



GREEN GLOBES® FOR  
**NEW CONSTRUCTION**  
**2013 - MULTIFAMILY**  
PROTOCOL GUIDANCE

VERSION 2.2

JULY 2022

## PREFACE FROM GREEN BUILDING INITIATIVE

The Green Building Initiative (GBI) is a 501(c)3 nonprofit organization and American National Standards Institute (ANSI) Standards Developing Organization (SDO) dedicated to accelerating the adoption of green building best practices. GBI is nimble and entrepreneurial in nature, believing that the market benefits from multiple pathways to integrate sustainability into the built environment. Creating credible, practical, third-party auditable assessment programs has been a priority since GBI was founded in 2004.

For many industry members, the expectation has been that achieving sustainable building certification must be costly and bureaucratic to be effective. GBI rejects that concept and has crafted an assessment program that is time- and cost-effective through Green Globes. Paperwork does not have to be laborious when a well-qualified Assessor visits the site and visually verifies the attributes of a building. A building team can have peace of mind knowing that their client service team will be supportive and transparent throughout the entire certification process. Green Globes is developed by the building industry for the building industry and has been deemed equivalent to other leading rating systems by the U.S. General Services Administration, Department of Energy, and Department of Defense. Large, progressive portfolio owners across the United States use Green Globes with the understanding that they can achieve improved sustainability results through a simple and seamless process. Green Globes provides a platform for teams to engage in the sustainability conversation and continue learning during the certification process.

Green Globes Multifamily for New Construction (Green Globes Multifamily NC) provides a certification option that meets the needs of owners and project teams with multifamily projects. Green Globes MF NC includes:

- Minimum requirements for energy efficiency that ensures resource conservation through operations and tenant best practices.
- Flexibility and multiple pathways to success.
- A question set prompts users to think critically about their project.
- Third-party Assessor onsite review providing assurance of certification claims.
- Customer service and technical staff through GBI that deliver step-by-step guidance.

These attributes make Green Globes the first choice for multifamily new construction. By engaging with Green Globes and reading through the question set in this manual, you will discover new ways to adopt green building best practices into your multifamily project.

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# Green Globes® Multifamily for New Construction Overview

## Introduction

Green Globes is a well-established green building guidance and assessment program that offers a practical and affordable way to advance the environmental performance and sustainability of a wide variety of building types. Green Globes Multifamily for New Construction (Green Globes Multifamily NC) is a rating system designed specifically for multifamily new construction, major renovation, and addition projects. This program is intended to be used for residential buildings on a multifamily property. Other buildings on the property, such as leasing offices, clubhouses, and community centers should use the standard Green Globes for New Construction program and technical manual if they account for more than 5% of the total property gross square footage.

Green Globes Multifamily NC is a smart alternative for rating and certifying new construction multifamily designs owing to these key attributes:

- Minimum requirements required of all projects to meet targeted ventilation and energy savings requirements and to be certified through the Green Globes Multifamily programs
- A comprehensive environmental assessment protocol using accepted criteria
- Best practices guidance for designing sustainable new construction, major renovation, and additions of multifamily buildings
- A practical and cost-effective approach using licensed, independent third-party professionals as assessors to work with owners and design teams
- Based on the only national consensus green building standard for new commercial construction, developed in 2010 by the Green Building Initiative and acknowledged by the federal General Services Administration and the US Department of Defense

## Green Globes Multifamily for New Construction

Prior to beginning the Green Globes Multifamily for New Construction assessment, project teams must review and complete the Minimum Requirements Survey for Multifamily New Construction to ensure their project meets program requirements.

The Green Globes Multifamily for NC assessment begins with the completion of a user-friendly online questionnaire that aids architects, engineers, construction professionals, owners, and building operators to evaluate and improve the environmental friendliness and sustainability of new building projects as well as major renovations.

Green Globes Multifamily for NC helps project teams to focus on sustainability, providing options when considering implementation of best practices. When combined with the third-party assessment process, Green Globes' value-added features provide a streamlined and affordable approach to assessing the environmental sustainability of new construction projects, leading to operating cost savings.

## Environmental Assessment Areas

The Green Globes Multifamily for New Construction rating system is modified from Green Globes for New Construction to account for the specific and unique needs and sustainability goals of multifamily project types.

