# GSAS 2019
## DESIGN & BUILD
### ASSESSMENT MANUAL

**Building Sustainably**

## FOR BUILDING TYPOLOGIES

**GSAS**
GLOBAL SUSTAINABILITY
ASSESSMENT SYSTEM
2007

SERVICE
GSAS
2007
PROVIDER

**Dr. Yousef Alhorr**, Founding Chairman

**4th Edition**

GORD
المنظمة الخليجية للبحث والتطوير
Gulf Organisation for Research & Development

**Crafting a Green Legacy**

اللجنة العليا للمشاريع والإرث
Supreme Committee
for Delivery & Legacy

**GSAS**
PUBLICATIONS SERIES

# GSAS 2019 DESIGN & BUILD: ASSESSMENT MANUAL FOR BUILDING TYPOLOGIES

## 4th Edition

COMMERCIAL
EDUCATION
HOMES
HOSPITALITY
LIGHT INDUSTRY
MOSQUES
OFFICES
RESIDENTIAL

**Dr. Yousef Mohammed Alhorr**
**Founding Chairman**

Supported by:

Supreme Committee
for Delivery & Legacy

Gulf Organisation for Research & Development

## DISCLAIMER

GSAS was prepared with the assistance and participation of many individuals and representatives from various organisations and the final outcome represents a general consensus. Unanimous support from each and every organisation and individual consulted is not implied. GSAS documentation is revised on a regular basis and as deemed necessary. GORD, through the Center of Excellence GSAS Trust, reserves the right to amend, update and change this manual periodically without prior notice. Where changes in regulations necessitate changes to the criteria assessment, notifications will be issued to all parties involved in the assessment and will be announced on GORD website at www.gord.qa. An appropriate transition period shall be allowed for projects undergoing the assessment process.

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

# TABLE OF CONTENTS

# *Founding Chairman*

The UN Urbanization Prospects Report 2014 states that 54 percent of the world's population is residing in urban areas, and by 2050, 66 percent is predicted to be urbanized. Continued population growth and urbanization are projected to add a further 2.5 billion people to the urban population of the world by 2050.

To put this urbanization issue into a GCC context, close to 90% of the population in Gulf countries will be in cities by 2050.

Cities are the hub of human life. It is critical to ensure that while we focus on the comforts of living, the cities remain sustainable, resilient and low-carbon. Sustainability is a way of life, which apart from reducing the environmental, social and economic burden, it also determines the quality of life and how human wellbeing is taken care of. As most of our time is spent in buildings and using associated infrastructure, they are the most common denominators that determine how sustainable the cities are and can be. Worldwide regional and international organizations are tirelessly working and cooperating to make cities better places to live with a special focus on the built environment.

Out of a deep concern on unsustainable urban living-especially in the Central and Western Asian continent, in 2007 GORD developed and implemented the green building and infrastructure certification system. This recognizes the pioneering efforts of the developers, contractors, practitioners and entire construction community that has assumed responsibility to care for the cause of sustainability. GORD has come a long way since stewarding the Global Sustainability Assessment System (GSAS), formerly known as (QSAS), the Middle East's first integrated and performance-based assessment system. Our mission is to encourage the development and implementation of sustainability principles and imperatives which stems from our vision on sustainable development of the region as well as globally. Over the last few years we have established a clear link of what we are doing in GSAS with the achievement on multiple Sustainable Development Goals of the United Nations. GSAS draws from top tier global sustainability systems and adds new facets and dimensions to the current practices in assessing the sustainability of the built environment. Over the years, GSAS has become one of the most comprehensive systems to date, that addresses the built environment from a macro level to a micro level targeting a wide range of building typologies and infrastructure projects.

GSAS Certifications now cover all the dimensions to assess and certify the sustainability of the built environment, be it design, construction or operation of projects. This performance based dynamic system, equipped with continually reviewed benchmarks and best practices, is a great tool in the hands of the building community to continually improve the sustainability standards of the built environment.

I would like to acknowledge the efforts and contributions from the State of Qatar, all our members, international partners and the associated consultants who helped in establishing the system and take it into new dimensions. Finally, the continuous support from Qatari Diar Real Estate Company (QD) and the Supreme Committee for Delivery and Legacy (SC) are highly appreciated, and without their support, GSAS would not be able to achieve what it has done in such a short space of time.

**DR. YOUSEF MOHAMMED ALHORR,
FOUNDING CHAIRMAN**

## QATARI GOVERNMENT AND SEMI-GOVERNMENT ENTITIES

- Aspire Zone Foundation (ASPIRE)

- Barwa Real Estate Group (BARWA)

- Cultural Village Foundation (KATARA)

- Economic Zones Company (MANATEQ)

- New Port Project Steering Committee

- Lusail Real Estate Development Company (LUSAIL)

- Ministry of Culture & Sports (MCS)

- Ministry of Endowment and Islamic Affairs (AWQAF)

- Ministry of Interior - Internal Security Forces (ISF)

- Ministry of Municipality & Environment (MME)

- Mwani Qatar

- Private Engineering Office – Amiri Diwan (PEO)

- Public Works Authority (ASHGHAL)

- Qatar Foundation (QF)

- Qatar General Electricity and Water (KAHRAMAA)

- Qatar General Organization for Standards and Metrology (QGOSM)

- Qatar Museums (QM)

- Qatar Olympic Committee (QOC)

- Qatar Petroleum (QP)

- Qatar Rail (QR)

- Qatar Science and Technology Park (QSTP)

- Qatar University (QU)

- Qatari Diar Real Estate Investment Company (QD)

- Supreme Committee for Delivery & Legacy (SC)

## REGIONAL PROFESSIONAL ORGANISATIONS

- State of Kuwait – Green Buildings Committee – National Buildings Codes Committee

## INTERNATIONAL EXPERT REVIEWERS AND CONSULTANTS (2007-2011)

- Dick Van Dijk, PhD [Netherlands]
  Member of ISO TC163 Energy Standardization Committee, TNO, Institute of Applied Physics.

- Frank Matero, PhD [US]
  Professor of Architecture and Historic Preservation, University of Pennsylvania.

- Greg Foliente, PhD [Australia]
  Principal Research Scientist, CSIRO (Commonwealth Scientific and Industrial Research Organisation) Sustainable Ecosystems.

- John Hogan, PE, AIA [US]
  City of Seattle Department of Planning and Development, Member of ASHRAE.

- Laurie Olin, RLA, ALSA [US]
  Partner, OLIN Studio.

- Mark Standen [UK]
  Building Research Establishment Environmental Assessment Method (BREEAM) Technical work.

- Matthew Bacon, PhD, RIBA, FRSA [UK]
  Professor, University Salford - Faculty Built Environment and Business Informatics; Chief Executive, Conclude Consultancy Limited; and Partner, Eleven Informatics LLP.

- Matt Dolf [Canada]
  Assistant Director, AISTS (International Academy of Sports Science and Technology).

- Matthew Janssen [Australia]
  Director of Construction and Infrastructure and Environmental Management Services Business Units (KMH Environmental); formerly the Sustainability Program Manager for Skanska.

- Muscoe Martin, AIA [US]
  Director, Sustainable Buildings Industries Council (SBIC), USGBC board member.

- Nils Larsson [Canada]
  Executive Director of the International Initiative for a Sustainable Built Environment (iiSBE).

- Raymond Cole, PhD [Canada]
  Director, School of Architecture and Landscape Architecture, University of British Columbia.

- Skip Graffam, PhD, RLA, ASLA [US]
  Partner, Director of Research, OLIN Studio.

- Sue Riddlestone [UK]
  Executive Director & Co-Founder of BioRegional, Co-Director of One Planet and M.D. of BioRegional MiniMills Ltd.

## PREFACE

Global Sustainability Assessment System (GSAS) is the first performance-based system in the Middle East and North Africa (MENA) region, developed for assessing and rating the buildings and infrastructures for their sustainability impacts. The primary objective of GSAS is to create a sustainable built environment that minimizes ecological impact and reduces resources consumption while addressing the local needs and environmental conditions specific to the region. GSAS adopts an integrated lifecycle approach for the assessment of the built environment including design, construction and operation phases.

The 4th Edition of GSAS launched in 2019 has capitalized on 10 years of experience and 'hands-on' implementation of GSAS, richness and capacity gained from the assessment of numerous and various building typologies totalling more than 217,000,000 square feet of built-up area and more than 1,872,000,000 square feet of district masterplanning, and multi-disciplinary research projects conducted in collaboration with renowned world-class institutes on various aspects of sustainability in the built environment.

GSAS supports the project stakeholders with manuals and tools to aid projects in the implementation of the certification processes throughout the various phases of project development from pre-design to post-occupancy.

The purpose of this manual is to provide projects with guidance and instructions on the assessment approach established by GSAS Trust to meet GSAS certification requirements for a specific building type. The manual offers valuable information on the requirements for assessing all criteria and describes the protocols and particulars for the evaluation of each criterion. The particulars include testing, reports, plans, simulations, calculators, and how to achieve the criterion levels. In addition, the manual lists the type and description of the supporting materials that the project needs to submit to demonstrate compliance.

Most sustainable design principles and practices are relevant for all building typologies. However, there are circumstances in which different building types require unique measurements and assessments to accurately evaluate the environmental impact of a development. Therefore, GSAS includes schemes and typologies to evaluate most types of projects including but not limited to Commercial, Education, Homes, Hospitality, Light Industry, Mosques, Offices and Residential schemes. The primary function of a specific development defines the scheme that is most applicable. A development may comprise different functions and in such cases, they are referred to as mixed use where applicable assessment protocols and tools should be applied to each part of the development and an aggregated overall rating will be granted to the project.

This manual should be read in conjunction with all other relevant GSAS manuals and publications.

## CRITERIA SUMMARY

### APPLICABILITY

The table below summarizes the applicability of GSAS Design & Build criteria for different building typologies:

| Legend | | | | |
|---|---|---|---|---|
| √ | Applicable | **N/A** | Not Applicable | |

| No | Category / Criteria | APPLICABILITY | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Commercial | Education | Homes | Hospitality | Light Industry | Mosques | Offices | Residential |
| **UC** | **URBAN CONNECTIVITY** | | | | | | | | |
| UC.1 | Proximity to Infrastructure | √ | √ | √ | √ | √ | √ | √ | √ |
| UC.2 | Proximity to Amenities | √ | √ | √ | √ | N/A | N/A | √ | √ |
| UC.3 | Load on Local Traffic Conditions | √ | √ | N/A | √ | √ | √ | √ | √ |
| UC.4 | Public Transportation | √ | √ | √ | √ | √ | √ | √ | √ |
| UC.5 | Green Transportation | √ | √ | N/A | √ | √ | N/A | √ | √ |
| UC.6 | Neighbourhood Acoustics | √ | √ | √ | √ | √ | √ | √ | √ |
| **S** | **SITE** | | | | | | | | |
| S.1 | Land Preservation | √ | √ | N/A | √ | √ | √ | √ | √ |
| S.2 | Waterbody Preservation | √ | √ | N/A | √ | √ | √ | √ | √ |
| S.3 | Biodiversity Preservation | √ | √ | N/A | √ | √ | √ | √ | √ |
| S.4 | Vegetation | √ | √ | √ | √ | √ | √ | √ | √ |
| S.5 | Drain & Stormwater Contamination | √ | √ | N/A | √ | √ | √ | √ | √ |
| S.6 | Rainwater Runoff | √ | √ | √ | √ | √ | √ | √ | √ |
| S.7 | Heat Island Effect | √ | √ | √ | √ | √ | √ | √ | √ |
| S.8 | Shading | √ | √ | N/A | √ | √ | √ | √ | √ |
| S.9 | Accessibility | √ | √ | N/A | √ | √ | √ | √ | √ |
| S.10 | External Lighting | √ | √ | N/A | √ | √ | √ | √ | √ |
| S.11 | Light Pollution | √ | √ | √ | √ | √ | √ | √ | √ |
| S.12 | Noise Pollution | √ | √ | N/A | √ | √ | √ | √ | √ |
| S.13 | Eco-Parking | √ | √ | √ | √ | √ | √ | √ | √ |
| S.14 | Mixed Use | √ | N/A | N/A | √ | N/A | N/A | √ | √ |
| S.15 | Construction Practices | √ | √ | √ | √ | √ | √ | √ | √ |

| No | Category / Criteria | APPLICABILITY | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Commercial | Education | Homes | Hospitality | Light Industry | Mosques | Offices | Residential |
| **E** | **ENERGY** | | | | | | | | |
| E.1 | Thermal Energy Demand Performance | √ | √ | √ | √ | √ | √ | √ | √ |
| E.2 | Energy Use Performance | √ | √ | √ | √ | √ | √ | √ | √ |
| E.3 | Primary Energy Performance | √ | √ | √ | √ | √ | √ | √ | √ |
| E.4 | $CO_2$ Emissions | √ | √ | √ | √ | √ | √ | √ | √ |
| E.5 | Energy Sub-Metering | √ | √ | √ | √ | √ | √ | √ | √ |
| E.6 | Renewable Energy | √ | √ | √ | √ | √ | √ | √ | √ |
| **W** | **WATER** | | | | | | | | |
| W.1 | Water Demand Performance | √ | √ | √ | √ | √ | √ | √ | √ |
| W.2 | Water Reuse Performance | √ | √ | √ | √ | √ | √ | √ | √ |
| W.3 | Water Sub-Metering | √ | √ | √ | √ | √ | √ | √ | √ |
| **M** | **MATERIALS** | | | | | | | | |
| M.1 | Locally Sourced Materials | √ | √ | √ | √ | √ | √ | √ | √ |
| M.2 | Materials Eco-Labeling | √ | √ | √ | √ | √ | √ | √ | √ |
| M.3 | Recycled Content of Materials | √ | √ | √ | √ | √ | √ | √ | √ |
| M.4 | Materials Reuse | √ | √ | N/A | √ | √ | √ | √ | √ |
| M.5 | Existing Structure Reuse | √ | √ | N/A | √ | √ | √ | √ | N/A |
| M.6 | Design for Disassembly | √ | √ | N/A | √ | √ | √ | √ | √ |
| M.7 | Responsible Sourcing of Materials | √ | √ | √ | √ | √ | √ | √ | √ |
| **IE** | **INDOOR ENVIRONMENT** | | | | | | | | |
| IE.1 | Thermal Comfort | √ | √ | N/A | √ | √ | √ | √ | √ |
| IE.2 | Natural Ventilation | √ | √ | √ | √ | √ | √ | √ | √ |
| IE.3 | Mechanical Ventilation | √ | √ | N/A | √ | √ | √ | √ | √ |
| IE.4 | Lighting | √ | √ | √ | √ | √ | √ | √ | √ |
| IE.5 | Daylight | √ | √ | √ | √ | √ | √ | √ | √ |
| IE.6 | Glare | √ | √ | N/A | √ | √ | √ | √ | N/A |
| IE.7 | Views | √ | √ | √ | √ | √ | N/A | √ | √ |
| IE.8 | Acoustics | √ | √ | √ | √ | √ | √ | √ | √ |
| IE.9 | Low-VOC Materials | √ | √ | √ | √ | √ | √ | √ | √ |
| IE.10 | Airborne Contaminants | √ | √ | N/A | √ | √ | √ | √ | √ |

| No | Category / Criteria | APPLICABILITY | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Commercial | Education | Homes | Hospitality | Light Industry | Mosques | Offices | Residential |
| **CE** | **CULTURAL & ECONOMIC VALUE** | | | | | | | | |
| CE.1 | Heritage & Cultural Identity | √ | √ | √ | √ | N/A | √ | √ | √ |
| CE.2 | Support of National Economy | √ | √ | √ | √ | √ | √ | √ | √ |
| **MO** | **MANAGEMENT & OPERATIONS** | | | | | | | | |
| MO.1 | Systems Commissioning | √ | √ | N/A | √ | √ | √ | √ | √ |
| MO.2 | Waste Management | √ | √ | N/A | √ | √ | N/A | √ | √ |
| MO.3 | Facility Management | √ | √ | N/A | √ | √ | √ | √ | √ |
| MO.4 | Leak Detection Systems | √ | √ | N/A | √ | √ | √ | √ | √ |
| MO.5 | Automated Control System | √ | √ | N/A | √ | √ | √ | √ | √ |
| MO.6 | Transportation Systems in Building | √ | √ | N/A | √ | √ | N/A | √ | √ |

## CRITERIA WEIGHTS

The table below summarizes the weights of GSAS Design & Build criteria for different building typologies:

| Legend | | | | | |
|---|---|---|---|---|---|
| **I** | Incentive Only | | **N/A** | Not Applicable | |

| No | Category / Criteria | LEVELS | | WEIGHTS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MIN | MAX | Commercial | Education | Homes | Hospitality | Light Industry | Mosques | Offices | Residential |
| **UC** | **URBAN CONNECTIVITY** | | | | | | | | | | |
| UC.1 | Proximity to Infrastructure | 0 | 3 | 1.39% | 1.36% | 2.38% | 1.35% | 1.49% | 1.78% | 1.35% | 1.50% |
| UC.2 | Proximity to Amenities | 0 | 3 | 1.55% | 0.82% | 2.49% | 0.80% | N/A | N/A | 0.82% | 0.76% |
| UC.3 | Load on Local Traffic Conditions | 0 | 3 | 0.76% | 1.62% | N/A | 1.81% | 1.68% | 1.93% | 1.62% | 1.82% |
| UC.4 | Public Transportation | 0 | 3 | 1.32% | 1.29% | 1.83% | 1.26% | 1.69% | 2.09% | 1.29% | 1.30% |
| UC.5 | Green Transportation | 0 | 3 | 0.55% | 0.52% | N/A | 0.46% | 0.65% | N/A | 0.52% | 0.42% |
| UC.6 | Neighborhood Acoustics | 0 | 3 | 0.43% | 0.39% | 0.30% | 0.32% | 0.49% | 0.20% | 0.40% | 0.20% |
| | **Total** | | | **6.00%** | **6.00%** | **7.00%** | **6.00%** | **6.00%** | **6.00%** | **6.00%** | **6.00%** |
| **S** | **SITE** | | | | | | | | | | |
| S.1 | Land Preservation | -1 | 3 | 1.35% | 1.28% | N/A | 1.21% | 1.15% | 1.22% | 1.29% | 1.28% |
| S.2 | Waterbody Preservation | -1 | 3 | 1.20% | 1.23% | N/A | 1.23% | 1.18% | 1.04% | 1.23% | 1.22% |
| S.3 | Biodiversity Preservation | -1 | 3 | 0.86% | 0.90% | N/A | 0.96% | 0.95% | 1.17% | 0.84% | 1.02% |
| S.4 | Vegetation | -1 | 3 | 1.24% | 1.23% | 2.20% | 1.20% | 1.14% | 1.32% | 1.23% | 1.15% |
| S.5 | Drain & Stormwater Contamination | -1 | 3 | 1.07% | 1.12% | N/A | 1.07% | 1.46% | 1.08% | 1.13% | 1.04% |
| S.6 | Rainwater Runoff | -1 | 3 | 0.85% | 0.87% | 2.20% | 0.88% | 0.97% | 1.02% | 0.81% | 0.88% |
| S.7 | Heat Island Effect | -1 | 3 | 0.98% | 1.27% | 2.20% | 1.01% | 1.21% | 1.02% | 0.97% | 1.02% |
| S.8 | Shading | -1 | 3 | 1.06% | 1.02% | N/A | 1.07% | 1.06% | 1.22% | 1.03% | 1.08% |
| S.9 | Accessibility | -1 | 3 | 0.94% | 1.27% | N/A | 1.09% | 1.08% | 1.16% | 1.08% | 0.99% |
| S.10 | External Lighting | -1 | 3 | 0.94% | 0.97% | N/A | 1.01% | 0.98% | 1.06% | 0.91% | 1.15% |
| S.11 | Light Pollution | -1 | 3 | 0.96% | 1.01% | 0.96% | 0.91% | 0.91% | 0.91% | 1.02% | 0.96% |
| S.12 | Noise Pollution | -1 | 3 | 0.81% | 0.83% | N/A | 0.82% | 0.91% | 0.72% | 0.77% | 0.74% |
| S.13 | Eco-Parking | -1 | 3 | 1.11% | 1.35% | 0.94% | 1.07% | 1.35% | 1.12% | 1.06% | 1.06% |
| S.14 | Mixed Use | -1 | 3 | 0.85% | N/A | N/A | 0.82% | N/A | N/A | 0.82% | 0.76% |
| S.15 | Construction Practices | -1 | 3 | 2.78% | 2.65% | 2.50% | 2.65% | 2.65% | 2.94% | 2.81% | 2.65% |
| | **Total** | | | **17.00%** | **17.00%** | **11.00%** | **17.00%** | **17.00%** | **17.00%** | **17.00%** | **17.00%** |

| No | Category / Criteria | LEVELS | | WEIGHTS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MIN | MAX | Commercial | Education | Homes | Hospitality | Light Industry | Mosques | Offices | Residential |
| **E** | **ENERGY** | | | | | | | | | | |
| E.1 | Thermal Energy Demand Performance | −1 | 3 | 11.00% | 11.00% | 13.48% | 11.00% | 11.00% | 11.00% | 11.00% | 11.00% |
| E.2 | Energy Use Performance | −1 | 3 | 7.76% | 7.76% | 9.44% | 7.76% | 7.76% | 7.76% | 7.76% | 7.76% |
| E.3 | Primary Energy Performance | −1 | 3 | 2.56% | 2.56% | 2.97% | 2.56% | 2.56% | 2.56% | 2.56% | 2.56% |
| E.4 | $CO_2$ Emissions | −1 | 3 | 2.68% | 2.68% | 3.11% | 2.68% | 2.68% | 2.68% | 2.68% | 2.68% |
| E.5 | Energy Sub-Metering | 0 | 3 | I | I | I | I | I | I | I | I |
| E.6 | Renewable Energy | 0 | 3 | I | I | I | I | I | I | I | I |
| | **Total** | | | **24.00%** | **24.00%** | **29.00%** | **24.00%** | **24.00%** | **24.00%** | **24.00%** | **24.00%** |
| **W** | **WATER** | | | | | | | | | | |
| W.1 | Water Demand Performance | −1 | 3 | 6.00% | 6.00% | 12.00% | 6.00% | 6.00% | 6.00% | 6.00% | 6.00% |
| W.2 | Water Reuse Performance | −1 | 3 | 10.00% | 10.00% | 6.00% | 10.00% | 10.00% | 10.00% | 10.00% | 10.00% |
| W.3 | Water Sub-Metering | 0 | 3 | I | I | I | I | I | I | I | I |
| | **Total** | | | **16.00%** | **16.00%** | **18.00%** | **16.00%** | **16.00%** | **16.00%** | **16.00%** | **16.00%** |
| **M** | **MATERIALS** | | | | | | | | | | |
| M.1 | Locally Sourced Materials | −1 | 3 | 1.77% | 1.53% | 2.90% | 1.52% | 1.50% | 1.94% | 1.50% | 2.31% |
| M.2 | Materials Eco-Labeling | −1 | 3 | 2.50% | 2.50% | 2.20% | 2.50% | 2.50% | 2.50% | 2.50% | 2.50% |
| M.3 | Recycled Content of Materials | −1 | 3 | 2.19% | 2.20% | 2.90% | 2.18% | 1.95% | 1.74% | 2.20% | 1.91% |
| M.4 | Materials Reuse | −1 | 3 | 1.24% | 1.24% | N/A | 1.25% | 1.25% | 1.27% | 1.25% | 1.24% |
| M.5 | Existing Structure Reuse | −1 | 3 | 0.46% | 0.44% | N/A | 0.45% | 0.65% | 0.45% | 0.45% | N/A |
| M.6 | Design for Disassembly | −1 | 3 | 0.84% | 1.09% | N/A | 1.10% | 1.15% | 1.10% | 1.10% | 1.04% |
| M.7 | Responsible Sourcing of Materials | 0 | 3 | I | I | I | I | I | I | I | I |
| | **Total** | | | **9.00%** | **9.00%** | **8.00%** | **9.00%** | **9.00%** | **9.00%** | **9.00%** | **9.00%** |

| No | Category / Criteria | LEVELS | | WEIGHTS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MIN | MAX | Commercial | Education | Homes | Hospitality | Light Industry | Mosques | Offices | Residential |
| **IE** | **INDOOR ENVIRONMENT** | | | | | | | | | | |
| IE.1 | Thermal Comfort | -1 | 3 | 1.99% | 1.67% | N/A | 1.72% | 1.85% | 1.88% | 1.87% | 1.89% |
| IE.2 | Natural Ventilation | -1 | 3 | 1.55% | 2.13% | 4.58% | 2.16% | 2.02% | 2.49% | 1.43% | 2.85% |
| IE.3 | Mechanical Ventilation | -1 | 3 | 2.75% | 2.13% | N/A | 2.16% | 2.02% | 2.49% | 2.63% | 2.85% |
| IE.4 | Lighting | -1 | 3 | 1.79% | 1.67% | 2.98% | 1.72% | 1.85% | 1.88% | 1.67% | 1.64% |
| IE.5 | Daylight | -1 | 3 | 2.25% | 2.13% | 3.92% | 2.16% | 2.02% | 2.49% | 2.13% | 2.85% |
| IE.6 | Glare | -1 | 3 | 1.20% | 1.67% | N/A | 1.20% | 1.85% | 1.22% | 1.67% | N/A |
| IE.7 | Views | -1 | 3 | 1.50% | 1.67% | 2.98% | 1.51% | 1.50% | N/A | 1.67% | 1.51% |
| IE.8 | Acoustics | -1 | 3 | 1.79% | 1.67% | 2.76% | 2.05% | 1.85% | 1.88% | 1.67% | 1.64% |
| IE.9 | Low-VOC Materials | -1 | 3 | 2.00% | 2.13% | 3.78% | 2.16% | 2.02% | 2.49% | 2.13% | 1.64% |
| IE.10 | Airborne Contaminants | -1 | 3 | 2.18% | 2.13% | N/A | 2.16% | 2.02% | 2.18% | 2.13% | 2.13% |
| | | | **Total** | **19.00%** | **19.00%** | **21.00%** | **19.00%** | **19.00%** | **19.00%** | **19.00%** | **19.00%** |
| **CE** | **CULTURAL & ECONOMIC VALUE** | | | | | | | | | | |
| CE.1 | Heritage & Cultural Identity | -1 | 3 | 1.36% | 1.62% | 2.44% | 1.62% | N/A | 1.62% | 1.62% | 2.12% |
| CE.2 | Support of National Economy | -1 | 3 | 2.64% | 2.38% | 3.56% | 2.38% | 4.00% | 2.38% | 2.38% | 1.88% |
| | | | **Total** | **4.00%** | **4.00%** | **6.00%** | **4.00%** | **4.00%** | **4.00%** | **4.00%** | **4.00%** |
| **MO** | **MANAGEMENT & OPERATIONS** | | | | | | | | | | |
| MO.1 | Systems Commissioning | 0 | 3 | 0.99% | 0.97% | N/A | 0.97% | 0.86% | 1.52% | 0.97% | 0.94% |
| MO.2 | Waste Management | 0 | 3 | 1.09% | 0.93% | N/A | 0.92% | 0.83% | N/A | 0.93% | 0.93% |
| MO.3 | Facility Management | 0 | 3 | 0.67% | 0.56% | N/A | 0.56% | 0.71% | 0.96% | 0.56% | 0.96% |
| MO.4 | Leak Detection Systems | 0 | 3 | 0.62% | 0.79% | N/A | 0.79% | 0.94% | 0.94% | 0.79% | 0.62% |
| MO.5 | Automated Control System | 0 | 3 | 0.96% | 0.98% | N/A | 0.99% | 0.88% | 1.58% | 0.98% | 0.93% |
| MO.6 | Transportation Systems in Building | 0 | 3 | 0.67% | 0.77% | N/A | 0.77% | 0.78% | N/A | 0.77% | 0.62% |
| | | | **Total** | **5.00%** | **5.00%** | **N/A** | **5.00%** | **5.00%** | **5.00%** | **5.00%** | **5.00%** |

## CRITERIA INCENTIVES

The table below summarizes the maximum incentive weights of GSAS Design & Build criteria for different building typologies:

| No | Category / Criteria | Commercial | Education | Homes | Hospitality | Light Industry | Mosques | Offices | Residential |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | INCENTIVES | | | | |
| **S** | **SITE** | | | | | | | | |
| S.15 | Construction Practices | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% |
| **E** | **ENERGY** | | | | | | | | |
| E.5 | Energy Sub-Metering | 2% | 2% | 2% | 2% | 2% | 2% | 2% | 2% |
| E.6 | Renewable Energy | 2% | 2% | 2% | 2% | 2% | 2% | 2% | 2% |
| **W** | **WATER** | | | | | | | | |
| W.3 | Water Sub-Metering | 2% | 2% | 2% | 2% | 2% | 2% | 2% | 2% |
| **M** | **MATERIALS** | | | | | | | | |
| M.2 | Materials Eco-Labeling | 2% | 2% | 2% | 2% | 2% | 2% | 2% | 2% |
| M.7 | Responsible Sourcing of Materials | 1% | 1% | 1% | 1% | 1% | 1% | 1% | 1% |
| **IE** | **INDOOR ENVIRONMENT** | | | | | | | | |
| IE.9 | Low-VOC Materials | 2% | 2% | 2% | 2% | 2% | 2% | 2% | 2% |

## STRUCTURE OF ASSESSMENT

The table below summarizes elements of the assessment for each criterion in GSAS Design & Build certification:

| | |
|---|---|
| **APPLICABILITY** | Lists GSAS building typologies the Criterion for assessment is applicable to. |
| **PURPOSE** | Outlines the objective of the Criterion. |
| **ASSESSMENT PRINCIPLES** | Summarizes the overall principle of the Criterion for assessment. |
| **ASSESSMENT** | Describes the requirements for assessing the Criterion. |
| **CRITERION LEVELS** | Lists the Levels associated with the indicators and compliance requirements of the Criterion. |
| **SUBMITTALS** | Lists the types and descriptions of the supporting materials that the project needs to submit to demonstrate compliance. |
| **EVALUATION** | Describes the general instruction and particulars for the evaluation of the Criterion.  The particulars include testing, reports, plans, simulations, calculators, and how to achieve the criterion levels. |

UC | S | E | W | M | IE | CE | MO

## 1.0    URBAN CONNECTIVITY

The Urban Connectivity [UC] category is concerned with the design of the proposed development having a direct impact on adjacent buildings, properties, neighborhoods, and the larger urban community.

Sustainable urban practices improve the development of neighborhoods and communities, in addition to minimizing the impacts on the surrounding environment including: climate change, fossil fuel depletion, water depletion and pollution, air pollution, land use and contamination, and human comfort and health.

**CRITERIA IN THIS CATEGORY:**

UC.1    Proximity to Infrastructure

UC.2    Proximity to Amenities

UC.3    Load on Local Traffic Conditions

UC.4    Public Transportation

UC.5    Green Transportation

UC.6    Neighborhood Acoustics

## CRITERIA SUMMARY

The table below summarizes the weights of the Urban Connectivity category and each of the associated criteria:

| Legend | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| √ | Incentive Only | | | | | N/A | Not Applicable | | | | |

| No | Category / Criteria | LEVELS | | WEIGHTS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MIN | MAX | Commercial | Education | Homes | Hospitality | Light Industry | Mosques | Offices | Residential |
| **UC** | **URBAN CONNECTIVITY** | | | | | | | | | | |
| UC.1 | Proximity to Infrastructure | 0 | 3 | 1.39% | 1.36% | 2.38% | 1.35% | 1.49% | 1.78% | 1.35% | 1.50% |
| UC.2 | Proximity to Amenities | 0 | 3 | 1.55% | 0.82% | 2.49% | 0.80% | N/A | N/A | 0.82% | 0.76% |
| UC.3 | Load on Local Traffic Conditions | 0 | 3 | 0.76% | 1.62% | N/A | 1.81% | 1.68% | 1.93% | 1.62% | 1.82% |
| UC.4 | Public Transportation | 0 | 3 | 1.32% | 1.29% | 1.83% | 1.26% | 1.69% | 2.09% | 1.29% | 1.30% |
| UC.5 | Green Transportation | 0 | 3 | 0.55% | 0.52% | N/A | 0.46% | 0.65% | N/A | 0.52% | 0.42% |
| UC.6 | Neighborhood Acoustics | 0 | 3 | 0.43% | 0.39% | 0.30% | 0.32% | 0.49% | 0.20% | 0.40% | 0.20% |
| | **Total** | | | **6.00%** | **6.00%** | **7.00%** | **6.00%** | **6.00%** | **6.00%** | **6.00%** | **6.00%** |

## 1.1 [UC.1] PROXIMITY TO INFRASTRUCTURE

### 1.1.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 1.1.2 PURPOSE

To minimize the amount of new infrastructure required by the development.

### 1.1.3 ASSESSMENT PRINCIPLES

- The Project will **assess** the existing or planned infrastructure network connections required to serve the needs of the development.

- The Project will complete the **calculator** for UC.1 Proximity to Infrastructure to establish the **criterion level**.

### 1.1.4 ASSESSMENT

The criterion requires **assessing** the connections to the primary and secondary infrastructure networks on-site or within the vicinity of the development. Examples of primary infrastructure networks that support the basic needs of users and occupants are: electricity, water, sewer, drainage, transportation, and communication networks. Examples of secondary infrastructure networks that enhance the level of comfort and quality of life are the internet and other utility connections. The assessment considers the connections to these networks to be 'available' based on the condition that the infrastructures are present on-site or at a neighboring site within 1 km and with sufficient capacities to support the infrastructure load of the development. The assessment considers the connections to planned infrastructures on the condition that the infrastructures are to be made available within 5 years from the completion of the development based on the evidence obtained from the infrastructure providers.

The **calculator** determines the indicator based on the number of primary and secondary networks, wherein numeric values of (1, 0.5, 0) are assigned to each type of infrastructure when network connections are available, planned, or not available.

The **criterion level** is established based on the result of the indicator for UC.1 Proximity to Infrastructure.

### 1.1.5 CRITERION LEVELS

| Levels | Primary Infrastructure Networks (X) Indicator<br>Secondary Infrastructure Networks (Y) Indicator |
|---|---|
| 0 | $X < 4.5$ |
| 1 | $X \geq 4.5$ AND $Y < 4$ |
| 2 | $X \geq 4.5$ AND $Y = 4$ |
| 3 | $X \geq 4.5$ AND $Y > 4$ |

### 1.1.6 SUBMITTALS

| Provisional Certification Stage (LOC) | |
|---|---|
| **Types** | **Descriptions** |
| Documents | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | List of primary and secondary infrastructure networks at site. |
| | Relevant infrastructure drawings and specifications showing the tie-in connections to the development. |
| | Specifications and other applicable documents demonstrating the required infrastructure has the capacity to support the additional load of the proposed development. |
| Calculator | UC.1 Proximity to Infrastructure Calculator. |

| Final Certification Stage (CDA) | |
|---|---|
| **Types** | **Descriptions** |
| Documents | A narrative explaining any updates or changes in the criterion assessment. |
| | As-built drawings showing tie-in connections to the development. |
| | When applicable, updated specifications and other applicable documents demonstrating the required infrastructure has the capacity to support the additional load of the proposed development |
| Calculator | Updated UC.1 Proximity to Infrastructure Calculator. |

### 1.1.7 EVALUATION

#### 1.1.7.1 General

- Identify all the types of infrastructure required to support the basic needs of users and occupants.

- Determine if the connections for the enumerated infrastructure networks in the calculator are not available, available, or planned.

- Obtain specifications and documentation to determine if the type of infrastructure required has sufficient capacity to support the infrastructure load of the development.

- Input the data into the calculator for UC.1 Proximity to Infrastructure to determine the primary and secondary infrastructure performance indicators.

- Prepare all applicable documentation.

#### 1.1.7.2 Calculator

##### A. Inputs

Part 1 – Primary Infrastructure Inputs

- Primary Networks Status: Select from the pulldown menu the status of the primary infrastructure networks.

Part 2 – Secondary Infrastructure Inputs

- Secondary Networks Status: Select from the pulldown menu the status of the secondary infrastructure networks.

- Use the blank green cells with the description Others, to add secondary infrastructure networks in the development not listed in the calculator.

##### B. Calculations

- (X) = calculated value based on the total number of available primary networks plus 50% of the total number of the planned primary networks.

- (Y) = calculated value based on the total number of available secondary networks.

- UC.1 criterion level = the generated criterion level for UC.1 Proximity to Infrastructure based on the specified range from the criterion levels.

## 1.2 [UC.2] PROXIMITY TO AMENITIES

### 1.2.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 1.2.2 PURPOSE

To select a site with surrounding amenities accessible to pedestrians and cyclists.

### 1.2.3 ASSESSMENT PRINCIPLES

- The Project will **assess** the quantity and diversity of accessible amenities within specified distance ranges.

- The Project will complete the **calculator** for UC.2 Proximity to Amenities to establish the **criterion level**.

### 1.2.4 ASSESSMENT

The criterion requires **assessing** the quantity and diversity of accessible amenities by counting the amenities based on the specified categories that are within the 1,000-meter distance from accessible entrances to the development site.  The specified categories for the amenities are public service, sport and recreation, places of worship, education, retail-services, and retail-foods and goods.  Retail services include, but are not necessarily limited to: banks, hotels, auto repair shops, salons or barber shops, pharmacies, and laundry services.  Foods and goods retail shops include, but are not necessarily limited to supermarkets, grocery or convenience stores, restaurants, coffee shops, hardware stores, fish markets, meat stores, vegetable markets, and other dry and wet goods stores.

The **calculator** determines the indicators based on the average weighted numbers and diversities of the accessible amenities for various categories within the specified distance ranges from the accessible entrances of the development site.

The **criterion level** is established based on the results of the indicators for UC.2 Proximity to Amenities.

## 1.2.5 CRITERION LEVELS

| Levels | Quantity (X) Indicator |
|--------|------------------------|
| 0 | X < 1 |
| 1 | 1 ≤ X < 2 |
| 2 | 2 ≤ X < 3 |
| 3 | X ≥ 3 |

| Levels | Diversity (Y) Indicator |
|--------|-------------------------|
| 0 | Y < 1 |
| 1 | 1 ≤ Y < 2 |
| 2 | 2 ≤ Y < 3 |
| 3 | Y ≥ 3 |

## 1.2.6 SUBMITTALS

| Provisional Certification Stage (LOC) | |
|---------------------------------------|---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | List of the number of amenities within the distances required in the assessment. |
| | Sitemap identifying all the locations and distances of the amenities accessible to the development. |
| **Calculator** | UC.2 Proximity to Amenities Calculator. |

| Final Certification Stage (CDA) | |
|---------------------------------|---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| **Calculator** | Updated UC.2 Proximity to Amenities Calculator. |

## 1.2.7 EVALUATION

### 1.2.7.1 General

- Use a sitemap to identify the locations of all the amenities that are accessible within the specified distance ranges from the accessible entrances of the development site.

- Prepare a list of all the amenities identified on the sitemap.

- Determine the total number of amenities for each category that are within the specified distance ranges of 500m, 750m, and 1,000m.

- Input the quantities into the calculator for UC.2 Proximity to Amenities to determine the quantity and diversity indicators.

- Prepare all applicable documentation.

### 1.2.7.2 Calculator

#### A. Inputs

Part 1 – Quantity Inputs

- Input the number of amenities for each category that are within 500m, 750m, and 1,000m distances from the accessible entrances to the site.

- The categories of the amenities listed in the calculator are as follows:
  - Public Service
  - Sports and Recreation
  - Places of Worship
  - Education
  - Retail – Services
  - Retail – Foods and Goods

- For the complete list of the types of amenities within each category, refer to the References tab in the calculator.

Part 2 – Diversity Inputs

- The calculator determines the number of diversities for each category of the amenities that are within 500m, 750m, and 1,000m distances from the accessible entrances based on the inputs in Part 1 – Quantity Inputs.

### B. Calculations

- Weights = fixed values (3, 2, and 1) assigned to give relative importance for the calculations of amenities within the specified distances.

- (X) = calculated value based on the average weighted-quantities of the amenities for various categories within the specified distance ranges from the accessible entrances.

- (Y) = calculated value based on the average weighted-diversities of the amenities for various categories within the specified distance ranges from the accessible entrances.

- UC.2 criterion level = the generated criterion level for UC.2 Proximity to Amenities based on the calculated average of (X) and (Y) indicators from the criterion levels.

