from wet areas.

Requirements

Criteria	1 Point
Install a local exhaust system in wet areas to remove moisture and odours from wet areas	1

Overview

Ventilation in Wet Areas (Health and Comfort Credit 2)

Wet areas are the rooms or spaces containing sanitary fixtures and appliances. They are subject to high levels of moisture from direct wetting, high humidity levels and condensation. Mould can grow in wet areas caused by high humidity that can result from everyday activities like cooking or showering and can contribute to poor indoor air quality and health problems. Along with good design and installation of waterproof membranes and impervious finishes to manage the moisture generated, proper ventilation can improve indoor air quality and prevent mould from growing.

Approach & Implementation

Ventilation in Wet Areas (Health and Comfort Credit 2)

This credit applies to all the following rooms in the building:

- Kitchens;
- bathrooms (any room containing a bathtub, shower, spa, or similar source of moisture);
- toilets (a space containing one or more water closets or urinals); and

For each room, either the requirements on continuous local ventilation exhaust or on intermittent local ventilation exhaust should be met.

- Continuous Local Ventilation Exhaust

The local exhaust system should operate continuously and automatically, and meet the following minimum airflow rates:

- Kitchen: airflow of at least 5 air changes per hour
- Bathroom: airflow of at least 10 L/s
- Toilets: airflow of at least 10 L/s

- Intermittent Local Ventilation Exhaust

The local exhaust system should be designed to be operated as needed by the occupant and the following minimum air flow rates must be met:

- Kitchen: airflow of at least 50 L/s
- Bathroom airflow of at least 25 L/s
- Toilets: airflow of at least 25 L/s

Control of the exhaust can be a manual switch or an automatic control using occupancy sensor or humidity sensor. All sorts of controls can be accepted as long as it does not impede the occupant control.

The kitchen exhaust requirement can be met with either a ceiling or wall mounted exhaust fan or with a vented range hood.

Systems with multiple speeds and switches with a delayed shutoff function that continues the exhaust fan flow for a set time after the occupant leaves the bathroom can also be used.

Calculation

The minimum airflow rate for the continuous local ventilation exhaust in kitchen areas should be verified the following way:

- Measure the length, width and height of the room to calculate the volume of the room in m^3
- 5 air changes per hour is equivalent to an exhaust rate 5 times the volume of the room per hour.
- Verify that the capacity of the exhaust fan(s) in m^3/h is higher than 5 air changes per hour

In other configurations, simply install an exhaust fan with an airflow rate higher than requirements.

Submissions

Design stage

Ventilation in Wet Areas (Health and Comfort Credit 2)

- Table outlining every wet space along with each space's ventilation exhaust rate
- Calculations demonstrating that the requirements are met
- Tender schematic mechanical drawings showing location of the exhaust fans
- Inventory of proposed exhaust fans equipment

As-built stage

Ventilation in Wet Areas (Health and Comfort Credit 2)

- As-built schematic mechanical drawings showing location of the exhaust fans
- Manufacturer's data of the exhaust fans showing fan capacity
- Evidence of the exhaust fans installed, such as photographs, invoices, receipts, commissioning report, etc.

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission
- Final table outlining every wet space along with each space's ventilation exhaust rate
- Final Calculations demonstrating that the requirements are met
- Final inventory of proposed exhaust fans equipment

H-3 Hazardous Materials

Intent

To minimise the negative impacts of hazardous materials such as volatile organic compounds (VOCs) & Formaldehydes from building materials on occupant's health

Requirements

Criteria	4 Points
Specify and install products with low VOC and formaldehyde content. Choose one type of products from the following: 1) All flooring systems 2) all interior paint and coatings 3) all adhesives and sealants 4) all composite wood products	1
1 point for every additional type of product chosen with low VOC and formaldehyde content (Up to 4 types of product)	4

Overview

Hazardous Materials (Health and Comfort Credit 3)

Volatile organic compounds (VOCs) are organic origin gases emitted from certain solid or liquid materials. VOCs feature in a wide range of chemicals, including some that have short and long-term negative effects on human health. Concentrations of many VOCs are consistently higher indoors (up to ten times higher) than outdoors and can cause significant health problems for frequent occupants. VOCs are emitted from a variety of products (e.g. paints and lacquers, paint strippers, cleaning supplies, building materials and furnishings, office equipment such as copiers and printers, correction fluids and carbonless copy paper, graphics and craft materials including glues and adhesives, permanent markers, and photographic solutions).

Formaldehyde is an important chemical used widely by industry to manufacture building materials and numerous household products. Thus, it may be present in substantial concentrations in indoor environments. Sources of formaldehyde include building materials, smokes, household products, and the use of un-vented, fuel-burning appliances, like gas stoves or kerosene space heaters. The most significant sources of formaldehyde are likely to be pressed wood products made using adhesives that contain urea-formaldehyde (UF) resin or phenol-formaldehyde (PF) resin. Pressed wood products made for indoor use include: particleboard (used as sub-flooring and shelving and in cabinetry and furniture); hardwood plywood panelling (used for decorative wall covering and used in cabinets and furniture); and medium density fibreboard (used for drawer fronts, cabinets, and furniture tops). Medium density fibreboard contains a higher resin-to-wood ratio than any other UF pressed wood product and is generally recognised as being the highest formaldehyde-emitting pressed wood product.

Approach & Implementation

Hazardous Materials (Health and Comfort Credit 3)

Use products which are certified as low VOC and/or low Formaldehydes products by any internationally or regionally recognised authorities (e.g. Singapore Green Label, LEED, European standard organisation, ISO, etc.). Such products can be chosen from the following types:

- Flooring systems
- Paint and coatings
- Adhesives and sealants
- Composite wood products

Submissions

Design stage

Hazardous Materials (Health and Comfort Credit 3)

- Tender schedule of all the products classified in the categories (flooring systems, interior paint and coatings, adhesives and sealants and/or composite wood products) targeted for low VOC/low Formaldehydes content,
- Tender stage specification extracts indicating the VOC limits for each product -OR- Manufacturer's published data on any proposed low VOC/low Formaldehyde product with an indication that the product adheres to a recognised international standard for VOC/Formaldehyde content

As-built stage

Hazardous Materials (Health and Comfort Credit 3)

- For each product, Manufacturer's published data on any used low VOC/low Formaldehyde product with an indication that the product adheres to a recognised international standard for VOC/Formaldehyde content or with an indication showing a low VOC/low Formaldehyde content

- Evidence of low VOC/low Formaldehyde products installed such as photographs, invoices, receipts, commissioning report, etc.

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission
- Final schedule of all the products classified in the categories (flooring systems, interior paint and coatings, adhesives and sealants and/or composite wood products) targeted for low VOC/low Formaldehydes content

H-4 Daylighting

Intent

To encourage building designs which maximise the use of daylight

Requirements

Criteria	3 Points
50% of the net occupied area have an average daylight factor between 1.5% and 3.5%	1
1 point for every additional 15% of the net occupied area has an average daylight factor between 1.5% and 3.5% (Up to 80%)	3

Overview

Daylighting (Health and Comfort Credit 4)

Daylighting involves the introduction of natural light, as opposed to artificial light, into an occupied space. This increases building occupant comfort while reducing the energy required for lighting. When designing for natural light, designers must balance many factors, such as solar heat gain, glare, light availability, visual quality and occupant requirements.

The positioning of glazing should consider how to allow the largest ingress of natural light while minimising the solar heat gains. The use of glazing can provide less insulation resulting in higher energy costs. These costs can often be outweighed by the increase in productivity and comfort that occupants typically display in naturally lit areas.

Approach & Implementation

Daylighting (Health and Comfort Credit 4)

Natural light promoting designs strategies include:

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

Calculation

Daylighting (Health and Comfort Credit 4)

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):

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

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 fenestration (Table H.1)

t = Visible light transmission (Values of Table H.2 can be used if manufacturer's data is not available)

ρ = Average reflectance of surrounding room surfaces (recommended values in Table H.3 can be used)

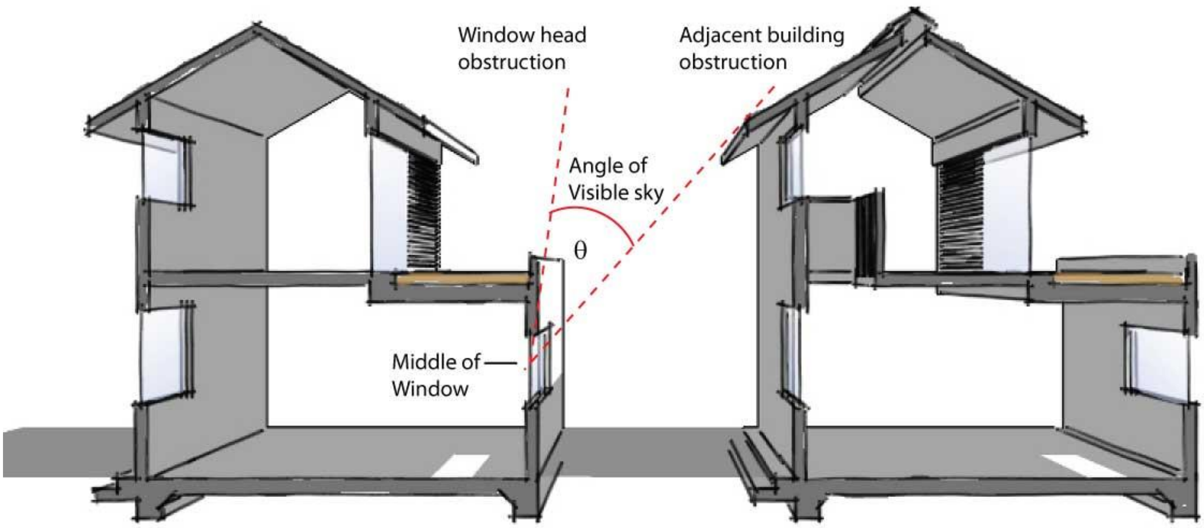

Figure H.1: Angle of visible sky from the mid-point of the window

Table H.1: 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.2: Visible light transmission (*S*ource: 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.3: 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

Design stage

Daylighting (Health and Comfort Credit 4)

- Daylight factor values from spreadsheet calculations or report indicating modelling software inputs and outputs
- Tender stage plans and elevations outlining net occupied areas, compliant areas and indicating all glazing and its size
- Calculations demonstrating compliance with the requirements

As-built stage

Daylighting (Health and Comfort Credit 4)

- As-built plans and elevations outlining net occupied areas, compliant areas and indicating all glazing and its size

If any deviation or addition to the design stage submission:

- Final as-built daylight factor values from calculations or final report indicating modelling software inputs and outputs
- Final as-built calculations demonstrating compliance with the requirements

H-5 Thermal Comfort

Intent

To encourage designs which achieve comfortable thermal conditions for occupants.

Requirements

Criteria	2 Points
To avoid overheating under hot summer conditions, 95% of the occupied spaces shall meet with one of the following requirements: • Air-conditioned and mixed-mode ventilated spaces: Air-conditioning system is designed to maintain an indoor operative temperature between 24°C to 26°C and a relative humidity below 70% during occupied hours. • Non air-conditioned spaces: Method 1: Spaces meet the requirements of Section 5.3 of ASHRAE 55-2004 with indoor operative temperature at design conditions in the 80% acceptability limits. -OR- Method 2: Spaces comply with at least 1 strategy in each of the three following categories: A. Indoor air velocity B. Reduction of external (solar) heat gains C. Reduction of internal heat gains	2

Overview

Thermal Comfort (Health and Comfort Credit 5)

Human thermal comfort is the condition of mind that expresses satisfaction with the thermal environment. It is a combination of a subjective sensation (how we feel) and several objective interaction with the environment (heat and mass transfer rates). Factors directly affecting thermal comfort are then both personal factors (metabolic rate and clothing level) and environmental factors (air temperature, radiant temperature, air speed and humidity).

Operative temperature (which can be defined as the average of the mean radiant and ambient air temperatures) describes combined effects of convective and radiant heat transfer. It is used in ASHRAE 55 – Thermal Environmental Conditions for Human occupancy and other standards as a means to assess thermal comfort.