Green Globes Multifamily for NC ensures that environmental impacts and key sustainability issues are comprehensively assessed using a 1,000-point scale among seven categories; Project Management, Site, Energy, Water, Materials & Resources, Emissions, and Indoor Environment. Each category uses weighted criteria assigning points to criteria based upon the impact to sustainability.

## Building Certification

A third-party assessment conducted by a GBI-trained assessor is required for a Green Globes Multifamily for NC rating and certification. Assessors with expertise in green building design, engineering, and construction interface with project teams and building owners during the assessment process by reviewing and evaluating documentation, conducting site visits, and creating comprehensive assessment reports.

To become Green Globes-certified, each project must achieve a minimum of 35% of the total applicable points. Certified projects are assigned a rating of one to four Green Globes, which is reflected in a certificate issued by the GBI.

## Green Globes Multifamily for New Construction Process

Green Globes Multifamily for New Construction (NC) is part of the Green Building Initiative's (GBI) suite of Green Globes programs. The Green Globes Multifamily for NC assessment includes completion and review of the Green Globes NC questionnaire as well as a Design Review and a Onsite Assessment. The questionnaire and assessments aid the Integrated Design Process (IDP) team throughout the design process per the unique goals and needs of each individual project, and to help the project team meet their ventilation and energy savings goals.

### Green Globes NC Questionnaire

The first step of the program is to register the project with GBI and order a third-party assessment. After purchase and receipt of payment, GBI provides questionnaire access to the client, who with the help of the project IDP team will complete it. The questionnaire used for the Green Globes Multifamily NC program is the same as used for the Green Globes for New Construction program. However, this technical manual is updated to include specific guidance for multi-residential buildings. The questionnaire collects information on a variety of environmental and sustainable characteristics, programs, policies, and technologies. On its own, the questionnaire is a helpful tool, but the strength and benefits of the program are best achieved when completing the questionnaire in tandem with the Green Globes Multifamily for NC assessment.

### Design Review

The Design Review is a third-party assessment of the project's construction documents<sup>1</sup>. This review can take place at any point during the process after documents are available. If the client desires, the review may happen prior to the 100% construction documents set is complete. When the Preliminary Assessment questionnaire is complete and supporting documentation are ready for assessor review, the client (or client's project manager) submits the questionnaire to GBI, who assigns a third-party Green Globes Assessor to perform the Design Review. The client works with the assigned assessor to deliver all needed documentation. The Green Globes Assessor reviews the questionnaire and submitted documentation to verify point awards.

When the review is complete, the assessor writes a Design Review report containing their findings. The report includes all points verified, points still needing verification, a preliminary (non-final) score, projected rating, and recommendations for the project. GBI reviews the report and, when approved<sup>2</sup>, issues it to the client along with the preliminary rating. The

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<sup>1</sup> **construction documents:** all of the written and graphic documents (including BIM, CAD, and other electronic files) prepared or assembled by the architect/engineer for communicating the design, requirements, and administration of the project. The term "Construction Documents" also includes the Project Manual that contains the bidding forms and instructions, contract forms and conditions, and specifications, as well as documentation of all modifications made after the construction agreements are signed.

<sup>2</sup> **approved:** acceptable to the code official or authority having jurisdiction.

client reviews the report and shares the results with their team. The Design Review is a non-binding assessment, meaning the results are preliminary not final. To be eligible for certification and subsequent rating, a project must complete the Onsite Assessment.

## **Onsite Assessment**

The Onsite Assessment is a third-party assessment of the project's completed construction. A completed Design Review is required prior to an Onsite Assessment. The final Green Globes rating and certification is based upon the assessor's site visit results, including review of additional supporting documentation as necessary. If there are any changes since the completion of the Design Review Report, the client will update the Final Assessment questionnaire and provide updated verification documentation as needed.

When construction is essentially complete (through the punch list) and the team is ready to schedule the site visit, the client submits the updated questionnaire and contacts GBI to provide the preferred visit timing. GBI schedules a third-party Green Globes Assessor to perform the Onsite Assessment and issues a formal scheduling letter to the client and assessor. The letter includes the contact information for both to facilitate direct contact. Whenever possible, GBI assigns the same assessor for both the Design Review and Onsite Assessment. Please note that the site visit typically requires 30 days advance notice (unless the certification has been expedited). In the weeks leading up to the site visit, the assigned assessor contacts the client to discuss the itinerary and specific details of the assessment.

