GSAS OPERATIONS
ASSESSMENT & GUIDELINES MANUAL

GLOBAL SUSTAINABILITY ASSESSMENT SYSTEM
GSAS
2007

Building Sustainably

FOR EXISTING BUILDINGS

Dr. Yousef Alhorr, Founding Chairman

4th Edition • Issue 2

GORD
المنظمة الخليجية للبحث والتطوير
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GSAS OPERATIONS: ASSESSMENT & GUIDELINES MANUAL FOR EXISTING BUILDINGS

4th Edition • Issue 2

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Dr. Yousef Mohammed Alhorr
Founding Chairman

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A MESSAGE FROM

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

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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 buildings and infrastructure 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 totaling more than 217,000,000 square feet of built-up area and more than 1,872,000,000 square feet of district master planning, 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 predesign to post-occupancy.

GSAS Operations certification aims to reduce the environmental impacts of existing buildings, to improve health and well-being and occupant satisfaction by adopting the best practice available. Irrespective of how buildings are designed and built, the actual sustainability footprint largely depends upon how buildings are operated. GSAS Operations certification emphasizes the importance of operational and maintenance practices and the resulting building performance.

The purpose of this manual is to provide projects with guidance and instructions on the assessment approach established by GSAS Trust to meet GSAS Operations certification requirements. It serves as a great tool in the hands of practitioners and building operators to adopt best practice and objectively demonstrate the minimized impact of building operations on six key aspects: energy consumption, water consumption, waste management, indoor environment, facility management and environmental policy & awareness.

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 reports, plans, calculators, and how to achieve the criterion levels. In addition, the manual lists the type and description of the supporting materials that the project is required to submit to demonstrate compliance.

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

SECTION (I)

CERTIFICATION OVERVIEW

1.0 INTRODUCTION

Building operations have a direct impact on the natural environment, the economy, and human health. These aspects can be improved through the way in which buildings are operated. The potential benefits of green building practices in operations are:

- Optimized energy use and reduced greenhouse gas emissions
- Optimized water use
- Improved indoor environmental quality
- Enhanced human comfort and well-being
- Improved occupant productivity
- Reduced operating and maintenance costs
- Increased environmental awareness

GSAS Operations certification aims to reduce the environmental impacts of existing buildings, to improve health and well-being and occupant satisfaction by adopting the best practice available. Irrespective of how buildings are designed and built, the actual sustainability footprint largely depends upon how buildings are operated.

GSAS Operations certification emphasizes the importance of operational and maintenance practices and the resulting building performance. The certification evaluates and rates how well the facility is managed and maintained to enable long-term sustainable operations at high performance levels. The assessment of building operations is an ongoing process that can evaluate the sustainability performance of an existing building over the course of its life.

2.0 SCOPE AND APPLICABILITY

GSAS Operations addresses the management, operation and maintenance of all types and ages of existing buildings, from a zone within a building, a single building to large buildings with multiple zones.

GSAS Operations can be used to evaluate the following building typologies:

- COMMERCIAL
- EDUCATION
- HEALTHCARE
- HOSPITALITY
- LIGHT INDUSTRY
- MOSQUES
- OFFICES
- RAILWAYS
- RESIDENTIAL
- SPORTS
- OTHERS

Buildings that can be rated using GSAS Operations include existing, newly built or renovated buildings, irrespective of whether they have been rated for GSAS Design & Build or not.

Target users of GSAS Operations are building owners, developers, planners, consultants, contractors, facility managers, building administrators, commissioning engineers, environmentalists, and the building occupants.

Projects that can submit for GSAS Operations certification may comprise the full facility or part(s) of the facility.

3.0 CATEGORIES AND CRITERIA

GSAS Operations consists of the following criteria: Energy [E], Water [W], Indoor Environment [IE] which includes Thermal comfort, Air Quality, Lighting, Day Light & Views and Acoustics, Waste Management [WM], Facility Management [FM] and Environmental Policy & Awareness [EPA]. Each criterion measures the operational environmental impacts and outlines the ways in which facility operators can mitigate the negative sustainability effects.

The criteria are used to evaluate various building types using uniform processes and assessment principles. Where necessary, the system recognizes the differences between the inherent features of building types and the impact caused by their operational profiles which are taken into consideration in developing the system tools and protocols.

Each of the above criteria is outlined below:

Energy [E]

The Energy criterion considers aspects associated with the total energy use of a facility that result in harmful emissions and climate change.

Water [W]

The Water criterion considers aspects associated with water consumption and reuse in order to mitigate the mitigate the impact on available water resources.

Indoor Environment [IE]

The Indoor Environment category considers aspects associated with indoor environmental quality to ensure human health, comfort and well-being.

Waste Management [WM]

The Waste Management criterion considers aspects associated with building operational practice for waste reduction, reuse and recycling to mitigate environmental impacts on landfills.

Facility Management [FM]

The Facility Management criterion considers aspects associated with practices and strategies implemented to ensure that facilities are operated and maintained in a sustainable manner.

Environmental Policy & Awareness [EPA]

The Environmental Policy & Awareness criterion considers aspects associated with educational campaigns for green initiatives and environmental awareness towards energy & water saving and improved indoor environment quality.

4.0 CRITERIA SUMMARY

The table below summarizes the weights of GSAS Operations criteria and incentives:

<table>
<tr><th rowspan="2">No.</th><th colspan="2" rowspan="2">Category / Criteria</th><th rowspan="2">Weight (%)</th><th rowspan="2">Incentive Weight (%)</th><th colspan="2">LEVEL</th><th colspan="2">BAND</th></tr>
<tr><th>Min</th><th>Max</th><th>Min</th><th>Max</th></tr>
<tr><td>[E]</td><td colspan="2">ENERGY</td><td>32.00%</td><td>12.50%</td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td colspan="2">As Built</td><td>9.00%</td><td></td><td>0</td><td>3</td><td>G</td><td>A*</td></tr>
<tr><td></td><td colspan="2">As Operated</td><td>23.00%</td><td></td><td>0</td><td>3</td><td>G</td><td>A*</td></tr>
<tr><td colspan="9">Incentives:</td></tr>
<tr><td colspan="3">- Sub-metering</td><td></td><td>2.50%</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="3">- 2.50% Renewable Energy Supply</td><td></td><td>2.50%</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="3">- 100% Solar Hot Water Supply</td><td></td><td>2.50%</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="3">- GSAS Accredited Commissioning Agent Service Provider</td><td></td><td>5.00 %</td><td></td><td></td><td></td><td></td></tr>
<tr><td>[W]</td><td colspan="2">WATER</td><td>16.00%</td><td>2.50%</td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td colspan="2">As Built</td><td>5.00%</td><td></td><td>0</td><td>3</td><td>G</td><td>A*</td></tr>
<tr><td></td><td colspan="2">As Operated</td><td>11.00%</td><td></td><td>0</td><td>3</td><td>G</td><td>A*</td></tr>
<tr><td colspan="9">Incentives:</td></tr>
<tr><td colspan="3">- Sub-metering</td><td></td><td>2.50%</td><td></td><td></td><td></td><td></td></tr>
<tr><td>[IE]</td><td colspan="2">INDOOR ENVIRONMENT</td><td>30.00%</td><td></td><td></td><td></td><td colspan="2">Not Applicable</td></tr>
<tr><td>IE.1</td><td colspan="2">Thermal Comfort</td><td>10.00%</td><td></td><td>0</td><td>3</td><td></td><td></td></tr>
<tr><td>IE.2</td><td colspan="2">Air Quality</td><td>8.00%</td><td></td><td>0</td><td>3</td><td></td><td></td></tr>
<tr><td>IE.3</td><td colspan="2">Lighting</td><td>5.00%</td><td></td><td>0</td><td>3</td><td></td><td></td></tr>
<tr><td rowspan="2">IE.4</td><td rowspan="2">Daylight & Views</td><td>Daylight</td><td>2.00%</td><td></td><td>0</td><td>3</td><td></td><td></td></tr>
<tr><td>Views</td><td>2.00%</td><td></td><td>0</td><td>3</td><td></td><td></td></tr>
<tr><td>IE.5</td><td colspan="2">Acoustics</td><td>3.00%</td><td></td><td>0</td><td>3</td><td></td><td></td></tr>
</table>

No.	Category / Criteria	Weight (%)	Incentive Weight (%)	LEVEL		BAND	
				Min	Max	Min	Max
[WM]	**WASTE MANAGEMENT**	**7.00%**	**5.00%**	**0**	**3**	Not Applicable	
Incentives:							
	- GSAS Accredited Waste Management Service Provider		5.00%				
[FM]	**FACILITY MANAGEMENT**	**9.00%**	**5.00%**	**0**	**3**	Not Applicable	
Incentives:							
	- GSAS Accredited Facility Management Service Provider		5.00%				
[EPA]	**ENVIRONMENTAL POLICY & AWARENESS**	**6.00%**		**0**	**3**	Not Applicable	
TOTAL		**100.00%**	**25.00%**				

5.0 SCHEMES & MARKS

There are TWO types of schemes and TWO types of Marks offered under GSAS Operations certification as described below:

5.1 OPERATIONS STANDARD SCHEME

The Standard Scheme covers Energy, Water, Waste Management, Facility Management and Environmental Policy & Awareness criteria. Projects which show compliance will receive a GSAS-OP certificate and plaque.

5.2 OPERATIONS PREMIUM SCHEME

The Premium Scheme covers Indoor Environment category in addition to the Standard Scheme criteria. Projects which show compliance will receive a GSAS-OP certificate and plaque.

5.3 ENERGY NEUTRAL MARK

The Energy Neutral Mark covers only Energy category in addition to providing 100% of annual energy requirements of the project through on-site renewable energy sources. Projects which show compliance will receive an “Energy Neutral Mark”.

An Energy Neutral building or Zero-Energy Building can be defined as a building that produces enough renewable energy to meet its own annual energy consumption requirements, thereby reducing the use of non-renewable energy in the building sector.

5.4 HEALTHY BUILDING MARK

The Healthy Building Mark covers only Indoor Environment category in addition to Waste Management and Facility Management criteria. Projects which show compliance will receive a “Healthy Building Mark”.

Mandatory Requirements and Important Notes

1. Standard scheme covers [E], [W], [WM], [FM] & [EPA], where:
    - Targeting all five criteria is mandatory to obtain GSAS certification.
    - Compliance in [E] Energy and [W] Water criteria with a minimum Level of 1 in each, is mandatory to obtain GSAS Gold certification.
    - Maximum attainable rating for Standard scheme is Gold rating.

2. Premium scheme covers [E], [W], [IE], [WM], [FM] & [EPA], where:
    - Targeting all six criteria is mandatory to obtain GSAS certification.
    - Compliance in [E] Energy and [W] Water criteria with a minimum Level of 1 in each, is mandatory to obtain GSAS Platinum certification or above.
3. Energy Neutral Mark covers only [E], where:
    - Targeting Energy criteria is mandatory to obtain Energy Neutral Mark.
    - Compliance in [E] Energy, with a minimum Level of 3 in each, is mandatory to obtain Energy Neutral Mark.
    - Compliance with 100% of annual energy requirements is mandatory to obtain Energy Neutral Mark.
4. Healthy Building Mark covers [IE], [WM] & [FM], where:
    - Targeting all three criteria is mandatory to obtain GSAS certification.
    - Compliance in [WM] Waste Management and [FM] Facility Management criteria with a minimum Level of 1 is mandatory to obtain Healthy Building Mark.
    - Compliance in [IE] Indoor Environment criteria with a minimum Level of 1 is mandatory to obtain GSAS certification, except [IE.2] Air Quality.
    - Compliance in [IE.2] Air Quality criterion with a minimum Level of 2 is mandatory to obtain Healthy Building Mark.
5. All projects targeting Diamond rating should demonstrate that at least 10% of the total electrical demand load of the facility is supplied using onsite renewable energy.
6. The [IE.2] Air Quality criterion under the Indoor Environment category covers the assessment of physicochemical pollutants of indoor air quality. It also covers the assessment of the active microbial agents of the indoor spaces.
7. An Air Quality Validation Audit is compulsory after two years from certificate issuance for projects targeting Healthy Building Mark. For non-standard buildings such as airports, transient facilities, hospitality, and healthcare buildings, an Air Quality Audit is required each year. GSAS Trust conducts on-site measurements for air quality parameters to ensure compliance with specified limits in GSAS Operations Manual.
8. The engagement of GSAS Accredited Service Providers in Waste Management and Facility Management categories will enable the project to be eligible to earn extra incentive weights.

6.0 CERTIFICATION RATINGS

6.1 STANDARD & PREMIUM SCHEMES

Five certification ratings are introduced for GSAS Operations Schemes to recognize the project achievement of measuring the sustainability impact of operational practices for a specific building type. These are Bronze, Silver, Gold, Platinum, and Diamond ratings, with Bronze representing the lowest achievement and Diamond representing the highest. The maximum attainable rating for Standard Scheme is Gold, while Platinum Schemes can reach up to Diamond rating. Each rating corresponds to a specific range of the aggregated score of all criteria as depicted in Figure 1 below.

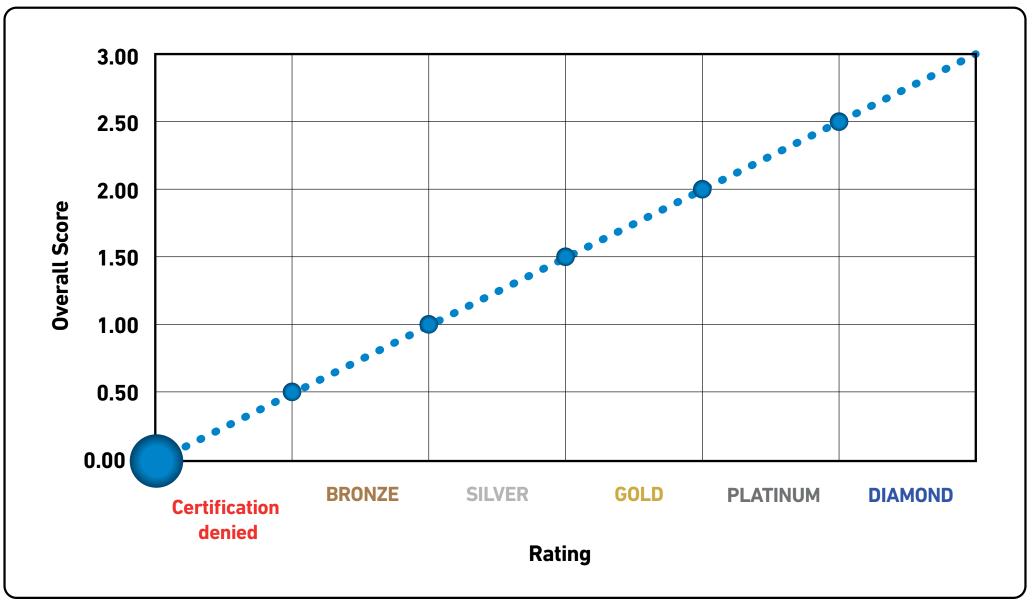

Figure 1: GSAS-OP Certification Rating

Assessment of criteria in GSAS Operations is either quantitative and/or qualitative. In GSAS Operations, level 0 refers to “evidence not acceptable” or “requirements not attained” and levels from 1 to 3 refers to gradual improvements in the sustainable practices related to the operation and maintenance of the building.

Each criterion has an associated weight based on the relative environmental, social, and economic impact. Once a level is assigned to each criterion in the assessment system, the values are multiplied by the weights to obtain the overall score which is then translated into a corresponding project rating. Certification can only be achieved when the final score is equal or greater than 0.5, earning a Bronze rating. The highest rating applicable to a project is Diamond, corresponding to a minimum score of 2.5 to a maximum limit of 3.0 (refer Figure 2).

SCORE	RATING
$X < 0.5$	CERTIFICATION DENIED
$0.5 \le X < 1.0$	BRONZE
$1.0 \le X < 1.5$	SILVER
$1.5 \le X < 2.0$	GOLD
$2.0 \le X < 2.5$	PLATINUM
$X \ge 2.5$	DIAMOND

Figure 2: GSAS-OP Tabulated Certification Scores and Ratings

The levels for the Energy and Water categories are obtained based on the building performance compared to a standardized benchmark specified for each type of building. Benchmarks for GSAS Operations are tailored to and vary from those used in GSAS Design & Build certification, taking into consideration the parameters related to the actual use of the building.

To demonstrate the performance of the project in Energy and Water categories, the levels are divided into bands ranging from A* to G, where A* represents the most efficient. The visual representations of bands achieved in these categories are illustrated in the Figures (3a) & (3b).

