KUALA LUMPUR
LOW CARBON BUILDING CHECKLIST
(KL LCBC 2023)

TECHNICAL GUIDE

Ver 1.0 (4/2024) - BETA

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Definition and abbreviations

ACMV	'Air Conditioning and Mechanical Ventilation System' a cooling system designed to give proper ventilation to a specific environment.
ASHRAE	'The American Society of Heating, Refrigerating and Air-Conditioning Engineers' a standard used by AC and refrigeration professionals as an up-to-date procedure when testing, installing and designing hardware. Different numbering specifies different topic of reference.
Baseline requirement	Baseline requirement - the minimum requirements of the green code, using either prescriptive or performance method as specified. May vary depending on the context, if not version of the green tool being referenced.
BP	'Building Plan' ensure that construction is according to the approved plan, with the DO as a precursor.
CCC	'Certificate of Completion and Compliance' an official recognition that the building is fit for the purpose it was built for and all the technical condition imposed by local authority have been met satisfactorily.
Circular economy	an economic model designed to minimize waste and make the most of resources, emphasizing on continual use and reuse of materials in a closed-loop system, reducing the consumption of finite resources and minimizing environmental impact.
COP	'coefficient of performance' is a ratio of useful heating or cooling provided to work (energy) required. Higher COPs equate to higher efficiency, lower energy (power) consumption and thus lower operating costs
DBKL checking officers	Local Authority officers that would be enforcing, reviewing and assessing the implementation of the LCB checklist.
DO / KM	'Development Order' an order granting or granting with conditions and application for a development permit. Also known as Kebenaran Merancang (KM)
Embodied carbon	Total amount of energy consumed and carbon released during the entire life cycle of a building including extraction, manufacturing, transportation, construction of building materials, transportation and energy used during construction activities.
ghg	'Green-house gas' refers to gases in Earth's atmosphere that trap heat. These gases, such as carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O), contribute to the greenhouse effect, warming the planet. Increased concentrations of GHGs, largely from human activities, lead to climate change and global warming.
LCBC	'Low Carbon Building Checklist' a checklist being developed to be incorporated as part of Malaysia's submitting requirement starting with Kuala Lumpur.
Life-cycle	Entire lifespan of a building or infrastructure from initial conception, design stages, construction, operation, maintenance and demolition or decommissioning.
lighting power density (LPD)	Represents the load of any lighting equipment in any defined area or the watts per square foot of the roof floor area of the lighting equipment.
MASMA	'Manual Saliran Mesra Alam' or 'Urban Stormwater Management Manual for Malaysia' integrate holistic approach to the management of urban water cycle including stormwater, water supply and wastewater into the sustainable urban design of a project including the Best Planning Processes and Best Management Processes.
MEPS	'Minimum Energy Performance Standard' an energy labelling requirements by Suruhanjaya Tenaga Malaysia
MS	'Malaysian Standard' a standard developed through consensus by committees which comprise balance representation of producers, users, consumers and others with relevant interests as may be appropriate to the subject at hand. Different numbering specifies different topic of reference.
MS1525	is a Malaysian Standard (MS) document specifically on the Code of Practice on Energy Efficiency and Use of Renewable Energy for Non-Residential Buildings.
OSC	'One Stop Centre' who is responsible for receiving, reviewing, signing and distributing application development proposal
OTTV	'Overall Thermal Transmittance Value' a measure of heat gain into the building through the building envelope. It also acts as an index for comparing the thermal performance of buildings.
Potable water	Water that are safe and suitable for human consumption that meets certain quality standards and is free from harmful contaminants

PSP	'Principal Submitting Person' a professional Architect or a professional Engineer who is responsible for overseeing the entire projects development and building to completion.
Rating tools	Rating system or assessment frameworks used to evaluate and measure the performance of sustainability of buildings, infrastructure or other systems.
SPAH	'Sistem Pengumpulan Air Hujan' or 'Rain Water Harvesting' a technic of collecting, storing and distributing rainwater for multiple uses.
Stakeholders	a person, group or organization with a vested interest or stake in the decision making and activities of a business. In the case of construction industry, stakeholders may involve and not limited to consultants, client, contractors, governing bodies, local authorities.
U-value	'Thermal transmittance' the rate of transfer of heat through a structure or matter.
UBBL	'Universal Building By Law' provides guidelines on the procedures for building plans approval and other means of development control.
VOC	'Volatile Organic Compounds' a large group of chemicals found in building materials that emits dangerous gases which may have adverse short- and long-term health effects.
Water Use Reduction	Can be achieved for indoor and/or outdoor uses. For outdoor water, it regulate water uses by reducing potable water use, irrigation etc. Indoor water use monitors usage on toilets and cleaning as well as internal water processes where applicable. Goal is to reduce as much as possible the dependency on the municipality water by flow reduction or water offset by means of water recycling or e.g. rainwater harvesting.

Mayor of Kuala Lumpur's Foreword

The increase in greenhouse gas (GHG) emissions caused significant environmental challenges as a result of city urbanisation growth. However, urban growth and GHG emissions reduction can co-exist through a conscious effort to ensure sustainable development, which involves duty and a shared responsibility between various stakeholders. Every activity carried out now will contribute to the city's future and its environmental impact. As such, with consideration to the future, Kuala Lumpur City Hall will play a role in reducing the city's GHG emissions.

As the first step towards our low-carbon journey, our in-house Carbon Management Plan for energy developed in 2015 served as a guide for us to mitigate climate change through proactive climate action. This was followed by the Kuala Lumpur Low Carbon Society Blueprint 2030 and Kuala Lumpur Climate Action Plan 2050. Kuala Lumpur's mission is to become a City for All while simultaneously promoting a thriving and sustainable economy in order to prioritise the environment, health, and safety of its citizens.

Building on our previous effort, we developed the Kuala Lumpur Low Carbon Building Checklist Technical Guide to provide a comprehensive guideline that must be complied at planning approval, building plan approval, engineering approval, and the completion stage by all Principle Submitting Persons (PSP), in order to reduce GHG emissions that result from building construction and operations.

This guideline is more than just a set of rules. It explains how to incorporate energy efficiency technologies, sustainable materials, and green design practices into building projects. By adhering to these principles, we can contribute to develop buildings that are more than just structures, but also beacons of sustainability, demonstrating our city's commitment to a greener future.

On behalf of Kuala Lumpur City Hall, I would like to express my gratitude to all stakeholders involved in the development of this technical guide and checklist, which will assist in translating policy into actions. With the valued feedback, this Kuala Lumpur Low Carbon Building Checklist Technical Guide would help contribute towards a brighter future through reduced emissions from buildings in the city.

YBhg Datuk Seri Sr Haji Kamarulzaman Bin Mat Salleh
Mayor of Kuala Lumpur

Acknowledgements

Our heartfelt appreciation to the dedicated team of experts, architects, engineers, local authorities, government agencies and sustainability enthusiasts who have passionately contributed their time and expertise to the creation of this document. And to the C40 Cities Climate Leadership Group (C40 Cities) for supporting the guide, through its Climate Action Implementation Programme, funded by the UK government. Their unwavering commitment and collaborative spirit have shaped this guide into a valuable resource that will inspire and guide sustainable building practices in our city. It is through their collective efforts that we have crafted a framework that aligns with our vision for a greener and more resilient future. Their contributions stand as a testament to our shared commitment to sustainability and innovation.

Introduction

Malaysia has pledged to reduce its greenhouse gas emissions by up to 45% by 2030, in accordance with the Paris Agreement. The country has set its sights on achieving carbon neutrality by 2050 and phasing out coal-powered energy generation.

The **Kuala Lumpur Climate Action Plan 2050 (KLCAP2050)** was launched by Kuala Lumpur City Hall (DBKL) to achieve its carbon neutral city target by 2050. The blueprint outlines five main strategies: mobility and infrastructure; green city adaptation; energy efficient and climate-proof buildings; smart waste management; and disaster management. DBKL has also outlined 245 low-carbon initiative programs under its **Kuala Lumpur Low Carbon Society Blueprint 2030 (KL LCSBP2030)**, aiming to reduce carbon emissions by 70%. This blueprint aligns with the city's vision and aims to reduce the city's carbon emissions while contributing to the economic growth targets.

As part of the KL LCSBP2030 framework, 10 Actions were outlined for the purpose of emissions reduction, based on 3 thrusts – Economy, Social and Environment, including Green Urban Governance as the enabler. **Action 6 – Low Carbon Green Buildings**, in particular is pertaining to buildings, which is projected to contribute to the lowering of GHG by 20.1%, by having green buildings for up to 60% by 2030 based on implementing of sustainable design strategies within Action 6 framework through the **Kuala Lumpur Low Carbon Building Checklist (LCBC)** at it's core. The checklist is designed to validate low carbon buildings and consists of four prioritized climate actions:

- **Efficient Building Envelope Performance**
- **Mitigation of Urban Heat Island (UHI) Phenomenon**
- **Increasing Building Water Efficiency**
- **Sustainable Low Carbon Building Construction**

The checklist is to be made mandatory for sustainable energy low carbon building assessment under the Low Carbon Building Facilitation Program. It aims to reduce carbon emissions by validating low carbon buildings and benchmarking their performance. The checklist is a technical guide that provides a comparison of barriers and opportunities for low carbon buildings.

This document is the Technical Guide for the LCBC developed jointly by DBKL with C40, and facilitated by CE-malaysiaGBC collaboration. It incorporates recommendations from C40 and DBKL for project plans submissions to DBKL up to CCC stage, and written in official Bahasa Malaysia with English translation. This document serves as a guide to LCBC's green building initiatives and its sustainability concepts, which includes self-check parameters for PSP to review their documentation before submission along with a pre-consultation review guideline.

This document sets the direction for the comprehensive technical documentation, ensuring that it will effectively convey the intended information, guidelines, and strategies related to the subject matter.

Energy Efficient and Climate-proof Buildings

Energy Efficient and Climate-proof Buildings is part of the five Prioritise Actions and Climate Strategies set in the KL Action Plan 2050. This is a thematic action and it focuses on the building sector. These five strategies is carefully mapped to also address the SDGs with focus on key impact groups, identified as vulnerable and would be most impacted by these actions implementation.

- Green Adaptive City	- Adaptation actions to reduce climate risk
- Mobility & Infrastructure	- Mitigation actions from transport sector
- **Energy Efficient & Climate-Proof Buildings**	**- Mitigation actions from building sector**
- Smart Waste Management	- Mitigation actions from waste sector
- Disaster Management	- Adaptation actions to build adaptive capacity

Buildings with low carbon emissions are designed and built to emit very little or no carbon during their lifecycles. This activity requires creating a Near Zero Emissions Building (NZEB) roadmap, as outlined in the KLCAP2050. It includes minimum requirements, timeframes for periodic performance rating assessments, and considerations for implementation changes to buildings. When done properly, significant reduction in energy usage can be observed, to the delight of its occupants. This lowering of energy is also associated with the reduction of carbon emissions, while the external design for more reflective surfaces and greeneries promotes the reduction of the UHI effect.

This LCBC is only the beginning – hence its starting point at this time is still on a fundamental level. It will be developed and implemented over a longer period of time with consideration of different building types, energy consumption profile, building policies, as well as performance analyses. Embarking on LCBC will require projects to consent to energy data disclosure and subscription to online data management that would enrich DBKL's building impact database. As time goes by, LCBC would be further improved to reflect market trends, and further developed, becoming more stringent, empowering more buildings to comply with LCBC in ensuring that DBKL meets the NZEB goals, befitting as a key tool towards sustainability and the city's transition towards Net Zero Carbon.

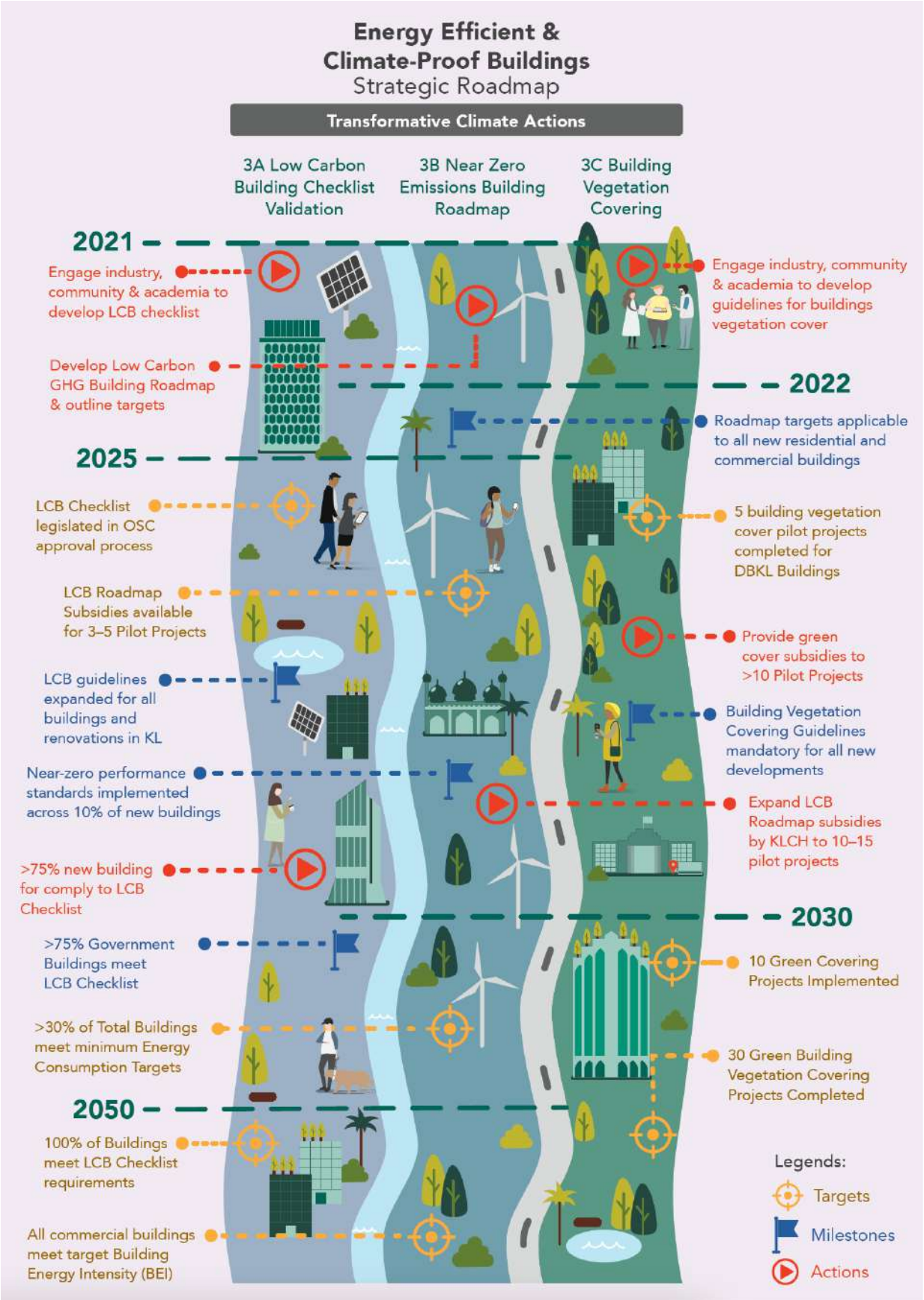


Figure 1 adopted KL CAP, this framework forms the basis of LCBC

Benefits of complying to LCBC

The LCBC is a kind of Green Building benchmarking.
It is designed to reduce the environmental impact of buildings and promote sustainable living.
Some benefits include:

Reduced greenhouse gas emissions
Green buildings are designed to reduce energy consumption, which in turn reduces greenhouse gas emissions. The LCBC is targeted to reduce up to 20.1% of carbon emissions by making buildings more energy-efficient, we can reduce the amount of CO2 released into the atmosphere.

Improved air quality
Green buildings can help improve indoor air quality by reducing the amount of pollutants and allergens in the air. Additionally, green infrastructure such as gardens and vegetative barriers, green parking lots, and water bodies, help reduce the impact of emissions and improve local air quality.

Improved health and well-being
Green buildings can help improve the health and well-being of occupants by providing better indoor air quality, natural light, and access to green spaces. A study by the Green Building Index (GBI) found that green certified buildings produce 60% fewer greenhouse gas emissions than any average building. Lower demand on the power grid, decreased greenhouse gas (GHG) emissions from energy production, improving well-being and productivity.

Reduced operating costs
Green buildings are designed to be more energy-efficient, which can lead to significant cost savings over time. According to the Malaysia Green Building Council, green buildings can save up to 30% on energy costs.

Reduced waste
Green buildings are designed to reduce waste by using sustainable materials and recycling waste. This can help reduce the amount of waste sent to landfills and promote a more circular economy, lower environmental impact, and decrease demand for raw materials.

Water Efficiency
Water efficiency practices in green building design bring about numerous benefits including lower water bills and reduced strain on local water sources, promoting the conservation of precious water resources and leading to decreased energy use for water treatment. It provides access to clean water and fostering awareness of water conservation. On a larger scale, these practices contribute to the preservation of water resources for the city, resulting in reduced water treatment costs and enhanced resilience to water scarcity.

Requirement for submission

The main checklist are the planning and building plan submission checklist, which would be available over the counter at OSC or at the DBKL portal. These are the two checklists:
[P2-KM-01] PERMOHONAN KEBENARAN PERANCANGAN kemaskini 16112022
[P2-PB-01] PERMOHONAN KELULUSAN PELAN BANGUNAN_kemaskini 16112022

The LCBC is mentioned in these checklists for the submission types as tabulated below.

Table 1 Sections requiring LCBC in DBKL submissions for DO and BP

Planning		Building	
B.11	New const./ demolish and rebuild	A.i.6	new construction
C.11	Amendment to approved DO	A.ii.4	new construction (link/ semi-D/ bglw)
D.7	Change of building use	B.i.5	Addition & renovation/ change of use
E.7	Add & renovation – no change use	B.ii.3	Addition & renovation to single home
F.9	Temporary building	Small permit or temporary bldg not required.	

There are several building/project typologies and all will require the LCBC. Complying with specific requirements from the LCBC, projects would need to adhere only to the items relevant to the project type. This requirement is to tailor specific project sustainability strategies to best suit their context. For instance, a fully new residential building might require compliance to a majority of the items in the LCBC, while a renovation projects only need to comply with a selected few items from the LCBC.

Adapting to building typology acknowledges that a one-size-fits-all approach isn't effective in sustainable design. The LCBC respects the inherent differences between project typologies and their complexities. Compliance with specific requirements based on building typology and project nature promotes practicality, innovation, and resource optimization. It acknowledges the complexity of construction and supports sustainable practices that are tailored to individual projects, ultimately fostering a more efficient and effective path towards a greener built environment.

For renovation and uncomplicated building extensions, the scope of necessary compliance criteria becomes significantly narrower. Among the initial 24 criteria outlined in the original LCBC, only up to 20 are required to any given building context. See project tabulation to code.

LCBC overview

The LCBC is divided into 4 categories, called Kod (Code). These Kods range from Planning strategies, Passive Design, Active Design, and Low Carbon Components. Within the Kods, are criteria that need to be fulfilled by projects during the stages of planning, building plan and CCC stage. The application of these criteria varies according to project type.

KOD 00 Planning strategies
1.1.1 Penggunaan bahan-bahan yang sesuai di permukaan bangunan (bumbung & lanskap kejur)
The use of appropriate materials on the surface of the building (roof and hardscape)
1.1.2 Meningkatkan keperluan litupan hijau bangunan
Increase the green coverage requirements of buildings
1.1.3 Memperbaiki Litupan hijau pada bumbung rata bangunan sediada
Enhanced green coverage on flat roof of existing building
3.1.1 Best Management Practices (BMPs) at construction sites

Kod 01 Passive Strategies
1.2.1 Keperluan minimum 'building envelope' (pengaliran haba)
Building envelope minimum requirement (heat conduction)
1.2.2 Memperbaiki 'building envelope' untuk bangunan sediada
Enhanced building envelope for existing building
1.2.3 Pengurangan kenaikan haba daripada radiasi solar secara langsung
Heat gain reduction from direct solar radiation
1.2.4 Memaksimumkan zon pencahayaan siang
Maximized daylighting zone
1.2.5 Menggalakkan penggunaan pengudaraan semulajadi.
To encourage the use of natural ventilation
1.3.1 Pelaksanaan penuaian air hujan
Implementation of rainwater harvesting
1.3.2 Penjimatan penggunaan air terawat
Savings on the use of treated water
1.3.3 Meningkatkan penggunaan air secara efisyen di bangunan sedia ada
Increase the use of water in existing buildings
1.3.4 Penggunaan semula bahan binaan untuk projek pembangunan semula
Reuse of building materials for redevelopment projects

Kod 02 Active strategies
2.1.1 Penyaman udara cekap tenaga
Energy efficient air conditioning system
2.1.2 Penukaran kepada penyaman udara cekap tenaga
Conversion to energy efficient air conditioning
2.2.1 Sistem pencahayaan cekap tenaga
Energy Efficient Lighting System
2.2.2 Penukaran kepada pencahayaan cekap tenaga
Conversion to energy efficient lighting
2.3.1 Pemasangan sistem tenaga boleh baharu
Installation of renewable energy system
2.3.2 Perlaksanaan Net Energy Metering (MET) untuk sistem Solar Panel (PV - Photo Voltaic)
Implementation of Net Energy Metering (MET) for Solar Panel (PV-Photo Voltaic) Systems
2.3.3 Pengiraan BEI (Building Energy Index) bangunan hijau rendah karbon
BEI (Building Energy Index) calculation for low-carbon green buildings

Kod 04 Low Carbon Components
4.1.1 Pengurusan Sisa Domestik yang mampan
Sustainable Domestic Waste Management
4.2.1 Sistem Pengurusan Tenaga (BEMS – Building Energy Management System)
(BEMS – Building Energy Management System)
4.2.2 Pengumpulan data bangunan pintar dan pusat
Smart and central building data collection
4.2.3 Manual Penggunaan Bangunan Hijau
Green building user manual

Table 2 Project type to criteria mapping

	PENERANGAN	Baharu - Kediaman <1,000m2	Baharu - Bukan Kediaman <1,000m2	Baharu - berskala besar - Kediaman >1,000m2	Baharu berskala besar - Bukan Kediaman >1,000m2	Sediada - Kediaman <1,000m2	Sediada - Bukan Kediaman <1,000m2	Sediada berskala besar - Kediaman >1,000m2
KOD 1.0 REKABENTUK PASIF: 1.1 Pengurangan Fenomena Pulau Haba Bandar (UHI – Urban Heat Island)								
1.1.1	Meningkatkan keperluan litupan hijau bangunan			√	√			
1.1.2	Penggunaan bahan-bahan yang sesuai di permukaan bangunan (bumbung & lanskap kejur)			√	√			
1.1.3	Memperbaiki Litupan hijau pada bumbung rata bangunan sediada							√
KOD 3.0 KOMPONEN RENDAH KARBON 3.1 Penghapusan atau Pengurangan Bahan Cemar dengan Punca Tidak Bertitik								
3.1.1	Amalan Pengurusan Terbaik *'Best Management Practices'* (BMPs) di tapak pembinaan			√	√			
KOD 1.0 REKABENTUK PASIF: 1.2 Prestasi 'Building Envolope' Yang Cekap								
1.2.1	Keperluan minimum '*building envelope*' (pengaliran haba) Nota: MS1525 atau MS2680	√	√	√	√			
1.2.2	Memperbaiki '*building envelope*' untuk bangunan sediada Nota: MS1525 atau MS2680					√	√	√
1.2.3	Pengurangan kenaikan haba daripada radiasi solar secara langsung Nota: MS1525 atau MS2680	√	√	√	√			
1.2.4	Memaksimumkan zon pencahayaan siang Nota: MS1525 atau MS2680				√			
1.2.5	Menggalakkan penggunaan pengudaraan semulajadi. Nota: MS1525 atau MS2680			√	√			
KOD 1.0 REKABENTUK PASIF: 1.3 Peningkatan Penggunaan Air Secara Efisien di dalam Bangunan								
1.3.1	Pelaksanaan penuaian air hujan	√	√	√	√			
1.3.2	Penjimatan penggunaan air terawat							
	a. cekap air	√	√	√	√			
	b. non-potable use	√	√	√	√			
1.3.3	Meningkatkan penggunaan air secara efisyen di bangunan sedia ada							
	a. cekap air					√	√	√
	b. non-potable use					√	√	√
1.3.4	Penggunaan semula bahan binaan untuk projek pembangunan semula			√	√			
KOD 1.0 REKABENTUK PASIF: 2.1 Sistem Penyaman Udara Cekap Tenaga								
2.1.1	Penyaman udara cekap tenaga		√		√			
2.1.2	Penukaran kepada penyaman udara cekap tenaga						√	
KOD 2.0 REKABENTUK PASIF: 2.2 Sistem Pencahayaan Cekap Tenaga								
2.2.1	Sistem pencahayaan cekap tenaga							
	a. pematuhan UBBL	√	√	√	√			
	b. sensor		√		√			
2.2.2	Penukaran kepada pencahayaan cekap tenaga							
	a. pematuhan UBBL					√	√	√
	b. sensor						√	
KOD 2.0 REKABENTUK PASIF: 2.3 Sistem Tenaga Boleh Baharu								
2.3.1	Pemasangan sistem tenaga boleh baharu			√	√			
2.3.2	Perlaksanaan *Net Energy Metering* (NEM) untuk sistem *Solar Panel* (PV - *Photo Voltaic)*			√	√			
2.3.3	Pengiraan BEI (*Building Energy Index*) bangunan hijau rendah karbon	√	√	√	√	√	√	√
KOD 4.0 KOMPONEN RENDAH KARBON 4.1 Pelan Bangunan Hijau Rendah Karbon								
4.1.1	Pengurusan Sisa Domestik yang mampan							
	a. bin center			√	√			
	b. recycling area			√	√			
	c. waste management plan			√	√			
KOD 4.0 KOMPONEN RENDAH KARBON 4.2 Pembangunan Mampan dan Audit Bangunan								
4.2.1	Sistem Pengurusan Tenaga (BEMS – *Building Energy Management System*)				√			
4.2.2	Pengumpulan data bangunan pintar dan pusat				√			
4.2.3	Manual Penggunaan Bangunan Hijau	√	√	√	√	√	√	√
	items to do	8	10	18	23	6	8	7

There are generally 2 project types – New and Existing. The criteria differ from these two project types. These include All buildings, non-residential only and large projects. One exception is for demolish-and-rebuilt projects, which are required to comply code 1.3.4 on material reuse, while still being required to comply with all other criteria as per New Buildings. In a nutshell, LCBC applies to all projects. As listed below:

1. New – Residential <1,000m2
2. New – Non-residential <1,000m2
3. New – Residential >1,000m2
4. New – Non-residential >1,000m2

5. Existing – Residential <1,000m2
6. Existing – Non-residential <1,000m2
7. Existing – Residential >1,000m2
8. Existing – Non-residential >1,000m2

Please note that items B.11 – “demolish and rebuild” projects may still be subjected to LCBC. These projects shall follow the requirements of “new” projects to their project sizes respectively.