Approach & Implementation

Thermal Comfort (Health and Comfort Credit 5)

Air-conditioned spaces and mixed-mode ventilated spaces:

Design the building and air-conditioning systems to employ the following strategies can help achieve this credit:

- Effective building envelope (cf credit E-2)
- Properly designed efficient air-conditioning system
- 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, artificial lighting, equipment, occupancy, etc.).

95% of occupied spaces in the building need to comply with at least 1 strategy in each of the three following categories to achieve this credit:

A. Enhance indoor air velocity
   - Meet requirements of strategy A-2 of credit E-3; or
   - Install ceiling or wall fans with at least one fan for every 20m^2

B. Reduction of external (solar) heat gains
   - Install effective external shadings on all fenestrations of the space to control radiant temperature; or
   - Limit solar radiation on opaque walls and roofs: 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
   - Reduce Lighting Power Density of the space by more than 30% compared to Table 3.5.1 of the Energy Performance Calculation Method; or
   - Install 50% of all the equipment and appliances installed have an energy label; or
   - Optimise daylighting (and thus limit the use of internal artificial lighting): average daylight factor is between 1.5% and 3.5%

Calculations

Thermal Comfort (Health and Comfort Credit 5)

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%.

The building energy simulation performed in the scope of the Credit E-1 shall be used 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: The following calculations should be realised for each occupied space:

A. Indoor air velocity
   - 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).

B. Reduction of external (solar) heat gains
   - The effectiveness of the external shadings installed on windows shall be demonstrated using the passive design analysis realised for the prerequisite E-PR-1

C. Reduction of internal heat gains
   - LPD reduction: LPD value of the space should be calculated following explanations in credit E-4. This value should be compared with the LPD value of the same space type in Table 3.5.1 of the Energy Performance Calculation Method in order to calculate the percentage of LPD reduction.
   - Calculate the percentage of equipment installed (based on power ratings) that meet the requirements of any recognised energy label: Energy Star, VNEEP (minimum 4 stars), etc.
   - Calculations in accordance with credit H-4 on daylighting to demonstrate the daylight factor of the space is between 1.5% and 3.5%. Unlike in credit H-4, spaces with a daylight factor higher than 3.5% and using internal manual shadings are not compliant with this method.

Submissions

Design stage

Thermal Comfort (Health and Comfort Credit 5)

Air-conditioned spaces and mixed-mode ventilated spaces:

- Report using inputs/outputs of the building energy simulation showing the temperature and humidity setpoints used and the number of unmet load hours.

Non-air-conditioned spaces:

If method 1 is followed:

- 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:

- Calculations showing compliance with the strategies pursued to limit heat gains and to enhance air velocity.
- Narrative demonstrating that the strategies implemented effectively improve thermal comfort in the non-air-conditioned spaces.

As-built stage

Thermal Comfort (Health and Comfort Credit 5)

Air-conditioned spaces and mixed-mode ventilated spaces:

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission
- Final report using inputs/outputs of the building energy simulation showing the temperature and humidity setpoints used and the number of unmet load hours.

Non-air-conditioned spaces:

If method 1 is followed and any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission
- 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 and any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission
- Final calculations showing compliance with the strategies pursued to limit heat gains and to enhance air velocity.
- Final narrative demonstrating that the strategies implemented effectively improve thermal comfort in the non-air-conditioned spaces. This can include a survey of the building occupants if the building has been occupied during one hot season.

H-6 Noise Insulation

Intent

To ensure a proper level of acoustic insulation within buildings.

Requirements

Criteria	1 Point
Design all walls and floors to comply with the requirements of TCXDVN 277:2002 on airborne and impact sound insulation for all classes	1

Overview

Noise Insulation (Health and Comfort Credit 6)

Noise levels largely affect the health and productivity of occupants. TCXDVN 277-2002 - Sound insulation standards of building elements between rooms - sets forth a minimum requirement on sound insulation in residential buildings (see Table H.4). CK^{tc} index is equivalent to the weighted noise reduction index (Rw) and CV^{tc} is equivalent to the weighted normalised impact level (Ln,w). The standard introduces classes for defining wall and floor insulation requirements depending on the types of rooms they divide (see Table H.5).

Table H.4: Minimum requirements for airborne and impact sound insulation of building elements between rooms (Source: TCXDVN 277-2002)

Class	Airborne Sound Insulation	Impact Sounds Insulation
Class I	$CK^{tc} \geq 55$	$CV^{tc} \leq 58$
Class II	$CK^{tc} \geq 50$	$CV^{tc} \leq 62$
Class III	$CK^{tc} \geq 45$	$CV^{tc} \leq 66$

Table H.5: Definition of floor and walls included in the noise classes of TCXDVN 277-2002.

Class	Definition
Class I	Elements requiring good sound insulation: Floor and walls separating bedrooms or studies from a space containing noisy equipment or services
Class II	Elements requiring medium sound insulation: Floor and walls of bedrooms and living rooms between units; Floor and walls separating bedrooms or living rooms with kitchens, toilets and stairs
Class III	Elements requiring low sound insulation: Walls between rooms of the same unit

Approach & Implementation

Noise Insulation (Health and Comfort Credit 6)

The TCVN standard outline many strategies which can be applied. Reduction of noise inside and outside of the building should be considered but not be limited to the following strategies:

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

Calculation

Noise Insulation (Health and Comfort Credit 6)

The calculations shall be made according to:

- ISO 717-1 – Rating sound insulation in buildings and of building elements. Part 1: Airborne Sound Insulation
- ISO 717-2 – Acoustics – Rating sound insulation in buildings and of building elements. Part 2: Impact Sound Insulation

Submissions

Design stage

Noise Insulation (Health and Comfort Credit 6)

- Report detailing the design strategies and technologies employed to ensure the proper level of acoustic insulation
- Tender schedule of the following:
  - All mechanical equipment proposed and all relevant noise sources indicating the noise level

- All designed floor and walls classes as for requirements in TCXDVN 277-2002 indicating the acoustic treatment
- Tender stage plans indicating the following:
  - Location of mechanical equipment proposed
  - Designed floor and wall classes, as for requirements in TCXDVN 277-2002
- Tender stage detailed sections of all the classes of floor and walls, as well as their junctions
- Tender stage specification extracts -OR- Manufacturer's published data for the following:
  - All mechanical equipment listed indicating sound levels
  - Materials and systems proposed to ensure the proper level of acoustic insulation, indicating their acoustic properties
- Calculations demonstrating compliance with the requirements

<u>As-built stage</u>

Noise Insulation (Health and Comfort Credit 6)

- As-built plans indicating the following:
  - Location of mechanical equipment installed
  - Floor and walls classes as for requirements in TCXDVN 277-2002
- As-built detailed sections of all the classes of floor and walls, as well as their junctions
- Manufacturer's published data for the following:
  - All mechanical equipment installed indicating sound levels
  - Materials and systems installed to ensure the proper level of acoustic insulation, indicating their acoustic properties
- Evidence that the acoustic insulation technologies and strategies were employed such as photographs, invoices, receipts, commissioning report, etc.

If any deviation or addition:
- Describe and highlight the deviations or additions to the design stage submission
- Final report detailing the design strategies and technologies employed to ensure the proper level of acoustic insulation
- Schedule of the following:
  - All mechanical equipment installed and all relevant noise sources indicating the noise level
  - All as-built floor and walls classes, as for requirements in TCXDVN 277-2002 indicating the acoustic treatment
- Final as-built calculations demonstrating compliance with the requirements

Adaptation & Mitigation

Climate change is widely accepted as being among the greatest challenges to face the human race this century. Today, the term climate change is usually used with regard to changes in global climate, which result from human activities. From the industrial revolution until today, we have been increasingly relying on fossil fuels as our main source of energy. The process of burning fossil fuels for energy has resulted in the release of large amounts of carbon dioxide into the atmosphere. The increasing concentration of carbon dioxide in the atmosphere changes the radiation balance of the earth, increasing the greenhouse effect and leading to global warming. The impacts of climate change can now be seen in the form of stronger and more frequent storms, frequent flooding and drought, sea level rise, and other extreme weather phenomena.

Although developed countries are responsible for 80% of Greenhouse Gas (GHG) emissions globally, it is the poorer developing countries which will face most of the impacts from climate change. In the first part of the century, it has been predicted that Vietnam will be one of the five countries most affected by climate change. In response to the severity of the situation, the government has issued guidance to all related sectors, instructing immediate preparation in response to climate change. However, current Vietnamese buildings built with conventional construction practices are susceptible to damage from flooding, storms and earthquakes. Therefore, it is crucial for buildings to start incorporating design strategies and technologies to improve resilience to natural disasters and maximise life span. The new technologies and designs will help occupants to adapt to the impacts of climate change, in particular, protecting them from associated natural disasters.

All credits within the Adaptation & Mitigation Category of LOTUS MFR target the building's resistance towards natural disasters and the reduction of GHG emissions. A green building has to account for all possible disasters such as flooding, inundation, storms, etc., and has to prepare comprehensive strategies to ensure the safety of occupants. At the same time, it should alleviate its own impacts on climate change by increasing the perviousness of the site and reducing the amount of paved surface that contributes to the heat island effect. It should also reduce the consumption of fossil fuels required for transport by inhabitants, throughout the life of the building.

Adaptation & Mitigation		10 Points
Item	Criteria	Points
A-1	Flooding Resistance	1 point
	Prepare a local flood risk report for the site	A&M Prerequisite 1
	Building design resists current highest flood level	1
A-2	Stormwater Runoff	2 points
	Average perviousness of the site is at least 30%	1
	Average perviousness of the site is at least 50%	2
A-3	Heat Island Effect	2 points
	30% of the paved and roof area limits the heat island effect	1
	50% of the paved and roof area limits the heat island effect	2
A-4	Green Transportation	3 points
	Provide and display building occupants with information on the different collective transportation means to travel to and from the building	A&M Prerequisite 2
	1 point for every of the following strategies implemented on the project: A. Provide bicycle parking spots for 15% of building residents B. Situate the building within a 500 m walking distance from one public transportation route OR within a 700 m walking distance of 2 different public transportation routes C. Provide private buses that are able to transport 10% of residents D. Install electric vehicle charging stations for 5% of the total vehicle parking capacity of the site E. Set up a collective transportation program	3
A-5	Local Materials	2 points
	Local material contents account for 30% of all building materials	1
	Local material contents account for 50% of all building materials	2

A-1 Flood Resistance

Intent

To encourage flood resistant designs and building features to adapt to climate change

Requirements

Criteria	1 Point
Prepare a local flood risk report for the site	A&M Prerequisite 1
Building design resists current highest flood level	1

Overview

Flood Resistance (Adaptation and Mitigation Prerequisite 1 and Credit 1)

Flooding is one of the biggest problems for urban areas as it causes severe damage to communities, buildings and the local economy. It is expected that flooding frequency and intensity will increase dramatically due to the impacts of climate change. In addition, the rapid growth of both Vietnam's economy and population has contributed to a great pressure on its aging and inadequate infrastructure system. Drainage systems in highly populated cities are seasonally overloaded and natural drainage systems are gradually disappearing in the rapid expansion of population and urban structures.

Currently flood hazard mapping is very limited in Vietnam but there will be increasing availability of useable maps over the next few years as research in this area grows in popularity amongst universities as well as the government.

Approach &Implementation

Flood Resistance (Adaptation and Mitigation Prerequisite 1)

A local flood risk report shall be prepared including the following information:

- A Flood map, if available, identifying whether the selected site is within flood prone area
- All relevant published data from local hydrometeorology institutes or other qualified organisations including:
    - Precipitation/rainfall level and history
    - Local history of storms

- Tropical low pressure and flooding
- Predicted climate change impacts like increased storm frequency or sea level rise

- A local flood survey must be conducted through collecting experiences and opinions of local communities and authorities regarding flooding in the past 15 years. Upon analysis of the collected information future flooding patterns can be predicted. The following information must be collected:
    - Local flood condition type(s)
    - Average and highest frequency per year
    - Annual flood peaks
    - Average and highest intensity/water height
    - How long the area remains flooded after all inputs halt
    - Existing flood hazards
    - Main cause(s) of flooding
- Potential flood damage to buildings
- Flooding trend for the next 50 years and worst-case scenario

Flood Resistance (Adaptation and Mitigation Credit 1)

The following are examples of strategies which can be employed to increase a building's ability to resist flood damage:

- Elevate buildings above the predicted flood level by piers, piles, columns or bearing walls
- Flood-proof the lower levels of buildings by sealing them against water penetration
- Employ wet flood-proofing methods
- Arrange all mechanical and electrical equipment in water-tight units or higher than the highest predicted flood level in the building
- Install water resistant and easy-to-clean materials for lower floors

Submissions

Design stage

Flood Resistance (Adaptation and Mitigation Prerequisite 1)

- Provide a local flood risk report including:
    - Flood map
    - Relevant published data
    - Local flood survey
    - Potential flood damage to buildings

Flood Resistance (Adaptation and Mitigation Credit 1)

- Tender stage plans indicating the flood resistance factors and strategies employed

As-built stage

Flood Resistance (Adaptation and Mitigation Credit 1)

- As-built plans indicating the flood resistance factors and strategies employed
- Evidence that the flood resistance factors and strategies were employed such as photographs, commissioning report, etc.