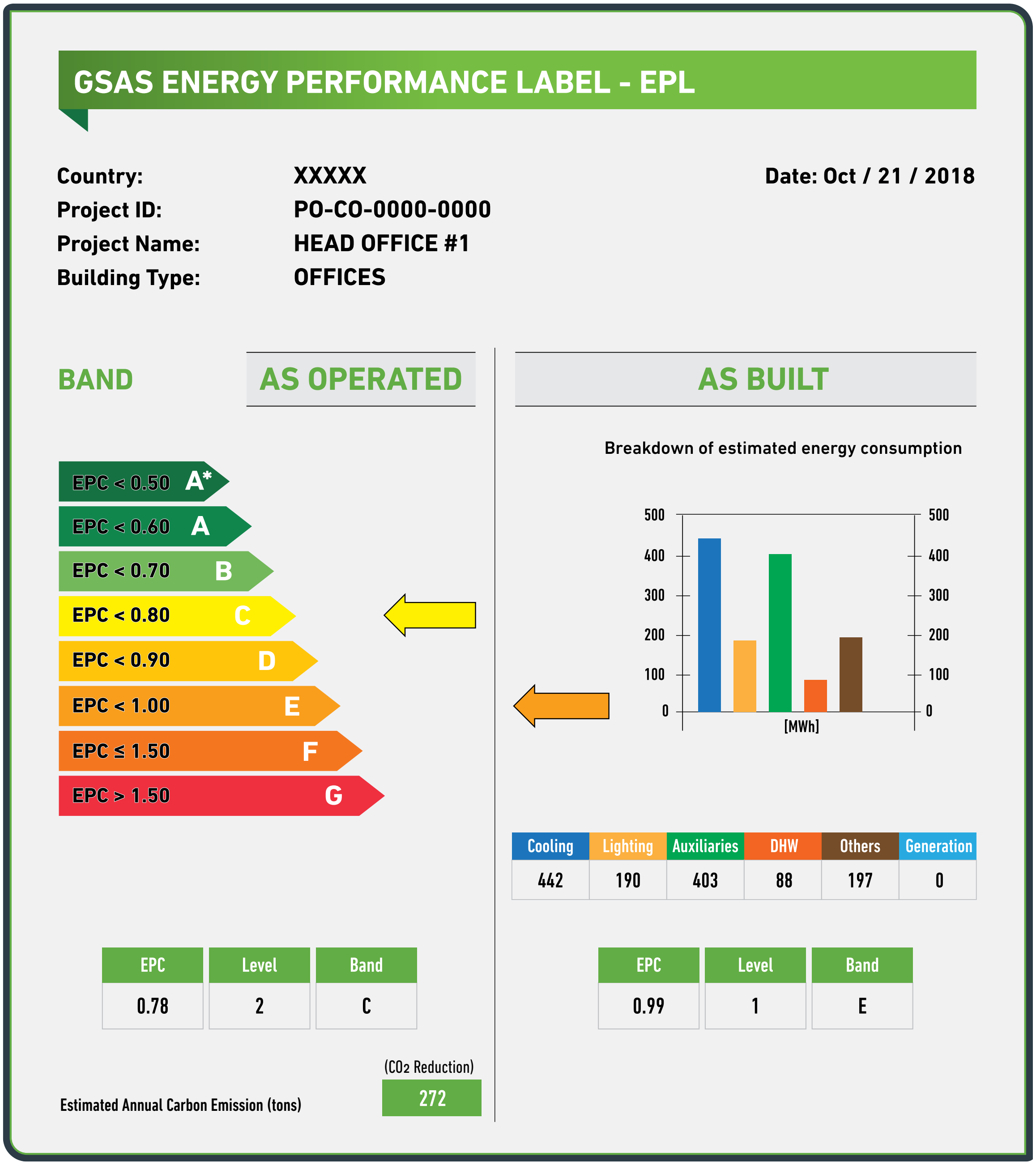

Figure (3a) Energy Performance Label Exhibit

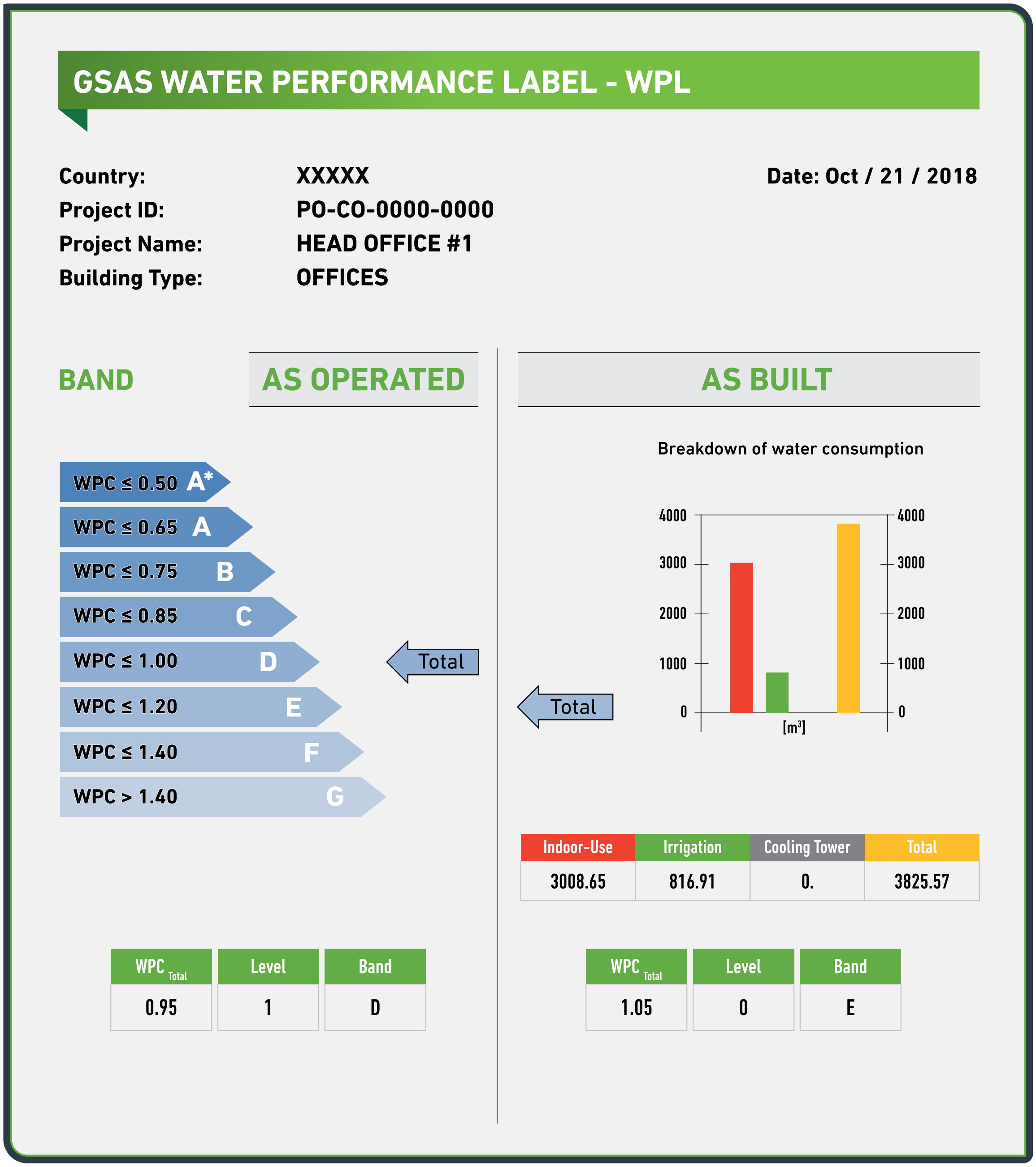

Figure (3b) Water Performance Label Exhibit

6.2 ENERGY NEUTRAL & HEALTHY BUILDING MARKS

For projects seeking Energy Neutral Mark or Healthy Building Mark, only one rating namely "Certified" is granted when compliance with the minimum requirements is demonstrated.

7.0 CERTIFICATION PROCESS

7.1 REGISTRATION AND FEES

All projects aiming to obtain the certification in GSAS Operations (GSAS-OP) will register the project on GSASgate - the online certification management portal of GSAS Trust and pay the associated fees for certification. For information on fees, please refer to www.gord.qa.

Registration of a project must be completed by a GSAS Operations Service Provider (GSAS-OP SP). GSAS-OP SP is required to have at least one GSAS Operations Certified Green Professional (GSAS-OP CGP) with valid licenses.

7.2 SUBMISSION

The required documents and evidences should be prepared and submitted via an authorized GSAS Service Provider following the guidelines and requirements for each criterion outlined in this manual.

7.3 ASSESSMENT

The assessment in GSAS Operations is comprised of two parts:

- **Desk Review**

A desk review for all the submitted documents is undertaken by GSAS Trust for each targeted criterion to ensure completeness and compliance with the requirement.

- **On-Site Audit**

An on-site audit is undertaken by GSAS Trust to verify compliance with the requirements under each targeted criterion and to review evidences claimed for the criterion.

7.4 CERTIFICATION

7.4.1 Initial Certification

The building under operation can apply for the certification at any time based on the as-built specifications. The requirements include submission of the energy and water metered data for the previous 12 months excluding the periods in which building was partially occupied. This is in addition to the submission of results of occupant surveys to be conducted once at the time of the application, if the targeted criterion requires it.

Further, the building under operation with no metered data for energy and water consumption can also apply for the certification, however the highest rating that can be achieved by such a project is the “GOLD Rating”.

7.4.2 Recertification

Recertification will require submission of at least 12 months of data collected on energy and water consumption and the results of occupant surveys conducted once, where applicable, in the year preceding recertification. If the project opts to apply for an improved certification rating for some reason (e.g. due to improvement in energy efficiency features of building), the application for the same can be submitted at any time to GSAS Trust with the necessary evidence.

Recertification fees will be applicable as per GSAS Trust policy.

7.4.3 Validity & Data Monitoring

The certificate is valid for four years after which the building must be reassessed to maintain continued certification. It is a pre-requisite for the continuity of the certificate to implement continuous monitoring and provide GSAS Trust with the annual data for energy and water consumption.

Based on the assessment at the time of renewal, the certification level may be improved, maintained or lowered. Renewal is subject to having at least 36 months of data collected from building operations.

7.4.4 Appeal

The Applicant may submit an appeal on any individual criterion should they disagree to and not accept the decision made by GSAS Trust. More details can be found on GORD website at www.gord.qa.

8.0 SCORING SHEET

GSAS Scoring Sheet is a useful sensitivity analysis tool to enable projects to compute the overall anticipated project score and certification rating under multiple scenarios. The tool provides the user with the opportunity to target, adjust and amend the level of each individual criterion to predict the final rating.

9.0 CALCULATORS

GSAS calculators are unique and user-friendly computational tools developed to perform the necessary calculations for the award of the criterion level.

The distinctive benefits and features of GSAS calculators include:

- Enables user input values through a simple interface
- Performs complex algorithms, equations and calculations seamlessly
- Avoids the need for the use of other complex software packages

10.0 GSAS ENERGIA SUITE™

GSAS Energia Suite™ calculates the building's energy use based on CEN-ISO calculation method. GSAS Energia Suite™ translates the calculated energy and emission into effective Energy Performance Coefficient (EPC) values and Energy Performance Label (EPL) in relation to applicable GSAS benchmarks. Additionally, it indicates the potential annual Carbon Emissions Performance (CEP).

11.0 GSAS WATER SUITE™

GSAS Water Suite™ calculates the building's water consumption. GSAS Water Suite™ translates the calculated water consumption into effective Water Performance Coefficient (WPC) values and Water Performance Label (WPL) in relation to applicable GSAS benchmarks.

12.0 OCCUPANT SURVEY

GSAS occupant survey is a method to evaluate the degree to which buildings satisfy the users. The survey assesses the occupant well-being and interactions with the indoor environment and facility management by analyzing the occupant feedback for a successful management and operational practices improvement. There are several criteria in GSAS operations which require the successful completion of an occupant survey including all Indoor Environment criteria and the Facility Management criterion.

A satisfactory sample size for the occupant survey to yield valid and accurate survey responses must be demonstrated. The Project will check the actual target population (occupants) to reduce the margin of error and ensure a higher confidence level. The acceptable sample size for the occupant survey is a minimum of 30 valid responses or 5% of the target population, whichever is higher.

13.0 GSASGATE™

GSASgate™ is the online portal of GSAS for managing the project submission, assessment and certification processes. GSASgate™ is an integrated platform for the participation of all stakeholders involved in GSAS certification process, including building owners/users, developers, facility managers/operators, GSAS Service Providers, contractors, consulting firms, government entities and GSAS Trust. The User manual for GSASgate™ is available for download from GORD website at www.gord.qa.

SECTION (II)

ASSESSMENT

STRUCTURE OF ASSESSMENT

The table below summarizes elements of the assessment for each criterion in GSAS Operations certification:

PURPOSE	Outlines the objective of the criterion.
ASSESSMENT PRINCIPLES	Summarizes the overall principles 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 is required to submit to demonstrate compliance.

1.0 ENERGY

The Energy criterion considers aspects associated with the total energy use of a facility that result in harmful emissions and climate change.

The table below summarizes the weights associated with the Energy criterion:

No.	Category / Criteria	LEVEL		BAND		Weight (%)	Incentive Weight (%)
		Min	Max	Min	Max		
[E]	**ENERGY**						
	As Built	0	3	G	A*	9.00%	-
	As Operated	0	3	G	A*	23.00%	-
	Incentives:						
	- Sub-metering					-	2.50%
	- 2.50% Renewable Energy Supply					-	2.50%
	- 100% Solar Hot Water Supply					-	2.50%
	- GSAS Accredited Commissioning Agent Service Provider					-	5.00 %
					TOTAL	**32.00%**	**12.50%**

1.1 PURPOSE

To reduce energy consumption and mitigate the impact of fossil-based energy use.

1.2 ASSESSMENT PRINCIPLES

- The Project will assess the total energy use of the facility for as-built and as-operated cases to determine:
  - GSAS Energy Use Performance Coefficient (EPC_{use}).
  - GSAS Energy Performance Label (EPL).
  - Carbon Emissions Performance.
- The project will complete ***GSAS Energia Suite™*** to establish the criterion level.

1.3 ASSESSMENT

The criterion requires assessing the Energy Use Performance Coefficient (EPC_{use}) for as-built and as-operated cases. These two cases are introduced by GSAS to assess the operational energy performance of the facility.

For the as-built case, the EPC for the total energy use is determined based on the sum of all energy-consuming building systems; while for the as-operated case, EPC for the total energy use is determined using the metered data for the period of one reference year. In determining the total energy use for a building in operation phase, all plug-in and auxiliary systems are taken into consideration in addition to building envelope characteristics, internal loads including lighting(external and internal); cooling and ventilation; heating, domestic hot water systems and renewable energy, cooling and dehumidification, ventilation, internal loads, pumps, and domestic hot water systems.

The EPCs are established using ***GSAS Energia Suite™*** for which the calculations are based on normative, standardized calculations of ISO/CEN series of standards. (Refer to GSAS 2019 Design & Build Assessment: Building Typologies manual for more information).

1.3.1 Energy Performance Coefficient (EPC)

EPC is a quantified measure for understanding how well a building performs in terms of energy consumption using the benchmark that represents the baseline for a specific building type. The EPC derives the benchmark for a specific building type by analyzing the data of different buildings of that type under various operational conditions.

Two main purposes of the EPC are:

- To determine the level of energy use performance for buildings of the same type; and,
- To identify potential savings, shown by the variance between the actual data and the benchmark: a lower performance against the benchmark indicates a more significant opportunity for improvement.

1.3.2 As-Built Evaluation

Evaluation of Energy Use Performance for the As-Built case ($EPC_{use\text{-}as\ built}$) demonstrates the building energy performance based on the as-built specifications, or retrofit specifications, independent of occupant behavior and operational variables compared to the benchmark.

As the resultant $EPC_{use\text{-}as\ built}$ using GSAS calculator compares a building under a standardized set of operating condition assumptions, it is a useful tool to compare buildings without including the impact of the operational practices. In addition, $EPC_{use\text{-}as\ built}$ is valuable for projects to understand if the full design potential is achieved.

$$EPC_{use\text{-}as\ built} = \frac{E_{use\text{-}as\ built}}{E_{use\text{-}benchmark}}$$

1.3.3 As-Operated Evaluation

Evaluation of Energy Use Performance for the As-Operated case ($EPC_{use\text{-}as\ operated}$) demonstrates the building energy performance based on metered energy data for the preceding 12 months compared to the benchmark.

The requirement of 12 months metering data is to ensure the impact of seasonal variations upon the performance of the building is captured. In this case, $EPC_{use\text{-}as\ operated}$ is valuable for projects to understand the impact of occupant behavior, operational practices, and building system efficiencies.

$$EPC_{use\text{-}as\ operated} = \frac{E_{use\text{-}as\ operated}}{E_{use\text{-}benchmark}}$$

Measurements Considerations

It is imperative to take into consideration the following aspects in the measurements for the calculation of the As-Operated EPC_{use}.

- Measurements period and frequency: continuous metering of energy consumption for 12 months to be undertaken.
- Operational conditions: measurements to represent all expected operating conditions, i.e., peak vs. non-peak electric consumption.
- Measurement locations: metering to be undertaken on the main electricity supply. If sub-metering is available, energy consumption of main uses such as cooling, lighting, auxiliaries, and equipment to be undertaken.
- Measuring devices: where possible, use permanent electricity meters and sub-meters with electronic data storing capabilities. Continuous online monitoring software packages offer a reliable on-demand source of information. Maintain the calibration of devices at all times.

1.3.4 Energy Performance Label (EPL)

The Energy Performance Label (EPL) provides a visual representation of As-Built and As-Operated energy performance and consumption of the building.

For representation of energy performance, the EPC_{use} values obtained are further divided into bands ranging from A* to G, where A* represents the most efficient.

In addition, the EPL provides a summary of the building energy consumption of various equipment and systems as well as the renewable energy contribution.

Note: If the project cannot submit metered data for a 12-month period, then the EPL for the building will show As-Built results only.

Refer to Figure (2a) for Energy Performance Label (EPL) exhibit.

1.3.5 Carbon Emissions Performance (CEP)

The Carbon Emissions Performance (CEP) is automatically estimated by GSAS Energia Suite™ based on the calculations performed for obtaining the EPC. The CEP provides As-Built and As-Operated potential annual CO2 emissions performance of the building. It provides the volume (in tons) of the building carbon reduction or excess in As-Built and As-Operated cases as compared with the corresponding benchmarks.

Note: Projects seeking verified carbon emissions footprint may approach Global Carbon Council (GCC).

1.4 CRITERION LEVELS

The criterion levels for $EPC_{use\text{-}as\ built}$ and $EPC_{use\text{-}as\ operated}$ are calculated separately. The allocated weights for $EPC_{use\text{-}as\ built}$ and $_{EPCuse\text{-}as\ operated}$ determine the contribution of the energy criteria in the overall project certification rating using GSAS Operations Scoring Sheet.