The definition of large buildings in accordance with DBKL are buildings above 1,000m2. Those who are familiar with MS1525 would immediately notice the difference LCBC and MS1525 floor area threshold of 4,000m2 (conditioned spaces). These two are not the same. For DBKL, the minimum size requirement was introduced as an identification that the building is large if it exceeds 1,000m2 and/or above 5 storeyes, and not as per OSC guidelines. It also helps to ensure that the building or space is large enough to accommodate the necessary sustainable features and technologies required for LCBC compliance, where the 4,000m2 in MS1525 is the trigger requirement for the installation of Energy Management System (EMS)

PSP is required to identify the requirement and attempt the relevant criteria.

Buildings to achieve Green Building Certification

In the pursuit of sustainable and environmentally conscious construction, and in line with the KL Climate Action Plan 2050, projects may also be subjected to green building certification depending on the conditions in the DO. The selection of tool is to the discretion of the project, be it LEED, GBI, GreenRE or pHJKR or MyCrest for government projects. However, compliance to LCBC shall remain based on LCBC technical guide and its calculator. The green building certification ensures that structures adhere to specified environmental standards, promoting resource efficiency, energy conservation, and reduced environmental impact. By embracing green building practices, constructions not only contribute to global efforts for a healthier planet but also create spaces that prioritize the well-being of occupants and align with the principles of a sustainable future.

Process

In its entirety, the fundamental of the LCBC is a plans submission requirement. This shall be required for sustainable design strategies throughout the development process, from the planning approval phase to building plans approval and project completion. This is to ensure the effective integration of sustainability principles as outlined in the LCBC.

In the planning approval phase, sustainable design strategies set the foundation for environmentally responsible development. Integrating green elements at this stage requires thoughtful consideration of site matters, which is only a few within the LCBC. However, projects will be required to included commitments to all relevant criteria as early as this planning stage. This includes strategies like light fittings selection and energy performance. The planning approval will be issued with the LCBC built-in in compliance with the project.

During the building plans approval phase, the integrated LCBC items are to be submitted as designed, to align with LCBC objectives on energy efficiency, water conservation, and indoor environmental quality.

During project completion stage, upon CCC, projects will be required to record the LCBC integration based on monitoring and verifying sustainable features from the checklist, as per approved building plans.

The continuous process of sustainable design approach from planning to completion will allow for LCBC's positive outcomes and its sustainability goals as set out in the overall KL Action Plan. It demonstrates a commitment to responsible development that benefits not only the environment but also the community, occupants, and the project's long-term success.

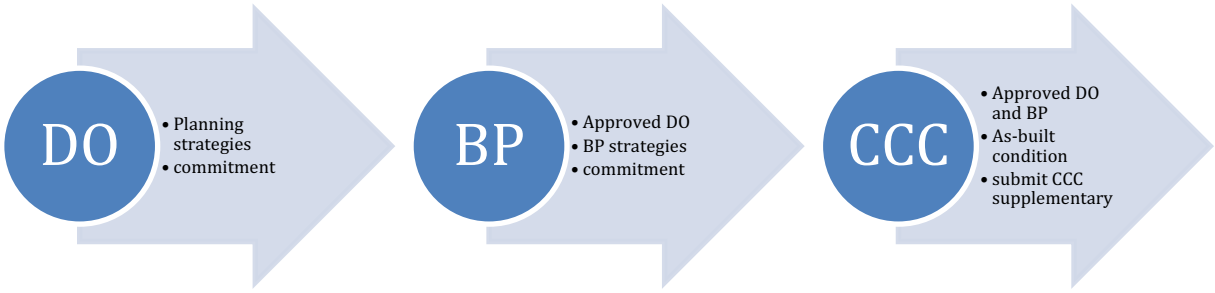


Figure 2 The LCB flow process

General process

The general process spans planning to completion. In planning, design strategies are selected to align with green goals. During construction, implementation is closely monitored to ensure adherence. Post-construction, documentation is compiled, and the project's sustainability performance is verified. Upon successful verification, certification (CCC) is issued, acknowledging the project's compliance with the LCB checklist. This holistic process, yet simplified, promotes environmentally responsible building practices, enhances energy efficiency, and elevates occupant well-being.

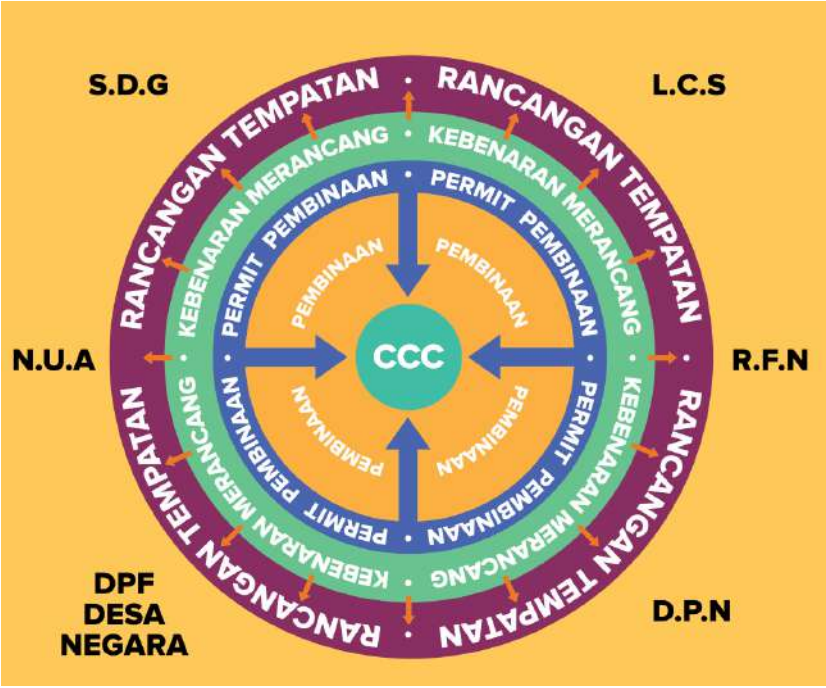


Figure 3 The Development nucleus *(excerpt from KPKT OSC document)*

P1 Pre-consultation

Process 1 of the OSC is for technical data gathering and is a **non-mandatory stage**. During this stage, it is good practice for the PSP/SP to engage with the local authority for pre-consultation and data collection as part of their due diligence. It is an invaluable process that allows for early assessment of project feasibility, minimizing risks, and ensuring alignment with project goals. Utilising this existing process, PSP/SP should also consult DBKL on the LCBC. This empowers PSP/SP to understand the LCBC requirement and to make informed decisions and devise effective strategies. Since the LCBC is a mandatory requirement, comprehensive data gathering and understanding of the LCBC will enable resource optimization, planning for project efficiency, and prevent costly setbacks. PSP/SP would also be able to address the LCBC requirements to the client and the project team for early action, paving the way for well-informed strategic design and construction processes. The LCBC is designed to be streamlined with conventional processes that PSP/SP would already be familiar with e.g. UBBL. This should eliminate the need for a designated ‘green consultant’ for the project.

P2 KM/DO Stage

The main objective of OSC's Process 2 is for processing and consideration of project applications that is received via OSC. This process requires compliance to a submission checklist, usually includes list of documents to be submitted, now, also includes LCBC. Since the items in the LCBC is building centric, at this stage, most items are considered to be complied by means of commitments. This is done through the LCBC 'calculator' and the LCBC summary page with the submission of documentation reflecting compliance to Kod 00 of the LCBC.

P2 BP

Upon issuance of DO, projects shall further develop for Building Plans submission. At this stage, all of the items in the LCBC that is relevant to the project will be required to be complied. The process shall utilize the LCBC calculator and its summary page along with the required documentation in its required format as described in the LCBC. The calculator will show the compliance status of each criteria based on user input. PSP/SP is advised to complete the calculator with all items 'complied' before proceeding with submission.

P6 CCC

Upon BP approval and project commencement, the project is required to be monitored to ensure all items as complied with the LCBC to be observed and documented based on their respective requirement. Project is expected to document all compliance progressively and to be compiled as supplementary documentation at CCC stage. This requires projects to again, utilize the LCBC calculator as a checking mechanism and subsequently as a reporting documentation for the CCC stage on all LCBC criteria compliance.

Documentation strategies

An LCBC folder template shall be utilized by the project. These folders are set as standard to all projects and should not be altered in order to preserve its uniformity. The documentations that are to be saved into these folders shall follow the template samples that is readily available in the respective folders, along with its naming conventions. As project documentation is done progressively, the PSP/SP would be able to monitor LCBC compliance throughout the construction progress and to be closed at the same time of the CCC. However, documentation for LCBC is not mandatory. It is used for PSP/SP to manage the compliances of all LCBC criteria, and may be reviewed by DBKL only if necessary.

Compliance to LCBC shall be based on the completion of the LCBC calculator, and the application of the strategies in the submission in the form of drawings, specification and tabulation.
All submissions must ensure the LCBC checklist is COMPLIED.

DBKL review process

Although the reviewing officers in DBKL are also technical persons, the responsibility to ensure compliance rests on the PSP/SP diligence to ensure compliance. The checking officers would use the LCBC calculator, submitted in its native format to do any counter checks whenever required. The submission plans (and supporting documentation) and their respective compliance based on the calculator should not defer from the one approved during its precedent stages as any deviation to the approved plans may be subject to resubmission of amendments to approved plans. As a mandatory requirement, the LCBC can become a factor in plans' rejection for non-compliance to the KL Low Carbon Society Blueprint 2030 initiative.

Table 3 DBKL processing departments

	PENERANGAN	SEMAKAN JABATAN
KOD 1.0 KEPRIHATINAN TAPAK: 1.1 Pengurangan Fenomena Pulau Haba Bandar (UHI – Urban Heat Island)		
1.0.1	Penggunaan bahan-bahan yang sesuai di permukaan bangunan (bumbung & lanskap kejur)	JKB
1.0.2	Meningkatkan keperluan litupan hijau bangunan	(UPL) JPRB
1.0.3	Memperbaiki Litupan hijau pada bumbung rata bangunan sediada	
KOD 1.1 KOMPONEN RENDAH KARBON 3.1 Penghapusan atau Pengurangan Bahan Cemar dengan Punca Tidak Bertitik		
1.1.1	Amalan Pengurusan Terbaik *'Best Management Practices'* (BMPs) di tapak pembinaan	JPRB (OSC), JKB
KOD 2.0 REKABENTUK PASIF: 1.1 Prestasi 'Building Envelope' Yang Cekap		
2.0.1	Keperluan minimum '*building envelope*' (pengaliran haba)	JKB
2.0.2	Memperbaiki '*building envelope*' untuk bangunan sediada	JKB
2.0.3	Pengurangan kenaikan haba daripada radiasi solar secara langsung	JKB
2.0.4	Memaksimumkan zon pencahayaan siang	JKB
2.0.5	Menggalakkan penggunaan pengudaraan semulajadi.	JKB
KOD 1.0 REKABENTUK PASIF: 1.3 Peningkatan Penggunaan Air Secara Efisien di dalam Bangunan		
1.3.1	Pelaksanaan penuaian air hujan	JPIF, JKB
1.3.2	Penjimatan penggunaan air terawat	JPIF, JKB
1.3.3	Meningkatkan penggunaan air secara efisyen di bangunan sedia ada	JPIF
1.3.4	Penggunaan semula bahan binaan untuk projek pembangunan semula	JKB
KOD 2.0 REKABENTUK AKTIF: 2.1 Sistem Penyaman Udara Cekap Tenaga		
2.1.1	Penyaman udara cekap tenaga	JKB
2.1.2	Penukaran kepada penyaman udara cekap tenaga	JPRB (OSC), JPIF
KOD 2.0 REKABENTUK AKTIF: 2.1 Sistem Penyaman Udara Cekap Tenaga		
2.2.1	Sistem pencahayaan cekap tenaga	JPRB (OSC), JPIF
2.2.2	Penukaran kepada pencahayaan cekap tenaga	JPRB (OSC), JPIF
KOD 2.0 REKABENTUK AKTIF: 2.1 Sistem Penyaman Udara Cekap Tenaga		
2.3.1	Pemasangan sistem tenaga boleh baharu	JPRB (OSC) , JKB
2.3.2	Perlaksanaan *Net Energy Metering* (MET) untuk sistem *Solar Panel* (PV - *Photo Voltaic)*	JPRB (OSC) , JKB
2.3.3	Pengiraan BEI (*Building Energy Index*) bangunan hijau rendah karbon	JPRB (OSC) , JKB
KOD 4.0 KOMPONEN RENDAH KARBON 4.1 Pelan Bangunan Hijau Rendah Karbon		
4.1.1	Pengurusan Sisa Domestik yang mampan	JPRB (OSC), SW Corp
KOD 4.0 KOMPONEN RENDAH KARBON 4.2 Pembangunan Mampan dan Audit Bangunan		
4.2.1	Sistem Pengurusan Tenaga (BEMS – *Building Energy Management System*)	JPRB (OSC) , JKB
4.2.2	Pengumpulan data bangunan pintar dan pusat	JPRB (OSC) , JKB
4.2.3	Manual Penggunaan Bangunan Hijau	JPRB (OSC) , JKB

Timeline

The LCBC effort shall match the project timeline as it is part of plan approvals and issuance of CCC. Aligning the LCBC compliance with the project timeline is crucial for seamless integration of environmentally responsible practices that should not jeopardize the project progress. Incorporating LCBC from the project's outset ensures timely consideration of energy-efficient systems, eco-friendly materials, and green design strategies. This alignment prevents costly retrofits and minimizes disruptions during the construction stage. By synchronizing LCBC milestones with the timeline, projects can achieve optimal energy performance and resource efficiency, meeting both sustainability and budgetary goals. This synergy between sustainability and timeline underscores the importance of proactive planning, ultimately creating buildings that are not only environmentally conscious but would also be completed on schedule.

Roles and responsibilities of the project team

Compliance with the LCBC is the responsibility of the project team. This requires client involvement with proactive attention by the respective project teams. Each discipline's responsibilities are intertwined, forming a collaborative effort essential for successful LCBC implementation, leading to environmentally responsible, high-performing buildings.

Architectural Discipline:

- *Compliance with all legislations and statutory requirements.*
- *Sustainable Design Integration:* Architects lead the incorporation of LCBC criteria into the building's architectural design, ensuring alignment with sustainable strategies.
- *Material Selection:* Architects choose eco-friendly materials and finishes that comply with LCBC requirements, optimizing indoor air quality and resource use.
- *Passive Design:* They implement passive design strategies for energy efficiency, daylighting, and thermal comfort, contributing to LCBC criteria.
- *Indoor Environmental Quality:* Architects focus on designing spaces with optimal ventilation, acoustics, and lighting, promoting occupant well-being.
- *Water Efficiency:* They create water-efficient plumbing and irrigation systems, complying with LCBC water efficiency criteria.

Engineering Discipline:

- *Compliance with all legislations and statutory requirements.*
- *Energy Systems:* Engineers design energy-efficient ACMV, lighting, and renewable energy systems, aiming to achieve LCBC energy-related criteria.
- *Commissioning:* Engineers oversee commissioning processes to ensure systems perform as intended, meeting LCBC requirements.
- *Mechanical and Electrical Integration:* Engineers ensure seamless integration of sustainable mechanical and electrical systems aligned with LCBC requirements.

Client Scope:

- *Resource Allocation:* Clients allocate resources for LCBC initiatives, recognizing potential long-term savings and benefits.
- *Decision-Making:* Clients make informed decisions that align with LCBC criteria, contributing to the overall sustainability strategy.
- *Ongoing Engagement:* Clients provide the necessary documentation and information required for LCBC certification, demonstrating commitment to sustainability.

Using the LCB calculator

The LCBC calculator is a tool that aids in estimating the potential LCBC criteria compliance. It offers a dynamic way to assess the impact of design decisions on LCBC criteria and helps project teams document effective documentation and compliance throughout the process.

Key uses of the LCBC calculator:

- *Selection of relevant criteria:* It predicts the number of LCBC criteria a project might be required to pursue based on inputs related to building types.
- ***Design Decision Support:*** The calculator assists in making informed design choices by illustrating the potential influence of different strategies on LCBC outcomes.
- ***Documentation:*** It guides project teams by suggesting the required documentation for each criteria and offering insights into the evidence needed for compliance.
- ***Early Planning:*** LCBC calculator enables early-stage assessment, allowing architects and engineers to consider sustainable options from the project's inception.
- ***Performance Tracking:*** As the project progresses, the calculator helps monitor compliance, flagging areas where additional documentation might be needed.

Incorporating the LCBC calculator streamlines the documentation process by providing as-you-go feedback on compliance efforts. It aids in collecting appropriate data and evidence, reducing the chances of missing required documentation. Furthermore, it enhances communication among team members, ensuring everyone is aligned with LCBC goals. It is a key to efficient, well-documented, and successful LCBC compliance.

KOD 00 Planning strategies

KOD 1.0 REKABENTUK PASIF / KOD 1.0 PASSIVE DESIGN
1.2 Pengurangan Fenomena Pulau Haba Bandar (Urban Heat Island)
1.2 Reduction of Urban Heat Island Phenomenon

KOD 3.0 KOMPONEN RENDAH KARBON / CODE 3.0 LOW CARBON COMPONENTS
3.1 Penghapusan atau Pengurangan Bahan Cemar dengan Punca Tidak Bertitik
3.1 Elimination or Reduction of Nonpoint Source Pollutants

1.1.1 Penggunaan bahan-bahan yang sesuai di permukaan bangunan (bumbung & lanskap kejur)

The use of appropriate materials on the surface of the building (roof and hardscape)

Kategori bangunan / Building category:
Baharu – skala besar (>1,000m2) Kediaman & Bukan Kediaman
New – large scale (>1,000m2) Residential & Non-Residential

Jabatan penyemak / *Checking department* : JKB

Keperluan PSP / PSP Requirement

Tujuan / Intent

Tingkatkan kecekapan tenaga dan kemampanan bangunan dengan memilih bahan bumbung dengan nilai Indeks Pantulan Suria (SRI) yang tinggi bagi mengurangkan penyerapan haba, meminimumkan kesan pulau haba, dan menggalakkan persekitaran binaan yang lebih sejuk dan selesa.
To enhance the energy efficiency and sustainability of buildings by selecting roofing materials with high Solar Reflectance Index (SRI) values, thereby reducing heat absorption, minimizing the urban heat island effect, and promoting a cooler and more comfortable built environment.

Keperluan / Requirement

1. Landskap Kejur / hardscape
   Minimum 50% kawasan lanskap kejur atau hardscape (pavement, permukaan parkir, dsbg) di aras tanah menggunakan bahan turapan dengan nilai SRI >29
   Minimum of 50% hardscape area (pavement, parking, etc.) on ground floor to apply materials with SRI >29.

2. Bumbung / Roof
   a. Kawasan bumbung cerun rendah (<9 darjah) perlu menggunakan bahan bumbung dengan SRI>78, merangkumi 75% kawasan permukaan bumbung (diukur dari pelan).
      Flat or low sloped roof (<9 degrees) to apply materials with SRI >79, covering 75% of total roof area (measured from plan).

   b. Kawasan bumbung cerun curam (>9 darjah) perlu menggunakan bahan bumbung dengan SRI > 29
      sloped roof (>9 degrees) to apply materials with SRI >29.

Pelaksanaan / Implementation

1. Kenal pasti luas kawasan mengikut pelan.
   Identify roof areas from plan.
2. Kenal pasti kawasan plinth.
   Identify plinth area.
3. Kenal pasti kawasan hijau dengan tumbuhan, tidak termasuk kawasan berumput.
   Identify green areas with vegetation, excluding turf areas.
4. Kenal pasti kawasan landskap kejur.
   Identify hardscape areas.
5. Kenal pasti kawasan jalan kenderaan (driveway). Jalan laluan kenderaan bukan konkrit tidak terpakai.
   Identify driveways, unless driveway is concrete, it would not comply.
6. Tetapkan kawasan landskap kejur atau bumbung dengan SRI yang berpatutan.
   Specify hardscape areas and roofs with the applicable SRI values.
7. Masukkan pengiraan kawasan ke dalam kalkulator dan pindahkan data ke lukisam pelan KM.
   Apply areas calculation into the LCBC calculator and transfer the data into the planning drawing.

Pematuhan / Compliance

Sediakan pengiraan dengan pengesahan PSP/SP pada pelan berdasarkan kalkulator LCBC dengan mematuhi keperluan kriteria ini.

Prepare the calculation that is endorsed by a PSP/SP on plan in accordance with the LCBC calculator in accordance with this criteria's requirement.

Contoh / Example

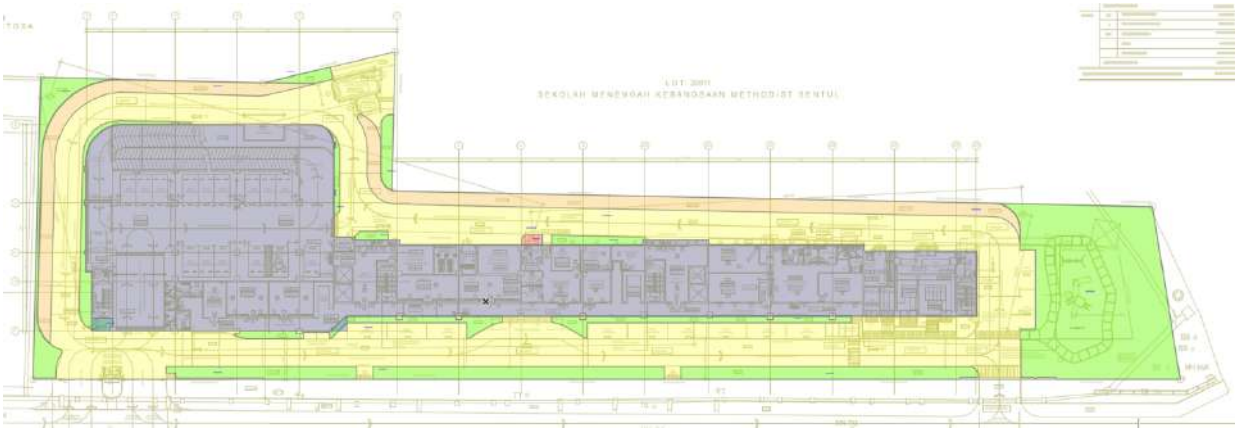


Figure 4 Example of project and green area demarcation

Figure 5 material table with SRI indication

Penerangan Lanjut / Further explanation

SRI is a measure used in the construction and roofing industry to assess the thermal performance of building materials, particularly roofing materials. It is a numerical value that takes into account a material's ability to reflect solar energy (solar reflectance) and its capacity to emit stored heat (thermal emittance). SRI values are typically used to evaluate how hot a material, like a roofing surface, can become when exposed to sunlight.

The higher the SRI value, the better a material is at reflecting sunlight and reducing heat absorption, making it a cooler and more energy-efficient choice for roofing in warm climates. Conversely, materials with lower SRI values tend to absorb more heat and can lead to increased cooling costs in buildings.

SRI values are an important consideration in green building and sustainable design, as they contribute to energy efficiency, reduce the urban heat island effect, and improve the comfort of indoor spaces.

it's essential to consider several factors to make informed decisions that align with the project's goals and local climate conditions. Here are some key considerations and tips:

1. *Material Type:* Different materials, such as cool roofing materials, asphalt shingles, metal roofing, or reflective coatings, have varying SRI values. Consider the material's properties in relation to the project's needs.
2. *Aesthetic and Design Preferences:* Balance performance with aesthetic preferences. Some high-SRI materials may have limited color choices, so consider the impact on the building's appearance.
3. *Long-Term Durability:* Evaluate the durability and expected lifespan of the material. Ensure it can maintain its reflective properties over time.
4. *Maintenance Requirements:* Consider the maintenance demands of the material. Some high-SRI materials may require specific care to retain their performance.

Kalkulator / Calculator

All input for this criteria is applied at the “General info” page for area calculations.
Project is then required to key in the material, color and SRI in the criteria page input.

Proses Semakan / Review process

Jabatan penyemak / *Checking department* : JKB

Pemeriksaan kendiri oleh PSP/SP / *PSP/SP selfcheck*

1. Lorekkan kawasan perlulah jelas sepaya senang di rujuk
   Markup of compliance areas for ease of review.
2. Pengiraan juga perlu jelas.
   Calculations to be clear.
3. Sertakan jadual SRI dan tandakan pemilihan yang mematuhi keperluan kirteria.
   Include SRI tabulation and highlight the selection that complies criteria requirement.

Proses Semakan oleh DBKL / *Review process by DBKL*

1. Semakan kepada ringkasan LCBC.
   LCBC summary and calculator review.
2. Jadual LCBC disertakan di dalam pelan lukisan
   Inclusion of LCBC tabulation in drawing
   a. Jumlah keseluruhan kawasan / *Total site area*
   b. Jumlah kawasan landskap kejur / *Total hardscape area*
   c. Pematuhan kepada keperluan SRI / *Compliance to SRI requirement.*

Keperluan Pengemukaan / Submission requirements

Pra-semakan / Pre-consultation

1. Pra-ketentuan pengiraan dan sediakan lukisan awalan untuk perbincangan.
   Pre-determine the calculation and provide preliminary plan for discussion.

Kebenaran merancang / *Planning approval (DO Stage)*

1. Jadual Pematuhan disertakan sebagai sebahagian daripada pelan pengemukaan DO.
   Compliance tabulation included as part of DO submission plan
2. Kalkulator LCBC yang telah dilengkapkan.
   Complete the LCBC calculator.
3. Dokumen sokongan, sekiranya ada.
   Optional documentation, if any.

Kelulusan Pelan Bangunan / *Building Plan approval (BP Stage)*

1. Nilai SRI untuk turapan ditandakan pada pelan bangunan
   SRI value of pavement is indicated/ annotated in Building plan.
2. Kalkulator LCBC yang telah dilengkapkan.
   Complete the LCBC calculator.
3. Beri keterangan sekiranya ada perubahan daripada peringkat sebelumnya.
   Describe deviation from previous stage of the LCBC calculator.

Peringkat CCC / *CCC stage*

1. Pematuahan kepada SRI disertakan dalam lukisan terbina.
   As-built plan indicating SRI compliance as approved.
2. Borang pengesahan pematuhan kriteria yang ditanda tangani oleh PSP/SP.
   Confirmation of criteria compliance form and signed by PSP/SP.
3. Bukti bergambar / Photo evidence
4. Sertakan sebagai sebahagian pengemukaan borang G tang bersesuaian.
   Attach as part of supplementary appendix documentation for relevant G forms.
5. Beri keterangan sekiranya ada perubahan daripada peringkat sebelumnya.
   Describe deviation from previous stage of the LCBC calculator.