Typically, the Onsite Assessment begins with an introductory meeting in which the assessor can interview the key project players (Architect, MEP Engineers, Project Manager/Owner, General Contractor, etc.). Someone knowledgeable about all aspects of the project should be onsite during the entire visit to ensure the assessor receives the information needed to verify any outstanding criteria. Afterwards, one or two people can guide the assessor through the building. If any follow-up documentation is requested during the site visit, it should be sent to the assessor within one week.

After the visit, the assessor will create a report of their findings that contains the recommended score and rating. GBI will review the report and, when approved, issue it to the project manager along with the final Green Globes rating. After reviewing the report and sharing the results with their team, the client may order recognition items (if not pre-ordered) to help celebrate and market the achievement.

The duration of the site visit varies considerably based on the scope and size of the completed new construction project. Please allow approximately 3-6 hours for the assessor to review new documentation onsite, conduct a thorough walk-through of the interior space, and interview personnel.

**Figure 1: Design Review / Onsite Assessment Process Flowchart**



For projects pursuing a financing incentive, GBI will provide a certificate of completion specifying Green Globes Multifamily for New Construction which can be forwarded to the lending institution.

## Green Globes Program Features

One of the defining qualities of Green Globes is its flexibility. The goal of the program is to promote the adoption of green building practices on a comprehensive scale by providing a flexible rating system that can be applied to a wide range of building types. To achieve this goal, Green Globes makes use of several important features and concepts, as follows.

### Weighted Criteria

The Green Globes 1000-point scale allows for weighted criteria, wherein the assigned number of points for individual criteria reflects their relative impact and/or benefit on the sustainability of the building. For example, energy is considered to be the most important area affecting the sustainability of a building, so it carries the highest point value of all the Green Globes Multifamily assessment areas within the New Construction (NC) and Existing Building (EB) programs. This method emphasizes sustainable design while minimizing unnecessary “point chasing” for criteria that are outside of the project scope or provide relatively little environmental benefit.

### Minimum Requirements

Green Globes Multifamily for New Construction includes Minimum Requirements as requirements to be eligible for the program. These minimum requirements are separate from the criteria used in the assessment, therefore, do not result in point awards. These Minimum Requirements work to ensure that multifamily new construction and modernization projects meet minimum thresholds in order to be certified as a Green Globes Multifamily NC project.

To be certified under the Green Globes Multifamily NC program, projects must achieve all Ventilation and Energy Minimum Requirements. In addition, to attain certification projects must also achieve a minimum 35% total score out of all applicable points, as is customary for all Green Globes projects.

### Third-Party Assessor

Green Globes Assessors are sustainability experts, generally with more than 10 years of applicable industry experience, who have successfully completed GBI’s Green Globes Assessor Training Program. Once certified, Green Globes Assessors are authorized to perform Green Globes and Guiding Principles Compliance assessments for GBI as independent contractors. Their professional judgment is critical in the assessment process to verify point awards, to determine criteria applicability, as well as to provide sustainability recommendations within their assessment report. Once assigned, the client has direct access to contact the assessor for assessment guidance. Although GBI assigns Green Globes Assessors to projects, the assessor decisions and recommendations are not revised or redirected by GBI, thus ensuring assessor autonomy and their third-party status.

### Non-Applicable Criteria


Within the Green Globes questionnaires, many criteria include a “non-applicable” (N/A) response selection. This provision increases the flexibility of the tool as points that are impossible or unreasonable for a building to achieve do not

result in a penalty as they would if the criteria yielded a “No” response. This feature encourages a more regional approach and recognizes differences—and potential conflicts—between various local codes and standards.

The user should only select an available N/A response within the questionnaire when there is a compelling, technical reason to do so. The non-applicable provision is not to be used when project teams/clients decide not to incorporate sustainability items that are part of the criteria measured in the assessment. In those cases, the client should select a “No” response, or reconsider incorporating more sustainable features and answer the question accordingly.

With the aid of several third-party assessors experienced in multifamily project assessments, GBI has identified Green Globes for New Construction criteria that are likely N/A for multifamily new construction projects. Wherever these criteria appear in this technical manual, the criterion’s details have been replaced with “Mark N/A for Green Globes Multifamily for New Construction” or “Leave blank for Green Globes Multifamily for New Construction.”