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission

A-2 Storm Water Runoff

Intent

To improve perviousness of site surfaces, thus reduce temporary load to municipal drainage system and improve groundwater recharge

Requirements

Criteria	2 Points
Average perviousness of the site is at least 30%	1
Average perviousness of the site is at least 50%	2

Overview

Storm Water Runoff (Adaptation and Mitigation Credit 2)

Storm water runoff is the water created during precipitation events which is then fed into sewer or river systems. All precipitation that falls on surfaces within the building's site boundary is considered to be storm water runoff.

Reducing storm water runoff reduces the site's contribution to downstream flooding. This is increasingly important as high intensity precipitation resulting from climate change threatens to increase flood levels and flooding frequency. The reduction of storm water runoff quantity and/or the improvement of its quality will reduce the amount of pollutants washed into water bodies.

One way to maximise site perviousness is to minimise hard surfaces and where hard surfaces are required, use pervious surface materials that allow water to pass through them. These strategies allow the site to take advantage of the infiltration capacity of the native soil. This is critical in minimising the impact on ground water quantity and quality, and reducing local flooding. Moreover, this strategy also prevents soil erosion.

Approach & Implementation

Storm Water Runoff (Adaptation and Mitigation Credit 2)

The most effective strategy to control storm water runoff quantity and quality is to increase the permeability of outside areas, and to restore the site's natural functions. Strategies to increase the site perviousness include:

- Minimise hardscape areas
- Use permeable hardscaping materials for driveways, parking lots and walkways such as:
    - Permeable paving blocks
    - Porous asphalt
    - Unbound gravel
    - Wood
    - Mulch
    - Brick, cobbles or natural stone arranged to promote infiltration
- Landscaping that diverts water from impervious areas to pervious areas, such as gardens and lawns, before leaving the site
- Use of vegetated swales, biofiltration swales, wetlands, dry wells and rain gardens improving water quality and infiltration
- Retention and detention ponds
- Green roofs

Calculation

Storm Water Runoff (Adaptation and Mitigation Credit 2)

The calculation shall take into account the entire site, less the area of any building footprint not covered by a green roof. Use the following method to determine the perviousness of the site:

- Quantify site area not occupied by a building
- Identify the area of each type of hardscaping or landscaping used
- Identify the runoff coefficient of each type of hardscaping or landscaping used
- Calculate average site perviousness using the following formula:

$$\text{Site Perviousness } [\%] = \frac{\sum A_i \times (1 - C_{i\text{-}})}{A_{site}} \times 100$$

A_i = Area of space n [m^2]

C_i = Run-off coefficient of covering material for space i

A_{site} = Total site area minus building footprint(s) not covered by green roof [m^2]

Runoff coefficients in Table A.1 should be used for the average site perviousness calculation unless manufacturer's published data is available for a specific surface material.

Table A.1: Runoff Coefficients of different surface

Character of surface	Runoff Coefficient
Pavement	
Roofs	0.92
Asphalt	0.90
Brick pavers	0.80
Concrete	0.92
Gravel (unbound)	0.7
Permeable pavers	0.5
Gardens and trees	
Garden bed/rain garden	0.15
Forest/dense vegetation	0.1
Agricultural land	0.4
Lawns (grass covers less than 50% area)	
Average slope 1-2%	0.44
Average slope 2-7%	0.49
Average slope >7%	0.52
Lawns (grass covers more than 50% area)	
Sandy soil, 0-2%	0.1
Sandy soil, 2-7%	0.15
Sandy soil, <7%	0.2
Heavy soil, 0-2%	0.15
Heavy soil, 2-7%	0.2
Heavy soil, <7%	0.25

Source: TCVN 7957:2008, American Society of Civil Engineers

Submissions

Design stage

Storm Water Runoff (Adaptation and Mitigation Credit 2)

- Tender stage site plan indicating all types of hardscape/landscape areas and materials proposed
- If runoff coefficients other than those from Table A.1 have been used, submit manufacturer's data or logical justification indicating runoff coefficients used.
- Calculations indicating adherence to the credit requirements

As-built stage

Storm Water Runoff (Adaptation and Mitigation Credit 2)

- As-built site plan indicating all types of hardscape/landscape areas and materials installed
- Photographs showing strategies for the onsite control and treatment of storm water runoff

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission
- Final calculations indicating adherence to the credit requirements
- If runoff coefficients other than those from Table A.1 have been used, submit manufacturer's data or logical justification indicating runoff coefficients used

A-3 Heat Island Effect

Intent

To minimise heat island effect and to reduce the impact of the built environment on microclimates, as well as human and wildlife populations

Requirements

Criteria	2 Points
30% of the paved and roof area limits heat island effect	1
50% of the paved and roof area limits heat island effect	2

Overview

Heat Island Effect (Adaptation and Mitigation Credit 4)

A microclimate is a local atmospheric zone that has distinct characteristics relative to its adjacent areas. Built environments can alter existing microclimates if their materials absorb and reradiate solar energy more than pre-existing and surrounding environments. This change in microclimate is known as the urban heat island effect (Figure A.1).

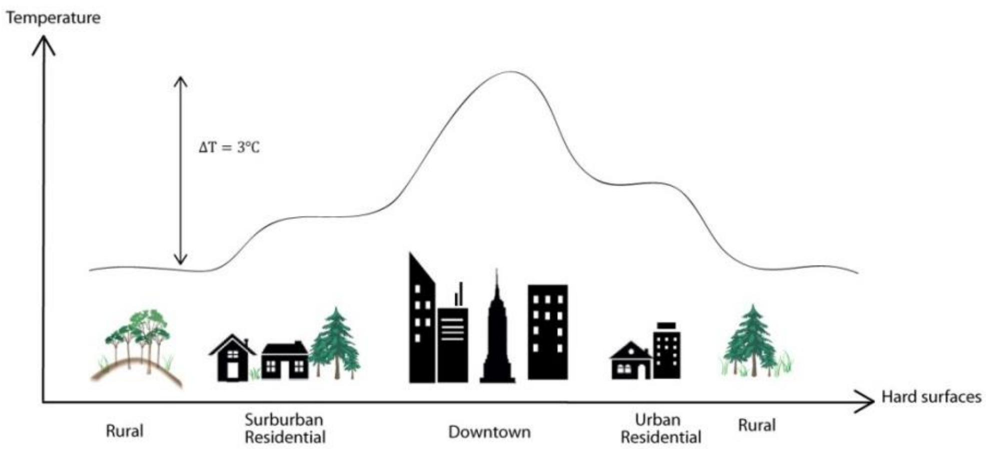

Figure A.1: Heat island effect

It occurs when the temperature gets warmer in urban landscapes than rural areas and it can cause detrimental effects on air quality, energy consumption and human health. Urban heat islands occur when surfaces made of brick, concrete and asphalt (such as streets, sidewalks, parking lots and buildings), retain the solar energy and reradiate that heat back into the surrounding atmosphere.

Approach & Implementation

Heat Island Effect (Adaptation and Mitigation Credit 4)

Reducing the heat island effect can be achieved by using design strategies below:

- Open grid pavement systems to reduced paved areas (at least 50% pervious)
- Shading devices with solar reflectance index (SRI) higher than 29 or Shading from existing trees canopy or within 10 years of landscape installation (shades must cover paved or roof areas)
- Paving materials with SRI higher than 29
- Roofing materials with SRI higher than 78 for low sloped roof (i.e. less than 2:12 rise over run) and 29 otherwise.
- Green roofs
- Solar panels

Calculation

Heat Island Effect (Adaptation and Mitigation Credit 4)

Calculation is based on paved and roof area. All areas on site that are paved or covered so that natural soil is not exposed to natural light are counted as paved area. The strategies listed in the Approach & Implementation constitute the exhaustive list of surfaces considered as limiting heat island effect. Areas covered with mechanical equipment should be deducted from the roof area.

Percentage of area that limits heat island effect can be calculated by the following method:

- Quantify total site's paved and roof area
- Quantify surfaces considered as limiting heat island effect.
    - For the shading devices, the area to consider is the area of the device as it can be seen from above.
    - For trees, shade must be calculated at 10 a.m., 12 noon, and 3 p.m. on the summer solstice. The arithmetic mean of the 3 values will be used as the effective shaded area. For simplification, 1 m^2 per tree can also be considered.
    - For the other surfaces considered as limiting heat island effect, the area to consider should be equal to their actual areas.
- Quantify areas that should be deducted from the total paved and roof area
- Demonstrate amount of surfaces limiting heat island effect with the following formula:

$$\text{Limiting Heat Island Effect Surface [\%]} = \frac{A_{low}}{A_{total\ paved\ +\ roof\ area}} \times 100$$

A_{low}= Area limiting heat island effect [m^2]

$A_{total\ paved\ +\ roof\ area}$ = Sum of the roof area and total site's paved area minus deducted areas [m^2]

Submissions

Design stage

Heat Island Effect (Adaptation and Mitigation Credit 4)

- Tender stage site plan indicating landscape, paved and roof areas as well as materials proposed for those areas
- Tender stage specification extracts -OR- Manufacturer's published data indicating SRI value of all proposed materials -OR- SRI value of materials (data must be from a VGBC approved source)
- Calculations demonstrating compliance with the requirements

As-built stage

Heat Island Effect (Adaptation and Mitigation Credit 4)

- As-built stage site plan indicating landscape, paved and roof areas as well as materials installed in those areas
- Manufacturer's published data indicating SRI value of all materials installed -OR- SRI value of materials (data must be from a VGBC approved source)
- Evidence of the materials installed, such as photographs, invoices, receipts, commissioning report, etc.

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission
- Final as-built calculations demonstrating compliance with the requirements

A-4 Green Transportation

Intent

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

Requirements

Criteria	3 Points
Provide and display building occupants with information on the different collective transportation means to travel to and from the site	A&M Prerequisite 2
1 point for every of the following strategies implemented on the project: A. Provide covered and secured bicycle parking spaces for 15% of residents B. Situate the building within a 500 m walking distance from one public transportation route OR within a 700 m walking distance of 2 different public transportation routes C. Provide private buses that are able to transport 10% of residents D. Install electric vehicle charging stations for 5% of the total vehicle parking capacity of the site E. Set up a collective transportation program	3

Overview

Green Transportation (Adaptation and Mitigation Prerequisite 2 and Credit 4)

Green transport refers to modes of transport that have a low impact on the environment. The most common forms of green transport include walking, cycling and catching public transport. It is important to promote green transport alternatives as motor vehicles in general, and private motor vehicles (cars and motor bikes) in particular, are responsible for many forms of pollution. Exhaust fumes emitted when motor vehicles burn fuel cause local air pollution in cities and contribute to global warming. In addition, a significant amount of energy is required to build vehicles and their supporting infrastructure such as roads and car parks.

Taking into account the current urban traffic situation, demography and urbanisation forecasts, Vietnam is set to have substantial challenges developing efficient and low carbon urban transportation systems in the future.

The prerequisite aims at ensuring that the utilisation of collective transportation is promoted effectively within the building. And the credit rewards buildings in which a number of strategies have been implemented to encourage occupants to use green commuting options to get to and from the building, thus reducing private motor vehicle usage. This reduces congestion, air pollution and CO_2 emissions generated from occupants travelling to and from the site.