1.1.2 Meningkatkan keperluan litupan hijau bangunan
Increase the green coverage requirements of buildings

Kategori bangunan / Building category:
Baharu – skala besar (>1,000m2) Kediaman & Bukan Kediaman
New – large scale (>1,000m2) Residential & Non-Residential

Jabatan penyemak / *Checking department* : (UPL) JPRB

Keperluan PSP / PSP Requirement

Tujuan / Intent

Kawasan hijau mampu meningkatkan interaksi pengguna dengan aktiviti di luar dan pendekatan kepada alam semula jadi.

Green open spaces can help to promote building occupant interaction with outdoor activities and closer to nature.

Keperluan / Requirement

1. Melebihi minimum Green Plot Ratio mengikut keluasan tanah iaitu >10%
   Exceed the minimum Green Plot Ratio by land area >10%

2. Digalakkan untuk membuat tambahan 10% kepada litupan hijau bangunan secara mendatar dan menegak, atau dengan jumlah kedua-duanya
   Encouraged to add 10% of green covered area, horizontal and vertical, or the total for both.

Pelaksanaan / Implementation

1. Identify green areas on plan, to be concentrated to enable it to be used for outdoor activities
2. Calculate the percentage of green area based on compliance

Pematuhan / Compliance

1. Plan, calculation and verification related to green coverage by certified consultant

Contoh / Example

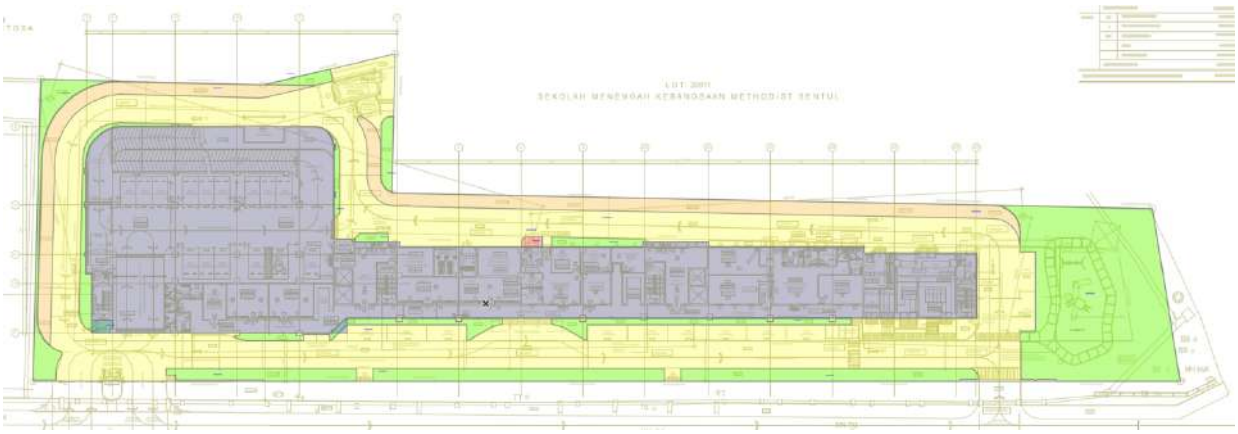


Figure 6 example of project site area calculation

Penerangan Lanjut / Further explanation

Green areas promote environmental sustainability in several ways. They support local biodiversity by providing habitats for diverse plant and animal species. Trees and vegetation within these areas help purify the air by removing pollutants and releasing oxygen, thus improving air quality. Additionally, green spaces aid in regulating temperature within urban environments, acting as natural coolers. This reduces the "urban heat island" effect, making the environment more comfortable.

LCBC's requirement for green areas offers opportunities for physical activity and relaxation where occupants can do plenty of outdoor activities. This promotes a healthy lifestyle and well-being. Access to green spaces is also associated with reduced stress and improved mental health, enhancing overall quality of life while providing a good setting for gatherings, cultural activities, and other social functions, strengthening social bonds and fostering a sense of community.

Pengiraan / Calculation

$$Green\ space\ provision = \frac{\min 10\ \%}{\text{Total site area}}$$

Equation 1 Green space area formula

$$increased\ of\ Green\ space\ provision = Green\ space\ provision\ x\ 110\%$$

Equation 2 increased of green space area formula

Green spaces enhance the visual aesthetics of a development. Trees, lawns, and landscaped areas contribute to the overall beauty of the surroundings, making the area more attractive to residents, visitors, and potential investors. It can also contribute in managing stormwater and help prevent flooding and drainage issues by absorbing rainwater, reducing runoff. Moreover, these natural settings filter and improve the quality of stormwater before it enters water bodies.

Kalkulator / Calculator

All input for this criteria is applied at the "General info" page for area calculations.
No input required in the criteria page input.

Proses Semakan / Review process

Jabatan Penyemak / *Checking department* : (UPL) JPRB

Pemeriksaan kendiri oleh PSP/SP / *PSP/SP selfcheck*

1. Lorekkan kawasan perlulah jelas sepaya senang di rujuk
   Markup of compliance areas for ease of review.
2. Pengiraan juga perlu jelas.
   Calculations to be clear.

Proses Semakan oleh DBKL / *Review process by DBKL*

1. Semakkan kawasan hijau yang dilaksanakan
   Review of green areas provided
2. Semak kebolehgunaan kawasan untuk aktiviti luar.
   Review usability of open areas for outdoor activities
3. Semakan kepada ringkasan LCBC.
   LCBC summary and calculator review.
4. Jadual LCBC disertakan di dalam pelan lukisan
   Inclusion of LCBC tabulation in drawing
   a. Jumlah keseluruhan kawasan / *Total site area*
   b. Jumlah kawasan terbuka / *Total open area*

Keperluan Pengemukaan / Submission requirements

Pra-semakan / Pre-consultation

1. Pre-determine the calculation and provide preliminary plan for discussion

Kebenaran merancang / *Planning approval (DO Stage)*

1. Compliance is included as part of KM submission plan and reports (if any)
2. Complete the LCBC calculator.
3. Optional documentation.

Kelulusan Pelan Bangunan / *Building Plan approval (BP Stage)*

1. Tabulation of area calculation is indicated/ annotated in Building plan
2. Complete LCBC calculator.
3. Describe deviation from the previous stage of the LCBC calculator, if any.

Peringkat CCC / *CCC stage*

1. As-built plan indicating green areas as approved
2. Confirmation of criteria compliance form and signed by PSP/SP

3. Photo evidence
4. Attach as part of supplementary appendix documentation for relevant G forms.
5. Describe deviation from the previous stage of the LCBC calculator, if any.

1.1.3 Memperbaiki Litupan hijau pada bumbung rata bangunan sediada

Enhanced green coverage on flat roof of existing building

Kategori bangunan / Building category:
Sediada – skala besar (>1,000m2) Kediaman & Bukan Kediaman
Existing – large scale (>1,000m2) Residential & Non-Residential

Jabatan penyemak / *Checking department* : (UPL) JPRB

Keperluan PSP / PSP Requirement

Tujuan / Intent

Meningkatkan kawasan hijau mampu menurunkan kadar serapan haba dan meggalakkan persekitaran yang lebih nyaman.

Enhancing green areas can reduce heat absorption rates and promote a more comfortable environment.

Keperluan / Requirement

Buat tambahan 10% kepada litupan hijau bangunan secara mendatar dan menegak, atau dengan jumlah kedua duanya.

To introduce an additional 10% in both horizontal and vertical green building coverage, or a combination of both.

Pelaksanaan / Implementation

1. Sediakan pelan tapak asal dan kira jumlah kawasan hijau sediada.
   Prepare the existing site plan and calculate its existing green area.
2. Semak jumlah kawasan keluasan bumbung dan potensi menaiktaraf sebagai bumbung hijau.
   Review areas for roof and estimate the possibility of converting it into a green roof.
3. Semak keluasan permukaan fasad dan potensi menaik taraf sebagai kawasan hijau menegak.
   Review façade area and the potential to convert some areas into vertical planting.
4. Rujuk cara terbaik untuk aplikasi penghijauan dengan mengambil kira keperluan asasi seperti keperluan waterproofing dan kemudahan pengairan.
   Review best practices for adding greenery while taking into consideration basic requirements for waterproofing and irrigation.

Pematuhan / Compliance

Sediakan pelan, pengiraan dan pengesahan berkaitan keperluan litupan hijau bangunan oleh PSP/SP

Prepare plan, calculation and verification by a PSP/SP

1. Nyatakan peratusan kawasan hijau atas tanah sedia ada.
   Identify existing green areas on grade in percentage.

2. Nyatakan kawasan hijau litupan bangunan
   Identify greeneries on building
   a. Mendatar / *Flat*
   b. Menegak / *Vertical*

Contoh / Example

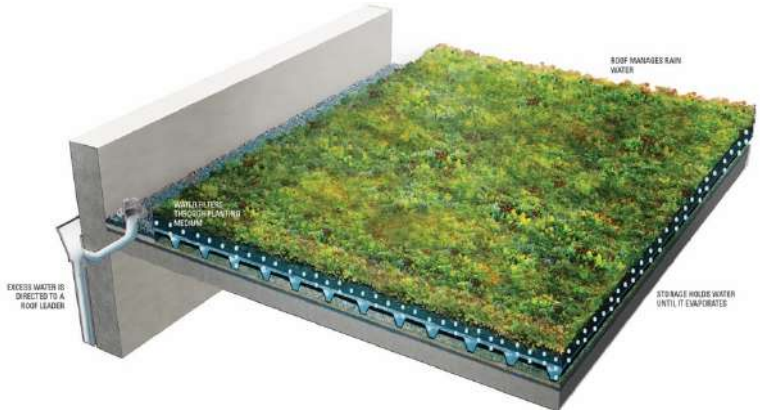


Figure 7 Sample green roof detail

Penerangan Lanjut / Further explanation

Adding a green roof to an existing building is a transformative step toward enhancing sustainability and urban well-being. Beyond the environmental advantages, such as mitigating the urban heat island effect and managing stormwater runoff, green roofs breathe new life into urban spaces. They provide natural insulation, regulating indoor temperatures and reducing energy consumption.

The aesthetic transformation is remarkable, with greenery adding visual appeal to the building and the surrounding area. Moreover, accessible green roofs become vibrant social hubs, offering spaces for relaxation, social gatherings, and even urban agriculture. The extended roof life due to protection from weather and UV rays is an economic benefit, while compliance with green building regulations and potential property value enhancement add further incentives.

When on buildings, green spaces can also offer energy-saving benefits especially if its integrated as part of the roof or 'green roof' which can reduce the need for energy-intensive cooling in buildings during hot weather.

Pengiraan / Calculation

$$\text{new green area (on roof + on facade)} = \text{existing green area x } 10\%$$

Equation 3 new green areas calculation formula

Apply the calculation as above. Paying attention that the area required to fulfill the criteria is only 10% when combined together on top of the existing green area on site.

Projects to review potential surfaces that can benefit from greeneries. This includes roof areas as well as façade areas. The requirements for both areas differ, so projects should carefully review the strategy and ensure application for greenery can become effective. Consider the requirement for irrigation and also fertilizing is needed, if not just simple maintenance. Being 'on' the building also poses a threat to water penetration that can lead to serious problems.

Kalkulator / Calculator

All input for this criteria is applied to the "General info" page for area calculations.
No input is required in the criteria page input.

Proses Semakan / Review process

Jabatan penyemak / *Checking department* : UPL (JPRB)

Pemeriksaan kendiri oleh PSP/SP / *PSP/SP selfcheck*

1. Lorekkan kawasan perlulah jelas sepaya senang di rujuk
2. Pengiraan juga perlu jelas.
3. Sediakan lukisan detail and reference imageries or rendering
4. Ensure planting system can be maintained and managed

Proses Semakan oleh DBKL / *Review process by DBKL*

1. Semakkan kawasan hijau yang dilaksanakan
2. Semak lain-lain keperluan teknikal.

Keperluan Pengemukaan / Submission requirements

Pra-semakan / Pre-consultation

1. Pre-determine the calculation and provide preliminary plan for discussion

Kebenaran merancang / *Planning approval (DO Stage)*

1. Compliance is included as part of KM submission plan and report (if any)

Kelulusan Pelan Bangunan / *Building Plan approval (BP Stage)*

1. Green area with calculation is indicated/ annotated in Building plan

Peringkat CCC / *CCC stage*

1. As-built plan indicating SRI compliance as approved
2. Confirmation of criteria compliance form and signed by PSP/SP
3. Photo evidence
4. Attach as part of supplementary appendix documentation for relevant G forms.

3.1.1 Amalan Pengurusan Terbaik '*Best Management Practices*' (BMPs)
Best Management Practices (BMPs)

Kategori bangunan / Building category:
Baharu – skala besar (>1,000m2) Kediaman & Bukan Kediaman
New – large scale (>1,000m2) Residential & Non-Residential

Jabatan penyemak / *Checking department* : JPRB (OSC), JKB

Keperluan PSP / PSP Requirement

Tujuan / Intent

Mengurangkan dan mengawal kadar larian hujan dan kualiti air dalam tapak sebelum disalurkan ke longkang bagi mengatasi masalah banjir kilat dan pencemaran melalui pencemaran dari aras permukaan.
Reducing and controlling rainwater runoff rates and water quality on-site before it is channeled into drains to address flash flood issues and pollution caused by surface-level contamination.

Keperluan / Requirement

1. Kawal air larian hujan dari terus memasuki longkang.
   Control surface runoff from directly discharging into drains.
2. Sediakan kawasan tapak yang mesra alam yang boleh menahan air larian hujan daripada terus disalurkan keluar.
   Prepare environmentally friendly areas that are capable to temporarily store stormwater runoff from being discharged directly.
3. Kira kadar air larian hujan dan cadangkan strategi pengurusan air larian hujan dengan cara BMP - infiltration, evapotranspiration atau catchment – termasuk SPAH.
   Estimate the rate of stormwater runoff and propose surface runoff management using BMPs – including RWH.
4. Pengurangan perlulah merujuk kepada Qpost<Qpre
   Water reduction should be Qpost<Qpre
5. Atau sediakan detention tank yang patuh Qpost<Qpre.
   Otherwise, design for an on-site detention to comply Qpost<Qpre.
6. Mematuhi garis panduan yang ditetapkan JPIF.
   Comply with JPIF requirements.

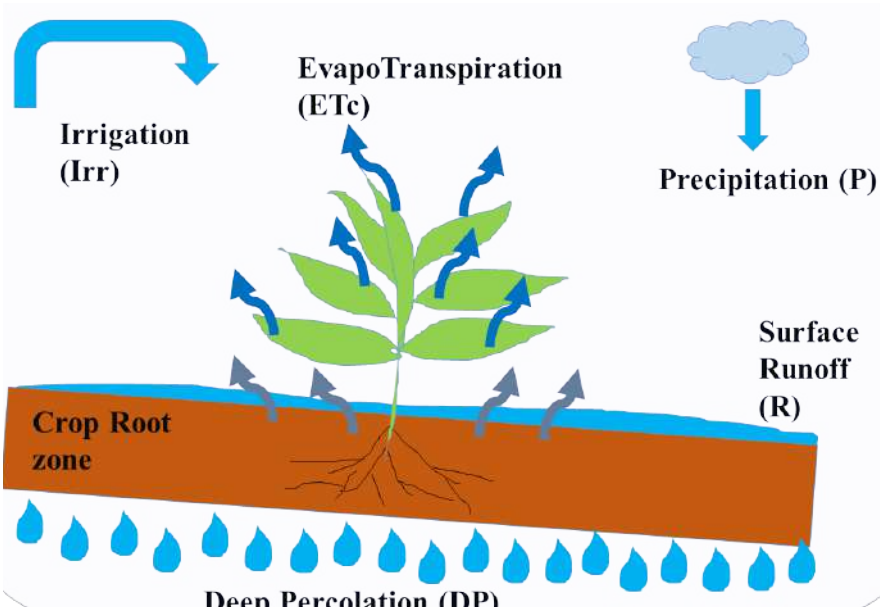
Pelaksanaan / Implementation

1. Semak kadar air larian hujan menggunakan MASMA.
   Review stormwater runoff based on MASMA.
2. Cadangkan strategi mesra alam di tapak
   Propose sustainable site strategies.
3. Sediakan pengiraan tadahan air larian hujan.
   Implement water catchment calculation.
4. Cadangan on-site detention sekiranya BMP tidak dapat dilaksanakan. OSD masih perlu mematuhi syarat kualiti air keluar sebagaimana dinyatakan didalam dokumen MASMA.
   Alternatively, provide an OSD is BMP cannot be met. OSD must still comply to discharge water quality as per MASMA requirement.

Pematuhan / Compliance

1. Pengiraan air larian hujan.
   Stormwater runoff calculation.
2. Cadangkan strategi mengekalkan air larian hujan dalam tapak.
   Stormwater runoff strategies on site.
3. Nyatakan jumlah air larian hujan yang kekalkan/ditahan sebelum disalirkan keluar dari tapak.
   Identify the total amount of water retained from being discharged out from the site.
4. Sertakan pematuhan kepada MASMA.
   Provide compliance to MASMA.

Contoh / Example



(source: internet)

Figure 8 BMP concept diagram

Penerangan Lanjut / Further explanation

Stormwater runoff or rainwater that flows across impervious surfaces like roads and rooftops, can lead to two significant environmental challenges: floods and downstream pollution. When excessive rainwater runoff occurs, it can overwhelm drainage systems and natural water bodies, resulting in flash floods. These sudden, intense floods can damage infrastructure and pose risks to public safety. Furthermore, stormwater runoff can carry pollutants such as oil, heavy metals, and chemicals from roads and urban areas into streams, rivers, and ultimately, larger bodies of water downstream. This pollution can harm aquatic ecosystems, affect water quality, and pose health risks to humans who rely on these water sources. To address these issues, effective stormwater management and pollution control measures are essential to mitigate the impacts of urban development and safeguard our water resources.

Best Management Practices (BMPs) are a set of strategies and techniques employed to effectively manage stormwater, reduce flooding, and mitigate pollution in urban environments. Its primary objective is to prevent or minimize the adverse effects of runoff. BMPs encompass a range of practices that can be implemented at different stages of urban development, from planning and design to post-construction maintenance.

BMPs include both structural and non-structural measures. Structural BMPs involve physical changes to the environment, such as the installation of retention basins, swales, permeable pavement, and green infrastructure like rain gardens and green roofs. These features help capture and manage stormwater, allowing it to infiltrate into the ground or be stored and slowly released, thus reducing the risk of flooding and filtering pollutants.

Pengiraan / Calculation

$$\frac{(\text{Rain garden}) + (\text{infiltration}) + (\text{evapotranspiration}) + (reuse)}{\text{rainfall depth}} > 50\% \; or \; provide \; OSD$$

Equation 4 Stormwater runoff calculation formula

Non-structural BMPs, on the other hand, focus on changing behaviors, policies, and practices to reduce stormwater pollution. These may include public education campaigns to promote responsible pet waste disposal, reduced fertilizer use, and proper disposal of hazardous materials. They also encompass zoning and land-use regulations that require developers to incorporate sustainable stormwater management practices into their projects. Here are a few examples of common BMPs:

1. **Retention and Detention Basins:** Retention and detention basins are engineered structures that capture and hold stormwater runoff. Retention basins permanently store water, allowing it to gradually infiltrate into the ground or evaporate, while detention basins temporarily hold water

before slowly releasing it into downstream water bodies. These BMPs help reduce the risk of flooding and filter pollutants from runoff.

2. **Permeable Pavement:** Permeable pavements, such as permeable concrete or pavers, are designed to allow water to penetrate through the surface and into the ground. They reduce runoff, encourage groundwater recharge, and help remove pollutants as water passes through the pavement materials.
3. **Green Roofs:** Green roofs are roofs covered with vegetation and growing medium. They absorb and retain rainwater, reducing stormwater runoff and cooling the building in hot weather. Green roofs also provide habitat for wildlife and contribute to improved air quality.
4. **Rain Gardens:** Rain gardens are shallow, landscaped depressions that capture stormwater from roofs and pavement. They are planted with native vegetation, which helps filter and treat the water, removing pollutants before it enters local water bodies.
5. **Erosion Control Measures** Erosion control BMPs, such as silt fences, sediment basins, and hydroseeding, are crucial on construction sites. They prevent soil erosion and the transport of sediment into water bodies, which can harm aquatic ecosystems and reduce water quality.
6. **Maintenance and Inspection Programs:** Regular maintenance and inspection of stormwater management infrastructure are essential BMPs. Ensuring that systems are functioning correctly and addressing issues promptly helps maintain their effectiveness over time.

Kalkulator / Calculator

Apart from complying to MASMA, the calculator wants to see how projects can retain water from rain, without having it leave the site. Rain calculation is based on an estimated 90th percentile, and depending on the strategies within this criteria, projects can show how the impact on the main drain can be reduced.

Majority of input is in the criteria page.
Insert the BMP strategies and the estimated water retained from going out of the site.
A sample of this calculation is included in the calculator.

Proses Semakan / Review process

Jabatan penyemak / *Checking department* : JPRB (OSC), JKB

Pemeriksaan kendiri oleh PSP/SP / *PSP/SP selfcheck*

1. Pengiraan jumlah hujan berdasarkan MASMA
   Calculation of stormwater runoff according MASMA
2. Strategi BMP berdasarkan jumlah keluasan kawasan
   Provision of BMP strategies based on total area
3. Pengiraan juga perlu jelas Qpost<Qpre.

Qpre<Qpost calculation should be clear.

4. Sediakan lukisan perincian
   Prepare detail drawings.
5. Nyatakan penggunaan strategi lain, contoh Bioswale sebagai kawasan aktiviti, penggunaan SPAH dalam bangunan dan siraman pokok, dsb.
   Provide explanation on BMP strategies e.g. bioswale as activity areas and RWH for irrigation, etc.

Proses Semakan oleh DBKL / *Review process by DBKL*

1. Pematuhan MASMA
   MASMA compliance
2. Semakkan kawasan BMP yang dilaksanakan
   Review of proposed BMPs
3. Kuantiti pengurangan/ pengekalan air larian hujan
   Stormwater runoff quantities.

Keperluan Pengemukaan / Submission requirements

Pra-semakan / Pre-consultation

1. Pre-determine the calculation and provide preliminary plan for discussion
2. Proposed strategies

Kebenaran merancang / *Planning approval (DO Stage)*

1. Compliance is included as part of KM submission plan and report (if any)
2. Compliance to MASMA
3. Complete the LCBC calculator.
4. Optional documentation.

Kelulusan Pelan Bangunan / *Building Plan approval (BP Stage)*

1. Reflect strategies and annotate in Building plan
2. Complete LCBC calculator.
3. Describe deviation from the previous stage of the LCBC calculator, if any.

Peringkat CCC / *CCC stage*

1. As-built plan indicating compliance as approved
2. Confirmation of criteria compliance form and signed by PSP/SP
3. Photo evidence
4. Attach as part of supplementary appendix documentation for relevant G forms.
5. Describe deviation from the previous stage of the LCBC calculator, if any.

Kod 01 Passive Strategies

KOD 1.0 REKABENTUK PASIF: 1.1 Prestasi 'Building Envelope' Yang Cekap

CODE 1.0 PASSIVE DESIGN: 1.1 Building Envelope Performance Efficiency

KOD 1.0 REKABENTUK PASIF: 1.3 Peningkatan Penggunaan Air Secara Efisien di dalam Bangunan

KOD 1.0 PASSIVE DESIGN: 1.3 Increased efficient use of water in building

1.2.1 Keperluan minimum '*building envelope*' (pengaliran haba)
Building envelope minimum requirement (heat conduction)

Kategori bangunan / Building category:
Baharu – semua jenis bangunan
New – all building types

Jabatan penyemak / *Checking department* : JKB

Keperluan PSP / PSP Requirement

Tujuan / Intent

OTTV adalah syarat pematuhan UBBL yang merangkumi tahap penyerapan haba ke dalam bangunan. Ianya berkait rapat dengan pengiraan keperluan pendingin hawa yang boleh mengakibatkan peningkatan penggunaan tenaga. OTTV yang baik boleh mengurangkan penggunaan tenaga, dan membolehkan penurunan suhu sesuatu bangunan walaupun tanpa pendingin hawa.
RTTV adalah konsep sama seperti OTTV untuk aplikasi bumbung apabila adanya skylight. Sekiranya tiada skylight, ianya tidak berkenaan.
OTTV is a UBBL compliance requirement that indicates the level of heat absorption or thermal transmittance into buildings. It is closely related to the calculation of air conditioning requirements which can result in increased energy consumption. A good OTTV can reduce energy consumption, and allow the temperature of a building to drop even without air conditioning.
RTTV is a similar concept as to OTTV but for roof applications when there are skylights. If there is no skylight, RTTV is negligible.

Keperluan / Requirement

Untuk semua jenis bangunan, pastikan OTTV<50W/m2 / *All buildings to comply OTTV≤50W/m2*
Sekiranya terdapat skylight, pastikan RTTV<25W/m2 / *when there is skylight, RTTV≤25W/m2*

Pelaksanaan / Implementation

Berdasarkan MS1525, OTTV terbahagi kepada 3 bahagian – dinding legap, dinding telus (tingkap) dan penghadang suria (SC). Pengiraan OTTV juga merangkumi factor keterbukaan fasad, rujuk bahagian berikut *Code 1.2.3*.
According to the MS1525, OTTV is divided into 3 parts – opaque façade, glazed façade, and shading coefficient (SC). The OTTV calculation also incorporates fenestration as per code 1.2.3.

Bagi menjalankan pengiraan OTTV, asas-asas di bawah perlu diambil kira:
These basics are required in order to calculate OTTV:

1. Pengiraan WWR / *Window-to-wall ratio*
2. Pengiraan U-value dinding luaran / *External opaque wall u-value*
3. Pengiraan U-value kaca tingkap / *External glazed wall u-value*
4. Pengiraan penghadang suria pada bangunan / *SC2 calculations*

5. Faktor penghadang suria kaca tingkap / *SC1 factor*

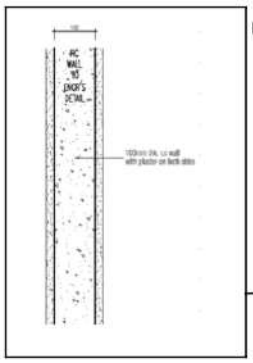
One of the first things that projects need to do is to establish the window-to-wall ratio (WWR). The WWR is the ratio of the total window area to the total wall area in a building. The easiest way is to use the elevation view, and firstly highlight areas that are not considered for calculation, such as roof area or podium carpark. What is left, shall be considered as "wall" area. Mark up all windows and calculate the total area. To get the WWR, divide the total window area by the total wall area (which also includes the windows). Architects would be familiar with this because it is very similar to setting up calculations for the compliance of the 6th schedule in the UBBL.