The Green Globes third-party assessor will validate all additional “N/A” responses (selected by the project team) during the third-party assessment based on four primary justifications: 1) Regional/climatic applicability; 2) Jurisdictional/code conflict or inconsistency; 3) Building occupancy type; and 4) Criteria that address a facility, design feature, or building appurtenance that is not designated or used for that particular project space, or is completely outside the control or influence of the client. Utilizing these four justifications, the Green Globes Assessor has the flexibility to use their professional judgment to categorize additional criteria as non-applicable.

Criteria with a  symbol denotes a N/A response for low and mid-rise buildings but may apply to high-rise buildings.

## Incremental Point Awards & Partial Credit

For some Green Globes criteria, there are threshold values, which allow the incremental award of points depending on the level of achievement. In these cases, reaching a higher threshold earns relatively more points. The third-party assessors are permitted to use their professional judgment to award partial credit where deserved, even when the thresholds don’t exist within the program.

The incorporation of these flexibility features; 1000-point scale, weighted criteria, no pre-requisites, non-applicable criteria, incremental point awards, and partial credit results in the highest possible accuracy of the final Green Globes score and rating. This flexibility recognizes the vast differences in building types and represents an accurate look at the nuances of every tenant improvement project.

## Environmental Assessment Areas & Point Allocation

<b>1</b>	<b>Project Management</b>	<b>50</b>
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1.2	Environmental Management During Construction	12
1.4	Commissioning	29
<b>2</b>	<b>Site</b>	<b>115</b>
2.1	Development Area	30
2.2	Ecological Impacts	32
2.3	Stormwater Management	18



2.4	Landscaping	28
2.5	Exterior Light Pollution	7
<b>3</b>	<b>Energy</b>	<b>390</b>
3.1	Energy Performance	100
3.2	Energy Demand	35
3.3	Metering, Measurement, and Verification	12
3.4	Building Opaque Envelope	31
3.5	Lighting	36
3.6	HVAC Systems and Controls	59
3.7	Other HVAC Systems and Controls	32
3.8	Other Energy Efficient Equipment and Measures	11
3.9	Renewable Energy	50
3.10	Energy Efficient Transportation	24
<b>4</b>	<b>Water</b>	<b>110</b>
4.1	Water Consumption	42
4.2	Cooling Towers	9
4.3	Boilers and Water Heaters	4
4.4	Water Intensive Applications	18
4.5	Water Treatment	3
4.6	Alternate Sources of Water	5
4.7	Metering	11
4.8	Irrigation	18
<b>5</b>	<b>Materials and Resources</b>	<b>125</b>
5.1	Building Assembly (core and shell including envelope)	33
5.2	Interior Fit-outs (Including Finishes and Furnishings)	16
5.3	Re-use of Existing Structures	26
5.4	Waste	9
5.5	Building Service Life Plan	7
5.6	Resource Conservation	6
5.7	Envelope – Roofing / Openings	10
5.8	Envelope – Foundation, Waterproofing	6
5.9	Envelope – Cladding	5
5.10	Envelope – Barriers	7
<b>6</b>	<b>Emissions</b>	<b>50</b>
6.1	Heating	18
6.2	Cooling	29