As-Built

Levels	$EPC_{del\text{-}as\ built}$	Band
0	$EPC_{del} > 1.50$	G
	$1.00 \leq EPC_{del} \leq 1.50$	F
1	$0.90 \leq EPC_{del} < 1.00$	E
	$0.80 \leq EPC_{del} < 0.90$	D
2	$0.70 \leq EPC_{del} < 0.80$	C
	$0.60 \leq EPC_{del} < 0.70$	B
3	$0.50 \leq EPC_{del} < 0.60$	A
	$EPC_{del} < 0.50$	A*

As-Operated

Levels	$EPC_{del\text{-}as\ operated}$	Band
0	$EPC_{del} > 1.50$	G
	$1.00 \leq EPC_{del} \leq 1.50$	F
1	$0.90 \leq EPC_{del} < 1.00$	E
	$0.80 \leq EPC_{del} < 0.90$	D
2	$0.70 \leq EPC_{del} < 0.80$	C
	$0.60 \leq EPC_{del} < 0.70$	B
3	$0.50 \leq EPC_{del} < 0.60$	A
	$EPC_{del} < 0.50$	A*

1.5 SUBMITTALS

Types	Descriptions
Documents	Executive Summary, highlighting the approach to the criterion, measures implemented and describing the structure and details of the submissions.
	As-Built architectural drawings for the building
	As-Built MEP drawings related to the building systems including specifications and data sheets
	Energy meters and monitoring data.
Calculator	GSAS Energia Suite™ and evidence of the relevant calculated and measured data.

2.0 WATER

The Water criterion considers aspects associated with water consumption and reuse in order to mitigate the impact on available water resources.

The table below summarizes the weights of the Water criterion:

No.	Category / Criteria	LEVEL		BAND		Weight (%)	Incentive Weight (%)
		Min	Max	Min	Max		
[W]	**WATER**						
	As Built	0	3	G	A*	5.00%	-
	As Operated	0	3	G	A*	11.00%	-
	Incentives:						
	- Sub-metering					-	2.50%
					TOTAL	**16.00 %**	**2.50%**

2.1 PURPOSE

To reduce water consumption and increase reuse of water to mitigate the impacts on municipal supply and treatment systems.

2.2 ASSESSMENT PRINCIPLES

- The Project will assess the total water consumption of the facility for as-built and as-operated cases to determine:
    - GSAS Water Performance Coefficient (WPC).
    - GSAS Water Performance Label (WPL).
- The project will complete ***GSAS Water Suite™*** to establish the criterion level.

2.3 ASSESSMENT

The criterion requires assessing Water Performance Coefficient (WPC) introduced by GSAS for as-built and as-operated cases. These two cases are introduced by GSAS to assess the operational water consumption performance of the facility.

For the as-built case, the total water consumption is determined based on the sum of all water-consuming systems in the facility while for the as-operated case it is determined using the metered data for the period of one reference year.

GSAS Water Suite™ establishes the as-built and as-operated water performance of the facility based on the following:

- Indoor water consumption;
- Irrigation water consumption; and
- Cooling tower make-up water consumption.

2.3.1 Water Performance Coefficient (WPC)

WPC is a quantified measure for understanding how well a building performs in terms of water consumption using the benchmark that represents the baseline for a specific building type. The WPC derives the benchmark for a specific building type by analyzing the data of different buildings of that type under various operational conditions.

Two main purposes of the WPC are:

- To determine the level of water performance with respect to other buildings of the same type; and,
- To identify potential savings, shown by the variance between the actual data and the benchmark: a lower performance against the benchmark indicates a greater opportunity for improvement.

2.3.2 As-Built Evaluation

Evaluation of WPC for the As-Built case demonstrates the building water performance based on the as-built specifications, or retrofit specifications, independent of occupant behavior and operational variables compared to the benchmark.

As the resultant WPC using GSAS calculator compares a building under a standardized set of operating condition assumptions, it is a useful tool to compare buildings without including the impact of the operational practices. In addition, the WPC is valuable for projects to understand if the full design potential is achieved.

$$WPC_{as\ built} = \frac{W_{as\ built}}{W_{benchmark}}$$

2.3.3 As-Operated Evaluation

Evaluation of the WPC for the As-Operated case demonstrates the building water performance based on metered water data for the preceding 12 months compared to the benchmark.

The requirement of 12 months metering data is to ensure the impact of seasonal variations upon the performance of the building is captured. In this case, the WPC is valuable for projects to understand the impact of occupant behavior, operational practices and building system efficiencies.

$$WPC_{as\ operated} = \frac{W_{as\ operated}}{W_{benchmark}}$$

Measurements Considerations

It is imperative to take into consideration the following aspects in the measurements for the calculation of the As-Operated WPC.

- Measurements period and frequency: continuous metering of water consumption for 12 months to be undertaken.
- Operational conditions: measurement to represent all expected operating conditions, i.e., peak vs. non-peak water consumption.
- Measurement locations: metering to be undertaken on the main water supply. If sub-metering is available, water consumption of indoor and outdoor main uses to be undertaken.
- Measuring devices: where possible, use permanent water meter and sub-meters with electronic data storing capabilities. Continuous online monitoring software packages offer a reliable on-demand source of information. Maintain the calibration of devices at all times.

2.3.4 Water Performance Label (WPL)

The Water Performance Label (WPL) provides a visual representation of As-Built and As-Operated water performance and consumption of the building.

For representation of water performance, the WPC values obtained are further divided into bands ranging from A* to G, where A* represents the most efficient.

In addition, the WPL provides a summary of the building water consumption of various fixtures and systems.

Note: If the project cannot submit metered data for a 12-month period, then the WPL for the building will show As Built results only.

Refer to Figure (2b) for Water Performance Label (WPL) exhibit.

2.4 CRITERION LEVELS

The criterion levels for $WPC_{as\ built}$ and $WPC_{as\ operated}$ are calculated separately. The allocated weights for $WPC_{as\ built}$ and for $WPC_{as\ operated}$ determine the contribution of the water criterion in the overall project certification rating using GSAS Operations Scoring Sheet.

As-Built

Levels	$WPC_{as\ built}$	Band
0	WPC > 1.40	G
	1.20 < WPC ≤ 1.40	F
	1.00 < WPC ≤ 1.20	E
1	0.85 < WPC ≤ 1.00	D
	0.75 < WPC ≤ 0.85	C
2	0.65 < WPC ≤ 0.75	B
3	0.50 < WPC ≤ 0.65	A
	WPC ≤ 0.50	A*

As-Operated

Levels	$WPC_{as\ operated}$	Band
0	WPC > 1.40	G
	1.20 < WPC ≤ 1.40	F
	1.00 < WPC ≤ 1.20	E
1	0.85 < WPC ≤ 1.00	D
	0.75 < WPC ≤ 0.85	C
2	0.65< WPC ≤ 0.75	B
3	0.50 < WPC ≤ 0.65	A
	WPC ≤ 0.50	A*

2.5 SUBMITTALS

Types	Descriptions
Documents	Executive Summary, highlighting the approach to the criterion, measures implemented and describing the structure and details of the submissions.
	As-Built architectural drawings for the building;
	As-Built MEP drawings related to the building systems including specifications and data sheets;
	Water meters and monitoring data;
	Drawings and technical data on landscape and plant species;
	Drawings and specifications of water recycling and reuse systems;
	Reused water tests/analysis, if applicable, by an accredited laboratory and approvals by concerned authorities.
Calculator	GSAS Water Suite™ and evidence of the relevant calculated and measured data.

3.0 INDOOR ENVIRONMENT

The Indoor Environment category considers aspects associated with indoor environmental quality to ensure human health, comfort and well-being.

The table below summarizes the weights of the Indoor Environment category:

<table>
<tr><th rowspan="2">No.</th><th rowspan="2" colspan="2">Category / Criteria</th><th colspan="2">LEVEL</th><th rowspan="2">Weight (%)</th></tr>
<tr><th>Min</th><th>Max</th></tr>
<tr><td>[IE]</td><td colspan="5">INDOOR ENVIRONMENT</td></tr>
<tr><td>IE.1</td><td colspan="2">Thermal Comfort</td><td>0</td><td>3</td><td>10.00%</td></tr>
<tr><td>IE.2</td><td colspan="2">Air Quality</td><td>0</td><td>3</td><td>8.00%</td></tr>
<tr><td>IE.3</td><td colspan="2">Lighting</td><td>0</td><td>3</td><td>5.00%</td></tr>
<tr><td rowspan="2">IE.4</td><td rowspan="2">Daylight & Views</td><td>Daylight</td><td>0</td><td>3</td><td>2.00%</td></tr>
<tr><td>Views</td><td>0</td><td>3</td><td>2.00%</td></tr>
<tr><td>IE.5</td><td colspan="2">Acoustics</td><td>0</td><td>3</td><td>3.00%</td></tr>
<tr><td colspan="5" align="right">TOTAL</td><td>30.00%</td></tr>
</table>

3.1 [IE.1] THERMAL COMFORT

3.1.1 PURPOSE

To provide and maintain conditions for a thermally comfortable environment for occupants and users of the facility.

3.1.2 ASSESSMENT PRINCIPLES

- The project will assess thermal comfort in predominantly occupied spaces for compliance with GSAS requirements based on recognized standards for the following environmental parameters:
  - Air Temperature
  - Relative Humidity
  - Air Speed
- The project will conduct an occupant survey to determine the level of satisfaction.

The ***criterion level*** is established based on the compliance of thermal comfort parameters with GSAS requirements and the level of occupant satisfaction.

3.1.3 ASSESSMENT

The criterion requires assessing indoor thermal comfort parameters by conducting physical on-site measurements and undertaking an occupant survey to verify the level of occupant satisfaction.

3.1.3.1 On-Site Measurements

- The ranges and limits for the three parameters are as follows:
  - Air temperature range of 22-25°C;
  - Relative humidity range of 35-55%; and,
  - Air speed below 0.2 m/s as measured at the occupant's location.
- Verify satisfactory air speed by taking multiple readings at a strategic location within the space.
- Conduct an air temperature analysis, by examining the impact of the floor surface temperature, vertical temperature difference, and radiant temperature asymmetry.
- Determine the best location for providing accurate humidity readings.
- Ensure that proof of performance for both air temperature and humidity is established through trended data. Where variables are going to be trended, successful comfort control is a function of a steady-state performance. Steady-state requires that the trended variables remain within a specified range without remarkable fluctuations.

Measurements Considerations

- Operating conditions: Ensure that the measurement period of parameters establishes the cyclic nature of the measured parameters at time of recording of readings. Ensure that measuring conditions represent the cooling period during the summer season and the heating period during the winter season.
- Measuring devices: Ensure that measuring devices include suitable digital thermometers for air temperature, anemometer for air speed and hygrometers for relative humidity. Continuous online monitoring software packages offer a reliable on-demand source of information. Maintain up-to-date calibration of devices at all times.
- Measurement positions: Take measurements in the center of the space and at least 1.0m inward from the space wall. For occupants performing sedentary activities, take measurements at the height of 1.0m and for those performing standing activities at the height of 1.7m.
- Measurement Location: Ensure that the measurement locations for large buildings with multiple zoning represent the worst case of thermal comfort in predominantly occupied spaces.

3.1.3.2 Occupant Survey

The objective of the occupant survey is to evaluate if the perceived thermal comfort in a room, building, etc., is acceptable to the majority of the occupants. It is important, however, for facility managers to ensure proper interpretation and use of the feedback collected from the survey. As space design conditions could have significant variance from actual operating conditions, survey results are not a definitive means of determining whether the design engineer has succeeded in meeting the expectations of the survey. Occupant psychosocial conditions can impose a strong influence on subjective assessments of the environment, that could render the assumed design parameters as invalid, and operating control modules may vary from those that the design engineer had anticipated. However, when properly used, occupant surveys are a direct method of assessment under given operating conditions and thus the optimum level of thermal comfort in the building. Survey feedback can also help the Facility Manager enhance operations protocols and help building operators identify and address the reasons for dissatisfaction.

3.1.4 CRITERION LEVELS

Levels	Requirements
0	On-Site Measurements and Occupant Surveys are not conducted
1	On-Site Measurements demonstrate compliance and Occupant Survey indicate 40-60% satisfaction
2	On-Site Measurements demonstrate compliance and Occupant Survey indicate 61-80% satisfaction
3	On-Site Measurements demonstrate compliance and Occupant Survey indicate greater than 80% satisfaction

3.1.5 SUBMITTALS

Types	Descriptions
Documents	Executive Summary for Occupant Survey.
	Executive Summary for On-Site Measurements of thermal comfort parameters including the trend logs and data analysis.

3.2 [IE.2] AIR QUALITY

3.2.1 PURPOSE

To provide and maintain a healthy indoor air quality for occupants and users of the facility.

3.2.2 ASSESSMENT PRINCIPLES

- The project will assess air quality in predominantly occupied spaces for compliance with GSAS requirements based on recognized standards for the following:

  1. Physicochemical Pollutants:

  1.1 Carbon Monoxide (CO)

  1.2 Carbon Dioxide (CO_2)

  1.3 Formaldehyde

  1.4 Total Volatile Organic Compounds (TVOCs)

  1.5 Nitrogen Dioxide (NO_2)

  1.6 Sulfur Dioxide (SO_2)

  1.7 Particulate Matters (PM2.5)

  1.8 Ozone (O_3)

  2. Microbial Pollutants:

  2.1 Bacteria

  2.2 Fungi (yeast and molds)

- The project will conduct an occupant survey to identify the level of occupant satisfaction.
- The project, where it is necessary to control a unique set of pollutants, will implement the Indoor Air Quality Procedure (IAQP).

The ***criterion level*** is established based on the compliance of airborne concentration levels with GSAS requirements and the level of occupant satisfaction.

3.2.3 ASSESSMENT

The criterion requires assessing indoor airborne concentration levels by conducting physical on-site measurements and undertaking an occupant survey to verify the level of occupant satisfaction.

3.2.3.1 On-Site Measurements

- The ranges and limits for the eight airborne pollutants are as follows:

Airborne Parameters	Maximum Allowable	Exposure Period (average)	Organisation	Reference
Carbon Monoxide (CO)	25 ppm	1-hour	WHO	Ref 1
Carbon Dioxide (CO_2)	800 ppm	8-hours	WHO	Ref 1,2,3,4
Formaldehyde	100 μg/m³ (0.081 ppm)	30-min	WHO	Ref 1
Total Volatile Organic Compounds (TVOCs)	300 μg/m³ (0.13 ppm)	8-hours	DGE	Ref 5
Nitrogen Dioxide (NO_2)	0.1 ppm	1-hour	WHO	Ref 1
Sulfur Dioxide (SO_2)	5 ppm	15-min	NIOSH	Ref 6
Particulate Matters (PM2.5)	35 μg/m³	24-hours	NAAQS/ EPA	Ref 7
Ozone (O_3)	0.12 ppm	1-hours	HEALTH CANADA	Ref 8

1. World Health Organization. 2000. Air Quality Guidelines for Europe, 2nd Edition. World Health Organization Regional Publications, European Series No. 91. World Health Organization, Regional Office for Europe, Copenhagen, www.euro.who.int/document/e71922.pdf.
2. WHO (World Health Organization), 2013. Health Effects of Particulate Matter: Policy Implications for Countries in Eastern Europe, Caucasus and Central Asia Regional Office for Europe, UN City, Marmorvej 51, DK–2100 Copenhagen.
3. WHO (World Health Organization), 2003. Health Aspects of Air Pollution with Particulate Matter, Ozone, and Nitrogen Dioxide EUR/04/5042688, W.R.O.f. Europe, Editor, Copenhagen.
4. WHO (World Health Organization), 2000. Air Quality Guidelines for Europe 2000, Second Edition, WHO Regional Publications, European Series, N.91, Regional Office for Europe, Copenhagen, 288 pages
5. Bluyssen, P., 2010. Product Policy and Indoor Air Quality. Indoor Sources and Health Effects: Background Information and Ways to Go. Directorate General for Environment, Brussels, Belgium.
6. NIOSH. 2004. NIOSH Pocket Guide to Chemical Hazards (NPG). National Institute for Occupational Safety and Health, February. www.cdc.gov/niosh/npg/npg.html.
7. U.S. Environmental Protection Agency. 2008. Code of Federal Regulations, Title 40, Part 50. National Ambient Air Quality Standards. www.epa.gov/air/ criteria.html.
8. Health Canada. 1995. Exposure Guidelines for Residential Indoor Air Quality: A Report of the Federal-Provincial Advisory Committee on Environmental and Occupational Health. Ottawa: Health Canada. www.hc-sc.gc.ca/hecssesc/air_quality/pdf/tr-156.pdf.

- The ranges and limits for the active microbial agents are as follows:

Active Microbial Agent	Maximum Allowable	Incubation Time (testing)	Organization	Reference
Bacteria	500 CFU/m³	24–120 hours	The Commission of the European Communities (CEC)	Ref 1
Fungi (yeast & molds)	1,000 CFU/m³	24–120 hours	EPA	Ref2

1. European Collaborative Center—Indoor Air Quality & Its Impact On Man, Report No. 12, Biological Particles in Indoor Environment, Luxembourg (1993).
2. U.S. EPA. (2003). A Standardized EPA. Protocol for Characterizing Indoor Air Quality in Large Office Buildings

- Conduct on-site measurement and analysis of the ten pollutants to comply with the thresholds indicated in the tables above to maintain the optimum level of air quality in most common building typologies.
- Ensure that proof of performance for the measured parameter is established through trended data. Where variables are going to be trended, successful air quality control is a function of steady-state performance. Steady-state requires that the trended variables remain within a specified range without remarkable fluctuations.

Measurements Considerations

- Operating conditions: Take measurements under all expected operating conditions, i.e. peak vs non-peak for the pollutants. Remarkable fluctuations in readings should be examined in relation to the indoor/outdoor polluting sources conditions.
- Measuring devices: Ensure measuring devices are suitable for accurately measuring the required parameters. Continuous online monitoring software packages offer reliable on-demand sources of information. Maintain up-to-date calibration of devices at all times.
- Measurement location: Ensure that measurement locations for large buildings with multiple zoning represent the worst case in predominantly occupied spaces.
- Measurements period: Take measurements in accordance with WHO or US-EPA recommended protocols.
- Frequency of On-Site Measurements: On-site measurements for each of the variables should be conducted during the certification period for the predominantly occupied spaces.