Approach & Implementation

Green Transportation (Adaptation and Mitigation Prerequisite 2)

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

Green Transportation (Adaptation and Mitigation Credit 4)

Implement some of the following strategies to encourage the use of green transport:

A. Provide covered and secured bicycle parking spaces for 15% of residents.
B. Situate the building within a 500 m walking distance from one public transportation route OR within a 700 m walking distance of 2 different public transportation routes
C. Provide private buses that are able to accommodate 10% of residents.
D. Install electric vehicle charging stations for 5% of the total vehicle parking capacity of the site.
E. Set up a collective 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): organising 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

Green Transportation (Adaptation and Mitigation Credit 4)

- Strategy A: Required number of bicycle parking spaces

Calculation is based on number of occupants. Capacity of bicycle parking spaces shall be calculated as follows:

- Quantify number of building occupants at peak period
- Demonstrate capacity of parking and showering facilities with the following formula:

$$\text{Number of parking spots} = \text{N}_\text{P} \times 0.15$$

N_P =Number of building occupants at peak period

- Strategy C: Provision of 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:

$$\text{Number of bus seats } = \text{N}_\text{T} \times 0.1$$

N_T = Total number of residents

- Strategy D: Required number of electric vehicle charging stations

Calculation is based on number of parking spaces. Number of electric vehicle charging stations shall be calculated as follows:

- Quantify total vehicle parking capacity
- Demonstrate quantity of electric vehicle charging stations with the following formula:

$$\text{Number of electric vehicle charging stations } = \text{T} \times 0.05$$

T = Total vehicle parking capacity (total number of parking spaces for cars and motorbikes)

Note: Non-integer values shall be rounded up. The minimum number of parking spots, showers and electric vehicle charging stations to be eligible to obtain points is 1.

Submissions

Design Stage

Green Transportation (Adaptation and Mitigation Prerequisite 2)

- Plans indicating location of collective transport information
- Letter of intent from owner indicating that the information will be maintained (if possible)

Green Transportation (Adaptation and Mitigation Credit 4)

Strategy A:

- Plans indicating location, size and capacity of parking
- Calculations demonstrating compliance with the requirements

Strategy B:

- Plans or maps indicating location of public transport stops within a 500 m or a 700 m walking distance of the site.
- Documentation indicating the number of public transport routes by which the stops are serviced

Strategy C:

- Report indicating proposed schedule, number of vehicles and estimated capacity of private collective transport system
- Plans or maps indicating location of private buses stops on the site and proposed routes of private collective transport systems
- Calculations demonstrating compliance with the requirements

Strategy D:

- Plans indicating location of the electric vehicle charging stations
- Calculations demonstrating compliance with the requirements

Strategy E:

- Report describing the collective transportation program with the different services and incentives planned to be implemented and how these services and incentives will encourage the building occupants to favour green mode of transports over motorized private transports.
- Letter of intent from building owner/developer committing to implement collective transportation program.

As-built Stage

Green Transportation (Adaptation and Mitigation Prerequisite 2)

- As-built plans indicating location of public transport information
- Photographs showing that the information is maintained

Green Transportation (Adaptation and Mitigation Credit 4)

Strategy A:

- As-built plans indicating location, size and capacity of parking
- Photographs of the parking and showering facilities

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission
- Final as-built calculations demonstrating compliance with the requirements

Strategy B:

- Final plans or maps indicating location of public transport stops within a 500 m or a 700 m walking distance of the site.
- Final documentation indicating the number public transport routes by which the stops are serviced

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission

Strategy C:

- Final plans or maps indicating location of private buses stops on the site and proposed routes of private collective transport systems
- Evidence showing the implementation of a private collective transport system, such as photographs, contracts with a bus company, invoices etc.

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission
- Final report indicating proposed schedule, number of vehicles and estimated capacity of private collective transport system
- Final calculations demonstrating compliance with the requirements

Strategy D:

- As-built plans indicating location of the electric vehicle charging stations
- Photographs of the electric vehicle charging stations in the parking

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission
- Final calculations demonstrating compliance with the requirements

Strategy E:

- Final report describing the collective transportation program with the different services and incentives implemented and how these services and incentives succeeded to make building occupants use green mode of transports over motorized private transports.
- Evidence showing the implementation of a collective transportation program, such as photographs, building policies, receipts, etc.

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission

A-5 Local Materials

Intent

To encourage the use of locally produced materials to minimise carbon footprint and promote the local industry

Requirements

Criteria	2 Points
Local material contents account for 30% of all building materials	1
Local material contents account for 50% of all building materials	2

Overview

Local Materials (Adaptation and Mitigation Credit 5)

The production, use and disposal of building materials account for a large proportion of negative environmental impacts. Material selection should be well considered and be from reused, recycled or sustainable sources. Furthermore, use of materials that are manufactured locally is encouraged; reducing environmental impacts resulting from long distance transportation whilst supporting the local economy.

Approach & Implementation

Local Materials (Adaptation and Mitigation Credit 5)

All building materials or products are considered, excluding mechanical, electrical and plumbing equipment such as HVAC systems, water fixtures, elevator systems, etc.

The integration of local materials should be considered during the early design stages. It must be ensured that materials specified during design are those installed during construction.

Calculation

Local Materials (Adaptation and Mitigation Credit 5)

Three types of local materials are considered for calculations:

- M1, which represents the materials that are extracted, harvested and manufactured locally in Vietnam. To be considered as such, a material must either:
  - have been extracted, harvested and manufactured within a 500 km radius of the project site.
  - or have been extracted, harvested and manufactured within a 500 km total transportation distance of the project site using a weighted average.

- M2, which represents the materials that are manufactured locally in Vietnam. To be considered as such, a material must either:
  - have been manufactured within a 500 km radius of the project site.
  - or have been manufactured within a 500 km total transportation distance of the project site using a weighted average.

- M3, which represents the materials that have been reused or salvaged locally in Vietnam. To be considered in the credit, a material must either:
  - have been salvaged within a 500 km radius of the project site.
  - or have been salvaged within a 500 km total transportation distance of the project site using a weighted average.

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

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

Percentage of local material contents should be calculated by the following method:

- Quantify cost of required materials
- Quantify cost of local materials
- Demonstrate amount of local material with the following formula:

$$Local\ Material\ contents\ [\%] = \frac{C_1 + 0.5 \times C_2 + C_3}{C_{tot}} \times 100$$

C_1 = Cost of local materials M1 [VND]

C_2 = Cost of local materials M2 [VND]

C_3 = Cost of local materials M3 [VND]

C_{tot} =Total cost of building materials [VND]

Table A.2: Example of Local Material Calculation

Building Materials	Local Material type	Cost of Material (1000vnd)	C_1, C_3 or 0.5 x C_2 (1000vnd)
Cement	M1	30,000	30,000
Sand	M1	15,000	15,000
Gravel	M1	8,000	8,000
Brick	M3	25,000	25,000
Rebar	M2	55,000	27,500
Steel	M2	33,000	16,500
Others	Not local	34,000	0
Total		200,000	122,000
Local Material Contents		61%	

Submissions

Design stage

Local Materials (Adaptation and Mitigation Credit 6)

- Tender stage specification extracts -OR- Manufacturer's published data -OR- Signed letter from the manufacturer indicating origin of materials
- Table showing all local materials and indicating either location in a 500km radius from project site or total transportation distance to the project site
- Bill of quantities -OR- Estimated cost detailing the cost of all materials required in the project and the cost of all materials from local sources
- Calculations demonstrating compliance with the requirements

As-built stage

Local Materials (Adaptation and Mitigation Credit 6)

- Manufacturer's published data -OR- Signed letter from the manufacturer indicating origin of material
- Bill of quantities detailing the cost of all materials required in the project and the cost of all materials from local sources
- Evidence of the local materials installed, such as photographs, invoices, receipts, etc.

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission
- Final as-built calculations demonstrating compliance with the requirements
- Final table showing all local materials and indicating either location in a 500km radius from project site or total transportation distance to the project site

Community

The undertaking of a construction project within an existing built environment impacts the surrounding community. The selection of the project site can have significant effects on the development of the surrounding community. Especially large-scale projects in rural areas of Vietnam are usually followed by rapid establishment or development of communities in the area. Although this development helps create more jobs and sometimes raises the living standard of nearby communities, it often increases carbon footprints to undeveloped areas as well as causing other damage.

Credits within the Community Category of LOTUS aim to maximise the benefits to the community and minimise the negative impacts of development to the community. Situating the building near basic services will help the building to increase the level of connectivity between the built environment and the local population. At the same time, it avoids further development around the building as well as unnecessary travelling to and from the building, which in turn prevents increasing the carbon footprint.

All buildings are to comply with Vietnam's legislation to provide convenient access for people with disability. Barrier-free design principles ensure age, physical ability or any other characteristic is not a limiting factor for use of the built environment. Moreover, a green building should provide open spaces for the building occupants and community members to utilize, and to further increase integration. This is important to ensure the built environment meshes organically with the existing human and wildlife populations of the area. Finally, it fits in with the concept of sustainable development, where the society, the economy and the environment develop in harmony.

Community		6 Points
Item	Criteria	Points
CY-PR-1	Access for People with Disabilities	PR
	Building must meet the QCVN 10:2014/BXD requirements	Community Prerequisite 1
CY-1	Community Connectivity	2 points
	There are 5 different basic services in 500m walking distance from the site	1
	There are 10 different basic services in 500m walking distance from the site	2
CY-2	Public Space	2 points
	5% of the site area is public space	1
	10% of the site area is public space	2
CY-3	Outdoor communal facilities for residents	2 points
	Provide 2 outdoor communal facilities for residents	1
	Provide 4 outdoor communal facilities for residents	2

CY-PR-1 Access for People with Disabilities

Intent

To promote access for people with disabilities to every portion of all building types

Requirements

Criteria	PR
Buildings meet the QCVN 10:2014/BXD requirements	Community Prerequisite 1

Overview

Access for People with Disabilities (Community Prerequisite 1)

People with Disabilities (PWD) are people with mobility and sight impairment. Providing access for PWD is a significant task to ensure social justice. According to statistics, 15.3% of Vietnam's population lives with a disability (National Coordinating Council on Disabilities, 2013). This is not a diminutive figure, thus ensuring basic comfort for the disabled to get access to buildings safely and conveniently is even more noteworthy for any construction project. Sharing the same point of view, the Ministry of Construction promulgated the Regulation QCVN 10:2014/BXD "National Technical Regulation on Construction for Disabled Access to Buildings and Facilities". LOTUS Residential projects are required to meet the requirements of the regulation.

Approach & Implementation

Access for People with Disabilities (Community Prerequisite 1)

Design of the project must comply with the requirements of the mandatory regulation QCVN 10:2014/BXD.

Submissions

Design stage

Access for People with Disabilities (Community Prerequisite 1)

- Report describing how the building design meets the requirements in QCVN 10:2014/BXD detailing all the measures taken to ensure barrier free access to the building

- Tender stage floor and site plans indicating the location of ramps and any other form of increased accessibility, in adherence to QCVN 10:2014/BXD
- If available, tender stage specification extracts identifying tactile, signage and other disability aids

As-built stage

Access for People with Disabilities (Community Prerequisite 1)

- As-built floor and site plans indicating location of ramps and any other form of increased accessibility, in adherence to QCVN 10:2014/BXD
- Evidence showing explanatory signage and the measures taken to ensure barrier free access to the building in adherence to QCVN 10:2014/BXD, such as photographs, commissioning report, etc.

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission

CY-1 Community Connectivity

Intent

To encourage developments to access existing amenities, infrastructure and services

Requirements

Criteria	2 Points
There are 5 different basic services in 500m walking distance from the building	1
There are 10 different basic services in 500m walking distance from the building	2

Overview

Community Connectivity (Community Credit 1)

A new building will connect with the community more readily if it is situated close to local amenities sufficient to provide for basic needs of the users of the building. Nearby basic services are not only convenient for the building occupants but also lessen the need for motorised transportation to and from the building. Moreover, it prevents the development of services around the building, which can cause impacts on surrounding undeveloped land.

Approach & Implementation

Community Connectivity (Community Credit 1)

Preference is given to construction or renovation of a building within an existing urban area with pedestrian access to a variety of basic services.

Basic services include, but are not limited to those listed in Table CY.1.