Pengiraan / Calculation

$$WWR = \frac{\text{total glazed facade}}{\text{Total facade area}}$$

Equation 5 WWR calculation formula

From the WWR, there shall be two types of facades – Opaque and glazed., identify all façade types – walls, walls with cladding, curtain walls, etc. and identify the construction layers. Establish the u-values for each construction. U-values is a reciprocal for R-value which measures thermal resistance. This is established by providing the layers of construction and calculating the R-value by dividing each construction layer thickness over its thermal transmittance value, known as K-value.



Item	Material/Surfaces	Thickness (m)	Conductivity K Value (W/mk)	T. Resistance R Value (m2k/W)	
1	External Surface			0.040	
2	External Skim coat	0.005	0.16	0.031	
3	RC Wall	0.1	1.442	0.069	
4	Internal wall plaster	0.012	0.16	0.075	
5	Internal surface			0.130	
		0.124	Total R	0.346	
			U Value	**2.894**	**W/m2K**

Figure 9 Sample U-value calculation

A similar calculation is also required for roof construction as per UBBL. Roof u-value is a mandatory requirement, however, it is not stressed out in the LCBC. Projects observing the UBBL are deemed to have complied with the UBBL U-value requirement. The compliance threshold is very stringent. Ensure thick insulations are provided in the roof construction to comply.

- Light weight roof ≤ 0.4 W/m2
- Heavy wight roof ≤ 0.6 W/m2

For glazing, the u-values are taken from the product's technical specifications. A simple tip on glass selection is to seek for a lower SC value rather than the u-value as it would greatly influence the OTTV calculation. However, if the SC is too low, it will make the glass darker and would impact daylight performance.

GLASS PERFORMANCE DATA

No.	Glass Item	Thk	Visible Light			Solar Radiation			U-Value (W/m2.K)		S.C.
		(mm)	Tm %	Ref % (Out)	Ref % (In)	Tm %	Ref %	Abs %	W	S	
a.	6mm ASG Medium Grey Annealed Float	6.00	44.00	5.00	5.00	44.00	5.00	51.00	-	5.70	0.66
b (i).	6mm ASG Medium Grey Tempered Float	6.00	44.00	5.00	5.00	44.00	5.00	51.00	-	5.70	0.66
b (ii).	6mm ASG Medium Grey Tempered Float with Heat Soaked	6.00	44.00	5.00	5.00	44.00	5.00	51.00	-	5.70	0.66

Figure 10 cut sheet showing SC of glass

Once collection of data is complete, ensure all units are properly converted, apply the formula.

Pengiraan / Calculation

$$OTTV = \frac{(\text{Opaque Facade}) + (\text{Glazed Façade}) + (\text{Shading Coefficient})}{\text{Total facade area}}$$

Equation 6 OTTV calculation formula

The OTTV is typically expressed in units like watts per square meter (W/m^2). A lower OTTV indicates better thermal performance and reduced heat gain through the building envelope.

RTTV hanya diperlukan sekiranya terdapat skylight. Ambil kira asas-asas berikut:
RTTV calculation is carried out only when all these factors are available:

1. Pengiraan keluasan bumbung / *total roof area*
2. Pengiraan keluasan skylight / *total skylight area*
3. Pengiraan U-value bumbung / *u-value roof*
4. Pengiraan U-value skylight / *u-value skylight*
5. Delta T
6. Faktor penghadang suria kaca skylight / *Skylight SC*

Pengiraan / Calculation

$$RTTV = \frac{(\text{Opaque Roof}) + (\text{Glazed Roof}) + (\text{Shading Coefficient})}{\text{Total Roof area}}$$

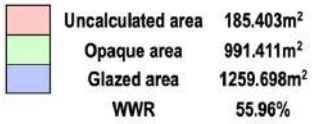
Equation 7 RTTV calculation formula

Formula-formula di atas adalah konsep bagi memberikan gambaran bagi tatacara pengiraan OTTV. Cara pengiraan OTTV dan RTTV boleh mengguna pakai system kalkulator LCBC yang dibangunkan.
Whilst these formulas are conceptual, it should provide clear indication of the OTTV requirements. OTTV and RTTV calculations shall utilize the LCBC calculator.

Pematuhan / Compliance

1. OTTV ≤ 50 W/m²
2. RTTV ≤ 25 W/m² - bagi bumbung dengan pencahayaan langit / *applicable with skylight*

Contoh / Example



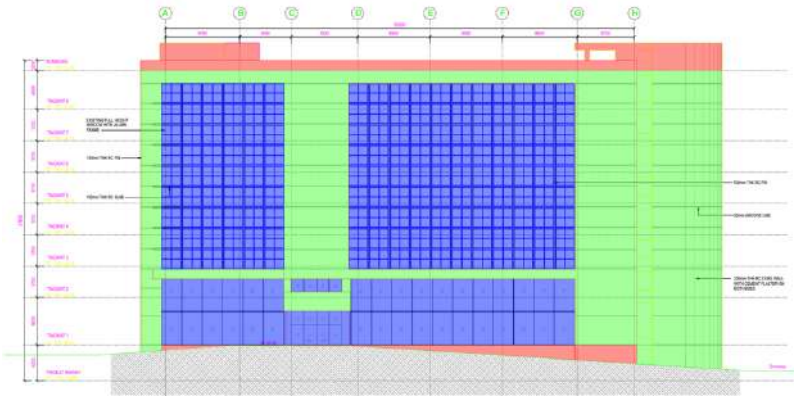


Figure 11 Sample WWR calculation based on facade marking

	ELEVATION	Façade Area (A) m^2	Constant	Solar Absorption Factor (α)	Window to Wall Ratio (WWR)	(1 - WWR)	U-Value W/m^2k (Uv)	Orientation Correction Factor (CF)	Shading Coeff SC = SC_1 x SC_2	Termal Transfer Value (OTTV)	A x OTTV
HEAT CONDUCTION THROUGH WALLS	North Wall (Alumn. Cladding)	1187.7	15	0.1	0.39	0.61	0.92	N/A	N/A	0.84	999.8
	South Wall (Alumn. Cladding)	2933.8	15	0.1	0.24	0.76	0.92	-	-	1.05	3,077.0
	East Wall (Alumn. Cladding)	2010.5	15	0.1	0.43	0.57	0.92	-	-	0.79	1,581.5
	West Wall (Alumn. Cladding)	2430.7	15	0.1	0.35	0.65	0.92	-	-	0.90	2,180.3
	North-East Wall (Alumn. Cladding)	683.2	15	0.1	0.46	0.54	0.92	-	-	0.75	509.1
	TOTAL WALL OTTV		15 x α x (1 - WWR) U								8,347.7
HEAT CONDUCTION THROUGH WINDOWS	North Window (Single, Grey)	1187.7	6	N/A	0.39	N/A	6.31	N/A	N/A	14.77	17,536.9
	South Window (Single, Grey)	2933.8	6	-	0.24	-	6.31	-	-	9.09	26,657.7
	East Window (Single, Grey)	2010.5	6	-	0.43	-	6.31	-	-	16.28	32,730.5
	West Window (Single, Grey)	2430.7	6	-	0.35	-	6.31	-	-	13.25	32,209.2
	North-East Window (Single, Grey)	683.2	6	-	0.46	-	6.31	-	-	17.42	11,898.3
	TOTAL WINDOW OTTV		6 x WWR x U								121,032.6
SOLAR HEAT GAIN THROUGH WINDOWS	North Window Shading	1187.7	194	N/A	0.39	N/A	N/A	0.90	0.56	38.13	45,290.1
	South Window Shading	2933.8	194	-	0.24	-	-	0.92	0.56	23.99	70,375.1
	East Window Shading	2010.5	194	-	0.43	-	-	1.23	0.56	57.46	115,522.7
	West Window Shading	2430.7	194	-	0.35	-	-	0.94	0.56	35.74	86,879.4
	North-East Window Shading	683.2	194	-	0.46	-	-	1.09	0.56 x 0.69	37.59	25,678.6
	TOTAL SOLAR HEAT GAIN		194 x CF x WWR x SC								343,746.0
	OVERALL BUILDING OTTV	9245.9								51.17	473,126.3

Figure 12 sample OTTV calculation tabulation

Penerangan Lanjut / Further explanation

In the context of Malaysia, OTTV (Overall Thermal Transfer Value) and RTTV (Roof Thermal Transfer Value) are metrics related to the energy efficiency and thermal performance of building envelopes, particularly roofs. These values are important for assessing and regulating the thermal characteristics of buildings to reduce energy consumption for cooling and improve overall sustainability. They are part of MS1525 and is also a bye-law under the UBBL.

OTTV is a measure of the heat gain through the building envelope, which includes the roof, walls, windows, and doors. It represents the ability of the building envelope to resist heat gain from the external environment. OTTV is a critical parameter in building design, particularly for commercial and industrial buildings. Compliance with OTTV standards is important to minimize the need for air conditioning and reduce energy consumption. Compliance is also mandatory for ALL buildings.

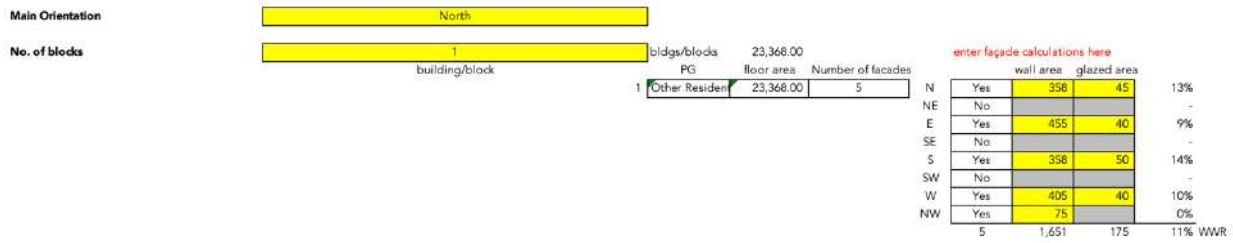
RTTV specifically focuses on the thermal performance of a building's roof. It measures the amount of heat transferred through the roof structure, impacting the indoor thermal comfort and cooling requirements. Like OTTV, RTTV standards are also set by the Malaysian UBBL and local building codes to ensure that roofs are designed to resist heat gain and maintain indoor comfort. The use of reflective roofing materials, insulation, and other design strategies can help reduce RTTV and improve the energy efficiency of buildings in Malaysia. RTTV calculation is highly impacted by skylight. Not having any would easily comply with the RTTV threshold requirement.

These are passive compliance and should be observed at the onset of design to ensure compliance and optimized design. Consider compliance to wall building exterior color, window recess, external shadings, glass selections and wall materials.

Kalkulator / Calculator

This criteria is perhaps the most complex.

Start at the General Info page and determine the main building orientation, and enter the façade areas.



Note that the façade area can also be one (1), this applies to intermediate terrace units where only one façade is exposed. The OTTV evaluation in the LCBC is based on each façade, and then overall. This is to allow designers to evaluate and optimised each face of the building to ensure lower solar gains.

Page for this criteria (1.2.1 & 1.2.2) is a “result” page. Projects must also complete u-values page and the 1.2.3 page for SC. The resultant OTTV is displayed on the following OTTV page.

Proses Semakan / Review process

Jabatan penyemak / *Checking department* : JKB

Pemeriksaan kendiri oleh PSP/SP / *PSP/SP selfcheck*

1. Pengiraan WWR / *WWR calculation*
2. Pengiraan u-values / *U-value calculation*
3. Data kaca tingkap dan kaca langit / *glass and skylight data*
4. Penggunaan kalkulator dengan pematuhan kriteria / *application of LCBC calculator*

Proses Semakan oleh DBKL / *Review process by DBKL*

1. Pematuhan kriteria melalui kalkulator LCBC / *compliance via LCBC calculator*
2. Pengemukaan pengiraan WWR, u-values dan SC / *calculation of WWR, u-values and SC*

Keperluan Pengemukaan / Submission requirements

Pra-semakan / *Pre-consultation*

1. Overall OTTV estimation

Kebenaran merancang / *Planning approval (DO Stage)*

1. OTTV calculation using LCBC calculator

Kelulusan Pelan Bangunan / *Building Plan approval (BP Stage)*

1. OTTV calculation on Building Plan as part of submission.
2. Describe deviation from the previous stage of the LCBC calculator, if any.

Peringkat CCC / *CCC stage*

1. As-built plan
2. Confirmation of criteria compliance form and signed by PSP/SP
3. Compilation of product brochures
4. Photo evidence
5. Attach as part of supplementary appendix documentation for relevant G forms.
6. Describe deviation from the previous stage of the LCBC calculator, if any.

1.2.2 Memperbaiki '*building envelope*' untuk bangunan sediada
Enhanced building envelope for existing building

Kategori bangunan / Building category:
Sediada – semua jenis bangunan
Existing – all building type

Jabatan penyemak / *Checking department* : JKB

REFER 1.2.1

The approach is similar to 1.2.1.

However, an existing building may not be able to comply with several OTTV calculation requirements as it could have high cost impact, especially for external glazing performance. Existing buildings are required to fulfill the OTTV/RTTV calculation, and where 50W/m2 or 25W/m2 is not complied, projects are required to provide a narrative on how lower solar gain can be achieved.

1.2.3 Pengurangan kenaikan haba daripada radiasi solar secara langsung
Heat gain reduction from direct solar radiation

Kategori bangunan / Building category:
Baharu – semua jenis bangunan
New – all building types

Jabatan penyemak / *Checking department* : JKB

Keperluan PSP / PSP Requirement

Tujuan / Intent

Solar gain to an internal space can be minimized by reducing the amount of opening and glazed areas. A more prudent strategy is by implementing external shading devices to cut off solar gain before it hits the building façade.

Keperluan / Requirement

Provide external shading devices to at least 40% of façade openings to achieve SC of at least 0.7.

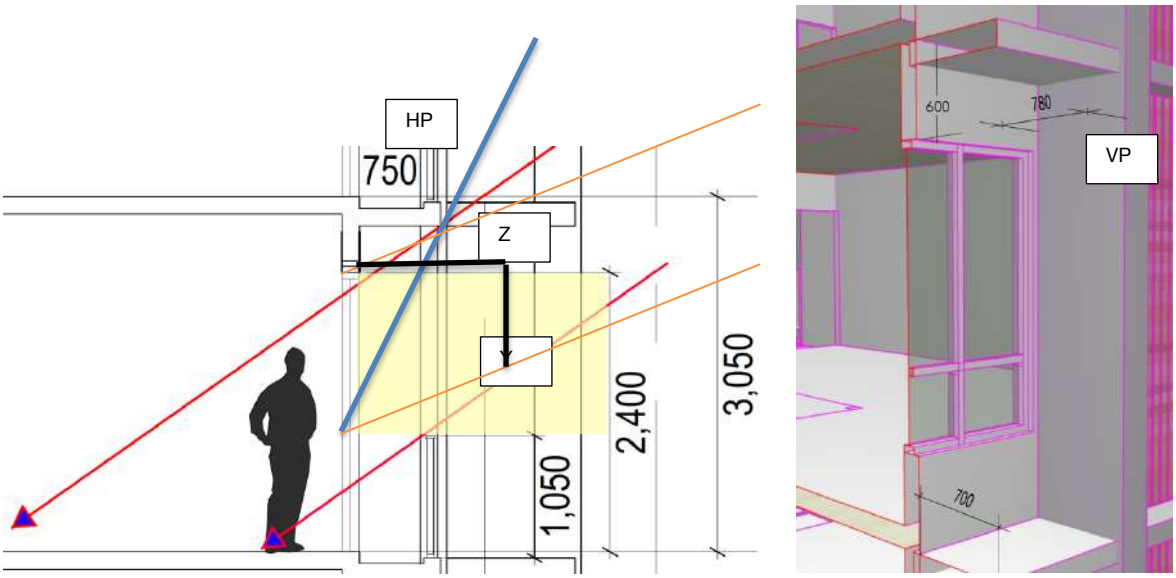
Pelaksanaan / Implementation

1. Refer to MS1525.
2. Based on the façade orientation, identify fenestrations.
3. Calculate the size of fenestrations and determine façade section.
4. Make reference to the Malaysia Sunpath diagram on sun attack angle for critical hours.
5. Design external shading to achieve SC2 of 0.7 or lower.

Pematuhan / Compliance

1. Minimum sun attack angle is established using the Malaysia Sunpath diagram, for each façade.
2. Design an external shading achieves min. SC2 of 0.7 or lower.
3. Based on projection, at least 40% of total fenestrations are externally shaded.

Contoh / Example



Horizontal projection (hp) = 750mm
Fenestration height (y) = 2,400 – 1,050 = 1,350mm
Space from window to sill (z), say = 450mm
R1 = 0.4

Vertical projection (vp) = 780mm
Window length (L) = 2,000mm
R2 = 0.39

Figure 13 sample SC2 calculation

Table 4 SC egg-crate louvers

Ratios		Orientation				
R1	R2	North/ South	East	West	North-East/ South-East	North-West/ South-West
0.20	0.20	0.71	0.77	0.77	0.73	0.75
	0.40 - 0.60	0.62	0.69	0.69	0.63	0.66
	0.60 - 1.80	0.56	0.62	0.61	0.55	0.58
0.40	0.20 - 0.40	0.59	0.63	0.64	0.60	0.63
	0.60 - 1.20	0.49	0.54	0.54	0.48	0.52
	1.40 - 1.80	0.46	0.50	0.51	0.44	0.48
0.60	0.20 - 0.60	0.52	0.54	0.56	0.51	0.55
	0.80 - 1.80	0.43	0.44	0.46	0.39	0.44
0.80	0.20 - 0.60	0.50	0.49	0.52	0.47	0.52
	0.80 - 1.80	0.40	0.39	0.42	0.36	0.41
1.00	0.20 - 0.40	0.51	0.48	0.52	0.48	0.52
	0.60 - 1.20	0.41	0.39	0.42	0.36	0.42
	1.40 - 1.80	0.38	0.35	0.38	0.32	0.38
1.20 -1.80	0.20 - 1.80	0.38	0.33	0.38	0.32	0.38

Penerangan Lanjut / Further explanation

The Shading Coefficient (SC) is an important metric in building design and energy efficiency, primarily used to assess how effective a glazing system or shading device is at controlling solar heat gain. It provides information about the extent to which a particular material or system can reduce or increase heat gain due to solar radiation. The SC is especially relevant when choosing windows, glazing, or shading solutions to optimize a building's thermal performance. This is SC1.

SC2 refers to the external shading of buildings. It specifically refers to the shading coefficient introduced by an external shading device, such as architectural elements or sunshades, used in building design to control solar heat gain and manage the amount of sunlight that enters a building's interior. It is a crucial parameter for architects and designers aiming to optimize energy efficiency and thermal comfort within a structure. SC2 represents how effective an external shading device is at reducing solar heat gain compared to a standard clear single-pane window without any shading.

Pengiraan / Calculation

$$SC2 = \frac{\text{external horizontal protrusion (x)}}{\text{Height of fenestration (y)} + \text{space between top sill to x (z)}}$$

Equation 8 SC2 (external shading) calculation formula

SC2 is particularly relevant in Malaysia, as we have significant amount of sunlight and high temperatures. These shading devices can take various forms, including overhangs, louvers, brise-soleil, sunshades, and pergolas. Their purpose is to block or diffuse direct sunlight, reducing the building's cooling load and maintaining a comfortable indoor environment.

These devices are designed to minimize solar heat gain and excessive glare, ensuring that indoor spaces remain cool and well-illuminated without relying extensively on air conditioning. The result is reduced energy consumption, lower cooling costs, and enhanced thermal comfort.

Kalkulator / Calculator

The calculator for this criteria depends on the input from the general info page for the relevant facades. In this criteria, projects must identify all possible external shading with its length and depth. When doing the façade calculation, identify all façade areas without external shading, and, façade with shading based on their distance of protrusion (or recess) and the width of the fenestration. Input the total width and the height of the fenestration (computing area). Based on these conditions, add to the calculator.

Select the type of glass for the SC1 input. At the farthest right, the resultant SC (SC1xSC2) is displayed, the weighted average is transferred to the OTTV calculation, as well as the WWR from this page.

Proses Semakan / Review process

Jabatan penyemak / *Checking department* : JKB

Pemeriksaan kendiri oleh PSP/SP / *PSP/SP selfcheck*

1. Façade area calculation, fenestration area
2. Design of external shading or recessed windows
3. All shading design comply SC2 0.7
4. Shading achieved for 40% of fenestrations

Proses Semakan oleh DBKL / *Review process by DBKL*

1. Façade area calculation
2. Design of external shading
3. Compliance to SC2 0.7

Keperluan Pengemukaan / Submission requirements

Pra-semakan / Pre-consultation

1. Commitment to reduce solar gain

Kebenaran merancang / *Planning approval (DO Stage)*

1. Pre-design based on sunpath and sun angles
2. Complete the LCBC calculator.
3. Optional documentation.

Kelulusan Pelan Bangunan / *Building Plan approval (BP Stage)*

1. Façade design with solar gain analysis
2. Complete LCBC calculator.
3. Describe deviation from the previous stage of the LCBC calculator, if any.

Peringkat CCC / *CCC stage*

1. As-built plan
2. Confirmation of criteria compliance form and signed by PSP/SP
3. Photo evidence
4. Attach as part of supplementary appendix documentation for relevant G forms.
5. Describe deviation from the previous stage of the LCBC calculator, if any.

1.2.4 Memaksimumkan zon pencahayaan siang
Maximized daylighting zone

Kategori bangunan / Building category:

Baharu – skala besar (>1,000m2) Bukan Kediaman
New – large scale (>1,000mq2) Non-Residential

Jabatan penyemak / *Checking department* : JKB

Keperluan PSP / PSP Requirement

Tujuan / Intent

Reap the many benefits of daylighting including the potential of lowering down electricity bills. Daylight is natural and healthy. It promotes good indoor environment and connects occupants to the outside.

Keperluan / Requirement

1. Minimum 50% kawasan boleh sewa bersih (NLA - Net Lettable Area) untuk memaksimumkan zon pencahayaan siang dengan faktor pencahayaan yang tidak melebihi (DF- Daylight Factor) kadar telus cahaya semulajadi DF = 1.0 – 3.5% (menepati international standard)
   A minimum of 50% Nett Lettable Area (NLA) to maximize the daylighting zone with a lighting factor that does not exceed the transparent rate of natural Daylight Factor (DF) = 1.0 - 3.5% (meet the requirements of international standard)

Pelaksanaan / Implementation

1. Establish NLA or habitable spaces (residential)
2. Evaluate the floor plan and access to daylighting
3. Estimate the internal DF using calculation
4. Daylight strategy will impact artificial light design

Pematuhan / Compliance

1. Tabulation of areas
2. Daylight strategies complying to the percentage required

Contoh / Example

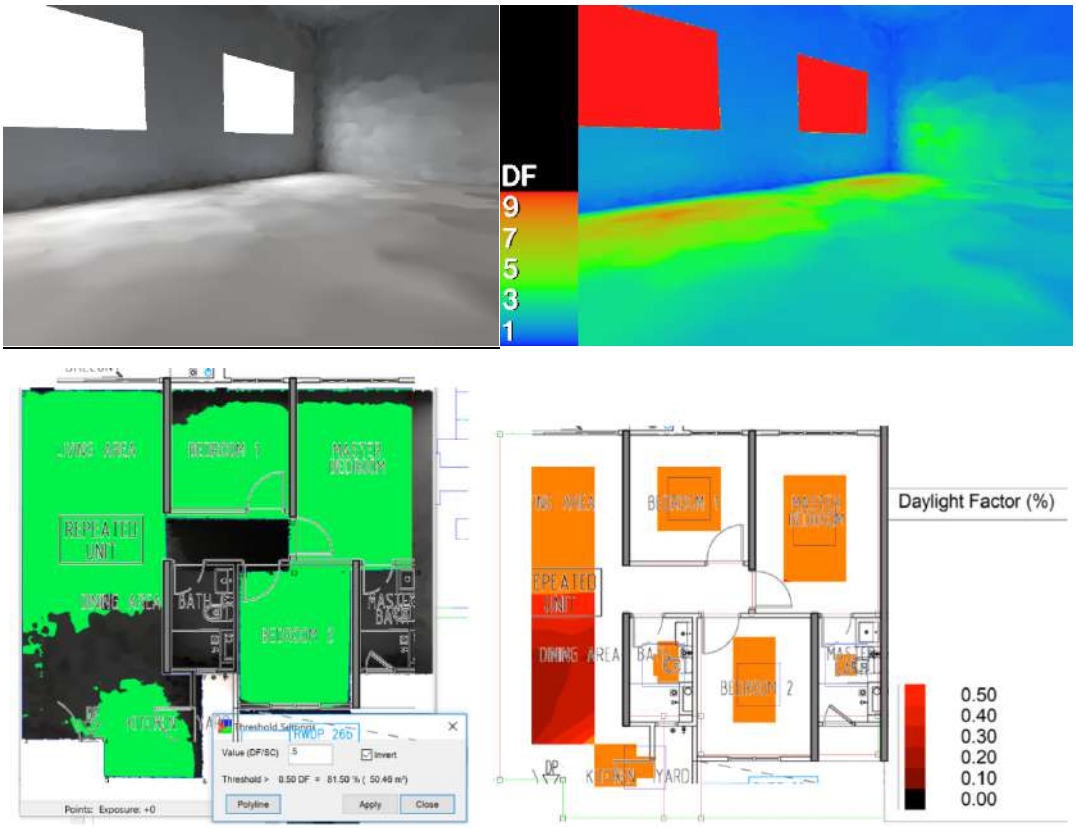


Figure 14 Daylight simulation examples showing DF and space coverage

Penerangan Lanjut / Further explanation

Daylight simulation is not mandatory, but preferred. There are plenty of free applications on the net that Architects and designers can use to design and simulate their internal spaces. A good rule of thumb is to ensure space design is not deep, and access to windows are abundant. When designing for daylight, consider the impact of direct sun access by ensuring external shading. This will promote diffuse light to the interior as well as eliminating glare.

Daylighting is a design strategy that harnesses natural sunlight to illuminate the interior spaces of buildings, reducing the reliance on artificial lighting and enhancing the overall quality of indoor environments. It involves the thoughtful placement of windows, skylights, and other openings to maximize the penetration of natural light while minimizing glare and excessive heat gain. Daylighting not only reduces energy consumption but also has a profound impact on the well-being of occupants, creating visually stimulating, comfortable, and healthier spaces.

When skilfully integrated into architectural designs, daylighting can transform spaces, accentuate architectural features, and foster a strong connection between the built environment and the natural world. This sustainable approach to lighting design is an integral component of green building practices, contributing to energy efficiency and environmental responsibility.