3.2.3.2 Occupant Survey

The objective of the occupant survey is to evaluate if the perceived ventilation in a room, building, etc., is acceptable to the majority of occupants. It is important, however, for facility managers to ensure proper interpretation and use of feedback collected from the survey. As space design conditions could have significant variance from actual operating conditions, survey results are not a definitive means of determining whether the design engineer has succeeded in meeting the expectations of the survey. Occupant psychosocial conditions can impose a strong influence on subjective assessments of the environment, that could render the assumed design parameters as invalid, and operating control modules may vary from those that the design engineer had anticipated. However, when properly used, occupant surveys are a direct method of assessing air quality under given operating conditions and, thus the adequacy of the ventilation in the building. Survey feedback can also help the Facility Manager enhance operations protocols and help building operators identify and address the reasons for dissatisfaction.

Frequency of Surveys

Surveys should be conducted for the occupants in predominantly occupied spaces during the same period in which on-site measurements are conducted.

3.2.3.3 Indoor Air Quality Procedure (IAQP)

For laboratory, industrial and other spaces where contaminants of concern do exist in addition to the above, the Indoor Air Quality Procedure (IAQP) of ASHRAE standard can be followed to help meet the targets for indoor air concentrations and occupant satisfaction. IAQP is a performance-based design approach, in which the building and the Air-Conditioning and Mechanical Ventilation (ACMV) systems are designed to maintain the concentrations of specific contaminants, within certain limits, to achieve the IAQP target level of indoor air quality acceptable to building occupants and/or visitors. Refer to the ASHRAE standard for more information on the compliance requirements of this procedure.

The IAQP includes:

- the list of contaminants and contaminant mixtures of concern considered in the design process;
- a table of the sources and emission rates of the contaminants of concern;
- a table of the concentration limits and exposure periods and the references for these limits;
- a report on the analytical approach used in determining the air quality rates and air-cleaning requirements;
- printout of the contaminants data loggers.

3.2.4 CRITERION LEVELS

Levels	Requirements
0	On-Site Measurements and Occupant Survey are not conducted
1	On-Site Measurements demonstrate compliance and Occupant Survey indicate 70-80% satisfaction
2	On-Site Measurements demonstrate compliance and Occupant Survey indicate 81-90% satisfaction
3	On-Site Measurements demonstrate compliance and Occupant Survey indicate greater than 90% satisfaction

3.2.5 SUBMITTALS

Types	Descriptions
Documents	Executive Summary for Occupant Survey.
	Executive Summary for On-Site Measurements for air pollutants including the trend logs and data analysis
	Indoor Air Quality Procedure (IAQP), if applicable.

3.3 [IE.3] LIGHTING

3.3.1 PURPOSE

To provide and maintain artificial lighting that meets the needs of occupants and users of the facility.

3.3.2 ASSESSMENT PRINCIPLES

- The project will assess illuminance (lux levels) provided by artificial lighting in predominantly occupied spaces for compliance with IESNA or equivalent standards.
- The project will conduct an occupant survey to identify the level of occupant satisfaction.

The ***criterion level*** is established based on the compliance of lighting levels parameters with GSAS requirements and the level of occupant satisfaction.

3.3.3 ASSESSMENT

The criterion requires assessing indoor artificial lighting levels by conducting physical on-site measurements and undertaking an occupant survey to verify the level of occupant satisfaction.

3.3.3.1 On-Site Measurements

Conduct on-site measurement and analysis of the lighting levels and cross-check the compliance of results in accordance with IESNA or equivalent standards.

Measurements Considerations

- Operating conditions: Take measurements under all expected operating conditions, i.e. day and night timings (as applicable) and clear and overcast skies.
- Measuring devices: Ensure measuring devices are suitable for accurately measuring the required lux level. Maintain up-to-date calibration of devices at all times.
- Measurement positions: Take measurements in the center of the space and at least 1.0m inward from the space wall. For occupants performing sedentary activities take measurements at the height of 1.0m and for those performing standing activities at the height of 1.7m.
- Measurement Location: Ensure that measurement locations for large buildings with multiple zoning represent the predominantly occupied spaces.

3.3.3.2 Occupant Survey

The objective of the occupant survey is to evaluate that the perceived lighting quality is acceptable to the majority of the occupants. It is important, however, for facility managers to ensure proper interpretation and use of the feedback collected from the survey. As space design conditions could have significant variance from actual operating conditions, survey results are not a definitive means of determining whether the design engineer has succeeded in meeting expectations of the survey. Occupant psychosocial conditions can impose a strong influence on subjective assessments of the environment, that could render the assumed design parameters as invalid, and operating control modules may vary from those that the design engineer had anticipated. However, when properly used, occupant surveys are a direct method of assessing lighting levels and lighting uniformity under given operating conditions and, thus, the optimum lighting quality in the building. Survey feedback can also help the Facility Manager enhance operations protocols and help building operators identify and address the reasons for dissatisfaction.

3.3.4 CRITERION LEVELS

Levels	Requirements
0	On-Site Measurements and Occupant Survey are not conducted
1	On-Site Measurements demonstrate compliance and Occupant Survey indicate 70-80% satisfaction
2	On-Site Measurements demonstrate compliance and Occupant Survey indicate 81-90% satisfaction
3	On-Site Measurements demonstrate compliance and Occupant Survey indicate greater than 90% satisfaction

3.3.5 SUBMITTALS

Types	Descriptions
Documents	Executive Summary for Occupant Survey.
	Executive Summary for On-Site Measurements of lighting levels including the trend logs and data analysis.
	Lux levels prescribed by IESNA or equivalent international standards for predominantly occupied space.
	Primary building layout drawings with specifications for critical spaces.
	Lighting system and controls layout, luminaire specifications and operation schedule.

3.4 [IE.4] DAYLIGHT & VIEWS

3.4.1 PURPOSE

To maximize exposure to daylight and external or internal views for the health and well-being of occupants and users of the facility.

3.4.2 ASSESSMENT PRINCIPLES

- The project will assess Illuminance (lux levels) in the predominantly occupied spaces exposed to natural light for compliance with GSAS requirements.
- The project will conduct an occupant survey to identify the level of occupant satisfaction for views.

The ***criterion level*** is established based on the compliance of daylight levels with GSAS requirements and the level of occupant satisfaction related to the provided views.

3.4.3 ASSESSMENT

The criterion requires assessing indoor daylight levels through the conduct of physical on-site measurements and undertaking an occupant survey to verify the level of occupant satisfaction.

3.4.3.1 On-Site Measurements

Conduct on-site measurements of daylight lux levels and cross check for compliance. The daylight in this criterion refers to the adequacy of lux levels of natural light for performing basic daily activities including walking, etc. but not for task-specific requirements.

Measurements Considerations

- Operating conditions: Ensure that measurement of daylight reflects the availability of the lux levels throughout the assessment period.
- Measuring devices: Use a digital lux level meter to measure the illumination in the identified locations. Maintain up-to-date calibration of devices at all times.
- Measurement positions: Take measurements in the representative areas which are exposed to daylight with the measurement position at least 1.0m inward from the space wall.
- Measurement location: Ensure that measurement locations represent predominantly occupied exposed spaces.

3.4.3.2 Occupant Survey

The objective of the occupant survey is to evaluate that the perceived 'views' in a room, building, etc., meet the satisfaction of occupants. It is important, however, for facility managers to ensure proper interpretation and use of feedback collected from the survey. As space design conditions could have significant variance from actual operating conditions, survey results are not a definitive means of determining whether the design engineer has succeeded in meeting expectations of the survey. Occupant psychosocial conditions can impose a strong influence on subjective assessments of the environment, that could render the assumed design parameters as invalid, and operating control modules may vary from those that the design engineer had anticipated. However, when properly used, occupant surveys are a direct method of assessing occupant satisfaction for the provision of 'views'. Survey feedback can also help the Facility Manager enhance operations protocols and help building operators identify and address reasons for dissatisfaction.

3.4.4 CRITERION LEVELS

(I) Daylight

Levels	Requirements (X = Total floor area exposed to daylight)
0	X < 5% OR daylight lux level does not demonstrate compliance
1	5% ≤ X < 10% and daylight lux levels demonstrates compliance
2	10% ≤ X < 25% and daylight lux levels demonstrates compliance
3	X ≥ 25% and daylight lux levels demonstrates compliance

(II) Views

Levels	Requirements
0	Occupant Survey are not conducted
1	Occupant Survey indicate 70-80% satisfaction
2	Occupant Survey indicate 81-90% satisfaction
3	Occupant Survey indicate greater than 90% satisfaction

3.4.5 SUBMITTALS

Types	Descriptions
Documents	Executive Summary for Occupant Survey.
	Executive Summary for On-Site Measurements of daylight levels.
	Records of daylight lux levels.
	Building layout and specifications for measured spaces.

3.5 [IE.5] ACOUSTICS

3.5.1 PURPOSE

To maintain acceptable indoor noise levels for the health and well-being of occupants and users of the facility.

3.5.2 ASSESSMENT PRINCIPLES

- The project will assess acoustic levels in the predominantly occupied spaces for compliance with GSAS requirements.
- The project will conduct an occupant survey to identify the level of occupant satisfaction.

The ***criterion level*** is established based on the compliance of indoor acoustic conditions with GSAS requirements and the level of occupant satisfaction.

3.5.3 ASSESSMENT

The criterion requires assessing indoor acoustic levels by conducting physical on-site measurements and undertaking an occupant survey to verify the level of occupant satisfaction.

3.5.3.1 On-Site Measurements

- The limits outlined below are required to be met by the total noise contributed by sources of external noise intrusion and building services.

Typical Occupied Space	Design Range $L_{Aeq,T}$ dB	
	Good	Reasonable
Private Office	40	50
Open-plan Office	45	50
Classroom	30	40
Prayer Halls	30	35
Guestrooms	30	35

- The baseline for on-site measurements is taken in unoccupied spaces. An unoccupied space refers to the area undergoing noise measurements that is free from the activity of occupants.
- Conduct on-site measurement and analysis of the noise levels and cross check the compliance of results in accordance with the levels given above, where applicable.

Measurements Considerations

- Operating conditions: Verify the acoustic performance under all expected operating conditions pertaining to indoor/outdoor noise generating sources.
- Measuring devices: Use a digital sound level meter to measure the pressure level of sound. Recent models are equipped with an LCD monitor which displays the noise level. Also, they are configured to cater for options for a slow response measurement for a stable noise, and a fast response measurement for frequently varying sounds. Maintain up-to-date calibration of devices at all times
- Measurement positions: Take measurements in the representative areas which are exposed to noise generating sources.

3.5.3.2 Occupant Survey

The objective of the occupant survey is to evaluate that the level of generated noise in a room, building, etc., is acceptable to the majority of the occupants. It is important, however, for facility managers to ensure proper interpretation and use of feedback collected from the survey. As space design conditions could have significant variance from actual operating conditions, survey results are not a definitive means of determining whether the design engineer has succeeded in meeting expectations of the survey. Occupant psychosocial conditions can impose a strong influence on subjective assessments of the environment, that could render the assumed design parameters as invalid, and operating control modules may vary from those that the design engineer had anticipated. However, when properly used, occupant surveys are a direct method of assessing the noise level under given operating conditions and, thus, the optimum level of the acoustic comfort in the building. Survey feedback can also help the Facility Manager enhance operations protocols and help building operators identify and address the reasons for dissatisfaction.

3.5.4 CRITERION LEVELS

Levels	Requirements
0	On-Site Measurements and Occupant Survey are not conducted
1	On-Site Measurements demonstrate compliance and Occupant Survey indicate 70-80% satisfaction
2	On-Site Measurements demonstrate compliance and Occupant Survey indicate 81-90% satisfaction
3	On-Site Measurements demonstrate compliance and Occupant Survey indicate greater than 90% satisfaction

3.5.5 SUBMITTALS

Types	Descriptions
Documents	Executive Summary for Occupant Survey.
	Executive Summary for On-Site Measurements of noise levels.
	Building layout with specifications for spaces exposed to noise generating sources.
	Noise generation sources details and specifications.

4.0 WASTE MANAGEMENT

The Waste Management criterion considers aspects associated with building operational practice for waste reduction, reuse and recycling to mitigate the environmental impacts on landfills.

The table below summarizes the weights of Waste Management criterion:

No.	Category / Criteria	LEVEL		Weight (%)	Incentive Weight (%)
		Min	Max		
[WM]	**WASTE MANAGEMENT**	0	3	7.00%	–
	Incentives:				
	- GSAS Accredited Waste Management Service Provider			-	5.00%
			TOTAL	**7.00%**	**5.00%**

4.1 PURPOSE

To implement waste management best practice throughout the operation of the facility.

4.2 ASSESSMENT PRINCIPLES

- The project will assess the implementation of a waste management plan for organic waste and recyclable materials on- and off-site.
- The project will assess the percentage of waste (by weight or volume) from the two most prominent waste streams diverted from landfill or incineration.

The ***criterion level*** is established based on the degree of compliance of the waste management plan and the percentage of the waste diverted from landfill or incineration.

4.3 ASSESSMENT

The criterion requires assessing the methods and measures planned and implemented as per the waste management plan, and the on-site measurements indicating the percentage of waste diverted from landfill or incineration.

4.3.5.1 Waste Management Plan

Develop a Waste Management Plan addressing the guidelines provided in 'Part (III) Guidelines' of this manual. The plan demonstrates the following requirements:

- Purchasing policy
- Collection, treatment and reuse of reusable materials
- Collection, segregation and transfer of recyclable waste.
- Collection and composting or transfer of organic waste.
- Waste storage, management, transfer and disposal.

4.3.5.2 On-Site Measurements

Measure the quantities collected for the most prevailing types of waste either by weight or volume and demonstrate the diversion methods/measures from landfill or incineration.

4.4 CRITERION LEVELS

Levels	Requirements
0	Waste Management Plan does not demonstrate compliance
1	Waste Management Plan demonstrates compliance
2	At least 50% of the two most prominent waste streams diverted from landfill or incineration.
3	At least 80% of the two most prominent waste streams diverted from landfill or incineration.

4.5 SUBMITTALS

Types	Descriptions
Documents	Executive Summary highlighting the measures implemented in accordance with the Waste Management Plan and describing the structure and details of the submissions.
	Records for evidence towards waste management actions (Photos/ videos, documents, etc.).
	On-site measurement records for waste diverted from landfill or incineration
Plan	Waste Management Plan

5.0 FACILITY MANAGEMENT

The Facility Management criterion considers aspects associated with practices and strategies implemented to ensure that facilities are operated and maintained in a sustainable manner.

The table below summarizes the weights of Facility Management criterion:

No.	Category / Criteria	LEVEL		Weight (%)	Incentive Weight (%)
		Min	Max		
[FM]	**FACILITY MANAGEMENT**	0	3	9.00%	–
	Incentives:				
	- GSAS Accredited Facility Management Service Provider			-	5.00%
			TOTAL	**9.00%**	**5.00%**

5.1 PURPOSE

To implement facility management best practice throughout the operation of the facility.

5.2 ASSESSMENT PRINCIPLES

- The project will assess the implementation of a facility management plan.
- The project will conduct an occupant survey to identify the level of occupant satisfaction.

The ***criterion level*** is established based on the degree of compliance of the facility management plan and the level of occupant satisfaction.

5.3 ASSESSMENT

The criterion requires assessing the methods and measures planned and implemented as per the facility management plan and undertaking an occupant survey to verify the level of occupant satisfaction.

5.3.1 Facility Management Plan

The project will develop a Facility Management Plan (FMP) addressing the methods and measures above, including evidences to demonstrate their implementation during the assessment period.

The FMP must clearly state:

- The roles, responsibilities and details of the FM provider, in-house or outsourced;
- The complete range of services, including details and whether these services are provided in-house or outsourced; and,
- The way the services are, or will be, managed, procured and implemented.

5.3.2 Occupant Survey

The objective of the occupant survey is to determine how effective the facility management is meeting the needs of occupants. The questions should be focused on areas such as building and cleaning, waste management and recycling, pest control, MEP systems and utilities support (e.g. HVAC, plumbing, electricity, water, etc.), safety, indoor air quality and elevator/escalator maintenance. The purpose of the survey is to assess occupant satisfaction in each of these areas and to determine areas for potential improvement.

It is important to ensure that the results of the survey are properly interpreted and used. Survey results will also assist the facility manager to enhance and improve operations, procedures and protocols and help building operators identify and address reasons for dissatisfaction. Surveys should be conducted once a year, by users who are not working for the Facility Management team.

5.4 CRITERION LEVELS

Levels	Requirements
0	Facility Management Plan does not demonstrate compliance
1	Facility Management Plan demonstrates compliance
2	Facility Management Plan demonstrates compliance and Occupant Surveys indicate a minimum of 60% satisfaction
3	Facility Management Plan demonstrates compliance and Occupant Surveys indicate greater than 85% satisfaction

5.5 SUBMITTALS

Types	Descriptions
Documents	Executive Summary highlighting the measures implemented in accordance with the Facility Management Plan and describing the structure and details of the submissions.
	Records for evidence towards facility management provisions.
	Executive Summary for the Occupant Survey.
Plan	Facility Management Plan

6.0 ENVIRONMENTAL POLICY & AWARENESS

The Environmental Policy & Awareness criterion considers aspects associated with the initiatives of the facility to promote and create awareness on the sustainability programs implemented for managing the assets and operations of the building.

The table below summarizes the weights of the Environmental Policy & Awareness criterion:

No.	Category / Criteria	LEVEL		Weight (%)
		Min	Max	
[EPA]	**ENVIRONMENTAL POLICY & AWARENESS**	0	3	6.00%
			TOTAL	**6.00%**

6.1 PURPOSE

To implement organization-wide environmental policy & awareness initiatives for occupants and users, with focus on energy saving, water conservation and waste management.

6.2 ASSESSMENT PRINCIPLES

- The project will assess the implementation of the environmental policy & awareness plan with focus on energy saving, water conservation and waste management.

The ***criterion level*** is established based on the comprehensiveness of the environmental policy & awareness plan.

6.3 ASSESSMENT

The criterion requires assessing the environmental policy & awareness plan for scope, reach, communication, effectiveness and continuity to achieve the short and long-term operational goals of the facility.