## 1.3 [UC.3] LOAD ON LOCAL TRAFFIC CONDITIONS

### 1.3.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 1.3.2 PURPOSE

To minimize the impact of the development on the local traffic conditions.

### 1.3.3 ASSESSMENT PRINCIPLES

- The Project will **assess** the traffic delay caused by the project at nearby intersection of major roadways.

- The Project will complete the **calculator** for UC.3 Load on Local Traffic Conditions or prepare a traffic impact study **report** to determine the traffic delays caused by the new project and to establish the **criterion level**.

### 1.3.4 ASSESSMENT

The criterion requires **assessing** the increment of traffic delay caused by the new development at major roadways and intersections leading to the site. The new development demand for additional traffic, entering and leaving the development, which could result in an increase in the traffic delay at the intersection of the major roadways. The assessment considers the increase of traffic of delay as the parameter to establish the criterion level. Increase of traffic delay means the difference between traffic delays calculated at the post-development and pre-development scenarios. The assessment considers traffic delays in the worst traffic conditions, the morning and afternoon peak hours.

For other building typologies, which may not follow the usual morning and afternoon peak hours, like Mosques buildings, the development follows the traffic analysis and calculate the traffic delay for the relevant peak hours. For example, in Mosques building typology, the assessment calculates the traffic delay at the peak hour immediately following Friday midday prayer for pre- and post-development conditions.

There are two options to demonstrate the increment of traffic delays caused by the development:

- Option 1 is to use the UC.3 Load on Local Traffic Conditions calculator.

- Option 2 is to prepare a traffic impact study report.

For a stand-alone development that is not part of a neighborhood, both options are valid.

For a development that is a part of a neighborhood, consider only Option 2 as the valid option since the calculator might not cater for complex traffic analysis.

The **calculator** in Option 1 determines the indicator based on the maximum increase in traffic delay from pre- and post-development analyses of the traffic conditions at the site.

The traffic impact study **report** in Option 2 demonstrates the following requirements:

- An analysis of the existing traffic conditions indicating the traffic volume and flow directions in the roadways leading to the project site.

- The calculations of the traffic delay during the specified morning and afternoon peak hours for pre- and post-development conditions.

- The strategies to mitigate the impact of increased delays due to the additional traffic load.

- The revised calculations of the traffic delay during the specified morning and afternoon peak hours for post-development condition due to the implementation of the recommended strategies.

- All applicable documentation as outlined in the submittals section of the assessment.


The **criterion level** is established based on the result of the increase of traffic delay indicator, whether calculated through a traffic impact study report or the UC.3 Load on Local Traffic Conditions calculator.

## 1.3.5   CRITERION LEVELS

| Levels | Maximum Increase in Traffic Delay, in minutes (X) Indicator |
|:---:|:---:|
| 0 | $X > 6$ |
| 1 | $4 < X \leq 6$ |
| 2 | $2 < X \leq 4$ |
| 3 | $X \leq 2$ |

## 1.3.6   SUBMITTALS

| Provisional Certification Stage (LOC) | |
|:---:|:---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Site drawings showing the building layout and adjacent road networks. |
| | Sitemap identifying the major roadways and intersections leading to the development. |
| | Specifications and other applicable documents showing the traffic flow directions and volumes of traffic for pre- and post-development conditions. |
| | Traffic Impact Study Report when submitting for Option 2. |
| **Calculator** | UC.3 Load on Local Traffic Calculator when submitting for Option 1. |

| Final Certification Stage (CDA) | |
|:---:|:---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | Relevant as-built drawings. |
| **Calculator** | Updated UC.3 Load on Local Traffic Calculator when submitting for Option 1. |

### 1.3.7 EVALUATION

#### 1.3.7.1 General

Option 1 - Using the calculator for UC.3 Load on Local Traffic Conditions tocalculate the traffic delay.

- Create site drawings to include the building layout and all the existing roadways that have access to the site or are related to the site's access.

- Determine from the sitemap the major roadways and intersections leading to the site by considering only the major roadways and studying one intersection only per major roadway for a maximum of three roadways.

- Determine the type of development and the number of occupants in the building.

- Obtain existing traffic volumes at AM peak hour and PM peak hour at the intersections under study. Obtain the data from the local authorities or from an on-site survey.

- In the case of traffic light intersections, obtain the existing geometry (number and type of lanes, lanes width) and the green phases and total cycle timings during the AM and PM peak hours.

- Input the data into the calculator for UC.3 Load on Local Traffic Conditions to determine the effect from the additional traffic load that a new project imposes on the major adjacent arterials or roadways.

- Prepare all applicable documentation.

Option 2 - Preparing a traffic impact study report to determine the traffic delay.

#### 1.3.7.2 Calculator

#### A. Inputs

Part 1 – Project Data Inputs

- Assessed Intersections Inputs
  - Input the number of roundabouts to be analyzed.
  - Input the number of traffic light intersections to be analyzed.

- Trips Generation Inputs
  - Select from the pulldown menu the type of development.

  - Input the total number of occupants in the building.

  - Select from the pulldown menu the household size (for residential building typology only).

  - Select from the pulldown menu the vehicle owned (for residential building typology only).

Part 2 – Roundabouts Inputs

- Pre-Development Inputs
  - Input the name of the roadway(s) to be studied.

  - Select from the pulldown menu the type of roundabout to be studied.

  - Input the volume of traffic entering the roundabout in the Approach A direction.

  - Input the volume of traffic entering the roundabout in the conflicting directions to Approach A.

  - For Approach B inputs, follow Approach A from above.

- -Post-Development Inputs
  - Select from the pulldown menu the type of roundabout in the post-development stage.

  - Input the distribution of development loads to incoming flows.

  - Select from the pulldown menu the flow or conflicting flows of Approach A that match the incoming additional flows.

  - Input the distribution of development loads to exiting flows.

  - Select from the pulldown menu the flow or conflicting flows of Approach A that match the exiting additional flows.

  - For Approach B inputs, follow the Approach A from above.

Part 3 – Traffic Lights Inputs

- Pre-Development Inputs
  - Input the name of the roadway to be studied.

  - Select Lane Groups A and B as the two maximum flows among the 6 incoming and exiting flows of the development.

  - Input the number of lanes in Lane Group A.

  - Input the lane width of Lane Group A.

  - Select from the pulldown menu the direction of Lane Group A.

  - Input the duration of the green phase in Lane Group A for the specified peak hours.

  - Input the total duration of the cycles of the traffic lights in the intersection during the specified peak hours.

  - Input the volume of traffic entering the Lane Group A for the specified peak hours.

  - For Lane Group B inputs, follow the Lane Group A from above.

- Post-Development Inputs
  - Input the distribution of development loads to Lane Group A incoming and exiting flows.

  - For Lane Group B inputs, follow the Lane Group A from above.

**B. Calculations**

Part 1 - Project Data Calculations

- Total number of assessed intersections = calculated value based on the number of roundabouts and traffic light intersections.

- Additional traffic loads of the total, incoming, and exiting flows = calculated value for the specified morning and afternoon peak hours.

Part 2 - Roundabouts Calculations

- Pre-Development Calculations
    - Pre-development traffic delay time for Approach A and Approach B for peak hour.


- Post-Development Calculations
    - The calculator computes the post-development traffic delay time for Approach A and Approach B per peak hour.

    - The calculator computes the increase in traffic delay time for Approach A and Approach B per peak hour.

Part 3 – Traffic Lights Calculations

- Pre-Development Calculations
    - Pre-development traffic delay for Lane Groups A and B per peak hour.

- Post-Development Calculations
    - Post-development traffic delay for Lane Groups A and B per peak hour.

    - Increase in traffic delay for Lane Groups A and B per peak hour.

Part 4 – Summary Calculations

- (X) = calculated value based on the maximum increase in traffic delay, in minutes, from pre- and post-development analyses of the traffic conditions at the site.

- UC.3 criterion level = the generated criterion level for UC.3 Load on Local Traffic Conditions, based on the specified range from the criterion levels.

## 1.4    [UC.4] PUBLIC TRANSPORTATION

### 1.4.1    APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 1.4.2    PURPOSE

To select a site in proximity to public transportation networks.

### 1.4.3    ASSESSMENT PRINCIPLES

- The Project will **assess** the availability of public transportation stops or stations within specified distance ranges.

- The Project will complete the **calculator** for UC.4 Public Transportation to establish the **criterion level**.

### 1.4.4    ASSESSMENT

The criterion requires **assessing** the availability of public transportation stops or stations by counting the number of public bus stops and rail or metro stations within the specified distance ranges from the accessible entrances of the development site.  The specified distance ranges are within the 500m, 750m, and 1,000m distances. The existing and planned locations of the public bus stops and rail or metro stations are as shown in the official maps of the Center for Geographic Information System (CGIS) or from other official transit guide maps from the transportation planning department.

The **calculator** determines the indicator based on the average weighted-quantities of the public bus stops, rail or metro stations within the specified distance ranges from the site entrance.

The **criterion level** is established based on the result of the indicator for UC.4 Public Transportation.

## 1.4.5 CRITERION LEVELS

| Levels | Public Transportation (X) Indicator |
|--------|-------------------------------------|
| 0 | $X < 2$ |
| 1 | $2 \leq X < 4$ |
| 2 | $4 \leq X < 6$ |
| 3 | $X \geq 6$ |

## 1.4.6 SUBMITTALS

| Provisional Certification Stage (LOC) | |
|---------------------------------------|---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | List of the number of public bus stops and rail or metro stations within the distances required in the assessment. |
| | Sitemap identifying the locations and distances of the public transportation stops and rail or metro stations within the distances required in the assessment. |
| **Calculator** | UC.4 Public Transportation Calculator. |

| Final Certification Stage (CDA) | |
|---------------------------------|---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| **Calculator** | Updated UC.4 Public Transportation Calculator. |

### 1.4.7    EVALUATION

**1.4.7.1  General**

- Use a site map to determine the total number of public bus stops and rail or metro stations that are within the specified actual walking distance ranges of 500m, 750m, and 1,000m.  The number of bus stops includes the number of bus routes the stop serves.

- Input the quantities of the public bus stops and rail or metro stations per distance range into the calculator for UC.4 Public Transportation to determine the Public Transportation indicator.

- Prepare all applicable documentation.

**1.4.7.2  Calculator**

#### A. Inputs

- Input the quantity of the public bus stops and rail or metro stations that are within 500m, 750m, and 1,000m distances from the main entrances of the site.

#### B. Calculations

- Weights = fixed values (ranging from 1 to 6) assigned to give relative importance for the calculations of performance value for public bus stops and rail or metro stations that are within the specified distances.

- (X) = calculated value based on the average weighted-quantities of the public bus stops and rail or metro stations that are within the specified distance ranges from the site entrance.

- UC.4 criterion level = the generated criterion level for UC.4 Public Transportation based on the specified range from the criterion levels.

## 1.5 [UC.5] GREEN TRANSPORTATION

### 1.5.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 1.5.2 PURPOSE

To provide facilities supporting the use of alternative transportation modes.

### 1.5.3 ASSESSMENT PRINCIPLES

- The Project will **assess** the provision, diversity and capacity of facilities that support green transportation.

- The Project will complete the **calculator** for UC.5 Green Transportation to establish the **criterion level**.

### 1.5.4 ASSESSMENT

The criterion requires **assessing** the provision, diversity and capacity of facilities that support green transportation by counting the number of such facilities provided in the development. Facilities that support green transportation are: bike racks, showers, lockers or storage facility, charging stations for electric vehicles, and shuttle bus parking spaces. The diversity of the supported green transportation is based on the calculated effective types of facilities assessed in this criterion. The types of facilities are: bike racks, electric vehicle charging stations, and shuttle bus parking spaces.

The **calculator** determines the indicators based on the percentage of users accommodated, and the facility types provided, including the sub-requirement for bike racks of 1 shower per 1 to 8 bike racks and 1 locker for each bike accommodated.

The **criterion level** is established based on the results of the indicators for UC.5 Green Transportation.

## 1.5.5  CRITERION LEVELS

| Levels | Percentage of Users Accommodated (X) Indicator<br>Number of Facility Types Used (Y) Indicator |
|:------:|:----------------------------------------------------------------------------------------------:|
| 0 | X < 5% |
| 1 | 5 ≤ X < 15% |
| 2 | 15 ≤ X < 25% |
| 3 | X ≥ 25% AND Y > 1 |

## 1.5.6  SUBMITTALS

| Provisional Certification Stage (LOC) | |
|:---:|:---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Transportation Plan including alternative transportation strategies. |
| | Relevant specifications and other applicable architectural drawings showing the types and quantities of facilities associated with green transportation including the number of users of the facilities. |
| **Calculator** | UC.5 Green Transportation Calculator. |

| Final Certification Stage (CDA) | |
|:---:|:---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| **Calculator** | Updated UC.5 Green Transportation Calculator. |

### 1.5.7    EVALUATION

#### 1.5.7.1  General

- Determine the total number of users of the facilities.

- Identify the types of facilities associated with green transportation. The types of facilities are as listed in the calculator for UC.5 Green Transportation.

- Determine the quantity provided for each type of facility.

- Input the quantities of the facilities into the calculator for UC.5 Green Transportation to determine the percentage of users accommodated, and the number of facility types used.

- Prepare all applicable documentation.

#### 1.5.7.2  Calculator

#### A. Inputs

- Input the number of project users.

- Input the number of bike racks, shower facilities, lockers or storage facility, electric vehicle charging stations, and shuttle bus parking spaces.

#### B. Calculations

- Number of users accommodated per facility = fixed values (1, 3, and 20) assigned to bike racks, electric vehicle charging stations, and shuttle bus parking stations, respectively for the calculations of the total number of users accommodated by facility.

- Weights = fixed values (0.5 and 1) assigned to give relative importance for the calculations of the total number of users accommodated by each type of facilities that support green transportation.

- Number of effective facilities = calculated value based on the number of facilities for each type.

- Total number of users accommodated = calculated value based on the number of effective facilities and assigned weights for each type.

- (X) = calculated percentage of users accommodated based on the facility types used and the calculated total number of users accommodated over the total number of project users.

- (Y) = calculated value based on the number of facility types used.

- UC.5 criterion level = the generated criterion level for UC.5 Green Transportation based on the specified range from the criterion levels.

## 1.6    [UC.6] NEIGHBORHOOD ACOUSTICS

### 1.6.1    APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 1.6.2    PURPOSE

To minimize exposure of the development to surrounding vehicular traffic noise.

### 1.6.3    ASSESSMENT PRINCIPLES

- The Project will **assess** the exposure to traffic noise and attenuation measures to establish the average day-night sound level.

- The Project will complete the **calculator** for UC.6 Neighborhood Acoustics to establish the **criterion level**.

### 1.6.4    ASSESSMENT

The criterion requires **assessing** the exposure to traffic noise and attenuation measures of the development by demonstrating the average day-night sound level (DNL) is within an acceptable noise range, stipulated in the U.S. Department of Housing and Urban Development, Office of Policy Development and Research guidelines.  The assessment includes the noise from vehicular roadway sources including cars and trucks within the 300m, and railways within 1,000m distance from the building's critical face.  The critical face of the building is the side of the building closest to the nearest roadway that has the highest adjusted average daily trips (ADT) or the railway that has the highest daily train trips (DDT).  Include the acoustic barriers, if any, when establishing the site DNL.  Barrier attenuation depends on the geometry and distances.  Acoustic barriers include, but are not necessarily limited to trees, fences, berms, and any other solid objects that permanently stand in between the noise source and the noise assessment location that would contribute to the attenuation of the vehicular noise at the site.  In the assessment, consider only at grade and elevated roadways and railways.  Exclude the underground railways.

The **calculator** determines the indicator based on the total DNL of the roadways and railways, and the maximum DNL value.

The **criterion level** is established based on the result of the indicator for UC.6 Neighborhood Acoustics.

## 1.6.5 CRITERION LEVELS

### 1.6.5.1 COMMERCIAL, LIGHT INDUSTRY, OFFICES and MOSQUES Schemes

| Levels | Day-Night Average Sound Level in dBA (X) Indicator |
|--------|----------------------------------------------------|
| 0 | $X > 63$ |
| 1 | $61 < X \leq 63$ |
| 2 | $59 < X \leq 61$ |
| 3 | $X \leq 59$ |

### 1.6.5.2 EDUCATION, HOMES, HOSPITALITY and RESIDENTIAL Schemes

| Levels | Day-Night Average Sound Level in dBA (X) Indicator |
|--------|----------------------------------------------------|
| 0 | $X > 59$ |
| 1 | $57 < X \leq 59$ |
| 2 | $55 < X \leq 57$ |
| 3 | $X \leq 55$ |

## 1.6.6 SUBMITTALS

| Provisional Certification Stage (LOC) | |
|---------------------------------------|---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Sitemap identifying the locations and distances of any major roads or railways from the development. |
| | Specifications and other applicable documents showing the average daily trips, average vehicle speed, and road gradients of the selected major roads. |
| | Relevant specifications and other applicable documents showing the average daily trips for roadways and railways. |
| | Site drawings and diagrams showing the geometric noise attenuating configuration of the barriers. |
| **Calculator** | UC.6 Neighborhood Acoustics Calculator. |

| Final Certification Stage (CDA) | |
|---|---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | Relevant as-built drawings. |
| **Calculator** | Updated UC.6 Neighborhood Acoustics Calculator. |

## 1.6.7    EVALUATION

### 1.6.7.1  General

- Determine the vehicular traffic data for the site and use that information for predicting the site DNL.

- Determine from the roadmap the roadways nearest to the critical face of the building.

- Determine the acoustic barriers in between the noise source and the noise assessment location.

- Determine the distance to the stop sign, the average vehicle speed, the night time fraction of average daily trips, and the percentage of road gradient.

- Determine the daily train trips, train average speed, night time fraction of daily trips, the type of engine, track made, and number of diesel locomotives and railway cars.

- Input the data into the calculator for UC.6 Neighborhood Acoustics to determine the roadways total DNL.

- Prepare all applicable documentation.

### 1.6.7.2  Calculator

#### A. Inputs

Part 1 – Roadways Inputs

- Cars and Medium Trucks Inputs
  - Input the average daily trips (ADT) of cars and medium trucks in the roadways, which is the sum of the ADT of the cars and ten times the medium trucks based on the 24 hours.
  - Input the effective distance from the noise assessment location to each roadway based on the average of the two distances to the following traffic lane edges:
    - The distance to the nearest edge of the nearest lane.
    - The distance to the farthest edge of the farthest lane.
  - Select from the pulldown menu the distance from the stop sign at the roadways to noise assessment location at the site.
  - Select from the pulldown menu the average speed in the roadways for cars and medium trucks.
  - Select from the pulldown menu the night time fraction of ADT from 10 pm to 7 am.
  - Input the h, R, and D dimensions based on the geometric configurations of the acoustic barrier.

- Heavy Trucks Inputs

    - Input the average daily trips (ADT) of heavy trucks in the roadways for each traffic lane direction.

    - Select from the pulldown menu the percentage of the gradient of the roadways in both traffic lane directions.

    - Select from the pulldown menu the average speed in the roadways for heavy trucks in both traffic lane directions.

    - Input the effective distance from the noise assessment location to each roadway based on the average of the two distances to the following traffic lane edges:

    - The distance to the nearest edge of the nearest lane.

    - The distance to the farthest edge of the farthest lane.

    - Select from the pulldown menu the existence of stop-sign in the roadways within 180m distance from the noise assessment location.

    - Select from the pulldown menu the night time fraction of ADT from 10 pm to 7 am.

    - Input the h, R, and D dimensions based on the geometric configurations of the acoustic barrier.

Part 2 – Railways Inputs

- Input the daily train trips (DTT) of railways based on the number of trains passing by within the 24 hours.

- Input the effective distance from the noise assessment location to the centerline of the nearest railways track.

- Select from the pulldown menu the average train speed.

- Select from the pulldown menu the night time fraction of DTT.

- Select from the pulldown menu the power source of the trains.

- If diesel locomotive, input the number of diesel locomotives.

- Input the number of railway cars per train.

- Select from the pulldown menu the railway track assembly type.

- Input the h, R, and D dimensions based on the geometric configurations of the acoustic barrier.

### B. Calculations

Part 1 – Roadways Calculations

- Cars and Medium Trucks Calculations

  - Stop-and-go adjustment factors for cars and medium trucks = calculated values based on the ADT and the distance to the stop sign in the roadways.

  - Speed adjustment factors = calculated values based on the average speed of cars and medium trucks in the roadways.

  - Nighttime adjustment factors = calculated values based on the nighttime fraction of the cars, and medium trucks' ADT from 10 pm to 7 am.

  - Adjusted Auto ADT of the vehicles = calculated values based on the ADT and the above adjustment factors for the cars and medium trucks.

  - Partial DNL = calculated values based on the Adjusted Auto ADT of cars and medium trucks, effective distance, and the acoustic barrier noise attenuation.

- Heavy Trucks Calculations

  - Road gradient adjustment factors = calculated values based on the ADT and the percentage of the gradient for the roadways for each traffic flow directions.

  - Stop-and-go adjustment factors for heavy trucks = calculated values based on the ADT and the existence of the stop sign in the roadways within 180m distance from the noise assessment location.

  - Speed adjustment factors = calculated values based on the average speed for heavy trucks in the roadways for both traffic lane directions.

  - Night time adjustment factors = calculated values based on the nighttime fraction of the heavy trucks' ADT from 10 pm to 7 am.

  - Adjusted Truck ADT (vehicles) = calculated values based on the ADT and the adjustment factors for the heavy trucks.

  - Partial DNL = calculated values based on the Adjusted Truck ADT of heavy trucks, effective distance, and the acoustic barrier noise attenuation.

  - Roadway total DNL = calculated values based on the roadways Partial DNL results for cars and medium trucks, and DNL Partial for heavy trucks.

Part 2 – Railways Calculations

- Night time adjustment factors = calculated values based on the nighttime fraction of the railways DTT from 10 pm to 7 am.

- If diesel locomotive, the following adjustment factors are calculated:
  - Locomotive, speed adjustment factors = calculated values based on the average train speed.

  - Locomotive, adjustment factor = calculated value based on the number of diesel locomotives.

  - Locomotive, adjusted number of operations = calculated value based on the DTT and adjustment factors for the diesel locomotives.

- Railway cars, speed adjustment factors = calculated values based on the average train speed.

- Railway cars adjustment factors = calculated values based on the number of railway cars per train.

- Railway track adjustment factors = calculated values based on the railway track assembly type.

- Adjusted no. of the operations = calculated values based on the DTT and the adjustment factors for the railway cars.

- Partial DNL = calculated values based on the railway cars adjusted DTT, effective distance, and the acoustic barrier noise attenuation.

- Railway total DNL = calculated values based on the railways partial DNL results.

Part 3 – Summary Calculations

- (X) = selected maximum DNL value based on the calculated total Roadways DNL and Railways DNL.

- UC.6 criterion level = the achieved criterion level for UC.6 Neighborhood Acoustics based on the specific dBA assessment criteria ranges from the criterion levels.

## 2.0   SITE

The Site category is concerned with the design of the proposed development having a direct impact on both the site of the development itself as well as any adjacent sites.

Sustainable landscaping and site design practices can improve the quality of the existing site and landscape and minimize impacts on the surrounding environment including: climate change, fossil fuel depletion, water depletion and pollution, air pollution, land use and contamination, and human comfort and health.

**CRITERIA IN THIS CATEGORY:**

S.1     Land Preservation

S.2     Waterbody Preservation

S.3     Biodiversity Preservation

S.4     Vegetation

S.5     Drain & Stormwater Contamination

S.6     Rainwater Runoff

S.7     Heat Island Effect

S.8     Shading

S.9     Accessibility

S.10    External Lighting

S.11    Light Pollution

S.12    Noise Pollution

S.13    Eco-Parking

S.14    Mixed Use

S.15    Construction Practices

## CRITERIA SUMMARY

The table below summarizes the weights of the Site category and each of the associated criteria:

| Legend | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **√** | Incentive Only | | | | **N/A** | Not Applicable | | | | | | |

| No | Category / Criteria | LEVELS | | WEIGHTS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MIN | MAX | Commercial | Education | Homes | Hospitality | Light Industry | Mosques | Offices | Residential |
| **S** | **SITE** | | | | | | | | | | |
| S.1 | Land Preservation | -1 | 3 | 1.35% | 1.28% | N/A | 1.21% | 1.15% | 1.22% | 1.29% | 1.28% |
| S.2 | Waterbody Preservation | -1 | 3 | 1.20% | 1.23% | N/A | 1.23% | 1.18% | 1.04% | 1.23% | 1.22% |
| S.3 | Biodiversity Preservation | -1 | 3 | 0.86% | 0.90% | N/A | 0.96% | 0.95% | 1.17% | 0.84% | 1.02% |
| S.4 | Vegetation | -1 | 3 | 1.24% | 1.23% | 2.20% | 1.20% | 1.14% | 1.32% | 1.23% | 1.15% |
| S.5 | Drain & Stormwater Contamination | -1 | 3 | 1.07% | 1.12% | N/A | 1.07% | 1.46% | 1.08% | 1.13% | 1.04% |
| S.6 | Rainwater Runoff | -1 | 3 | 0.85% | 0.87% | 2.20% | 0.88% | 0.97% | 1.02% | 0.81% | 0.88% |
| S.7 | Heat Island Effect | -1 | 3 | 0.98% | 1.27% | 2.20% | 1.01% | 1.21% | 1.02% | 0.97% | 1.02% |
| S.8 | Shading | -1 | 3 | 1.06% | 1.02% | N/A | 1.07% | 1.06% | 1.22% | 1.03% | 1.08% |
| S.9 | Accessibility | -1 | 3 | 0.94% | 1.27% | N/A | 1.09% | 1.08% | 1.16% | 1.08% | 0.99% |
| S.10 | External Lighting | -1 | 3 | 0.94% | 0.97% | N/A | 1.01% | 0.98% | 1.06% | 0.91% | 1.15% |
| S.11 | Light Pollution | -1 | 3 | 0.96% | 1.01% | 0.96% | 0.91% | 0.91% | 0.91% | 1.02% | 0.96% |
| S.12 | Noise Pollution | -1 | 3 | 0.81% | 0.83% | N/A | 0.82% | 0.91% | 0.72% | 0.77% | 0.74% |
| S.13 | Eco-Parking | -1 | 3 | 1.11% | 1.35% | 0.94% | 1.07% | 1.35% | 1.12% | 1.06% | 1.06% |
| S.14 | Mixed Use | -1 | 3 | 0.85% | N/A | N/A | 0.82% | N/A | N/A | 0.82% | 0.76% |
| S.15 | Construction Practices | -1 | 3 | 2.78% | 2.65% | 2.50% | 2.65% | 2.65% | 2.94% | 2.81% | 2.65% |
| | | | **Total** | 17.00% | 17.00% | 11.00% | 17.00% | 17.00% | 17.00% | 17.00% | 17.00% |

## 2.1 [S.1] LAND PRESERVATION

### 2.1.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 2.1.2 PURPOSE

To enhance the ecological value of the development site.

### 2.1.3 ASSESSMENT PRINCIPLES

- The Project will **assess**:
    - The pre-development ecological value of the site.
    - The post-development remediation, enhancement, or preservation strategies.

- The Project will complete the **calculator** for S.1 Land Preservation based on the site **testing** and assessment **report** to establish the **criterion level**.

### 2.1.4 ASSESSMENT

The criterion requires **assessing** the existing ecological value of the site by quantifying the pre- and post-development conditions of the areas of the land based on the geological and environmental testing and assessment report. The pre-development areas are the surveyed areas of the land classified to be contaminated, previously developed, has no ecological value, or with low, moderate, or high ecological value. The post-development areas are the areas of the land with or without improved classifications after applying the land remediation measures or planned enhancement strategies. Areas of the land found to be contaminated would require complete remediation before commencing the works at site. Complete remediation means that there are post-development sampling tests conducted on the remediated lands.

The geological and environmental **testing** of the site require sampling analyses from an accredited laboratory. The geological testing includes the investigations of the surface and subsurface soil stratification along with the geological conditions and the physical and mechanical properties of the ground materials. The environmental testing determines the presence and levels of heavy metals, hydrocarbons and their possible sources, pathways, and potential receptors.

The testing demonstrates the following requirements:

- The required geological and environmental testing of the site in accordance with the applicable standards.

- The results of the sampling analyses from an accredited laboratory.

The assessment **report** is the executive summary prepared by a specialist. Based on the results of the relevant testing, the specialist prepares recommendations that promotes the protection and enhancement of the natural features and environmental quality of the site without compromising the need for development of land and built environment.

The report demonstrates the following requirements:

- Ecological Conservation - describes the strategies and measures on the conservation and management of ecologically valuable lands to prevent adverse impact on biodiversity during the development of the project site.

- Site Restoration - describes the strategies and measures for restoring the previously developed or contaminated land into its original ecological state. This includes restoration of temporary construction areas and logistics into its previous condition.

- Soil Contamination - describes any potential constraints of contaminated land to the development and includes the procedures and guidelines for soil management during excavation, soil sampling, and backfilling works. Refer to BS 10175:2011+ A1:2013 Investigation of potentially contaminated sites - Code of practice or equivalent.

The **calculator** determines the indicator based on the improvement factors for each land classifications and the adequacy of the site assessment report including the relevant testing requirements.

The **criterion level** is established based on the result of the indicator for S.1 Land Preservation.

### 2.1.5 CRITERION LEVELS

| Levels | Land Preservation (X) Indicator |
|--------|--------------------------------|
| -1 | X ≤ 0, OR the Report does not demonstrate compliance with the requirements. |
| 0 | 0.00 < X < 0.25 |
| 1 | 0.25 ≤ X < 0.50 |
| 2 | 0.50 ≤ X < 0.75 |
| 3 | X ≥ 0.75 |

### 2.1.6 SUBMITTALS

| Provisional Certification Stage (LOC) | |
|---------------------------------------|---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Relevant Landscape drawings and specifications. |
| | Sitemap identifying the location and vicinity of the development. |
| | Applicable permits from concerned authorities. |
| **Report** | Assessment Report. |
| **Testing** | Geological and Environmental Testing in accordance with the applicable standards, including the report of the results and analyses from an accredited laboratory. |
| **Calculator** | S.1 Land Preservation Calculator. |

| Final Certification Stage (CDA) | |
|---|---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | Relevant as-built drawings. |
| **Report** | Updated Land Preservation Report, when applicable. |
| **Testing** | Post-development environmental testing. |
| **Calculator** | Updated S.1 Land Preservation Calculator. |

## 2.1.7 EVALUATION

### 2.1.7.1 General

- Engage a specialist in assessing the site by evaluating the ecological value of the land's soil quality and areas of the land that are contaminated or have been previously developed.

- Conduct geological and environmental testing in accordance with the applicable standards and prepare a report of the results and analysis.

- Determine from the environmental testing report the degree of contamination and proposed strategies for remediating the sources of contamination.

- Establish from the testing the pre-development, the existing ecological value of the land.

- Prepare the post-development remediations or enhancement strategy for the land.

- Input the data into the calculator for S.1 Land Preservation to determine the improvement factor of the ecological value of the land.

- Prepare all applicable documentation and obtain relevant permits.

### 2.1.7.2 Calculator

#### A. Inputs

Part 1 – Assessment Report Inputs

- Input if there is an assessment report or executive summary of the site conditions from an Ecologist or Specialist.

Part 2 – Ecological Value Inputs

- Input the areas of land classified as contaminated, previously developed, has no ecological value, with low, moderate, and high ecological values. The ecological value of land can be described as follows:

  - **Contaminated Land:** land in which the soil/surface layer contains one or more contaminant(s) at a concentration level equal to or exceeding the intervention value identified in the new Dutch List. Where remediation only requires the removal of asbestos within an existing building, the overall site cannot be classified as 'contaminated land'.

  - **Previously Developed Land:** land that has been graded or directly altered by human activity. This might include also some buildings, roads or parking lots.

- **No Value:** land in which the surface layer has a very limited capacity to function as a natural substrate for plants, or land which does not contain virtually any organic matter and thus has no organic aggregates. It is dominated by large grain material (gravel) with insufficient small grain material (sand/silt/clay) to form an aggregate soil structure, with very low water retention and very low available water capacity.

- **Low Value:** land which is not located within 2km of a protected area or within 500m of a site of specific scientific interest. It does not include habitats or trees over 10 years old. It consists of poor soil structure, related to limited aggregate formation due to a high proportion of large grain material and a low volume of organic matter. It has evidences of limited/stunted plant growth.

- **Moderate Value:** land in which the surface layer can be defined as soil and fulfill most functions expected of a natural substrate. It consists of a moderate soil structure dominated by small grain aggregates with a low proportion of large grain material. It has evidences of plants growing effectively.

- **High Value:** land that has evidence of strong plant growth, contains trees or hedges above 1m in height or with a trunk diameter greater than 100 mm or mature strong trees older than 10 years. It might have ponds, streams or rivers running through the site. It may include meadows or species-rich grassland present on the site. The surface layer can be clearly defined as soil and is fulfilling all functions expected of a natural substrate.

- Input the post-development areas of the lands with and without improved classifications relative to the pre-development classifications.

## B. Calculations

- Weighing factors = fixed values (-1, 0, 1, 2, and 3) assigned to give relative importance for the calculations of improvement factors for contaminated lands, lands that are previously developed, lands with no ecological value, lands with low ecological value, lands with moderate ecological value, and lands with high ecological value, respectively.

- Factors = fixed values (-1, 0, 1, 2, and 3) assigned to give relative importance for the calculations of each land classifications.

- Improvement factors = calculated values for each land classifications.

- Land Preservation indicator = calculated value based on the assessed improvements factors for each land classifications.

- (X) = calculated value based on the calculated improvement factors for each land classifications.

- S.1 criterion level = the generated criterion level for S.1 Land Preservation based on the specified range from the criterion levels.

## 2.2    [S.2] WATERBODY PRESERVATION

### 2.2.1    APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 2.2.2    PURPOSE

To minimize ecological degradation of waterbodies affected by the development.

### 2.2.3    ASSESSMENT PRINCIPLES

- The Project will **assess**:
  - The condition of existing waterbodies on or nearby the site.
  - The post-development conservation, restoration, or enhancement strategy.
- The Project will prepare an inspection **report** or waterbody preservation **plan** based on the site **testing** to establish the **criterion level**.

### 2.2.4    ASSESSMENT

The criterion requires **assessing** the existence and quality of waterbodies on or nearby the site by preparing an inspection report or waterbody preservation plan.  Waterbodies are areas that hold surface water or groundwater, including but not necessarily limited to water streams, rivers, lakes, estuaries, bays, lagoons, gulfs, and aquifers. Waterbodies on or nearby the site are existing natural bodies of water located within a 200m buffer zone around the development.

The hydrological and environmental **testing** of the site require sampling analyses from an accredited laboratory.  The hydrological testing includes the amount and quality of water being stored or conveyed on the land surface, and in soils and rocks near the surface. The environmental testing of waterbodies determines the presence and levels of heavy metals, hydrocarbons and their possible sources, pathways, and potential receptors.

The testing demonstrates the following requirements:

- The required hydrological and environmental testing of the site in accordance with the applicable standards.
- The results of the sampling analyses from an accredited laboratory.

The inspection **report** is a limited scope document prepared by a specialist that demonstrates the existence of surface water and groundwater on or nearby the site.  The assessment requires a report based on visual inspections and hydrological testing of the site to verify available data and record observations of the presence of surface water and groundwater.

The report demonstrates the following requirements:

- Analysis of the depth of the groundwater table and evaluates the potential of the development's impact on the groundwater over time.

- An executive summary of the inspections conducted at the site with photos demonstrating the existence of natural bodies of water on or nearby the site.

The waterbody preservation ***plan*** is a comprehensive document prepared by a specialist, which demonstrates the presence of waterbodies on or nearby the site and the remedial measures and strategies to be implemented for the protection, restoration or enhancement of existing natural bodies of water against water pollution or contamination based on the results of the relevant testing.

The plan demonstrates the following requirements:

- The potential impacts of the development on all existing natural bodies of water on or nearby the site.

- The measures and strategies to mitigate the impacts of water pollution and contamination that exceeds the limits specified by local regulations.

- The remedial measures or strategies to be implemented for waterbody conservation, coastal protection, or groundwater protection.

The ***criterion level*** is established based on the degree of compliance of the report or plan to the requirements of S.2 WaterBody Preservation.

## 2.2.5 CRITERION LEVELS

| Levels | Requirements |
|--------|--------------|
| -1 | Report or Plan does not demonstrate compliance with the requirements. |
| 0 | Report demonstrates the non-existence of waterbodies on or nearby the site. |
| 1 | Plan demonstrates partial compliance with the requirements. |
| 3 | Plan demonstrates full compliance with the requirements. |

## 2.2.6 SUBMITTALS

| Provisional Certification Stage (LOC) | |
|---------------------------------------|---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Sitemap identifying the location of natural bodies of water on or nearby the development. |
| | Applicable permits from concerned authorities. |
| **Testing** | Hydrological and Environmental Testing in accordance with the applicable standards, including the report of the results and analyses from an accredited laboratory. |
| **Report** | Inspection Report. |
| **Plan** | Waterbody Preservation Plan. |

| Final Certification Stage (CDA) | |
|---|---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | Relevant as-built drawings. |
| **Testing** | Post-development environmental testing. |
| **Plan** | Updated Waterbody Preservation Plan, when applicable. |

## 2.2.7  EVALUATION

### 2.2.7.1  General

- Partial compliance for this criterion is associated with the plan demonstrates there is no ecological degradation of waterbodies affected by the development.

- Full compliance for this criterion is associated with the plan demonstrates the potential impacts of the development on all existing natural bodies of water on or nearby the site, identifies the impacts that exceed the limits from local regulations, and provides measures and strategies to mitigate the impacts.

- Engage a specialist in evaluating the site for the existence and quality of waterbodies on or nearby the site.

- Conduct hydrological and environmental testing in accordance with the applicable standards and prepare a report of the results and analysis.

- Determine from the environmental testing report the potential impacts of the development to the existing natural bodies of water on nearby the site.

- Establish from the testing the remedial measures, strategies, and contamination and management plan to protect all existing natural waterbodies of water on or nearby the site.

- Prepare all applicable documentation and obtain relevant permits.

## 2.3 [S.3] BIODIVERSITY PRESERVATION

### 2.3.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 2.3.2 PURPOSE

To preserve and enhance the natural biodiversity of the site.

### 2.3.3 ASSESSMENT PRINCIPLES

- The Project will **assess**:
    - The plants and endangered animals within the site and adjacent areas.
    - The post-development conservation, restoration, or enhancement strategy.

- The Project will prepare a biodiversity inspection **report** or preservation **plan** to establish the **criterion level**.

### 2.3.4 ASSESSMENT

The criterion requires **assessing** the existence of plants and endangered animals including the habitats within the site and adjacent areas. The investigated plants exclude the low-value shrubs, ground cover, and seasonal and invasive species from the analysis. In development with a large site, the location may impact the habitats of the endangered animals, migration or living patterns, the adjacent areas of the site are subject for analysis and evaluation. Refer to relevant documents from concerned local authorities for more information on endangered animals. The assessment includes preparing an inspection report or biodiversity preservation plan that identifies the post-development conservation, restoration, or enhancement strategies of the site's biodiversity.

The inspection **report** is a limited scope document prepared by a specialist that demonstrates the existence of plants and endangered animals including their habitats within the site, and where applicable, the adjacent areas. The visual inspection verifies the available data and records of observations of the site.

The report demonstrates the following requirements:

- An executive summary of the inspections conducted at the site with observations and conclusions.

- Visual evidences demonstrating the existence of plants and endangered animals, including their habitats within the site and adjacent areas.

The biodiversity preservation **plan** is a comprehensive document prepared by a specialist, which demonstrates the existence, enhancement, preservation, and protection of plant species and endangered animals including its natural habitats during and after construction. The plan includes identifying the types and number of plants and endangered animals and the potential of the development to damage the interaction of the ecosystem with the site and surrounding areas.

The plan demonstrates the following requirements:

- The types and number of the endangered animals.

- The types and number of the plants, excluding the low-value shrubs, groundcover, seasonal and invasive species.

- The potential impacts of the development to the ecosystem's interaction with the site and its surrounding areas.

- The measures and strategies for the enhancement, preservation, and protection of plants and endangered animals, including their habitats within the site and adjacent areas.