Pengiraan / Calculation

$$Daylight\ Factor\ (DF) = \frac{\text{internal light value}}{\text{external irradiance value}}$$

Equation 9 Daylight Factor (DF) formula

Pengiraan / Calculation

$$Daylit\ area = \ 50\% = \frac{\text{total daylit area range } 1.0 - 3.5 \text{ DF}}{\text{Total NLA or Total habitable spaces}}$$

Equation 10 Daylight area compliance calculation formula

LCBC observes Daylight Factor (DF) as opposed to lux levels. The key difference between Lux Level and Daylight Factor is what they measure. Lux Level quantifies the actual brightness of light in a specific location, considering both natural and artificial light sources, while Daylight Factor focuses on the contribution of natural daylight to the total lighting in a room by indoor to outdoor illuminance ratio. Both metrics are important in lighting design, with Lux Level ensuring adequate illumination for specific tasks and activities, and Daylight Factor evaluating the effectiveness of daylighting strategies in reducing energy consumption.

Kalkulator / Calculator

Review common spaces with similar attributes - openings and area. These spaces should be habitable spaces. Calculate to shoe compliance of DF between 1-3.5%.
Compare the compliant areas over total NLA.

Proses Semakan / Review process

Jabatan penyemak / *Checking department* : JKB

Pemeriksaan kendiri oleh PSP/SP / *PSP/SP selfcheck*

1. Lorekkan kawasan perlulah jelas supaya senang dirujuk.
   Markup of daylit area should be clear for easy reference.
2. Pengiraan juga perlu jelas.
   Area calculation must be clearly indicated.
3. Sertakan jadual DF dan tandakan pemilihan yang mematuhi keperluan kirteria.
   Include DF tabulation and highlight compliance to criteria requirements.
4. Pastikan keberkesanan pencahayaan siang dengan pengurangan penggunaan pencahayaan dari lampu.

Ensure Daylight strategy impact to artificial light design.

Proses Semakan oleh DBKL / *Review process by DBKL*

1. Total complied DF area against GFA
2. Floor plan daylight distribution diagram

Keperluan Pengemukaan / Submission requirements

Pra-semakan / Pre-consultation

1. Estimation of light access

Kebenaran merancang / *Planning approval (DO Stage)*

1. Preliminary DF simulation/ calculation using LCBC calculator.

Kelulusan Pelan Bangunan / *Building Plan approval (BP Stage)*

1. Complete LCBC calculator.
2. Describe deviation from the previous stage of the LCBC calculator, if any.
3. Optional documentation
    a. DF evaluation report based on simulation/calculation as indicated/ annotated in Building plan

Peringkat CCC / *CCC stage*

1. As-built plan indicating DF compliance
2. Confirmation of criteria compliance form and signed by PSP/SP
3. Photo evidence
4. Attach as part of supplementary appendix documentation for relevant G forms.
5. Describe deviation from the previous stage of the LCBC calculator, if any.

1.2.5 Menggalakkan penggunaan pengudaraan semulajadi.

To encourage the use of natural ventilation

Kategori bangunan / Building category:
Baharu – skala besar (>1,000m2) Kediaman & Bukan Kediaman
New – large scale (>1,000m2) Residential & Non-Residential

Jabatan penyemak / *Checking department* : JKB

Keperluan PSP / PSP Requirement

Tujuan / Intent

Natural ventilation is the procedure of entering fresh air into an indoor space from outside. This new air forces the dirty, warm air in the rooms without mechanical assistance. It is one of the most practical techniques to decrease energy usage in buildings and helps to promote a healthier lifestyle.

Keperluan / Requirement

Achieve natural ventilation to 50% of public areas, and maximize cross ventilation to indoor spaces by layout compliance.

Reference

UBBL, open structures, 10th schedule.

Pelaksanaan / Implementation

Based on the prevailing winds, estimate potential localized prevailing winds based on site obstructions, or identify prevailing winds on site. Review the wind flow against the building massing. Identify openings and estimate if there are potential wind penetrations. For both strategies, provide full diagrammatic illustration on plan.

Natural Ventilation in common areas

1. Refer to the KL windrose or establish localized site prevailing winds.
2. Using the floor plan, draw the estimated/presumed air flow throughout the public spaces.
3. Measure the total length of the perimeter of the floor area
4. Ensure up to 50% of common areas have available natural ventilation

Cross ventilation for indoor spaces

1. Using the floor plan, assess the permissible flow of air based on the principle of two openings on opposite sides.
2. The two openings must be windows or ventilation blocks/ grills.

3. Doors can be used as openings if it is designed to stay open. Otherwise, cross ventilation through doors is an optional approach for occasional use only.

Pematuhan / Compliance

Natural ventilation

1. Calculation of NV spaces

Contoh / Example

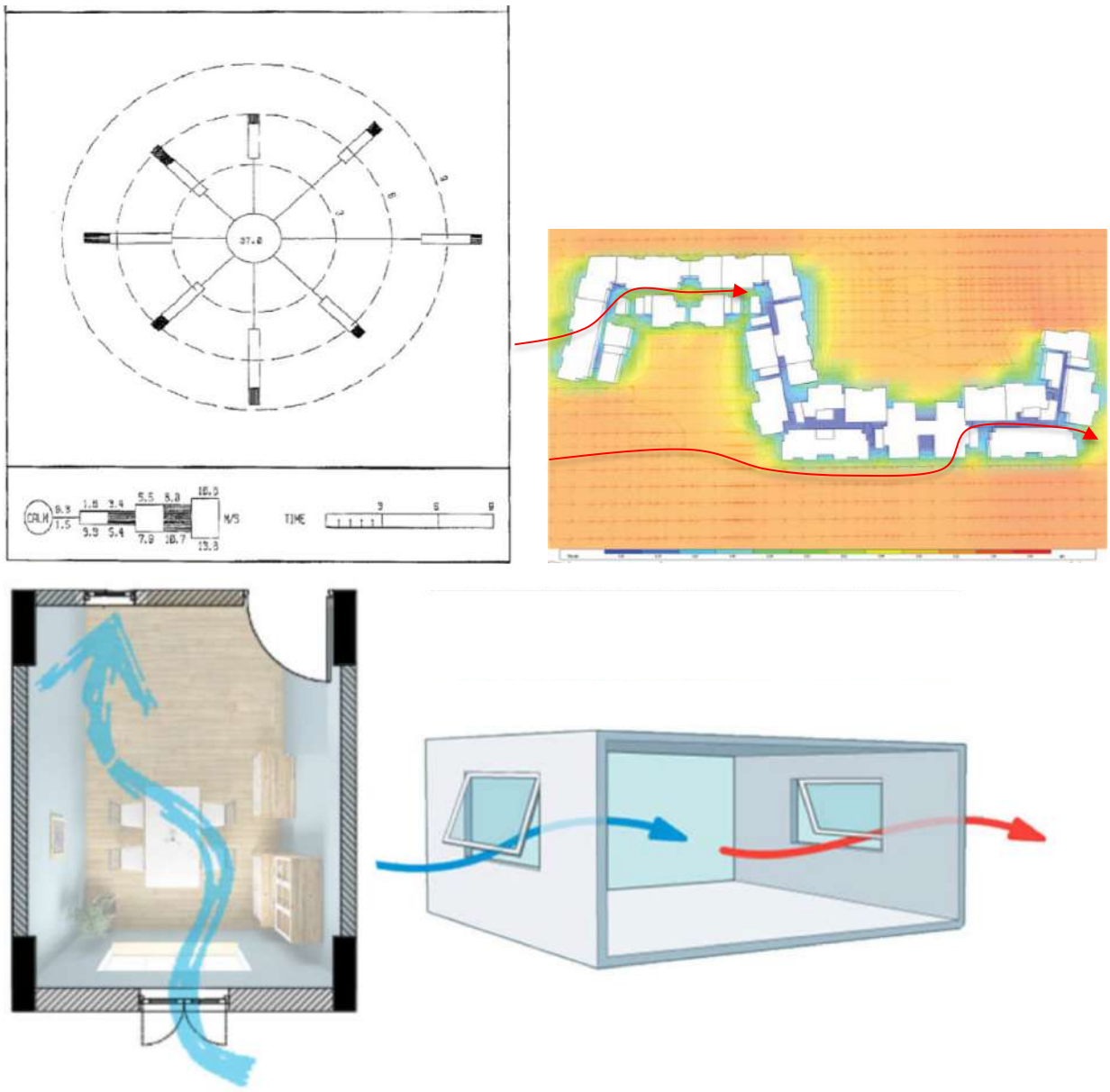


Figure 15 Sample wind rose showing summarized direction of prevailing winds and some design application for cross ventilation

Penerangan Lanjut / Further explanation

Wind flow simulation is not mandatory and not expected. Architects and designers have long designed for winds and have been very successful at doing so. This is usually done by establishing the localized wind direction or prevailing wind as data from the meteorological department and localized conditions may vary, even more so when the building is in the city center. To achieve natural ventilation is by providing openings, and this is already part of UBBL and a requirement when submitting plans. The impact of winds in buildings can be felt when cross ventilation is induced. This is by having openings at two opposite sides that allows air current to pass.

When designing for cross ventilation, be reminded of potential 'wind-driven-rains'. Strong winds can carry water particles horizontally and penetrate buildings. In this condition, rain screens would be effective. Remember to design proper water obstructions and also required outlets for water to drain out. A careful design of this feature can ensure that cross ventilation is continuously available. Whenever possible, try to avoid the option of completely shutting off the openings. This is used when its raining, but is not usually re-opened after the rain.

Natural ventilation is a building design strategy that utilizes the natural forces of wind and temperature differences to provide fresh air, cooling, and comfort to indoor spaces. It relies on the movement of outdoor air through the building to maintain a healthy and comfortable indoor environment while minimizing the need for mechanical ventilation systems.

Wind pressure on a building's surfaces can force outdoor air through openings on one side and expel indoor air through openings on the opposite side. Wind-driven ventilation depends on the prevailing wind direction and building design to be effective. Natural ventilation reduces the need for mechanical cooling systems, resulting in lower energy consumption and reduced operational costs. It's particularly valuable in regions with mild climates.

Natural ventilation aligns with sustainability and green building principles by reducing a building's environmental impact and energy demands, contributing to lower greenhouse gas emissions. Lower energy consumption translates into reduced utility bills, making natural ventilation an economical choice for building owners and occupants.

Kalkulator / Calculator

Like daylight, only input public areas are designed for natural ventilation.

Proses Semakan / Review process

Jabatan penyemak / *Checking department* : JKB

Pemeriksaan kendiri oleh PSP/SP / *PSP/SP selfcheck*

1. Façade opening against winds direction
2. Passive façade features that can redirect air flows
3. Common area floor area calculation, compliance to 50% perimeter length openings
4. Internal spaces cross ventilation diagram

Proses Semakan oleh DBKL / *Review process by DBKL*

1. Winds penetration on plan
2. Common area opening calculation
3. Cross ventilation for indoor spaces

Keperluan Pengemukaan / Submission requirements

Pra-semakan / Pre-consultation

1. Pre-determine the calculation and provide preliminary plan for discussion

Kebenaran merancang / *Planning approval (DO Stage)*

1. Compliance is included as part of KM submission plan and report (if any)
2. Complete the LCBC calculator.
3. Optional documentation.

Kelulusan Pelan Bangunan / *Building Plan approval (BP Stage)*

1. Winds indicated/ annotated in Building plan
2. Complete LCBC calculator.
3. Describe deviation from previous stage of the LCBC calculator, if any.

Peringkat CCC / *CCC stage*

1. As-built plan indicating compliance as approved
2. Confirmation of criteria compliance form and signed by PSP/SP
3. Photo evidence
4. Attach as part of supplementary appendix documentation for relevant G forms.
5. Describe deviation from the previous stage of the LCBC calculator, if any.

1.3.1 Pelaksanaan penuaian air hujan
Implementation of rainwater harvesting

Kategori bangunan / Building category:

Baharu - semua jenis bangunan

New - all building types

Jabatan penyemak / *Checking department* : JPIF

Keperluan PSP / PSP Requirement

Tujuan / Intent

Rainwater harvesting directly impacts stormwater runoffs. Captured water has various purposes for non-potable used like watering plants, flushing toilets and as make up water for reflective pools. It saves the use of municipally supplied water and reduces water waste.

Rujukan / Reference

UBBL 115, Nahrim, MASMA

Keperluan / Requirement

Reduce the use of potable water inside the building by utilizing harvested rainwater collected from a minimum 30% of effective roof area.

Pelaksanaan / Implementation

1. Pengiraan LCBC menggunakan kaedah rasional “Coefficient-intensity-area” (CIA).
   The LCBC calculator utilised the CIA calculation.
2. Pengiraan harus merangkumi / *calculation shall include:*
   a. Jumlah potensi tadahan dari bumbung
      Potential catchment area from roof
   b. Jumlah tadahan sebenar
      Actual catchent area
   c. Rekabentuk dan bahan bumbung bagi mengenal pasti *runoff coefficiency*
      Roof design and material runoff coefficiency
   d. Jumlah taburan hujan
      Rain intensity
   e. Jumlah penggunaan air keseluruhan
      Total potable water use
   f. Jumlah penjimatan air daripada penggunaan SPAH
      Total water savings from RWH system

Pematuhan / Compliance

1. Pelan SPAH serta diagram sistem SPAH yang dicadangkan.
   Proposed RWH system plan and diagram.
2. Pengiraan hidraulik berkaitan keperluan MASMA
   Hydraulic calculation when required under MASMA
3. Penggunaan kalkulator LCBC
   Utilization of the LCBC calculator

Contoh / Example

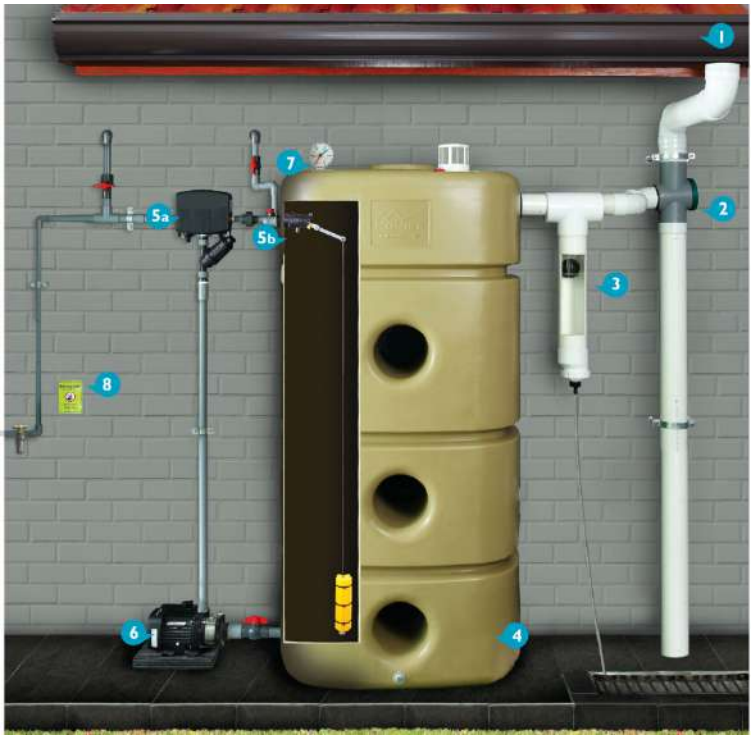


Figure 16 Sample commercial system that can be installed at home

Penerangan Lanjut / Further explanation

Rainwater harvesting is the practice of collecting and storing rainwater for various non-potable uses, such as irrigation, flushing toilets, and general cleaning. It is part of the UBBL and is mandatory. It mandates the inclusion of rainwater harvesting systems in all types of buildings, typically those with a large roof area would not have trouble complying to the requirement. The specific requirements can vary by state, but the UBBL sets the framework for this practice.

Projects can customized, or buy off-the-shelf systems, but what is important is the usage of the harvested water. Designed should design the RWH tank as part of a main tank, where water pass through the tank every day. This will eliminate the threat of stale water and waterborne diseases. Traditionally, there is also a dedicated and separate piping for RWH, hence the need for separate pipe color. Today, most RWH design is integrated. Water when not available in the RWH tank would constantly be refilled, partly. So, there will always be water for flushing and irrigation. When it rains, RWH tanks gets filled almost instantly and all balance water would be drained as regularly.

Pengiraan / Calculation

$$RWH = \mathrm{C\,x\,I\,x\,A}$$

Where,
C = roof runoff coefficiency
I = annual rain intensity (mm/yr)
A = roof catchment area > 20% total roof area

Equation 11 RWH calculation formula

Guidelines for the design and sizing of rainwater harvesting systems can be referred to from Nahrim, It usually includes rainwater collected from rooftops that can contain impurities, debris, and contaminants. UBBL requires the inclusion of filtration and treatment components to ensure the harvested water is of sufficient quality for its intended use. For LCBC compliance these minimum components must be included in the RWH system, which includes (but not limited to):

- first flush diverters,
- smoothing inlet
- part filter for make up water
- incoming meter for make up supply
- floating valve
- outgoing meter

It is crucial to ensure that the part filter is set to the minimum 1-day use limit or any reasonable quantity. In case of drought or no rain, the RWH tank shall be part filled with water from the supply. Meters must be installed to measure the use of potable water in the RWH tank over total water use from the RWH tank. This will demonstrate the effectiveness of the RWH system. When possible, design to increase the tank by allocating a larger catchment area from the roof. Ultimately, the best utilization of the RWH is to offset 100% of water used for irrigation, toilet flushing and other non-potable uses like general cleaning of roads, drains and refuse chamber. When designed properly, it could also be utilized for cooling tower makeup water.

Harvested rainwater for non-potable applications is common. By doing so, the demand on municipal water supplies is reduced, contributing to overall water conservation. It is a sustainable and environmentally responsible practice in Malaysian building design considering we receive a lot of rain annually. It not only conserves water resources but also promotes water self-sufficiency for various non-potable applications within buildings, reducing the strain on municipal water supplies and contributing to more sustainable and eco-friendly construction practices and promotes in lowering carbon emissions.

Kalkulator / Calculator

The main compliance in DBKL requirement is 30% compliance from roof area to capture rainwater. However, the performance of this criteria shall be reviewed based on water demand. Projects will find that the provision of space 30% roof area capture to RWH/SPAH tank might be too little or too big depending on the project. Eventually, the capacity shall be dictated by the space available to store the water, and the standard tank sizing in the market.

Comply with JPIF requirement, and compare results based on demand usage, project shall comply to whichever is higher.

Proses Semakan / Review process

Jabatan penyemak / *Checking department* : JPIF / JKB

Pemeriksaan kendiri oleh PSP/SP / *PSP/SP selfcheck*

1. Roof area suitable for rain catchment
2. Annual rainfall and total rain collection
3. Areas to utilize rainwater
4. Calculation of water offset

Proses Semakan oleh DBKL / *Review process by DBKL*

1. Total calculation of water use
2. SPAH system review
3. Compliance to water savings requirement

Keperluan Pengemukaan / Submission requirements

Pra-semakan / Pre-consultation

1. Commitment to use SPAH

Kebenaran merancang / *Planning approval (DO Stage)*

1. Preliminary location of catchment and tank location
2. Complete the LCBC calculator.
3. Optional documentation.

Kelulusan Pelan Bangunan / *Building Plan approval (BP Stage)*

1. Schematic diagram of SPAH
2. Complete LCBC calculator.
3. Describe deviation from the previous stage of the LCBC calculator, if any.

Peringkat CCC / *CCC stage*

1. As-built plan
2. Confirmation of water catchment
3. Photo evidence
4. Attach as part of supplementary appendix documentation for relevant G forms.
5. Describe deviation from the previous stage of the LCBC calculator, if any.

1.3.2 Penjimatan penggunaan air terawat
Savings on the use of treated water

Kategori bangunan / Building category:

Baharu - Semua jenis bangunan

New - all building types

Jabatan penyemak / *Checking department* : JPIF, JKB

Keperluan PSP / PSP Requirement

Tujuan / Intent

To reduce the use of treated water by utilizing low water consumption wares and fittings and preserve potable water resources.

Rujukan / Reference

SPAN WEPLS

Keperluan / Requirement

1. Kelengkapan peralatan penjimatan penggunaan air seperti timer tap, sensor dan lain-lain
   Water saving equipments such as timer for taps, sensors and others.
2. Mengemukakan kegunaan air dari pelaksanaan penuaian air hujan untuk tujuan seperti siraman pokok, pembersihan laman dan lain-lain
   Present the use of water from the implementation of rainwater harvesting for water trees, cleaning the yard and others.
3. Penggunaan sistem kitar semula air seperti SPAH, *condensation water,* dll
   Implement water recycling systems such as RWH, condensate water recovery, etc.

Pelaksanaan / Implementation

1. Identify all potential water savings component
2. Identify water savings based on SPAN WEPLS data
3. Implementation of water LCBC calculator

Pematuhan / Compliance

1. Product selection and implementation in project

Contoh / Example

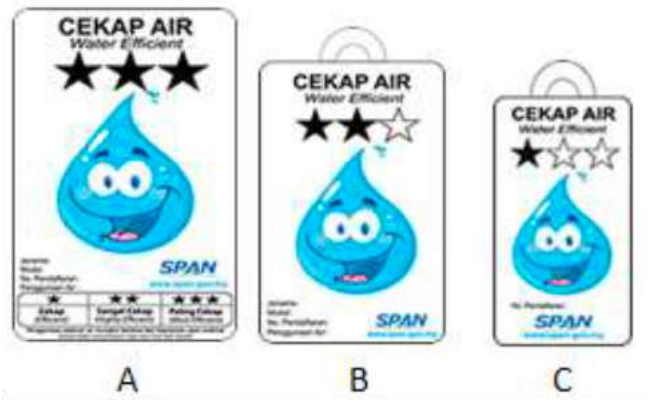


Figure 17 SPAN cekap air tagging

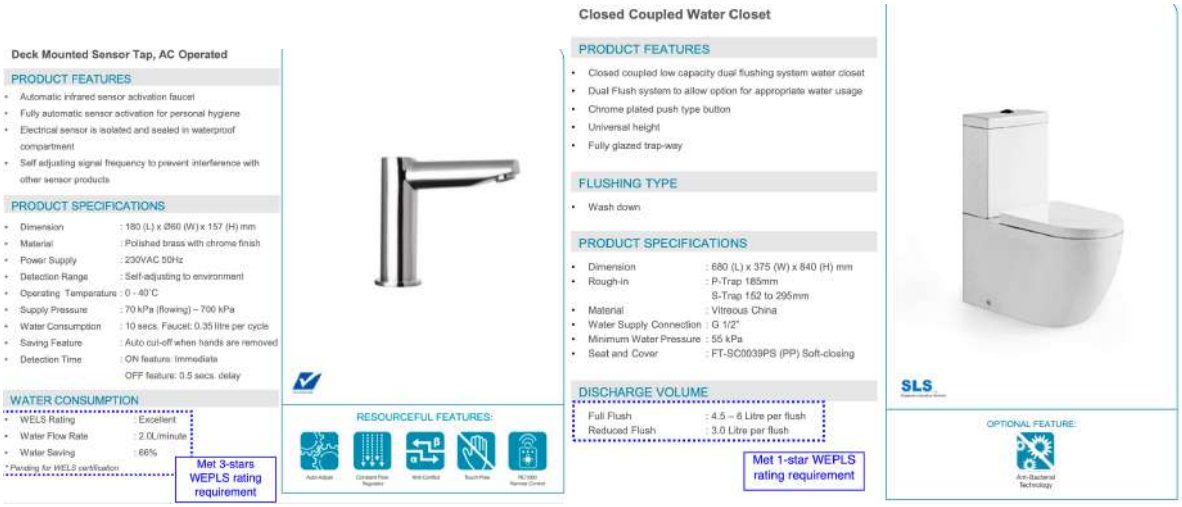


Figure 18 Sample of product with SPAN WEPLS compliance

Penerangan Lanjut / Further explanation

Water efficient fittings, often referred to as water-efficient fixtures, are plumbing components designed to reduce water consumption in homes and commercial buildings. These fittings are essential for promoting water conservation and reducing the environmental impact of excessive water use. In Malaysia, the dual flush is usually a requirement by local authorities, however it is not properly observed or complied with. PSP to ensure at the very least all WCs to be of dual flush type, or otherwise a reduced amount if it is a flush valve type.

The use of water-saving fittings contributes to reduced water consumption, lower utility bills, and decreased strain on water resources and wastewater treatment systems. These fittings are an essential part of sustainable building design and help address water scarcity and environmental conservation challenges. These are the WE fittings commonly used in projects:

1. **Low-Flow Toilets:** Low-flow toilets use less water per flush than traditional toilets. They are designed to maintain effective flushing performance while significantly reducing water consumption.

2. **Low-Flow Showerheads:** Low-flow showerheads limit the flow of water while maintaining good shower performance. They reduce water waste without compromising the shower experience.
3. **Faucet Aerators:** Faucet aerators mix air with the water flow, maintaining the sensation of a strong stream while reducing water usage. They are installed on taps and faucets.
4. **Dual-Flush Toilets:** Dual-flush toilets provide two flush options – one for liquid waste (with lower water volume) and one for solid waste (with higher water volume), allowing users to choose the appropriate flush for the situation.
5. **Sensor-Activated Fixtures:** Sensor-activated faucets and flush valves automatically control water flow, reducing water waste by ensuring that water is only used when needed. They are commonly found in public restrooms.
6. **Water-Efficient Appliances:** Water-saving fittings extend to appliances like dishwashers and washing machines, which have water-efficient models that use less water without sacrificing performance.

Kalkulator / Calculator

Enter the sanitaryware and fittings at the general info page. Provide detail selection of products when available. Generally, dual flush toilets and low flow faucets are ready requirements based on SPAN, and should make this criteria easily complied. Projects should elaborate on all water uses, and where possible suggest to incorporate RWH/SPAH.

Proses Semakan / Review process

Jabatan penyemak / *Checking department* : JPIF/JKB

Pemeriksaan kendiri oleh PSP/SP / *PSP/SP selfcheck*

1. Identify suitable sanitaryware/ fittings
2. Calculation using LCBC calculator

Proses Semakan oleh DBKL / *Review process by DBKL*

1. Review of selection materials
2. Review of LCBC calculator

Keperluan Pengemukaan / Submission requirements

Pra-semakan / Pre-consultation

1. Intention to utilize SPAN WEPLS

Kebenaran merancang / *Planning approval (DO Stage)*

1. Commitment to utilize SPAN WEPLS
2. Complete the LCBC calculator.
3. Optional documentation.

Kelulusan Pelan Bangunan / *Building Plan approval (BP Stage)*

1. Confirmation of sanitaryware/fittings selection
2. Complete LCBC calculator.
3. Describe deviation from previous stage of the LCBC calculator, if any.