The plan will demonstrate the following requirements:

- Commitment of the organization to environmental sustainability.
- Goals and objectives.
- Framework for setting and reviewing environmental goals and objectives.
- Action plan including scope, reach and details of the initiatives.
- Communication channels and tools.
- Resources allocation.
- Timeline(s).
- Implementation report and outcomes.

6.4 CRITERION LEVELS

Levels	Requirements
0	Environmental Policy & Awareness Plan do not demonstrate compliance with the requirements.
1	Environmental Policy & Awareness Plan demonstrate partial compliance with the requirements targeting permanent building occupants.
3	Environmental Policy & Awareness Plan demonstrate full compliance with the requirements.

6.5 SUBMITTALS

Types	Descriptions
Documents	Samples of initiatives materials.
	Implementation report
	Photos and other evidence of implemented initiatives.
Plan	Environmental Policy & Awareness Plan.

SECTION (III)

GUIDELINES

1.0 ENERGY

1.1 PURPOSE

To reduce energy consumption and mitigate the impact of fossil-based energy use.

1.2 CONTEXT

More than 90 percent of our time is spent in buildings i.e. either in the office or at home. All of the building energy consumption occurs during the operational phase. As such, the operation of buildings contributes to 30-40% of total global energy use and associated CO_2 emissions (UNIDO, 2009). Considering the building type and the local climate conditions, the major sources of energy consumption are cooling, heating, lighting, and the power consumed by the systems that support the building operation. The expected operational energy consumption is determined, mostly during the design phase, however, the energy efficiency can still be optimized during operations of the building through efficient facility management, retrofits/refurbishment and responsible occupant behavior.

Energy efficiency for buildings can be achieved through various approaches for reducing energy consumption without affecting the comfort level of the occupants. Key areas to be addressed are as follows:

- Building Envelope;
- Internal Loads;
- Cooling and Ventilation Systems;
- Heating System;
- Auxiliaries & Plug-in Loads;
- Renewable Energy; and
- Energy Audits;

Methods and measures listed below work best when they are implemented in the design stage. However, during maintenance, renovations and retrofitting various improvements in energy performance can be planned, subject to the intent of the upgrades and allocated budget.

1.3 GUIDELINES

1.3.1 Building Envelope

- Retrofit, where required, envelope elements with low U-Values (high R-Values) to reduce both solar and conductive heat gains and losses. Baseline recommendations for selecting the U-Values of envelope elements can be found in international standards for different climatic zones.
- Retrofit, where required, all windows and skylights with low solar transmittance to control solar gain and reduce cooling load. Baseline recommendations for selecting the shading coefficient of windows and skylights can be found in international standards for different climatic zones.
- Increase roof surface reflectance and emittance using reflective paints, materials or coatings.
- Ensure that all the joints around the windows, skylights, doors, and junctions between walls and other structural elements, are airtight to minimize air leakage rates.
- Reduce solar gains using external shading devices where feasible.
- Reduce solar gains using mid pane blinds (where blinds are integrated between the panes of the double or triple glazing unit). They can be raised when solar gains and glare are not significant, and they can be lowered when solar gains and glare are evident.
- Use overhangs and fixed shading devices to control high angle summer sun on south facing elevations. Solar gains to east and west glazing are more difficult to control and will require adjustable shading devices.

1.3.2 Internal Loads

- Use daylighting provisions to decrease the minimum required energy intensity of lighting. This decreases the size of the equipment. However, when daylighting is utilized to reduce lighting electricity, the solar heat gain through glazing should be controlled, and in addition, glare and contrast must be controlled to provide a comfortable indoor environment.
- Use occupancy sensors to decrease the local lighting load. The use of occupancy sensors with manual-on and automatic-off control in daylit spaces, such as classrooms, offices, mechanical rooms, and restrooms, saves lighting energy.
- Use local articulated task lights (desk lamps that can be adjusted in three planes) in daylit spaces to decrease the lighting load and increase occupant satisfaction.
- Use more efficient interior lighting. Compact fluorescent lamps (CFLs) and light-emitting-diodes (LEDs) reduce lighting electricity consumption and heat gains.
- Apply a comprehensive lighting management system, where external solar shading, internal shading, and artificial lighting are controlled in a holistic manner.

1.3.3 Cooling and Ventilation Systems

- Optimize the chiller selection by using variable speed chillers and pumping systems to ensure that system efficiency is maintained at lower loads. For primary-secondary pumping systems, it is more efficient to start the chillers one-by-one to ensure that there is more primary chilled water than secondary chilled water in the loop.
- Use the plant Direct Digital Control (DDC) system to start/stop chillers and use chiller controls (not the plant DDC system) to start/stop primary pumps to ensure additional energy savings.
- Use variable-speed-driven secondary pumps. This reduces pump energy by allowing each pump to operate at close to rated system head. This also improves balancing of the system and creates better part load performance.
- Use an energy recovery system to recover the heating or cooling from the exhaust air before discharging it outdoors.
- Use a variable air volume (VAV) system to reduce the chance of over-cooling or over-heating a space when it is not at its peak load condition. For specific applications, constant volume systems, such as fan coil units (FCUs), can be used to provide better performance. Such systems are more efficient due to their smaller size, multiple units, and limited control requirements.
- Provide local temperature sensors that can be controlled by a Building Management System (BMS) to avoid misuse of control features.
- Use direct digital control systems to optimize start-up or shut-down of the systems.
- Ensure that ventilation systems for a building designate the appropriate amount of outside air ventilation to the building, to provide a comfortable environment for occupants. Avoid an excessive amount of outside air which will result in a high level of energy consumption.
- Provide motorized dampers for stairs and elevator shafts to reduce the possibility of wasting conditioned air through these openings.
- Provide motorized dampers for all intake and relief/exhaust louvers and vents to protect the conditioned air from leaving the building and prevent unconditioned outdoor air from coming into the building.
- Use flow measuring stations at outdoor air intakes to the air handling units to control the quantity of the outdoor air.
- Use, where possible, one or more of the following control strategies to improve the efficiency of the system: chilled and condenser water reset, fan cycling, demand limiting, duty cycling, and fan pressure optimization at part load operation.

- Use, where applicable, high efficiency chillers to increase the chiller efficiency. Where the chilled water piping volume relative to the chiller capacity is small, provide an inertia or buffer tank to protect the chiller operation against extreme on-off cycling.
- Provide, where applicable, dedicated controlled exhaust systems for copy rooms to exhaust air from the room only when the copiers are functioning.
- Provide adequate air intake space for outdoor air-cooled equipment, such as cooling towers, to let them operate at the highest efficiency rating.
- Prevent stratification of return air and outside air within the mixing box to improve the air handling unit efficiency.

1.3.4 Heating System

- Ensure the most appropriate and efficient form of heating for a building depending on the use of the building.
- Use, where applicable, radiant heating for buildings which are used intermittently, or which have large air volumes (such as industrial units) as radiant heating may be an effective form of heating for such buildings.
- Use conventional central hot water systems for buildings which are used more regularly and with smaller air volumes, as these systems will be more effective.
- Use modular boilers for non-domestic buildings with varying loads, to prevent boilers operating at part load.
- Install time controls and set them to correctly reflect the hours of hot water requirement.
- Set sanitary hot water thermostats to the appropriate temperature; e.g. no more than 60°C for normal requirements (but ensure the water does not drop below 56°C to avoid health related issues).
- Switch off electric heating elements (immersion heaters) when hot water from the boiler is available;
- Replace any damaged or missing insulation from the entire hot water pipe work and cylinders through a periodic maintenance schedule.
- Use solar water heating which offers the most significant reduction in primary energy use.

1.3.5 Auxiliaries & Plug-in Loads

- Select more energy efficient appliances to reduce the electricity requirements of plug loads and reduce heat gains from the use of appliances, office equipment, and other devices plugged into electrical outlets.

- Use switching off or enabling power down mode to reduce the energy consumption and heat produced by equipment, which in turn lowers the cooling load.
- Upgrade existing equipment with energy-efficient appliances which will generate savings over the lifetime of the equipment.
- Procure equipment with recognized energy labelling schemes. Some of the examples of the benefits of energy efficient equipment are as follows (UNIDO, 2009):
  - Computers use up to 70% less electricity than computers without enabled power management;
  - Monitors use up to 60 percent less electricity than standard models;
  - Printers use at least 60 percent less electricity and must automatically enter a lower power setting after a period of inactivity;
  - Refrigerators are at least 15% more efficient than standard models;
  - TVs consume 3 watts or less when switched off, compared to a standard TV, which consumes almost 6 watts on average; and,
  - LEDs use up to 90% less energy than a standard incandescent lamp.

1.3.6 Sub-Metering

Use of energy submetering in buildings generates awareness of energy conservation among users including landlords and tenants as they will be aware of the exact consumption profile and costs associated with their behavior.

Energy sub-metering will also facilitate the development of strategies to help improve performance, thereby ensuring the overall efficiency of systems operations. In addition, Users can apply consumption data to implement conservation or renovation projects to lower usage & costs and meet government regulations.

Sub-metering devices are installed to monitor and evaluate energy performance and consumption during the building operations phase. Major energy systems should be metered and monitored in conjunction with data logging to enable continued accountability of energy consumption over the lifespan of the development. Consumption data provides users with the information to locate high-consumption areas.

- Provide monitoring devices that display and record the energy consumption data of major systems in the building.
- Provide energy sub-meters for all major energy-consuming systems, such as lighting, hot water heaters, boilers, fans, cooling, humidification, space heating, competition-related equipment, large-scale broadcast and media systems, equipment associated with industrial processes, and large-scale food service equipment.
- Ensure the energy sub-metering is properly and clearly labeled, easily accessible and convenient for regular access by the facility operators.

- Specify the appropriate location of energy sub-meters, for example in the plant room, distribution room, or control room.
- Determine the optimal quantity and specific locations of energy meters according to the types and complexity of systems to be monitored.
- Consider utilizing energy simulations or engineering analysis to predict overall energy consumption and evaluate major energy system performance.
- Determine measures and strategies for continued improvement of energy efficient building operations, throughout the design of the development and during the operational phase of the development.

1.3.7 Renewable Energy

Use of renewable energy reduces the use of primary fossil-based energy sources, thereby reducing the associated environmental footprints. Using photovoltaic cells to generate electricity can be an effective method for the generation of on-site electricity. PV cells are sources of renewable energy that convert sun energy directly into electricity using semiconductors. PV cells produce a direct current, which needs to be converted to an alternating current before it can be used in buildings. The common technique is to store direct current from PV cells in batteries and change it to an alternating current using an inverter. The major advantage of an alternating current created by the inverter is that the alternating current is compatible with the city utility grid. If the local PV system can generate additional electricity, the excess electricity can be transferred to the main utility grid and sold to the city electric provider, specifically when the city grid experiences high demand from customers during certain times of the day.

Similarly, solar water heating and thermal or electrical energy generation using other renewable sources such as mini windmills, renewable biomass or geothermal sources help to reduce the environmental impact of primary fossil-based energy.

1.3.8 CO_2 Emissions

The energy performance for CO_2 emissions is a performance indicator sensitive to changes in the method of energy delivery. It is subject to different types of energy delivery, using various types of energy supply networks including electricity, gas, and district cooling. These factors are largely dependent on the city infrastructure and in the region the prevalent networks are electricity from large, gas-fired power plants and chilled water delivery by district cooling plants.

1.3.9 Energy Audit

As defined by ASHRAE "An energy audit is developing an understanding of the specific energy-using patterns of a particular facility or building". The Energy audit is designed to determine where, when, why and how energy is being used. This information can then be used to identify opportunities to improve efficiency, decrease energy costs, reduce greenhouse gas emissions that contribute to climate change. Energy audits can also verify the effectiveness of energy management opportunities (EMOs) after they have been implemented.

- Determine the primary usage of the building.
- Set targets for energy, demand and cost savings to reach Energy use Performance (Euse).
- Walk through the facility/building to become familiar with its construction, equipment, operation, and maintenance.
- Determine whether any maintenance problems and/or practices affect efficiency.
- Identify low-cost/no-cost changes to operation and maintenance (O&M) procedures.
- Identify potential capital improvements for further study and estimate the approximate savings that will result from these changes.
- Set target for the building to achieve a certain band in GSAS Operations Energy Performance Label (EPL).

For further guidance refer to the GORD Energy Audit Manual.

1.3.10 Re-Commissioning

Re-commissioning is known as the process of achieving the current facility requirements of the existing building and its systems in addition to providing a program to maintain and enhance the building components and systems for the length of its life span. Re-commissioning can reduce energy consumption and costs. The re-commissioning process helps facility managers and building owners in achieving many goals ranging from reductions in the utility cost, increasing property value, healthier indoor environment for the occupant, and reduction in the repair and replacement costs.

The re-commissioning processes consists of planning, investigation, implementation, and hand-off phases and shall address the following:

- Identify goals and develop the re-commissioning plan during the planning phase.
- Utilize expertise of commissioning agents or qualified professionals.
- Include operators interview, building documentation review, gathering and analyzing systems operation data in the investigation, and prepare recommendation reports.
- Implement the recommendation report findings, implement performance selected measures, and monitor results through metering and log reviews.
- Update building documentation, train the operation team on the performance measures, and implement re-commissioning plan prior to handing-off the project the commissioning team.

FURTHER RESOURCES

Publications:

1. ISO 52016-1:2017_Energy performance of buildings - Part 1: Calculation procedures.
2. Sustainable Energy Regulation & Policymaking Training Manual, Module 18: Energy Efficiency in buildings, UNIDO, 2008.
3. Energy Standard for Buildings Except Low-Rise Residential Buildings. ASHRAE Standard 90.1-2016. Washington: American Society of Heating, Refrigerating and Air-Conditioning Engineers, 2016. Print.
4. Complainville, C. and J. O.-Martins (1994), "NOx/SOx Emissions and Carbon Abatement", OECD Economics Department Working Papers, No. 151. Organisation for Economic Cooperation and Development (OECD). OECD Publishing, 1994. Print.
5. Deru, M., & Torcellini, P. Source Energy and Emission Factors for Energy Use in Buildings (No. NREL/TP-550-38617). Golden: National Renewable Energy Laboratory, 2007. Print.
6. Dijk, D. v., & Spiekman, M. CEN Standards for the EPBD - Calculation of Energy Needs for Heating and Cooling. EPBD Buildings Platform, 2007. Print.
7. "Heating systems in buildings – Methods for calculation of system energy requirements and system efficiencies, Part 3-1: Domestic hot water systems, characterization of needs (tapping requirement)." EN 15316-3-1. Brussels: European Committee for Standardization (CEN). Print.
8. "Heating systems in buildings – Methods for calculation of system energy requirements and system efficiencies, Part 4-6: Heating generation systems, photovoltaic systems." EN 15316-4-6 Brussels: European Committee for Standardization (CEN). Print.
9. "Energy performance of buildings - Overall energy use and definition of energy." EN 15603. Brussels: European Committee for Standardization (CEN). Print.
10. "Energy performance of buildings - Calculation of energy use for space heating and heating." EN-ISO 13790. Brussels: European Committee for Standardization (CEN) and International Organization for Standardization (ISO). Print.
11. District Heating - Heating More with Less. Brussels: Euroheat & Power, 2005. Print.
12. Energy Performance of Non-Residential Buildings. Determination Method. NEN 2916:1998. Delft: Nederlands Normalisatie-instituut, 1998. Print.
13. "Energy performance of buildings - Energy requirements for lighting." PrEN 15193. Brussels: European Committee for Standardization (CEN). Print.
14. "Energy performance of buildings - Methods for expressing energy performance and for energy certification of buildings." PrEN 15217. Brussels: European Committee for Standardization (CEN). Print.

15. "Energy performance of buildings Impact of building automation, controls and building management." PrEN 15232. Brussels: European Committee for Standardization (CEN). Print.

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2.0 WATER

2.1 PURPOSE

To reduce water consumption and increase reuse of water to mitigate impacts on the municipal supply and treatment systems.

2.2 CONTEXT

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.

Water use has increased globally by a factor of six over the past 100 years and continues to grow steadily at a rate of about 1% per year. In MENA region, results of a recent study show that total water demand will increase to 393 km3 per year in 2050, while total water shortage will grow to 199 km3 per year in 2050 for the average climate change projection indicating substantial increase in water demand. Such increases are attributed to climate change, population growth and economic development, with associated increases in irrigation, domestic and industrial water requirements.

Water conservation is becoming a viable alternative and is complementary to developing new water supplies. It involves a combination of retrofits, an upgrade of water related equipment and fixtures, the maintenance of infrastructure, and a collective water conservation ethic focused on resource use, allocation, and protection. There are ample opportunities in all types of buildings to achieve significant water savings, indoors and outdoors, by making improvements in several operational areas.

Water saving in buildings can be achieved through various approaches while maintaining the level of comfort for occupants. Key areas to be addressed are as follows:

- Monitoring of Water Use and Leak Detection;
- Sanitary Fixtures and Equipment;
- Outdoor Water Use;
- On-Site Alternative Water Sources;

The methods and measures listed below work best when they are implemented in the design stage. However, during maintenance, renovations or retrofitting various aspects of improvements can be pursued depending on the intent of the upgrades and allocated budget.

2.3 GUIDELINES

2.3.1 Monitoring of Water Use and Leak Detection

- Install appropriate submeters where required to monitor indoor water use from specific activities, such as toilets and baths, kitchen and server areas, laundry areas etc.
- Install submeters for major outdoor water use (e.g., cooling tower make-up water lines, Reverse Osmosis (RO) system supply lines, water features and irrigation systems).
- Implement an effective water management plan that utilizes meters and submetering systems.
- Integrate the operation of the meters and submeters into the building management system.
- Identify and repair leaks and other water use anomalies within the water distribution system or from processes or equipment to keep a facility from wasting significant quantities of water.
- Monitor and record the water meter readings during off-peak hours when all water-using equipment is turned off. Monitor and record water meter readings between peak and off-peak hours to establish if leaks are occurring within the water distribution system.
- Install fail-safe control devices, or leak detection systems, on major water-using equipment or distribution lines.
- Conduct visual and detection and alarm system inspections of the facility on a periodic basis.
- Perform random and routine visits in the building, including visual inspections of the ceilings and floors, toilets, kitchens, plantrooms and other spaces where possible water accumulations could occur due to water leaks.
- Provide information campaign materials to building occupants, employees, and visitors to immediately report to facility maintenance staff any leaks that have been observed in private restrooms, kitchen areas, or any part of the facility.