The **criterion level** is established based on the degree of compliance of the report or plan to the requirements of S.3 Biodiversity Preservation.

## 2.3.5 CRITERION LEVELS

| Levels | Requirements |
|--------|--------------|
| -1 | Report or Plan does not demonstrate compliance with the requirements. |
| 0 | Report demonstrates the non-existence of plants or habitats of endangered animals. |
| 1 | Plan demonstrates partial compliance with the requirements. |
| 3 | Plan demonstrates full compliance with the requirements. |

## 2.3.6 SUBMITTALS

| Provisional Certification Stage (LOC) | |
|---------|-------------|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Sitemap identifying the location of plants and habitats of endangered animals within the site and adjacent areas. |
| | List of plants and habitats of endangered animals discovered within the site and adjacent areas. |
| | Applicable permits from concerned authorities. |
| **Report** | Inspection Report. |
| **Plan** | Biodiversity Preservation Plan. |

| Final Certification Stage (CDA) | |
|---------|-------------|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | Relevant as-built drawings. |
| **Plan** | Updated Biodiversity Preservation Plan, when applicable. |

### 2.3.7 EVALUATION

**2.3.7.1 General**

- Partial compliance for this criterion is associated with the plan demonstrates preservation or enhancement of either the plants or habitats of the endangered animals.

- Full compliance for this criterion is associated with the plan establishes the inventory of the plants and endangered animals, assesses the potential impacts of the development to the ecosystem, and describes the post-development conservation, restoration, or enhancement strategies of the site's biodiversity.

- Engage a specialist in evaluating the site for the existence of plants and habitats of endangered animals.

- Determine the potential for the development to damage the ecosystem's interaction with the site and the surrounding areas.

- Determine the strategies to enhance protect or preserve plant species and endangered animals, including their habitats as a result of the development.

- Prepare all applicable documentation and obtain relevant permits.

## 2.4 [S.4] VEGETATION

### 2.4.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 2.4.2 PURPOSE

To vegetate the site using native, low-impact or productive plant species.

### 2.4.3 ASSESSMENT PRINCIPLES

- The Project will **assess** the areas of vegetation, lawn, and native plants used for soft landscaping.
- The Project will complete the **calculator** for S.4 Vegetation to establish the **criterion level**.

### 2.4.4 ASSESSMENT

The criterion requires **assessing** the areas of vegetation, lawn and native plants used for landscaping by measuring the vegetated areas of the site and counting the quantities of each plant species. Vegetated areas include the outdoor soft landscapes within the boundary of the development. It consists of outdoor soft landscapes at ground, podium and roof levels cultivated with lawns and plant species. The assessment considers the growth form and the characteristics of the selected lawns and plant species. The selections for growth form are trees, shrubs, climbers, desert plants, ground covers, and grass. The selections for characteristics are native, adaptive, non-native, and edible or medicinal.

The **calculator** determines the indicators based on the following:

- Percentage of vegetated areas.
- Percentage of native or adaptive plant areas.
- Percentage of grass areas.

The **criterion level** is established based on the results of the indicators for S.4 Vegetation.

## 2.4.5 CRITERION LEVELS

### 2.4.5.1 COMMERCIAL, EDUCATION, HOMES, LIGHT INDUSTRY, MOSQUES, OFFICES and RESIDENTIAL Schemes

| Levels | Percentage of Vegetated Areas (X) Indicator<br>Percentage of Native and Adaptive Plant Areas (Y) Indicator<br>Percentage of Grass Areas (Z) Indicator |
|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| -1 | X < 5%   OR   Y < 20%   OR   Z > 50% |
| 0 | 5% ≤ X < 10%   AND   20% ≤ Y < 30% |
| 1 | 10% ≤ X < 15%   AND   30% ≤ Y < 40% |
| 2 | 15% ≤ X < 20%   AND   40% ≤ Y < 50% |
| 3 | X ≥ 20%   AND   Y ≥ 50% |

### 2.4.5.2 HOSPITALITY Scheme

| Levels | Percentage of Vegetated Areas (X) Indicator<br>Percentage of Native and Adaptive Plant Areas (Y) Indicator<br>Percentage of Grass Areas (Z) Indicator |
|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| -1 | X < 10%   OR   Y < 20%   OR   Z > 50% |
| 0 | 10% ≤ X < 15%   AND   20% ≤ Y < 30% |
| 1 | 15% ≤ X < 20%   AND   30% ≤ Y < 40% |
| 2 | 20% ≤ X < 25%   AND   40% ≤ Y < 50% |
| 3 | X ≥ 25%   AND   Y ≥ 50% |

### 2.4.6 SUBMITTALS

| Provisional Certification Stage (LOC) | |
|---|---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Relevant landscape drawings and specifications. |
| | Softscape material data sheets. |
| **Calculator** | S.4 Vegetation Calculator. |

| Final Certification Stage (CDA) | |
|---|---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | Relevant as-built drawings. |
| **Calculator** | Updated S.4 Vegetation Calculator. |

### 2.4.7   EVALUATION

#### 2.4.7.1  General

- Identify the total site area.

- Identify and count the number of plant species used for soft landscaping.

- Determine the types, growth form, and quantities of the lawn and plant species used for soft landscaping.

- Determine the characteristics of the plants, whether it is native, adaptive, non-native, edible, or medicinal.

- Determine the area covered by each plant and lawn.

- Input the data into the calculator for S.4 Vegetation to determine the factors.

- Prepare all applicable documentation.

#### 2.4.7.2  Calculator

**A. Inputs**

Site Inputs

- Input the total site area of the development.

Vegetation Analysis Inputs

- Input the scientific name of the plant species used for soft landscaping.

- Select from the pulldown menu the growth form of the plant species.

- Select from the pulldown menu the plant nativity of the plant species.

- Input the quantities of each plant species.

- Input the vegetated areas covered by each plant species.

**B. Calculations**

- Total vegetated areas = calculated value based on the quantity and area coverage of each plant species.

- (X) = calculated value based on the percentage of vegetated areas over the total site area.

- (Y) = calculated value based on the percentage of native or adaptive plant areas over the total vegetated areas.

- (Z) = calculated value based on the percentage of grass areas over the total vegetated areas.

- S.4 criterion level = the generated criterion level for S.4 Vegetation based on the specified range from the criterion levels.

## 2.5 [S.5] DRAIN & STORMWATER CONTAMINATION

### 2.5.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 2.5.2 PURPOSE

To prevent the contamination of drain and stormwater discharged from the site.

### 2.5.3 ASSESSMENT PRINCIPLES

- The Project will **assess** the mitigation measures for the prevention of drain and stormwater contamination prior to discharge from the site.

- The Project will prepare a drain and stormwater contamination **plan** to establish the **criterion level**.

### 2.5.4 ASSESSMENT

The criterion requires **assessing** the mitigation measures for the prevention of drain and stormwater contamination by preparing a drain and stormwater contamination plan that identifies the collection and removal of all toxic and harmful substances from drain and stormwater before discharging into the public systems.  Toxic and harmful substances include, but not necessarily limited to solids, sludge, floating debris, oil, scum, or any substances associated with the industrial process.

The drain and stormwater contamination **plan** demonstrates any of the following requirements:

- No presence of toxic or harmful substances in the drainage systems.

- Strategies for filtering, collecting, and treating sanitary and stormwater drains.

The **criterion level** is established based on the degree of compliance of the plan to the requirements of S.5 Drain and Water Contamination.

## 2.5.5  CRITERION LEVELS

| Levels | Requirements |
|--------|--------------|
| -1 | Plan does not demonstrate compliance with the requirements. |
| 0 | Plan demonstrates the non-existence of toxic or harmful substances in the drainage and stormwater systems. |
| 3 | Plan demonstrates full compliance with the requirements. |

## 2.5.6  SUBMITTALS

| Provisional Certification Stage (LOC) | |
|---------------------------------------|--|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Relevant drainage system drawings and specifications. |
| | Relevant stormwater system drawings and specifications. |
| | Relevant tank and filtration systems drawings and specifications. |
| **Plan** | Drain & Stormwater Contamination Plan. |

| Final Certification Stage (CDA) | |
|---------------------------------|--|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | Relevant as-built drawings. |
| | Updated relevant specifications, where applicable |
| **Plan** | Updated Drain & Stormwater Contamination Plan, where applicable. |

### 2.5.7 EVALUATION

**2.5.7.1 General**

- Full compliance for this criterion is associated with the plan demonstrates compliance with the requirements for filtration, separation, or treatment of the contaminants in the sanitary drainage and stormwater drainage systems.

- Identify from the drawings the sanitary and stormwater drainage systems of the development.

- Determine the specifications of the sanitary and stormwater drainage systems.

- Illustrate the final terminations and connection details of the sanitary and stormwater drainage systems of the development to the public systems.

- Identify the filtration, separation, collection or treatment strategies and facilities required to remove all toxic substances from drain and stormwater.

- Demonstrate the absence of toxic substances in the drain and stormwater if applicable.

- Prepare all applicable documentation.

## 2.6 [S.6] RAINWATER RUNOFF

### 2.6.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 2.6.2 PURPOSE

To maximize the potential for harvesting and reusing rainwater falling on the development.

### 2.6.3 ASSESSMENT PRINCIPLES

- The Project will **assess**:
  - The systems for harvesting rainwater falling on site and buildings.
  - The reuse of rainwater collected on site.

- The Project will prepare a rainwater runoff **plan** to establish the **criterion level**.

### 2.6.4 ASSESSMENT

The criterion requires **assessing** the systems for harvesting and reusing rainwater collected on-site and building surfaces by preparing a rainwater runoff **plan** that identifies the collection, treatment, storage, and reuse of rainwater.

The Rainwater Runoff plan demonstrates the strategies for filtering, collecting, treating, storing, and reusing rainwater runoffs.

The **criterion level** is established based on the degree of compliance of the plan to the requirements of S.6 Rainwater Runoff.

### 2.6.5  CRITERION LEVELS

| Levels | Requirements |
|--------|--------------|
| -1 | Plan does not demonstrate compliance with the requirements. |
| 3 | Plan demonstrates full compliance with the requirements. |

### 2.6.6  SUBMITTALS

| Provisional Certification Stage (LOC) | |
|-----------|-------------|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Relevant softscape and hardscape drawings and specifications. |
| | Relevant stormwater drainage system drawings and specifications. |
| | Relevant storage tank drawings and specifications. |
| | Relevant drawings and specifications demonstrating rainwater reuse. |
| **Plan** | Rainwater Runoff Plan. |

| Final Certification Stage (CDA) | |
|-----------|-------------|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | Relevant as-built drawings. |
| | Updated relevant specifications, where applicable |
| **Plan** | Updated Rainwater Runoff Plan, where applicable. |

### 2.6.7    EVALUATION

**2.6.7.1  General**

- Full compliance for this criterion is associated with the plan demonstrates compliance with the requirements for harvesting and reusing rainwater collected on-site and building surfaces.

- Identify from the drawings the external surfaces of the site and the buildings that have the potential to harvest rainwater runoffs.

- Determine the specifications of the rainwater harvesting system.

- Determine how the rainwater that falls on impervious surfaces are collected.

- Illustrate in the roof and podium drawings how the rainwater that falls on the building roofs and wall surfaces are collected and stored.

- Illustrate in the landscape drawings the types of soft and hardscaped areas and the type of pavement materials for all impervious surfaces.

- Illustrate in the landscape drawings how the collected rainwater is treated, stored, and reused on-site.

- Prepare all applicable documentation.

## 2.7 [S.7] HEAT ISLAND EFFECT

### 2.7.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 2.7.2 PURPOSE

To reduce heat island effect of the development on the surrounding environment.

### 2.7.3 ASSESSMENT PRINCIPLES

- The Project will **assess**:
  - The pre-development albedo value of the site and surrounding environment.
  - The post-development impact on the albedo value.

- The Project will complete the **calculator** for S.7 Heat Island Effect for conventionally shaped buildings to establish the **criterion level**. The Project will undertake **simulation** modelling for irregularly shaped buildings.

### 2.7.4 ASSESSMENT

The criterion requires **assessing** the pre-development albedo value of the site and surrounding environment and the post-development impact on the albedo value by calculating the albedo difference between pre- and post-development albedo values. The albedo value is the ratio of solar energy reflected off a surface to incident solar energy in the urban fabric.

The basis of calculation of the pre-development albedo value are the coordinates and heights of the neighboring walls and the coordinates, area, and solar reflectance value of the site. Include only the walls of the adjacent neighboring buildings within a 200m radius from the site in the pre-development albedo value assessment. For the walls of other neighboring buildings that are partially within the 200m radius, the selection indicator determines the inclusion of building walls in the assessment. The selection indicator is calculated based on the width of the neighboring building exposed to the site (W) multiplied by the exposed height to the site (H) and divided by the perpendicular distance between the site and the neighboring building (D).

$$Selection\ Indicator\ = \frac{W\,x\,H}{W\,x\,H}$$

For an illustrative example on how to use the selection indicator, please refer to the latest GSAS Training Manual.

The basis of calculation of the post-development albedo value are the coordinates, heights, and solar reflectance values of the project walls and roofs under consideration and the remaining site areas.

The **simulation** determines the albedo values of the pre- and post-development site conditions for irregularly shaped buildings.

The **calculator** determines the indicator based on the albedo difference from the calculated albedo values of the pre- and post-development site conditions for regularly shaped buildings.

The **criterion level** is established based on the result of the indicator for S.7 Heat Island Effect.

### 2.7.5 CRITERION LEVELS

| Levels | Albedo Difference (X) Indicator |
|:---:|:---:|
| **-1** | X < -0.3 |
| **0** | –0.3 ≤ X < -0.2 |
| **1** | –0.2 ≤ X < -0.1 |
| **2** | –0.1 ≤ X < 0 |
| **3** | X ≥ 0 |

### 2.7.6 SUBMITTALS

| Provisional Certification Stage (LOC) | |
|:---|:---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Sitemap identifying neighboring buildings within 200m radius of the development. |
| | Relevant architectural drawings and specifications. |
| **Simulation** | Simulation results when submitting in lieu of the calculator. |
| **Calculator** | S.7 Heat Island Effect Calculator. |

| Final Certification Stage (CDA) | |
|:---|:---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | Relevant as-built drawings. |
| | Evidence for the relevant selected materials. |
| **Calculator** | Updated S.7 Heat Island Effect Calculator. |

### 2.7.7 EVALUATION

#### 2.7.7.1 General

- Determine the pre-development albedo value of the site and the surrounding environment, and the impact of the post-development on the albedo value.

- Determine the pre-development adjacent neighboring building walls under consideration for the heat island effect calculation or simulation.

- Determine the pre- and post-development site areas for the heat island effect calculation or simulation.

- Determine the post-development project walls and roofs under consideration for the heat island effect calculation or simulation.

- Input the data into the calculator for S.7 Heat Island Effect to determine the albedo values.

- Prepare all applicable documentation.

#### 2.7.7.2 Calculator

**A. Inputs**

Part 1 – Pre-Development Inputs

- Input the wall coordinates and heights of each neighboring building under consideration.

- Input the coordinates, area, and solar reflectance value of the project site.

Part 2 – Post-Development Inputs

- Input the coordinates, heights, and solar reflectance values of the project walls. Perform an area-weighted calculation to obtain the solar reflectance value of the project walls comprised of multiple materials with varying solar reflectance.

- Input the coordinates, height, and solar reflectance values of the project roof.

- Select from the pulldown menu the ID code of the neighboring walls exposed to each project roof and walls.

- Input the remaining site areas and solar reflectance values, excluding the building footprints.

**B. Calculations**

- Pre-development albedo value = calculated value or simulated value based on the project site and neighboring building conditions.

- Post-development albedo value = calculated value or simulated value based on the project walls, roof, and other remaining site areas.

- (X) = calculated albedo difference based on the calculated albedo values of the pre- and post-development site conditions (post-development albedo – pre-development albedo)

- S.7 criterion level = the generated criterion level for S.7 Heat Island Effect based on the specified range from the criterion levels.

**2.7.7.3 Simulation**

- Use an approved simulation software to demonstrate the pre- and post-development albedo values for irregularly-shaped buildings that are outside the capacity of the calculator for S.7 Heat Island Effect.

## 2.8 [S.8] SHADING

### 2.8.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 2.8.2 PURPOSE

To provide shading for commonly used outdoor areas.

### 2.8.3 ASSESSMENT PRINCIPLES

- The Project will **assess** the area of shaded hardscaped pedestrian pathways, parking, and commonly used outdoor areas.

- The Project will complete the **calculator** for S.8 Shading based on the results from approved shading **simulation** software to establish the **criterion level**.

### 2.8.4 ASSESSMENT

The criterion requires **assessing** the shaded areas based on the amount of shade cast on the hardscaped pedestrian pathways, parking areas, and common areas using an approved shading simulation software. The hardscaped common areas include, but are not necessarily limited to hardscaped plazas, courtyards, and other spaces that are open and accessible to the general public.

The **simulation** determines the amount of shade cast on 21$^{st}$ of June at 15:00 hours.

The indicators calculate the percentage of shaded areas based on simulation results. If any of the indicators resulted with the calculated value falling within the range of Level (-1), the criterion receives Level (-1).

The **calculator** determines the indicator based on the percentage of shade cast on the following areas:

- Hardscaped pedestrian pathways and parking areas.
- Hardscaped common areas.
- Picnic and seating areas (applicable only for Hospitality building typology).

The **criterion level** is established based on the result of the indicator for S.8 Shading.

### 2.8.5 CRITERION LEVELS

The calculator determines the criterion level based on the averaged results of the (X) and (Y) indicators. If any of the shading indicators resulted with calculated value falling within the range of Level (-1), the S.8 Shading criterion receives Level (-1).

#### 2.8.5.1 COMMERCIAL, EDUCATION, HOMES, LIGHT INDUSTRY, MOSQUES, OFFICES and RESIDENTIAL Schemes

| Levels | Percentage of Shaded Hardscaped Pedestrian Pathways & Parking Areas (X) Indicator |
|--------|------------------------------------------------------------------------------------|
| -1 | X < 60% |
| 0 | 60% ≤ X < 70% |
| 1 | 70% ≤ X < 80% |
| 2 | 80% ≤ X < 90% |
| 3 | X ≥ 90% |

| Levels | Percentage of Shaded Hardscaped Common Areas (Y) Indicator |
|--------|-------------------------------------------------------------|
| -1 | Y < 25% |
| 0 | 25% ≤ Y < 30% |
| 1 | 30% ≤ Y < 35% |
| 2 | 35% ≤ Y < 40% |
| 3 | Y ≥ 40% |

### 2.8.5.2 HOSPITALITY Scheme

| Levels | Percentage of Shaded Hardscaped Pedestrian Pathways & Parking Areas (X) Indicator |
|:---:|:---:|
| -1 | X < 60% |
| 0 | 60% ≤ X < 70% |
| 1 | 70% ≤ X < 80% |
| 2 | 80% ≤ X < 90% |
| 3 | X ≥ 90% |

| Levels | Percentage of Shaded Hardscaped Common Areas (Y) Indicator |
|:---:|:---:|
| -1 | Y < 25% |
| 0 | 25% ≤ Y < 30% |
| 1 | 30% ≤ Y < 35% |
| 2 | 35% ≤ Y < 40% |
| 3 | Y ≥ 40% |

| Levels | Percentage of Shaded Picnic and Seating Areas (Z) Indicator |
|:---:|:---:|
| -1 | Z < 80% |
| 0 | 80% ≤ Z < 85% |
| 1 | 85% ≤ Z < 90% |
| 2 | 90% ≤ Z < 95% |
| 3 | Z ≥ 95% |

### 2.8.6    SUBMITTALS

| Provisional Certification Stage (LOC) | |
|---|---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Site drawings outlining all building footprints, pedestrian pathways, parking areas, common areas. |
| | Site drawings outlining all building footprints, pedestrian pathways, picnic and seating areas (for Hospitality building typology only). |
| | Relevant architectural and landscape drawings and specifications. |
| **Simulation** | Shading Simulation results. |
| **Calculator** | S.8 Shading Calculator. |

| Final Certification Stage (CDA) | |
|---|---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | Relevant as-built drawings. |
| **Simulation** | Updated Shading Simulation results. |
| **Calculator** | Updated S.8 Shading Calculator. |

### 2.8.7    EVALUATION

#### 2.8.7.1        General

- Determine the landscape features that contribute to the shading requirements.

- Determine the architectural features that contribute to the shading requirements. This can also include the shading contribution of the project building(s).

- Determine from the simulation the area of the shaded hardscaped pedestrian pathways, parking, and commonly used outdoor areas.

- Input the data into the calculator for S.8 Shading to determine the percentage of shaded areas.

- Prepare all applicable documentation.

#### 2.8.7.2  Simulation

- Use an approved simulation software to demonstrate the amount of shade cast on the hardscaped pedestrian pathways, parking areas, and common areas on 21$^{st}$ of June at 15:00 hours.

#### 2.8.7.3  Calculator

#### A. Inputs

Shading Cast References Inputs

- Input the nearest city representing the location of the development.

Part 1 – Percentage of Shaded Hardscaped Pedestrian Pathways & Parking Areas Inputs

- Select Yes from the pulldown menu if there are hardscaped pedestrian pathways or parking areas at the site.

- If Yes, input the total area.

- Input the shaded area based on the simulation results.

Part 2 – Percentage of Shaded Hardscaped Common Areas Inputs

- Select Yes from the pulldown menu if there are hardscaped common areas at the site.

- If Yes, input the total area.

- Input the shaded area based on the simulation results.

Part 3 – Percentage of Shaded Picnic and Seating Areas Inputs (for Hospitality building typology only)

- Select Yes from the pulldown menu if there are picnic and seating areas in the Hotel.

- If Yes, input the total area.

- Input shaded area based on the simulation results.

**B. Calculations**

- Total shading cast on hardscaped pedestrian pathways and parking areas = result based on simulations.

- Total shading cast on hardscaped common areas = result based on simulations.

- Total shading cast on picnic and seating areas = result based on simulations.

- (X) = calculated percentage of shaded hardscaped pedestrian pathways and parking areas.

- (Y) = calculated percentage of shaded hardscaped common areas.

- S.8 criterion level = the generated criterion level for S.8 Shading based on the calculated average of (X) and (Y) indicators from the criterion levels.

## 2.9 [S.9] ACCESSIBILITY

### 2.9.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 2.9.2 PURPOSE

To maximize accessibility to and within the site for all users, in particular those with special needs.

### 2.9.3 ASSESSMENT PRINCIPLES

- The Project will **assess** the accessible entrances of the development.
- The Project will prepare an accessibility **plan** to demonstrate compliance with the Architectural Barriers Act (ABA) for Outdoor Spaces and to establish the **criterion level**.

### 2.9.4 ASSESSMENT

The criterion requires **assessing** the accessibility of the paved pathways by preparing an accessibility **plan** that demonstrates compliance with the Architectural Barriers Act (ABA) for outdoor spaces. The accessibility plan demonstrates all pathways are provided with adequate signage strategies at all intersections and regular intervals along an unbroken length of a pathway. Signage strategies include, but are not necessarily limited to street signage, pathway labels, trash and recycling receptacles, and directional signs leading to major attractions, parking, entrances, and exits.

The plan demonstrates the following requirements:

- Accessible entrances and paved pathways that meet the ABA guidelines for outdoor spaces.
- Signages along the pathways throughout the site.
- Safety and advisory warning signs in hazardous and potentially hazardous areas, signs indicating all public, administrative, and maintenance facilities, and interpretative signs for any historical, artistic, and cultural attractions.
- Safe connection between the building and the public areas including parking spaces, leisure areas, recreational spaces, etc. Areas could be attached to the building, as in podiums and basements, or detached, as outdoor areas, or in different building within the site.

The **criterion level** is established based on the degree of compliance of the plan to the requirements of S.9 Accessibility.

### 2.9.5 CRITERION LEVELS

| Levels | Requirements |
|--------|--------------|
| -1 | Plan does not demonstrate compliance with the requirements. |
| 0 | Plan demonstrates the provision of an adequate number of accessible entrances. |
| 3 | Plan demonstrates full compliance with the requirements. |

### 2.9.6 SUBMITTALS

| Provisional Certification Stage (LOC) | |
|------|------|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Site drawings identifying all accessible pathways within the development boundary to and from the accessible entrances of the development. |
| | Relevant architectural and signage drawings and pathway material specifications. |
| **Plan** | Accessibility Plan. |

| Final Certification Stage (CDA) | |
|------|------|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | As-built drawings identifying all accessible pathways within the development boundary to and from the accessible entrances of the development. |
| | As-built architectural and signage drawings and specifications. |
| **Plan** | Updated Accessibility Plan, where applicable. |

### 2.9.7 EVALUATION

**2.9.7.1 General**

- Determine all accessible, paved pathways that connect built spaces, parking areas, and any other major facilities within the development site.

- Illustrate in the site development drawings all signages along the paved pathways, street signs, pathway labels, trash, and recycling receptacles, directional signs, safety signs, and signs identifying facilities and attractions.

- Determine the provision of adequate, accessible pathways that meet the ABA Standards for Outdoor Spaces.

- Prepare all applicable documentation.

## 2.10   [S.10] EXTERNAL LIGHTING

### 2.10.1  APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 2.10.2  PURPOSE

To meet minimum compliance requirements for external lighting and avoid over-lighting of commonly used outdoor areas.

### 2.10.3  ASSESSMENT PRINCIPLES

- The Project will **assess**:
  - Compliance with IESNA or equivalent standards, for the minimum illuminance and uniformity levels.

  - The percentage of over-lit areas in commonly used outdoor spaces

- The Project will complete the **calculator** for S.10 External Lighting based on the results from lighting **simulation** software to establish the **criterion level**.

### 2.10.4  ASSESSMENT

The criterion requires **assessing** the lighting illumination and uniformity levels of all access roads, parking areas, and pedestrian pathways and its compliance to meet the minimum requirements from IESNA or approved equivalent lighting standards using an approved lighting **simulation** software.

The simulation determines the lighting and uniformity levels of outdoor spaces and the over-lit areas.

The **calculator** determines the indicator based on simulated results of the following:

- The lighting illumination and uniformity levels for each outdoor space.

- The percentage of the total area that is over-lit by more than 25% from IESNA or approved equivalent lighting standards.

The **criterion level** is established based on the result of the indicator for S.10 External Lighting.

## 2.10.5  CRITERION LEVELS

| Levels | Percentage of the Total Area that is Over-Lit by more than 25% (X) Indicator |
|--------|------------------------------------------------------------------------------|
| -1 | Illuminance and uniformity levels failed to meet the IESNA standards. |
| 0 | X > 30% |
| 1 | 20% < X ≤ 30% |
| 2 | 10% < X ≤ 20% |
| 3 | X ≤ 10% |

## 2.10.6  SUBMITTALS

| Provisional Certification Stage (LOC) | |
|--------|--------|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Sitemap identifying all access roads, parking areas and pedestrian pathways, and the location of lighting fixtures. |
| | Lighting photometric data sheets from manufacturers |
| | Relevant lighting drawings and specifications. |
| **Simulation** | Lighting Simulation results. |
| **Calculator** | S.10 External Lighting Calculator. |

| Final Certification Stage (CDA) | |
|--------|--------|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | Relevant as-built drawings. |
| **Simulation** | Updated Lighting Simulation results. |
| **Calculator** | Updated S.10 External Lighting Calculator. |

### 2.10.7  EVALUATION

#### 2.10.7.1  General

- Determine the illuminance and uniformity levels of all access roads, parking areas, and pedestrian pathways.

- Determine from the lighting standards the minimum required lighting illumination and uniformity levels for each outdoor space.

- Determine from simulation results the lighting illumination and uniformity levels for each outdoor space.

- Input the data into the calculator for S.10 External Lighting to determine the percentage of the total area that is over-lit by more than 25%.

- Prepare all applicable documentation.

#### 2.10.7.2  Simulation

- Use an approved lighting simulation software to demonstrate the lighting illumination and uniformity levels for each outdoor space.

#### 2.10.7.3  Calculator

##### A. Inputs

Area Types & Illuminance and Uniformity Levels Inputs

- Input the description of the lighted area.

- Input the area of each important spaces within the development.

- Input the minimum required illumination levels based on the IESNA standards or approved equivalent.

- Input the minimum required uniformity levels based on the IESNA standards or approved equivalent.

- Input the resulting illumination levels from the lighting simulation.

- Input the resulting uniformity levels from the lighting simulation.

## B. Calculations

- Compliance with IESNA or approved equivalent lighting standard = established based on the results of the simulation on the lighting illumination and uniformity levels for each outdoor space.

- Percentage of total areas over-lit by more than 25% from IESNA (or approved equivalent lighting standard) = established based on the calculated ratio in percentage of the over-lit areas over the total area.

- The total area = calculated value based on the sum of each lighted outdoor spaces.

- The percentage of total area over-lit by more than 25% from IESNA or approved equivalent lighting standards = calculated value based on the over-lit areas over the total area of the spaces.

- (X) = calculated percentage of the total area that is over-lit by more than 25%.

- S.10 criterion level = the generated criterion level for S.10 External Lighting based on the specified range from the criterion levels.

## 2.11 [S.11] LIGHT POLLUTION

### 2.11.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 2.11.2 PURPOSE

To minimize the amount of light emitted from the development.

### 2.11.3 ASSESSMENT PRINCIPLES

- The Project will **assess**:
  - The light trespass of external lighting fixtures based on the zone classification using lighting **simulation** software.

  - The upward light emission of external lighting fixtures based on the zone classification.

- The Project will complete the **calculator** for S.11 Light Pollution to establish the **criterion level**.

### 2.11.4 ASSESSMENT

The criterion requires **assessing** the extent of light trespass and upward light emission of external lighting fixtures affecting nocturnal activities and nighttime sky based on the lighting zone classifications from IESNA standard using an approved lighting **simulation** software.

The simulation determines the maximum illuminance at site boundary and the upward light emission limit.

The extent of light trespass calculates the maximum illuminance to IESNA light trespass limit ratio for pre-curfew and post-curfew periods. The upward light emission calculates the fixture lumens above 90deg from Nadir to ULE limit ratio.

The **calculator** determines the indicators based on the simulated results on the following:

- The extent of light trespass.

- Upward light emission.

The **criterion level** is established based on the results of the indicators for S.11 Light Pollution.

## 2.11.5   CRITERION LEVELS

The calculator determines the criterion level based on the averaged results of the (X) and (Y) indicators. If any of these two indicators resulted with calculated value falling within the range of Level (-1), the criterion receives Level (-1).

| Pre-Curfew Levels | Post-Curfew Levels | Maximum Illuminance to IESNA Light trespass limit ratio (X) Indicator(X) Indicator |
|---|---|---|
| -1 | -1 | X > 1.2 |
| 0 | 0 | 1.2 ≥ X > 1.0 |
| 3 | 3 | X ≤ 1.0 |

| Levels | Fixture Lumens Above 90deg From Nadir to ULE Limit (Y) Indicator |
|---|---|
| -1 | Y > 1.2 |
| 0 | 1.2 ≥ Y > 1.0 |
| 3 | Y ≤ 1.0 |

## 2.11.6   SUBMITTALS

| Provisional Certification Stage (LOC) | |
|---|---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Relevant external lighting drawings and specifications. |
| | Lighting photometric data sheets from manufacturers |
| **Simulation** | Lighting Simulation results. |
| **Calculator** | S.11 Light Pollution Calculator. |

| Final Certification Stage (CDA) | |
|---|---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | Relevant as-built drawings. |
| **Simulation** | Updated lighting Simulation results. |
| **Calculator** | Updated S.11 Light Pollution Calculator |

### 2.11.7 EVALUATION

#### 2.11.7.1 General

- Determine the lighting zone following the IESNA standard.

- Determine the specifications and quantities of the external lighting fixtures.

- Input the data into the calculator for S.11 Light Pollution to determine the extent of light trespass and the upward light emission.

- Prepare all applicable documentation.

#### 2.11.7.2 Simulation

- Use an approved lighting simulation software to demonstrate maximum illuminance at site boundary and the upward light emission limit.

#### 2.11.7.3 Calculator

##### A. Inputs

Part 1 – External Lighting Design Inputs

- Select from the pulldown menu the lighting zone classification of the assessed areas based on IESNA standard. The lighting zones are classified as follows:

  - **LZ0**: Zones with no ambient light. Zones, where the natural environment will be seriously and adversely affected by lighting. Impacts include disturbing the biological cycles of flora and fauna and/or detracting from human enjoyment and appreciation of the natural environment. Human activity is subordinate in importance to nature. The vision of human residents and users is adapted to the darkness, and they expect to see little or no lighting. The maximum vertical illumination levels at the site boundaries should not exceed 0.1 lux pre-curfew and 0 lux post-curfew. The maximum allowed Upward Light Emission is 0% (i.e. no Upward Light Emission allowed for this zone).

  - **LZ1**: Zones with low Ambient Lighting, where lighting might adversely affect flora and fauna or disturb the character of the area. The vision of human residents and users is adapted to low light levels. Lighting may be used for safety and convenience, but it is not necessarily uniform or continuous. The maximum vertical illumination levels at the site boundaries should not exceed 1 lux pre-curfew and 0 lux post-curfew. The maximum allowed Upward Light Emission is 0%(i.e. no Upward Light Emission allowed for this zone).

- **LZ2**: Zones with moderate Ambient Lighting, where the vision of human residents and users is adapted to moderate light levels. Lighting may typically be used for safety and convenience, but it is not necessarily uniform or continuous. The maximum vertical illumination levels at the site boundaries should not exceed 3 lux pre-curfew and 1 lux post-curfew. The maximum allowed Upward Light Emission is 2.5%.

- **LZ3**: Zones with moderately high Ambient Lighting, where the vision of human residents and users is adapted to moderately high light levels. Lighting is generally desired for safety, security and/or convenience and it is often uniform and/or continuous. The maximum vertical illumination levels at the site boundaries should not exceed 8 lux pre-curfew and 3 lux post-curfew. The maximum allowed Upward Light Emission is 5%.

- **LZ4**: Zones with high Ambient Lighting, where the vision of human residents and users is adapted to high light levels. Lighting is generally considered necessary for safety, security and/or convenience and it is mostly uniform and/or continuous. The maximum vertical illumination levels at the site boundaries should not exceed 15 lux pre-curfew and 6 lux post-curfew. The maximum allowed Upward Light Emission is 15%.

- Input the description of the lighting fixtures.

- Input the lumens per fixture for each lighting fixtures.

- Input the quantities for each lighting fixtures.

Part 2 – Extent of Light Trespass Inputs

- Input the results from the lighting simulation for the pre-curfew and post-curfew periods.

Part 3 – Upward Light Emission Inputs

- Select from the pulldown menu the method used for calculating the upward light emission.

- Input the average light flux upward and downward components from the results of the lighting simulation when analyzing based on CIE guidance.

- Input the initial lumens from the fixture above 90deg from nadir as installed, per fixture when analyzing each luminaire for the upward light component.

## B. Calculations

- Calculated average light flux upward, average light flux downward, and upward light emission = assigned fixed values when "analyzing each luminaire for the upward light component" method is selected.

- IESNA light trespass limit = fixed values assigned for pre-curfew and post-curfew periods.

- Percentage of the maximum illumination at site boundary to IESNA light trespass limit = calculated values based on the lighting simulation of pre-curfew and post-curfew periods.

- Sum of total fixture lumens above 90deg from nadir = calculated value based on the lighting simulation results.

- Sum of total fixture lumens = calculated value based on the lighting simulation results.

- Upward light emission limit = calculated value based on the selected lighting zone classification of the assessed areas.

- The percentage of fixture lumens above 90deg from nadir = calculated based on the simulated total fixture lumens.

- Fixture lumens above 90deg from nadir to upward light emission limit ratio = established value based on the calculated percentage of fixture lumens above 90deg from nadir.

- (X) = calculated percentage of maximum illumination level to IESNA light trespass limit ratio.

- (Y) = calculated percentage of fixture lumens above 90deg from nadir to upward light emission limit ratio.

- S.11 criterion level = the generated criterion level for S.11 Light Pollution based on the calculated average of (X) and (Y) indicators from the criterion levels.

## 2.12 [S.12] NOISE POLLUTION

### 2.12.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 2.12.2 PURPOSE

To minimize the level of outdoor noise produced by the development.

### 2.12.3 ASSESSMENT PRINCIPLES

- The Project will **assess** the increase in outdoor noise level between the pre- and post-development conditions relative to the nature of the surrounding environment.

- The Project will complete the **calculator** for S.12 Noise Pollution to establish the **criterion level**.

### 2.12.4 ASSESSMENT

The criterion requires **assessing** the outdoor noise levels for the pre- and post-development conditions of the site, which is to be done by measuring the noise levels during the pre-development period and calculating the noise additions for the post-development period. The pre-development assessment considers measurement points selected at the edge of the site boundary in north, east, south and west orientations at 2m above the ground surface.

The classifications of the noise sensitivity of the surrounding area is as follows:

- Type 1 – existence of a neighboring noise-sensitive building is existing within the 500m radius from the site. Noise-sensitive buildings include the following:
  - Educational buildings (school, university, etc.)
  - Hotels
  - Medical facilities (Hospital, Clinic, etc.)
  - Residential buildings (single family, multi-family, high-rise, etc.)
  - Library
  - Place of worship
- Type 2 – no neighboring noise-sensitive buildings.

Using approved sound meters, establish the A-weighted pre-development sound pressure levels in the north, east, south, and west measurement points for a continuous 24-hour period.

The **calculator** determines the indicator based on the relative pre- to post-development noise level increase.

The **criterion level** is established based on the result of the indicator for S.12 Noise Pollution.

## 2.12.5  CRITERION LEVELS

| Levels | Maximum Noise Increase in dBA (X) Indicator | |
| :---: | :---: | :---: |
| | Type 1 | Type 2 |
| **-1** | X ≥ 3dBA | X ≥ 6dBA |
| **0** | 1dBA < X < 3dBA | 2dBA < X < 6dBA |
| **3** | X ≤ 1dBA | X ≤ 2dBA |

## 2.12.6  SUBMITTALS

| Provisional Certification Stage (LOC) | |
| :---: | :--- |
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Sitemap identifying the types of the existing buildings within 500m radius from the site. |
| | Documented pre-development noise levels survey data. |
| | Relevant Mechanical and Electrical drawings, specifications, and schedules. |
| **Calculator** | S.12 Noise Pollution Calculator. |

| Final Certification Stage (CDA) | |
| :---: | :--- |
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | Relevant as-built drawings. |
| **Calculator** | Updated S.12 Noise Pollution Calculator. |

### 2.12.7 EVALUATION

**2.12.7.1 General**

- Determine the relative pre- to post-development increase in outdoor noise level considering surrounding area land use and its noise sensitivity.

- Determine the existence of noise-sensitive buildings within 500m radius from the site.

- Measure the pre-development noise levels.

- Determine the post-development noise levels.

- Input the data into the calculator for S12. Noise Pollution to determine the relative pre- to post-development noise increase.

- Prepare all applicable documentation.

**2.12.7.2 Calculator**

**A. Inputs**

Part 1 – Site Type Specification Input

- Select Yes from the pulldown menu if there is a noise-sensitive building within 500m radius from the site.

Part 2 – Pre-Development Measurement Input

- Input the 24-hour readings of the measured A-weighted sound pressure levels in the north, east, south, and west measuring points.

Part 3 – Post Development Input

- Input the noise-generating facilities, the A-weighted sound levels, the day-night operation factors, the noise source location parameters, and the directivity factor. Noise-generating facilities include outdoor generators, chillers, a/c outdoor units, etc.

### B. Calculations

- Site type = assigned fixed value (Type 1 or Type 2) based on the selected site condition.

- Directivity factor = assigned fixed values (1, 2, 4, and 8) for the described geometry.

- Measurement height = assigned fixed value (2) in the location parameters.

- Pre- and post-development day-night equivalent noise levels (DNL) for each orientation = calculated based on the resulting daytime equivalent and nighttime equivalent noise levels.

- Additional noise in dBA = calculated value based on the pre-development noise measurements and post-development noise calculations.

- Maximum noise increase in dBA = established based on the calculated maximum additional noise in north, east, south, and west orientations of the site.

- (X) = calculated maximum noise increase in dBA for Type 1 and Type 2 site conditions.

- S.12 criterion level = the achieved criterion level for S.12 Noise Pollution based on the specific dBA assessment criteria ranges from the criterion levels.