Peringkat CCC / *CCC stage*

1. As-built plan
2. Confirmation of criteria compliance form and signed by PSP/SP
3. Photo evidence
4. Attach as part of supplementary appendix documentation for relevant G forms.
5. Describe deviation from previous stage of the LCBC calculator, if any.

1.3.3 Meningkatkan penggunaan air secara efisyen di bangunan sedia ada
Increase the use of water in existing buildings

Kategori bangunan / Building category:

Sediada – semua jenis bangunan

Existing – all building type

Jabatan penyemak / *Checking department* : JKB

REFER PREVIOUS 1.3.2

The approach is similar to 1.3.2.

Upgrading may require additional work on piping and is a potential cost item.

If existing installation is already complying to the requirement, provide photo evidence and other relevant documentation for proof.

1.3.4 Penggunaan semula bahan binaan untuk projek pembangunan semula
Reuse of building materials for redevelopment projects

Kategori bangunan / Building category:

Meroboh dan bina semula - projek besar sahaja

Demolish and rebuild - large projects only

Jabatan penyemak / *Checking department* : JKB

Keperluan PSP / PSP Requirement

Tujuan / Intent

To reduce impact of construction waste from going to landfill. Reusing existing building materials will also help in managing site demolition work due to need for careful dismantling, handling and sorting of reused or salvaged building materials.

Rujukan / Reference

SWCorp CWM

Keperluan / Requirement

1. Minimum 15% daripada bahan binaan bangunan sedia ada yang dirobohkan untuk diguna semula kepada projek pembangunan baharu
   A minimum of 15% from the demolished existing building construction materials are to be reused for project development

Pelaksanaan / Implementation

1. Before demolition work, survey the existing building and note on building materials that can be salvaged and/or reused. Prepare an inventory.
2. Calculate the quantum of reused materials in volume or cost equivalent.
3. Plan and carefully dismantle the materials that can be reused and store them at a suitable location and protected from the weather.
4. Demolition work shall be organized with demolition waste and debris sorted.
5. Send construction waste that are recyclable to cycling centers.
6. Note on materials that could be reused at site such as crusher run or timber bidding.

Pematuhan / Compliance

1. Prepare tabulation of all demolition and highlight volume of reused or salvaged materials.
2. Prepare tabulation of new construction materials, reused or salvaged material should account for 15% of new construction materials in volume or cost equivalent.

Contoh / Example

Figure 19 Samples of salvaged and reused building materials

Penerangan Lanjut / Further explanation

Maintain the existing building structure (including structural floor and roof decking) and envelope (the exterior skin and framing, excluding window assemblies and nonstructural roofing material). Hazardous materials that are remediated as a part of the project must be excluded from the calculation of the percentage maintained.

Pengiraan / Calculation

PATH 1 : maintain existing structures

$$Reuse\ materials = \frac{\text{Total structures maintained}}{\text{Total existing structures}}$$

Equation 12 Material reused – path 1 calculation formula

PATH 2 : reuse or salvage existing materials

$$Reuse\ materials = \frac{\text{Total materials reused or salvaged}}{\text{Total new materais equivalent}}$$

Equation 13 Material reused – path 2 calculation formula

Use salvaged, refurbished or reused materials for an additional 15% (established based on cost or volume). Mechanical, electrical and plumbing components and specialty items such as elevators and equipment shall not be included in this calculation. Only include materials permanently installed in the project. Furniture may be included.

If the project will reuse part of an existing building, inventory the existing conditions. Develop a floor plan showing the location of existing structural components, exterior and party walls, and exterior windows and doors. The drawings should be detailed enough to determine the surface area of all elements to be reused.

Confirm that the structural and envelope elements designated for reuse can be reused and take the necessary steps to retain and maintain them.

Kalkulator / Calculator

This criteria has 2 paths;

- Calculate existing building elements to qualify as reused (since it is not demolished and rebuilt)
- Calculate the estimated cost of reused building materials, on-site or imported from another existing site. An estimate materials costs is based on materials cost assumed to be 45% from total construction cost (TCC). Adjust the TCC at the general info page.

Proses Semakan / Review process

Jabatan penyemak / *Checking department* : JKB

Pemeriksaan kendiri oleh PSP/SP / *PSP/SP selfcheck*

1. Lorekkan kawasan yang akan diguna semula.
   Markup areas using material reuse.
2. Pengiraan kuantiti bahan dan bahan guna semula.
   Provide calculation of materials reuse.
3. Jumlah peratusan yang jelas.
   Provide the percentage of compliance.

Proses Semakan oleh DBKL / *Review process by DBKL*

1. Lorekkan kawasan yang akan diguna semula.
   Mark up areas and materials reused.
2. Pengiraan kuantiti bahan dan bahan guna semula.
   Material reuse calculation.

3. Jumlah peratusan.

   Total percentage showing compliance.

Keperluan Pengemukaan / Submission requirements

Pra-semakan / Pre-consultation

1. Pre-determine the calculation and provide preliminary plan for discussion

Kebenaran merancang / *Planning approval (DO Stage)*

1. Compliance is included as part of KM submission plan and report (if any)
2. Complete the LCBC calculator.
3. Optional documentation.

Kelulusan Pelan Bangunan / *Building Plan approval (BP Stage)*

1. Indication of reused materials indicated/ annotated in Building plan
2. Tabulation of material compliance.
3. Complete LCBC calculator.
4. Describe deviation from previous stage of the LCBC calculator, if any.

Peringkat CCC / *CCC stage*

1. As-built plan indicating area of compliance as approved
2. Confirmation of criteria compliance form and signed by PSP/SP
3. Photo evidence
4. Attach as part of supplementary appendix documentation for relevant G forms.
5. Describe deviation from the previous stage of the LCBC calculator, if any.

Kod 02 Active strategies

KOD 2.0 REKABENTUK AKTIF: 2.1 Sistem Penyaman Udara Cekap Tenaga

KOD 2.0 ACTIVE DESIGN: 2.1 Energy Efficient Air Conditioning System

KOD 2.0 REKABENTUK AKTIF: 2.1 Sistem Penyaman Udara Cekap Tenaga

KOD 2.0 ACTIVE DESIGN: 2.1 Energy Efficient Air Conditioning System

KOD 2.0 REKABENTUK AKTIF: 2.1 Sistem Penyaman Udara Cekap Tenaga

KOD 2.0 ACTIVE DESIGN: 2.1 Energy Efficient Air Conditioning System

2.1.1 Penyaman udara cekap tenaga

Energy efficient air conditioning system

Kategori bangunan / Building category:
Baharu - bukan kediaman
New - non-residential

Jabatan penyemak / *Checking department* : JKB

Keperluan PSP / PSP Requirement

Tujuan / Intent
To reduce energy consumption and lower electricity bills while providing the same level of performance for air conditioning systems.

Rujukan / Reference
ST, MS1525

Keperluan / Requirement

1. Penyaman udara mesti mematuhi prestasi bersamaan 5-bintang ST berdasarkan pematuhan MS1525, dan
2. Sekiranya terdapat sistem tunggal sehingga 2.5hp ianya hendaklah mempunyai status 5-bintang ST.
   If there are any ACSU systems up to 2.5hp it must comply with the 5-star green label certification by ST.

Pelaksanaan / Implementation

1. Proposed new ACMV specification
2. Proposed energy calculation or simulation
3. Installation of new equipments
4. Performance measurement and review
5. calculate energy impact

Contoh / Example

5.0 Star Rating

The star rating shall be in accordance with Tables 1 and 2.

Table 1 :
The rated cooling capacity < 4.5kW

Star Rating	Tested CSPF (Wh/Wh)
5	≥5.30
4	4.60 ≤CSPF<5.30
3	3.30 ≤ CSPF<4.60
2	3.10 ≤ CSPF<3.30
1	<3.10

Table 2:
4.5kW ≤Rated Cooling Capacity ≤ 7.1kW

Star Rating	Tested CSPF (Wh/Wh)
5	5.10≤
4	4.00≤ CSPF<5.10
3	3.10≤ CSPF<4.00
2	2.90 ≤ CSPF<3.10
1	<2.90

Note : Star Rating will be given by certification body appointed by the Commission in the test report or assessment letter

Figure 20 ST 5-star EE label as per MEPS document

Penerangan Lanjut / Further explanation

Designing air conditioning systems for a large building involves a systematic and comprehensive approach. However, for the LCBC, designers are required to only provide their estimation.

After a thorough analysis of the building's characteristics and usage patterns is conducted - including the understanding of the building's orientation, occupancy, thermal performance, and heat-generating equipment, conduct a load calculation estimate to determine the cooling load requirements of the building. When required, Divide the building into zones based on similar thermal characteristics and occupancy patterns. Allocate appropriate cooling capacities to each zone based on its specific requirements.

A suitable ACMV system is usually chosen based on this load calculation and zoning analysis. Large buildings often employ central air conditioning systems such as Variable Refrigerant Flow (VRF) or Chilled Water Systems. Incorporate energy-efficient technologies and practices, such as variable speed drives, energy recovery systems, and programmable thermostats. Implementing these measures enhances system efficiency and reduces energy consumption. Large systems may need to implement advanced control systems and automation (EMS) to optimize the operation of the ACMV system. This includes scheduling, temperature setbacks during unoccupied periods, and real-time monitoring to identify and address inefficiencies.

For LCBC, ensure that the design complies with MS1525 equivalent to a 5-star rating as mentioned in ST's MEPS document.

Non-ducted ACSU shall be classified based on the rated CSPF of the product. The classification represents the Star rating as per ST MEPS document.

CSPF stands for Cooling Seasonal Performance Factor, evaluates the yearly energy consumption and effectiveness of an air conditioning unit. It considers seasons and temperature variations at cooling demands. This includes scenarios when the unit is in standby mode or running at a partial load, especially when utilizing inverter technology. CSPF provides a more precise and practical representation of energy efficiency for cooling or "actual use condition". A higher CSPF rating signifies a more energy-efficient air conditioner.

Pengiraan / Calculation

$$CSPF = \frac{Cooling\ Seasonal\ Total\ Load\ (Wh)}{Cooling\ Seasonal\ Energy\ Consumption\ (Wh)}$$

Equation 14 CSPF formula

Cooling Seasonal Total Load (CSTL)

Total amount of heat that is removed from the indoor air when equipment is operated for cooling the building during the cooling season or loosely explained as *total cooling load.*

Cooling Seasonal Energy Consumption (CSEC)

Total amount of energy consumed by the equipment when it is operated for cooling during the cooling season or loosely explained as *total equipment power.*

In simpler terms, this means to divide vairables which is based on actual required power to remove heat from the space, as such:

CSPF = Total Cooling Load (Wh) over *Total Energy Consumption (Wh)*

This is slightly different from the common Coefficient of Performance (COP) based on the equipment capacity and is used for larger cooling applications.

COP = Cooling capacity (kW) / Cooling power consumption (kW)

Monthly energy (kWh) consumption is based on hourly usage is expressed as follows:

Monthly energy consumption = power input x daily operating hours

Further annual energy can be obtained by changing to total annual working hours, with operation factor as required, or as expressed in the MEPS document as 4380 hours.

The MEPS for <7.1kW document is silent on ducted systems application for the CSPF and does not discuss the CSPF calculation for effective power input if there are indoor re-circulating fans. Whilst a correction factor of the rated power input can be applied in the calculator, it is not being considered at the moment.

<u>ACSU</u>

The second part of this criteria focuses on AC units with cooling capacity below 7.1kW in accordance with ST's MEPS.

BTU is the unit used to indicate the energy used to remove heat from space in one hour. A simple way to calculate the requirement of AC is to calculate the room area by 20 BTU. It is an imperial unit, therefore conversion factor is required when using SI units.

Pengiraan / Calculation

$$20BTU\ x\ 1\ sqft$$

Equation 15 BTU formula

e.g. 10 x 10ft room x 20 BTU = 2,000 BTU/ft2
this is assuming that the room is 10ft high.
Divide the BTU/hr by 9,000 to get the horsepower (HP)
2000/9000 = 0.2 HP, therefore it is likely that a 1.0 HP ACSU would be the appropriate size for the room. HP (horsepower) refers to the compressor power of the ACSU. The higher the HP the more power it has to provide cooling.

12,000 BTU is approximately 1 ton of cooling, and approximately 3.5kW energy. Depending on the usage, say the ACSU is switched on from 9pm to 6am = 9 hours, room energy (2000/12000) x 3.5 x 9 = 5.25kWh for one night. That is equivalent to RM1.84 for one good night's sleep.

kW cooling load to HP is 1.341
This means that a 1HP ACSU should be able to accommodate a space with cooling requirement of 0.75kW. There are many other variables to this, including the temperature outside, your room construction, windows and openings, people inside the space and many more. This sample calculation is just to illustrate the impact of air-conditioning your space. Consult a mechanical engineer or an experienced AC technician to properly specify the ACSU.

AC design for buildings depend on the system proposed by the Mechanical Engineer. Typical system would be a split unit system, which is designed for smaller spaces and localized control. Some larger building would use a water-cooled system that comes with a plant consisting of waterside chiller, cooling tower, and airside from the handling unit, distribution ducts and the supply to spaces.

Kalkulator / Calculator

This criteria requires that all ACs are either ST 5-Star rating or high COP/CSPF in accordance with MS1525. Select where applicable and insert relevant information. Input shall be indicative intended for LCBC assessment only meant only for design intent. Use the narrative box for further explaination.

Proses Semakan / Review process

Jabatan penyemak / *Checking department* : JKB

Pemeriksaan kendiri oleh PSP/SP / *PSP/SP selfcheck*

1. review of product brochures
2. calculation cooling requirement, and selection of equipment.
3. review of CSPF/COP to meet ST and/or MS1525 criteria

Proses Semakan oleh DBKL / *Review process by DBKL*

1. LCBC summary and calculator review

Keperluan Pengemukaan / Submission requirements

Pra-semakan / Pre-consultation

1. Pre-determine the load and equipment to be used.

Kebenaran merancang / *Planning approval (DO Stage)*

1. Compliance of the LCBC calculator.
2. Optional documentation.

Kelulusan Pelan Bangunan / *Building Plan approval (BP Stage)*

1. Compliance of the LCBC calculator.
2. Optional documentation.
3. State deviation to DO stage, if any.

Peringkat CCC / *CCC stage*

1. Confirmation of criteria compliance form and signed by PSP/SP
2. Compliance of the LCBC calculator during construction.
3. State deviation to BP stage, if any.
4. Optional documentation
    a. Photo evidence
    b. Attach as part of supplementary appendix documentation for relevant G forms.

2.1.2 Penukaran kepada penyaman udara cekap tenaga
Conversion to energy efficient air conditioning

Kategori bangunan / Building category:

Sediada - bukan kediaman

Existing - non-residential

Jabatan penyemak / *Checking department* : JPRB (OSC), JPIF

Keperluan PSP / PSP Requirement

Tujuan / Intent

To convert from an existing air conditioning system to an energy-efficient one, to reduce energy consumption and lower electricity bills while providing the same level of cooling as traditional air conditioning systems, energy-efficient air conditioning systems are designed.

Rujukan / Reference

ST, MS1525

Keperluan / Requirement

The approach is similar to 2.2.1. However, for an existing building may require more capital expenditure, but the payback would be worthwhile.

1. Re-establish all ACMV systems and propose means comply to ST 5-star equivalent according to MS1525.
2. Replace all Air conditioners up to 2.5hp to comply with the 5-star green label certification.
   or
3. If the project systems already complied to MS1525, provide documentation for proof.

Pelaksanaan / Implementation

1. Existing ACMV specification
2. Proposed new ACMV specification
3. Proposed energy calculation or simulation
4. Installation of new equipments
5. Performance measurement and review
6. calculate energy impact

Contoh / Example

Figure 21 Dismantling of old cooling tower to replace with a more flexible and efficient VRF system

Penerangan Lanjut / Further explanation

Similar to 2.1.1, This criteria focuses on compliance in accordance with MS1525 and ST's MEPS.

To retrofit an existing air conditioning system, assess the current system's performance and identify areas that require improvement. This can be done by conducting an energy audit or hiring a professional to evaluate the system. Once the areas that need improvement have been identified, selection of energy-efficient air conditioning system can be done. Energy-efficient air conditioning systems are designed to reduce energy consumption and lower electricity bills while providing the same level of cooling as traditional air conditioning systems. They are equipped with advanced features such as programmable thermostats, variable speed compressors, and smart controls that allow users to adjust the temperature and humidity levels according to their preferences. These systems also use eco-friendly refrigerants that have a lower impact on the environment. An energy-efficient air conditioning system can save money on energy bills and reduce carbon footprint.

If the existing air conditioning system is already efficient, consider upgrading to a newer model that has additional features such as smart controls or eco-friendly refrigerants. However, it's important to note that upgrading to a new system may not always be cost-effective. Projects should weigh the benefits of upgrading against the costs of purchasing and installing a new system. If a decision is made to upgrade, consult a professional to determine the best system based on the needs and budget.

Kalkulator / Calculator

This criteria shares the calculator with 2.1.1.

Input ACMV as designed for the existing building. No comparison required.

Proses Semakan / Review process

Jabatan penyemak / *Checking department* : JPRB (OSC) / JPIF

Pemeriksaan kendiri oleh PSP/SP / *PSP/SP selfcheck*

1. review of existing installation
2. review of product brochures
3. calculation cooling requirement, and selection of equipment.
4. review of CSPF/COP to meet ST and/or MS1525 criteria

Proses Semakan oleh DBKL / *Review process by DBKL*

1. LCBC summary and calculator review

Keperluan Pengemukaan / Submission requirements

Pra-semakan / Pre-consultation

1. Pre-determine the load and equipment to be used.
2. Comparison between old and new installation.

Kebenaran merancang / *Planning approval (DO Stage)*

1. Compliance of the LCBC calculator.
2. Optional documentation.

Kelulusan Pelan Bangunan / *Building Plan approval (BP Stage)*

1. Compliance of the LCBC calculator.
2. Optional documentation.
3. State deviation to DO stage, if any.

Peringkat CCC / *CCC stage*

1. Confirmation of criteria compliance form and signed by PSP/SP
2. Optional documentation
    a. Photo evidence
    b. Attach as part of supplementary appendix documentation for relevant G forms.

2.2.1 Sistem pencahayaan cekap tenaga

Energy Efficient Lighting Sytem

Kategori bangunan / Building category:
Baharu – semua bangunan baru
New – all building type

Bagi peruntukan sensor / For sensor requirement
Bangunan baharu (bukan kediaman)
New buildings (non-residential)

Jabatan penyemak / *Checking department* : JPRB (OSC), JPIF

Keperluan PSP / PSP Requirement

Tujuan / Intent
To enhance the energy efficiency and illumination quality of indoor and outdoor spaces through the utilization of energy-efficient lighting fixtures.

Rujukan / Reference
MS1525

Keperluan / Requirement

1. Menggunakan lampu cekap tenaga seperti yang dinyatakan dalam MS1525 (bukan kediaman) atau MS2680 (kediaman)
   Using energy efficient lighting as specified in MS1525 (non-residential) or MS2680 (residential)

2. Zon pencahayaan yang cekap dengan sistem kawalan sensor yang fleksibel seperti yang dinyatakan dalam MS1525.
   Efficient lighting zones with flexible sensor control systems as specified in MS1525.

Pelaksanaan / Implementation

1. Proposed new lighting specification
2. Proposed calculation or simulation
3. Installation of new fittings
4. Performance measurement and review
5. calculate energy impact

Contoh / Example

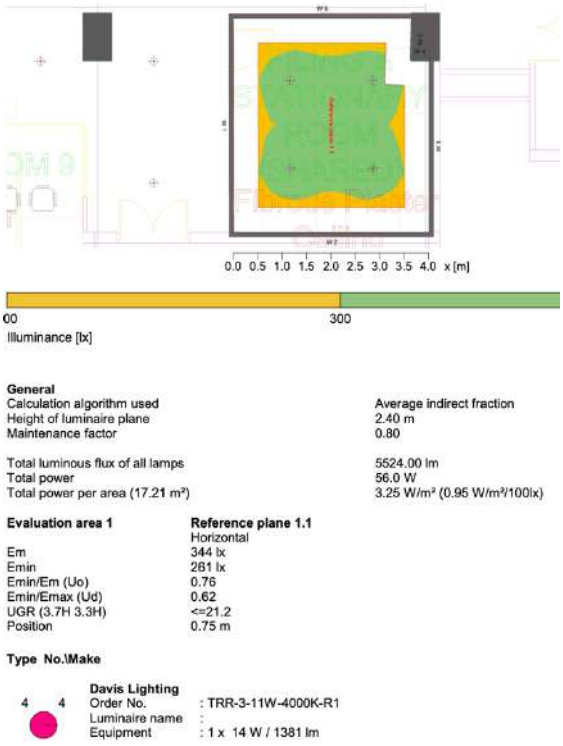


Figure 22 Lux level at design stage, and remeasurement at CCC stage

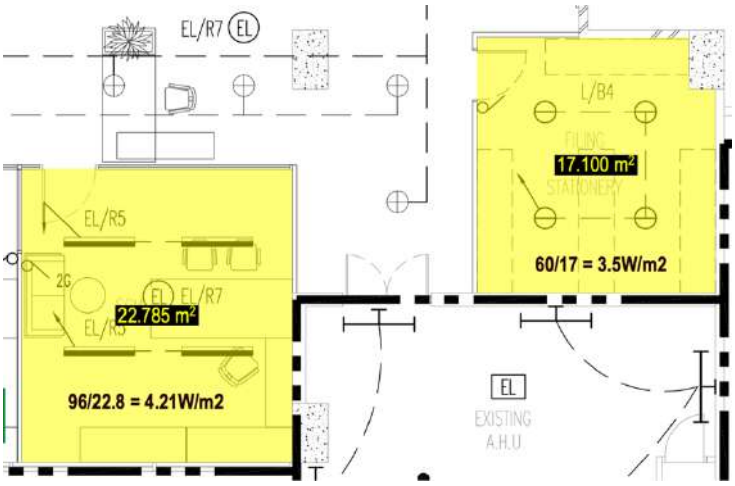


Figure 23 Example of LPD compliance to MS1525

Penerangan Lanjut / Further explanation

Design based on lux levels as recommended by MS1525. This requires meticulous process to ensure that lighting within a space meets the specified standards for visual comfort and task performance. The design process begins with a thorough understanding of the space's functions, activities, and user requirements. Determine the appropriate illuminance levels in accordance with MS1525.

Although not required by LCBC, designers can get the lighting supplier or vendor to sun simulation based on design – usually at no cost. The design looks at the selection of appropriate lighting fixtures, their placement, and the overall lighting layout to achieve the recommended lux levels consistently across the space. Throughout the process, we prioritize energy efficiency, sustainability, and the creation of a

visually comfortable and productive environment, ensuring that the final design aligns with the criteria outlined in MS1525. Projects can check the compliance on LPD by reviewing the simulation result, or by reviewing the simulation result, or by manual calculation as follows:

Pengiraan / Calculation

$$LPD = \frac{\text{Total Watt}}{\text{Total room area}}$$

Equation 16 Light power density (LPD) formula

Energy-efficient lighting practices are vital for reducing energy consumption and environmental impact while simultaneously cutting operational costs. The adoption of LED lighting fixtures, known for their exceptional energy efficiency and extended lifespan, forms the core of these practices.

Equally crucial are advanced lighting control systems, including occupancy sensors and daylight sensors, which automatically regulate lighting levels based on occupancy and available natural light. Task lighting, a strategy focused on illuminating specific work areas, minimizes energy waste by directing light only where it's needed. Lighting zoning, daylight harvesting, and the utilization of energy-efficient lamps such as compact fluorescent lamps (CFLs) further enhance energy savings.

A well-maintained lighting system, combined with proper lighting design principles, ensures that lighting is both efficient and comfortable.

<u>Sensors</u>

Non-residential projects are required to install sensors.

For intermittently used spaces or spaces with little to no occupancy, installed motion sensor. These sensors can either be motion sensor, occupancy sensor or infrared sensors. Spaces such the following will benefit from this installation:

- corridors
- fire escape staircase
- toilets
- janitor rooms
- pantry
- equipment rooms
- utility rooms, etc.

Habitable spaces like meeting rooms, gathering areas, lounge, etc. could also benefit from these sensors as the use of the spaces are also intermittent in nature. Careful design is required. Areas with good daylighting should be installed with photo or daylight sensors, and to be design with the lighting circuitry. Projects should also look into the use of 3 light levels “Full ON – partial ON – Full Off“, whenever possible.

Kalkulator / Calculator

Similar to daylighting calculation in criteria 1.2.4, plan out the spaces and group similar ones based on LDP, and sensor provisions. Key in representative spaces. Copy+paste the rows where required.

Proses Semakan / Review process

Jabatan penyemak / *Checking department* : JKB

Pemeriksaan kendiri oleh PSP/SP / *PSP/SP selfcheck*

5. impact on lighting layout change
6. new fittings brochures
7. calculation of energy reduction impact
8. review of lux levels to meet MS1525 criteria

Proses Semakan oleh DBKL / *Review process by DBKL*

2. performance report
3. Photo evidence

Keperluan Pengemukaan / Submission requirements

Pra-semakan / Pre-consultation

1. Commitment to change

Kebenaran merancang / *Planning approval (DO Stage)*

1. Prelim layout (Planning required if abv certain floor area)

Kelulusan Pelan Bangunan / *Building Plan approval (BP Stage)*

1. Proposed layout

Peringkat CCC / *CCC stage*

1. As-built plan
2. Confirmation of criteria compliance form and signed by PSP/SP
3. Photo evidence
4. Attach as part of supplementary appendix documentation for relevant G forms.

2.2.2 Penukaran kepada pencahayaan cekap tenaga
Conversion to energy efficient lighting

Kategori bangunan / Building category:

Sediada – semua jenis bangunan

Existing – all building types

Bagi peruntukan sensor / For sensor requirement

Bangunan sediada (bukan kediaman)

Existing buildings (non-residential)

Jabatan penyemak / *Checking department* : JPRB ()SC), JPIF

Keperluan PSP / PSP Requirement

Tujuan / Intent

To enhance the energy efficiency and illumination quality of indoor and outdoor spaces through the utilization of energy-efficient lighting fixtures.

Rujukan / Reference

MS1525

Keperluan / Requirement

1. Menggunakan lampu cekap tenaga seperti yang dinyatakan dalam MS1525.
   Using energy efficient lighting as specified in MS1525.
2. Zon pencahayaan yang cekap dengan sistem kawalan sensor yang fleksibel seperti yang dinyatakan dalam MS1525.
   Efficient lighting zones with flexible sensor control systems as specified in MS1525.