2.3.2 Sanitary Fixtures and Equipment

- Verify and identify inefficient water fixtures. Replace water closets and flush valves with models that meet GSAS requirements for water efficiency. While current codes require the lower flow rate for new fixtures, existing buildings often use older, high-flow flush valves.
- Replace existing plumbing fixtures with water-efficient fixtures. In most cases, fixtures and valves will need to be replaced to ensure proper operation of the fixture and reduce the chance of clogging.
- Utilize dual-flush valves on water closets. For example, dual-flush valves provide a full 6.0-lpf flush and an optional 3.0-lpf half flush.

- Install water-efficient urinals, which use as little as half a liter of water per flush, or less than 10 percent of current low-flow models, especially in densely populated areas.
- Install or replace existing lavatory faucets and sink aerators with more restrictive and high efficiency aerators.
- Use treated grey water supply systems as an alternative water source for use in water closets and urinals. The use of grey water can considerably reduce consumption of domestic water.
- Maintain and operate laundry and dishwashing equipment to its optimum capacity. Check and repair any leaks and damaged components for efficient operation.
- Install appliances with technologies that can significantly reduce water and energy use.

2.3.3 Outdoor Water Use

- Periodically review all landscape service and maintenance contracts. Update the requirements for water-efficiency where applicable.
- Maintain a sufficient quantity of good topsoil to capture precipitation as it falls and to release water back to plants over time, reducing irrigation requirements.
- Add mulch to plant beds to cover bare soil. Re-mulch areas annually to maintain soil coverage and prevent erosion.
- Keep the irrigated landscape trimmed and free of weeds.
- Provide structured shaded areas in the overall landscape design to reduce the water needs of surrounding plants.
- Use water-efficient engineered systems for water feature recirculating systems. Maintain and operate water recirculation systems periodically for leaks and other damage. Where feasible, use recycled water in water features.
- Avoid using fresh water to dust-sweep the grounds or floors of outdoor areas, such as driveways and walkways, parking lots, playing courts, hard decks and courtyards, or other hardscapes. Use alternative means, such as brooms and pans to dust-clean these outdoor areas to conserve water.
- Ensure the irrigation schedule is appropriate for the climate conditions, soil conditions, plant species, grading, and season.
- Check that the sprinkler components are installed and calibrated such that the supplied water is irrigating the plants and not the pavements or roadways.
- Require a full audit of the irrigation system on a periodic basis. A full audit should include an in-depth assessment of the irrigation system, performance, and schedule.

- Ensure efficient grouping of plants with similar irrigation needs using a hydrozoning technique in consultation with field experts.
- Specify plants and irrigation systems that can significantly lower the volume of water needed to sustain the landscape. Refer to GSAS D&B manual for plant types and irrigation methods that could meet the water budget based on the local climate. The Water Budget Tool can help evaluate the relative water savings that can be achieved with a different plant palette and technology choices.
- Use other alternative water sources, where feasible, as a substitute for potable water sources for irrigation.
- Utilize bushes, mulch, rain gardens, permeable hardscape, or curb cuts in parking lot islands or in the areas between sidewalks and the roadway for water run-offs.
- Check and maintain water features regularly to ensure they are continuously operating at optimum capacity. Use an engineered recirculating system, designed and tested to operate with an optimized water flow rate and energy use.
- Consult with landscape professionals, preferably trained and certified, but more importantly with working experience on practical applications of water-efficient and climate-appropriate landscaping works.

2.3.4 Onsite Alternative Water Sources

Conserve water by using onsite alternative water sources to further reduce the demand for fresh water.

An onsite alternative water source is water sourced, collected, treated, stored, and utilized as recycled water. Recycled water has varying degrees of quality. Take precautionary measures when using recycled water. Select only recycled water of a quality that is safe and appropriate for the intended use.

Instead of using fresh water for some applications that require the use of water, first study the feasibility of utilizing recycled water from condensate drain water, rainwater, treated wastewater (grey water), blowdown water, or reject water. Maintained and operated properly, these onsite alternative water sources provide significant contributions to the reduction on fresh water demand.

Water quality is of prime importance for reuse of onsite sources of water in terms of the source and the potential types of treatment that may be needed to meet the quality needs of the proposed end use. It is critical to ensure that the quality of the recycled water is appropriate according to local regulations. The table below provides guidance on the concerns (or risks) related to the quality of recycled water. (Water Sense at Work; published by EPA, 2012).

Possible Sources	Level of Water Quality Concern					
	Sediment	Total Dissolved Solids (TDS)	Hardness	Organic biological Oxygen Demand (BOD)	Pathogens (A)	Other Considerations
Rainwater	Low/ Medium	Low	Low	Low	Low	None
Stormwater	High	Depends	Low	Medium	Medium	Pesticides & fertilizers
Air Handling Condensate	Low	Low	Low	Low	Medium	May contain copper when coil cleaned
Cooling Tower Blowdown	Medium	High	High	Medium	Medium	Cooling tower treatment chemicals
Reverse Osmosis and Nanofiltration Reject Water	Low	High	High	Low	Low	High salt content
Grey Water	High	Medium	Medium	High	High	Detergents & bleach
Foundation Drain Water	Low	Depends	Depends	Medium	Medium	Similar to stormwater

*Key:
Low: Low level of concern
Medium: Medium level of concern; may need additional treatment depending on end use High: High concentrations possible and additional treatment likely
Depends: Dependent upon local conditions
(A): Disinfection for pathogens is recommended for all water used indoors for toilet flushing or other uses

2.3.4.1 Condensate Drain Water

Condensate drain water from the air conditioning equipment is the airborne water vapor that condenses in the cooling coil of the air conditioner. The water is collected in the drain pan and discharged outside through the building drainage system.

The volume of condensate drain water from an air conditioning equipment varies. There are factors affecting the volume of condensate drain water produced from the operation of air conditioning equipment. The water quality from the condensate drain is usually good for cooling tower make-up water, as it is generally free from minerals and total dissolved solids (TDS).

Condensate drain water is generally safe for direct use in cooling towers with biocide control, or for sub-surface irrigation without the need for additional treatment. Condensate drain water however, when sourced from the recirculated air in the building, could develop bacterial growth and contaminate the recycled water. Thus, recycled water applications where humans can inhale or come in direct contact with contaminated vapors (e.g., spray irrigation), should be filtered and disinfected prior to discharging.

2.3.4.2 Rainwater

Facilities with large areas of impervious surfaces (horizontal and vertical) can capture rainfall for use in non- potable applications instead of discharging it directly to the storm drainage system. Rainwater run-offs from rooftops and building surfaces are typically of good quality for recycling, making it suitable for a wide variety of applications. In most facilities, it is used to supplement or replace irrigation water with minimal treatment or filtering requirements.

Rainwater that runs off on non-roof or podium surfaces, such as outdoor parking lots, hardscapes, and landscapes, around the building perimeters can also be a good source of irrigation water for landscapes; provided it can be collected, treated, and stored. Generally, this collected water can be captured and distributed from onsite features, such as berms, swales, or rain gardens, or can be diverted to a long-term storage retention pond, where the water can be pumped for landscape irrigation or other uses. The rainwater quality from the ground is much more variable than that collected from rooftops, as ground levels tend to pick up more varieties of pollutants as it travels across the landscape. Identify the required recycled water quality for the intended application and provide the appropriate treatment before rainwater is used.

2.3.4.3 Treated Grey Water

Grey water is all wastewater that is generated in buildings and is free of human waste. It should be separated from soiled water (black water) from toilets or urinals and excludes wastewater from kitchen sinks. Grey water can be treated and reused for specific onsite applications; however, health and safety standards and regulations must be fully complied with. To avoid bacterial and pathogens growth, ensure the use of treated grey water as advised by the concerned authorities. Treated grey water used for irrigation should not be used for vegetation intended for human consumption. The applications for an on-site treated grey water system may include indoor restricted urban water use, such as toilet and urinal flushing, and outdoor unrestricted urban water use, such as irrigation.

The selection of treated grey water as an on-site alternative water source requires a careful and site-specific analysis. Before installing an on-site grey water treatment facility, consult the authority having jurisdiction first to ensure that the treated grey water system meets the appropriate regulations. Further, check with the manufacturers of the fixtures and equipment the applications of non-potable water to determine which conditions those items can function with treated grey water and what impact such use will have on warranty coverage.

2.3.4.4 Cooling Equipment Blowdown

The cooling equipment blowdown is the cooling water that is periodically ejected from the cooling equipment to lessen the build-up of Total Dissolved Solids (TDS) that can cause scaling as water is evaporated from the heat exchangers. Cooling equipment that requires blowdown can include cooling towers, evaporative air condensers and evaporative coolers.

The blowdown cooling water when not used is typically discharged to the sanitary sewer. The water quality of blowdown could still be sufficient for use with other on-site applications such as irrigation water. However, the blowdown water has TDS content of 2 to 5 times that of the original source water. Algae, bacteria, or pathogens and water treatment chemicals, such as biocides or corrosion inhibitors are contaminants that may be present in the water and with high concentrations could harm humans that come into contact with the vapors. Therefore, blowdown water should not be used for applications that pose a direct threat to human health. However, blowdown water could be treated using nano filtration or RO membranes to make it suitable for other uses, including recycling as make-up water for cooling equipment. Facility managers should conduct a risk assessment before reusing this blowdown water.

2.3.4.5 Reverse Osmosis System Reject Water

The onsite RO treatment facility uses membranes to filter the feedwater contaminants. The RO filtration process will have a residual stream, called the reject water, that remains after the feedwater has been permeated through the membrane. A RO system with a recovery rate between 50% and 75% produces 50% to 25% of rejected water from the system. This reject water is less pure than the feedwater entering the system but may still be useable for other applications.

Reject water when unused is sent directly to the sanitary sewer. Some reject water is still suitable for other on-site applications. If sanitary conditions are maintained for storage and transfer, reject water can be appropriate for end uses requiring suitable water quality, such as: toilet and urinal flushing water; cooling tower make-up water; above-ground irrigation water; make-up water for water features; or other processes or uses not requiring potable water. Reject water with elevated levels of TDS may be used as irrigation water for plants with a high tolerance for salinity. If used for cooling tower make- up water, the reject water TDS concentration should not exceed the cooling tower TDS set point.

2.3.5 Sub-Metering

use of water submetering in buildings generates awareness of water conservation among users including landlords and tenants as they will be aware of the exact consumption profile and costs associated with their behavior.

Water sub-metering will also facilitate the development of strategies to help improve performance, thereby ensuring the overall efficiency of systems operations. In addition, Users can apply consumption data to implement conservation or renovation projects to lower usage & costs and meet government regulations.

Sub-metering devices are installed to monitor and evaluate energy performance and consumption during the building operations phase. Major water systems should be metered and monitored in conjunction with data logging to enable continued accountability of energy consumption over the lifespan of the development. Consumption data provides users with the information to locate leaks and high-consumption areas - Provide monitoring devices that display and record the energy consumption data of major systems in the building.

- Install water meters on the main water supply to each building in the proposed development.
- Provide water sub-meters for all major water-consuming systems, such as bathroom fixtures, hot water heaters, boilers, cooling towers, chilled water systems, competition-related equipment, and largescale food service equipment.
- Ensure that water meters are clearly labelled, easily accessible and convenient for facilities operators.
- Provide means for monitoring irrigation systems to control over-watering and to detect the build-up of nutrients for example: nitrogen, calcium, potassium, and sodium.
- Consider connecting the water meter to the building monitoring system using a pulsed output to ensure detection of inefficiencies in water use and consumption.
- Provide monitoring devices that display and record the water consumption data of major systems in the building.

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3.0 INDOOR ENVIRONMENT

3.1 [IE.1] THERMAL COMFORT

3.1.1 PURPOSE

To provide and maintain conditions for a thermally comfortable environment for occupants and users of the facility.

3.1.2 CONTEXT

Thermal comfort is the condition of mind which expresses satisfaction with the thermal environment.

Accumulated research studies on the relationship between temperature and performance of occupants indicated that there is an observed 10% reduction in performance due to a warmer temperature of 30°C and a cooler temperature of 15°C, compared to a human comfort temperature range of 21°C to 23°C, leaving little doubt about the impact that thermal comfort has on occupants. Similarly, work-related fatigue is higher at higher relative humidity (e.g. 70% RH) compared with a lower relative humidity (30-40% RH).

It is evident that occupied space needs to be thermally comfortable for occupants to function at full capability. However, thermal comfort is based on thermal adaptation of the individual occupant which is correlated to factors such as geographic location and climate, time of year, gender, race, and age.

Thermal discomfort occurs when the thermal environment does not meet the requirements of the human mind or body. In warm environments perspiration will start, possibly leading to hyperthermia in extreme cases. On the other hand, in cold environments, occupants feel cold, the temperature of their hands and feet drop substantially; and in extreme cases may result in hypothermia. All these responses are reactions to uncomfortable environments.

Provision of the means to control parameters of thermal comfort is a key factor. Where occupants can adapt to their thermal environment by adjusting clothing, changing air speed or adjusting blinds, the wider variations in the temperature of the space can be tolerated.

Thermal comfort can be attained and maintained using one of the following methods: active conditioning (mechanical HVAC systems), passive conditioning (natural ventilation), or a combination of both active and passive conditioning (hybrid system). A hybrid system may be more suitable and effective for projects in a hot and dry climate. In addition, comfortable and casual dressing by occupants is a self-adaptive strategy for comfort.

Thermal comfort of building occupants is dependent upon both environmental conditions and personal factors.

Environmental conditions include:

- Ambient temperature (air temperature);
- Radiant temperature (the temperature of the surfaces around the occupants such as walls, ceiling, floor and windows);
- Relative humidity (indicative of the amount of water vapor in the air -vapor mixture); and,
- Air velocity (the rate at which air moves around and touches skin).

Whereas personal factors include:

- Metabolic rate (the activity of a person in terms of the amount of energy ex-pended); and,
- Clothing insulation (type and quantity of clothes a person is wearing to retain or dissipate body heat).

3.1.3 GUIDELINES

- Develop Operations and Maintenance (O&M) Manual and implement the elements that include O&M procedures and maintenance schedules based on the manufacturer's instructions.
- Ensure that the O&M Manual is updated frequently for the applicable systems.
- Ensure acceptable and uniform distribution of temperature of the air surrounding the occupants.
- Ensure uniform mean radiant temperatures for occupants in spaces exposed to external climate conditions. Mean radiant temperature is the spatial average of the temperature of surfaces surrounding the occupant such as windows, doors and skylights.
- Ensure an acceptable speed of air to which the body is exposed. Careful attention should be paid to split unit air-conditioning systems, whether wall-mounted or free-standing types, since the direction and speed of air may cause a high level of thermal discomfort.
- Ensure an adequate level of humidity at all times through the proper operation of an active cooling and ventilation system and the use of humidifiers/dehumidifiers.
- Ensure that discomfort to occupants is avoided through proper furniture layout and seating arrangements in relation to windows and AC diffusers and grills. Special considerations should be given to people with health problems such as sinuses, asthma and allergies.
- Provide appropriate control devices to set the optimum thermal conditions to the extent that they do not compromise the energy performance of the building. Ensure the HVAC system is flexible and can respond to part-load demands to provide optimum thermal conditions to minimize energy use.

- Fix leaking doors/windows by replacing the gasket and/or pane or the whole window, if needed.
- Provide blinds and shutters to block solar radiation thus reducing the amount of heat entering a room. Overheating can be efficiently reduced, and even eliminated with appropriate solar shading.
- Consider cooling by natural ventilation (e.g. opening windows), as it is a direct and fast method of influencing the thermal environment during specific times of the year. An open window will cause increased air motion and cool the space if the outdoor temperature is lower than the indoor temperature. Even when the outdoor air temperature is slightly higher than the indoor temperature the elevated air speed, due to an increased airflow, will increase the cooling of the body and reduce adverse thermal sensations.
- Retrofit building systems including HVAC equipment, control systems and the thermal envelope to enable them to meet all combinations of conditions that are expected to occur during occupancy, except for extreme conditions.
- Select the HVAC system capacity for a zone satisfying the peak cooling load such that the thermal comfort of occupants in a zone can be guaranteed for the hottest times of the year.
- Install automatic control systems for thermal comfort including those dynamic elements that have an influence on the thermal environment such as electric window openers, external shading and/or internal blinds.
- Consider, for spaces which are subject to direct exposure to the external climate, factors that impact the mean radiant temperature such as exterior construction materials and the presence of shading devices.
- Conduct building simulations, where feasible, for inner spaces that are not exposed directly to external walls. Verify the zoning layout and control levels necessary to achieve the desired thermal comfort levels over the entire year, and with variable occupancy/vacancy schedules.

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3.2 [IE.2] AIR QUALITY

3.2.1 PURPOSE

To provide and maintain a healthy indoor air quality for occupants and users of the facility.

3.2.2 CONTEXT

There are two indoor air quality requirements the room or space must maintain for the occupants. The first requirement is the air in the breathing zones should conform to the local health standards tolerance for a health risk. The second requirement is the supply air and recirculated air in the space, as perceived by occupants, must be fresh and pleasant rather than stale, stuffy and irritating.

With prolonged exposure, there are indoor air pollutants that could pose certain health risks to human beings. The health risks associated comprise distinct, acute, or long-term adverse effects.

It is important to have efficient and properly functioning air-conditioning and mechanical ventilation systems in the building to maintain the desired indoor air quality control. The quality of the indoor air can greatly impact the incidence of respiratory diseases, the symptoms of allergies and asthma, the transmission of infectious diseases, chemical sensitivity and occupant productivity. High-efficiency particulate air filters can significantly reduce the risk of airborne pollutants, thus reducing the infection rates of a wide range of other aerosolized pathogens.