Table CY.1: Basic services

1. Bank	10. Laundry	19. Restaurant/Coffee shop
2. Beauty/Hairdresser	11. Library	20. School
3. Cleaners	12. Hospital/Clinic/Dental/Optician	21. Senior care facility
4. Community centre	13. Museum	22. Supermarket
5. Convenience grocery	14. Playground/Park	23. Art/Entertainment center
6. Day care	15. Pharmacy	24. Electronic Repair Shops/Vehicle Repair Shops
7. Fitness center/Sport center/Swimming pool	16. Place of worship	25. Police station
8. Fire station	17. Post Office	26. Bookstore
9. Petrol Station	18. ATM	27. Wet market

Submissions

Design stage

Community Connectivity (Community Credit 1)

- List at least 5 or 10 basic services located within a 500m walking distance of the building
- Map or plan indicating position of at least 5 or 10 basic services located within a 500m walking distance of the building

As-built stage

Community Connectivity (Community Credit 1)

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission
- List at least 5 or 10 basic services located within a 500m walking distance of the building
- Map or plan indicating position of at least 5 or 10 basic services located within a 500m walking distance of the building

CY-2 Public Space

Intent

To encourage designs that set aside a portion of the space for use and enjoyment by the public to increase community connectivity

Requirements

Criteria	2 Points
5% of the site area is public space	1
10% of the site area is public space	2

Overview

Public Space (Community Credit 2)

Public space or recreational facilities play an important role in improving neighbourhood' quality of life and increasing connectivity between the building and the community.

Approach & Implementation

Public Space (Community Credit 2)

Public spaces are any space which is open to the general public, not limited to building occupants. Examples of public space include but are not limited to:

- Beaches
- Green space, such as parks
- Piazzas, city squares

Calculation

Public Space (Community Credit 2)

Calculation is based on area. Percentage of public space can be calculated by the following method:

- Quantify total site area
- Quantify area of public spaces
- Demonstrate amount of public space with the following formula:

$$\text{Public Space [\%]} = \frac{A_{pub}}{A_{tot}} \times 100$$

A_{pub}= Area of public space [m^2]

A_{tot} = Total site area [m^2]

Submissions

Design stage

Public Space (Community Credit 2)

- Report indicating nature of public spaces
- Tender stage site plan indicating public spaces and their areas as well as total site area
- Calculations demonstrating compliance with the requirements

As-built stage

Public Space (Community Credit 2)

- As-built site plan indicating public spaces and their areas as well as total site area
- Final as-built drawings demonstrating compliance with the requirements
- Photographs of the public spaces

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission

CY-3 Outdoor communal facilities for residents

Intent

To encourage projects to provide facilities that enable residents to engage in communal outdoor activities.

Requirements

Criteria	2 Points
Provide 2 outdoor communal facilities for residents	1
Provide 4 outdoor communal facilities for residents	2

Overview

Outdoor communal facilities for residents (Community Credit 3)

Outdoor communal facilities can help to improve the quality of life, increase the social interactions among residents and provide recreational activities.

Approach & Implementation

Outdoor communal facilities for residents (Community Credit 3)

Provide the following types of outdoor communal facilities for residents:

- Playground areas: Includes such items as climbing apparatuses, balance beams, ropes, swings, etc. Playground areas are to be exclusively for play, and must be fenced off.
- Open landscaped areas for active play: Includes open areas for group and/or individual play such as areas for running, jumping, chasing, ball games, sporting activities, and areas for wheeled toys such as bike pathways.
- Outdoor Gym with at least three separate facilities for exercise
- Seating in quiet areas and sun-shaded areas
- Swimming pool
- Composting facilities
- Vegetable gardens

Submissions

Design stage

Outdoor communal facilities for residents (Community Credit 3)

- List of all the outdoor communal facilities to be provided
- Tender stage plans showing the location of the facilities

As-built stage

Outdoor communal facilities for residents (Community Credit 3)

- Final list of all the outdoor communal facilities provided
- As-built stage plans showing the location of the facilities
- Evidence of the facilities provided, such as photographs, etc.

Management

The execution of an environmentally sustainable construction project involves a number of parties from various backgrounds, with a wide range of specialisation. The credits and requirements within LOTUS MFR ensure an optimised collaboration framework between everyone involved, even before the design stage has begun. To attain the standards expected of a LOTUS MFR 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 buildings users and managers so that the building's design features are understood and used, ensuring the intended performance goals are met throughout the life of the building.

The concept of an "eco-charrette", is a crucial pre-design step, during which the project team made up of a minimum of the developer/client, the architect and the consultant engineers, together define a strategy and a performance level for the project. This process ensures a complete commitment from the whole design team, before the design work has started, allowing for a full understanding of the aims throughout every step of design development and construction.

During the construction phase, it is necessary to implement a complete and systematic management scheme to ensure the construction phase is carried out without discrepancies. LOTUS encourages the use of an internationally recognised project management scheme during this phase to ensure this is realised. LOTUS also encourages the training of contractors on the green aspects of the building to ensure that the design intent flows down to all teams that are working on the building and construction progresses smoothly.

Commissioning is a critical operation to ensure building performance meets design specification. Recognising the vital importance of a properly employed commissioning program, LOTUS MFR will award points to ensure the step is executed effectively. In order to benefit fully from the commissioning stage, it is necessary to implement targeted and continuous preventative maintenance programs to ensure optimised performance of all equipment. This will decrease the risk of breakdown, and increase the building's life span.

Management		12 Points
Item	Criteria	Points
Man-1	Design Stage	1 point
	Perform an Eco-Charrette	Management Prerequisite 1
	Involve a LOTUS AP as a member of the design team	1
Man-2	Construction Stage	2 points
	Produce a safety policy and safety plan	Management Prerequisite 2
	Strategy A: Project management	
	Project management is performed in accordance with internationally recognised systems	1
	Strategy B: Trades training	
	Conduct trades training on the green aspects of the building design	1
Man-3	Commissioning	4 points
	Ensure commissioning is conducted by each individual contractor	1
	Appoint a commissioning team to conduct commissioning until building occupancy or verify individual contractor commissioning by a third party	3
	Appoint a commissioning team to conduct commissioning until building occupancy or verify individual contractor commissioning by a third party -AND- Conduct post-occupancy analysis	4
Man-4	Maintenance	2 points
	Provide a Building Operation & Maintenance Manual	Management Prerequisite 3
	Produce a preventative maintenance plan	1
	Produce a preventative maintenance plan and involve the technical team before commissioning	2
Man-5	Green Management Practice	1 point
	Provide a Building User's Guide to all dwelling units	Management Prerequisite 4
	Implement a Green Management System	1
Man-6	Green Awareness	2 points
	1 point for each of the following strategies implemented (up to 2 strategies): A. Provide signs and/or displays to demonstrate the project's green features B. Provide sustainable practice guides to building residents and tenants C. Organise Green activities or Green events	2

Man-1 Design Stage

Intent

To ensure all sustainable design aspects are identified and planned for at the earliest stage of the project and to encourage the involvement of a qualified individual to manage these aspects through the design process and maintained during the construction stage.

Requirements

Criteria	1 Point
Perform an Eco-Charrette	Man Prerequisite 1
Involve a LOTUS AP as a member of the design team	1

Overview

Design Stage (Management Prerequisite 1)

An Eco-Charrette is an interactive, multi-stakeholder, team-building exercise that explores the key green building and green development aspects of a project before any design decisions are made. Through this process, stakeholders work together to generate and target green building and sustainability goals prior to developing a more detailed approach. This is usually a minimum one-day facilitated meeting but is highly dependent on the size and complexity of the project.

Design Stage (Management Credit 1)

Environmental impacts resulting from the development and operation of a building can be understood and significantly reduced through effective design stage planning. By the appointment of a qualified individuals, it can be assured that objectives of the project are met in a uniform and coherent manner.

Approach & Implementation

Design Stage (Management Prerequisite 1)

The Eco-Charrette should bring together a mix of:

- Owners
- Architects, engineers and designers
- Contractors
- Building staff and tenants
- Local officials, planners and neighbours

Through a process of education, discussion and small-group activities, the Eco-Charrette should utilise the skills of participants to arrive at major design decisions. This will allow full recognition of the potential interactions of green building measures with building requirements. More specifically, its defined objectives should be to:

- Set up sustainability targets and objectives for the project
- Educate the team, owner, and community about environmental and energy efficiency issues
- Gain a long-term perspective of environmental impacts from building development
- Begin the collaborative approach necessary for a successful integrated design
- Form an expanded network of expertise and experience for input and advice throughout the project
- Instill all parties with a sense of mission and ownership of the process and outcome
- Develop a Design Development program of documentation milestones to review sustainability targets and objectives for the project.

Design Stage (Management Credit 1)

A qualified individual, internal or external, is 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 been taken and 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

Design stage

Design Stage (Management Prerequisite 1)

- Information about the Eco-Charrette, including:
    - Minutes of the meeting
    - Outcomes of any major discussions
    - Attending members and their capacity within the design team
    - Development program of documentation and meeting milestones to review sustainability targets and objectives for the project

Design Stage (Management Credit 1)

- Evidence showing the involvement of a LOTUS AP
- Copy of the LOTUS AP certificate

Man-2 Project Management

Intent

To ensure safety in construction and that the sustainability targets and objectives developed during the design stage are being met. To encourage the development of a recognised Project Management framework for a smooth construction process and to encourage the education and training of contractors regarding the green requirements of the project.

Requirements

Criteria	2 points
Produce a safety policy and safety plan	Management Prerequisite 2
Strategy A: Project management	
Project management is performed in accordance with internationally recognised systems	1
Strategy B: Trades training	
Conduct trades training on the green aspects of the building design	1

Overview

Project Management (Management Prerequisite 2)

A project safety plan is a plan setup by the contractor to ensure that safety during construction is prioritised and enforced. In order to ensure the safety of all employees and other persons present at site, contractors must deploy all necessary human, administrative and equipment resources to achieve this objective. “No. 22/2010/TT-BXD - Circular on Labour Safety in Work Construction” outlines the safety requirements for construction projects in Vietnam.

Project Management (Management Credit 2)

Strategy A: Project management

In order to construct a large, multi-discipline project with defined objectives and targets, it is essential that a clear and transparent process of staged project management is undertaken. Through such endeavours, the resources within a project can remain in scope while being managed and monitored more efficiently. This credit aims at encouraging the implementation of internationally recognised project management tools and procedures to ensure effectiveness and efficiency during construction works.

Strategy B: Trades training

This credit encourages projects to conduct a trades training workshop in order to educate the contractors about the green attributes, performance requirements and targets of the building. Through the trades training workshop, contractors will be introduced to the unique green aspects of the building so they can identify any project specific requirements that their trade will be expected to adhere to as well as unify the goals of the whole project team. It must occur before construction begins, but after the trades have been hired.

Approach & Implementation

Project Management (Management Prerequisite 2)

- The safety plan must comply with Circular No. 22/2010/TT-BXD

Project Management (Management Credit 2)

Strategy A: Project management

- Project Management frameworks include and are not limited to the following recognised systems:
  - FIDIC
  - ISO 10006
  - PMBOK (Project Management Body of Knowledge)
  - PRINCE2

Other recognised international Project Management systems may be considered, subject to VGBC approval. Project Management shall be undertaken by any experienced and competent internal or external individual/s through a recognised framework.

Strategy B: Trades training

At the trades training workshop, all prerequisites and any other requirements that the contractors will be expected to meet shall be explained. As a minimum the following contractors are to be included:

- Mechanical and Electrical (M&E)
- Civil Works

Submissions

Design stage

Construction Stage (Management Prerequisite 2)

- Provide the safety plan -OR- Tender stage specification extracts and a signed letter from the owner/developer that the safety plan will be produced and followed

Construction Stage (Management Credit 2)

Strategy A: Project Management

- Report indicating the project management standard to be used -OR- Tender stage specification extracts indicating the proposed project management standard to be used

Strategy B: Trades Training

- Letter of intent from building owner/developer committing to perform trades training to educate contractors

As-built stage

Construction Stage (Management Prerequisite 2)

- Provide the safety plan
- Evidence that the safety plan was followed such as photographs and safety training evidence for all workers, list of names of the safety team, safety equipment, etc.