Pelaksanaan / Implementation

1. Existing lighting layout and fittings specification
2. Proposed new lighting specification
3. Proposed calculation or simulation
4. Installation of new fittings
5. Performance measurement and review
6. calculate energy impact

Contoh / Example

Figure 24 Retrofitted light fittings with built in motion sensor

Penerangan Lanjut / Further explanation

Retrofitting existing systems with energy-efficient components, adhering to energy codes and standards, educating building occupants, and implementing monitoring and evaluation systems are integral to comprehensive energy-efficient lighting practices. Collectively, these measures significantly reduce energy use and promote sustainability.

Similar to 2.2.1, prepare lighting strategy by spaces and explore compliance by design. In retrofitting light fittings for existing buildings, a strategic and comprehensive approach is important. The process begins with a thorough assessment of the current lighting system, considering factors such as energy efficiency, illumination levels, and the specific needs of the occupants. The retrofit design aims to enhance overall energy performance by replacing outdated fixtures with modern, energy-efficient alternatives, such as LED technology.

Careful consideration is given to lighting controls, including the implementation of sensors and smart technologies to optimize usage. Throughout the retrofit, compatibility with existing infrastructure must be prioritized to minimize disruption. The goal is to achieve improved lighting quality, reduced energy consumption, and a more sustainable and cost-effective lighting solution for the existing built environment.

Kalkulator / Calculator

This criteria shares the calculator with 2.2.1.

Input light fittings as designed for the existing building. No comparison required.

Proses Semakan / Review process

Jabatan penyemak / *Checking department* : JKB

Pemeriksaan kendiri oleh PSP/SP / *PSP/SP selfcheck*

1. impact on lighting layout change
2. new fittings brochures
3. calculation of energy reduction impact
4. review of lux levels to meet MS1525 criteria

Proses Semakan oleh DBKL / *Review process by DBKL*

1. performance report
2. Photo evidence

Keperluan Pengemukaan / Submission requirements

Pra-semakan / Pre-consultation

1. Commitment to change

Kebenaran merancang / *Planning approval (DO Stage)*

1. Prelim layout (Planning required if abv certain floor area)

Kelulusan Pelan Bangunan / *Building Plan approval (BP Stage)*

1. Proposed layout

Peringkat CCC / *CCC stage*

1. As-built plan
2. Confirmation of criteria compliance form and signed by PSP/SP
3. Photo evidence
4. Attach as part of supplementary appendix documentation for relevant G forms.

2.3.1 Pemasangan sistem tenaga boleh baharu
Installation of renewable energy system

Kategori bangunan / Building category:
Baharu – skala besar (>1,000m2) Kediaman & Bukan Kediaman
New – large scale (>1,000m2) Residential & Non-Residential

Jabatan penyemak / *Checking department* : JPRB (OSC), JKB

Keperluan PSP / PSP Requirement

Tujuan / Intent

To harness renewable solar energy and reduce reliance on non-renewable power sources by installing solar panels on rooftops and open spaces.

Rujukan / Reference

SEDA

Keperluan / Requirement

1. Memasang sistem tenaga boleh diperbaharui (daripada solar) > 30% berdasarkan keluasan litupan rata termasuk berbumbung pada bangunan yang dicadangkan.
   Installation of renewable energy system (from solar) > 30% based on the flat coverage area including roof on proposed building

   At the moment limited to solar PV application.

Pelaksanaan / Implementation

1. Calculation of total roof area
2. Estimation of solar potential and over shadowing risks
3. Highlight roof area to comply 30% coverage
4. product selection

Contoh / Example

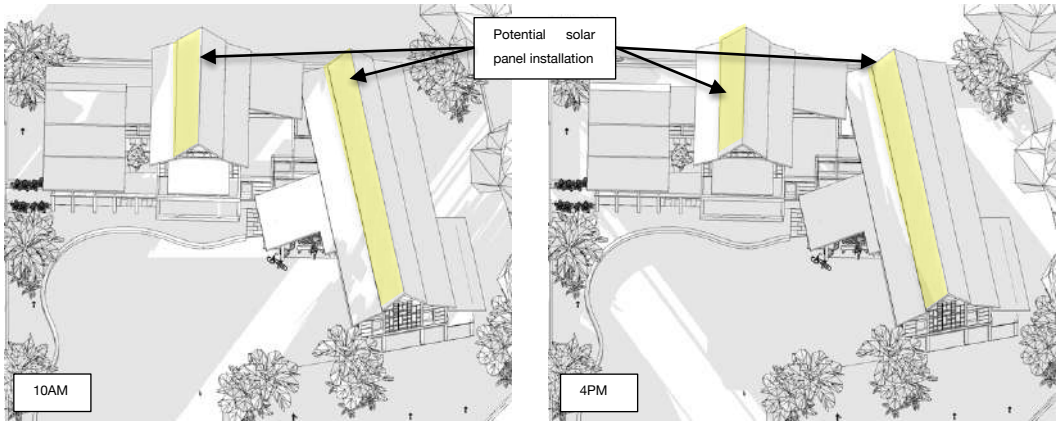


Figure 25 Architect's simple solar analysis

Figure 26 sample roof with solar panel integration produced by a solar PV vendor

Penerangan Lanjut / Further explanation

Implementing renewable energy is a great way to reduce your carbon footprint and save money on electricity bills.

In order to install solar PV on roof, make ready the roof plan. Calculate the roof area from the top and estimate a 30% area that would be likely for solar PV installation. Ensure that all roofs are suitable for PV panel installations. Identify areas that are not suitable for PV installation i.e. when there are equipment, green roof, etc. Subtract all non-complying roof areas to determine the actual roof area suitable for PV installation.

Pengiraan / Calculation

$$Solar\ PV\ on\ roof = \frac{\geq 30\%}{\text{Total roof area} - (\text{equipment on roof} + \text{green roof} + \text{shaded area})}$$

Equation 17 Solar PV area provision calculation formula

There are many ways to install the panel, some system requires light structures while some only need brackets and can be integrated with the roof construction itself. Projects should consult a PV specialist. Develop a renewable energy strategy**.** Given the complexity of current renewable energy markets and the variety of options for installing or purchasing renewable energy, it is important to develop a coordinated strategy. Many larger retailers have published greenhouse gas emission goals to reduce their contributions to climate change. Compliance to this LCBC criteria is mandatory, but it needs careful attention to its implementation.

PSP to ensure space requirement for the effective installation of solar panels including inverter room, meter room, link to MSB, maintenance protocol, etc.

When considering renewable energy, many people imagine rooftop solar panels. On-site rooftop solar is just one option. Projects may also consider other options such as solar parking canopies, wind turbines, or any other RE strategies available on the market.

Understand available financing and incentives**:** Investigate available financing and incentives to help offset the cost of installing renewable energy systems.

Kalkulator / Calculator

Roof area is calculated based on input from the general info page. In the criteria page, input the amount of shared area. These are areas where overshadowing occurs, and may not be feasible to install solar PV panels.

Insert the area of proposed/installed PV panels and its estimated power generation. 30% of the area is the a requirement. Additionally, projects to also provide an estimated energy offset.

Proses Semakan / Review process

Jabatan penyemak / *Checking department* : JKB

Pemeriksaan kendiri oleh PSP/SP / *PSP/SP selfcheck*

1. Potential area of installation
2. Calculation of possible yield
3. Details on installation
4. Incentives or financial support

Proses Semakan oleh DBKL / *Review process by DBKL*

1. Compliance to area provision and installation
2. Provision of Solar PV on plan with specifications

Keperluan Pengemukaan / Submission requirements

Pra-semakan / Pre-consultation

1. Intent to install

Kebenaran merancang / *Planning approval (DO Stage)*

1. Pre-calculation of area coverage on roof

Kelulusan Pelan Bangunan / *Building Plan approval (BP Stage)*

1. Installation area as indicated/ annotated in Building plan

Peringkat CCC / *CCC stage*

1. As-built plan
2. Confirmation of installation by vendor
3. Photo evidence
4. Attach as part of supplementary appendix documentation for relevant G forms.

2.3.2 Perlaksanaan Net Energy Metering (MET) - sistem Solar Panel Photo Voltaic
Implementation of Net Energy Metering (MET) - Solar Panel Photo Voltaic Systems

Kategori bangunan / Building category:
Baharu – skala besar (>1,000m2) Kediaman & Bukan Kediaman
New – large scale (>1,000m2) Residential & Non-Residential

Jabatan penyemak / *Checking department* : JPRB (OSC), JKB

Keperluan PSP / PSP Requirement

Tujuan / Intent

To enable efficient monitoring and management of energy consumption, a net energy meter is designed with the intent to measure the electricity flowing in and out of a facility.

Rujukan / Reference

SEDA

Keperluan / Requirement

1. Installation of Solar Photovoltaics
2. Availability of excess power generation from building's own use

Pelaksanaan / Implementation

1. The amount of energy required to qualify for NEM is still very low at 1kWh. This means that any project with Solar PV would be eligible.
2. Project to be completed first to become eligible to apply.
3. Install solar PV and ensure excess energy will become available for NEM.

Pematuhan / Compliance

1. Project is completed with excess energy generated from solar PV.
2. Provide proof of energy generation and consumption.
3. Apply to SEDA for NEM.

Contoh / Example

no example available.

Penerangan Lanjut / Further explanation

This technology provides a comprehensive overview of the energy dynamics, allowing users to track both the consumption from the grid and the excess energy generated and fed back into the grid by renewable energy sources like solar panels. By facilitating a bi-directional flow measurement, net energy

meters play a crucial role in promoting renewable energy integration, supporting grid stability, and empowering users to make informed decisions for optimizing their energy usage and contributing to a more sustainable energy landscape.

The Net Energy Metering (NEM) scheme was introduced by the Malaysian government in November 2016 to encourage the uptake of renewable energy. The scheme allows electricity consumers to install solar PV systems on the roofs of their premises to save on their electricity bills. The energy produced from the solar PV installation is consumed first, and any excess is exported to TNB at prevailing displaced cost.

The NEM 3.0 program was introduced on December 29, 2020, to provide more opportunities to electricity consumers to install solar PV systems on the roofs of their premises to save on their electricity bill. The program will be in effect from 2021 to 2023, and the total quota allocation is up to 1050 MW. The NEM 3.0 program will be divided into the following three new initiatives/categories:

NEM Rakyat Programme: This program is open to all Malaysian citizens who own residential properties. Solar PV systems must have a minimum capacity of 1kWh and be installed by an authorized installer.

NOVA Programme: This program is open to registered consumers of TNB in Peninsular Malaysia or a person applying to be a consumer of TNB. Domestic consumers who have not participated in any of the prior solar programs are also eligible.

Apart from Net Metering, SELCO is another option for projects to generate electricity from their own solar PV system, to offset or reduce electricity bills. SELCO allows the consumption of all the electricity generated by the solar system but will not allow any excess to flow into the utility network. Power flow study is required to be presented to TNB of the proposed connection of the generating plant/source.

Kalkulator / Calculator

This criteria is a self-declaration.

Proses Semakan / Review process

Jabatan penyemak / *Checking department* : JPRB (OSC), JKB

Pemeriksaan kendiri oleh PSP/SP / *PSP/SP selfcheck*

1. Ensure installation of solar PV generation to exceed building energy consumption
2. Prepare calculation and proof of compliance.
3. Prepare for NEM or SELCO application to SEDA.

Proses Semakan oleh DBKL / *Review process by DBKL*

1. Solar PV is installed.
2. Commitment to apply for NEM or SELCO

Keperluan Pengemukaan / Submission requirements

Pra-semakan / Pre-consultation

1. Client commitment

Kebenaran merancang / *Planning approval (DO Stage)*

1. Client commitment

Kelulusan Pelan Bangunan / *Building Plan approval (BP Stage)*

1. Client commitment
2. Energy estimation

Peringkat CCC / *CCC stage*

1. Proof of application of NEM/SELCO

2.3.3 Pengiraan BEI (*Building Energy Intensity*) bangunan hijau rendah karbon
BEI (Building Energy Intensity) calculation for low-carbon green buildings

Kategori bangunan / Building category:

Semua jenis bangunan

All building types

Jabatan penyemak / *Checking department* : JPRB (OSC), JKB

Keperluan PSP / PSP Requirement

Tujuan / Intent

To facilitate sustainable development in the built environment by registering Building Energy Intensity (BEI) with the Building Energy Online Data Monitoring (BeDOS) under the purview of SEDA Malaysia, which is designed to foster transparency and accountability in building energy consumption.

Rujukan / Reference

MS1525 / SEDA

Keperluan / Requirement

1. Mendaftar dan mengisi data maklumat bangunan baru dalam sistem BeDOS (Pengisian kepada anggaran tenaga dan pengiraan kepada (BEI) bangunan)
   Register and provide new building information in BeDOS system (Fulfillment to energy estimation and calculations for building BEI)

Pelaksanaan / Implementation

1. Identify all energy related items
2. Identify building usage, profiling and system scheduling
3. Prepare a BEI estimate by calculation or energy simulation
4. There are more. To elaborate

Pematuhan / Compliance

1. Submit proof of BeDOS registration during building plan registration
2. BEMS read out with BEI indication

Contoh / Example

refer BeDOS website.

Penerangan Lanjut / Further explanation

The BEI acts as a standardized benchmark for evaluating and comparing the energy performance of buildings. Registering with BeDOS, administered by SEDA Malaysia, extends this purpose by establishing a centralized platform for building owners to disclose their energy usage data. This collaborative initiative aims to enhance awareness, drive energy efficiency endeavors, and contribute to the overarching objective of reducing carbon emissions and promoting sustainability in the built environment.

"Building Energy Online Data Monitoring (BEDOS)" System is a system designed to monitor the energy usage by consumer/building owner. Energy consumers/building owner will be able to publish their energy consumption by this system. BEDOS is able to provide historical energy consumption data display and analyze the data to provide energy reports. Apart from energy consumption, it is also allow users to establish energy baselines and trace energy saving performance to help consumer manage energy usage.

BEDOS system also provide consumer/building owner to;

- Building Registration (capture building information);
- Submission of the monthly building electricity consumption;
- Generate report (but not limited to) regarding energy consumption, carbon emission, and energy saving in chart and able to be exported into csv format; and
- Data migration from previous manual data collection (excel)

The system provides a platform for the application of Sustainable Low Carbon Building Assessment GreenPASS, a voluntary program that appreciate the sustainable energy low carbon building initiatives by any consumer/building owner.

Sustainable Low carbon Building (LCB) performance certifications is to give an environmental evaluation of building performance based on energy efficiency and carbon dioxide emissions.

Pengiraan / Calculation

$$BEI = \frac{(\text{TBEC} - \text{CPEC} - \text{DCEC})}{(\text{GFA(excluding carpark)} - \text{DCA} - \text{GLA} * \text{FVR})} \text{x} \frac{52}{\text{WOH}}$$

Equation 18 BEI calculation formula

Before embarking on BeDOS, project is encourage to run their own BEI estimation. Although the known BEI benchmark is 250kWh/m2/yr, this benchmark was setup for general office use. Project should be able to refer to BEI as setup by Greenbuildingindex (GBI) that has establish benchmarks for various building types.

Alternatively, projects may also run their own bespoke BEI estimation by calculating the probable energy consumption of the building design using parameters as setup in MS1525. Once completed, run a second calculation using design parameters. The difference would become the basis for the building's BEI pending actual energy data that would later arrive from the TNB bill.

It is also common for projects to generate a normalised BEI based on the sequence as follows:

1. Modeling of the building massing in 3D
2. Application of designed building templates
    a. Building materials as designed
    b. Thermal template (rooms AC 24 hours, AC office hours, AC intermittent use, Natural ventilation)
    c. Windows profile (open, closed or open based on designated profile)
    d. Surface properties (colors and reflectance properties)
    e. Internal gains (people, plugloads, equipments, etc)
3. The use of building user profiling – hours of use – based on an hourly designed profile to simulate user pattern daily, for 7 days a week and 12 months a year situation. This profiling however, takes into account holidays or off-days.
4. The simulation uses hourly weather data
5. Rated hours were weighted averaged using the data obtained from the software and is tabulated as follow (sample):

Space	*Hours*	*Area*
Office	*3920*	*60712.80*
Staircase	*8,760.00*	*5,060.00*
Restrooms	*3,200.00*	*7,455.00*
Meeting	*2,352.00*	*3,659.00*
Lobby	*3,200.00*	*1,183.00*
Corridor	*2,700.00*	*2,150.00*
M & E		
Car park		
Others	*2,700.00*	*1,768.00*
Rated hour	*2845.61*	

6. Example
   Results BEI prediction by Whole Building Energy Simulation (BES)
   = 12,789,900 kWh / 115,668.80 m2
   = 110.57 kWh/m2/yr

   BEI minus (carpark + Data center)
   = 12,789,900 – (396,111+ 1,191,360)kWh / 115,668.80 – 33,145.50 m2
   = 11,202,429 kWh / 82,523.30 m2
   = 135.74 kWh/m2/yr

   BEI normalized to 2700 hrs
   = rated hours = 2845 hrs
   = 11,202,429 kWh / (82,523 m2 * 2,845) * 2,700
   = 128.8 kWh/m2/yr

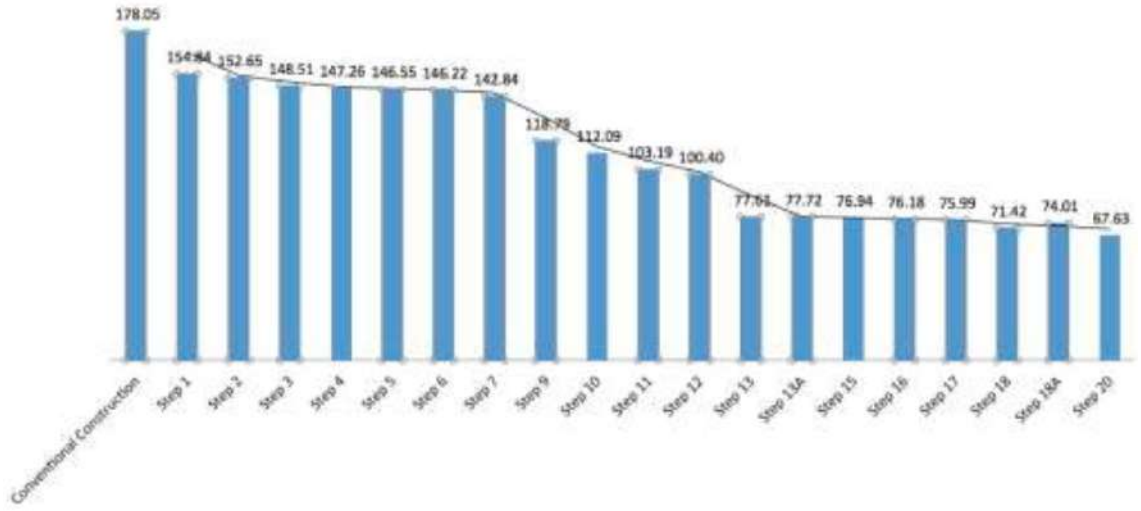


Figure 27 example of BEI reduction by doinf step-by-step method.

It is also common practice – to identify key energy performance items such as building materials, energy equipment, power, lighting and even occupancy patterns. Project stand the gain from itemized review of energy performance, that can also be made to refer cost implications. Where cost is too high without good payback, that strategy can be flagged as not feasible, and can be substituted with a better option.

Step-by-step performance is a good exercise and gives project a clearer picture on building energy performance and its contribution to carbon reduction. Stop designing using rule-of-thumb and start making informed decision using optimized design solutions.

Kalkulator / Calculator

This criteria is a self-declaration.

Proses Semakan / Review process

Jabatan penyemak / *Checking department* : JKB

Pemeriksaan kendiri oleh PSP/SP / *PSP/SP selfcheck*

1. Refer BEI checklist
2. Run cost and energy impact analysis.
3. Setup goals and decide on the optimized design.

Proses Semakan oleh DBKL / *Review process by DBKL*

1. Commitment to enrole in BeDOS system.

Keperluan Pengemukaan / Submission requirements

Pra-semakan / Pre-consultation

1. Quick energy estimation based on expected total energy/GFA

Kebenaran merancang / *Planning approval (DO Stage)*

1. BEI pre-calculation

Kelulusan Pelan Bangunan / *Building Plan approval (BP Stage)*

1. Predictive BEI calculation

Peringkat CCC / *CCC stage*

1. Total energy based on actual power less FVR
2. BEMS read out
3. Proof of registration to BeDOS.

Kod 04 Low Carbon Components

KOD 4.0 KOMPONEN RENDAH KARBON 4.1 Pelan Bangunan Hijau Rendah Karbon

CODE 4.0 LOW CARBON COMPONENTS 4.1 Low Carbon Building Plan

4.1.1 Pengurusan Sisa Domestik yang mampan
Sustainable Domestic Waste Management

Kategori bangunan / Building category:
Baharu – skala besar (>1,000m2) Kediaman & Bukan Kediaman
New – large scale (>1,000m2) Residential & Non-Residential

Jabatan penyemak / *Checking department* : JPRB (OSC), SW Corp

Keperluan PSP / PSP Requirement

Tujuan / Intent

To reduce impact of construction waste from going to landfills by establishing an ecologically responsible and environmentally sound approach in the building's sustainable waste management to systematically and responsibly handle waste materials and to promote recycling.

Rujukan / Reference

SWCorp

Keperluan / Requirement

1. Refuse Room and an area for Bulky Waste
2. An area for waste sorting for recycling
3. Building Domestic Waste Management Plan

Pelaksanaan / Implementation

1. To indicate suitable location for Bin center on plan
2. To indicate location of 3R bins within the project
3. To monitor waste management and recycling at source

Pematuhan / Compliance

1. Location of Bin center on plan
2. Location of 3R bins on plan
3. Building waste management (BWM) plan

Contoh / Example

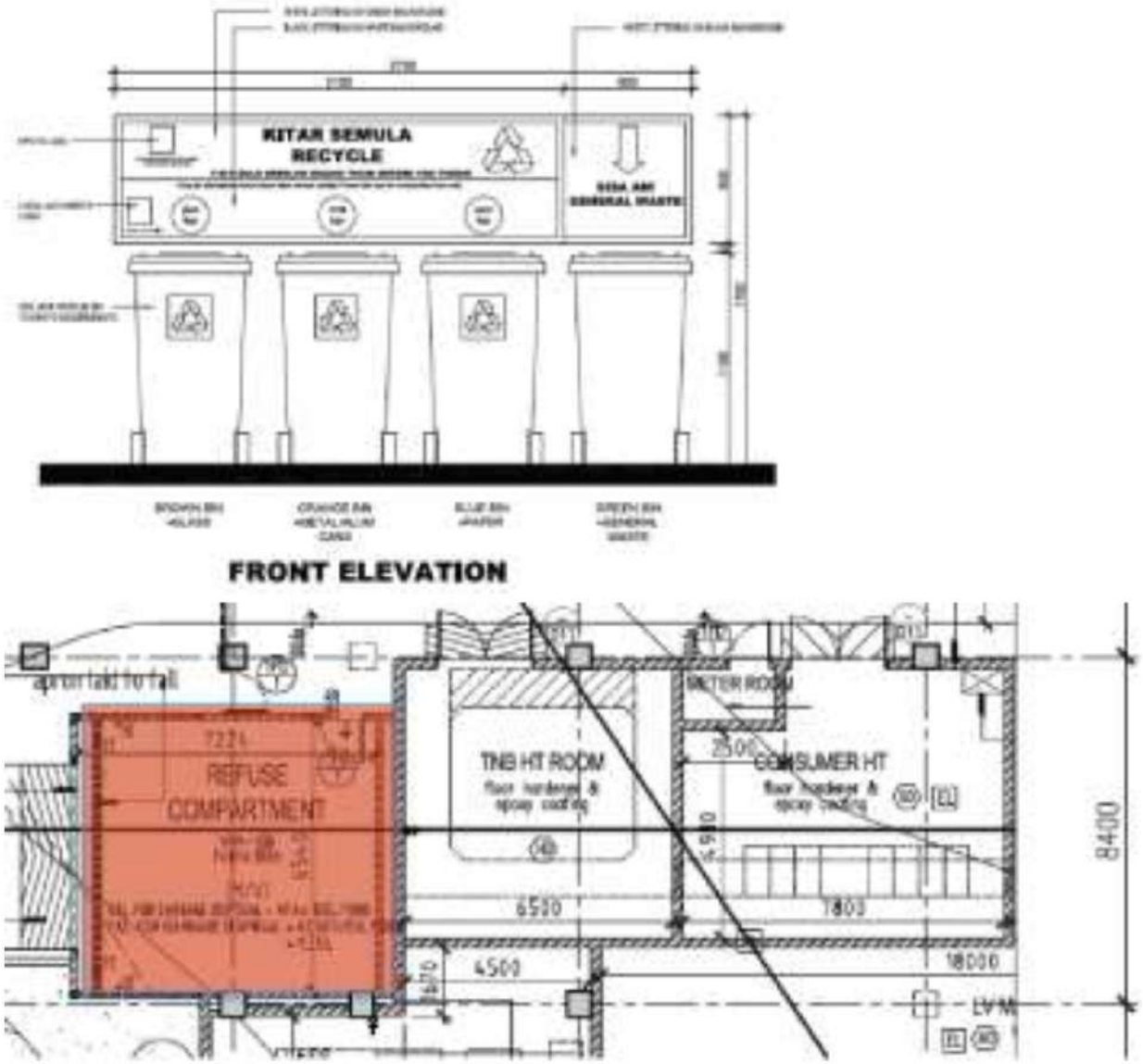


Figure 28 examples of 3R bins and a enlarged bin center

Penerangan Lanjut / Further explanation

Managing waste in building involves minimizing waste generation, promoting recycling and reuse, and adopting efficient disposal methods that reduce environmental impact. The overarching goal is to contribute to the conservation of resources, mitigate pollution, and move towards a circular economy where waste is viewed not as a problem but as a potential resource. Sustainable waste management practices aim to strike a balance between meeting societal needs, protecting public health, and ensuring the preservation of ecosystems for current and future generations.

Building should have a plan on waste generation and its management. Different types of buildings generate different types of waste. The standard hierarchy of waste management involves five crucial steps: reuse, reduce, recycling, treatment, and disposal. The current the most predominantly employed step in Malaysia is disposal and it is a “waste of wastes” when looked from circular economy point of view.

To achieve a sustainable solid waste management system, careful planning alongside efficient resource allocation and management is vital. Common sustainable management of waste are as follows:

Reduce: Reduce the amount of waste generated by using less material, reducing packaging, and choosing products with minimal packaging.

Reuse: Reuse items such as bags, containers, and bottles instead of throwing them away.

Recycle: Recycle materials such as paper, plastic, glass, and metal. Waste must be separated at source. This starts from the unit itself, be it a home, office, shop, etc. occupant must be educated to separate waste properly. These waste are then sent to the refuse room where it will be collected and transferred to the bin center. This is where an enlarged bin center is crucial – to be able to be used to sort recyclable waste. Recyclables are then sent or will be collected for recycling.