A higher indoor CO_2 concentration level, due to inadequate ventilation, is associated with building occupants experiencing a tendency to be less satisfied with indoor air quality, as they report more acute health symptoms (e.g., headache, mucosal irritation). It is argued that higher levels of various indoor-generated pollutants that directly cause the adverse effects, are correlated with when higher indoor CO_2 concentrations occur at lower outdoor air ventilation rates.

Indoor air quality in a building is not constant. It is influenced by changes in building operation, occupant activity and outdoor climate. Pollutant sources include building materials, furniture, office equipment, human metabolism and outdoor air. Among different pollutants several substances are of special concern for human health including Carbon Monoxide (CO), Nitrogen Oxides (NO_X), Sulfur Oxide (SO_X), Formaldehyde, Volatile Organic Compounds (VOC's), particulate matters (PM2.5), Ozone (O3), metabolic gases, micro-organisms and airborne bacteria.

The biological quality of air in sensitive buildings such as healthcare facilities, wellness centers and schools is of particular concern as such facilities are susceptible for the spread of pathogenic bacteria. The transmission of airborne bacteria is highly affected by the overall environment including air contaminants. For example, research examining indoor air pollutants in the food service sector observed a positive correlation between particulate matters (PM), total volatile organic compounds (TVOCs), polycyclic aromatic hydrocarbons (PAHs) and kidney inflammation. Common sources of aerosol transmission in hospitals include respiratory discharge from the mouth and nose, skin exudates and infected wounds, which may infect the occupants through transmission means such as respiratory apparatus and air-conditioning. Therefore, considerable attention is needed in operating such buildings towards controlling pathogenic bacteria.

Microbial pollution is a key element of indoor air pollution. It is caused by hundreds of species of bacteria and fungi, in particular filamentous fungi (mould), growing indoors when sufficient moisture is available. In such cases, hundreds of species of bacteria and fungi – particularly mould – pollute indoor air. The most important effects of exposure to these pollutants are the increased prevalence of respiratory symptoms, allergies and asthma, as well as disturbance of the immune system. Preventing (or minimizing) persistent dampness and microbial growth on interior surfaces is the most important means of avoiding harmful effects on health.

Indoor air quality may be controlled by a combination of source control and ventilation. Humans produce Carbon Dioxide (CO_2) proportional to their metabolic rate. At low concentrations, typically occurring indoors, CO_2 is harmless to humans. It is a good indicator of the concentration of other human bio effluents being perceived as a nuisance. In addition, other pollution sources or hazardous air pollutants such as CO, NO_X, PM2.5, SO_X, O3 and VOCs as well as the microbial pollutants must be considered in assessing the indoor air quality.

ASHRAE has defined the acceptable indoor air quality as the air in which there are no known contaminants at harmful concentrations, as determined by local regulations, and with which a substantial majority (80% or more) of the people exposed do not express dissatisfaction.

Methods and measures listed below work best when they are implemented in the design stage. However, during maintenance, renovations and retrofitting various improvements in ventilation can be implemented, depending on the intent of the upgrades and allocated budget.

3.2.3 GUIDELINES

- Develop an Operations and Maintenance (O&M) Manual and implement the elements that include O&M procedures and maintenance schedules based on the manufacturer's instructions.
- Ensure that the O&M Manual is updated frequently for the applicable systems.
- Provide effective filtration systems including particle filters or air-cleaning devices to clean the air prior to the introduction to occupied spaces - especially if the outdoor air is judged to be unacceptable, or exceeding the limits identified by the regulatory authority for outdoor contaminants.
- Ensure fresh air intakes are positioned away from exhaust vents to minimize short cycling.
- Protect outdoor air intake openings from rainwater, insects, animals and debris with screens and bird guards, and specify ventilation linings that will not release contaminants into the air path.
- Locate outdoor air intakes away from contaminant sources including building exhaust air

louvers, exhaust outlets from adjacent buildings, cooling towers, loading docks, air exhaust from waste facilities, parking garages, transportation stops, smoke discharge openings and dedicated exhausts from toilets and kitchens.

- Ensure a high-efficiency air filtration system is utilized to remove particles from the outdoor air, before being distributed throughout the building.
- Ensure all airstream surfaces in equipment and ducts in the ventilating system have adequate resistance to mold growth.
- Minimize the risk of contamination by encapsulating or removing exposed insulation inside ducts, air-handling units and variable-air-volume boxes.
- Provide building occupants/users with the ability to control ventilation rates to ensure comfort.
- Ensure ventilation equipment can be easily accessed for inspection and routine maintenance, including filter replacement and fan belt adjustment and replacement.
- Ensure the air distribution system including access doors, panels, or other means are provided in ductwork and plenums, located and sized to allow convenient and unobstructed access for inspection, cleaning, and routine maintenance.
- Ensure, where applicable, a CO_2 based demand control ventilation (DCV) system for mechanical ventilation to provide the minimum ventilation, as per the standard only for spaces, and not for occupants, during off hours to minimize excessive energy use.
- Consider the use of positive building pressurization in hot climates to prevent warm and humid air from seeping into the building.
- Consider the balance between fresh air supply and energy efficiency. Carbon dioxide sensors can be used in air-conditioned buildings.
- Maintain relative humidity below 60 percent within buildings.
- Use air conditioners or dehumidifiers during humid months and maintain them properly.
- Provide adequate ventilation in buildings, including exhaust fans in kitchens and bathrooms.
- Keep bathroom and kitchen surfaces clean and regularly treat them with disinfecting products.
- Do not place carpeting in bathrooms, basements or other areas where humidity is high.
- Remove or replace carpets and upholstery if they cannot be dried out immediately after becoming wet.

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3.3 [IE.3] LIGHTING

3.3.1 PURPOSE

To provide and maintain artificial lighting that meets the needs of occupants and users of the facility.

3.3.2 CONTEXT

Lighting at work is critical to the wellbeing and security of everybody utilizing the work environment. Poor lighting can influence the health of people at work causing side effects such as eye fatigue, headache and migraines. It is also connected to 'Sick Building Syndrome' in new and renovated buildings. Side effects of this incorporate cerebral pains, laziness, crabbiness and poor focus. Poor lighting in the workplace can have negative impacts on productivity and efficiency which may result in increased absenteeism.

The other misguided judgment is that office lighting is required to provide a uniform lighting level over the entire space. Uniform lighting is required across each task area, typically comprising of generally distributed small areas for similar types of activities. The lighting in the wider workplace may differ to have visual interest. It is argued that prolonged exposure to high-intensity lighting has been associated with losing a major stimulus for maintaining normal 24-hour functioning. Thus, it is important to recognize the effects of the intensity and timing of light on different user groups.

Aspects that would normally be considered for ensuring a high quality of visual performance include levels of illumination; uniformity and ratios of illuminance; glare; color and room reflectance; energy efficiency; and other special considerations.

The illuminance values recommended by established standards are valid for normal visual conditions and consider the following factors: psycho-physiological aspects including visual; comfort and well-being; visual task requirements; visual ergonomics; practical experience; contribution to functional safety; and economic impact.

The illuminance should be maintained at higher levels when: visual work is critical; errors are costly to rectify; accuracy, higher productivity or increased concentration is of great importance; task details are of unusually small size or low contrast; the task is undertaken for an unusually long time; and the visual capacity of the occupant is below normal.

3.3.3 GUIDELINES

- Ensure the lighting system meets relevant standards in terms of minimum illuminance levels, light uniformity and glare control.
- Ensure the lighting controls system meets relevant building users' operational requirements (based on building use, anticipated lighting system usage patterns, automation and daylight integration requirements, etc.).

- Provide lighting controllability to occupants in terms of the amount of control for an individual to turn lights on and off, brightness adjustment, and change the positioning of fixtures.
- Use energy efficient lighting lamp technology, such as solid-state LED lamps or other energy saving fixtures.
- Use lamps having adequate color correlated temperature (CCT) for the given application (e.g. offices-neutral to cold; residential-neutral to warm etc.)
- Implement an adequate lighting and lighting controls system maintenance plan (regular inspection and testing, re-lamping and luminaires cleaning etc.)
- Implement, where applicable, an adequate maintenance plan for blinds, (regular cleaning, replacement of damaged slats/vanes, inspection and functional testing of actuators, if automated etc.)
- Utilize, where applicable, daylighting to reduce the energy required for electrical lighting, being mindful that introducing daylight into building interiors may also increase solar heat gain and cooling loads.
- Ensure, when daylighting is utilized for performing specific tasks, that factors impacting the quality and quantity of daylighting within the building such as window placement and sizes, glazing transmittance, room geometry, interior surface finishes, and shadows cast from nearby buildings are taken into consideration.
- Determine the appropriate light levels for each of the different task-related spaces in the proposed building and provide the lighting system to meet these requirements.
- Avoid over-illumination of entire rooms or spaces by providing individual task or accent lighting where higher illumination levels are required.
- Ensure the extent and type of lighting controls relate to the function of each space, the number of occupants, the frequency of use, and the level of daylighting within each space.
- Coordinate light fixture layouts in conjunction with furniture layouts to maximize lighting efficacy.
- Use high frequency fittings to minimize discomfort due to the flicker caused by luminaires that have a low frequency, such as conventional fluorescent luminaries.
- Ensure the color, texture, and reflectance of surface materials in a room help to improve lighting conditions and minimize lighting needs.

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3.4 [IE.4] DAYLIGHT & VIEWS

3.4.1 PURPOSE

To maximize exposure to daylight and external or internal views for the health and well-being of occupants and users of the facility.

3.4.2 CONTEXT

Daylight. Based on research studies among staff, daylight has been associated with reduced stress, improved performance and reduced errors, reduced absenteeism, increased positive attitude, reduced fatigue and improved job satisfaction. In addition, daylight provides contact with the outside living environment and improves circadian rhythms by affecting melatonin production and regulation. Also, windows provide a feeling of closeness to the surroundings and atmosphere.

The average daylight factor is influenced by building form, size and area of windows in relation to the room, the light transmittance of the glass, how bright internal surfaces and finishes are, the presence of overhangs and other external obstructions which may restrict the amount of daylight entering the room.

Building geometry and interior space planning should promote, rather than preclude, the distribution of daylight. Based on the building form, side-lighting is considered the primary way of introducing daylight into buildings. Besides supplying light, side lighting through windows can provide view, create orientation, allow connectivity to the outdoors and allow ventilation during less harsh times of the year. The size and proportion of windows should depend on the amount of daylight required, type of view, the size of the internal space, and the position and mobility of occupants. When windows are confined to one wall only, it is recommended that the total width of the windows range between 25-50% of the length of the wall to offer the optimum viewing opportunity. Additionally, window glass selection, reflectance of interior finishes and the interior layout play a role in enhancing the illuminance of the work place.

Top lighting is when daylight penetrates a building from above the ceiling plane or is concentrated in the roof. Top lighting can provide greater freedom of source placement to achieve more uniform illumination and takes advantage of high wall surfaces and other architectural elements to distribute light where required. Common top lighting strategies including skylights, courtyards, lightwells and atria.

Sunlight should be admitted unless it is likely to cause thermal or visual discomfort to the users, or deterioration of materials. Generally, sunlight should not fall on visual tasks or directly on people at work. It should, on the other hand, be used to enhance the overall brightness of interiors with patches of high illuminance. Interiors in which the occupants have a reasonable expectation of direct sunlight should receive at least 25% of probable sunlight hours. It is the duration of sunlight in an interior, rather than the intensity or the size of the sunny patch, which correlates best with occupant satisfaction. However, adequate measures should be taken for controlling glare while designing to maximize daylight in buildings.

Glare. Distraction, a poor luminance balance between task and background, and discomfort glare can all occur if the visual task is viewed directly against the bright sky. Although a view outside should be provided, it is usually improved if the glazing is at the side of workers, rather than directly facing them. Glare from the sun, viewed directly or reflected, can be unacceptable in a working environment. Low transmittance glazing is unlikely to attenuate the beam sufficiently to eliminate glare; diffusing glazing materials, in scattering the beam, may cause the window or roof light itself to become an unacceptably bright source of light.

Views. Unless an activity requires the exclusion of daylight, a view out-of-doors should be provided irrespective of its quality. Most people prefer a view of a natural scene: trees, grass, plants and open space. All occupants of a building should have the opportunity for the refreshment and relaxation afforded by a change of scene and focus. Even a limited view to the outside can be valuable. If an external view cannot be provided, occupants should have an internal view possessing some of the qualities of a view outdoors, for example, into an atrium.

For interior zones where no direct daylight is provided the indoor nature exposure (INE) that replicates nature including plant-based features, organic textures, fish tanks, live or artificial plants, nature photography or art and sounds and aromas can be considered potential means of improving health and creating health-promoting environments. In particular, studies have shown that plants offer a guarantee of enhancing perception and contribute to wellbeing and that people perceive buildings with interior planting to be more welcoming and more relaxed.

3.4.3 GUIDELINES

- Integrate daylighting into the overall lighting approach of the building to provide a balance between natural and artificial lighting. Determine the lighting needs in the spaces throughout the facility and take measures to maximize the daylighting potential of the building.
- Consider design elements, such as atria, courtyards, skylights, and shading devices, to harvest and control natural light.
- Incorporate appropriate window openings in areas of maximum daylight exposure.
- Minimize the depth of rooms and building floor plates, where feasible, to increase the amount of natural light entering the space.
- Increase the quantity of natural light by promoting design elements such as light shelves, light ducts, and other apparatus to capture light.
- Design the project to balance and control factors such as heat gain and loss, glare, visual quality, and variations in daylight availability.
- Specify low reflective interior color schemes and materials to balance visual quality and quantity.

- Consider the use of sun shades, louvers, operable blinds and drapes and exterior light shelves to control and reduce glare.
- Design frit patterns for glazing surfaces and specify glass which can reduce solar heat gain while allowing natural light into the space.
- Locate the maximum number of spaces near daylight through efficient interior space planning and configuration.
- Integrate building systems, including artificial lighting with daylighting through control systems.
- Reflect daylight within a space to increase room brightness. A light shelf, if properly designed, has the potential to increase room brightness and decrease window brightness.
- Slope ceilings to direct more light into a space. Sloping the ceiling away from the fenestration area will help increase the surface brightness of the ceiling further into a space.
- Avoid direct beam daylight on critical visual tasks. Poor visibility and discomfort will result if excessive brightness differences occur in the vicinity of critical visual tasks.
- Filter daylight. The harshness of direct light can be filtered with vegetation, curtains, louvers, or similar and will help distribute light.
- Ensure that daylight-responsive electric lighting controls are fully operational during regular building operations and maintenance program.
- Ensure that all windows and daylight redirection devices are cleaned and maintained to ensure the best practice performance of the reflecting surfaces.
- Ensure that site obstruction objects are cleared, and daylight flows seamlessly to the spaces inside the building.
- Provide sufficient indoor planting in enclosed spaces lacking in natural views. Ensure proper housekeeping to control any presence of insects which might result in a negative impact on occupants.
- Incorporate nature and nature-inspired design indoors.
- Provide indoor objects to enclosed spaces in the form of organic textures, fish tanks, nature photography or art as an alternative to natural views and ensure adequate distribution and locations.
- Create an indoor atrium, where applicable, in high traffic zone and provide planting and water features to create a place of attraction in the workplace.
- Provide an outdoor courtyard, where feasible, with greenery and landscape that can be used by occupants for relaxation and break time.

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3.5 [IE.5] ACOUSTICS

3.5.1 PURPOSE

To maintain acceptable indoor noise levels for the health and well-being of occupants and users of the facility.

3.5.2 CONTEXT

Good acoustic performance is essential for all building typologies, from open offices to places of worship. Some workplaces are exposed to high and unsafe noise levels for the occupants. To successfully address these issues, acoustics must be considered in the design and in the operation phases.

For offices, the attenuation of sound between neighboring work stations in an open-plan environment is typically much less than that potentially available between closed offices. Nevertheless, a degree of acoustic privacy can be achieved if the component selection and interaction are understood. To ensure good acoustic performance in an open plan office, careful coordination of several components should be sought including ceiling, wall treatments, furniture and furnishings, heating, ventilation and air-conditioning system, and the masking sound system.

Noise within buildings is received from two sources:

1. Intrusion from external surroundings.
2. Building services.

Typical external noise intrusion sources include traffic noise (road, rail and/or aircraft sources); mechanical plant and equipment associated with adjacent buildings and industrial activities and local activities such as markets, maintenance, sport and leisure.

Building services noise includes noise sources, such as fans, air-conditioning, motors and pumps etc. The noise can be transferred to internal useable spaces by two mechanisms namely; air-borne noise transmission and structure-borne noise transmission. Both mechanisms of transmission must be considered in buildings by the provision of appropriate sound insulation and structural isolation.

3.5.3 GUIDELINES

- Mitigate the effects of external noise sources by using vegetation, earth berms, or other noise barriers on the site as a means of muffling off-site noise before it reaches the building.
- Ensure building components have an appropriate sound transmission class rating, such as exterior walls, windows, and doors to protect interior spaces from harmful noise sources.
- Ensure the office layout is designed to avoid obvious noise intrusion possibilities. Individual work stations can be positioned relative to columns, walls, and each other to avoid

uninterrupted sound paths between adjoining work stations. Occupant orientation is also important, as there is a significant difference between the sound level when someone talking faces the listener, versus someone talking facing away from the listener.