## 2.13    [S.13] ECO-PARKING

### 2.13.1  APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 2.13.2  PURPOSE

To maximize the number of sustainable parking spaces in the development.

### 2.13.3  ASSESSMENT PRINCIPLES

- The Project will **assess** the number of sustainable parking spaces provided in the development while satisfying local regulations for total parking requirements.
- The Project will complete the **calculator** for S.13 Eco-Parking to establish the **criterion level**.

### 2.13.4  ASSESSMENT

The criterion requires **assessing** the percentage of sustainable parking spaces from the total number of parking spaces within the development while satisfying the local regulation requirements. Sustainable parking spaces are parking types designed and built with sustainable techniques to mitigate the negative impacts of heat island effect and rainwater runoff. Parking types considered sustainable are structured multi-level parking, on-street parallel parking, underground parking, and other alternative and innovative solutions such as porous parking and automated parking systems. The assessment considers at-grade parking to be sustainable if shading, porous surfaces, and sufficient artificial lighting are provided.

The **calculator** determines the indicator based on the sufficiency of the total number of parking spaces provided in the development and the percentage of sustainable parking spaces.

The **criterion level** is established based on the result of the indicator for S.13 Eco-Parking.

### 2.13.5  CRITERION LEVELS

| Levels | Sufficiency of Total Number of Car Parks Provided (X) Indicator<br>Percentage of Sustainable Carparking Spaces (Y) Indicator |
|--------|--------------------------------------------------------------|
| -1 | X = Insufficient    OR    Y < 20% |
| 0 | 20% ≤ Y < 40% |
| 1 | 40% ≤ Y < 60% |
| 2 | 60% ≤ Y < 80% |
| 3 | Y ≥ 80% |

### 2.13.6  SUBMITTALS

| Provisional Certification Stage (LOC) | |
|---------------------------------------|--|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Relevant architectural drawings and landscape drawings and specifications. |
| **Calculator** | S.13 Eco-Parking Calculator. |

| Final Certification Stage (CDA) | |
|---------------------------------|--|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | Relevant as-built drawings. |
| **Calculator** | Updated S.13 Eco-Parking Calculator. |

### 2.13.7 EVALUATION

**2.13.7.1 General**

- Determine the minimum number of parking spaces required by local regulations.

- Determine the total number of sustainable parking spaces.

- Determine the total number of parking spaces.

- Input the data into the calculator for S.13 Eco-Parking to determine the percentage of sustainable car parking spaces provided in the development.

- Prepare all applicable documentation.

**2.13.7.2 Calculator**

**A. Inputs**

- Input the required minimum number of parking spaces in accordance with local regulations.

- Input the number of sustainable parking spaces provided in the development.

- Input the total number of parking spaces provided in the development.

**B. Calculations**

- Number of parking spaces in excess of local regulation requirements = calculated value based on the minimum number of parking spaces, number of sustainable parking spaces, and the total number of parking spaces.

- Sufficiency of the total number of parking spaces in the development = established value based on the number of parking spaces in excess of the regulations.

- Percentage of sustainable parking spaces = calculated value based on the number of sustainable parking spaces over the total number of parking spaces provided in the development.

- (X) = established sufficiency of the total number of parking spaces provided in the development.

- (Y) = calculated percentage of sustainable parking spaces in the development.

- S.13 criterion level = the generated criterion level for S.13 Eco-Parking based on the specified range from the criterion levels.

## 2.14 [S.14] MIXED USE

### 2.14.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 2.14.2 PURPOSE

To diversify the major occupancy uses within the development.

### 2.14.3 ASSESSMENT PRINCIPLES

- The Project will **assess** the number of major occupancy uses with the required support facilities and arrangements.

- The Project will complete the **calculator** for S.14 Mixed Use to establish the **criterion level**.

### 2.14.4 ASSESSMENT

The criterion requires **assessing** the quantity of mixed use in the development by calculating the total number of major occupancy uses that have the required support facilities and arrangements based on the gross area of each type of occupancy. Samples of the required facilities and arrangements that support the major occupancy uses are: toilets for occupants, ablution for the mosques, stores for retail, and other required support facilities and arrangements necessary for each occupancy use to fully function for each intended use.

The gross area must be greater than or equal to 5% of the total gross area to be counted as a major occupancy use. In a clustered development with multiple buildings, the occupancy use is identified based on the major function of each building type. Examples of building types are: office building, residential building, commercial center, hotel, mosque, convention center, school building, hospital, retail store, sports club, health and wellness center, museum, etc. The gross area of the occupancy use must be greater than or equal to 5% of the total gross area for each building type. The total gross area for each building type excludes the areas of carparks and building services, for example: plant room, shaft, toilet, lift, stair, mechanical room, electrical room, utility room, tank room, pump room, roof, and storage areas.

The **calculator** determines the indicator based on the total number of major occupancy uses in the development.

The **criterion level** is established based on the result of the indicator for S.14 Mixed Use.

## 2.14.5 CRITERION LEVELS

| Levels | Number of Major Occupancy Uses (X) Indicator |
|--------|----------------------------------------------|
| 0 | X = 1 |
| 1 | X = 2 |
| 2 | X = 3 |
| 3 | X = 4 |

## 2.14.6 SUBMITTALS

| Provisional Certification Stage (LOC) | |
|---|---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Relevant documentation for gross area of the overall building and the major occupancy uses. |
| **Calculator** | S.14 Mixed Use Calculator. |

| Final Certification Stage (CDA) | |
|---|---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | As-built architectural drawings. |
| **Calculator** | Updated S.14 Mixed Use Calculator. |

### 2.14.7 EVALUATION

#### 2.14.7.1 General

- Determine the number of major occupancies having the required support facilities and arrangements associated with each use.

- Determine the gross area of each occupancy use.

- Input the data into the calculator for S.14 Mixed Use to determine the number of major occupancy types.

- Prepare all applicable documentation.

#### 2.14.7.2 Calculator

##### A. Inputs

Occupancy Inputs

- Input the major use or function for each occupancy use.

- Input the gross area of each occupancy use.

##### B. Calculations

- Total building gross area = sum of all the areas of each occupancy use.

- Percentage of the gross area for each occupancy use = calculated value based on the gross area for each occupancy use over the total building gross area.

- Major occupancy = assigned quantity for each occupancy use.

- Total number of major occupancies = calculated based on the number of assigned quantities for each occupancy use.

- (X) = calculated number of major occupancies in the development.

- S.14 criterion level = the generated criterion level for S.14 Mixed Use based on the specified range from the criterion levels.

## 2.15 [S.15] CONSTRUCTION PRACTICES

### 2.15.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 2.15.2 PURPOSE

To adopt responsible construction practices and mitigate the adverse impacts of on-site construction activities.

### 2.15.3 ASSESSMENT PRINCIPLES

- The Project will **assess** the construction practices in accordance with the requirements of GSAS Construction Management certification.

- The Project will obtain GSAS Construction Management **certification** to establish the **criterion level**.

### 2.15.4 ASSESSMENT

The criterion requires **assessing** the construction practices that conforms with the latest GSAS Construction Management (GSAS-CM) assessment and guidelines. The assessment includes obtaining proof of contractually binding commitment from the owner to pursue the **GSAS-CM certification** for the construction practices of the main contractor prior to commencing the construction activities at the site. The proof or evidence indicates the commitment to achieve a minimum target rating in GSAS-CM certification. GSAS-CM certificates from the lowest to the highest ratings are Class D, C, B, A, and A★. During the CDA stage, the assessment verifies the implementation of the commitment for GSAS-CM certification of the construction practices.

The **criterion level** is established based on achieved rating of the development in GSAS-CM certification.

### 2.15.5 CRITERION LEVELS

| Levels | Requirements |
|:------:|--------------|
| -1 | Development does not demonstrate compliance with the requirements. |
| 0 | Development receives GSAS-CM certificate with Class D rating. |
| 1 | Development receives GSAS-CM certificate with Class C rating. |
| 2 | Development receives GSAS-CM certificate with Class B rating. |
| 3 | Development receives GSAS-CM certificate with Class A or A★ rating. |

### 2.15.6 SUBMITTALS

| Provisional Certification Stage (LOC) | |
|---|---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Proof of contractually binding commitment from the owner stating the targeted GSAS-CM certification rating. |
| | Proof of GSASgate registration for construction management certification. |

| Final Certification Stage (CDA) | |
|---|---|
| **Types** | **Descriptions** |
| **Certificate** | GSAS-CM certificate issued by GSAS Trust. |

### 2.15.7  EVALUATION

**2.15.7.1 General**

- Obtain from the owner the proof or evidence of the contractually binding commitment to pursue GSAS-CM certification.

- Determine during construction the proof or evidence that the contractor registers for GSAS-CM certification using GSASgate.

- Prepare all applicable documentation.

## 3.0   ENERGY

The Energy category is concerned with improving the design and energy performance of the development having a direct and positive impact on both the consumption of resources and environmental quality including climate change, fossil fuel depletion, air pollution and human comfort, health and well-being.

### CRITERIA IN THIS CATEGORY:

E.1     Thermal Energy Demand Performance

E.2     Energy Use Performance

E.3     Primary Energy Performance

E.4     $CO_2$ Emissions

E.5     Energy Sub-Metering

E.6     Renewable Energy

## CRITERIA SUMMARY

The table below summarizes the weights of the Energy category and each of the associated criteria:

| Legend | | | | |
|--------|---|---|---|---|
| √ | Incentive Only | | **N/A** | Not Applicable |

| No | Category / Criteria | LEVELS | | WEIGHTS | | | | | | | |
|----|---------------------|--------|-----|-----------|-----------|-------|-------------|----------------|---------|---------|-------------|
| | | MIN | MAX | Commercial | Education | Homes | Hospitality | Light Industry | Mosques | Offices | Residential |
| **E** | **ENERGY** | | | | | | | | | | |
| E.1 | Thermal Energy Demand Performance | -1 | 3 | 11.00% | 11.00% | 13.48% | 11.00% | 11.00% | 11.00% | 11.00% | 11.00% |
| E.2 | Energy Use Performance | -1 | 3 | 7.76% | 7.76% | 9.44% | 7.76% | 7.76% | 7.76% | 7.76% | 7.76% |
| E.3 | Primary Energy Performance | -1 | 3 | 2.56% | 2.56% | 2.97% | 2.56% | 2.56% | 2.56% | 2.56% | 2.56% |
| E.4 | $CO_2$ Emissions | -1 | 3 | 2.68% | 2.68% | 3.11% | 2.68% | 2.68% | 2.68% | 2.68% | 2.68% |
| E.5 | Energy Sub-Metering | 0 | 3 | √ | √ | √ | √ | √ | √ | √ | √ |
| E.6 | Renewable Energy | 0 | 3 | √ | √ | √ | √ | √ | √ | √ | √ |
| | | | **Total** | 24.00% | 24.00% | 29.00% | 24.00% | 24.00% | 24.00% | 24.00% | 24.00% |

# GSAS ENERGY FRAMEWORK

## INTRODUCTION

In the past, energy codes were formulated in prescriptive terms (i.e., prescribing certain features of the planned building). Now, many countries are grounding their energy regulations and standards on a performance basis. This transition requires that the code only contains statements that one must prove and that the expected performance complies with a certain minimal requirement. This means that the code needs to be supported by a standard that defines the performance and normatively states the way to calculate it, with phase relevant parameters as input. The latter means that for an "as-designed" performance one would define which design parameters are used as inputs, whereas for "as-operated" performance one would use parameters that describe the operation of the building in addition to design specification.

It is generally agreed upon that a performance-based approach is the better approach to regulate energy consumption without constraining design solutions; thus, guaranteeing maximum innovation capacity in coming up with new solutions. The evaluation methods can be based on either normative calculation or simulation. The evaluation method must be effective and easy to implement, and the transparent calculation procedure must be applicable to all buildings. A simple transparent method guarantees that there is no bias in doing the calculations, but simplified calculation routines lack the accuracy of dynamic simulation. The latter is however more time consuming, requires deep expertise, and is biased by the experience of the individual consultant. Another drawback of simulation is its opaqueness, which makes it harder for the regulators to check appropriateness and accuracy. After weighing the plusses and minuses of both methods, it seems the current trend is towards normatively defined, simplified calculations.

In light of this, the new energy code and standard for GSAS will therefore adhere to the following two principles:

- Performance-based code, i.e., only related to energy outcomes, not features.

- A standard that normatively defines the simplified calculation of energy outcomes.

## SIMULATION VERSUS NORMATIVE CALCULATION

### Simulation Method

Energy simulation uses the solution of time dependent models of building energy behavior. It is based on scientific models and techniques for the analysis of the dynamic energy flows in and between all components and systems of the building; all building energy flows can be calculated, as an output of the simulation, to determine the energy consumption of the building systems. Building models can be made to be very detailed and the result of the simulation can be very close to reality. However, recent research has shown that even with the most detailed models, simulation is in many cases still a poor approximation of the energy consumption in the actual buildings. The main reason for this is the unpredictability of certain parameter values, as well as usage patterns and inevitable modeling inaccuracies. It is now an accepted fact that detailed dynamic simulation gives a false sense of accurateness compared to actual as-used consumption.

### Normative Calculation Method

A normative calculation is usually based on a simplified method to calculate energy flows in a building. The simplified method is typically derived from macro heat balance equations that are integrated over time (i.e. calculating total energy amount per month or per week). Although the resulting value cannot be taken as an accurate prediction of the monthly or weekly total, it is in most cases good enough as an indicator of energy performance. A big advantage of a normatively declared performance indicator is that its value can be calculated directly from the relevant set of building design (and operation) parameters. Simplified calculations represent the best of both worlds: they represent the physics-based approach of simulation (albeit simplified) and the transparency and ease of use of rating methods.

## PRESCRIPTIVE VERSUS PERFORMANCE-BASED APPROACH

### Prescriptive Approach

The intent of prescriptive statements is to set minimum requirements for certain building features that are deemed mandatory to arrive at an energy efficient design. Prescriptive statements may address certain features of the envelope, HVAC, power, water heating, and lighting systems. Prescriptive statements can be found in many traditional building regulations, but recent approaches are moving away from them and towards performance-based codes. However, there will always be areas that are better covered by prescriptive codes. Fire protection codes are an example of this; given the insurance and liability issues, prescriptive codes provide the protection that practice requires. The ASHRAE 90.1 energy code (in fact a "standard", written in "code language"), which is enforced in the US and adopted by several other countries, is a hybrid of prescriptive statements and performance-based statements. The basic reasoning behind this is the belief that it is necessary to define a set of minimum requirements on building properties and then require the energy outcome of the building to meet a certain minimum improvement over a baseline design for the same building.

From a purely performance-based thinking method (which dictates that only outcomes matter), one would reject the prescriptive part of ASHRAE's hybrid approach. However, one can debate whether one can leave everything to the industry (the credo of performance- based approach), or one should set some rules to prescribe desirable properties of solutions. ASHRAE takes a sensible middle road approach to this.

### Performance-based approach

The fundamental issue in any performance-based approach is to only set targets for the outcome. In the case of energy, this means that we only hold energy performance (a calculated or measured outcome) to a certain minimum requirement, both for new and existing buildings. Simply speaking, a performance-based method never gives points for building features and only gives points for outcomes.

The goal for a performance-based code is to specify and enforce a minimum requirement for a building's energy performance. It does so by referencing a standardized "measurement method" for the building energy performance evaluation.

Benefits for a purely performance-based approach are to not impinge on the design freedom. The absence of prescriptive statements means that there will be no resistance from the building industry when the code is made more stringent over time. Making prescriptive features more stringent typically results in certain building products no longer being admissible, which leads to market resistance and therefore slower adoption of the code over time.

Looking at the existing building energy standards, the two most well-known energy standards use different approaches:

1. CEN/ISO: supports a purely performance-based approach, based on the normative calculation method.

2. ASHRAE: uses a hybrid approach combining prescriptive items with a performance-based compliance analysis; typically backed up by dynamic simulation (a simplified calculation method is not defined). Another anomaly of ASHRAE is that it is essentially a standard but written in enforceable code language; thus, this blurs the distinction between the technical specification and the legal-enforceable code.


## ENERGY PERFORMANCE OF BUILDINGS DIRECTIVE OF CEN/ISO STANDARDS

GSAS energy framework is developed based on the philosophy of CEN/ISO building energy performance standards with adaptation to the local condition. It can be used as a normative reference for building energy performance evaluation of all building types during the design phase. The energy performance of a project is an integral part of GSAS scoring system, which determines a score based on the normative calculation approach.

The approach defined hereafter relies on the relevant CEN/ISO standards for building energy performance, which have been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association (Mandate M/343). This mandate supports the essential requirements of EU Directive 2002/91/EC on the Energy Performance of Buildings Directive (EPBD). This series of standards aims to provide consistent methodologies for the calculation of the energy performance of buildings.

The CEN/ISO standard refers to three allowed calculation methods, all of which should be performed for the period of one reference year: (1) hourly simplified, (2) monthly simplified, and (3) dynamic simulation.

The newly developed *GSAS Energia Suite™*, adopts the monthly simplified method for the energy performance calculations. It does not support the hourly simplified calculation method or the dynamic simulation method.


## SET OF EPBD CEN STANDARDS

By 2010, about 28 standards had been produced, covering the different elements of the calculation procedures, system inspection procedures, and other relevant procedures. The set of EPBD CEN standards can be grouped as follows:

1. The building physics standards, e.g., describing the calculation of heat transfer by transmission and ventilation, load and summer temperature, solar transmittance, and the calculation of the energy need for heating and cooling of the building.

2. In the second group, there are standards on the description and properties (classification) of ventilation systems plus cooling and air conditioning systems.

3. The third group focuses on the description of space heating and domestic hot water systems:

   • Generation efficiency

   • Emission efficiency

   • Domestic hot water systems

   • Low temperature heating and cooling systems integrated in the building elements (embedded systems)

4. The fourth group is a series of supporting standards on:

   • Lighting systems for buildings (including the effect of daylight)

   • Controls and automation for building services

   • Classification of the indoor environment

   • Financial economic evaluation of sustainable energy applications

5. The fifth group is a set of standards on inspection:

   • Boilers and heating systems

   • Cooling- and AC systems

   • Ventilation systems.

6. Finally, the sixth group has the two key standards on expressing energy performance and for energy certification of buildings, the overall energy use, primary energy and $CO_2$ emissions, the assessment of energy use and definition of energy performance ratings.

The main relations between different (clusters of) CEN standards are shown in Figure 1, which can also be found in the CEN TR15615 "Umbrella Document". The starting point is the EPBD. The requirements as given in various articles and the Annex of the EPBD have been the starting point for developing the set of CEN standards.
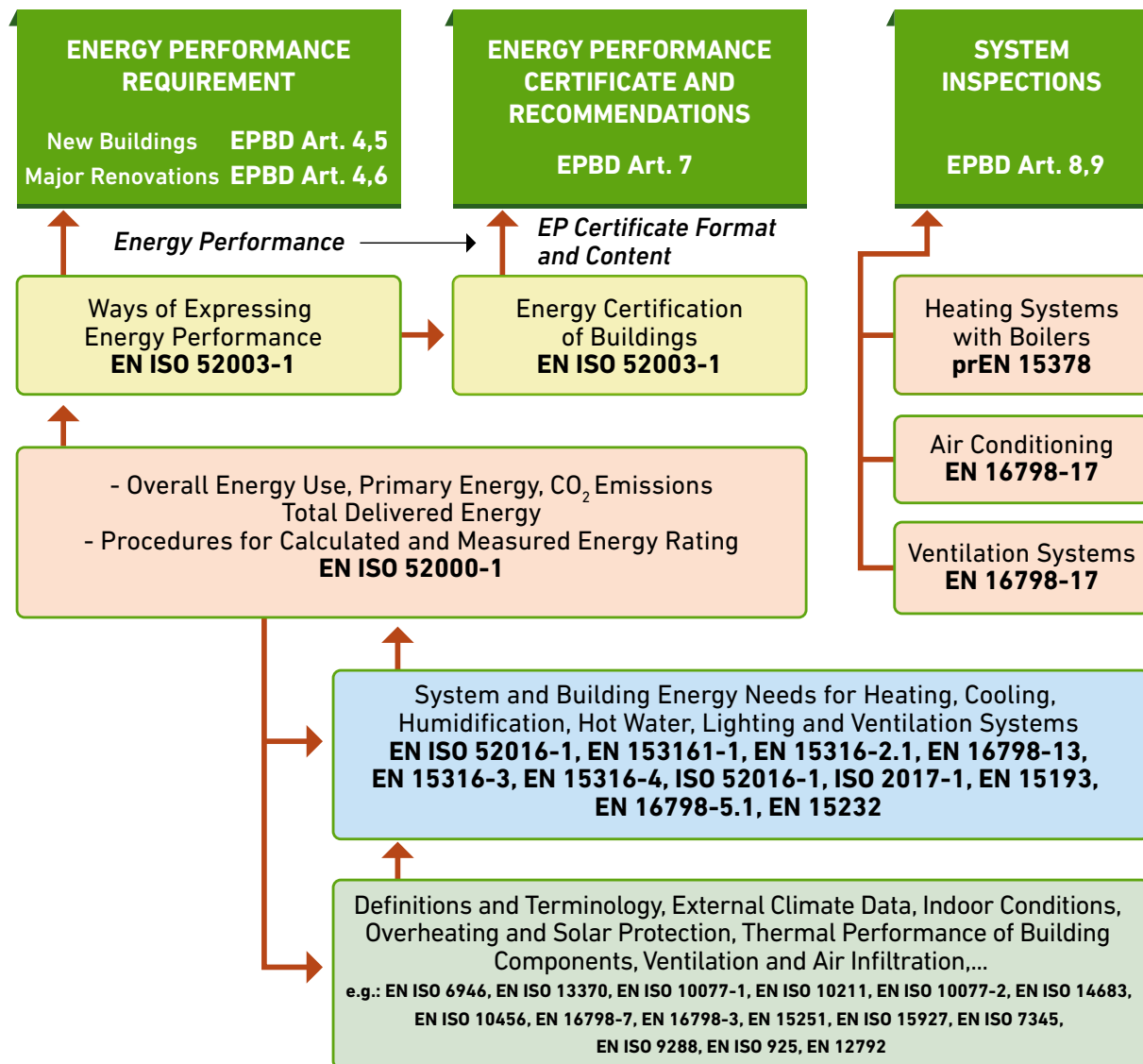
**ENERGY PERFORMANCE REQUIREMENT**

New Buildings **EPBD Art. 4,5**
Major Renovations **EPBD Art. 4,6**

**ENERGY PERFORMANCE CERTIFICATE AND RECOMMENDATIONS**

**EPBD Art. 7**

**SYSTEM INSPECTIONS**

**EPBD Art. 8,9**

*Energy Performance* → *EP Certificate Format and Content*

Ways of Expressing Energy Performance
**EN ISO 52003-1**

Energy Certification of Buildings
**EN ISO 52003-1**

Heating Systems with Boilers
**prEN 15378**

Air Conditioning
**EN 16798-17**

Ventilation Systems
**EN 16798-17**

- Overall Energy Use, Primary Energy, $CO_2$ Emissions
Total Delivered Energy
- Procedures for Calculated and Measured Energy Rating
**EN ISO 52000-1**

System and Building Energy Needs for Heating, Cooling, Humidification, Hot Water, Lighting and Ventilation Systems
**EN ISO 52016-1, EN 153161-1, EN 15316-2.1, EN 16798-13, EN 15316-3, EN 15316-4, ISO 52016-1, ISO 2017-1, EN 15193, EN 16798-5.1, EN 15232**

Definitions and Terminology, External Climate Data, Indoor Conditions, Overheating and Solar Protection, Thermal Performance of Building Components, Ventilation and Air Infiltration,...
**e.g.: EN ISO 6946, EN ISO 13370, EN ISO 10077-1, EN ISO 10211, EN ISO 10077-2, EN ISO 14683, EN ISO 10456, EN 16798-7, EN 16798-3, EN 15251, EN ISO 15927, EN ISO 7345, EN ISO 9288, EN ISO 925, EN 12792**

*Figure 1: Basic theme of CEN standards*

## ENERGY PERFORMANCE COEFFICIENT (EPC) APPROACH

The goal of this approach is to set minimum requirements for the energy performance of new and existing buildings. A detailed energy simulation can serve as the energy performance calculation in most cases, but a normative calculation procedure may be used alternatively to assess the total building energy performance.

The normative method defines the energy demand of a building with reference to the simplified calculation of heat gains, loss, occupancy, controls, and system efficiencies.

The EPC is calculated from the calculated energy characteristic value on a certain level, divided by a standardized energy reference (reference value). The energy consumption of reference buildings is equivalent to the notional building that should be defined by the national level, but with the same scale in the same building type, so:

$$EPC \ = \ \frac{Design \ value}{Referernce \ value}$$

The design value can be derived from the calculation of thermal energy, energy use, primary energy performance, and $CO_2$ emissions. The EPC can be expressed at three granularity levels and this can be expressed as following:

Level 1 - For thermal energy demand: $\qquad EPC_{dem} = \dfrac{Q_{(dem\_norm)}}{Q_{(dem\_ref)}}$

Level 2 - For energy use: $\qquad EPC_{use} = \dfrac{E_{(use\_norm)}}{E_{(use\_ref)}}$

Level 3a - For primary energy: $\qquad EPC_{pri} = \dfrac{E_{(pri\_norm)}}{E_{(pri\_ref)}}$

Level 3b - For $CO_2$ emissions: $\qquad EPC_{CO2} = \dfrac{mCO2_{norm}}{mCO2_{ref}}$

Where:

$EPC_{dem}$      is the energy performance coefficient of thermal energy demand;

$EPC_{use}$      is the energy performance coefficient of energy use;

$EPC_{pri}$      is the energy performance coefficient of primary energy;

$EPC_{CO2}$      is the energy performance coefficient of $CO_2$ emissions;

$Q_{dem\_norm}$      is the normalized thermal energy demand, in annual kWh/m²;

$E_{use\_norm}$      is the normalized energy use, in annual kWh/m²;

$E_{pri\_norm}$      is the normalized primary energy consumed for the building, in annual kWh/m²;

$m_{CO2norm}$      is the normalized mass of $CO_2$ emissions;

$Q_{dem\_ref}$      is the reference energy for the thermal energy demand, in annual kWh/m²;

$E_{use\_ref}$      is the reference energy for energy use, in annual kWh/m²;

$E_{pri\_ref}$      is the reference energy for primary energy, in annual kWh/m²;

$m_{CO2ref}$      is the reference energy for mass of $CO_2$ emissions.

The EPC concept was derived from the Dutch Building Regulations since 1995 for the housing energy performance increase.  The EPC represents the efficiency of a given building including system installations. The EPC can be used as an index for integral judgment of the energy performance of a given building including installations.

GSAS D&B energy framework does not cover the calculation of energy during the building construction phase and does not deal with the comparison of predicted energy use and actual use in the operation phase. Applicable version of *GSAS Energia Suite*™ should be used for GSAS Construction Management (GSAS-CM) and GSAS Operations (GSAS-OP).  It should be noted that GSAD D&B energy framework covers the calculations to predict energy consumption during the operational stages of the building, based on design documentation.

Standard for the endorsed calculation methods:

The key standard related to calculation method for GSAS energy framework is EN-ISO13790 which is now replaced with EN-ISO 52016. This standard describes the simplified monthly calculation method that is adopted as the baseline and is the only supported calculation method for the energy performance score in GSAS method.

## DIAGRAM OF ENERGY STANDARDS LINKAGE

Figure 2 illustrates linkages between the various standards. Arrows indicate where the result from one standard is used as an input into another standard.
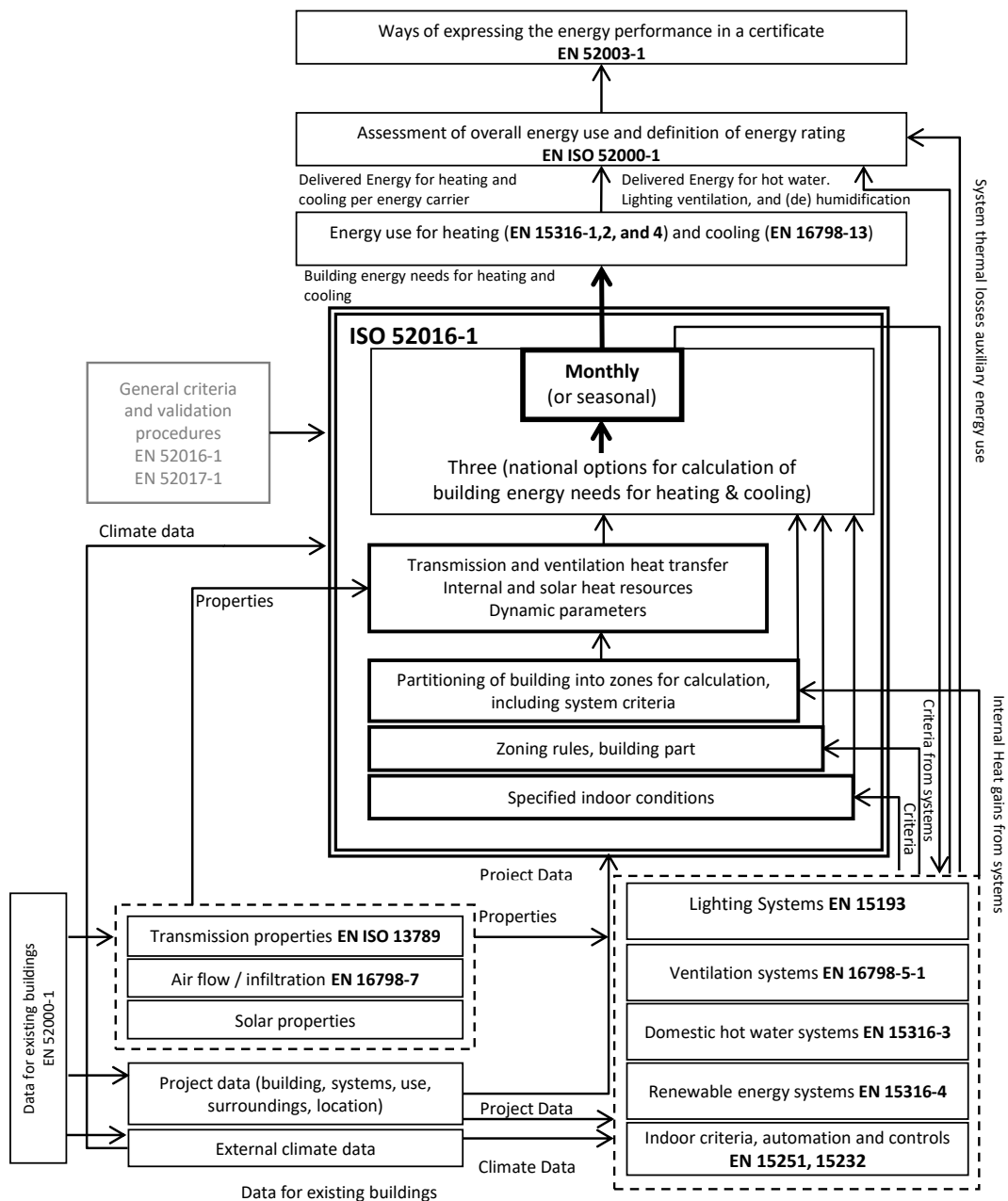


*Figure 2 : Outline of Linkage Diagram for the Building Part*

## ENERGY PERFORMANCE CALCULATION LEVELS

### Energy Flows

The following Figure 3 illustrates energy flows which are to be calculated by the predefined calculation methods in the standards.
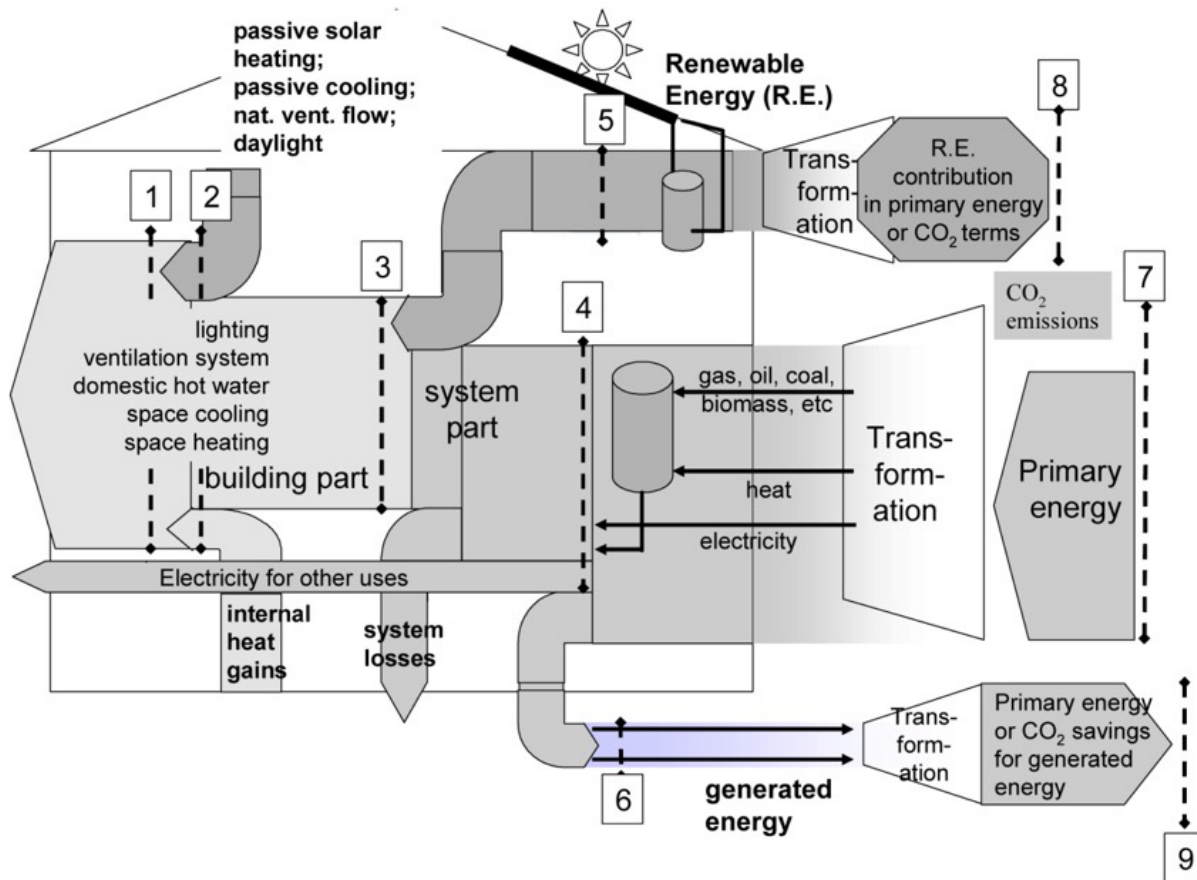


*Figure 3 : Schematic Illustration of the Calculation Scheme*

Explanation of the calculation nodes in Figure 3 above is given below.

Node [1]   represents the required energy to fulfill the user's requirements for heating, cooling, lighting, etc. according to levels that are specified for the purpose of calculation.

Node [2]   represents the "natural" energy gains – passive solar heating, passive cooling, natural ventilation, day lighting – together with internal gains (occupants, lighting, electrical equipment, etc.).

Node [3]   represents the building's energy demand, obtained from node [1] and node [2] along with the characteristics of the building itself.

Node [4]   represents the energy use, recorded separately for each energy carrier and inclusive of auxiliary energy, used by space heating, cooling, ventilation, domestic hot water and lighting systems, taking into account renewable energy sources and co-generation. This may be expressed in energy units or in units of energy types (kg, $m^3$, kWh, etc.).

Node [5]   represents the produced renewable energy on the building premises.

Node [6]   represents generated energy, produced on the premises and exported to the market; this can include part of node [5].

Node [7]   represents the primary energy usage or the emissions including $CO_2$, associated with the building.

Node [8]   represents the primary energy or emissions associated with on-site generation, which is used on-site and thus is not subtracted from node [7].

Node [9]   represents the primary energy or emissions savings associated with energy exported to the market, which is thus subtracted from node [7].

**Energy Performance Calculation Levels**

The overall calculation process involves the following energy flow nodes from the left to the right in Figure 3. These calculation nodes explained in the previous section (Figure 2) can be grouped according to the procedure of performance-based assessment:

Level 1: Thermal energy demand ($Q_{dem}$) - [1], [2], [3]

Level 2: Energy use ($E_{use}$) - [4], [5], [6]

Level 3: (a) Primary energy ($E_{pri}$) and (b) $CO_2$ emissions - [7], [8], [9]

The outcome of each energy calculation consists of the various calculation and supporting standards as introduced before.

Calculation starts from Level 1: Thermal energy demand ($Q_{dem}$), which take account of energy losses (transmission and ventilation), heat gains (solar, internal, and system heat sources), and dynamic parameters (gain and loss utilization factor).

On Level 2: Energy use ($E_{use}$), the required energy for heating, cooling, ventilation, domestic hot water, lighting, and auxiliary system is calculated. It is necessary to first calculate the thermal energy demand for heating and cooling. The energy requirements of each system are calculated based on the type of system. Heating and cooling energy losses via water or air delivery and renewable energy generation on-site are all taken into account.

In Level 3: Primary energy ($E_{pri}$) and $CO_2$ emissions are calculated on the basis of the calculated delivered energy and weighting factors using primary energy factors with additional factors that recognize the transmission losses of the supply system. For the emissions, similar factors are used, linking delivered energy to the supply system through emission coefficients that indicate the different conversion steps and the emissions that are associated with them.

Figure 4 illustrates the framework of three levels of the energy performance calculation and rating method. The major calculation standards directly relevant to each category are listed.
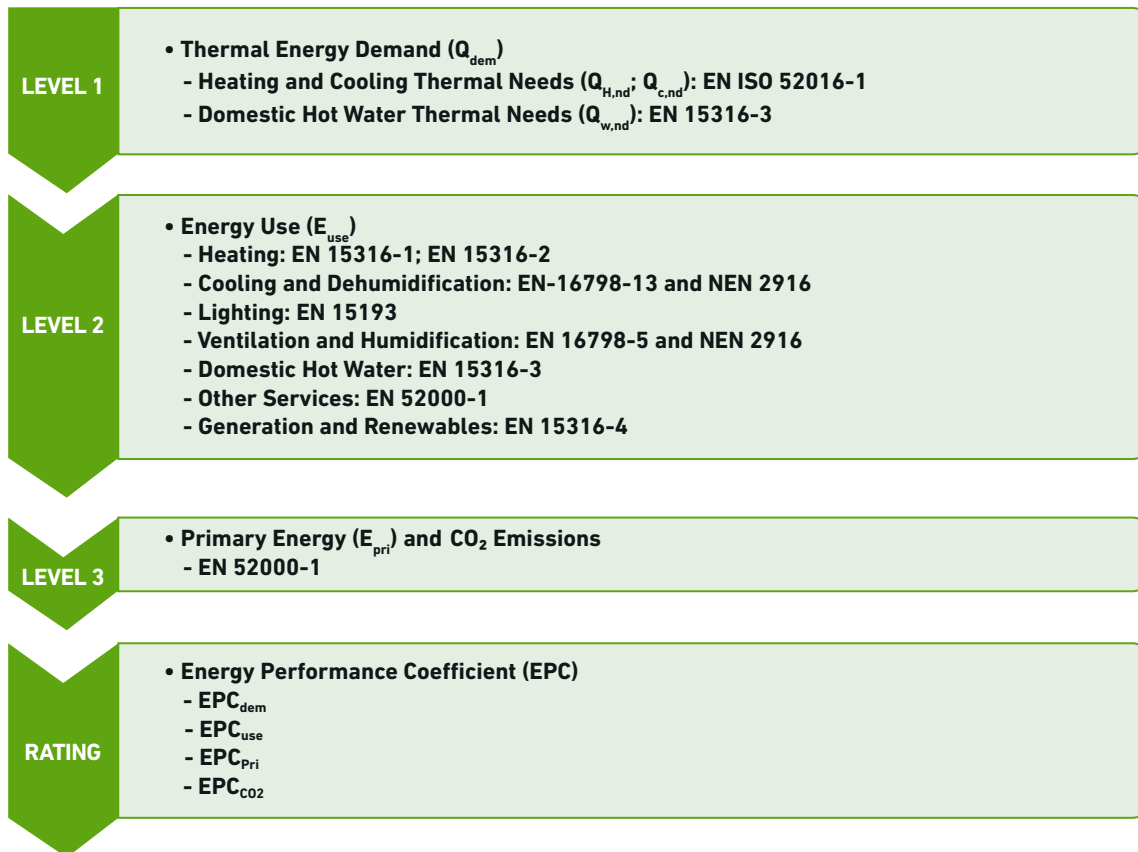
**LEVEL 1**
- **Thermal Energy Demand ($Q_{dem}$)**
  - **Heating and Cooling Thermal Needs ($Q_{H,nd}$; $Q_{c,nd}$): EN ISO 52016-1**
  - **Domestic Hot Water Thermal Needs ($Q_{w,nd}$): EN 15316-3**

**LEVEL 2**
- **Energy Use ($E_{use}$)**
  - **Heating: EN 15316-1; EN 15316-2**
  - **Cooling and Dehumidification: EN-16798-13 and NEN 2916**
  - **Lighting: EN 15193**
  - **Ventilation and Humidification: EN 16798-5 and NEN 2916**
  - **Domestic Hot Water: EN 15316-3**
  - **Other Services: EN 52000-1**
  - **Generation and Renewables: EN 15316-4**

**LEVEL 3**
- **Primary Energy ($E_{pri}$) and $CO_2$ Emissions**
  - **EN 52000-1**

**RATING**
- **Energy Performance Coefficient (EPC)**
  - **$EPC_{dem}$**
  - **$EPC_{use}$**
  - **$EPC_{Pri}$**
  - **$EPC_{CO2}$**

*Figure 4: Schematic View of 3 Levels for Energy Performance Calculation*

A systematic building energy performance assessment is used to establish holistic analyses of the predicted building energy consumption for new buildings. The assessment methodology is composed of performance-based normative calculations that follow the framework of current international calculation standards. The calculation procedure is explained further in GSAS Building Energy Application document and is based on a variety of building energy standards, including those issued by the European Committee for Standardization (CEN), International Organisation for Standardization (ISO), and Nederlands Normalisatie Institute (NEN). The energy calculation approach in GSAS Building Energy Application document explains the specific aspects of the calculation. The calculation results are used to assess the integrated energy performance of buildings.