Construction Stage (Management Credit 2)

Strategy A: Project Management

- System and related procedures or software outputs
- Evidence of competence (certification with project management standard)

If any deviation or addition:

- Describe and highlight the deviations or additions to the design stage submission
- Report indicating the project management standard used

Strategy B: Trades Training:

- Trades training workshop programme
- Signatures of contractors in attendance at the trades training workshop

Man-3 Commissioning (Cx)

Intent

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

Requirements

Criteria	4 Points
Ensure commissioning is conducted by each individual contractor	1
Appoint a commissioning team to conduct commissioning until building occupancy or verify individual contractor commissioning by a third party	3
Appoint a commissioning team to conduct commissioning until building occupancy or verify individual contractor commissioning by a third party -AND- Conduct post-occupancy analysis	4

Overview

Commissioning (Management Credit 3)

Commissioning is a planned and systematic form of quality control which involves all members of the design team. Ideally a commissioning agent (CxA) will lead the commissioning team. The CxA is an independent consultant, a qualified staff member of the client company or an employee of a firm offering construction project management services, but must be independent from the designers.

In practice, many buildings do not operate as design specifications would intend. This is largely due to poor commissioning practice upon transfer to the buildings user, where the risk of information loss and knowledge is common. At the commissioning stage, it is essential to ensure all building services systems are installed, tested, understood, and will be able to be operated and maintained to the operational requirements of their respective design brief.

In addition, within 6 to 18 months from the completion of the building (with minimum 50% occupancy), once operations are stabilised, a post-occupation analysis should be carried out to assess and improve performance in terms of end-user satisfaction, operational effectiveness and sustainability should be undertaken. LOTUS awards maximum points for projects that carry through commissioning to post-occupancy stage.

Approach & Implementation

Commissioning (Management Credit 3)

All the commissioning procedures should comply with the "TCXDVN 371-2006: Acceptance of constructional quality of building works". 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)

Contractor's commissioning:
Where commissioning is undertaken by individual contractors, they are required to provide evidence of installation and performance of each of their building services/equipment through technical specifications, as-built drawings and detailed testing results conforming to basis of design.

Third party commissioning:

If each individual contractor's commissioning is able to be verified for quality control by a third party, the project is eligible to apply for an extra point. However, where possible the engagement of an independent commissioning team to commission the entire project is recommended.

Where a commissioning team is appointed, the following steps shall be undertaken by the indicated party:

- The owner shall appoint a CxA. This should be done very early in the design stage. The CxA should be included in the Eco-Charrette. The CxA shall be responsible for, as a minimum:
    - Directing the commissioning team (Cx team)
    - Coordinating, performing and overseeing all commissioning activities
    - Reviewing results from the commissioning processes

- The owner shall provide a clear outline of the project requirements. The project requirements should contain the following:
    - User requirements, including building use, occupancy, future expansion, etc.
    - Environmental, energy and efficiency goals
    - Indoor environmental quality requirements
    - System and equipment expectations, including lifespan, automation and maintenance requirements
    - Operation and maintenance personnel
- The design team shall develop a basis for design. The basis for design must include the following:
    - Primary assumptions, including space use, design conditions and occupancy
    - Standards, codes, guidelines and regulations to which the design must adhere
    - Performance criteria of equipment including: HVAC, lighting, hot water and power systems
- The CxA shall review the owner's requirements and the basis for design. The CxA shall ensure the basis for design meets the requirements of the owner.
- The CxA shall develop a commissioning plan (Cx plan). The commissioning plan shall contain, as a minimum, the following components:
    - Overview of Cx processes
    - Overview of Cx team, including responsibilities of each member
    - List of all equipment, systems and assemblies to be included in the Cx processes
    - Communication matrix for Cx processes
    - List of Cx milestones
- The design team shall incorporate the Cx documents into the construction documents. The specification is used to describe the contractor's responsibility pertaining to Cx. The following, as a minimum, shall be incorporated into the construction documents:
    - Cx team involvement
    - Contractor's responsibilities regarding the Cx processes
    - Requirements for submittals and submittal review
    - Requirements for operation and maintenance documentation
    - Required site meetings
    - Construction verification process
    - Start-up and implementation of systems and equipment
    - Performance testing of equipment
    - Acceptance and closeout

- Operation and maintenance personnel training
- Warranty review

- The CxA shall review the construction documents to ensure continued adherence of the design to the owner's requirements. At least one review shall take place prior to the completion of the construction documents
- The CxA shall review all submittals provided by the contractor relating to systems, equipment or assemblies which are included in the Cx plan. This review shall happen concurrently with the review conducted by the design team and owner
- The Cx team shall verify the installation and performance of all systems, equipment and assemblies outlined within the Cx plan. The verification shall include 3 steps:
    - Installation inspections to ensure systems have been installed as specified by instructions from the engineers, architects and manufacturers
    - Performance testing to ensure that systems operate correctly and as expected. The performance testing shall take place after the systems, equipment and assemblies to be commissioned have been installed, energised, balanced and otherwise made ready for use. Testing shall include every process in the sequence of operation for each system, such as start-up, shut-down, capacity modulation, emergency mode, failure mode and interlocks to other systems
    - Evaluation of results to ensure systems performed according to specification
- The CxA shall develop a system manual which shall provide future operating staff the information required to properly operate building systems. The CxA shall also ensure the training procedures have been successfully undertaken

<u>Post-occupancy analysis</u>:

- The CxA shall submit a post-occupancy analysis plan ensuring 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

Design stage

Commissioning (Management Credit 3)

Contractor's commissioning:

- Specifications to contractors requiring them to perform commissioning

Third party commissioning:

- Project requirements produced by the owner
- Cx plan produced -OR- Tender stage specification extracts that the Cx plan will be produced and followed. The plan should include at least:
    - List of equipment to be commissioned
    - Methodology
    - Testing equipment
    - Person in charge

As-built stage

Commissioning (Management Credit 3)

Contractor's commissioning:

- Contractors' commissioning including:
    - List of equipment commissioned
    - Equipment factory certificate
    - Description of the operation of the building's systems, equipment and assemblies performed as per the design, construction documents and the owner's project requirements
    - Evaluation of result obtained during installation and performance testing

Third party commissioning:

- Cx plan used on the project. The plan should include at least:
    - List of equipment to be commissioned
    - Methodology
    - Testing equipment
    - Person in charge

- Cx report including:
  - List of equipment commissioned
  - Equipment factory certificate
  - Description of the operation of the building's systems, equipment and assemblies performed as per the design, construction documents and the owner's project requirements
  - Evaluation of results obtained during installation and performance testing

Post-occupancy analysis:

- Post-occupancy analysis plan
- Results of the post-occupancy analysis (surveys, fine tuning, measurements, etc.)

Man-4 Maintenance

Intent

To encourage the development of a preventative maintenance plan to ensure that the building's systems and equipment are achieving optimum performance

Requirements

Criteria	2 Points
Provide a Building Operation & Maintenance Manual	Man Prerequisite 3
Produce a preventative maintenance plan	1
Produce a preventative maintenance plan and involve the technical team before commissioning	2

Overview

Maintenance (Management Credit 4)

The primary goal of maintenance is to prevent the failure before it occurs and thus mitigate the damage to the building and its occupants. It includes preserving and restoring equipment reliability to maximise the life of equipment and services.

Preventive maintenance activities include systematic inspection, partial or complete overhauls at specified periods, oil changes, lubrication, cleaning, etc. In addition, maintenance workers record equipment deterioration so parts can be repaired or replaced before they cause system failure. This will require a dedicated in-house team or qualified maintenance contractors. Ideally the dedicated in-house team will be hired before the construction is complete so that this team will be able to attend and participate in the installation and the commissioning of all equipment and will be in charge to operate and maintain later on. Training can be provided by a member of the Cx team that has a complete understanding of the building's operational and maintenance requirements.

Approach & Implementation

Maintenance (Management Prerequisite 3)

The building operation and maintenance manual (O&M manual) includes the necessary information for the operation and maintenance of the building. The building 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

Maintenance (Management Credit 4)

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 and monitoring systems
  - 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

To have a total of 2 points for the credit, the technical team that will be in charge of the operation and maintenance of the building must be involved during the commissioning process.

Submissions

Design stage

Maintenance (Management Prerequisite 3)

- Tender stage specification extracts and (if possible) signed letter from the owner/developer that a building operation and maintenance manual will be produced

Maintenance (Management Credit 4)

- Tender stage specification extracts and, if possible, signed letter from the owner/developer that a preventative maintenance plan will be produced and followed -OR- preventative maintenance plan including:
    - Tender schedule of all equipment requiring maintenance
    - Timeline for maintenance for all listed equipment
    - Tender schedule indicating when each maintenance operation must be conducted

As-built stage

Maintenance (Management Prerequisite 3)

- Building operation and maintenance manual

Maintenance (Management Credit 4)

- Preventative maintenance plan including:
    - Schedule of all equipment requiring maintenance
    - Timeline for maintenance for all listed equipment
    - Schedule indicating when each maintenance operation must be conducted

Technical team involvement before commissioning:

- Evidence that the technical team has been involved before commissioning, including a list of people involved, their qualifications and their level of involvement

Man-5 Green Management Practice

Intent

To achieve optimal building performance by improving the interaction between building occupants and building systems and to encourage the development of a green management system during the development and operation of the building

Requirements

Criteria	1 Point
Provide a Building User's Guide to all dwelling units	Man Prerequisite 4
Implement a Green Management System	1

Overview

Green Management Practice (Management Prerequisite 4)

Many buildings although designed with numerous energy or water efficient features, rarely perform as well as they were intended to. Most of the time, the main factor affecting the building's performance is the behaviour of building occupants who do not always make best use of the building's sustainable design features. Giving all occupants access to information on how to operate the building efficiently through a building user's guide is a good first step and should be implemented in all green buildings.

Green Management Practice (Management Credit 5)

A Green Management System (GMS) is a set of procedures and associated documentation that enable an organisation to reduce its environmental impacts and improve operating efficiency. The benefits of adhering to a green management system include:

- Provides a framework for all environmental initiatives
- Enhances corporate reputation and commitment to environmental responsibility
- Increases attractiveness to investors and potential tenants
- Differentiates building owners, managers and tenants from competitors

Approach & Implementation

Green Management Practice (Management Prerequisite 4)

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

- Design specifications of the building and how these affect its operation
- The building's standard of performance
- Energy efficiency features
- Water-saving features (including irrigation)
- 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

Green Management Practice (Management Credit 5)

GMS can focus on areas such as; waste reduction, sustainable purchasing, energy savings, water savings, transportation, health and comfort as well as occupant safety.

In a multi-tenant building, the building owner or the building's property manager should implement the GMS. Depending on the areas of focus and the targets set, the tenants may have to contribute or not to the proper realisation of the GMS.

Projects should select at least 3 of these specific areas where they will aim to reduce their environmental impacts. For each selected area, the green management system, outlined in a green management system manual, should encompass the following:

- Policy statement: A statement of the organisation's commitment to the environment
- Identification of significant environmental impacts: Environmental attributes of products, activities and services and their effects on the environment
- Objectives and targets: Measurable environmental goals for the organisation
- Action plan: Practical steps to meet objectives and targets
- Training: Instruction to ensure employees are aware and capable of fulfilling their environmental responsibilities
- Management review

Through the last step, management review, building owners or property managers should check periodically that the action plans are implemented and that they are effective in meeting targets.

In case objectives are not met, either the action plans should be modified or the objectives should be adjusted. The building owner should choose a recognised international framework (standards) to define and implement its environmental strategy.

Submissions

Design stage

Green Management (Management Prerequisite 4)

- Tender stage specification extracts and (if possible) signed letter from the owner/developer that a building user's guide will be produced

Green Management (Management Credit 5)

- Signed letter from the owner/developer that a Green Management system will be implemented (if possible)

As-built stage

Green Management (Management Prerequisite 4)

- Provide the building user's guide:
    - submit photographs or scans showing front cover, table of contents, and at least 3 key sheets of the building user's guide,
    - or, if available in an electronic version, submit full building user's guide document.

Green Management (Management Credit 5)

- Provide the Green Management System manual (including management review), subject to VGBC approval
- Provide documents showing the Green Management System is being implemented

Man-6 Green Awareness

Intent

To raise awareness and knowledge related to sustainability issues.