Composting: Composting is a natural process that turns organic waste into nutrient-rich soil. For most application, just by composting landscape waste already makes a lot of difference. Tree cutting and trimmings are usually lump at one side and sometimes takes days to be collected. This will impact the ground it is on, it attracts people to throw rubbish on the pile and can also be fire hazard. Projects with its own workable compound, like housing development or buildings with adequate greeneries can install composting bins on-site by identifying a suitable location that is obscured, or can even make it open to show the effort, although it can become a little messy of not managed properly. The process of landscape composting is similar to regular composting, but it requires a larger area and more time to complete. Landscape composting turns into nutrient-rich soil and the finished compost can be used as a fertilizer for plants. To use compost as a fertilizer, it is important to ensure that the compost is fully matured. Finished compost should have a sweetly fragrant and loamy smell, feel crumbly and smooth, and be a rich, dark color. Once the compost is ready, it can be used as a soil amendment to improve soil for planting vegetable gardens, landscape areas, and lawns.

Waste-to-energy: Waste-to-energy is a process that converts waste into energy. Cooking oil can be recycled into energy through a process called anaerobic digestion. This process involves breaking down the used cooking oil into biogas, which can be used to generate electricity, heat water, and power cars. In Malaysia, there are several ways to recycle cooking oil into energy. One way is to contact a professional who collects spent cooking oil and either recycles it or transports it to a recycling facility. The collected cooking oil is then broken down through anaerobic digestion, and the resulting biogas is used to generate energy. Another way to recycle cooking oil into energy is to use it as a fuel directly or use a chemical conversion process to produce biodiesel from cooking oils like soybean oil. This method is more suitable for large commercial restaurants that generate a significant amount of used cooking oil. It is important to note that recycling cooking oil into energy is an environmentally friendly alternative to disposing of it improperly. When pursuing this initiative, projects should take these precautionary actions:

*Filter the oil***:** After the oil has cooled down, filter it to remove any food particles or debris using a fine mesh strainer or cheesecloth.

Store the oil: Pour the filtered oil into a sealable container like a plastic bottle or metal can. Close the container tightly to avoid any spills.

Pack the container: Place the container into a plastic bag and seal it to avoid any leakage.

Recycle the oil: Bring the sealed container to a recycling center that accepts cooking oil. Some centers even pay a small fee to the donors to buy the used oil from them.

Used cooking oil can be reused in many ways, for example to make soaps, candles, as well as renewable energy. In Malaysia, Pusat Teknologi Biomass UPM, and companies like Fat Hopes Energy; and Agricode Green turn used cooking oil into biodiesel. Soaps made out of used cooking oil may sometimes be referred to as eco soap or green soap

It is important to note that the Malaysian government has taken steps to promote a more effective way of waste management by encouraging the reuse and reduce method and ultimately reducing landfill wastes. Careful planning alongside efficient resource allocation and management are vital in achieving a sustainable solid waste management system.

Kalkulator / Calculator

This criteria is a self-declaration.

Proses Semakan / Review process

Jabatan penyemak / *Checking department* : JKB

Pemeriksaan kendiri oleh PSP/SP / *PSP/SP selfcheck*

1. Identify bin center on plan and mark it up
2. If composting is planned, highlight the area of the composting bin
3. Provide clear calculation for waste as required by SWCorp.
4. When recycling is practiced, indicate it in plan clearly.
5. Establish a waste management plan.

Proses Semakan oleh DBKL / *Review process by DBKL*

1. Location of Bin center and 3R bins
2. Waste management plan

Keperluan Pengemukaan / Submission requirements

Pra-semakan / Pre-consultation

1. Intention to provide 3R initiatives, and or other waste management plan.

Kebenaran merancang / *Planning approval (DO Stage)*

1. Confirmation of refuse area calculation by SWCorp
2. Confirmation of other initiatives.

Kelulusan Pelan Bangunan / *Building Plan approval (BP Stage)*

1. Location of bin center on plan
2. Building waste management plan document framework

Peringkat CCC / *CCC stage*

1. As-built plan indicating Bin center and location s of 3R Bins
2. BWM plan
3. Photo evidence

4.2.1 Sistem Pengurusan Tenaga (BEMS – *Building Energy Management System*)
(BEMS – Building Energy Management System)

Kategori bangunan / Building category
Baharu – skala besar (>1,000m2) Bukan Kediaman
New – large scale (>1,000m2) Non-Residential

Jabatan penyemak / *Checking department* : JPRB (OSC), JKB

Keperluan PSP / PSP Requirement

Tujuan / Intent

To enhance the efficiency and sustainability of building energy usage in accordance with MS1525 as a comprehensive framework for monitoring, controlling, and optimizing energy consumption within a building.

Rujukan / Reference

MS1525

Keperluan / Requirement

1. EMS system architecture.
2. Installation of meters and sensors.
3. Installation of a maximum demand limiting program.
4. Extension into public display for awareness.

Pelaksanaan / Implementation

1. Identify areas where to be monitored and control.
2. Determine how much energy you want to reduce and set achievable targets.
3. Identify the EMS to track real-time energy use.
4. Plan for use automation systems for lighting, ACMV, and other equipment to optimize energy use. This can include timers and sensors.
5. Integrate renewable energy sources.

Pematuhan / Compliance

1. Verification of BEMS by verified consultants
2. Submit proof of installation as an attachment during CCC submission

Contoh / Example

No example available

Penerangan Lanjut / Further explanation

The EMS system aims to facilitate informed decision-making by collecting and analysing real-time data on energy performance, allowing for adjustments to be made in response to varying energy demands and environmental conditions. By aligning with the guidelines set forth in MS1525, an EMS contributes to the overarching goal of reducing energy consumption, improving operational efficiency, and promoting the implementation of energy conservation measures in line with recognized standards for building energy management.

Projects should first identify all systems to be monitored and control. This includes identifying areas where energy consumption can be reduced. An EMS should be able to monitor energy consumption in real-time. This can help identify areas where energy is being wasted and where improvements can be made. Setting energy targets can help motivate building occupants to reduce energy consumption. Targets can be set for individual systems and ultimately for the entire building.

The EMS is able to provide feedback to building management and occupants on their energy consumption can help raise awareness and encourage energy-saving behaviors. This should lead to **r**egular maintenance of equipment to ensure that all systems are operating efficiently, help reduce energy consumption and extend the life of the equipment.

Projects to train building management team the functions of the EMS, trouble shooting and on energy-saving behaviors to ensure the reduction of energy consumption.

Kalkulator / Calculator

This criteria is a self-declaration.

Proses Semakan / Review process

Jabatan penyemak / *Checking department* : JKB

Pemeriksaan kendiri oleh PSP/SP / *PSP/SP selfcheck*

1. System proposal and performance requirements
2. I/O points
3. System commissioning

Proses Semakan oleh DBKL / *Review process by DBKL*

1. System implementation report

Keperluan Pengemukaan / Submission requirements

Pra-semakan / Pre-consultation

1. Intention of BEMS installation

Kebenaran merancang / *Planning approval (DO Stage)*

1. Planned BEMS

Kelulusan Pelan Bangunan / *Building Plan approval (BP Stage)*

1. Planned BEMS
2. Location of BEMS room

Peringkat CCC / *CCC stage*

1. As-built plan indicating location of BEMS room
2. BEMS schematic
3. BEMS print out during commissioning
4. Compilation of product brochures
5. Proto evidence

4.2.2 Pengumpulan data bangunan pintar dan pusat
Smart and central building data collection

Kategori bangunan / Building category
Baharu – skala besar (>1,000m2) Bukan Kediaman
New – large scale (>1,000m2) Non-Residential

Jabatan penyemak / *Checking department* : JPRB (OSC), JKB

Keperluan PSP / PSP Requirement

Tujuan / Intent

To gather, analyse, and utilize data to enhance the energy efficiency, sustainability, and overall performance of buildings. This process involves the collection of real-time or historical data related to a building's energy consumption, systems, and environmental conditions.

Rujukan / Reference

SEDA

Keperluan / Requirement

1. Data tenaga BEMS (4.2.1) dikongsi ke sistem BeDOS dan juga akan dipaparkan di bangunan tersebut.
   BEMS energy data (4.2.1) is shared to BeDOS system will also be displayed in the building

Pelaksanaan / Implementation

1. Register the project to BeDOS.
2. Upon completion, update the energy data of the building onto the BeDOS system.
3. Maintain data sharing to BeDOS.

Pematuhan / Compliance

1. Verification of BEMS by verified consultants
2. Submit proof of installation as an attachment during CCC submission
3. Confirmation of registration to BeDOS and update during CCC submission

Contoh / Example

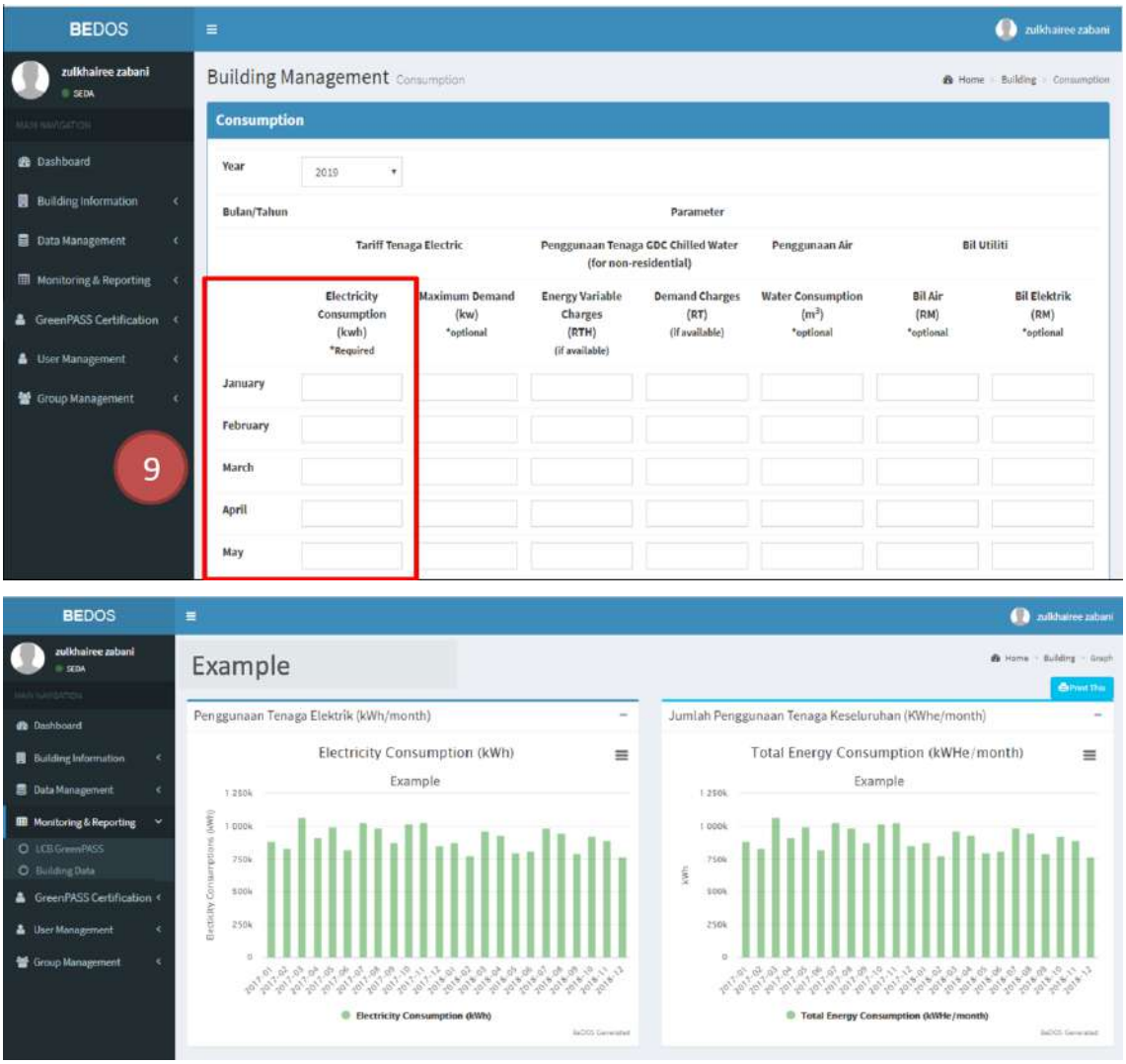


Figure 29 Screenshots of the BeDOS system

Penerangan Lanjut / Further explanation

"Building Energy Online Data Monitoring (BEDOS)" System is a system designed to monitor the energy usage by consumer/building owner. Energy consumer/building owner will be able to publish their energy consumption by this system. BEDOS able to provide historical energy consumption data display and analyze the data to provide energy report. Apart from energy consumption, it is also allow users to establish energy baselines and trace energy saving performance to help consumer manage energy usage. BEDOS system also provide consumer/building owner to;

- Building Registration (capture building information);
- Submission of the monthly building electricity consumption;
- Generate report (but not limited to) regarding energy consumption, carbon emission, energy saving in chart and able to be exported into csv format; and
- Data migration from previous manual data collection (excel)

The system provide platform for the application of Sustainable Low Carbon Building Assessment GreenPASS, a voluntary program that appreciate the sustainable energy low carbon building initiatives by any consumer/building owner. Sustainable Low carbon Building (LCB) performance certifications is to give an environmental evaluation of building performance based on energy efficiency and carbon dioxide emissions.

For more information, refer SEDA website.

Kalkulator / Calculator

This criteria is a self-declaration.

Proses Semakan / Review process

Jabatan penyemak / *Checking department* : JKB

Pemeriksaan kendiri oleh PSP/SP / *PSP/SP selfcheck*

1. BEMS system completed and commissioned
2. Registration to BeDOS

Proses Semakan oleh DBKL / *Review process by DBKL*

1. Proof of registration to BeDOS

Keperluan Pengemukaan / Submission requirements

Pra-semakan / Pre-consultation

1. Confirmation of requirement BeDOS

Kebenaran merancang / *Planning approval (DO Stage)*

1. Client intent letter to register to BeDOS

Kelulusan Pelan Bangunan / *Building Plan approval (BP Stage)*

1. Client intent letter to register to BeDOS

Peringkat CCC / *CCC stage*

1. BEMS commissioning documentation endorsed by SP
2. Confirmation of registration to BeDOS
3. Screenshot of the BeDOS system online.

4.2.3 Manual Penggunaan Bangunan Hijau
Green building user manual

Kategori bangunan / Building category

Semua jenis bangunan

All building types

Jabatan penyemak / Checking department : JPRB (OSC), JKB

Keperluan PSP / PSP Requirement

Tujuan / Intent

To create a comprehensive document that provides guidance and instructions on how to identify and maintain a building with focus on environmental sustainability and resource efficiency.

Rujukan / Reference

Refer existing mainstream green rating tools.

Keperluan / Requirement

1. Mengemukakan Operation and Manual (O&M) Manual
   Submit Operation and Manual (O&M) Manual

Pelaksanaan / Implementation

1. Identify all building compements/ equipments/ items/ etc that are related to Low Carbon and sustainability.
2. Prepare a list
3. Prepare the compliance page based on the LCBC template
4. Compile relevant documentations
5. Record the first training or briefing to the building user
6. Ensure hardcopy version is provided at the premises
7. Plan for on-going maintenance review of LCBC compliance

Pematuhan / Compliance

1. Manual O&M LCBC untuk semua kod dan kelestarian projek.
   O&M Manual for all LCBC and sustainability related items in the project

Contoh/ Example

To be developed on project-to-project basis.

Penerangan Lanjut / Further explanation

The document provides **standardization and consistency to ensure** that all LCBC items in the buildings are maintained well post construction. It offers insights into strategies and technologies for maintaining and improving energy efficiency, which can lead to reduced operational costs, lower greenhouse gas emissions, and enhanced occupant comfort. The manual provides recommendations for building maintenance and operations to ensure that green features continue to function as intended, preserving long-term sustainability. Green Building Manual plays a pivotal role in promoting sustainable building practices, reducing environmental impact, and optimizing operational efficiency. It is a valuable resource for professionals involved in green building projects, ensuring that sustainability goals are met and maintained over the building's lifecycle.

Ongoing Performance Monitoring

To ensure your building continues to perform optimally, it is essential to monitor energy, water, and waste management systems regularly. Implement a robust facility management plan that includes the following:

Regular audits: Conduct energy, water, and waste audits to assess your building's performance and identify opportunities for improvement. These audits will help you detect inefficiencies and address them promptly.

Preventive maintenance: Establish a preventive maintenance schedule for your building's systems, such as HVAC, lighting, plumbing, and waste management. Regular maintenance helps prevent equipment breakdowns, extends the lifespan of your systems, and ensures they operate at peak efficiency.

Ongoing commissioning: Continuously evaluate and optimize your building's systems to maintain high performance over time. Ongoing commissioning involves retesting and re-calibrating systems, updating operating procedures, and training for building staff.

Kalkulator / Calculator

This criteria is a self-declaration.

Proses Semakan / Review process

Jabatan penyemak / *Checking department* : JPRB (OSC), JKB

Pemeriksaan kendiri oleh PSP/SP / *PSP/SP selfcheck*

1. Review list items
2. Record the requirement for compliance
3. Ensure all related documentations are compiled

Proses Semakan oleh DBKL / *Review process by DBKL*

1. Completion of information in accordance with LCBC template
2. Complete compilation based on the content description
3. Proof of training done

Keperluan Pengemukaan / Submission requirements

Pra-semakan / Pre-consultation

1. Outline of the user manual

Kebenaran merancang / *Planning approval (DO Stage)*

1. Outline of the user manual

Kelulusan Pelan Bangunan / *Building Plan approval (BP Stage)*

1. Outline of the user manual
2. Description of compliance items

Peringkat CCC / *CCC stage*

1. LCBC Green manual document
2. Compilation of relevant items as described in the manual.

APPENDIX

Appendix

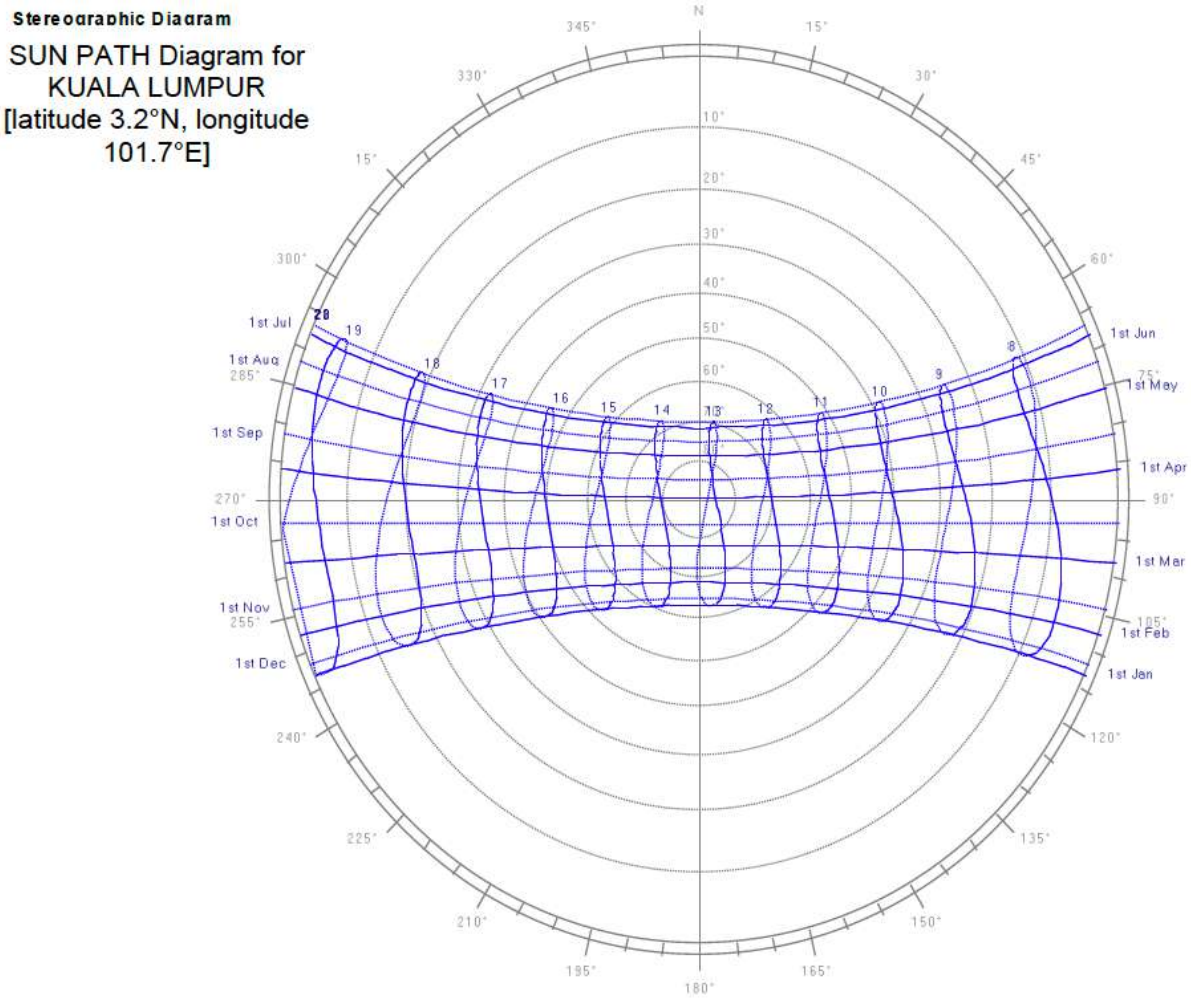


Figure 2. Sun path diagram

Excerpts from MS1525

$$OTTV_i = 15\,\alpha\,(1-WWR)\,U_w + 6\,(WWR)\,U_f + (194 \times OF \times WWR \times SC) \quad (2)$$

where

WWR is the window-to-gross exterior wall area ratio for the orientation under consideration;

α is the solar absorptivity of the opaque wall, as in Table 8;

U_w is the thermal transmittance of opaque wall (W/m^2 K);

U_f is the thermal transmittance of fenestration system (W/m^2 K);

OF is the solar orientation factor; as in Table 7; and

SC is the effective shading coefficient of the fenestration system; whereby Solar Heat Gain Coefficient (SHGC) = SC x 0.87

OTTV formula as per MS1525

$$RTTV = \frac{\left(A_r \times U_r \times T_{Deq}\right) + \left(A_s \times U_s \times \Delta T\right) + \left(A_s \times SC \times SF\right)}{A_0}$$

where

RTTV is the roof thermal transfer value (W/m^2);

A_r is the opaque roof area (m^2);

U_r is the thermal transmittance of opaque roof area (W/m^2 K);

TD_{eq} is the equivalent temperature difference (K), as from Table 11;

A_s is the skylight area (m^2);

U_s is the thermal transmittance of skylight area (W/m^2);

ΔT is the temperature difference between exterior and interior design conditions (5 K);

RTTV formula as per MS1525

Excerpts from MS1525

Table 7. Solar Orientation Factors

Orientation	Orientation Factors (OF)
North	0.90
North-East	1.09
East	1.23
South-East	1.13
South	0.92
South-West	0.90
West	0.94
North-West	0.90

NOTES:

1. This table specifies OF for the various orientation of the fenestration. For the calculation of OF, it is recommended that the nearest predominant orientation be selected.

2. A fenestration system may consist of a glazing material such as glass, a shading device and a combination of both.

Table 9. Shading coefficient of egg-crate louvres

Ratios		Orientation				
R1	R2	North/ South	East	West	North-East/ South-East	North-West/ South-West
0.20	0.20	0.71	0.77	0.77	0.73	0.75
	0.40 - 0.60	0.62	0.69	0.69	0.63	0.66
	0.60 - 1.80	0.56	0.62	0.61	0.55	0.58
0.40	0.20 - 0.40	0.59	0.63	0.64	0.60	0.63
	0.60 - 1.20	0.49	0.54	0.54	0.48	0.52
	1.40 - 1.80	0.46	0.50	0.51	0.44	0.48
0.60	0.20 - 0.60	0.52	0.54	0.56	0.51	0.55
	0.80 - 1.80	0.43	0.44	0.46	0.39	0.44
0.80	0.20 - 0.60	0.50	0.49	0.52	0.47	0.52
	0.80 - 1.80	0.40	0.39	0.42	0.36	0.41
1.00	0.20 - 0.40	0.51	0.48	0.52	0.48	0.52
	0.60 - 1.20	0.41	0.39	0.42	0.36	0.42
	1.40 - 1.80	0.38	0.35	0.38	0.32	0.38
1.20 -1.80	0.20 - 1.80	0.38	0.33	0.38	0.32	0.38

Excerpts from MS1525

Table 13. Recommended average illuminance levels

Task and applications	Illuminance (Lux)
a) Lighting for infrequently used area:	
- Minimum service illuminance	20
- Interior walkway and car-park	100
- Hotel bedroom	100
- Lift interior	100
- Corridor, passageways, stairs	100
- Escalator, travellator	150
- Entrance and exit	100
- Staff changing room, locker and cleaner room, cloak room, lavatories, stores.	100
- Entrance hall, lobbies, waiting room	100
- Inquiry desk	300
- Gate house	200
b) Lighting for working interiors	
- Infrequent reading and writing	200
- General offices, shops and stores, reading and writing	300 - 400
- Drawing office	300 - 400
- Restroom	150
- Restaurant, canteen, cafeteria	200
- Kitchen	150 - 300
- Lounge	150
- Bathroom	150
- Toilet	100
- Bedroom	100
- Class room, library	300 - 500
- Shop/supermarket/department store	200 - 750
- Museum and gallery	300
c) Localised lighting for exacting task	
- Proof reading	500
- Exacting drawing	1 000
- Detailed and precise work	2 000

Excerpts from MS1525

Table 15. Interior lighting power density (including ballast loss) allowance for typical building area

Type of usage	Maximum lighting power density (W/m^2)
a) Lighting for infrequently used area:	
- Minimum service illuminance	3
- Interior walkway and car-park	5
- Lift interior	5
- Corridor, passageways, stairs	5
- Escalator, travellator	6
- Entrance and exit	5
- Staff changing room, locker and cleaner room, cloak room, lavatories, stores.	5
- Entrance hall, lobbies, waiting room	5
- Inquiry desk	11
- Guard house	8
b) Lighting for working interiors	
- Infrequent reading and writing	8
- General offices, shops and stores, reading and writing	12
- Drawing office	14
- Restroom	6
- Restaurant, canteen, cafeteria	8
- Kitchen	11
- Lounge	6
- Bathroom	6
- Toilet	5
- Bedroom	5
- Class room, library, reading area	15
- Retail	24
- Museum and gallery	11
- Proof reading	18
- Exacting drawing	40
- Detailed and precise work	60
NOTE. For other areas not listed, refer to ANSI/ASHRAE/IES Standard 90.1 for the requirement.	

DBKL LCB Checklist 2023

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