An evaluation of the building's thermal energy demand commences the energy calculations for criteria [E.1] through [E.4]. Thermal energy demand is calculated by utilizing normative references of internal heat gain, occupancy, and fresh air ventilation. From this evaluated thermal energy demand, the total energy use is determined as the sum of all energy-consuming building systems, including ventilating, lighting, pumps, cooling, (de) humidifying, and domestic

hot water preparation, with consideration given to operational controls and system efficiencies. By utilizing the characteristics of the overall energy supply network, losses, and generation, the energy consumption of the building is then translated into the depletion of primary energy and the amount of $CO_2$ emitted during generation processes. The outcomes of the energy calculations are defined on four levels: (1) thermal energy demand, (2) energy use, (3) primary energy, (4) $CO_2$ emissions.

The energy performance estimation enables performance comparisons between buildings, at each outcome level, based on a national energy consumption reference or the EPC. The calculated outcomes for each of the 4 levels, [E.1] Thermal Energy Demand, [E.2] Energy Use, [E.3] Primary Energy, and [E.4] $CO_2$ Emissions, are used to derive the EPCs, which are then divided by the national energy benchmarks to help in establishing the comparative performances of the building typologies. Each of the 4 EPCs or a combination of EPCs can be used as an index for the integral judgment of the energy performance of a given building.

**Important Note**

1. Currently, this performance-based normative calculation method and energy performance rating approach is not used in other sustainable building rating systems. In most cases, a detailed energy simulation is used as the energy assessment on which a score is based. The normative calculation procedure introduced in GSAS has distinctive advantages: easiness, transparency, robustness, and reproducibility. The normative calculation method based on the CEN-ISO standards is increasingly applied in EU countries for building energy regulation purposes.

2. The normative energy performance calculations treated in this manual serve the sole purpose to calculate the energy performance of a building. Nothing included in this methodology and manual relates to the proper design, system choices, component sizing, safety, and other building and system design considerations. For such considerations, other sources need to be inspected, dependent upon local regulations, client specifications, and contractual agreements. All applying ASHRAE, ANSI, CEN, etc. standards are in no way subsumed or affected by our approach, which only targets the calculation of energy outcomes for the purpose of rating.

## 3.1 [E.1] THERMAL ENERGY DEMAND PERFORMANCE

### 3.1.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 3.1.2 PURPOSE

To minimize the building energy demand through the establishment of GSAS thermal energy demand performance.

### 3.1.3 ASSESSMENT PRINCIPLES

- The Project will **assess** GSAS energy performance coefficient of the thermal energy demand ($EPC_{dem}$) in relation to applicable GSAS benchmark.
- The Project will complete **GSAS Energia Suite™** for E.1 Thermal Energy Demand Performance to establish the **criterion level**.

### 3.1.4 ASSESSMENT

The criterion requires **assessing** the annual thermal energy demand of the building by calculating the EPC value using **GSAS Energia Suite™**. The assessment considers the thermal energy demand associated with the external and internal heat gains of the building.

The external heat gains are generally impacted by the passive design practice, which incorporates the building site, orientation, form, envelope characteristics & properties, and shadings.

The internal heat gains are generally impacted by the transmission gains from ventilation, people, lights, and appliances.

**GSAS Energia Suite™** determines for each building type, the energy performance coefficient ($EPC_{dem}$) based on the external and internal heat gains.

$$EPC_{dem} = \frac{Q_{dem\_norm}}{Q_{dem\_ref}}$$

Where:

$EPC_{dem}$     is the thermal energy demand performance coefficient.

$Q_{dem\_norm}$     is the normalized thermal energy demand in $kWh/m^2/yr$.

$Q_{dem\_ref}$     is GSAS benchmark for the thermal energy demand. It is the reference energy of the notional building for a specific building type in $kWh/m^2/yr$.

The **criterion level** is established based on the result of the $EPC_{dem}$:

### 3.1.5 CRITERION LEVELS

| Levels | Thermal Energy Demand Performance (EPC$_{dem}$) Indicator |
|:---:|:---:|
| -1 | EPC$_{dem}$ > 1.0 |
| 0 | 0.8 < EPC$_{dem}$ ≤ 1.0 |
| 1 | 0.7 < EPC$_{dem}$ ≤ 0.8 |
| 2 | 0.6 < EPC$_{dem}$ ≤ 0.7 |
| 3 | EPC$_{dem}$ ≤ 0.6 |

### 3.1.6 SUBMITTALS

| Provisional Certification Stage (LOC) | |
|:---:|:---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Relevant HVAC design drawings, specifications, cooling load and other supplementary calculations. |
| | Relevant architectural design drawings and specifications of the window and wall glazing. |
| **Tool** | *GSAS Energia Suite™.* |

| Final Certification Stage (CDA) | |
|:---:|:---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | Relevant construction drawings showing the areas of the evaluated spaces. |
| | Relevant shop drawings and material data sheets of the installed window and wall glazing and air terminal devices. |
| **Report** | Commissioning or TAB Report of the HVAC system. |
| **Tool** | Updated *GSAS Energia Suite™.* |

### 3.1.7 EVALUATION

#### 3.1.7.1 General

- Determine the project information, and zone type for the energy criteria assessments.

- Determine the building envelope design information.

- Determine the indoor lighting design information.

- Determine the fresh air requirements of the building.

- Determine the design information of the physical characteristics of the envelope.

- Determine the shading reduction factors, if applicable.

- Input the data into *GSAS Energia Suite™* to determine the EPC value for E.1 Thermal Energy Demand Performance.

- Prepare all applicable documentation.

#### 3.1.7.2 Calculator

**A. Inputs**

General Information Inputs

- Input the project details.

- Select from the pulldown menu if there is unoccupied internal temperature setback.

- Tick the applicable category/zone type for the EPC calculations.

- Select envelope tab to input values required to calculate the thermal energy demand of the building envelope.

- Select the lighting tab to input values required to calculate the lighting system thermal energy demand.

Envelope Information Inputs

- Input the internal total gross floor area of the airconditioned spaces.

- Input the building volume of the airconditioned spaces.

- Input the building height.

- Input the exposed opaque wall area for each orientation of the building façade.

- Input the opaque wall U-value for each wall orientation.

- Input the exposed door wall area for each orientation of the building façade.

- Input the door U-value for each wall orientation.

- Input the window area for each orientation of the building façade.

- Input the window U-value for each wall orientation.

- Input the solar reduction factors of the windows.

- Input the solar transmittance values of the windows for each wall orientation.

- Input the frame fraction of the windows for each wall orientation.

Lighting Information Inputs

- Input the installed peak power intensity of the lighting system in watts per square meter.

- Input the decorative lighting power in watts per square meter.

- Select from the pulldown menu the maintained illuminance of the lighting fixtures.

- Input the lighting occupancy dependency factor.

- Input the façade opening area for the natural lighting.

Ventilation System Inputs

- Input the fresh air ventilation requirements of the design.

- Input the minimum fresh air ventilation rates.

## B. Calculations

- *GSAS Energia Suite™* automatically calculates the EPC value of thermal energy demand and generates the corresponding E.1 Thermal Energy Demand Performance criterion level.

## 3.2    [E.2] ENERGY USE PERFORMANCE

### 3.2.1    APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 3.2.2   PURPOSE

To minimize the building energy use through the establishment of GSAS energy use performance.

### 3.2.3   ASSESSMENT PRINCIPLES

- The Project will **assess** GSAS energy performance coefficient of the energy use (EPCuse) in relation to applicable GSAS benchmark.

- The Project will complete **GSAS Energia Suite™** for E.2 Energy Use Performance to establish the **criterion level**.

### 3.2.4   ASSESSMENT

The criterion requires **assessing** the annual energy use of the building by calculating the EPC value using *GSAS Energia Suite™*.  Based on occupancy, operations profile and building type, the assessment considers the energy use associated with the design of the following building systems:

- Cooling systems based on seasonal energy efficiency ratio (SEER) or coefficient of performance (COP).

- Lighting system and controls.

- Auxiliary systems comprising of ventilation system, air supply system, and HVAC pump system.

- Domestic hot water system

- Energy generation systems, such as photovoltaic (PV), solar hot water, wind turbine, absorption chiller, and combined heat and power (CHP).

**GSAS Energia Suite™** determines for each building type, the energy performance coefficient (EPC$_{use}$) based on the aspects of the building systems design.

$$EPC_{use} = \frac{E_{use\_norm}}{E_{use\_ref}}$$

Where:

EPC$_{use}$ is the energy use performance coefficient.

E$_{use\_norm}$ is the normalized energy use in kWh/m$^2$/yr.

E$_{use\_ref}$ is GSAS benchmark for the energy use. It is the reference energy of the notional building for a specific building type in kWh/m$^2$/yr.

The **criterion level** is established based on the result of the EPC$_{use}$.

### 3.2.5  CRITERION LEVELS

| Levels | Energy Use Performance (EPC$_{use}$) Indicator |
|--------|------------------------------------------------|
| -1 | EPC$_{use}$ > 1.0 |
| 0 | 0.8 < EPC$_{use}$ ≤ 1.0 |
| 1 | 0.7 < EPC$_{use}$ ≤ 0.8 |
| 2 | 0.6 < EPC$_{use}$ ≤ 0.7 |
| 3 | EPC$_{use}$ ≤ 0.6 |

### 3.2.6  SUBMITTALS

| Provisional Certification Stage (LOC) | |
|---|---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Relevant HVAC design drawings, specifications, cooling load and other supplementary calculations. |
| | Relevant architectural design drawings and specifications of the window and wall glazing. |
| **Tool** | *GSAS Energia Suite™*. |

| Final Certification Stage (CDA) | |
|---|---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | Relevant construction drawings showing the areas of the evaluated spaces. |
| | Relevant shop drawings and material data sheets of the installed window and wall glazing and air terminal devices. |
| **Report** | Commissioning or TAB Report of the HVAC system. |
| **Tool** | Updated *GSAS Energia Suite™*. |

### 3.2.7 EVALUATION

#### 3.2.7.1 General

- Determine the cooling system information.

- Determine the ventilation and pump system information.

- Determine the renewable energy system design information.

- Determine the system of controls for the HVAC system, indoor lighting system, renewable energy system, and the hot water generation system.

- Determine the design information of the hot water generation system.

- Determine the specification of the renewable energy system.

- Input the data into *GSAS Energia Suite*™ to determine the EPC value for E.2 Energy Use Performance.

- Prepare all applicable documentation.

#### 3.2.7.2 Calculator

**A. Inputs**

- In addition to the inputs in E.1 the following are the inputs required for the E.2 criterion.

Cooling Information Inputs

- Select the type of cooling system applicable to the project SEER or COP

- Input the seasonal energy efficiency ratio (SEER) value of the chilled water systems, OR

- Input the coefficient of performance (COP) of the other cooling system at 46 deg. C ambient conditions.

Lighting Information Input

- Select from the pulldown menu the control for the artificial lighting system.

Ventilation System Inputs

- Select from the pulldown menu the ventilation system.

- Select from the pulldown menu if the ventilation system utilizes 100% fresh air ventilation.

- Select from the pulldown menu the building air leakage.

- Input the controlled demand ventilation fraction.

- Input the ventilation fan operation fraction.

- Input the heat recovery efficiency.

- Input the ventilation specific fan power.

Air Supply System Inputs

- Select from the pulldown menu the HVAC type.

- Input the supply air flow rate.

- Input the supply air specific fan power.

- Input the supply air fan operation time fraction.

Pump System Input

- Select from the pulldown menu the pump control for cooling.

### B. Calculations

- *GSAS Energia Suite*™ automatically calculates the EPC value of the energy use and generate the corresponding E.2 Energy Use Performance criterion level.

## 3.3 [E.3] PRIMARY ENERGY PERFORMANCE

### 3.3.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 3.3.2 PURPOSE

To reduce the dependence on fossil-based primary energy supply and delivery network through the establishment of GSAS primary energy performance.

### 3.3.3 ASSESSMENT PRINCIPLES

- The Project will **assess** GSAS energy performance coefficient of the primary energy ($EPC_{pri}$) in relation to applicable GSAS benchmark.
- The Project will complete **GSAS Energia Suite™** for E.3 Primary Energy Performance to establish the **criterion level**.

### 3.3.4 ASSESSMENT

The criterion requires **assessing** the annual primary energy of the building by calculating the EPC value using *GSAS Energia Suite™*. The assessment considers the net delivered energy and the primary energy factor (PEF) determined at the national level. Net delivered energy is linked to the various types of energy supply including electricity, gas, thermal, and renewable energy using different types of energy delivery networks.

**GSAS Energia Suite™** determines the energy performance coefficient ($EPC_{pri}$) based on the energy supply and delivery network.

$$EPC_{pri} = \frac{E_{pri\_norm}}{E_{pri\_ref}}$$

Where:

$EPC_{pri}$ is the primary energy performance coefficient.

$E_{pri\_norm}$ is the normalized primary energy supplied to the building, in kWh/m²/yr.

$E_{pri\_ref}$ is GSAS benchmark for the primary energy supply and delivery network for a specific country, in kWh/m²/yr.

The **criterion level** is established based on the result of the EPCpri.

### 3.3.5  CRITERION LEVELS

| Levels | Primary Energy Performance (EPC$_{pri}$) Indicator |
|--------|---------------------------------------------------|
| -1 | $EPC_{pri} > 1.0$ |
| 0 | $0.8 < EPC_{pri} \leq 1.0$ |
| 1 | $0.7 < EPC_{pri} \leq 0.8$ |
| 2 | $0.6 < EPC_{pri} \leq 0.7$ |
| 3 | $EPC_{pri} \leq 0.6$ |

### 3.3.6  SUBMITTALS

| Provisional Certification Stage (LOC) | |
|--------|---------|
| **Types** | **Descriptions** |
| Documents | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Relevant HVAC design drawings, specifications, cooling load and other supplementary calculations. |
| | Relevant architectural design drawings and specifications of the window and wall glazing. |
| Tool | *GSAS Energia Suite™.* |

| Final Certification Stage (CDA) | |
|--------|---------|
| **Types** | **Descriptions** |
| Documents | A narrative explaining any updates or changes in the criterion assessment. |
| | Relevant construction drawings showing the areas of the evaluated spaces. |
| | Relevant shop drawings and material data sheets of the installed window and wall glazing and air terminal devices. |
| Report | Commissioning or TAB Report of the HVAC system. |
| Tool | Updated *GSAS Energia Suite™.* |

### 3.3.7    EVALUATION

#### 3.3.7.1  General

- Determine the primary energy sources of the delivered energy to the site.

- Input the data into *GSAS Energia Suite*™ to determine the EPC value for E.3 Primary Energy Performance.

- Prepare all applicable documentation.

#### 3.3.7.2  Calculator

#### A. Inputs

In addition to the inputs in E.1 and E.2 the following are the inputs required for the E.3 criterion.

Primary Energy Inputs

- Select from the pulldown menu the primary energy for domestic hot water production.

- Select from the pulldown menu the primary energy for the combined heat and power equipment.

#### B. Calculations

- *GSAS Energia Suite*™ automatically calculates the EPC value of the primary energy and generate the corresponding E.3 Primary Energy Performance criterion level.

## 3.4    [E.4] CO₂ EMISSIONS

### 3.4.1    APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 3.4.2    PURPOSE

To establish $CO_2$ emissions performance associated with the primary energy supply and delivery network.

### 3.4.3    ASSESSMENT PRINCIPLES

- The Project will **assess** GSAS energy performance coefficient of the $CO_2$ emissions ($EPC_{CO2}$) in relation to applicable GSAS benchmark.
- The Project will complete **GSAS Energia Suite™** for E.4 $CO_2$ Emissions to establish the **criterion level**.

### 3.4.4    ASSESSMENT

The criterion requires **assessing** the annual $CO_2$ emissions of the building by calculating the EPC value using *GSAS Energia Suite*™.  The assessment considers the net delivered energy and the $CO_2$ emission coefficient determined at the national level.  Net delivered energy is linked to the various types of energy supply including electricity, gas, thermal, and renewable energy using different types of energy delivery networks.

**GSAS Energia Suite™** determines the energy performance coefficient ($EPC_{CO2}$) based on the energy supply and delivery network.

$$EPC_{CO2} = \frac{E_{CO2\_norm}}{E_{CO2\_ref}}$$

Where:

$EPC_{CO2}$    is the $CO_2$ emissions performance coefficient.

$E_{CO2\_norm}$    is the normalized $CO_2$ emissions, in kWh/m²/yr.

$E_{CO2\_ref}$    is GSAS benchmark for the $CO_2$ emissions for a specific country, in kWh/m²/yr.

The **criterion level** is established based on the result of the $EPC_{CO2}$.

### 3.4.5 CRITERION LEVELS

| Levels | $CO_2$ Emissions ($EPC_{CO2}$) Indicator |
|--------|------------------------------------------|
| -1 | $EPC_{CO2} > 1.0$ |
| 0 | $0.8 < EPC_{CO2} \leq 1.0$ |
| 1 | $0.7 < EPC_{CO2} \leq 0.8$ |
| 2 | $0.6 < EPC_{CO2} \leq 0.7$ |
| 3 | $EPC_{CO2} \leq 0.6$ |

### 3.4.6 SUBMITTALS

| Provisional Certification Stage (LOC) | |
|---------------------------------------|--|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Relevant HVAC design drawings, specifications, cooling load and other supplementary calculations. |
| | Relevant architectural design drawings and specifications of the window and wall glazing. |
| **Tool** | *GSAS Energia Suite™*. |

| Final Certification Stage (CDA) | |
|---------------------------------|--|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | Relevant construction drawings showing the areas of the evaluated spaces. |
| | Relevant shop drawings and material data sheets of the installed window and wall glazing and air terminal devices. |
| **Report** | Commissioning or TAB Report of the HVAC system. |
| **Tool** | Updated *GSAS Energia Suite™*. |

### 3.4.7 EVALUATION

#### 3.4.7.1 General

- Determine the mix of primary energy supply.

- Input the data into *GSAS Energia Suite*™ to determine the EPC value for E.4 $CO_2$ Emissions.

- Prepare all applicable documentation.

#### 3.4.7.2 Calculator

##### A. Inputs

- In addition to the inputs in E.1, E.2and E.3 the following are the inputs required for the E.4 criterion.

Primary Energy Inputs

- Select from the pulldown menu the primary energy for domestic hot water production.

- Select from the pulldown menu the primary energy for the combined heat and power equipment.

##### B. Calculations

- *GSAS Energia Suite*™ automatically calculates the EPC value of the $CO_2$ emissions and generate the corresponding E.4 $CO_2$ Emissions criterion level.

## 3.5 [E.5] ENERGY SUB-METERING

### 3.5.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 3.5.2 PURPOSE

To install sub-meters for monitoring the major energy consuming systems.

### 3.5.3 ASSESSMENT PRINCIPLES

- The Project will **assess** the installation of energy sub-meters for monitoring the major energy consuming systems.

- The Project will prepare the Energy Sub-Metering **plan** to establish the **criterion level**.

### 3.5.4 ASSESSMENT

The criterion requires **assessing** the energy sub-metering system. The system provides monitoring, controlling, recording, and reporting of the energy-consuming systems and equipment, devices and appliances, and other motorized equipment. The energy-consuming systems that requires sub-meters are, but not necessarily limited to, HVAC system, lighting system, electric power-driven equipment, and other system's mains in the electrical panel boards. The energy sub-metering plan includes the descriptions of the energy sub-metering system designs and specifications.

The energy sub-metering **plan** is a document that fully describes the strategies for monitoring, controlling, recording, analyzing, and reporting the energy-consuming systems and equipment, devices and appliances, and other motorized equipment. The comprehensiveness of the plan to demonstrate compliance with the energy sub-metering installation requirements of the criterion determines the criterion level.

The plan demonstrates the following requirements:

- Strategy for monitoring and recording of the power consumption of the energy-consuming equipment and systems in the development.

- Where applicable, provisions for real time data monitoring and recording of the information suitable for analysis and reporting.

- Instrumentation and control system diagrams that fully describe the specification of the instruments and devices installed for monitoring the energy consuming systems including HVAC system, lighting system, and other motorized equipment.

The **criterion level** is established based on the degree of compliance of all the required submittals to completely support the narratives of the energy sub-metering plan.

### 3.5.5    CRITERION LEVELS

| Level | Requirements |
|:---:|:---:|
| 0 | Plan does not demonstrate compliance with the requirements. |
| 1 | Plan demonstrates partial compliance with the requirements. |
| 3 | Plan demonstrates full compliance with the requirements |

### 3.5.6    SUBMITTALS

| Provisional Certification Stage (LOC) | |
|:---:|:---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Relevant design drawings, diagrams, and specifications. |
| | Where applicable, the BMS schedule of points and control system showing the energy sub-metering system integration with the BMS. |
| **Plan** | Energy Sub-Metering Plan. |

| Final Certification Stage (CDA) | |
|:---:|:---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | Relevant construction drawings, diagrams, and specifications. |
| | Relevant as-built drawings showing the updates to the previous LOC stage submittals. |
| **Plan** | Updated Energy Sub-Metering Plan, when applicable. |

### 3.5.7  EVALUATION

#### 3.5.7.1  General

- Partial compliance for this criterion demonstrates the installation of sub-meters for HVAC, lighting, and fan-motors.

- Full compliance for this criterion demonstrates the installation of sub-meters for all major energy-consuming systems.

- Determine the provision of a system for monitoring, controlling, recording, and reporting of major energy-consuming equipment, fixtures, devices, and appliances.

- Illustrate in the presentation materials or diagrams the strategy adopted for monitoring the energy consumption of the facilities.

- Identify the locations and tapping points of the energy sub-meters.

- Provide the testing and commissioning report of the energy sub-metering system.

- Determine the training program for the proper calibration, use, care, and upkeeping of the energy sub-metering system.

- Prepare all applicable documentation.

## 3.6 [E.6] RENEWABLE ENERGY

### 3.6.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 3.6.2 PURPOSE

To install on-site renewable energy generation systems.

### 3.6.3 ASSESSMENT PRINCIPLES

- The Project will **assess** the installation of on-site renewable energy generating systems with the capacity to contribute to the total annual energy need of the development.

- The Project will prepare the Renewable Energy **plan** to establish the **criterion level**.

### 3.6.4 ASSESSMENT

The criterion requires **assessing** the installation of the on-site renewable energy generating systems for the development. The renewable energy generating systems are the equipment, devices, networks, and controls and instrumentation for collecting, storing, and distributing energy generated from renewable sources. The assessment considers renewable sources such as solar, wind, geothermal, and other sources of renewable energy.

The renewable energy **plan** is a document that fully describes the system and strategies for generating energy from renewable sources.

The plan demonstrates the following requirements:

- Strategy for installing and making the system operational to supply the power needs of the energy-consuming equipment, fixtures, and appliances in the facilities.

- Instrumentation and control system diagrams that fully describe the specification of the instruments and devices installed, tested, and commissioned for renewable energy generation and distribution.

The **criterion level** is established based on the percentage of contribution of the onsite renewable energy to the total annual energy need of the development.

### 3.6.5    CRITERION LEVELS

| Level | Percentage of Renewable Energy (X) Indicator |
|-------|-----------------------------------------------|
| 0     | X < 2%                                        |
| 1     | 2% ≤ X < 3.5%                                 |
| 2     | 3.5% ≤ X ≤ 5%                                 |
| 3     | X > 5%                                        |

### 3.6.6    SUBMITTALS

| Provisional Certification Stage (LOC) | |
|---------|-----------------------------------------------|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Relevant design drawings, diagrams, and specifications. |
| | Where applicable, the BMS schedule of points and control system showing the renewable energy system integration with the BMS. |
| **Plan** | Renewable Energy Plan. |

| Final Certification Stage (CDA) | |
|---------|-----------------------------------------------|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | Relevant construction drawings, diagrams, and specifications. |
| | Relevant as-built drawings showing the updates to the previous LOC stage submittals. |
| **Plan** | Updated Renewable Energy Plan, when applicable. |

### 3.6.7    EVALUATION

#### 3.6.7.1  General

- Determine the provision of a renewable energy system for generating and distributing power generated from renewable sources.

- Illustrate in the presentation materials or diagrams the feasibility study conducted for developing and delivering renewable energy system for the development.

- Identify from the drawings the locations of the equipment and distribution networks.

- Determine the testing and commissioning report of the renewable energy system.

- Determine the training program for the proper calibration, use, care, and upkeeping of the renewable energy system.

- Prepare all applicable documentation.

## 4.0   WATER

The Water category is concerned with water conservation for indoor and outdoor use. The natural water cycle is a system in which water resources are continuously exchanged between the atmosphere, soil water, surface water, ground water, and plants. This cycle treats and recharges freshwater supplies. Human consumption of fresh water outpaces the natural cycle and under these circumstances, water cannot be considered as a renewable resource.

Sustainable practices for the efficient use of water, the collection, recycling and reuse of water to mitigate environmental impacts associated with water scarcity and depletion.

### CRITERIA IN THIS CATEGORY:

W.1     Water Demand Performance

W.2     Water Reuse Performance

W.3     Water Sub-Metering

## CRITERIA SUMMARY

The table below summarizes the weights of the Water category and each of the associated criteria:

| Legend | | | | |
|---|---|---|---|---|
| √ | Incentive Only | | **N/A** | Not Applicable |

| No | Category / Criteria | LEVELS | | WEIGHTS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MIN | MAX | Commercial | Education | Homes | Hospitality | Light Industry | Mosques | Offices | Residential |
| **W** | **WATER** | | | | | | | | | | |
| W.1 | Water Demand Performance | −1 | 3 | 6.00% | 6.00% | 12.00% | 6.00% | 6.00% | 6.00% | 6.00% | 6.00% |
| W.2 | Water Reuse Performance | −1 | 3 | 10.00% | 10.00% | 6.00% | 10.00% | 10.00% | 10.00% | 10.00% | 10.00% |
| W.3 | Water Sub-Metering | 0 | 3 | √ | √ | √ | √ | √ | √ | √ | √ |
| | | | **Total** | **16.00%** | **16.00%** | **18.00%** | **16.00%** | **16.00%** | **16.00%** | **16.00%** | **16.00%** |

## 4.1 [W.1] WATER DEMAND PERFORMANCE

### 4.1.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 4.1.2 PURPOSE

To reduce the indoor and outdoor water demand of the development.

### 4.1.3 ASSESSMENT PRINCIPLES

- The Project will **assess** GSAS water performance coefficient of the indoor and outdoor water demand (WPC$_{dem}$) in relation to applicable GSAS benchmark.
- The Project will complete **GSAS Water Suite™** for W.1 Water Demand Performance to establish the **criterion level**.

### 4.1.4 ASSESSMENT

The criterion requires **assessing** the annual water demand of the development by calculating the WPC value using *GSAS Water Suite™*. Based on occupancy, operations profile and building type the assessment considers the water demand associated with the indoor and outdoor water consumption.

The indoor water consumption is linked to the specifications and schedules of plumbing fixtures and water-consuming appliances.

The outdoor water consumption is linked to the softscape schedules, the crop coefficients, the irrigation system, and the cooling tower makeup water.

The process water consumption includes the indoor and outdoor pools and water features, and health and wellness facilities assessed by evaluating the features of the water-consuming equipment.

**GSAS Water Suite™** determines the Water Performance Coefficient of the indoor and outdoor water demand (WPC$_{dem}$).

$$WPC_{dem} = \frac{W_{dem\_occ} + W_{dem\_out}}{W_{ref\_occ} + W_{ref\_occ}}$$

Where:

$WPC_{dem}$ is the water demand performance coefficient.

$W_{dem\_occ}$ is the normalized water demand of the occupants for indoor use, in $m^3/yr$.

$W_{dem\_out}$ is the normalized water demand of the outdoor use, in $m^3/yr$.

$W_{ref\_occ}$ is GSAS benchmark for the water demand of the occupants for indoor use for a specific building type, in $m^3/yr$.

$W_{ref\_out}$ is GSAS benchmark for the water demand of the outdoor use, in $m^3/yr$.

The **criterion level** is established based on the result of the WPCdem.

### 4.1.5   CRITERION LEVELS

| Level | Water Demand Performance ($WPC_{dem}$) Indicator |
|:---:|:---:|
| -1 | $WPC_{dem} > 1.00$ |
| 0 | $0.90 < WPC_{dem} \leq 1.00$ |
| 1 | $0.85 < WPC_{dem} \leq 0.90$ |
| 2 | $0.80 < WPC_{dem} \leq 0.85$ |
| 3 | $WPC_{dem} \leq 0.80$ |

### 4.1.6   SUBMITTALS

| Provisional Certification Stage (LOC) | |
|:---:|:---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Report stating number of occupants, operating hours, floor or site area and other supporting information. |
| | Specifications for plumbing fixtures. |
| | Landscaping and irrigation plan. |
| **Tool** | *GSAS Water Suite™.* |

| Final Certification Stage (CDA) | |
|:---:|:---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | Relevant construction drawings. |
| | Relevant shop drawings and material data sheets. |
| **Report** | Testing Reports for the plumbing and irrigation systems. |
| **Tool** | Updated *GSAS Water Suite™.* |

## 4.1.7 EVALUATION

### 4.1.7.1 General

- Determine the project information, category, and zone type for the water criteria assessments.

- Determine the site area, the built-up area, and the landscape area.

- Determine the design occupancy load of the development.

- Illustrate in the design drawings and schedule the quantities of the plumbing fixtures and its documented flowrates.

- Determine if there is demand for process water which can include water features, swimming pool or other specific applications.

- Determine the landscape design that requires water for irrigation.

- Determine from HVAC drawings and specification the make-up water requirements of the cooling towers.

- Input the data into *GSAS Water Suite*™ to determine the WPC value for W.1 Water Demand Performance.

- Prepare all applicable documentation.

### 4.1.7.2 Calculator

#### A. Inputs

General Information Inputs

- Input the project details.

- Input the site area

- Input the built-up area.

- Input the Landscape area.

- Input the number of daily regular occupants of the facility.

- Input the number of average daily visitors of the facility.

- Input the gender ratio of the occupants.

- Tick the applicable category/zone type for the WPC calculations.

- Select indoor-use tab to input values required to calculate the water demand for indoor use.

- Select the irrigation tab to input values required to calculate the water demand for outdoor irrigation water.

- Select the cooling tower tab to input values required to calculate the makeup water demand of the cooling tower.

Indoor-Use Inputs

- Part 1a: Fixtures
    - Input the documented flowrates and quantities of the flush fixtures.
    - Input the documented flowrates and quantities of the flow fixtures.

- Part 1b: Prescriptive Method for Process Water
    - Select from the pulldown menu if non-standardized water is use for the water features.
    - Select from the pulldown menu if there are indoor water features.
    - Select from the pulldown menu if there are swimming pools.
    - Select from the pulldown menu if there is a jacuzzi.
    - Select from the pulldown menu if there is a sauna.
    - Select from the pulldown menu if there are medical hot tubs.
    - Select from the pulldown menu if there are other facilities or fixtures that require non-standardized water.

Outdoor-Use Inputs

- Part 1: Landscape Section
    - Input the species name of the landscape section in the corresponding species type.
    - Input the area of the landscape section in the corresponding species type.
    - Input the nativity of the species in the landscape section.
    - Input the species factor of the species in the landscape section.
    - Input the density factor of the species in the landscape section.
    - Input the microclimate factor of the species in the landscape section.
    - Input type of irrigation system if using sprinkler or drip type.

Cooling Tower Inputs

- Part 1: Cooling Tower
  - Input the annual volume of make-up water required by the cooling towers of the HVAC system.

### B. Calculations

- *GSAS Water Suite™* automatically calculates the WPC value of water demand and generate the corresponding W.1 Water Demand Performance criterion level.

## 4.2 [W.2] WATER REUSE PERFORMANCE

### 4.2.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 4.2.2 PURPOSE

To maximize water recycling and reuse in the development.

### 4.2.3 ASSESSMENT PRINCIPLES

- The Project will **assess** GSAS water performance coefficient of the water supply from recycling and reuse strategies ($WPC_{re}$) in relation to the applicable GSAS benchmark.

- The Project will complete **GSAS Water Suite™** for W.2 Water Reuse Performance to establish the **criterion level**.

### 4.2.4 ASSESSMENT

The criterion requires assessing the design and installation of water reuse and recycling systems. Such systems include the equipment, piping, storage tanks, and filtration system that collectively performs to collect, treat, store, and distribute treated water for reuse and recycling. The assessment considers treated water from rainwater, greywater, cooling tower water, HVAC condensate drain water and community based Treated Sewage Effluent (TSE) supply.

**GSAS Water Suite™** determines the Water Performance Coefficient of the water supply from recycling and reuse strategies ($WPC_{re}$).

$$WPC_{reuse} = \frac{(W_{dem\_occ} + W_{dem\_out}) - W_{reuse}}{W_{ref\_occ} + W_{ref\_out}}$$

Where:

$WPC_{reuse}$      is the water reuse performance coefficient.

$W_{dem\_occ}$      is the normalized water demand of the occupants for indoor use, in m³/yr.

$W_{dem\_out}$      is the normalized water demand of the outdoor use, in m³/yr.

$W_{reuse}$      is the total amount of water reclaimed from various sources including rainwater, condensate water, greywater and TSE, in m³/yr.

$W_{ref\_occ}$      is GSAS benchmark for the water demand of the occupants for indoor use for a specific building type, in m³/yr.

$W_{ref\_out}$      is GSAS benchmark for the water demand of the outdoor use, in m³/yr.

The **criterion level** is established based on the result of the $WPC_{reuse}$.

### 4.2.5    CRITERION LEVELS

| Level | Water Reuse Performance (WPC$_{reuse}$) Indicator |
|:---:|:---:|
| -1 | WPC$_{reuse}$ > 1.00 |
| 0 | 0.85 < WPC$_{reuse}$ ≤ 1.00 |
| 1 | 0.75 < WPC$_{reuse}$ ≤ 0.85 |
| 2 | 0.65 < WPC$_{reuse}$ ≤ 0.75 |
| 3 | WPC$_{reuse}$ ≤ 0.65 |

### 4.2.6    SUBMITTALS

| Provisional Certification Stage (LOC) | |
|:---:|:---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Information for the water reclamation and treatment systems, including plans, drawings, specifications and controls. |
| **Tool** | *GSAS Water Suite™.* |

| Final Certification Stage (CDA) | |
|:---:|:---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | Relevant construction drawings. |
| | Relevant shop drawings and material data sheets. |
| **Report** | Commissioning report of the water reclamation and treatment systems. |
| **Tool** | Updated *GSAS Water Suite™.* |

### 4.2.7    EVALUATION

#### 4.2.7.1  General

- Determine the reclaimed water that is recycled and reuse for toilet flushing.

- Determine the reclaimed water that is recycled and reuse for irrigation water system.

- Determine the availability of the community treated sewage effluent (TSE).

- Illustrate in the design drawings the point-of-use of the recycled water and TSE water.

- Input the data into *GSAS Water Suite*™ to determine the WPC value for W.2 Water Reuse Performance.

- Prepare all applicable documentation.

#### 4.2.7.2  Calculator

#### A. Inputs

Inputs for the Reclamation for Non-Potable Water Stored

- Select from the pulldown menu if reclaimed water is to be reuse for toilet flushing.

- Input the capacity or volume of reclaimed water to be reuse for toilet flushing.

Inputs for the Reclaimed Water for Irrigation

- Select from the pulldown menu if there are rainwater sensors available for irrigation network.

- Select from the pulldown menu if collected rainwater is to be use for irrigation.

- Input the details of the collection areas when collected rainwater is reuse for irrigation. Exclude the exposed surfaces as well as interlock and asphalt paving that have no proper surface water collections and piping network.

- Select from the pulldown menu if condensate water from HVAC system is to be use for irrigation.

- Input the estimated volume of condensate water to be collected in the entire year when the condensate water is harvested to be use for irrigation.

- Select from the pulldown menu if treated greywater is to be use for irrigation.

- Input the estimated annual volume of greywater to be treated and recycled for irrigation water use.

- Select from the pulldown menu if the community TSE water generated from public utility plant and distributed through public utility network is to be use for irrigation.

- Input the estimated annual volume of TSE water required to be use for irrigation.

- Select from the pulldown menu if TSE water is use for cooling tower makeup water.

- Input the estimated annual volume of TSE water use for cooling tower makeup water.

## B. Calculations

- *GSAS Water Suite*™ automatically calculates the WPC value of water reuse and generate the corresponding W.2 Water Reuse Performance criterion level.

## 4.3 [W.3] WATER SUB-METERING

### 4.3.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 4.3.2 PURPOSE

To install sub-meters for monitoring the major water consuming systems.

### 4.3.3 ASSESSMENT PRINCIPLES

- The Project will **assess** the installation of water sub-meters for monitoring the major water consuming systems.

- The Project will prepare the Water Sub-Metering **plan** to establish the **criterion level**.

### 4.3.4 ASSESSMENT

The criterion requires **assessing** the water sub-metering system. The system provides monitoring and recording of the development mains' domestic and irrigation water consumptions. The water-consuming systems that requires sub-meters are the indoor and outdoor plumbing and irrigation systems. The water sub-metering plan includes the descriptions of the water sub-metering system designs and specifications.

The water sub-metering **plan** is a document that fully describes the strategies for monitoring and recording of the development mains' domestic and irrigation water consumptions. The comprehensiveness of the plan to demonstrate compliance with the water sub-metering installation requirements of the criterion determines the criterion level.

The plan demonstrates the following requirements:

- Strategy for monitoring and recording of the water consumption of equipment, fixtures, and appliances in the development.

- Where applicable, provisions for real time data monitoring and recording of the information suitable for analysis and reporting.

- Instrumentation and control system diagram that fully describes the specification of the instruments and devices installed for monitoring the water consuming systems, such as plumbing and irrigation water systems.

The **criterion level** is established based on the degree of compliance of all the required submittals to completely support the narratives of the water sub-metering plan.