Requirements

Criteria	2 Points
1 point for each of the following strategies implemented (up to 2 strategies): A. Provide signs and/or displays to demonstrate the project's green features B. Provide sustainable practice guides to building residents and tenants C. Organise Green activities or Green events	2

Overview

Green Awareness (Management Credit 6)

Awareness of climate change and other environmental concerns is still relatively low in Vietnam and there is still a lot of work to be done to increase public awareness and environmentally friendly behaviour. Green buildings should not only implement sustainable design and construction practices but also should help to educate community members and encourage them to change their behaviours.

Approach & Implementation

Green Awareness (Management Credit 6)

A. Provide signs and/or displays to demonstrate the project's green features

- Provide instructional materials or signs to explain the project's green building features.
- For projects with renewable energy generation, provide an educational display about the system in a publicly visible area.

B. Provide sustainable practice guides to building residents and tenants

A sustainable practice guide must be an illustrated document that:

- Gives a list of sustainable practices on energy efficiency, water efficiency, waste management and purchasing.
- Provides a clear description of the sustainable practices in order to help residents and tenants implement them

Different guides should be provided for business tenants and residents.

C. Organise Green activities or events to educate and raise awareness of the community

- Provide building tours on a regular basis (biweekly or monthly when the project first opens and at longer intervals depending on the community interest).
- Provide activities or events for children to raise their awareness on the topics of environmental protection, climate change, sustainable use of resources, endangered species, etc.
- Set up an organic community gardening project
- Other activities/events shall be subject to VGBC approval

Submissions

Design stage

Green Awareness (Management Credit 6)

- Signed letter from the owner/developer that signs and/or displays will be installed –OR– sustainable practice guides will be provided –OR– Green activities or events will be organised (if possible)

As-built stage

Green Awareness (Management Credit 6)

- A. Photographs showing signs and/or displays installed in different locations of the project
- B. Copies of the sustainable practice guides
- B. Evidences showing that the sustainable practice guides are handed to tenants and residents
- C. Report describing the Green activities and events planned and already carried out
- C. Evidences showing that the activities occurred, such as photographs, announcements, etc.

Innovation

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

There are up to 8 points available over the 2 credits, but these points are not specifically assessed to one or the other credit.

Innovation		8 bonus Points
Item	Criteria	Points
Inn-1	Exceptional Performance Enhancement	8
	Exceed significantly the credit requirements of LOTUS credits	
Inn-2	Innovative techniques / initiatives	
	Create a credit template for a technique or strategy outside the scope of LOTUS and adhere to the requirements	

Inn-1 Exceptional Performance Enhancement

Intent

To encourage exceptional performance, and recognise projects that achieves environmental benefits in excess of the current LOTUS rating tool benchmarks

Requirements

Criteria	Points
Exceed significantly the credit requirements of LOTUS credits	1-8

Overview

Exceptional Performance Enhancement (Innovation Credit 1)

The weightings and benchmarks in LOTUS have been set to reflect what is perceived as possible in the current market. However, if any innovative idea allows the design team to exceed significantly the requirements of the highest threshold, points will be rewarded. The applicant must describe what innovative strategies/initiatives have been implemented in order to achieve the Exceptional Performance Enhancement Credit. The VGBC reserves the right to not award points where the performance improvement is not demonstrated to be achieved by innovative measures or where required evidence is not adequately provided.

Approach & Implementation

Exceptional Performance Enhancement (Innovation Credit 1)

Innovation credits are considered on a case by case basis. Up to 8 Exceptional Performance Enhancement Innovation credits may be targeted (1 point each) out of a maximum of 8 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 two 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 A-3 Heat Island Effect

- Requirement (Level 1) – 30% of the paved and roof area limits heat island effect
- Requirement (Level 2) – 50% of the paved and roof area limits heat island effect
- Surpass by the next increment – 70% or more of the paved and roof area limits heat island effect, therefore building 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

Calculation

Exceptional Performance Enhancement (Innovation Credit 1)

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

Submissions

Design stage

Exceptional Performance Enhancement (Innovation Credit 1)

- Submissions as per initial credit requirements
- Report indicating what measures were taken to surpass the initial credit requirement

As-built stage

Exceptional Performance Enhancement (Innovation Credit 1)

- Submissions as per initial credit requirements

If any deviation or addition:

- Describe any deviation or addition to the design stage submission
- Final report indicating what measures were taken to surpass the initial credit requirement

Inn-2 Innovative Techniques/Initiatives

Intent

To promote techniques and/or initiatives that are out of the scope of the current LOTUS rating tool

Requirements

Criteria	Points
Create a credit template for a technique or strategy outside the scope of LOTUS and adhere to the requirements	1-8

Overview

Innovative Techniques/Initiatives (Innovation Credit 2)

LOTUS MFR covers a broad range of credits for measuring the environmental performance of a building. However, through this credit, it is also recognised that there may be a strategy or practice in the building that is not addressed by any LOTUS MFR credits. For innovative strategies, the applicant must justify measures taken and the achieved performance in order to be awarded points.

Approach & Implementation

Innovative Techniques/Initiatives (Innovation Credit 2)

An Inn-2 submission must be a concise report that clearly articulates the nature and magnitude of the environmental benefit achieved by the proposed initiative. Innovation credits are considered on a case by case basis. The VGBC reserves the right to not award points where adequate justification for the innovative nature of the strategy and environmental benefit cannot be provided. For this reason it is advisable to confirm the proposed innovation credit nature, thresholds and submittal requirements with the LOTUS team at any time prior to submittal.

Submissions

Design stage

Innovative Techniques/Initiatives (Innovation Credit 2)

- Report outlining the proposed innovative strategy and the expected/achieved performance
- Supporting evidence verifying the expected performance such as manufacturer's data, calculations, etc. Note if full evidence is submitted already in a credit folder then the folder is not required to be re-submitted under this credit.

As-built stage

Innovative Techniques/Initiatives (Innovation Credit 2)

- Supporting evidence required to demonstrate that the construction or installation has been done according to the designed features. Note if full evidence is submitted already in a credit folder then the folder is not required to be re-submitted under this credit.

If any deviation or addition:

- Describe any deviation or addition to the design stage submission
- Final report outlining the proposed innovative strategy and the expected/achieved performance

Glossary

Additions - Construction work on an existing building resulting in an increased floor area.

Alterations - Improvement work not related to the primary structural components, exterior shell or roof of the building. Specifically renovation work that may result in changes to the building envelope or floor plan, such as removing/erecting interior walls, removing/installing new windows. This does not include minor changes such as the installation of new water fixtures, replacement of electrical equipment, replacement of windows etc.

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

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/Certification Fee and the signing of the Provisional Certification Agreement.

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

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.

Baseline model - A baseline model of building X would inherit all design and orientation characteristics of building X (e.g. orientation, GFA, number of occupants, number of floors, shape, local weather conditions, number of operational days, etc.). However, the materials and equipment used in the baseline model are conventional ones, as opposed to the “Design model”, to which green and efficient practices will be applied.

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 labour and their costs are itemised. It may also detail the terms and conditions of the construction or repair contract and itemise all work to enable a contractor to price the work for which he or she is bidding.

Biodiversity - Or Biological diversity is a term that includes the variety of all life forms (plants, animals, microorganisms, their genes) together with the ecosystems they are a part of. Biodiversity changes constantly due to processes such as evolution, extinction, habitat degradation, etc.

Black water - Wastewater which contains wastes from toilets, kitchen taps or industrial waste and requires treatment before reuse.

Building envelope - The elements of a building that enclose conditioned spaces through which thermal energy may be transferred to or from the exterior or to or from unconditioned spaces.

Building footprint - The area of the building in plan on the ground floor or ground plane that is enclosed by exterior walls and adjoining structures sharing the same foundation as the building such as decks, porches and garages. (Figure G1)

Calculations - The mathematical interpretation and computation of numbers and quantities. Calculations are generally required for many LOTUS credits to prove that a building is qualified for LOTUS certification.

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

Certification Fee - The Certification Fee, value dependent on the size of the project, is a one off charge by the VGBC for the total administration process of LOTUS Provisional and LOTUS Full Certification and is bound by the VGBC Certification Agreement.

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 recognised 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.

Common Areas - Those areas within a building or tenancy not leased to a particular tenant, but which are available for the use of all tenants and usually of members of the public.

Completion of construction - Defined as building commissioning, building practical completion or beginning of building operation, whichever occurs first.

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.

Contract - A binding legal agreement of an exchange of promises between two or more parties. Contracts are documents that ensure the safety of parties who sign it by making personal and business agreements official and binding. Contracts help all parties involved as well as any contractor administering the contract to understand the terms of the agreement and the individual rights and obligations.

Credit - Each Credit has a specific intent that, if followed and achieved, allows the user to gain points within a LOTUS Rating Tool. In addition, some Credits have mandatory Prerequisites.

Credit Cover Sheet - The standardised template for all credit submissions provided to the Applicant Representative by the VGBC Representative. The provided Credit Cover Sheets are the only documentation allowed to be used within the all certification processes to apply for credit points.

Daylight Factor -The daylight factor is the ratio of the interior illuminance to the global horizontal illuminance under CIE standard overcast sky conditions.

Description of Intent- A written document outlining anticipated or planned actions.

Design Model - "Design Model" refers to the case of the proposed project. It carries with it the assumption that it will have a calculable improvement in green performance as compared to what is deemed standard practice for a building of equivalent size, location and use - Baseline model.

Detail drawings - Detail drawings show a small part of the construction at a larger scale, to show how the component parts fit together.

Development Footprint - The area of a site that is directly impacted by development activity including; building structures, hardscaping, access roads, car parking and non-building facilities. (Figure G1)

Domestic Water - Treated water supplied to the building from municipal water supply systems for domestic uses and meets the quality requirement as stated in TCVN 5502:2003 - Domestic Supply Water - Quality Requirements. LOTUS considers both municipal water and groundwater as domestic water.

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

Eco-Charrette - A crucial pre-design step, during which a minimum of the developer, the architect and the engineers, together define a strategy and a performance level for the project. This process ensures a complete commitment from the whole design team, before the design work has started, allowing for a full understanding of the aims throughout every step of the design.

Eco-value - Or ecological value of a piece of land is its ability to support native life as a part of the natural ecosystem. Land is often of high ecological value when it is in its most natural state supporting the existing population.

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

Environmental Impact Assessment (EIA) - A detailed and verifiable assessment of specific negative or positive impacts a project will have on the local and global environment.

Fenestration - Any light-transmitting component in a building wall or roof. The fenestration includes glazing material (which may be glass or plastic), framing (mullions, muntins, and dividers) external shading devices, internal shading devices, and integral (between-glass) shading devices.

Follow-up Report - A written document describing the effects of specific decisions or systems that have been used in a project once they have been implemented.

Forest Stewardship Council (FSC) - FSC was established to promote the responsible management of the world's forests. FSC promote responsible forest management. Products carrying the FSC label are independently certified to assure consumers that they come from forests that are managed to meet the social, economic and ecological needs of present and future generations.

Gray water - Waste water recovered from households or buildings and has not come to contact with food or human/animal waste.

Greenhouse gases (GHG) - Gases in the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of thermal infrared radiation emitted by the Earth's surface, the atmosphere itself, and by clouds. This property causes the greenhouse effect. Water vapour (H_2O), carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4) and ozone (O_3) are the primary greenhouse gases in the Earth's atmosphere. (As defined in the IPCC AR4 SYR Appendix Glossary).

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 at all floor levels. Some commercial and public authorities use variants of this definition. Car parks are not to be included as GFA.

Habitable spaces - In a residential building, habitable spaces include kitchen, living room, dining room, bedroom and study but exclude bathrooms, storage, and utility spaces. All habitable spaces are considered occupied spaces.

Habitat - The natural environment in which one organism exists.

Hardscaping -The practice of landscaping that refers to paved areas like streets & sidewalks, large business complexes & housing developments and other industrial areas. (Figure G.1)

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.

Installation Schedule - A timeline of a devices initial placement within a building and the date it commences operation, all organised sequentially.

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

IPLV - IPLV is the abbreviation for Integrated Part Load Value. The IPLV measures the efficiency of air conditioners under a variety of conditions - that is, when the unit is operating at 25%, 50%, 75% and 100% of capacity and at different temperatures.