- Locate problematic noise generation sources- computers, business machines, copiers, typewriters, and other noise generating devices in isolated (enclosed) rooms or areas to minimize noise intrusion into the work station. Where this is impractical, care should be exercised in eliminating or minimizing the noise generation aspects. Telephones and "speaker phones" are a frequent problem. The former should be equipped with flashing lights, rather than ringers (audible annunciators).
- Select appropriate ceiling elements, such as return air grilles or fixtures, to avoid leakage of sound from the masking system or surface reflections of incident sounds.
- Manage the sound generated within the work station and potentially intruding into adjacent work spaces through one of the following two ways: (1) using barriers that are properly absorptive and appropriately impervious to sound penetration; and (2) reducing the tendency of sound to "flank" or diffract around the perimeters of such barriers.
- Treat vertical surfaces which are possible sound reflectors if not specifically treated. Hard, flat, smooth surfaces represent the worst condition. To reduce or eliminate these reflections, such surfaces should be highly absorptive to the sound of the frequency range that is of concern.
- Control flanking transition by considering the height and length of the barrier, the horizontal distance between adjacent barriers, and the sound absorptive characteristics of the adjacent barriers. The most practical method of reducing flanking is to employ vertical barriers that are as high and as long, if possible. This may conflict with the desire for "openness" or clear view through the office space.
- Ensure, if applicable, that the barrier height is more than 1.5m as below this height is ineffective for acoustical barriers in open plan offices. As a general rule, barrier heights greater than 2 m provide diminishing returns. "Trade-off" decisions, in the determination of the required height against the original motive for considering the aesthetic factors associated with such systems, are required.
- Consider using acoustic ceiling tiles and wall panels or spray-on acoustic treatments in spaces where additional sound absorption is necessary.
- Provide sufficient noise insulation to mitigate impacts from interior noise sources such as those generated by plumbing systems, mechanical ventilation systems, and air conditioning equipment.
- Minimize excessive vibration from services and equipment as per the latest ISO standard or equivalent, to mitigate acoustic problems in the building interior.
- Consider the use of soft, sound absorbent materials for interior finishes including walls,

floors, and ceilings to reduce noise levels. A higher sound absorption rate will attenuate noise transferred from the exterior, or generated within the building, and will increase the acoustic performance within the building.

- Consider the floor impact sound level and the performance of sound insulation as related to impact noises both heavy and light. An example of light floor impact noise is a light weight plastic chair being dragged on a concrete floor, whereas a heavy floor impact noise might be the sound of children jumping.
- Ensure the use of materials with appropriate Impact Insulation Class (IIC) (a measure of the impact of sound insulation of a floor/ceiling) to provide the proper acoustic performance levels for interior spaces.

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4.0 WASTE MANAGEMENT

4.1 PURPOSE

To implement waste management best practice throughout the operation of the facility.

4.2 CONTEXT

Waste generation constitutes one of the most important health and environmental issues worldwide. The primary causes are the increase in population and the increased rate of resource consumption. Societies can opt to reduce the amount of waste either taken to landfill, or incinerated through the adoption of a Waste Management hierarchy as follows:

- Reduce;
- Reuse;
- Recycle/composting; and,
- Disposal, when none of the above options are feasible.

The composition of the solid waste generated from each building typology differs depending on its functionality and use. The non-organic waste generated by buildings is insufficiently reused worldwide. Similarly, organic waste, the main stream of waste generated, accounts for 50 to 60% of the municipal solid waste with very little being composted for reuse. This makes composting a practice that can significantly mitigate the problem.

Industrial buildings generate hazardous waste that poses a great risk to human health and habitat contamination. Deviation of hazardous waste from landfill is essential to avoid such major health and environmental impacts.

4.3 GUIDELINES

4.3.1 Purchasing Policy

- Identify the supply requirements for good purchase planning, avoiding over ordering, which eventually converts into waste.
- Purchase low packaging materials, even bulk materials if possible.
- Purchase reusable items like coffee mugs and glasses instead of plastic cups, etc.
- Purchase materials with recycled content, e.g. recycled paper to encourage manufacturers to implement recycling practices.

4.3.2 Storage Management Practices

- Implement good storage practices to prevent the deterioration of materials.
- Store and handle hazardous materials according to the Materials Specifications Data Sheets (MSDS).
- Train building management/maintenance staff on good storage and handling practices.
- Maintain good housekeeping to reduce waste generation.

4.3.3 Waste Reuse

- Send bulky waste items to organizations which are willing to repair and/or reuse them.
- Encourage double-sided printing and the reuse of single sided printing as office notepads, draft printing, etc.
- Reuse office supplies such as folders, document wallets, paper clips, etc.

4.3.4 Waste Collection System

- Determine the types, quantities, sizes and location of the different segregation containers based on the following:
- Identify types of waste generated to determine the different waste streams;
- Forecast waste quantities for each building typology; and,
- Identify the waste generation areas.
- Provide occupants with easy access to containers for all types of waste potentially generated.
- Inform occupants about the different waste streams and location of the waste collection containers.
- Clearly label the waste containers using photos, color code and different languages where necessary to facilitate proper segregation at source and to avoid mixing waste.
- Segregate, for the ease of post collection treatment, the waste generated into different types including, but not limited to the following: paper, dry recyclable waste (tetra pack, plastic containers, cans), cardboard, food and organic waste, glass, metals, wood and non-recyclable.
- Ensure that hazardous waste, e.g. batteries, lamps, mineral oil, vegetable oil, clinical waste, tyres, etc. are appropriately segregated.
- Ensure that bulky waste, consisting of large materials which do not fit any of the above categories, e.g. waste electronic or electrical equipment and furniture are disposed of in the most appropriate manner.

- Plan a regular collection of waste from the containers to the central waste storage area, and from there to the recycling or disposal facilities.
- Designate suitable areas outside the building for smoking and cigarette butts.

4.3.5 Composting of Organic Waste

- Determine the types of organic waste that will be produced, including food waste, plant trimmings, or wood waste.
- Provide sufficient collection points for organic waste throughout the building, especially near food service locations where most organic waste is produced.
- Provide, where feasible, on-site facilities for composting or disposal of organic waste at off-site composting facilities.
- Consider the placement of composting equipment away from 'clean' areas such as post-purification worship spaces and ablution rooms.
- Consider using the biomass of generated organic waste as energy.

4.3.6 Waste Storage

- Ensure that facilities for central waste storage are properly contained and ventilated to minimize negative impacts to the surrounding spaces such as odor.
- Ensure that facilities for central waste storage enable ease of access for collection vehicles.
- Consider the installation of compactors and wheeled bins to reduce the volume of waste and facilitate storage if required.
- Store food waste in containers with closed metal or hard plastic tops.
- Keep flammable substances away from any sources of ignition.
- Provide fire prevention systems and/or extinguishers appropriate for each of the collected waste types.

4.3.7 Hazardous Waste Management

- Retain hazardous waste in a secure area separate from non-hazardous waste and away from any sources of ignition.
- Store different types of hazardous waste separately to avoid adverse chemical reactions and potential accidents.
- Strictly follow the storage and handling instructions given in the related MSDS for each type of hazardous waste.

- Store hazardous waste in tightly closed, leak-proof containers made of, or lined with, materials compatible with the hazardous waste to be stored. Clearly mark the containers with appropriate warning labels to accurately describe their contents and any detailed safety precautions.
- Maintain a register of all hazardous waste and disposal methods. The classification of hazardous waste is in accordance with the latest local government regulations.

4.3.8 Waste Transportation & Disposal

- Arrange the collection, transportation and disposal of each type of waste with the relevant Authority or licensed Waste Management Contractor.
- Transport waste to a disposal/recycling facility approved by the relevant Authority.
- Ensure that vehicles delivering waste to the disposal area are covered, when necessary, to prevent dropping, leaking or blowing of solid waste from the vehicle.
- Ensure the safe removal/disposal at an authorized landfill for non-recyclable waste.

4.3.9 Waste Records

- Maintain and update a waste log on a regular basis prepared by both the waste generator and collector.
- Ensure that the waste contractor is collecting the required data on waste generation and disposal/ recycling.
- Issue a Disposal Waste Transfer Note (DWTN) at the time waste is disposed. The DWTN includes the type of waste and quantity (weight or volume).
- Maintain a register of all hazardous waste and the disposal methods. Include in the record of waste being disposed of- the date, time, type of waste and quantity of waste.

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5.0 FACILITY MANAGEMENT

5.1 PURPOSE

To implement facility management best practice throughout the operation of the facility.

5.2 CONTEXT

Facility Management (FM) can be defined as a profession that encompasses multiple disciplines to ensure functionality of the built environment by integrating people, place, process and technology. It is a process of managing and maintaining the facilities of the organization, which includes at least buildings, physical resources, site and any other mechanical and electrical utilities that can cause health or safety hazards to occupants or impact the performance of the organization.

The benefits of adopting best practice in FM include financial savings related to avoiding costs due to ignorance of adequate preventive maintenance and an increase in return on investment, personnel retention by maintaining a safe, comfortable and pleasant environment and core business performance due to well-maintained and uninterrupted business operations.

FM involves guiding and managing the operations and maintenance of buildings, precincts and community infrastructure on behalf of property owners. It is focused on the efficient and effective delivery of support services. FM is a vital element in supporting any organization in undertaking its core business by providing a safe and effective environment in which to operate.

FM includes two principal areas: 'Space & Infrastructure' (e.g. planning, design, workplace, construction, lease, occupancy, maintenance, furniture and cleaning) and 'People & Organization' (e.g. catering, ICT, HR, accounting, marketing, hospitality, etc.). These two broad areas of operation are commonly referred to as 'Hard FM' and 'Soft FM'. The first refers to the physical built environment with focus on space and building infrastructure. The second covers the people and is related to work psychology and occupational physiology.

It is generally accepted that there are various models for the delivery of FM services ranging from in-house FM department to total out-sourcing FM services (Total FM Contract).

- In-house FM Department: A dedicated management team with in-house employees trained to deliver all FM services. Specialist services can be outsourced where the required expertise is not available in-house, for example: elevator and escalator maintenance.
- Total FM Contract: The FM supplier will deliver all FM services to the client organization through strategic partnerships, joint ventures, subsidiary companies or in-house resources – a total FM solution or 'one-stop-shop'.

The size of the organization and the complexity of its operations influence the scope of facilities management services and the delivery model. Increasingly it is common practice for organizations to concentrate on their core business and to outsource support services including FM services.

The role of the Facility Manager spans across business functions. The primary priority of the Facility Manager is keeping people comfortable and safe. The Facility Manager must operate at two levels:

- Strategically-tactically: helping clients, customers and end-users understand the potential impact of their decisions in the provision of space, services, cost and business risk; and,
- Operationally: ensuring a corporate and cost-effective environment for the occupants to function.

5.3 GUIDELINES

5.3.1 Establish Resources Management Plan

FM should have adequate resources and structure to deliver the required scope with a satisfactory level of service. The resourcing plan should outline the staffing level, organization structure, roles and responsibilities, expertise, work schedule and resources.

5.3.2 Manage Environment, Health and Safety

The FM should control and manage many environmental and safety related issues of the organization. Failure to control and manage such issues can result in unhealthy conditions, occupants falling sick, injury, loss of business and the potential for prosecution and insurance claims. Customer and investor confidence in the organization might also be impacted through negative publicity from health and safety failures.

5.3.3 Manage Fire Safety

Fire represents one of the highest risks to loss of life. The potential damage to property could result in an organization totally shutting down its entire operations. The FM department ensures that there are systems and methods in place for the maintenance, inspection and testing of all the fire safety equipment and systems. The FM department keeps records and certificates of compliance where required.

5.3.4 Manage Security Services

The protection of occupants and the organization is frequently under the control of the FM department, in particular the maintenance of security software and hardware. This can also include manned guards should the organization require this level of additional security although such provision can be the responsibility of another department or outsourced.

5.3.5 Manage Maintenance, Testing and Inspections

The FM department ensures that the Operations & Maintenance (O&M) manuals for all systems and equipment specific to the organization are in a safe, accessible central location. Further, the FM department ensures the timely maintenance, testing and inspections are implemented within schedules to ensure that the facility and organization are operating safely and efficiently, and to maximize the lifespan of the systems and equipment to reduce the risk of failure. All works should meet the statutory obligations and requirements. Plan all works beforehand with the aid of relevant management tools or appropriate application software.

5.3.6 Manage Building Fabric Works

Building fabric includes all preventative, remedial and upgrade works required for the upkeep and improvement of buildings and their components. Such work can include disciplines such as painting, and decorating, carpentry, plumbing, glazing, plastering, and tiling and other such renovation works.

5.3.7 Manage Janitorial Services

Janitorial services include the regular cleaning of toilets, replenishing consumable items (such as toilet rolls, soap) and the uplift of litter. It is good practice for janitorial services to have a proactive response to the need for such actions. Schedule the cleaning as a series of periodic (daily, weekly, monthly) tasks. Sustainable and healthy practices are of prime importance for the health and wellbeing of occupants. Carefully select the type and chemical content of the materials used for janitorial services.

5.3.8 Manage Operational Performance

The FM department has responsibilities for the general day-to-day running of the building. These activities may be undertaken internally by employed staff or outsourced. This is often a policy issue, subject to the size and complexity of the organization. The immediacy of the response required in many of the activities involving the facilities manager will often require daily reports or an escalation procedure.

Some issues can require more than only periodic maintenance, for example those that can stop or obstruct the productivity of the business or that could have health and safety implications.

5.3.9 Manage Customer Needs

The receipt of occupant requests or complaints must be handled by a central point. This can be in the form of a help-desk enabling contact through telephone or email. The response to help desk calls can be prioritized based on the urgency of the issues raised.

The help desk can also be used to book meeting rooms, car parking spaces and many other services. This often depends on how the FM department is organized.

5.3.10 Manage Business Continuity Planning

All organizations should consider having a continuity plan in order that in the event of a fire, or major failure, the business can recover as quickly as possible and continue operating. In large organizations, staff could be relocated to another location that has been set up to reflect the existing operational model. The FM department is one of the key facilitators, should it be necessary to move the business to a recovery location.

5.3.11 Manage Space Allocation and Changes

Office layouts are subject to frequent changes in many organizations. This process is referred to as 'churn' and the percentage of staff moved during a year is known as the 'churn rate'. Such moves and change are normally planned by the FM department. In addition, consideration may also be given to vending, catering or staff restrooms and pantries.

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6.0 ENVIRONMENTAL POLICY & AWARENESS

6.1 PURPOSE

To implement organization-wide environmental policy & awareness initiatives for occupants and users, with focus on energy saving, water conservation and waste management.

6.2 CONTEXT

It is important for an organization that plans to conserve resources and reduce negative impacts on the environment to develop an environmental policy that outlines the overall intentions and direction to achieve these goals and ensure that all occupants and users become increasingly aware of energy and water consumption, indoor environmental quality degradation and waste generation.

An environmental policy, as defined by the organization's senior management, forms the foundation for environmental improvements and determines key environmental aims and principles of the organization. Awareness initiatives are required to ensure that appropriate guidance is provided to all parties, internal or external to the organization, to perform their activities in relation to the environmental impact. This can be achieved by developing and implementing an appropriate organization-wide sustainability awareness campaign.

With clear policy and adequate awareness, simple changes to habit and practice can quickly lead to a significant reduction in energy and water consumption and increased financial benefits. Such changes will only take place when people are made aware of the consumption and how to implement reduction and control measures. Similarly, an increasing awareness of the need to reduce, reuse and recycle waste is of benefit to an organization and the wider environment.

Appropriate guidance and encouragement for users can achieve a substantial consumption reduction. Motivation to save energy, water and reduce waste can only happen when users are educated about the value of energy and water resource conservation and the need to reduce waste.

6.3 GUIDELINES

6.3.1 Part A: Environmental Policy

1. Develop Framework for Goals and Objectives

Provide the overarching goals for safeguarding the environment within the policy consistent with the regulatory framework and compliance requirements, organization objectives and stakeholders' expectations.

The policy refers to the following goals: energy conservation, water saving, waste management, facility management and enhancing indoor environmental quality in terms of thermal comfort, indoor air quality, lighting, daylight and views & acoustics.

2. Ensure Appropriateness to the Organization

The environmental policy should be appropriate to the environmental impacts associated with the organization activities and services, taking into consideration its purpose, context, nature and scale. The environmental policy should be reviewed periodically to ensure that it remains relevant and appropriate to the organization.

3. Incorporate Continual Improvement Cycle

A commitment for continual improvement of the processes affecting the environmental policy incorporating feedback and views of all parties involved with the implementation of the policy should be considered.

6.3.2 Part B: Sustainability Awareness

1. Obtain Management Commitment

An effective commitment to energy saving, water conservation and waste reduction should be initiated by senior management and reinforced by a robust resources conservation policy. Senior management commitment can be demonstrated by promoting best practice in resource savings, and the development of a procurement policy whereby energy and water-efficient products and services are specified for the project, in addition to the implementation of an effective waste management plan.

2. Identify Key Objectives

Primarily, it is important to identify the main objectives for each initiative. This may include one or more of the three areas; energy saving, water conservation and waste management. The facility management team may decide to dedicate an initiative for each of the three areas or to combine two or more in one initiative as applicable.

The key objectives shall be clear and simple. They will act as guiding principles for the subsequent action plan and related communication and resources.

3. Develop Action Plan

An action plan is a document that lists what steps must be taken in order to achieve a specific goal. The purpose of an action plan is to clarify what resources are required to reach the goal, formulate a timeline for when specific tasks need to be completed and determine what resources are required. A well-developed action plan can serve as a blueprint for the project manager to break a large project into smaller, more manageable projects through SMART (Specific, Measurable, Attainable, Realistic and Time-based) goals.

4. Identify Timeline

The initiative timeline should outline the activity durations, lags and leads to achieve the identified key objectives according to the initiative action plan. The timelines of different initiatives may overlap according to the overall timeframe. Such overlaps should be carefully studied and addressed to avoid confusion for the users. Overlaps, however, can be invested to create a holistic understanding of energy saving, water conservation and waste management.

The initiatives timelines can be arranged to establish a better ambiance for users allowing them to easily correlate between various environmental aspects. In such cases, the overall results of the initiatives will be much more valuable than the results of each individual initiative if applied separately. Initiative timelines can be planned and managed together to achieve the ultimate objectives of the sustainability awareness campaign.

5. Identify Resources

The resourcing plan should outline the staffing level, organization structure, roles and responsibilities, expertise, work schedule and resources. Critical resources and their calendars shall be identified for each initiative to avoid non-necessary lags.

6. Identify Communication Channels

Communication channels state the tools and materials used to promote and communicate the key objectives of the plan to the users according to the action program. Selecting which communication channel is the most suitable for an audience is very important and should spearhead any dissemination activities.

A range of channels through which materials can be disseminated includes, but is not limited to, publications, websites, poster campaign, events, social media and social networking.

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