### 4.3.5    CRITERION LEVELS

| Level | Requirements |
|-------|--------------|
| 0 | Plan does not demonstrate compliance with the requirements. |
| 1 | Plan demonstrates partial compliance with the requirements, including the plans for the main water. |
| 3 | Plan demonstrates full compliance with the requirements |

### 4.3.6    SUBMITTALS

| Provisional Certification Stage (LOC) | |
|-------|--------------|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Relevant design drawings, diagrams, and specifications. |
| | Where applicable, the BMS schedule of points and control system showing the water sub-metering system integration with the BMS. |
| **Plan** | Water Sub-Metering Plan. |

| Final Certification Stage (CDA) | |
|-------|--------------|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | Relevant construction drawings, diagrams, and specifications. |
| | Relevant as-built drawings showing the updates to the previous LOC stage submittals. |
| **Plan** | Updated Water Sub-Metering Plan, when applicable. |

### 4.3.7    EVALUATION

**4.3.7.1  General**

- Partial compliance for this criterion demonstrates the installation of sub-meters for indoor OR outdoor water consuming systems.

- Full compliance for this criterion demonstrates the installation of sub-meters for indoor AND outdoor water consuming systems.

- Determine the provision of a system for monitoring, and recording of major water-consuming equipment, fixtures, and appliances.

- Illustrate in the presentation materials or diagrams the strategy adopted for monitoring the water consumption of the facilities.

- Identify the locations and tapping points of the water sub-meters.

- Provide the testing and commissioning report of the water sub-metering system.

- Determine the training program for the proper calibration, use, care, and upkeeping of the water sub-metering system.

- Prepare all applicable documentation.

## 5.0    MATERIALS

The Materials category is concerned with the conservation of natural resources and the use or reuse of materials and structure to have the least environmental impact. The construction sector has a significant impact on the environment. It accounts for the consumption of approximately 40% of the raw stone, gravel, and sand used worldwide annually, 25% of the raw timber and the associated embodied carbon emissions for such materials.

Eco-friendly construction materials can contribute to reduce the adverse impacts on the environment, and create sustainable buildings promoting the health and well-being of occupants.

**CRITERIA IN THIS CATEGORY:**

M.1    Locally Sourced Materials

M.2    Materials Eco-Labeling

M.3    Recycled Content of Materials

M.4    Materials Reuse

M.5    Existing Structure Reuse

M.6    Design for Disassembly

M.7    Responsible Sourcing of Materials

## CRITERIA SUMMARY

The table below summarizes the weights of the Materials category and each of the associated criteria:

| Legend | | | | |
|---|---|---|---|---|
| **√** | Incentive Only | | **N/A** | Not Applicable |

| No | Category / Criteria | LEVELS | | WEIGHTS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MIN | MAX | Commercial | Education | Homes | Hospitality | Light Industry | Mosques | Offices | Residential |
| **M** | **MATERIALS** | | | | | | | | | | |
| M.1 | Locally Sourced Materials | –1 | 3 | 1.77% | 1.53% | 2.90% | 1.52% | 1.50% | 1.94% | 1.50% | 2.31% |
| M.2 | Materials Eco-Labeling | –1 | 3 | 2.50% | 2.50% | 2.20% | 2.50% | 2.50% | 2.50% | 2.50% | 2.50% |
| M.3 | Recycled Content of Materials | –1 | 3 | 2.19% | 2.20% | 2.90% | 2.18% | 1.95% | 1.74% | 2.20% | 1.91% |
| M.4 | Materials Reuse | –1 | 3 | 1.24% | 1.24% | N/A | 1.25% | 1.25% | 1.27% | 1.25% | 1.24% |
| M.5 | Existing Structure Reuse | –1 | 3 | 0.46% | 0.44% | N/A | 0.45% | 0.65% | 0.45% | 0.45% | N/A |
| M.6 | Design for Disassembly | –1 | 3 | 0.84% | 1.09% | N/A | 1.10% | 1.15% | 1.10% | 1.10% | 1.04% |
| M.7 | Responsible Sourcing of Materials | 0 | 3 | √ | √ | √ | √ | √ | √ | √ | √ |
| | | | **Total** | **9.00%** | **9.00%** | **8.00%** | **9.00%** | **9.00%** | **9.00%** | **9.00%** | **9.00%** |

## 5.1 [M.1] LOCALLY SOURCED MATERIALS

### 5.1.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 5.1.2 PURPOSE

To maximize the use of local material and reduce the impact of long-distance transportation.

### 5.1.3 ASSESSMENT PRINCIPLES

- The Project will **assess** the cost and number of raw materials and manufactured/ assembled products of local origin.

- The Project will complete the **calculator** for M.1 Locally Sourced Materials to establish the **criterion level**.

### 5.1.4 ASSESSMENT

The criterion requires **assessing** the local content cost and availability fraction of the locally sourced materials.  Locally sourced materials are locally manufactured or assembled materials with content or components either coming from local or foreign origins.  Materials vary according to the percentage of their local contents or components or the location of their assembly.

There are two groups of material listings of the locally sourced materials in the assessment, the major construction materials, and the minor construction materials.  The major construction materials are locally sourced materials that have significant contributions to the percentage of total material cost. The cost of local content is calculated based on a percentage of the local content weight to the total material weight multiplied by the material cost. The minor construction materials are materials that have relatively small contributions to the development in terms of weight, volume or cost and therefore are grouped under this category to promote capacity building of various industries in the construction sector.

The **calculator** determines the indicator based on the sum of the percentages of the local content cost in major construction materials and the availability fraction for minor construction materials.

The **criterion level** is established based on the result of the indicator for M.1 Locally Sourced Materials.

## 5.1.5   CRITERION LEVELS

| Levels | Locally Sourced Materials (X) Indicator |
|:------:|:---------------------------------------:|
| -1 | X < 30% |
| 0 | 30% ≤ X < 40% |
| 1 | 40% ≤ X < 50% |
| 2 | 50% ≤ X < 60% |
| 3 | X ≥ 60% |

## 5.1.6   SUBMITTALS

| Provisional Certification Stage (LOC) | |
|:---:|:---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Evidence of total materials cost such as bill of quantities. |
| | Evidence of locally sourced materials cost such as cost estimates or bill of quantities. |
| | Relevant specifications indicating the origin of the locally sourced materials and percentage of local content. |
| **Calculator** | M.1 Locally Sourced Materials Calculator. |

| Final Certification Stage (CDA) | |
|---|---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | Evidence of the locally sourced materials cost and the total materials cost for the project, such as excerpts of up to date monthly certification approved by the Client (BOQ format). |
| | Evidence of the use of the locally sourced materials on site, such as Material Approval Requests. |
| | If applicable, updated specifications indicating the origin of the locally sourced materials and the percentage of local content. |
| **Calculator** | Updated M.1 Locally Sourced Materials Calculator. |

### 5.1.7  EVALUATION

#### 5.1.7.1  General

- Determine the specifications and bill of quantities of the construction materials and products.

- Determine the specified locally sourced construction materials and products.

- Determine from the material data sheets the percentage of the local content of the specified locally sourced construction materials and products.

- Determine from the bill of quantities the itemized cost of each material and the total cost of the construction materials.

- Prepare the descriptions of the construction materials following the latest Construction Specification Institute (CSI) MasterFormat and use a uniform currency for costings and pricings.

- Input the data into the calculator for M.1 Locally Sourced Materials to determine the percentages of the local content cost in major construction materials and the availability fraction for minor construction materials.

- Prepare all applicable documentation.

#### 5.1.7.2  Calculator

##### A. Inputs

Part 1 – Major Construction Materials Inputs

- Input the descriptions of the locally manufactured or assembled major construction materials.

- Input the costs of the materials.

- Select from the pulldown menu the percentage of local content or "Locally Assembled" in case the local content is 0% but the material is assembled in the country.

Part 2 – Minor Construction Materials Inputs

- Input the descriptions of the locally manufactured or assembled minor construction materials.

- Select from the pulldown menu the percentage of local content or "Locally Assembled" in case the local content is 0% but the material is assembled in the country.

## B. Calculations

Part 1 – Major Construction Materials Calculations

- Cost of local content = calculated value based on the cost of material and the local content factor.

- Total cost of the local content = sum of the local content costs of the major construction materials.

- Total cost of materials for the project = sum of the sub-total costs and lump sum cost of the construction materials, obtained from the Materials input sheet.

- Percentage of the local content cost = calculated value based on the total cost of the local content over the total cost of the construction materials.

Part 2 – Minor Construction Materials Calculations

- Factor = assigned value based on the selected percentage of local content of the major construction material.

- Total availability fraction = sum of the availability fraction of all minor construction materials.

Summary Calculations

- Achieved values = results of Part 1 and Part 2 calculations.

- Maximum targets = fixed values assigned for the calculations of the percentages of the local content cost in major construction materials and availability fraction for minor construction materials.

- Weights = fixed values assigned to give relative importance for the calculations of local content cost and availability fraction.

- Weighted percentage of the local content cost = calculated value based on the achieved value, maximum target, and the assigned weight for major construction materials.

- Weighted percentage of the availability fraction = calculated value based on the achieved value, maximum target, and the assigned weight for minor construction materials.

- (X) = sum of the weighted percentages of the local content cost in major construction materials and the availability fraction of minor construction materials.

- M.1 criterion level = the generated criterion level for M.1 Locally Sourced Materials based on the specified range from the criterion levels.

## 5.2 [M.2] MATERIALS ECO-LABELING

### 5.2.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 5.2.2 PURPOSE

To use certified products and materials with enhanced environmental, health and resources conservation attributes.

### 5.2.3 ASSESSMENT PRINCIPLES

- The Project will **assess** the cost and number of products and materials with GSAS approved certification for eco-labeling.

- The Project will complete the **calculator** for M.2 Materials Eco-Labeling to establish the **criterion level**.

### 5.2.4 ASSESSMENT

The criterion requires **assessing** the major construction materials and minor construction materials with eco-labels. Eco-labeled materials are materials labeled with GSAS approved certification. Certificates identify eco-labeled materials as follows:

- Material with Environmental Product Declaration (EPD)

- Multi-attribute material

- Single-attribute material

There are two groups of material listings of the eco-labeled materials in the assessment, the major construction materials and the minor construction materials. The major construction materials are eco-labeled materials that have significant contributions to the percentage of total material cost. The assessment considers the cost of eco-labeled major materials. The minor construction materials are materials that have relatively small contributions to the development in terms of weight, volume or cost and therefore are grouped under this category to promote capacity building of various industries in the construction sector.

The **calculator** determines the indicator based on the percentage of cost of major materials with eco-labeling and the availability fraction of eco-labeled minor construction materials. The calculator adds the incentive weights given for having more than four eco-labeled minor construction materials.

The **criterion level** is established based on the result of the indicator for M.2 Materials Eco-Labeling.

## 5.2.5 CRITERION LEVELS

| Levels | Materials Eco-Labeling (X) Indicator |
|--------|--------------------------------------|
| -1 | X < 15% |
| 0 | 15% ≤ X < 35% |
| 1 | 35% ≤ X < 55% |
| 2 | 55% ≤ X < 75% |
| 3 | X ≥ 75% |
| Incentive | 0.5% per additional eco-labeled minor material up to 2% max |

## 5.2.6 SUBMITTALS

| Provisional Certification Stage (LOC) | |
|---------------------------------------|---|
| **Types** | **Descriptions** |
| Documents | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Evidence of total materials cost such as bill of quantities. |
| | Evidence of eco-labeled materials cost such as cost estimates or bill of quantities. |
| | Certificates of the materials with eco-labeling. |
| Calculator | M.2 Materials Eco-Labeling Calculator. |

| Final Certification Stage (CDA) | |
|---------------------------------|---|
| **Types** | **Descriptions** |
| Documents | A narrative explaining any updates or changes in the criterion assessment. |
| | Evidence of the eco-labeled materials cost and the total materials cost for the project, such as excerpts of up to date monthly certification approved by the Client (BOQ format). |
| | Evidence of the use of the eco-labeled materials on site, such as Material Approval Requests. |
| Calculator | Updated M.2 Materials Eco-Labeling Calculator. |

### 5.2.7 EVALUATION

**5.2.7.1 General**

- Determine the specified eco-labeled materials and products.

- Input the data into the calculator for M.2 Materials Eco-Labeling to determine the percentages of the eco-labeled major construction materials and the availability fraction for minor construction materials.

- Prepare all applicable documentation.

**5.2.7.2 Calculator**

**A. Inputs**

Part 1 – Major Construction Materials Inputs

- Input the descriptions of the major construction materials with eco-labeling. Include in the descriptions of the name of the manufacturer of the supplied materials and products.

- Input the costs of the materials.

- Select from the pulldown menu the label type of the eco-labeled major construction materials.

Part 2 – Minor Construction Materials Inputs

- Input the descriptions of the minor construction materials with eco-labeling.

- Select from the pulldown menu the label type of the eco-labeled specialty materials.

- Extended List of eco-labeled materials. In case there are more than four eco-labeled minor materials, enter them in this list to achieve incentive score.

**B. Calculations**

Part 1 – Major Construction Materials Calculations

- Total cost of major construction materials with eco-labeling = sum of the itemized major construction materials with eco-labeling.

- Total cost of materials for the project = sum of the sub-total costs and lump sum cost of the construction materials, obtained from the Materials input sheet.

- Percentage of the cost of major materials with eco-labeling = calculated value based on the total cost of major construction materials with eco-labeling over the total cost of the materials for the development.

Part 2 – Minor Construction Materials Calculations

- Availability fraction = calculated value based on the eco-labeling of minor construction materials.

- Total availability fraction of Eco-labeled material = sum of the availability fraction of all minor construction materials.

- Availability fraction of extended list (for incentive weight) = sum of the availability fraction of incentivized minor construction materials.

Summary Calculations

- Achieved values = results of Part 1 and Part 2 calculations.

- Maximum targets = fixed values assigned for the calculations of the percentages of the cost of major construction materials with eco-labeling and availability fraction for minor construction materials.

- Weights = fixed values assigned to give relative importance for the calculations of cost of major construction materials with eco-labeling and availability fraction.

- Weighted percentage cost of major construction materials with eco-labeling = calculated value based on the achieved value, maximum target, and the assigned weight for major construction materials.

- Weighted percentage of the availability fraction = calculated value based on the achieved value, maximum target, and the assigned weight for minor construction materials.

- (X) = sum of the weighted percentages of cost of major materials with eco-labeling and the availability fraction of eco-labeled materials.

- Incentive score (%) = calculated value based on the availability fraction of the eco-labeled materials exceed the maximum target set by the calculator.

- M.2 criterion level = the generated criterion level for M.2 Materials Eco-Labeling based on the specified range from the criterion levels.

## 5.3 [M.3] RECYCLED CONTENT OF MATERIALS

### 5.3.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 5.3.2 PURPOSE

To use products and materials with recycled content.

### 5.3.3 ASSESSMENT PRINCIPLES

- The Project will **assess** the cost of building materials with recycled content, excluding MEP components, against the total cost of materials.

- The Project will complete the **calculator** for M.3 Recycled Content of Materials to establish the **criterion level**.

### 5.3.4 ASSESSMENT

The criterion requires **assessing** the construction materials with recycled content to help reduce the impacts associated with the use of virgin materials. Construction materials with recycled contents are building elements and materials manufactured with recycled materials. The assessment excludes materials from the mechanical, electrical, and plumbing (MEP) systems and equipment. Where materials are eligible for both M.3 Recycled Content of Materials and M.4 Materials Reuse criteria, the assessment permits claiming for one criterion only to avoid double counting.

The **calculator** determines the indicator based on the percentage of total cost of recycled content over the total cost of materials.

The **criterion level** is established based on the result of the indicator for M.3 Recycled Content of Materials.

## 5.3.5 CRITERION LEVELS

| Levels | Recycled Content (X) Indicator |
|--------|-------------------------------|
| -1 | X < 10% |
| 0 | 10% ≤ X < 15% |
| 1 | 15% ≤ X < 20% |
| 2 | 20% ≤ X < 25% |
| 3 | X ≥ 25% |

## 5.3.6 SUBMITTALS

| Provisional Certification Stage (LOC) | |
|--------|-------------------------------|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Evidence of total materials cost (MEP excluded) such as bill of quantities. |
| | Evidence of materials with recycled content cost such as cost estimates or bill of quantities. |
| | Specifications of the materials with recycled content indicating the percentage of recycled content. |
| **Calculator** | M.3 Recycled Content of Materials Calculator. |

| Final Certification Stage (CDA) | |
|---|---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | Evidence of the materials with recycled content cost and the total materials cost for the project, such as excerpts of up to date monthly certification approved by the Client (BOQ format). |
| | Evidence of the use of materials with recycled content on site, such as Material Approval Requests. |
| | If applicable, update material data sheets of the materials with recycled content indicating the percentage of recycled content. |
| **Calculator** | M.3 Recycled Content of Materials Calculator. |

### 5.3.7 EVALUATION

#### 5.3.7.1 General

- For this criterion, use the unified Materials Inputs sheet in the calculator to list all the relevant construction materials and corresponding cost estimates.  The list follows the format of the Construction Specification Institute (CSI) MasterFormat 2016.

- Determine the specified materials with recycled content.

- Determine from the material data sheets the percentage of recycled content in the materials.

- Determine from the bill of quantities and specification, the percentage of the recycled content weight to the total material weight.

- Prepare all applicable documentation.

#### 5.3.7.2 Calculator

#### A. Inputs

Materials Inputs Sheet

- Input in this section the costs of materials considered in the different materials criteria, as per the CSI materials classification. The Materials Input sheet includes cells for inputting all other materials that are not listed by default in the calculator's materials division numbers.

- If any of the materials to be considered is not in the list, use one of the blank lines within the corresponding Division.

- Use the 'Not broken-down materials' rows at the end of each Division for materials have no contribution toward any of material criteria. Use these rows and the Total Cost of MEP row to ensure that the calculated Total Cost of Materials for each division matches those in the BOQ of the project.

Recycled Content Inputs

- Input the percentage of recycled content of the construction materials.

**B. Calculations**

Materials Input Sheet Calculations

- Sub-total Cost of Materials per Division = sum of the Costs of Materials per Division, including the lump sums (Not Broken-Down Materials).

Recycled Content Calculations

- Descriptions and costs of construction materials with recycled content = referenced from materials input section.

- Cost of recycled content = calculated value based from the cost of material with recycled content and the percentage of cost of the recycled content.

- Sub-total cost per division = sum of the breakdown of costs of materials per division.

- Total cost of recycled content per division = sum of the breakdown of sub-total cost of recycled content per division.

- Total cost of materials (excluding MEP) = sum of the sub-total costs of materials per division excluding MEP.

- (X) = calculated value based on the percentage of total cost of recycled content over the total cost of materials, excluding MEP.

- M.3 criterion level = the generated criterion level for M.3 Recycled Content of Materials based on the specified range from the criterion levels.

## 5.4 [M.4] MATERIALS REUSE

### 5.4.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 5.4.2 PURPOSE

To reuse building materials recovered from on or off-site sources.

### 5.4.3 ASSESSMENT PRINCIPLES

- The Project will **assess** the cost of reused building materials, components and products, excluding MEP materials, recovered from on-site or off-site sources against the total cost of materials.

- The Project will complete the **calculator** for M.4 Materials Reuse to establish the **criterion level**.

### 5.4.4 ASSESSMENT

The criterion requires **assessing** the reused construction materials. Reused construction materials are building elements and materials that are salvaged, reused, or refurbished from on- or off-site. Where materials are eligible for both M.3 Recycled Content of Materials and M.4 Materials Reuse criteria, the assessment permits claiming for one criterion only to avoid double counting. The assessment excludes materials from the mechanical, electrical, and plumbing (MEP) systems and equipment.

The **calculator** determines the indicator based on the percentage of total value of reused materials over the total cost of construction materials excluding the MEP systems.

The **criterion level** is established based on the result of the indicator for M.4 Materials Reuse.

## 5.4.5 CRITERION LEVELS

| Levels | Materials Reuse (X) Indicator |
|--------|-------------------------------|
| -1 | X < 1.5% |
| 0 | 1.5% ≤ X < 2.5% |
| 1 | 2.5% ≤ X < 5% |
| 2 | 5% ≤ X < 7.5% |
| 3 | X ≥ 7.5% |

## 5.4.6 SUBMITTALS

| Provisional Certification Stage (LOC) | |
|---------------------------------------|---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Evidence of total materials cost (MEP excluded) such as bill of quantities. |
| | Evidence of reused materials cost such as cost estimates or bill of quantities. |
| | Relevant specifications describing the reused materials. |
| **Calculator** | M.4 Materials Reuse Calculator. |

| Final Certification Stage (CDA) | |
|---------------------------------|---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | Evidence of the reused materials cost and the total materials cost for the project, such as excerpts of up to date monthly certification approved by the Client (BOQ format). |
| | Evidence of the use of the reused materials on site, such as Material Approval Requests. |
| **Calculator** | M.4 Materials Reuse Calculator. |

### 5.4.7 EVALUATION

#### 5.4.7.1 General

- For this criterion use the unified Materials Input Sheet in the calculator to list all the relevant construction materials and corresponding cost estimates. The list follows the format of the Construction Specification Institute (CSI) MasterFormat 2016.

- Determine the relevant reused materials.

- Determine the current economic value or market value of the reused materials.

- Input the data into the calculator for M.4 Materials Reuse to determine the percentage of reused materials over the total material cost of the development (excluding MEP).

- Prepare all applicable documentation.

#### 5.4.7.2 Calculator

**A. Inputs**

Materials Inputs Sheet

- Input in this section the costs of materials considered in the different materials criteria, as per the CSI materials classification. The Materials Input sheet includes cells for inputting all other materials that are not listed by default in the calculator's materials division numbers.

- If any of the materials to be considered is not in the list, use one of the blank lines within the corresponding Division.

- Use the 'Not broken-down materials' rows at the bottom of each Division and the Total Cost of MEP line to calculate the Total Cost of Materials for the development. Ensure the calculated Total Cost of Materials for each division matches those in the BOQ of the project.

Reused Material Value Inputs

- Input the current economic value or market value or contract value of the reused materials.

**B. Calculations**

Materials Input Sheet Calculations

- Sub-total Cost of Materials per Division = sum of the Costs of Materials per Division, including the lump sums (Not Broken-Down Materials).

Reused Material Value Calculations

- Sub-total cost of materials per division = sum of the breakdown of costs of construction materials.

- Total cost of materials (excluding MEP) = sum of the sub-total cost of materials per division excluding MEP.

- Sub-total value of reused materials per division = sum of the breakdown of reused material value.

- Total value of reused materials = sum of the sub-total value of reused materials per division excluding MEP.

- (X) = calculated value based on the percentage of reused materials over the total cost of materials (excluding MEP).

- M.4 criterion level = the generated criterion level for M.4 Materials Reuse based on the specified range from the criterion levels.

## 5.5 [M.5] EXISTING STRUCTURE REUSE

### 5.5.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 5.5.2 PURPOSE

To reuse or renovate existing on-site structural systems.

### 5.5.3 ASSESSMENT PRINCIPLES

- The Project will **assess** the cost saving of reusing on-site existing structural systems against the cost of new construction.

- The Project will complete the **calculator** for M.5 Existing Structure Reuse to establish the **criterion level**.

### 5.5.4 ASSESSMENT

The criterion requires **assessing** the cost saving of reusing existing structural systems. Existing structural systems include permanently installed existing structural elements. Examples of permanently installed structural elements are the foundations, slabs, pillars or columns, beams, structural or load bearing walls, stairs, and the roof structures. The assessment determines the cost savings of reusing permanently installed existing structural elements in the development in comparison with demolishing the existing structure and build it anew.

Note that the assessment excludes the use of structural systems that are not in usable condition and could pose life safety risks to building occupants.

The assessment considers the recycling of the existing structural systems by the development provided that the recycling process adheres to local regulatory accepted practices.

The **calculator** determines the indicator based on the percentage of total savings from reusing existing structural systems over the total costs of demolition and new construction works.

The **criterion level** is established based on the result of the indicator for M.5 Existing Structure Reuse. For sites with no existing structures, the criterion level will be normalized to 0.

## 5.5.5  CRITERION LEVELS

| Levels | Existing Structure Reuse (X) Indicator<br>Existing Structure Status (Y) Indicator |
|:---:|:---:|
| -1 | X < 25% |
| 0 | 25% ≤ X < 40%    OR    Y = No |
| 1 | 40% ≤ X < 60% |
| 2 | 60% ≤ X < 80% |
| 3 | X ≥ 80% |

## 5.5.6  SUBMITTALS

| Provisional Certification Stage (LOC) | |
|:---:|:---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Evidence of cost of reusing structural elements as per design, such as bill of quantities or cost estimates. |
| | Evidence of demolishing the existing structure and building it anew, such as bill of quantities and/or cost estimates. |
| | List of existing structural elements to be reused and its area take-offs. |
| | Relevant drawings and specifications showing the existing structural elements to be reused. |
| **Calculator** | M.5 Existing Structure Reuse Calculator. |

UC | S | E | W | **M** | IE | CE | MO

| Final Certification Stage (CDA) | |
|---|---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | Evidence of the cost of reusing structural elements as per design, such as excerpts of up to date monthly certification approved by the Client (BOQ format). |
| | Evidence of demolishing the existing structure and building it anew, such as cost estimates and excerpts of up to date monthly certification approved by the Client (BOQ format). |
| | Relevant as-built drawings and specifications showing the reused existing structural elements. |
| | List of reused structural elements and its area take-offs. |
| **Calculator** | Updated M.5 Existing Structure Reuse Calculator. |

### 5.5.7 EVALUATION

**5.5.7.1 General**

- Determine the relevant existing structural elements.

- Determine the design cost and demolition and new construction cost of each existing structural element to be reused.

- Input the data into the calculator for M.5 Existing Structure Reuse to determine the percentage of total savings from reusing existing structures.

- Prepare all applicable documentation.

**5.5.7.2 Calculator**

**A. Inputs**

Inputs for Existing Structural Elements to be Reused

- Select from the pulldown menu if there is an existing structure on site or there was an existing structure and has already been demolished.

- Input the descriptions of all the existing structural systems regardless if they are going to be reused or not.  Structural elements not in usable condition are excluded.

- Input the cost of demolition and new construction (scenario 1).

- Input the cost of the structural systems as per the design (scenario 2).

**B. Calculations**

- Savings from reusing structural systems = the cost difference between the cost of demolition and new construction to the cost as per design.

- Total savings from reusing existing structure = sum of the breakdown of savings from reusing structural systems.

- Total costs of demolition and new construction = sum of the cost breakdowns of the demolition and new construction works.

- (X) = calculated value based on the percentage of total savings from reusing existing structure over the total costs of demolition and new construction works.

- (Y) = selected status of on-site structure whether existing/demolished or none.

- M.5 criterion level = the generated criterion level for M.5 Existing Structure Reuse based on the specified range from the criterion levels.

## 5.6 [M.6] DESIGN FOR DISASSEMBLY

### 5.6.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 5.6.2 PURPOSE

To design building elements for ease of disassembly and facilitate future reuse.

### 5.6.3 ASSESSMENT PRINCIPLES

- The Project will **assess** the cost of building elements and components, excluding MEP materials, that can be readily disassembled, fit for purpose for future reuse against the total cost of materials.

- The Project will complete the **calculator** for M.6 Design for Disassembly to establish the **criterion level**.

### 5.6.4 ASSESSMENT

The criterion requires **assessing** the cost of materials designed for disassembly. The materials designed for disassembly are building elements and components that can be readily disassembled and fit for purpose for future reuse, excluding mechanical, electrical, and plumbing (MEP) systems and items subject to wear and tear during their service life.

The **calculator** determines the indicator based on the percentage of total cost of materials designed for disassembly over the total cost of construction materials, excluding MEP, and items prone to wear and tear.

The **criterion level** is established based on the result of the indicator for M.6 Design for Disassembly.

## 5.6.5 CRITERION LEVELS

| Levels | Design for Disassembly (X) Indicator |
|--------|--------------------------------------|
| -1 | X < 10% |
| 0 | 10% ≤ X < 20% |
| 1 | 20% ≤ X < 30% |
| 2 | 30% ≤ X < 40% |
| 3 | X ≥ 40% |

## 5.6.6 SUBMITTALS

| Provisional Certification Stage (LOC) | |
|---------------------------------------|---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Evidence of total materials cost for the project (excluding MEP and materials subject to wear and tear), for example the bill of quantities. |
| | Evidence of designed for disassembly materials cost, for example cost estimates or bill of quantities. |
| | Relevant drawings and specifications showing the elements that can be disassembled and reuse in the future and the method statements demonstrating the disassembly of materials. |
| **Calculator** | M.6 Design for Disassembly Calculator. |

| Final Certification Stage (CDA) | |
| --- | --- |
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | Evidence of the cost of designed for disassembly materials, such as excerpts of up to date monthly certification approved by the Client (BOQ format). |
| | As-built drawings showing the elements that can be disassembled and reused in future. |
| | Evidence of the use of materials designed for disassembly on site, such as Materials Approval Requests. |
| **Calculator** | Updated M.6 Design for Disassembly Calculator. |

## 5.6.7 EVALUATION

### 5.6.7.1 General

- For this criterion use the unified Materials Inputs tab in the calculator to list all the specified construction materials and cost estimates. The list follows the format of the Construction Specification Institute (CSI) MasterFormat 2016.

- Determine the specified materials designed for disassembly.

- Determine the costs of materials designed for disassembly.

- Input the data into the calculator for M.6 Design for Disassembly to determine the percentage of total cost of materials designed for disassembly.

- Prepare all applicable documentation.

### 5.6.7.2 Calculator

#### A. Inputs

Materials Inputs Sheet

- Input in this section the costs of materials considered in the different materials criteria, as per the CSI materials classification. The Materials Input sheet includes cells for inputting all other materials that are not listed by default in the calculator's materials division numbers.

- If any of the materials to be considered is not in the list, use one of the blank lines within the corresponding Division.

- Use the 'Not broken-down materials' rows at the end of each Division for materials have no contribution toward any of material criteria. Use these rows and the Total Cost of MEP row to ensure that the calculated Total Cost of Materials for each division matches those in the BOQ of the project.

Materials Designed for Disassembly Inputs

- Input the cost of materials designed for disassembly.

#### B. Calculations

Materials Input Sheet Calculations

- Sub-total Cost of Materials per Division = sum of the Costs of Materials per Division, including the lump sums (Not Broken-Down Materials).

Materials Designed for Disassembly Calculations

- Total cost of materials (excluding MEP) = sum of the sub-total cost of materials per division excluding MEP.

- Sub-total cost of materials designed for disassembly per division = sum of the cost breakdown of materials designed for disassembly.

- Total cost of materials designed for disassembly = sum of the sub-total costs of materials designed for disassembly per division.

- (X) = calculated value based on the percentage of total cost of materials designed for disassembly over the total cost of construction materials, excluding MEP.

- M.6 criterion level = the generated criterion level for M.6 Design for Disassembly based on the specified range from the criterion levels.

## 5.7 [M.7] RESPONSIBLE SOURCING OF MATERIALS

### 5.7.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 5.7.2 PURPOSE

To use certified responsibly sourced materials.

### 5.7.3 ASSESSMENT PRINCIPLES

- The Project will **assess** the number of products and materials with GSAS approved certification for responsibly sourced materials.

- The Project will complete the **calculator** for M.7 Responsible Sourcing of Materials to establish the **criterion level**.

### 5.7.4 ASSESSMENT

The criterion requires **assessing** the responsibly sourced materials with GSAS approved certificates.

To be considered in the assessment, materials should comply with the Certification Body approved scheme for responsible sourcing of materials guided by regionally or internationally recognized standards, such as BS8902:2009 or equivalent.

Timber products should be sourced from sustainably managed forests to be considered in the assessment. Suppliers must hold Forest Stewardship Council (FSC) Chain of Custody Certification.

The **calculator** determines the indicator based on the numbers of responsibly sourced materials used in the project.

The **criterion level** is established based on the result of the indicator for M.7 Responsible Sourcing of Materials.

## 5.7.5   CRITERION LEVELS

| Levels | Responsible Sourcing (X) Indicator |
|:------:|:----------------------------------:|
| 0 | X = 0 |
| 1 | X = 1 |
| 2 | X = 2 |
| 3 | X = 3 |

## 5.7.6   SUBMITTALS

| Provisional Certification Stage (LOC) | |
|:---:|:---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | List and certificates of the responsibly sourced materials. |
| | Relevant specifications describing the responsibly sourced materials. |
| **Calculator** | M.7 Responsible Sourcing of Materials Calculator. |

| Final Certification Stage (CDA) | |
|:---:|:---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | If applicable, updated list and certificates of the responsibly sourced materials. |
| | Evidence of the use of responsibly sourced materials on site, such as Materials Approval Requests. |
| **Calculator** | Updated M.7 Responsible Sourcing of Materials Calculator. |

### 5.7.7 EVALUATION

#### 5.7.7.1 General

- Determine the relevant responsibly sourced materials.

- Input the data into the calculator for M.7 Responsible Sourcing of Materials to determine the number of responsibly sourced materials and the additional incentives.

- Prepare all applicable documentation.

#### 5.7.7.2 Calculator

##### A. Inputs

Inputs for Responsibly Sourced Materials

- Input the descriptions of responsibly sourced materials with GSAS approved certificates.

- Input the title of GSAS approved certificates of the responsibly sourced materials.

##### B. Calculations

- (X) = number of responsibly sourced materials.

- M.7 criterion level = the generated criterion level for M.7 Responsible Sourcing of Materials based on the specified range from the criterion levels.

- Incentive score (%) = 0.33% per material up to a maximum of 1%.

## 6.0    INDOOR ENVIRONMENT

The Indoor Environment category is concerned with the quality of the indoor environment for the comfort, health and well-being of occupants and users. People spend most of their time indoors and the quality of the indoor environment has a direct impact on their health, comfort, well-being and satisfaction. The building design should promote a comfortable, healthy and safe environment for building occupants and users.

### CRITERIA IN THIS CATEGORY:

IE.1      Thermal Comfort

IE.2      Natural Ventilation

IE.3      Mechanical Ventilation

IE.4      Lighting

IE.5      Daylight

IE.6      Glare

IE.7      Views

IE.8      Acoustics

IE.9      Low-VOC Materials

IE.10    Airborne Contaminants

## CRITERIA SUMMARY

The table below summarizes the weights of the Indoor Environment category and each of the associated criteria:

| Legend | | | | |
|---|---|---|---|---|
| √ | Incentive Only | | **N/A** | Not Applicable |

| No | Category / Criteria | LEVELS | | WEIGHTS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MIN | MAX | Commercial | Education | Homes | Hospitality | Light Industry | Mosques | Offices | Residential |
| **IE** | **INDOOR ENVIRONMENT** | | | | | | | | | | |
| IE.1 | Thermal Comfort | -1 | 3 | 1.99% | 1.67% | N/A | 1.72% | 1.85% | 1.88% | 1.87% | 1.89% |
| IE.2 | Natural Ventilation | -1 | 3 | 1.55% | 2.13% | 4.58% | 2.16% | 2.02% | 2.49% | 1.43% | 2.85% |
| IE.3 | Mechanical Ventilation | -1 | 3 | 2.75% | 2.13% | N/A | 2.16% | 2.02% | 2.49% | 2.63% | 2.85% |
| IE.4 | Lighting | -1 | 3 | 1.79% | 1.67% | 2.98% | 1.72% | 1.85% | 1.88% | 1.67% | 1.64% |
| IE.5 | Daylight | -1 | 3 | 2.25% | 2.13% | 3.92% | 2.16% | 2.02% | 2.49% | 2.13% | 2.85% |
| IE.6 | Glare | -1 | 3 | 1.20% | 1.67% | N/A | 1.20% | 1.85% | 1.22% | 1.67% | N/A |
| IE.7 | Views | -1 | 3 | 1.50% | 1.67% | 2.98% | 1.51% | 1.50% | N/A | 1.67% | 1.51% |
| IE.8 | Acoustics | -1 | 3 | 1.79% | 1.67% | 2.76% | 2.05% | 1.85% | 1.88% | 1.67% | 1.64% |
| IE.9 | Low-VOC Materials | -1 | 3 | 2.00% | 2.13% | 3.78% | 2.16% | 2.02% | 2.49% | 2.13% | 1.64% |
| IE.10 | Airborne Contaminants | -1 | 3 | 2.18% | 2.13% | N/A | 2.16% | 2.02% | 2.18% | 2.13% | 2.13% |
| | | | Total | 19.00% | 19.00% | 21.00% | 19.00% | 19.00% | 19.00% | 19.00% | 19.00% |

## 6.1 [IE.1] THERMAL COMFORT

### 6.1.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 6.1.2 PURPOSE

To optimize conditions for a thermally comfortable environment.

### 6.1.3 ASSESSMENT PRINCIPLES

- The Project will **assess** thermal comfort in predominantly occupied typical spaces for the hottest hour of the year using one of the following methods:
  - Absolute Predicted Mean Vote (PMV).
  - Air Diffusion Performance Index (ADPI).

- The Project will complete the **calculator** for IE.1 Thermal Comfort to establish the **criterion level**.

### 6.1.4 ASSESSMENT

The criterion requires **assessing** the thermal comfort of the predominantly occupied typical spaces during the hottest hour of the year. The predominantly occupied typical spaces are the typical indoor rooms or spaces where occupants stay for work or conduct businesses most of the time. Examples of such rooms or spaces are the offices, reception areas, training rooms, and meeting rooms. The hottest hour of the year is that time of the year when the window or wall glazing experience the highest solar heat gain.

The assessment establishes the thermal comfort of the spaces based on the absolute Predictive Mean Vote (PMV) method and/or the Air Diffusion Performance Index (ADPI) method.

The occupant's thermal comfort based on the PMV method requires selecting the two positions of the occupants in the room for the analysis, one position that is closest to the window or wall glazing and the other one that is farthest. The occupant's thermal comfort based on the ADPI method requires selecting the throw ratios and comfort index based on the type of the air terminal device and the room or space load.

The **calculator** determines the indicator based on the area-weighted average of the calculated levels from PMV and ADPI methods. If any of the methods resulted with calculated value falling within the range of Level (-1), the criterion receives Level (-1).

The **criterion level** is established based on the results of the indicator for IE.1 Thermal Comfort.

## 6.1.5    CRITERION LEVELS

| Levels | Thermal Comfort (X) Indicator |
|--------|-------------------------------|
| -1 | PMV > 2    OR    ADPI < 80    in any space |
| 0 | $0 \leq X < 0.75$ |
| 1 | $0.75 \leq X < 1.50$ |
| 2 | $1.50 \leq X < 2.25$ |
| 3 | $X \geq 2.25$ |

## 6.1.6    SUBMITTALS

| Provisional Certification Stage (LOC) | |
|---------------------------------------|--|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Relevant HVAC design drawings, specifications, and cooling load calculations of the evaluated rooms or spaces. |
| | Relevant architectural design drawings and specifications of the window and wall glazing. |
| **Calculator** | IE.1 Thermal Comfort Calculator. |

| Final Certification Stage (CDA) | |
|---------------------------------|--|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | Relevant construction drawings showing the areas of the evaluated rooms or spaces. |
| | Relevant shop drawings and material data sheets of the installed window and wall glazing and air terminal devices. |
| **Report** | Commissioning or TAB Report of the HVAC system of the rooms or spaces. |
| **Calculator** | Updated IE.1 Thermal Comfort Calculator. |

## 6.1.7    EVALUATION

### 6.1.7.1  General

- Determine from the design drawings the predominantly occupied typical spaces for evaluation including their internal areas and assessment methods.  Internal area means the internal floor area measured from the visible faces of the perimeter walls in the room or space. Select PMV as assessment method for spaces with direct exposure to solar heat gain. Select ADPI for other spaces.

- Determine from the selected room or space the positions of the occupant closest and farthest to the window or wall glazing.

- Illustrate in the design drawings the distances of the occupant's positions and the dimensions of the window in the evaluated room or space.

- Determine from the design documents the room design conditions and glazing specifications.

- Determine from the design documents the air terminal devices and characteristics of the selected room or space for ADPI calculations.

- Illustrate in the design drawings the positions and distances of the air terminal devices.

- Input the data into the calculator for IE.1 Thermal Comfort to determine the absolute PMV value and ADPI value.

- Prepare all applicable documentation.

### 6.1.7.2 Calculator

**A. Inputs**

Part 1 – Space Information

- Input the name of the room or space.

- Input the measured internal area of the room or space.

- Select from the pulldown menu the assessment method.

Part 2 – Predicted Mean Vote (PMV) Inputs

- Input the design indoor air temperature.

- Input the distances of the occupant's positions from the window.

- Input the required window or wall glazing measurements.

- Input the wall orientation and specifications of the glazing materials.

- Input the design room air velocity.

- Input the design indoor air relative humidity.