ISO Standard - Standards set by the International Organization for Standardization. Although ISO is a non-governmental organization, its standards often become law through either treaties or referencing by national standards and are usually integrated in green building assessment tools.

Landscaping - All activities that modify the visible features of the non-building area.

Landscape design drawing/plans - Scaled maps illustrating all features and relevant properties of a building landscape.

Lighting Ballast - A device used to obtain the necessary circuit conditions (voltage, current, and wave form) for starting and operating an electric-discharge lamp. Ballast factor (BF) is the ratio of commercial ballast lamp lumens to a reference ballast lamp lumens, used to correct the lamp lumen output from rated to actual.

Line of sight - An imaginary line/path from occupant eyes to perceived objects. A direct line of sight refers to an unobstructed path from a building occupant eyes to the external view.

LOTUS Accredited Professional - The LOTUS Accredited Professional or LOTUS AP has undergone training and successfully passed the LOTUS Rating Tool 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 Full 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 a LOTUS Provisional and Full Certificate. It provides technical guidance for all LOTUS Credits in order for users to understand intents, requirements, approaches and implementations, calculations and submissions.

Lumen (Lm) - SI unit of luminous flux. Radio-metrically, it is determined from the radiant power. Photo-metrically, it is the luminous flux emitted within a unit solid angle (one steradian) by a point source having a uniform luminous intensity of one candela.

Material Safety Data Sheet (MSDS) - A form including data on the properties of a particular chemical substance. It is intended to ensure workplace safety by providing workers and emergency personnel with procedures for handling or working with that substance in a safe manner, and includes information such as physical data (melting point, boiling point, flash point, etc.), toxicity, health effects, first aid, reactivity, storage, disposal, protective equipment, and spill-handling procedures.

Minutes - A written account of actions decided upon during a meeting.

Modelling Simulation - A visual representation of how something that is designed will perform, using a software program to show interactions and the results of multiple variables.

Natural lighting - Technologies or design strategies used to provide lighting to buildings without power consumption. Although maximising natural lighting will minimise 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.

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.

Net Occupied Area (NOA) - The area for which a tenant could be charged for occupancy under a lease. Generally, it is the floor space contained within a tenancy at each floor level measured from the internal finished surfaces of permanent external walls and permanent internal walls but excluding features such as balconies and verandas, common use areas, areas less than 1.5 m in height, service areas and public spaces and thoroughfares.

Non-Building area - The site area minus the building footprint. Includes Open space as well as hardscaping, access roads, car parking and non-building facilities. (Figure G1)

Notification Form - The Notification Form is submitted by the Applicant Representative to notify the VGBC that the Client 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 VGBC to organise the period in which the project will be assessed.

Operations Manual - A dated written record of the intended application of a device or process and its expected quantitative performance and operating procedures.

Overall Thermal Transfer Value (OTTV) - OTTV is a measure of the average heat gain into a building through its envelope. It is measured in W/m2. Abuilding with a higher OTTV will impose a greater load on the air-conditioning system, which would have to expend more electrical energy in removing it. The aim of low OTTV is to ensure adequately designed building envelopes which cut down external heat gains and hence reduce the cooling load of air-conditioning systems.

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.

Passive Design Analysis - An account of the decisions made and steps taken to implement a design that reduces energy consumption of a building by taking advantage of natural heating, cooling and lighting.

Permeable hardscape - All areas of a building landscape that are paved with construction materials allowing water to pass through to the soil underneath.

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 metre above floor level), showing walls, window and door openings and other features at that level.

Prerequisite *or* LOTUS Prerequisite - Indicates the minimum requirements for each categories in a LOTUS rating tool. There are stand-alone prerequisites as well as credit-involved prerequisites, but regardless of types, buildings that apply for LOTUS certification are obliged to fulfil all prerequisites in every category. Each prerequisite is organised in a standard format, similar to credit format. A list of all prerequisites is provided at the beginning of the LOTUS Technical Manual.

Project Assessment Committee (VGBC) - The committee led by a VGBC project manager and consisting of VGBC and external experts responsible for the initial and most detailed assessment of LOTUS submissions.

Product Specification - A document that clearly states actual (not advertised) attributes or requirements of a product. The purpose of product specifications is to ensure that the design and development of a product meets the needs of a user. Attributes or requirements may include, but are not limited to, quantitative performance ratings, dimensions, weight, cost, material composition, life expectancy, safety issues, industry or manufacturer codes or numbers associated with the product, quantity and maintenance requirements.

Project Design Team - The Project Design Team are the core team of experts involved in the design of a project that must integrate the principles of sustainability into the design process in order to gain points for certification.

Project Identification Number (PIN) - The Project Identification Number (PIN) is a unique 8 digit 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.

Public space - Any space which is open to the public, not limited to building occupants. There might be certain rules applied to the spaces but no fee must be paid to access.

Purchase order - A purchase order (PO) is a commercial document issued by a buyer to a seller, indicating types, quantities, and agreed prices for products or services they require the seller to provide. Sending a purchase order to a supplier constitutes a legal offer to buy products or services and the acceptance of such purchase order by a seller usually forms a contract.

Quy chuẩn xây dựng Việt Nam (Vietnam Construction Regulation/Building Code) - All mandatory regulations applied in building activities, which are issued by governmental authorities on building. (TCXDVN definition at item 19 and 20, Article3, Building Code - 26/2003/L-CTN issued on 10/12/2003)

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.

Recycling - A process in which materials that have been once processed into products are collected, processed again and returned to the market as raw materials or as finished goods.

Registration Fee - The Registration Fee is a one off charge by the VGBC for the administration process of registration to a LOTUS Rating Tool and is bound by the VGBC Certification Agreement.

Remediation - Efforts in minimising the negative effects of contaminations on the environment

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

Reports - A written document usually required for LOTUS certification submission that describes how a structure or system of a building satisfies the requirements of a certain LOTUS credit.

Reuse - A process in which processed materials are collected and returned to the market without reprocessing to change form or characteristics

Schematics - A diagram that represents the elements of a system using symbols.

Site Area - The total area of the building site, the area of the lot(s) on which have been/are to be developed. (Figure G1)

Site Plans - 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.

Specification - A detailed statement describing the requirements for construction, installation or manufactured elements, in particular the materials, dimensions, quality of work and required performance and/or adherence to standards and codes.

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

Submission Section - The Submission Section details all requirements that will be assessed for LOTUS Certification.

System Description - A document that describes the function of interacting elements designed to work as a whole.

TCVN (Vietnam standard) - All technical documents describing principles, guidelines or properties/results of activities issued by authorized agencies to help maximizing effectiveness in certain conditions (25/2001 QD-BXD issued on 4/9/2001). Application of most TCVN is on voluntary basis except for standards relating to life safety, fire and explosion protection, environment sanitation and environmental conditions recording. The Vietnam Directorate for Standards, Metrology and Quality is mainly responsible for issuing Vietnamese standards.

TCXD/TCXDVN (Vietnam Construction Standard) - All Vietnamese standards which are applicable to construction and building, but are not mandatory as opposed to the Vietnam Construction Regulation or building code. (TCXDVN definition at item 19 and 20, Article 3, Building Code - 26/2003/L-CTN issued on 10/12/2003)

Tender Stage Documentation - Documents provided to potential tenderers when they are invited to tender and which form the basis on which tenders are submitted, including instructions to tenderers, contract conditions, specifications and drawings, pricing documents, form of tender and tenderers' responses. The stage occurs upon completion of the majority of the design work and the documents are what is used (but not limited to) cost a proposal.

Thermal Comfort - A term describing conditions in which a building occupants are comfortable with the surrounding thermal environment. Conditions include air temperature, radiant temperature, humidity, draught, clothing and activity rates.

Thermal Efficiency - A dimensionless performance measure of a thermal device such as an internal combustion engine. It is a ratio of usable heat energy output to energy input. The thermal efficiency of heat pumps and refrigerators is measured as Coefficient of Performance (COP), see definition of COP.

Thermal Mass - Materials with mass heat capacity and surface area capable of affecting building loads by storing and releasing heat as the interior and/or exterior temperature and radiant conditions fluctuate.

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.

Vegetated Area - Any areas on the building site that are not paved and have plant cover. (Figure G1)

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.

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

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

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

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

Xeriscaping - Landscaping that minimises the need for supplemented watering. Xeriscaping is particularly encouraged in areas where fresh water accessibility is limited.

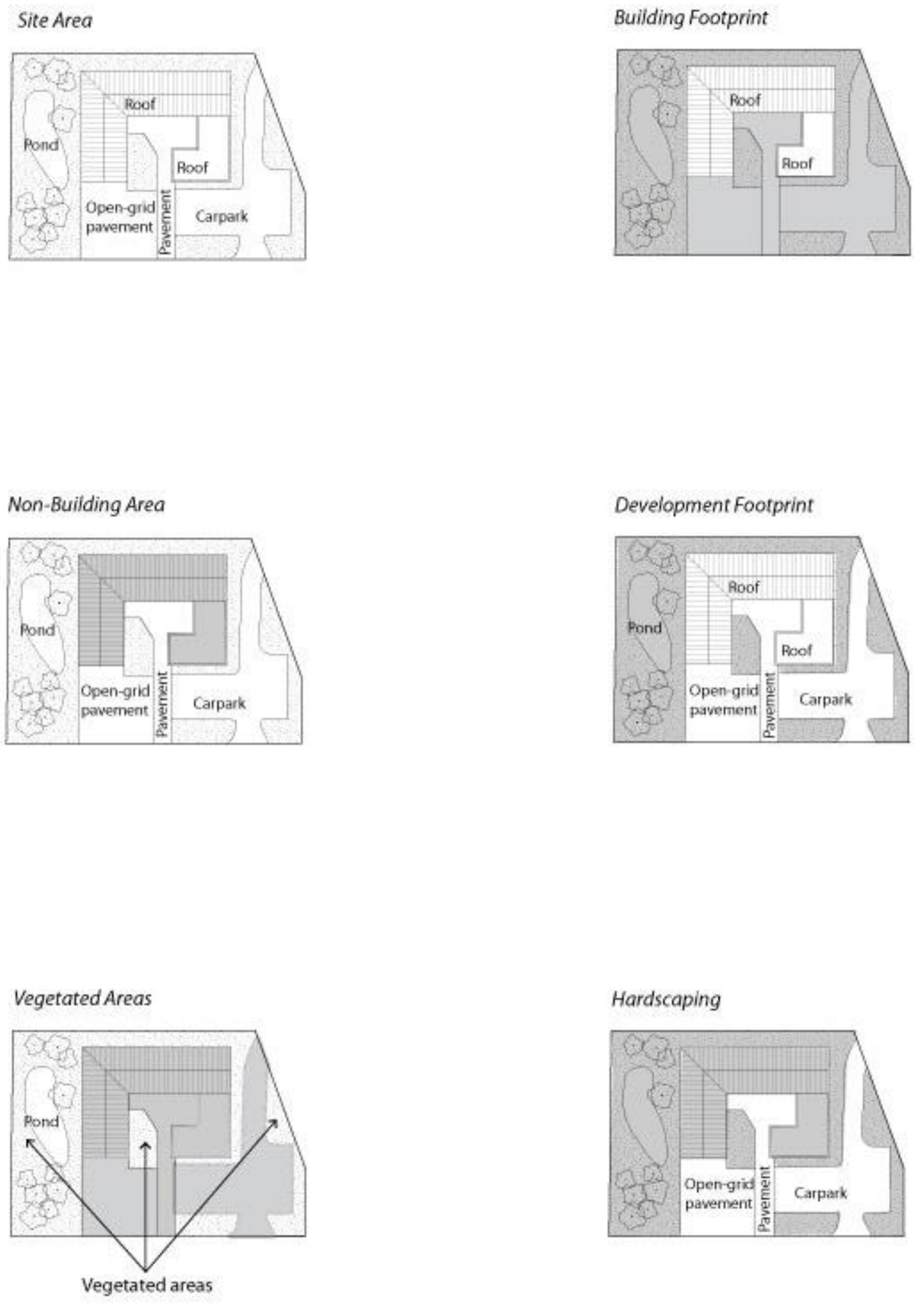

Figure G.1: Site area illustrations