- Repeat the same for all other rooms and spaces.

Part 3 – Air Diffusion Performance Index (ADPI) Inputs

- Input the number of air terminal device in the evaluated room or space.

- Select from the pulldown menu the range of the calculated specific cooling load of the room or space.

- Throw ratios are determined based on the cooling load and type of air terminal device.

- The comfort indexes are determined based on the cooling load and type of air terminal device.

- Input the room or space characteristic length.

- Input the throw data of the air terminal devices in the room or space.

- Repeat the same for all other rooms and spaces.

**B. Calculations**

Part 2 – Predicted Mean Vote (PMV) Calculations

- Glass heat gain = calculated value based on the glazing properties.

- Shape factors = calculated values based on the measured distances and dimensions of the window to the occupant.

- Mean radiant temperature = calculated value based on the design indoor air temperature, total shape factor, and blind surface temperature.

- Absolute PMV value = calculated absolute value based on thermal load on body and the metabolic heat production.

Part 3 – Air Diffusion Performance Index (ADPI) Calculations

- Throw ratio = calculated value based on the ratio of the air terminal device throw data to room characteristic length.

- ADPI = calculated value based on the throw data and throw ratios of the air terminal devices, room load and characteristic length, and comfort index.

Part 4 – Summary Calculations

- (X) = area weight indicator calculated based on PMV and ADPI values.

- IE.1 criterion level = the generated criterion level for IE.1 Thermal Comfort based on the specified range from the criterion levels.

## 6.2 [IE.2] NATURAL VENTILATION

### 6.2.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 6.2.2 PURPOSE

To maximize fresh air supplied naturally when conditions permit without the aid of mechanical systems.

### 6.2.3 ASSESSMENT PRINCIPLES

- The Project will **assess** the duration in which natural ventilation can be utilized for predominantly occupied typical spaces.
- The Project will complete the **calculator** for IE.2 Natural Ventilation to establish the **criterion level**.

### 6.2.4 ASSESSMENT

The criterion requires **assessing** the number of months that natural ventilation can be utilized based on the hourly climatic conditions of the site, the operable area of the window, and the required ventilation rate of the room or space.  Included in the assessment are the selections of the typical rooms or spaces that are predominantly occupied, including but not limited to, offices, reception areas, training rooms, and meeting rooms. For commercial scheme, the assessment excludes showrooms in retail and shopping malls. The assessment considers only the rooms or spaces with operable windows or access to natural ventilation.  Natural ventilation means the natural draft of fresh air ventilates the room or space without the aid of non-renewable, power-supplied mechanical equipment.

The **calculator** determines the indicator based on the number of months that the natural ventilation can be utilized from the 1st day of January up to the 31st day of December.

The **criterion level** is established based on the result of the indicator for IE.2 Natural Ventilation.

### 6.2.5 CRITERION LEVELS

#### 6.2.5.1 COMMERCIAL, EDUCATION, MOSQUES, HOSPITALITY, LIGHT INDUSTRY and OFFICES Schemes

| Levels | Area Weighted Number of Months that Natural Ventilation can be Utilized (X) Indicator |
|--------|---------------------------------------------------------------------------------------|
| -1 | No possible natural ventilation year-round. |
| 0 | $0 \leq X < 1$ month of the year |
| 1 | $1 \leq X < 2$ months of the year |
| 2 | $2 \leq X < 3$ months of the year |
| 3 | $X \geq 3$ months of the year |

#### 6.2.5.2 HOMES and RESIDENTIAL Schemes

| Levels | Requirements |
|--------|--------------|
| -1 | Natural ventilation strategy does not demonstrate compliance with the requirements. |
| 3 | Natural ventilation strategy fully demonstrates compliance with the requirements. |

### 6.2.6 SUBMITTALS

| Provisional Certification Stage (LOC) | |
|---------------------------------------|--|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Relevant architectural design drawings of the selected rooms or spaces. |
| | Room data sheets or furniture layouts showing the number of occupants designed for each room or space. |
| | Schedule of the hourly climatic data of the weather station listed from the standard or from the weather bureau. |
| **Calculator** | IE.2 Natural Ventilation Calculator. |

| Final Certification Stage (CDA) | |
|---|---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | Relevant construction drawings showing the areas of the evaluated rooms or spaces. |
| | Relevant shop drawings and materials data sheets of the installed operable windows showing the dimensions, window closer, and seals. |
| **Calculator** | Updated IE.2 Natural Ventilation Calculator. |

### 6.2.7    EVALUATION

#### 6.2.7.1  General

- Determine the hourly climatic data of the site.

- Determine from the design drawings and specifications the ventilated rooms or spaces with operable windows.

- Determine the fresh air ventilation requirements based on the number of occupants considered in the design of each room or space.

- Determine the relevant as-built floor plans and elevations or shop drawings showing the designed window and wall openings of the occupied spaces.

- Input the data into the calculator for IE.2 Natural Ventilation to determine the number of months that natural ventilation can be utilized from January 1 up to December 31.

- Prepare all applicable documentation.

#### 6.2.7.2  Calculator

##### A. Inputs

Climatic Data Inputs

- Input the weather station of the climatic data within the same or nearest to the location of the development.

- Input the following climatic data taken from the standards or from a weather station that has minimum data for 10 years of long-term hourly observations:
    - Dry-bulb air temperature

    - Relative humidity

    - Wind speed

Summary Inputs

- Input the total floor area of the room or space.

- Input the operable window area of the room or space.

- Input the number of occupants considered in the design of the room or space.

- Repeat the same for all other rooms and spaces.

## B. Calculations

- Number of possible months = calculated value based on the floor area, window area, and number of occupants in the room or space.

- Minimum ventilation rate per person = fixed value from the ventilation standard.

- Adjusted ventilation rate for building type = fixed value based on the minimum fresh air ventilation rate according to standard for the selected building typology.

- (X) = calculated area weighted number of months that natural ventilation can be utilized from the 1st day of January 1 up to the 31st day of December.

- IE.2 criterion level = the generated criterion level for IE.2 Natural Ventilation based on the specified range from the criterion levels.

## 6.3    [IE.3] MECHANICAL VENTILATION

### 6.3.1    APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 6.3.2    PURPOSE

To maximize fresh air supplied with efficient mechanical ventilation systems.

### 6.3.3    ASSESSMENT PRINCIPLES

- The Project will **assess**:
  - Compliance with minimum requirements of ASHRAE (or equivalent) standards for outdoor air and motor efficiency.
  - The ventilation rates above the minimum requirements of ASHRAE (or equivalent) standards.
  - The Percentage of Dissatisfied (PD) based on $CO_2$ levels in predominantly occupied typical spaces.

- The Project will complete the **calculator** for IE.3 Mechanical Ventilation to establish the **criterion level**.

### 6.3.4    ASSESSMENT

The criterion requires **assessing** the percentage of ventilation rate above the minimum requirements of ASHRAE standard and the percentage of dissatisfied with room or space ventilation within specific zones. Included in the assessment are the conformance of the efficiency of the mechanical equipment with ASHRAE standard and the adequacy of the outdoor air supply to predominantly occupied typical spaces.

The assessment considers both the system-based and zone-based evaluations of the ventilation requirements.  The system-based assessment of the mechanical ventilation evaluates the general ventilation rate requirement of the whole building.  The zone-based assessment of the mechanical ventilation evaluates the ventilation rate requirement of the predominantly occupied typical spaces and estimates the percentage of dissatisfied.  Mechanical ventilation means the non-renewable, power-supplied mechanical equipment supplies outdoor air to ventilate the predominantly occupied typical spaces.

The **calculator** determines the indicators based on the calculated average of the percentage of ventilation rate above the requirements of ASHRAE standard and the percentage of dissatisfied with room or space ventilation.

The **criterion level** is established based on the results of the indicators for IE.3 Mechanical Ventilation.

### 6.3.5 CRITERION LEVELS

The calculator determines the criterion level based on the averaged results of the (X) and (Y) indicators. If any of the mechanical ventilation indicators resulted with calculated value falling within the range of Level (-1), the IE.3 Mechanical Ventilation criterion receives Level (-1).

| Levels | Ventilation Rate Above Requirements (X) Indicator |
|--------|---------------------------------------------------|
| -1 | Insufficient outdoor air OR Inefficient equipment according to the standards. |
| 0 | X < 5% |
| 1 | 5% ≤ X < 10% |
| 2 | 10% ≤ X < 15% |
| 3 | X ≥ 15% |

| Levels | Percentage of Dissatisfied (Y) Indicator |
|--------|------------------------------------------|
| -1 | Outdoor air is less than the standards. |
| 0 | Y > 25% OR any zone with no $CO_2$ control |
| 1 | 22.5% < Y ≤ 25% |
| 2 | 20% < Y ≤ 22.5% |
| 3 | Y ≤ 20% |

### 6.3.6    SUBMITTALS

| Provisional Certification Stage (LOC) | |
|---|---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Relevant design drawings, specifications, equipment schedules, and outdoor air ventilation rate calculations of the evaluated rooms or spaces. |
| | Calculations showing compliance to fan motor efficiency |
| | Extract of the standards showing the fan-motor efficiency and minimum outdoor air requirements. |
| **Calculator** | IE.3 Mechanical Ventilation Calculator. |

| Final Certification Stage (CDA) | |
|---|---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | Relevant construction drawings showing the areas of the evaluated rooms or spaces. |
| | Relevant shop drawings or schematic diagrams of the air distribution system. |
| | Equipment nameplate ratings or performance specifications of the procured air-conditioning and ventilation equipment. |
| **Report** | Commissioning or TAB Report of the outdoor air ventilation system of the rooms or spaces. |
| **Calculator** | Updated IE.3 Mechanical Ventilation Calculator. |

### 6.3.7    EVALUATION

#### 6.3.7.1  General

- Determine from the design drawings the total gross floor area of the zones supplied with outdoor air from the mechanical ventilation system.

- Determine from the design drawings the predominantly occupied typical spaces for evaluation including its internal areas.  Internal area means the internal floor area measured from the visible faces of the perimeter walls in the room or space.

- Determine from the design documents the room design conditions, the calculations, and the controls system of the mechanical ventilation.

- Determine from ASHRAE standard the mechanical equipment efficiency and the minimum ventilation requirements.

- Determine from the equipment schedules the fan-motor efficiencies of the mechanical equipment.

- Determine from the relevant construction documents the required submittals of the conformance to design audits.

- Input the data into the calculator of IE.3 Mechanical Ventilation to determine the percentage of ventilation above the requirements of ASHRAE standard and the percentage of dissatisfied with room or space ventilation.

- Prepare all applicable documentation.

#### 6.3.7.2  Calculator

#### A. Inputs

Part 1 – General Ventilation Inputs

- Input the total gross floor area of the mechanically ventilated zones.

- Input the calculated total outdoor air supply requirements of the building.

- Select from the pulldown menu if the specified fan-motor efficiencies comply with ASHRAE 90.1 or International Mechanical Code (IMC).

- Input the minimum outdoor air requirement based on ASHRAE 62.1 or EN-ISO 15243 standards.

Part 2 – Room or Space Ventilation Inputs

- Input the name of the room or space.

- Input the calculated outdoor air supply requirement of the room or space.

- Input the minimum outdoor air requirement for the room or space based ASHRAE 62.1 or EN-ISO 15243 standards.

- Input the number of occupants designed for the room or space.

- Input the measured internal area of the room or space.

- Select from the pulldown menu if there are $CO_2$ sensors for ventilation control.

- Select from the pulldown menu the room ventilation system.

- Input the supply air design temperature.

- Input the room air design temperature.

- Repeat the same for all other rooms and spaces.

## B. Calculations

Part 1 – General Ventilation Calculations

- Outdoor air/equipment efficiency = generated result based on compliance of the requirements to meet the standards.

- Ventilation rate above requirements = calculated percentage of total outdoor air supply over the standard's minimum requirement.

Part 2 – Room or Space Ventilation Calculations

- Percentage of dissatisfied = calculated percentage of dissatisfied for each room or space.

- Area-weighted percentage of dissatisfied = calculated value based on the ratio of the sum of weighted PD over the total areas of the evaluated rooms or spaces.

Summary Calculations

- (X) = calculated percentage of the total outdoor air supply over the standard's minimum requirement.

- (Y) = calculated percentage of the ratio of the sum of weighted PD over the total areas of the evaluated rooms or spaces.

- IE.3 criterion level = the generated criterion level for IE.3 Mechanical Ventilation based on the calculated average of (X) and (Y) indicators from the criterion levels.

## 6.4    [IE.4] LIGHTING

### 6.4.1    APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 6.4.2    PURPOSE

To meet minimum compliance requirements for artificial illumination performance and avoid over-lighting of indoor spaces.

### 6.4.3    ASSESSMENT PRINCIPLES

- The Project will **assess** the lighting in predominantly occupied typical spaces for the building:
  - Compliance with the minimum requirements of IESNA (or equivalent) standards for illuminance and uniformity.
  - The percentage of the total area over-lit by more than the specified limit.
- The Project will complete the **calculator** for IE.4 Lighting based on the results from lighting **simulation** software to establish the **criterion level**.

### 6.4.4    ASSESSMENT

The criterion requires **assessing** the illuminance and uniformity levels of the lighting design in predominantly occupied typical spaces. Included in the assessment is the compliance of the lighting design to meet the minimum requirements from IESNA or approved equivalent lighting standards using an approved lighting **simulation** software.

The software simulates the illuminance and uniformity level of the lighting design model of each room or space.  The lighting design model includes the lighting layouts and light fixtures specified for each room or space and the lighting control system.

The **calculator** determines the indicator based on the simulated results of the following:

- The illuminances and uniformity levels of the lighting design of the predominantly occupied typical spaces.
- The percentage of the total area that is over-lit by more than 20% from IESNA or approved equivalent lighting standards.

The **criterion level** is established based on the result of the indicator for IE.4 Lighting.

## 6.4.5 CRITERION LEVELS

| Levels | Percentage of Total Area Over-Lit by more than 20% (X) Indicator |
|:------:|:-----------------------------------------------------------------|
| -1 | Illuminance and uniformity levels failed to meet the IESNA standards. |
| 0 | X > 30% |
| 1 | 20% < X ≤ 30% |
| 2 | 10% < X ≤ 20% |
| 3 | X ≤ 10% |

## 6.4.6 SUBMITTALS

| Provisional Certification Stage (LOC) | |
|:--------------------------------------|:--|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Relevant lighting design drawings and specifications. |
| | Schedule of lighting fixtures. |
| **Simulation** | Lighting Simulation results. |
| **Calculator** | IE.4 Lighting Calculator. |

| Final Certification Stage (CDA) | |
|:--------------------------------|:--|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | Relevant construction drawings and specifications. |
| | List of installed lighting fixtures. |
| **Report** | Commissioning or Testing Report of the lighting systems. |
| **Calculator** | Updated IE.4 Lighting Calculator. |

### 6.4.7 EVALUATION

#### 6.4.7.1 General

- Determine the illuminances and uniformity levels of the predominantly occupied typical spaces, such as but not limited to, the offices, reception areas, training rooms, and meeting rooms.

- Determine from the lighting standards the minimum required illuminance and uniformity level for each type of room or space.

- Determine from the results of the lighting simulation the illuminance and uniformity level of each room or space.

- Input the data into the calculator for IE.4 Lighting to determine the percentage of the total area that is over-lit by more than 20%.

- Prepare all applicable documentation.

#### 6.4.7.2 Simulation

- Use an approved lighting simulation software to demonstrate the illuminance and uniformity levels of the lighting design in predominantly occupied typical spaces.

#### 6.4.7.3 Calculator

**A. Inputs**

Space Type & Illuminance and Uniformity Level Inputs

- Input the description of the names and quantities of the typical spaces.

- Input the total area of the typical space.

- Input the minimum required illuminance and uniformity level for each typical space from IESNA standards or approved equivalent.

- Input the resulting illuminance and uniformity level of the simulated lighting design of each typical space.

**B. Calculations**

- IESNA compliant = established compliance of the simulated lighting design from the IESNA standard's minimum illuminance and uniformity level for each typical space.

- Over-lit by more than 20% = established the 20% over-lit of the lighting design of each typical space.

- (X) = calculated percentage of the total area that is over-lit by more than 20%.

- IE.4 criterion level = the generated criterion level for IE.4 Lighting based on the specified range from the criterion levels.

## 6.5 [IE.5] DAYLIGHT

### 6.5.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 6.5.2 PURPOSE

To maximize exposure to daylight and reduce the demand for artificial lighting.

### 6.5.3 ASSESSMENT PRINCIPLES

- The Project will **assess** the daylight illumination levels below the minimum requirements of IESNA (or equivalent) standards in predominantly occupied typical spaces.

- The Project will complete the **calculator** for IE.5 Daylight based on the results from lighting **simulation** software to establish the **criterion level**.

### 6.5.4 ASSESSMENT

The criterion requires **assessing** the daylight illumination levels in the predominantly occupied typical spaces. Included in the assessment is the compliance of the lighting design to meet the minimum requirements from IESNA or approved equivalent lighting standards using an approved computer **simulation** software.

The computer software simulates the daylight illumination level for each room or space. The assessment includes the simulation of daylight in the room with all artificial lights turned off and with an overcast CIE sky condition on 21st of December at solar noon time.

The **calculator** determines the indicator based on the area weighted average of the percentage of illumination level below the recommended level.

The **criterion level** is established based on the result of the indicator for IE.5 Daylight.

### 6.5.5 CRITERION LEVELS

| Levels | Area-Weighted Average of the Percentage Below Recommended Light Level (X) Indicator |
|:---:|:---:|
| -1 | X > 40% |
| 0 | 30% < X ≤ 40% |
| 1 | 20% < X ≤ 30% |
| 2 | 10% < X ≤ 20% |
| 3 | X ≤ 10% |

### 6.5.6 SUBMITTALS

| Provisional Certification Stage (LOC) | |
|:---:|:---:|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Relevant architectural design drawings and specifications. |
| **Simulation** | Daylight Simulation results. |
| **Calculator** | IE.5 Daylight Calculator. |

| Final Certification Stage (CDA) | |
|:---:|:---:|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | Relevant construction drawings and specifications. |
| **Report** | Commissioning or Testing Report of the lux meter's measured illuminance levels of the daylight in the rooms or spaces. |
| **Calculator** | Updated IE.5 Daylight Calculator. |

### 6.5.7 EVALUATION

#### 6.5.7.1 General

- Determine from the lighting standards the minimum recommended illumination level for each type of room or space.

- Determine from simulation results the daylight illumination level of each room or space according to the following basis:

  - For spaces that are greater than 21 meters in length or width:

    - Subdivide each space into a 7 meters x 7 meters grid to locate the measuring points.

    - Start by drawing a virtual line in the center of the space, then draw a perpendicular virtual line from the midpoint of the initial virtual line, and offset these lines by 7 meters until the lines reach the boundaries of the space creating a 7 meters x 7 meters grid.

    - The measuring points are located at each intersection of the grid lines at a height of 1.2 meters above the finished floor.

    - Any measuring point located less than 3.5 meters from the boundaries of the space should not be considered for calculations.

  - For spaces that are less than 21 meters in length or width:

    - Define the center of each typical space, and locate a measuring point at a height of 1.2 meters above the finished floor.

- Input the data into the calculator for IE.5 Daylight to determine the area weighted average of the percentage of illumination level below the recommended level.

- Prepare all applicable documentation.

#### 6.5.7.2 Simulation

- Use an approved lighting simulation software to demonstrate the daylight illumination levels in the predominantly occupied typical spaces.

#### 6.5.7.3 Calculator

##### A. Inputs

Daylight Illumination Inputs

- Select the type of the room or space from the pulldown menu.

- Input the daylight measuring points in the room or space.

- Input the measured daylight illuminations in the measuring points based from the results of the simulation.

Part 1 – Inputs for Spaces Greater than 21m in Length or Width

- Input the recommended illumination level.

- Input the area of room or space.

Part 2 – Inputs for Spaces Less than 21m in Length or Width

- Input the name of the room or space.

- Input the space number associated with the inputted name of the room or space.

- Input the measured daylight illumination at the center of the room or space at 1.2m height based from the results of the simulation.

- Input the recommended illumination level.

- Input the area of room or space.

**B. Calculations**

Daylight Illumination Calculations

- Average daylight illumination level = average of the sum of the measured daylight illuminations in the room or space.

Part 1 – Calculations for Spaces Greater than 21m in Length or Width

- Space type = fixed value from the inputted name of the room or space.

- Space number = fixed value associated with the inputted name of the room or space.

- Average daylight illumination level = fixed value from the calculated average daylight illumination level of the room or space.

- Illumination level below recommended level = calculated percentage of difference between simulated and recommended illumination levels over the recommended illumination level.

Part 2 – Calculations for Spaces Less than 21m in Length or Width

- Illumination level below recommended level = calculated percentage of difference between simulated and recommended illumination levels over the recommended illumination level.

Summary

- (X) = calculated area weighted average of the percentage of illumination level below the recommended level.

- IE.5 criterion level = the generated criterion level for IE.5 Daylight based on the specified range from the criterion levels.

## 6.6 [IE.6] GLARE

### 6.6.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 6.6.2 PURPOSE

To reduce the level of visual discomfort from direct or reflected glare from sunlight.

### 6.6.3 ASSESSMENT PRINCIPLES

- The Project will **assess**:
    - The measures implemented to reduce glare.
    - The Daylight Glare Index (DGI) in predominantly occupied typical spaces in accordance with CIBSE (or equivalent) standards.

- The Project will complete the **calculator** for IE.6 Glare based on the results from glare simulation software or measures implemented for glare mitigation to establish the **criterion level**.

### 6.6.4 ASSESSMENT

The criterion requires **assessing** the daylight glare index in the typical space types for option 1 and glare mitigation for option 2. Options 1 and 2 are the two compliance pathways to establish the criterion level. The compliance pathways of the two options are:

- Option 1 by using computer simulation to calculate the daylight glare index (DGI) in accordance with CIBSE standards or approved equivalent.
- Option 2 by glare mitigation.

The **calculator** determines the indicator based on the simulation results from option 1 or based on measures implemented for option 2 glare mitigation.

The **criterion level** is established based on the result of the indicator for IE.6 Glare.

### 6.6.5    CRITERION LEVELS

**Option 1**

| Levels | Area Weighted Average DGI (X) Indicator |
|--------|------------------------------------------|
| -1     | X > 22                                   |
| 0      | 20 < X ≤ 22                              |
| 1      | 18 < X ≤ 20                              |
| 2      | 16 < X ≤ 18                              |
| 3      | X ≤ 16                                    |

**Option 2**

| Levels | Requirements |
|--------|--------------|
| -1     | Building design incorporates an inadequate level of glare control. |
| 0      | Building design incorporates a low level of glare control. |
| 1      | Building design incorporates some glare control. |

### 6.6.6    SUBMITTALS

| Provisional Certification Stage (LOC) | |
|---------------------------------------|---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
|  | Relevant design drawings and specifications. |
| **Simulation** | Daylight Glare Simulation results. |
| **Calculator** | IE.6 Glare Calculator. |

| Final Certification Stage (CDA) | |
|---|---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | Relevant construction drawings and specifications. |
| | Relevant as-built drawings showing the updates to the previous LOC stage submittals. |
| **Calculator** | Updated IE.6 Glare Calculator. |

### 6.6.7    EVALUATION

#### 6.6.7.1  General

- Determine the dimensions of the typical spaces.

- Determine the properties of the indoor finishes.

- Determine the results of the computer simulation on the average DGI for each typical space type for option 1.

- Determine the glare mitigation for option 2.

- Input the data into the calculator for IE.6 Glare to determine the area weighted average of the DGI or to determine the glare mitigation.

- Prepare all applicable documentation.

#### 6.6.7.2  Calculator

#### A. Inputs

Option Selection Inputs

- Select from the pulldown menu the option for compliance.

Option 1 – Computer Simulation Inputs

- Typical Space Definition for Each Type
    - Input the names of the typical space.
    - Input the total area of typical spaces with similar layouts.
    - Input the height from the ground.
    - Input the ground reflectance value.
    - Input the sky condition lux value.
    - Input the degree of the solar angle.
    - Materials Specification and Simulation for Each Type and Building Orientation
    - Input the wall reflectance value.
    - Input the floor reflectance value.
    - Input the ceiling reflectance value.
    - Input the glass transmittance value.
    - Input the point 1 – south average DGI based on the simulation results.
    - Follow the same inputs from above for the point 2-north, point 3-west, and point 4-east orientations.

- Option 2 – Glare Mitigation Inputs

  - Select Yes from the pulldown menu if the development incorporates blinds for 50% (or more) of the glazed area.

  - Select Yes from the pulldown menu if the blinds are independently user operable.

## B. Calculations

- Typical space type = default value based on the inputted typical space type.

- Total area of spaces with similar layouts = calculated value based on the sum of the areas for each typical space type.

- Average DGI for each typical space type = calculated value based on the reflectance and transmittance values of the indoor finishes and the results of the DGI simulations.

- Total area of evaluated spaces = calculated value based on the sum of the total area of spaces with similar layouts.

- (X) = calculated area weighted average of the DGI for option 1.

- (Y) = calculated glare mitigation for option 2.

- IE.6 criterion level = the generated criterion level for IE.6 Glare based on the specified range from the criterion levels.

## 6.7     [IE.7] VIEWS

### 6.7.1     APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 6.7.2     PURPOSE

To maximize exposure to external or internal views.

### 6.7.3     ASSESSMENT PRINCIPLES

- The Project will **assess** the accessibility to external and internal views based on the floor and window areas for predominantly occupied typical spaces.

- The Project will complete the **calculator** for IE.7 Views to establish the **criterion level**.

### 6.7.4     ASSESSMENT

The criterion requires **assessing** the accessibility to external and internal views from rooms or spaces for the comfort and well-being of occupants. External views are those to the exterior surrounding environment of the building when viewed from inside predominantly occupied rooms or spaces. Internal views are those to internal common spaces, for example an atrium or courtyard and to points of specific interest forming part of the interior design of the building for occupants to enjoy, for example water features, artwork or sculptures.

The assessment establishes the accessibility to views based on the occupiable area analysis and the window area analysis. The occupiable area analysis determines the area weighted percentage of the access to views within 7 meters from the perimeter walls. The occupiable area is the area predominantly occupied and can exclude, for example: plant rooms, stairwells, technical rooms. The window area analysis determines the area weighted percentage of the window areas or unobstructed wall openings to the wall areas within the same façade orientation.

The **calculator** determines the indicator based on the area weighted view accessibility and area weighted window area factor.

The **criterion level** is established based on the result of the indicator for IE.7 Views.

## 6.7.5    CRITERION LEVELS

| Levels | Area Weighted View Accessibility (X) Indicator<br>Area Weighted Window Area Factor (Y) Indicator |
|--------|--------------------------------------------------------------------------|
| -1 | X < 60%    OR    Y < 20% |
| 0 | 60% ≤ X < 70% |
| 1 | 70% ≤ X < 80% |
| 2 | 80% ≤ X < 90% |
| 3 | X ≥ 90% |

## 6.7.6    SUBMITTALS

| Provisional Certification Stage (LOC) | |
|--------|---------------------------------------|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Relevant architectural drawings. |
| **Calculator** | IE.7 Views Calculator. |

| Final Certification Stage (CDA) | |
|--------|---------------------------------|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | Relevant as-built drawings. |
| **Calculator** | Updated IE.7 Views Calculator. |

## 6.7.7 EVALUATION

### 6.7.7.1 General

- Determine from the architectural drawings the floor areas, area within the 7-meter offset from perimeter boundary and window areas of the typical floors.

- Input the data into the calculator for IE.7 Views to determine the area weighted view accessibility and area weighted window area factor.

- Prepare all applicable documentation.

### 6.7.7.2 Calculator

#### A. Inputs

Typical Floor Type Inputs

- Input the building typology of the typical floor.

Occupiable Area Analysis Inputs

- Input the occupiable floor area of the typical floor.

- Input the occupiable floor area within 7m from the viewing perimeter walls of the typical floor.

Window Area Analysis Inputs

- Input the total wall area of the typical floor. Consider finished floor to finished ceiling levels for area calculations.

- Input the total window area of the typical floor.

Summary Inputs

- Input the total area of floors with similar layouts.

#### B. Calculations

Occupiable Area Analysis Calculations

- View accessibility factor for typical floor = calculated value based on the percentage of the occupiable floor area within 7m of the perimeter walls over the total occupiable floor area for each typical floor.

Window Area Analysis Calculations

- Window area factor for typical floor = calculated value based on the percentage of the total window area over the total wall area for each typical floor.

Summary Calculations

- Typical floor type = default value based on the inputted building typology of the typical floor.

- View accessibility factor = default value based on the calculated area weighted view accessibility factor for each typical floor.

- Window area factor = default value based on the calculated area weighted window area factor for each typical floor.

- Total area of evaluated spaces = calculated value based on the sum of total area of floors with similar layouts.

- (X) = calculated area weighted view accessibility.

- (Y) = calculated area weighted window area factor.

- IE.7 criterion level = the generated criterion level for IE.7 Views based on the specified range from the criterion levels.

## 6.8 [IE.8] ACOUSTICS

### 6.8.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 6.8.2 PURPOSE

To meet the minimum acoustic performance requirements for indoor environments.

### 6.8.3 ASSESSMENT PRINCIPLES

- The Project will **assess** the acoustic quality for background noises and reverberation time in accordance with the relevant standards for various noise sources in predominantly occupied typical spaces.

- The Project will complete the **calculator** for IE.8 Acoustics to establish the **criterion level**.

### 6.8.4 ASSESSMENT

The criterion requires **assessing** the acoustic quality of the selected room or space based on the analysis of the background noises and reverberation time of the sound emissions from noise sources. The predominantly occupied typical spaces are the typical indoor rooms or spaces where occupants stay for work or conduct businesses most of the time. Examples of such rooms or spaces are the offices, reception areas, training rooms, and meeting rooms.

The assessment establishes the acoustic quality based on the total room sound level and reverberation time. It includes analyzing the total room sound level due to background noises coming from outside traffic noise, diffuse sounds from air terminal devices, radiated sounds from noise sources in the ceiling plenum, and the discharge sounds from air distribution system. Where required in building typology, the assessment includes the calculations of the sound decay time called reverberation time based on the space geometry and the absorption properties of the interior finishes.

The **calculator** determines the indicator based on the background noise levels and reverberation time in the selected room or space predicted to experience the worst-case scenario. Worst-case scenario means the room or space has the highest predicted exposure to background noises and reverberation time for each type of predominantly occupied typical spaces based on the design drawings and specifications. If anyone of the evaluated spaces resulted with the calculated reverberation time that exceeds the value of 0.60, then the maximum attainable level for the criterion will be (0).

The **criterion level** is established based on the result of the indicator for IE.8 Acoustics.

### 6.8.5 CRITERION LEVELS

#### 6.8.5.1 COMMERCIAL, EDUCATION, LIGHT INDUSTRY and OFFICES Schemes

| Levels | Background Noise (X) Indicator<br>Reverberation Time (Y) Indicator |
|--------|---------------------------------------------------------|
| -1 | $X > 1$ |
| 0 | $1 \geq X > 0.95$ |
| 1 | $0.95 \geq X > 0.90$ AND all $Y \leq 0.6$ |
| 2 | $0.90 \geq X > 0.85$ AND all $Y \leq 0.6$ |
| 3 | $X \leq 0.85$ AND all $Y \leq 0.6$ |

#### 6.8.5.2 HOMES, HOSPITALITY and RESIDENTIAL Schemes

| Levels | Background Noise (X) Indicator |
|--------|-------------------------------|
| -1 | $X > 1$ |
| 0 | $1 \geq X > 0.95$ |
| 1 | $0.95 \geq X > 0.90$ |
| 2 | $0.90 \geq X > 0.85$ |
| 3 | $X \leq 0.85$ |

#### 6.8.5.3 MOSQUES Scheme

| Levels | Background Noise (X) Indicator<br>Reverberation Time (Y) Indicator |
|--------|---------------------------------------------------------|
| -1 | $X > 1$ |
| 0 | $1 \geq X > 0.95$ |
| 1 | $0.95 \geq X > 0.90$ AND all $Y \leq 2$ |
| 2 | $0.90 \geq X > 0.85$ AND all $Y \leq 2$ |
| 3 | $X \leq 0.85$ AND all $Y \leq 2$ |

### 6.8.6   SUBMITTALS

| Provisional Certification Stage (LOC) | |
| --- | --- |
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Relevant design drawings and specifications. |
| | Manufacturer's performance catalogues or cut sheets. |
| | Building materials specifications of the room finishes. |
| **Calculator** | IE.8 Acoustics Calculator. |

| Final Certification Stage (CDA) | |
| --- | --- |
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | Relevant construction drawings and specifications. |
| **Report** | Commissioning or Acoustic Report of the HVAC systems. |
| **Calculator** | Updated IE.8 Acoustics Calculator. |

### 6.8.7    EVALUATION

#### 6.8.7.1   General

- Determine the background noise sources in the predicted room or space with worst-case scenario.

- Determine the dimensions of the space geometry and absorption property of the interior finishes of the predicted room or space with worst-case scenario.

- Classify the selected spaces into quiet and active spaces.  See the training manual for more details.

- Input the data into the calculator for IE.8. Acoustics to determine the background noise levels and reverberation time for each selected room or space

- Input the background noise levels and reverberation time generated for each of the selected spaces into the Acoustic Results calculator.

- Prepare all applicable documentation.

#### 6.8.7.2   Calculator

#### A. Inputs

Space Definition Inputs

- Input the space name, area and height

- Input the surface areas and absorption properties of the indoor finishes.

Background Noise Inputs

- Traffic Noise from the Nearby Roadways
  - Input the average number of cars passing by the nearby roadways per hour.

  - Input the average speed of the cars.

  - Input the average number of medium trucks passing by the same roadways per hour.

  - Input the average speed of the medium trucks.

  - Input the average number of heavy trucks passing by the same roadways per hour.

  - Input the average speed of the heavy trucks.

  - Input the perpendicular distance between the traffic noise sources and the receiver.

- Input the road segments angles in radians from the line of the perpendicular distance.

- Input the road gradient adjustment in dBA.

- Input the shielding adjustment in dBA of the buildings and trees between the noise sources and the receiver.

- Input the building envelope area of the room.

- Input the transmission loss of the building envelope area in dBA.

- Background Noise from Air Outlets Sounds
  - Input the distances of each air outlets to the center of the room at 1.5m height from finished floor level.

  - Input the sound power levels of each air outlets for each frequency.

- Background Noise from Radiated Sounds
  - Input the distances of each noise sources inside the ceiling to the center of the room at 1.5m height from finished floor level.

  - Input the ceiling effect attenuation for each frequency of each noise sources based on the ceiling types.

- Background Noise from Discharge Sounds
  - Input the number of elbows of the air ducts inside the ceiling.

  - Input the number of tees of the air ducts inside the ceiling.

  - Input the number of zones supplied by the air ducts.

  - Input the distance from the air outlet to the center of the room at 1.5m height from finished floor level.

  - Input the discharge sound power level for each frequency.

  - Input the end reflection sound attenuation for each frequency.

  - Input the duct insertion loss of lined air ducts for each frequency.

  - Input the tee reduction sound attenuation for each frequency.

  - Input the elbow reduction sound attenuation for each frequency.

Acoustics Results Calculator

- Enter types of predominantly occupied typical space

- Enter area represented by the worst-case scenario per each predominantly occupied typical spaces type.

- Select the classification of the space type (Quiet/Active).

- Enter Background noise and Reverberation time as calculated in Acoustics Calculator.

**B. Calculations**

Part 1 – Background Noise Calculations

Space Definition

- Room volume = calculated value based on the room area and room height.

- Sabins = calculated value based on the surface area and absorption properties of the indoor finishes.

Traffic Noise from the Nearby Roadways

- Automobile noise emission level = calculated value based on the average speed of cars.

- Medium trucks noise emission level = calculated value based on the average speed of medium trucks.

- Heavy trucks noise emission level = calculated value based on the average speed of heavy trucks.

- Automobile traffic flow adjustment = calculated value based on the average number and speed of cars.

- Medium trucks traffic flow adjustment = calculated value based on the average number and speed of medium trucks.

- Heavy trucks traffic flow adjustment = calculated value based on the average number and speed of heavy trucks.

- Distance adjustment = calculated value based on the perpendicular distance between the traffic noise sources and the receiver.

- Road segment adjustment = calculated value based on the road segments angles from the line of the perpendicular distance.

- Automobile average sound level = calculated value based on the noise emission level and the adjustment factors of the cars.

- Medium trucks average sound level = calculated value based on the noise emission level and the adjustment factors of the medium trucks.

- Heavy trucks average sound level = calculated value based on the noise emission level and the adjustment factors of the heavy trucks.

- Noise reduction = calculated value based on the Sabin value of the indoor finishes and the area and transmission loss of the building envelope.

- Sound level = calculated value based on the difference between the total average sound level and the noise reduction value.

- Total sound level = calculated value based on the total sound levels from the roadways.

Background Noise from Air Outlets Sounds

- Octave band = identified octave band number for each frequency.

- Mid frequency = identified range of frequencies.

- Environmental factor = assigned value for each octave band.

- Space effect = calculated value based on the sound power levels for each frequency of each air outlets.

- Sound pressure level = calculated value based on the space effect attenuations, sound power levels, and environmental factors for each frequency.

- Total air outlet sound pressure level = calculated value of the sound pressure levels for each frequency of all the air outlets.

- Adjustment factor = fixed value assigned for each frequency.

- Sound level from air outlets = calculated value based on the total air outlets sound pressure level and the adjustment factor.

Background Noise from Radiated Sounds

- Octave band = identified octave band number for each frequency.

- Mid frequency = identified range of frequencies.

- Environmental factor = assigned value for each octave band.

- Space effect = calculated value based on the radiated sound power levels for each frequency of each noise sources inside the ceiling.

- Sound pressure level = calculated value based on the space effect attenuations, sound radiated power levels, and environmental factors for each frequency.

- Total noise sources radiated sound pressure level = calculated value of the sound pressure levels for each frequency of all the noise sources inside the ceiling.

- Adjustment factor = fixed value assigned for each frequency.

- Sound level from radiated sounds = calculated value based on the total noise sources radiated sound pressure level and the adjustment factor.

Background Noise from Discharge Sounds

- Flow division = calculated value based on the number of zones supplied by the air ducts.

- Sound effect = calculated value based on the room volume, distance of the air outlets, and the second band mid frequency.

- Sound pressure level = calculated value based on the flow division attenuation, sound effect attenuation, end reflection attenuation, duct insertion loss, duct fittings insertion losses, and the environmental factors for each frequency.

- Total air ducts discharge sound pressure level = calculated value of the sound pressure levels for each frequency of the air ducts inside the ceiling.

- Adjustment factor = fixed value assigned for each frequency.

- Sound level from discharge sounds = calculated value based on the total air ducts discharge sound pressure level and the adjustment factor.

Total Background Noise Sound Levels

- Sound level from background noise of traffic = calculated value based on the total sound levels from the roadways.

- Sound level from background noise of air outlet = calculated value based on the total air outlets sound pressure level and the adjustment factor.

- Sound level from background noise of radiated sound = calculated value based on the total noise sources radiated sound pressure level and the adjustment factor.

- Sound level from background noise of discharge sound = calculated value based on the total air ducts discharge sound pressure level and the adjustment factor.

- Total room sound level = calculated value based on the sum of the sound levels from background noises.

Part 2 – Reverberation Time Calculations

- Reverberation time = calculated value using the Sabin equations based on the room volume, surface area and absorption properties of the indoor finishes.

Part 3 – Summary Calculations

- (X) = calculated total room sound level based on the sum of the sound levels from background noises.

- (Y) = calculated reverberation time based on the Sabin equations.

Acoustics Results Calculator

- (X) = Acoustic Indicator calculated based on the total background noises of each of the worst-case scenarios.

- (Y) = Reverberation Time for each of the worst-case scenarios

## 6.9 [IE.9] LOW-VOC MATERIALS

### 6.9.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 6.9.2 PURPOSE

To maximize the use of certified low Volatile Organic Compound (VOC) materials.

### 6.9.3 ASSESSMENT PRINCIPLES

- The Project will *assess* the number of Low-VOC materials and finishes with GSAS Approved certifications.

- The Project will complete the *calculator* for IE.9 Low-VOC Materials to establish the *criterion level*.

### 6.9.4 ASSESSMENT

The criterion requires *assessing* the number of specified Low-VOC materials with GSAS approved certification. Low-VOC materials are building materials, products, and finishes with zero or close-to-none rates of volatile organic compounds (VOC) emissions with GSAS approved certification.

The *calculator* determines the indicator based on the number of Low-VOC materials with GSAS approved certification. The calculator adds the incentive weights given for having more than six Low-VOC materials with GSAS approved certification.

The *criterion level* is established based on the result of the indicator for IE.9 Low-VOC Materials.

### 6.9.5    CRITERION LEVELS

| Levels | Number of Low-VOC Materials (X) Indicator |
|--------|-------------------------------------------|
| -1 | X < 3 |
| 0 | X = 3 |
| 1 | X = 4 |
| 2 | X = 5 |
| 3 | X = 6 |
| Incentive | 0.5% per additional Low-VOC material with GSAS approved certification |

### 6.9.6    SUBMITTALS

| Provisional Certification Stage (LOC) | |
|---------------------------------------|--|
| **Types** | **Descriptions** |
| Documents | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Evidences of proposed materials being relevant to the project, such as excerpts of the BOQ or design specifications. |
| | GSAS approved certification for Low-VOC materials. |
| Calculator | IE.9 Low-VOC Materials Calculator. |

| Final Certification Stage (CDA) | |
|---------------------------------|--|
| **Types** | **Descriptions** |
| Documents | A narrative explaining any updates or changes in the criterion assessment. |
| | GSAS approved certification for the procured Low-VOC materials. |
| | Evidences of proposed materials being used on site, such as material approval requests. |
| Calculator | Updated IE.9 Low-VOC Materials Calculator. |

### 6.9.7    EVALUATION

#### 6.9.7.1  General

- Identify from the design document the materials that potentially have VOC content.

- Identify from the market Low-VOC materials meeting the project specifications.

- Obtain GSAS approved certificates from material suppliers.

- Prepare all applicable documentation.

#### 6.9.7.2  Calculator

##### A. Inputs

Low-VOC Materials Inputs

- Input the descriptions of the Low-VOC materials following the descriptions shown in the specification or material data sheets.

- Input the name of the certificates of the specified Low-VOC materials with GSAS approved certificates.

- Follow the same inputs for the extended list of Low-VOC materials with GSAS approved certificates.  Extended list caters for other specified Low-VOC materials with GSAS approved certificates in excess of the first 6 Low-VOC materials inputted above.

##### B. Calculations

- (X) = calculated number of Low-VOC materials with GSAS approved certificates.

- (Y) = calculated incentive weights.

- IE.9 criterion level = the generated criterion level for IE.9 Low-VOC Materials plus the incentives, based on the specified range from the criterion levels.

## 6.10    [IE.10] AIRBORNE CONTAMINANTS

### 6.10.1  APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 6.10.2  PURPOSE

To provide measures for the control of potentially hazardous airborne contaminants.

### 6.10.3  ASSESSMENT PRINCIPLES

- The Project will **assess** the potential sources and control measures to mitigate the impact of hazardous airborne contaminants.
- The Project will prepare an airborne contaminants control **plan** to establish the **criterion level**.

### 6.10.4  ASSESSMENT

The criterion requires **assessing** the system of controls for potentially hazardous airborne contaminants by preparing an airborne contaminants control plan. Potentially hazardous airborne contaminants are hazardous particulates and chemical or biological contaminants that mix in the air that is supplied and recirculated in the rooms or spaces that could potentially cause a greater risk to human health and comfort of the occupants.  The plan includes identifying the potential sources and the system or measures developed to control the growth and dispersion of the potentially hazardous airborne contaminants.

The airborne contaminants control **plan** is a document that outlines the plan for controlling the sources of the potentially hazardous contaminants to mix in the indoor air.

The plan demonstrates the following requirements:

- The potential existence of the sources of hazardous airborne particulates and contaminants in the rooms or spaces.
- Systems of control or any methods to capture or isolate, reduce or dilute, and filter or remove the source emissions in the rooms or spaces during construction and post-occupancy phases of the development.
- Management policy or facility to control the environmental tobacco smoke (ETS).
- Measures for materials safety handling or ban of the use of construction materials, components, and processes with carcinogenic properties.
- Where applicable, processes described in the plan for air quality sampling tests and analysis of the airborne particulates and contaminants in the indoor air.

The **criterion level** is established based on the degree of compliance of the plan to the requirements of IE.10 Airborne Contaminants.

### 6.10.5  CRITERION LEVELS

| Levels | Requirements |
|--------|--------------|
| -1 | Plan does not demonstrate compliance with the requirements. |
| 3 | Plan demonstrates compliance with the requirements, or the development does not contain any potential sources of contamination. |

### 6.10.6  SUBMITTALS

| Provisional Certification Stage (LOC) | |
|--------|--------------|
| **Types** | **Descriptions** |
| Documents | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Relevant design drawings, air balancing diagrams/calculations, and specifications. |
| | Schedule of air cleaning devices. |
| Plan | Airborne Contaminants Control Plan. |

| Final Certification Stage (CDA) | |
|--------|--------------|
| **Types** | **Descriptions** |
| Documents | A narrative explaining any updates or changes in the criterion assessment. |
| | Relevant construction drawings, air balancing diagrams/calculations, and specifications. |
| | Relevant as-built drawings showing the updates to the previous LOC stage submittals. |
| Plan | Updated Airborne Contaminants Control Plan, when applicable. |
| Report | Commissioning or TAB Report of the ventilation system of the rooms or spaces. |

## 6.10.7  EVALUATION

**6.10.7.1 General**

- Determine any dedicated mechanical systems, exhaust systems, and negative pressure spaces for sources of contamination.

- Determine from the mechanical drawings and in the Construction Specification, all the types of filtration systems in use, and the effectiveness of these systems.

- Determine all entrances to the building and the entryway and ventilation systems used to capture any potentially harmful particles.

- Determine the list of rooms or spaces assessed to contain potential sources of hazardous airborne particulates and contaminants.

- Determine the provision of an airborne contaminants control plan that outlines the systems, methods, and measures for the control of source emissions.

- Determine the ETS policy at site.

- Determine from the design and construction documents the layouts and specification of the source emissions control.

- Determine the materials safety handling methods and list of the banned materials, components, and processes.

- Where applicable, determine the specification of air quality sampling tests and analysis of the particulates and contaminants in the indoor air.

- Prepare all applicable documentation.

## 7.0    CULTURAL & ECONOMIC VALUE

The Culture & Economic Value category is concerned with the cultural impacts in the design of the built environment and support of the national economy.

The architecture of the built environment can contribute towards the preservation of local cultural identity and heritage. Design expression should align with and integrate the development into the existing cultural fabric. In addition, the use of local materials and local workforce contributes towards the growth of the national economy.

**CRITERIA IN THIS CATEGORY:**

CE.1    Heritage & Cultural Identity

CE.2    Support of National Economy

## CRITERIA SUMMARY

The table below summarizes the weights of the Cultural & Economic Value category and each of the associated criteria:

| Legend | | | | |
|---|---|---|---|---|
| √ | Incentive Only | | **N/A** | Not Applicable |

| No | Category / Criteria | LEVELS | | WEIGHTS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MIN | MAX | Commercial | Education | Homes | Hospitality | Light Industry | Mosques | Offices | Residential |
| **IE** | **INDOOR ENVIRONMENT** | | | | | | | | | | |
| CE.1 | Heritage & Cultural Identity | -1 | 3 | 1.36% | 1.62% | 2.44% | 1.62% | N/A | 1.62% | 1.62% | 2.12% |
| CE.2 | Support of National Economy | -1 | 3 | 2.64% | 2.38% | 3.56% | 2.38% | 4.00% | 2.38% | 2.38% | 1.88% |
| | | | **Total** | 4.00% | 4.00% | 6.00% | 4.00% | 4.00% | 4.00% | 4.00% | 4.00% |

## 7.1 [CE.1] HERITAGE & CULTURAL IDENTITY

### 7.1.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 7.1.2 PURPOSE

To encourage design expression in alignment with heritage and cultural identity.

### 7.1.3 ASSESSMENT PRINCIPLES

- The Project will **assess** the architectural design expression for alignment with heritage and cultural identity.

- The Project will prepare a **concept brief** and relevant design information to establish the **criterion level**.

### 7.1.4 ASSESSMENT

The criterion requires **assessing** the architectural design of the development by reviewing and verifying the concept brief that demonstrates the alignment of design strategies and reflection of architectural design expressions with heritage and cultural identity.

The **concept brief** and presentation materials demonstrate any of the following requirements:

- Design strategies that meet the enhancement, strengthening, and reflection of heritage and cultural identity of the region.

- Architectural design expressions that harmonize with cultural values and traditions of the people.

Level 3 target requires a formal request from the development to convene the Expert Heritage Panel (EHP) for the evaluation of the submittals. Level 2 requires formal request from the development to obtain clearance from the Authority Having Jurisdiction (AHJ) to submit for evaluation.

The **criterion level** is established based on the degree of compliance of the concept brief and presentation materials to the requirements of CE.1 Heritage & Cultural Identity.

### 7.1.5 CRITERION LEVELS

| Levels | Requirements |
|---|---|
| -1 | Design expressions do not conform to GSAS Trust evaluations. |
| 0 | Design expressions generally conform to GSAS Trust evaluations. |
| 1 | Design expressions and submittals conform to GSAS Trust evaluations. |
| 2 | Design expressions and submittals conform to the evaluations of the Authority Having Jurisdiction or to the Expert Heritage Panel. |
| 3 | Design expressions and submittals conform to the evaluations of the Expert Heritage Panel. |

### 7.1.6 SUBMITTALS

| Provisional Certification Stage (LOC) | |
|---|---|
| **Types** | **Descriptions** |
| **Documents** | Concept design brief. |
| | Relevant architectural design drawings and presentation materials. |

| Final Certification Stage (CDA) | |
|---|---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | As-built architectural drawings. |

### 7.1.7   EVALUATION

**7.1.7.1  General**

- Determine the targeted Level for the assessment and notify GORD of the project intention to pursue the targeted Level.

- Identify strategies to strengthen or enhance cultural identity:

  - Conduct research into the cultural identity and traditions of the region.

  - Consult, if necessary, a local heritage expert for further recommendations and detailed guidance on the proposed design.

  - Demonstrate how the urban planning, site development, architectural form and layout, use of space, natural lighting, selection of materials, and overall aesthetic quality of the development reflect the heritage and cultural identity of the region.

  - Determine the architectural design expressions that align with and strengthen the cultural values and traditions of the region.

  - Ensure the proposed design will not degrade the cultural character of any existing buildings on adjacent properties.

  - Study the existing building fabric when designing the features and components of the new development.

  - Illustrate in the presentation narrative and materials, which can include exterior and interior 3-D renderings, how the architectural design meets the requirements of the criterion and where applicable:

    - The relationship of the development to the wider context of the city and the immediate neighborhood

    - The sequence and experience of arrival.

    - How the development will be used by occupants and visitors.

    - Features of specific interest associated with the criterion.

- Prepare all applicable documentation.

## 7.2 [CE.2] SUPPORT OF NATIONAL ECONOMY

### 7.2.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 7.2.2 PURPOSE

To maximize the value of construction expenditures benefitting the national economy.

### 7.2.3 ASSESSMENT PRINCIPLES

- The Project will **assess** the value of the construction expenditures for local goods and services benefitting national economic growth.
- The Project will complete the **calculator** for CE.2 Support of National Economy to establish the **criterion level**.

### 7.2.4 ASSESSMENT

The criterion requires **assessing** the construction expenditures of the development that benefit the national economy and support economic growth.  Construction expenditures include the fees and costs of:

- Professional and consultancy services
- Contractors and subcontractors
- Building and construction materials
- Construction tools, equipment, and machineries
- Temporary facilities and rental spaces
- Other miscellaneous expenditures

The **calculator** determines the indicator based on the percentage of construction expenditures that benefit the national economy.

The **criterion level** is established based on the result of the indicator for CE.2 Support of National Economy.

### 7.2.5 CRITERION LEVELS

| Levels | Percentage of Construction Expenditures that Benefit the National Economy (X) Indicator |
|--------|------------------------------------------------------------------|
| -1 | X < 10% |
| 0 | 10% ≤ X < 30% |
| 1 | 30% ≤ X < 40% |
| 2 | 40% ≤ X < 50% |
| 3 | X ≥ 50% |

### 7.2.6 SUBMITTALS

| Provisional Certification Stage (LOC) | |
|--------|------------------------------------------------------------------|
| **Types** | **Descriptions** |
| Documents | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Intended list of local suppliers/subcontractors. |
| | Evidence of supplier/subcontractor being local, such as the Commercial Registration. |
| | Evidence of cost estimation per supplier/subcontractor, such as excerpts of the Bill of Quantities. |
| | Evidence of the Total Construction Cost, such as excerpts of the Bill of Quantities. |
| Calculator | CE.2 Support of National Economy Calculator |

| Final Certification Stage (CDA) | |
|---|---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | Evidence of supplier/subcontractors being hired for the project, such as Material Approval Requests and Subcontractors Approval Requests. |
| | Evidence of cost related to supplier/subcontractor, such as excerpts of the Bill of Quantities. |
| | Updated Commercial Registrations, when applicable. |
| **Calculator** | Updated CE.2 Support of National Economy Calculator |

### 7.2.7 EVALUATION

**7.2.7.1 General**

- Identify in the design documents goods and services potentially provided by local companies.

- Search in the local market companies that can provide goods and services suitable for the project.

- Determine from the design documents the total construction costs.

- Input the data into the calculator for CE.2 Support of National Economy to determine the percentage of construction expenditures that benefit the national economy.

- Prepare all applicable documentation.

**7.2.7.2 Calculator**

**A. Inputs**

National Construction Expenditures Inputs

- Input the name of local suppliers/subcontractors and the description of the related goods/services in the correspondent section among:
    - Professional Services/consultations
    - Contractors/Subcontractors
    - Building Materials
    - Construction Tools/Equipment/Machinery
    - Temporary Facilities
    - Others

- Input the cost associated with the supplier/subcontractor.

- Input the total construction cost (labor, equipment, and materials, etc.).

**B. Calculations**

- Total cost of the national construction elements = sum of the construction expenditures that benefit the national economy.

- (X) = calculated percentage of construction expenditures that benefit the national economy.

- CE.2 criterion level = the generated criterion level for CE.2 Support of National Economy based on the specified range from the criterion levels.

## 8.0    MANAGEMENT & OPERATIONS

The Management & Operations category is concerned with the design of the development for use during the operational phase. The development should plan for and implement sustainable and effective building management and operations practices.

Sustainable building management and operations can mitigate environmental impacts such as water depletion, materials depletion and human comfort and health.

**CRITERIA IN THIS CATEGORY:**

MO.1    Systems Commissioning

MO.2    Waste Management

MO.3    Facility Management

MO.4    Leak Detection Systems

MO.5    Automated Control System

MO.6    Transportation Systems in Building

## CRITERIA SUMMARY

The table below summarizes the weights of the Management & Operations category and each of the associated criteria:

| Legend | | | | |
|---|---|---|---|---|
| √ | Incentive Only | **N/A** | Not Applicable | |

| No | Category / Criteria | LEVELS | | WEIGHTS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MIN | MAX | Commercial | Education | Homes | Hospitality | Light Industry | Mosques | Offices | Residential |
| **IE** | **INDOOR ENVIRONMENT** | | | | | | | | | | |
| MO.1 | Systems Commissioning | 0 | 3 | 0.99% | 0.97% | N/A | 0.97% | 0.86% | 1.52% | 0.97% | 0.94% |
| MO.2 | Waste Management | 0 | 3 | 1.09% | 0.93% | N/A | 0.92% | 0.83% | N/A | 0.93% | 0.93% |
| MO.3 | Facility Management | 0 | 3 | 0.67% | 0.56% | N/A | 0.56% | 0.71% | 0.96% | 0.56% | 0.96% |
| MO.4 | Leak Detection Systems | 0 | 3 | 0.62% | 0.79% | N/A | 0.79% | 0.94% | 0.94% | 0.79% | 0.62% |
| MO.5 | Automated Control System | 0 | 3 | 0.96% | 0.98% | N/A | 0.99% | 0.88% | 1.58% | 0.98% | 0.93% |
| MO.6 | Transportation Systems in Building | 0 | 3 | 0.67% | 0.77% | N/A | 0.77% | 0.78% | N/A | 0.77% | 0.62% |
| | | | **Total** | **5.00%** | **5.00%** | **N/A** | **5.00%** | **5.00%** | **5.00%** | **5.00%** | **5.00%** |

## 8.1     [MO.1] SYSTEMS COMMISSIONING

### 8.1.1     APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 8.1.2     PURPOSE

To develop and implement a commissioning process that ensures the delivery and performance of the systems within the development.

### 8.1.3     ASSESSMENT PRINCIPLES

- The Project will **assess** the testing, adjusting, balancing, and commissioning in addition to training requirements associated with the Project systems.

- The Project will prepare relevant commissioning **plan** or **report** to establish the **criterion level**.

### 8.1.4     ASSESSMENT

The criterion requires **assessing** the commissioning of the development systems which include, but not limited to, HVAC systems, lighting systems and controls, electrical systems, water-use systems and renewable energy systems. The assessment considers measures associated with systems planning, design, installation, testing and operations under projected occupancy loads and conditions.

The commissioning **plan** is a comprehensive document that outlines the commissioning process and the facilities to be commissioned.  Commissioning process means a quality-oriented process that meets the requirements for assessing and documenting the commissioning anywhere throughout the design and construction phases of the development.

The commissioning plan demonstrates the following requirements:

- Establishment of Commissioning Scope

- Establishment of Commissioning Program

- Establishment of Commissioning Schedules

- Establishment of Testing and Inspection Plans

- Development of Commissioning Specifications

- Determination of Special Testing Needs

- Determination of Operational Staff Training Needs

Alternatively, a commissioning ***report*** documents the limited scope of commissioning which is conducted at the final stages of the construction. The report covers the commissioning of main MEP systems in the development based on the owner or developer requirements.

The commissioning report demonstrates the following requirements:

- Records of the calibrations of the instruments and devices used for commissioning the performances of the systems.

- Records and analyses of the collected data of the performances of the systems.

- Signed-off forms and templates of the Testing & Commissioning (T&C) and Testing, Adjusting & Balancing (TAB) reports.

In addition, GSAS accredited third-party Commissioning Agent (CxA) contracted by the owner or developer prepares and leads the comprehensive GSAS commissioning plan throughout the design and construction phases in collaboration with the consultants, contractors, and operator of the facilities. The CxA develops the OPR as part of the commissioning plan, in conjunction with the project owner and ensures the requirements are quantifiable and measurable to verify that the development objectives will be achieved.

The ***criterion level*** is established based on the degree of compliance of the plan or report to the requirements of MO.1 Systems Commissioning.

### 8.1.5 CRITERION LEVELS

| Levels | Requirements |
|--------|--------------|
| 0 | Plan or Report does not demonstrate compliance with the requirements. |
| 1 | Report demonstrates compliance with the requirements for MEP systems. |
| 2 | Plan demonstrates compliance with the requirements for all systems. |
| 3 | Plan demonstrates compliance with the requirements for all systems by GSAS accredited commissioning agent (CxA). |

### 8.1.6 SUBMITTALS

| Provisional Certification Stage (LOC) | |
|---------------------------------------|--|
| **Types** | **Descriptions** |
| Document | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Commissioning Specification. |
| | List of the facilities to be commissioned. |
| Plan | For levels 2 and 3, Commissioning Plan including relevant forms and templates for the T&C and TAB Reports. |

| Final Certification Stage (CDA) | |
|---------------------------------|--|
| **Types** | **Descriptions** |
| Document | A narrative explaining any updates or changes in the criterion assessment. |
| | Updated Commissioning Specification, when applicable. |
| Plan | For levels 2 and 3, Updated Commissioning Plan, when applicable. |
| Report | For level 1, Commissioning Report |
| | Relevant T&C and TAB Reports of the results of the system commissioning. |

### 8.1.7    EVALUATION

**8.1.7.1  General**

- Confirm the provision of a commissioning report or plan that outlines the scope of works and process adopted for commissioning.

- Determine the systems to be commissioned.

- Illustrate in the presentation materials or diagrams the commissioning process adopted for the design, construction, and operations of the facilities.

- Prepare all applicable documentation.

## 8.2 [MO.2] WASTE MANAGEMENT

### 8.2.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 8.2.2 PURPOSE

To provide measures for the implementation of waste management best practice during the post-occupancy phase.

### 8.2.3 ASSESSMENT PRINCIPLES

- The Project will **assess** the measures implemented for managing organic waste and recyclable materials on- or off-site.

- The Project will prepare a waste management **plan** to establish the **criterion level**.

### 8.2.4 ASSESSMENT

The criterion requires **assessing** the best practices adopted for the management of the wastes produced by the development by preparing a waste management plan. The plan includes the measures and strategies to be implemented for the proper handling and disposal of organic waste and recyclable materials of the development.

The waste management **plan** is a document that outlines the plan for managing waste produced during the post-occupancy stage of the development.

The plan demonstrates the following requirements:

- System for the collection and transfer of organic waste

- System for collection, segregation and transfer of recyclable waste.

- Provision for ventilation of facilities for the storing and sorting of wastes prior to its final disposal.

- Process for composting the organic waste and recycling of materials on- or off-site.

The **criterion level** is established based on the degree of compliance of the plan to the requirements of MO.2 Waste Management.

### 8.2.5    CRITERION LEVELS

| Levels | Requirements |
|:---:|:---|
| 0 | Plan does not demonstrate compliance with the requirements. |
| 1 | Plan demonstrates compliance with the requirements of collection, storage, and final disposal of waste. |
| 2 | Plan demonstrates partial compliance with the requirements. |
| 3 | Plan demonstrates full compliance with the requirements. |

### 8.2.6    SUBMITTALS

| Provisional Certification Stage (LOC) | |
|:---:|:---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Relevant design drawings and specifications of waste storage and collection area/s. |
| | Relevant design drawings and specifications of composting facilities on-site, when applicable. |
| | Evidence of contractually binding commitment to composting organic waste off-site, when applicable. |
| | Evidence of contractually binding commitment to recycling waste off-site, when applicable. |
| | Relevant waste management process diagram. |
| **Plan** | Waste Management Plan. |

| Final Certification Stage (CDA) | |
| --- | --- |
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | Relevant updated specifications of waste storage and collection areas/s and on-site composting facilities, when applicable. |
| | Relevant as-built drawings. |
| **Plan** | Updated Waste Management Plan, when applicable. |

## 8.2.7    EVALUATION

### 8.2.7.1  General

- Partial compliance for this criterion is associated with the plan demonstrates compliance with the requirements of collection, storage, final disposal of waste and either the composting requirements of organic waste OR the recycling requirements of the recyclable waste on- or off-site.

- Full compliance for this criterion is associated with the plan demonstrates compliance with the requirements of collection, storage, final disposal of waste and both the composting requirements of organic waste AND the recycling requirements of the recyclable waste on- or off-site.

- Confirm the provision of a waste management plan.

- Illustrate in the design drawings the facilities for the collection, storage, and segregation of the organic waste and recyclable waste.

- Illustrate in the design drawings the facilities for the on-site composting facilities, when applicable.

- Obtain from the owner contractually binding commitment documents for off-site composting, when applicable.

- Obtain from the owner contractually binding commitment documents for off-site recycling of waste.

- Prepare all applicable documentation.

## 8.3 [MO.3] FACILITY MANAGEMENT

### 8.3.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 8.3.2 PURPOSE

To provide measures for the implementation of facility management best practice during the post-occupancy phase.

### 8.3.3 ASSESSMENT PRINCIPLES

- The Project will **assess** the measures implemented for the management, operation, and maintenance of the development.

- The Project will prepare a facility management **plan** to establish the **criterion level**.

### 8.3.4 ASSESSMENT

The criterion requires **assessing** the best practices adopted for the operational management of the facility and the upkeep of the property assets of the development by preparing a facility management plan.

The facility management **plan** is a document that outlines the sustainable approach to the strategic management process for operating and maintaining a facility.  A sustainable approach indicates there is a comprehensive model followed for strategic planning.

The plan demonstrates the following requirements:

- Provisions required for proper housekeeping of the development operations including janitorial, help desk support, storing facility, security, etc.

- Provisions required for proper operation and maintenance of the development including building maintenance unit, access control, surveillance, MEP associated services, etc.

The **criterion level** is established based on the degree of compliance of the plan to the requirements of MO.3 Facility Management.

### 8.3.5  CRITERION LEVELS

| Levels | Requirements |
|:---:|:---|
| 0 | Plan does not demonstrate compliance with the requirements. |
| 1 | Plan demonstrates partial compliance with the requirements. |
| 3 | Plan demonstrates full compliance with the requirements. |

### 8.3.6  SUBMITTALS

| Provisional Certification Stage (LOC) | |
|:---:|:---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Relevant schematics, diagrams, and illustrations. |
| | Relevant forms and templates. |
| | Lists of green supply chains and management standards. |
| **Plan** | Facility Management Plan. |

| Final Certification Stage (CDA) | |
|:---:|:---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | Relevant construction drawings and specifications. |
| | Relevant handover documents showing the updates to the previous LOC stage submittals. |
| | Proof of contractually binding commitment from the Client stating the targeted GSAS-OP certification. |
| **Plan** | Updated Facility Management Plan, when applicable. |

### 8.3.7    EVALUATION

**8.3.7.1  General**

- Partial compliance for this criterion demonstrates that the facility management plan is meeting the requirements of either soft OR hard facility management services.

- Full compliance for this criterion demonstrates that the facility management plan is meeting the requirements of both soft AND hard facility management services.

- Confirm the provision of a facility management plan for the post-occupancy operational phase.

- Illustrate in the presentation material the comprehensive model of the strategic management process followed for the strategy formulation, implementation, and evaluation of the facility operations.

- Prepare all applicable documentation.

## 8.4 [MO.4] LEAK DETECTION SYSTEMS

### 8.4.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 8.4.2 PURPOSE

To install leak detection systems for major water supply and refrigerant pipes.

### 8.4.3 ASSESSMENT PRINCIPLES

- The Project will **assess** the installation of:
  - A leak detection system in the major water supply lines.
  - A refrigerant leak detection system in the air-conditioning systems.
- The Project will prepare a leak detection **plan** to establish the **criterion level**.

### 8.4.4 ASSESSMENT

The criterion requires **assessing** the systems for detecting refrigerant leaks in large air-conditioning and refrigeration installations and water leaks in major water supply lines by preparing a leak detection plan. The large air-conditioning and refrigeration installations that requires refrigerant leak detection system are the refrigeration plant of the central chilled water system, the refrigerant network (RefNet) system of the direct expansion (DX) plant, and other refrigeration systems that use stratospheric ozone-depleting substances such as the cold rooms, walk-in coolers and freezers, and refrigerated display cabinets. The major water supply lines that requires water leak detection system are the water supply mains to the development and the main distribution lines to the wet areas such as the showers and bathrooms, toilets, laundry facilities, water filtration and pump rooms, and water tank rooms.

The leak detection **plan** is a document that outlines the development's plan for the systems for automatic detection of refrigerant and water leaks.

The plan demonstrates the following requirements:

- Provision of a system for the automatic detection of the refrigerant leaks in the large air-conditioning and refrigeration plants.
- Provision of a system for the automatic detection of the water leaks in the water supply mains and distribution lines.
- Layouts, schematics, sequence of operations, and specifications to understand the functionalities of the provided leak detection systems.
- Training schedules and modules for the facility management personnel on the proper operations and maintenance of the leak detection systems.

The **criterion level** is established based on the degree of compliance of the plan to the requirements of MO.4 Leak Detection Systems.

### 8.4.5 CRITERION LEVELS

| Levels | Requirements |
|:---:|---|
| 0 | Plan does not demonstrate compliance with the requirements. |
| 1 | Plan demonstrates partial compliance with the requirements. |
| 3 | Plan demonstrates full compliance with the requirements. |

### 8.4.6 SUBMITTALS

| Provisional Certification Stage (LOC) | |
|---|---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Relevant design drawings, diagrams, and specifications. |
| | Where applicable, the BMS schedule of points and control system showing the leak detection system integration with the BMS. |
| **Report** | Relevant commissioning reports |
| **Plan** | Leak Detection Plan. |

| Final Certification Stage (CDA) | |
|---|---|
| **Types** | **Descriptions** |
| **Documents** | A narrative explaining any updates or changes in the criterion assessment. |
| | Relevant construction drawings, diagrams, and specifications. |
| | Relevant as-built drawings. |
| **Plan** | Updated Leak Detection Plan, when applicable. |

### 8.4.7    EVALUATION

#### 8.4.7.1  General

- Partial compliance for this criterion demonstrates the installation of leak detection system for major water supply lines OR refrigeration installations.

- Full compliance for this criterion demonstrates the installation of leak detection system for major water supply lines AND refrigeration installations.

- Confirm the provision of a system for detecting refrigerant leaks in the large air-conditioning and refrigeration installations.

- Confirm the provision of a system for detecting water leaks in the water supply mains and distribution lines.

- Illustrate in the presentation material the reliability of the chosen leak detection systems to provide real time responses to refrigerant and water leaks.

- Ensure that leak detection systems meet the following requirements:

  - Be capable of detecting higher than normal flow rates at water meters for longer than a pre-set period of time.

  - Be capable of identifying various levels of leakage rates.

  - Be programmable and adjustable.

  - Be clearly audible.

  - Minimize the possibility of false alarms.

  - Provide refrigerant recovery system where necessary.

- Prepare all applicable documentation.

## 8.5 [MO.5] AUTOMATED CONTROL SYSTEM

### 8.5.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 8.5.2 PURPOSE

To provide automated control system(s) that optimize the operational performance of the facility.

### 8.5.3 ASSESSMENT PRINCIPLES

- The Project will **assess** the installation and commissioning of an automated control system to manage HVAC, lighting, and irrigation systems.

- The Project will prepare an automated control system **plan** to establish the **criterion level**.

### 8.5.4 ASSESSMENT

The criterion requires **assessing** the system of automated controls for the energy and water systems of the facility by preparing an automated control system plan. The energy systems of the facility for assessment of its automated controls include the air-conditioning and ventilation systems and the lighting system. The water system of the facility for assessment of its automated controls includes the irrigation system only.

The automated control system **plan** is a document that outlines the development's plan for a system of automated controls and monitoring of the operational performance of the listed energy and water systems from above.

The plan demonstrates the following requirements:

- Provision of a system for the automated controls and monitoring of the energy and water systems of the facility.

- Layouts, schematics, sequence of operations, and specifications to understand the functionalities of the provided automated control system.

- Training schedules and modules for the facility management personnel on the proper operations and maintenance of the control system.

- Handover documents for the facility management.

The **criterion level** is established based on the degree of compliance of the plan to the requirements of MO.5 Automated Control System.

### 8.5.5    CRITERION LEVELS

| Levels | Requirements |
|--------|--------------|
| 0 | Plan does not demonstrate compliance with the requirements. |
| 1 | Plan demonstrates compliance with the requirements for either in the energy systems or water systems. |
| 3 | Plan demonstrates full compliance with the requirements for both the energy systems and water systems. |

### 8.5.6    SUBMITTALS

| Provisional Certification Stage (LOC) | |
|--------|--------------|
| **Types** | **Descriptions** |
| Documents | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Relevant design drawings, control diagrams, BMS schedule of points, specifications, and sequence of operations. |
| Plan | Automated Control System Plan. |

| Final Certification Stage (CDA) | |
|--------|--------------|
| **Types** | **Descriptions** |
| Documents | A narrative explaining any updates or changes in the criterion assessment. |
| | Relevant construction drawings, control diagrams, specifications, and sequence of operations. |
| | Relevant as-built drawings. |
| Report | Relevant commissioning reports |
| Plan | Updated Automated Control System Plan, when applicable. |

### 8.5.7 EVALUATION

#### 8.5.7.1 General

- Partial compliance for this criterion demonstrates the installation of an automated system control for either water OR energy systems.

- Full compliance for this criterion demonstrates the installation of automated system control for both water AND energy systems.

- Confirm the provision of a system of automated controls for the energy systems of HVAC and lighting, and water system of irrigations.

- Illustrate in the presentation material the significant features and functionalities of the control system that contributes to the optimization of the operational performance of the facilities.

- Prepare all applicable documentation.

## 8.6 [MO.6] TRANSPORTATION SYSTEMS IN BUILDING

### 8.6.1 APPLICABILITY

COMMERCIAL | EDUCATION | HOMES | HOSPITALITY | LIGHT INDUSTRY | MOSQUES | OFFICES | RESIDENTIAL

### 8.6.2 PURPOSE

To provide an effective automated means of travel for occupants and users between floors and spaces in the development.

### 8.6.3 ASSESSMENT PRINCIPLES

- The Project will **assess** the installation of robust, efficient and adequate automated vertical and horizontal transportation systems in the development.
- The Project will prepare transportation systems **plan** to establish the **criterion level**.

### 8.6.4 ASSESSMENT

The criterion requires **assessing** the vertical and horizontal automated transportation systems by preparing a transportation systems plan. The assessment considers several factors when selecting any mechanical equipment used for circulation in buildings including, but not limited to the shape and size of the building, number of people, purpose of building, distribution of occupants and type of occupants e.g. children, the elderly or less able-bodied, in addition to traffic behaviour and occupancy loads.

The transportation systems **plan** is a document that that outlines the development's plan for transportation systems in the building considering the operational performance of the vertical and horizontal systems.

The plan demonstrates the following requirements:

- Passenger traffic demand and traffic flows
- Building functionality, form and layout arrangements
- Where applicable, results of simulation software used to determine the design requirements of the transportation systems.
- Identification of appropriate numbers of vertical and horizontal transportation, type, capacity and speed.
- Design specifications and selection of equipment and systems based on the recognized codes and standards applicable to the region.
- Provisions to meet the requirements for use by persons with disabilities.
- Energy management and control strategies.

The **criterion level** is established based on the degree of compliance of the plan to the requirements of MO.6 Transportation Systems in Buildings.

### 8.6.5 CRITERION LEVELS

| Levels | Requirements |
|--------|--------------|
| 0 | Plan does not demonstrate compliance with the requirements. |
| 3 | Plan demonstrates full compliance with the requirements. |

### 8.6.6 SUBMITTALS

| Provisional Certification Stage (LOC) | |
|---------------------------------------|--|
| **Types** | **Descriptions** |
| Documents | A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions. |
| | Relevant design drawings, control diagrams, specifications, and sequence of operations. |
| Plan | Transportation Systems Plan. |

| Final Certification Stage (CDA) | |
|---------------------------------|--|
| **Types** | **Descriptions** |
| Documents | A narrative explaining any updates or changes in the criterion assessment. |
| | Relevant construction drawings, control diagrams, specifications, and sequence of operations. |
| | Relevant as-built drawings and testing and commissioning reports. |
| Plan | Updated Transportation Systems Plan, when applicable. |

### 8.6.7 EVALUATION

**8.6.7.1 General**

- Determine the passenger traffic demand and analyze passenger traffic flows.

- Determine the building functionality, form and layout arrangements to ensure the incorporation of these parameters into the design of the proposed transportation systems.

- Use, if necessary, simulation software to determine the design requirements of the transportation systems.

- Design the transportation systems according to recognized codes and standards applicable to the region, building typology, uses and user requirements.

- Specify vertical and horizontal transportation to meet the requirements of handling capacity and robustness in terms of for example: number of lifts, size, speed, waiting time, response time depending on the expected usage and building type.

- Design elevators to meet the requirements for use by persons with disabilities.

- Specify proper control and energy management of equipment.

- Prepare all applicable documentation.

# TERMS AND ABBREVIATIONS

| A | |
|---|---|
| ADPI | Air Diffusion Performance Index |
| ADT | Average Daily Trips |
| ASHRAE | The American Society of Heating, Refrigerating, and Air-Conditioning Engineers |

| B | |
|---|---|
| BOQ | Bill of Quantities |

| C | |
|---|---|
| Carcinogenic | Material substances agents with properties known to promote cancer. |
| CDA | Conformance to Design Audit |
| CDA stage | The stage of GSAS certification for obtaining the final certificate. |
| CIBSE | Chartered Institution of Building Services Engineers |
| Criterion level | The established level of the assessed criterion for meeting the requirement of Level (–1), (0), (1), (2), or (3). |

| D | |
|---|---|
| Development | The real estate development or the site development or the building project. |
| DGI | Daylight Glare Index |
| DNL | Day-Night Sound Level |

| E | |
|---|---|
| Eco-labeling | Labeling of products and materials with enhanced environmental, health, and resources conservation attributes. |
| ETS | Environmental Tobacco Smoke |

| G | |
|---|---|
| GORD | Gulf Organisation for Research & Development |
| Green transportation | Mode of transportation that does not rely on fossil fuel. |
| GSAS | Global Sustainability Assessment System |

| GSAS commissioning plan | In systems commissioning, it means a comprehensive document that outlines the commissioning process and the facilities to be commissioned. |
|---|---|
| GSAS-CM | GSAS Construction Management |

| **I** | |
|---|---|
| IESNA | Illuminating Engineering Society of North America |
| Illuminance | The measure of the amount of light received on a surface. |
| Indicator | (X), (Y), and (Z) in the criterion level. |
| Indicator result | The values of (X), (Y), and (Z) indicators. |

| **L** | |
|---|---|
| Light trespass | Obtrusive light which causes annoyance, discomfort, distraction, or a reduction in visibility. |
| LOC | Letter of Conformance |
| LOC stage | The stage of GSAS certification for obtaining the LOC. |

| **M** | |
|---|---|
| MDS | Material Data Sheet |
| MEP | Mechanical, Electrical, and Plumbing |
| MEPF | Mechanical, Electrical, Plumbing, and Fire Protection |

| **P** | |
|---|---|
| PMV | Predicted Mean Vote |
| Project, the | The project stakeholders including client, design team and consultants. |

| **R** | |
|---|---|
| Reflectance | The ratio of the amount of light reflected by a surface over the total amount of light incident on the surface. |

| **S** | |
|---|---|
| Sustainable approach | In facility management plan, it means there is a comprehensive model followed for strategic planning. |
| Sustainable parking spaces | In eco-parking, it means parking types are designed and built with sustainable techniques. |

| Sustainable techniques | In eco-parking, it means techniques that mitigate the negative impacts of heat island effect, rainwater runoff, and other open hardscapes with no shadings |
|---|---|

| **T** | |
|---|---|
| TAB | Testing, Adjusting and Balancing |
| T&C | Testing and Commissioning |
| Transmittance | The ratio of the amount of light passing through the surface over the total amount of light incident on the surface. |

| **U** | |
|---|---|
| ULE | Upward Light Emission |

| **V** | |
|---|---|
| VOC | Volatile Organic Compound |

## END USER'S AGREEMENT TO THE TERMS AND CONDITIONS OF USE OF THIS MANUAL

The use of this assessment manual is governed by the end user's agreement to the following terms and conditions.

This manual is designed, developed and maintained by the Gulf Organisation for Research & Development (GORD) with business address located in Doha, State of Qatar.

Careful attention to details were exerted in the creation of this manual to ensure the accuracy, clarity, and relevancy of the contents. However, the same should not be construed as a statement of law or used for any legal purposes.

For any clarifications or inquiries, users are advised to verify or check with GSAS Trust, a division of GORD with website address at www.gord.qa, and to obtain appropriate professional advice.

GORD or any of its centers of excellence, under any circumstances be liable for any cost, expense, loss, or damage from the use or loss of use of the information in this manual.

Dispute or claim in connection with the use or loss of use of the information contained in this manual are subject to the jurisdiction of the courts in the State of Qatar.

The information contained in this manual could include pointers or links to information created and maintained by non-Government or private organisations.

GORD is providing these links and guides solely for your information and convenience.

External sources are subject to the privacy and security policies of its owners/sponsors and are outside GORD's domain.

GORD does not guarantee the availability of such outside sources or linked pages at all times.

GORD cannot authorize the use of copyrighted materials contained in external sources or linked websites.

Users are advised to request such authorization from the owner of the outside sources or related sites.

GORD does not provide any guarantees on the accuracy, currency, and relevancy of the pointed or linked information from external sources.

By proceeding to download or receive this manual, you now agree to be bounded by the terms and conditions of use set forth in this manual.

**Building Sustainably**

Crafting a Green Legacy