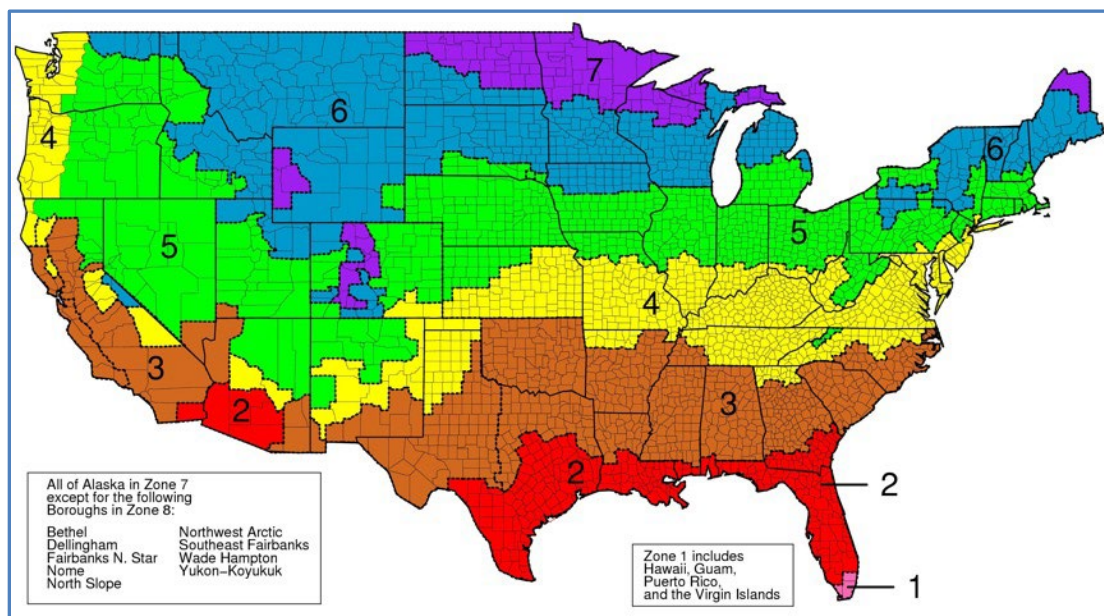
6.3	Janitorial Equipment	3
<b>7</b>	<b>Indoor Environment</b>	<b>160</b>
7.1	Ventilation	37
7.2	Source Control and Measurement of Indoor Pollutants	46
7.3	Lighting Design and Systems	30
7.4	Thermal Comfort	18
7.5	Acoustic Comfort	29
<b>TOTAL</b>		<b>1000</b>

## Additional Information

Some helpful hints before filling out the online questionnaire:

- For definitions used throughout this text, see Glossary at the end of this document.
- To determine which climate zone a project is in, reference a Climate Zone map, which can be found in multiple documents, including *ASHRAE 90.1* (Energy Standard for Buildings Except Low-Rise Residential Buildings), the *International Energy Conservation Code* (IECC), and the *International Green Construction Code* (IgCC). A simplified version of the map is shown below for reference. If the project's climate zone can't be determined from the map, consult the references above for a list of cities and their zones.

Figure 2: ASHRAE Climate Zones map<sup>3</sup>



- Items from the “Suggested Documentation” list at the end of each criterion are typical documents that the Assessors will evaluate prior to or in conjunction with the Onsite Assessment site visit and walk-through to assess compliance, though other documentation may be requested or substituted prior to or during the onsite visit. The more documentation that can be provided to the Assessor prior to the Onsite Assessment, the more productive the field survey can be.
- The project should incorporate development and simulation of at least one energy design model to satisfy the requirements of several criteria in the Energy section in addition to the 3.3.1.1 Assessing Energy Performance subsection. Owners should be aware of this requirement prior to deciding to pursue Green Globes certification. Provisions should be made with one of the design firms or with an outside consultant to include at least one energy design model in their scope of work. The number of iterations and the detail level of the model(s) will need to be determined by the project manager/sustainability consultant based on which criteria will be pursued that require information or results from the energy model(s).

<sup>3</sup> Reprinted from ASHRAE/IES Standard 90.1-2013, © 2013 by ASHRAE. [www.ashrae.org/standard901](http://www.ashrae.org/standard901)

## Minimum Requirements for Green Globes Multifamily (NC)

To be certified through Green Globes Multifamily for New Construction, projects must achieve all Ventilation and Energy Minimum Requirements. In addition, projects must also achieve a minimum 35% total score out of all applicable points in the Green Globes Multifamily NC program. Minimum Requirements must be met to be eligible for the program but are separate from the criteria used in the assessment.

### Meet all Ventilation and Energy Minimum Requirements

## VENTILATION MINIMUM REQUIREMENTS

Building design must establish and meet minimum indoor air quality performance by meeting all three Ventilation Minimum Requirements listed below.

### 1. Ventilation Air Quantity

The quantity of ventilation for the building is compliant with one of the following:

- **Option 1:** ANSI/ASHRAE Standard 62.1-2013 Ventilation for Acceptable Indoor Air Quality;  
ANSI/ASHRAE 62.1-2013 (read only): [https://ashrae.iwrapper.com/ViewOnline/Standard\\_62.1-2013](https://ashrae.iwrapper.com/ViewOnline/Standard_62.1-2013)
- **Option 2 (Lowrise and Midrise Multifamily Only):** ANSI/ASHRAE Standard 62.2-2013 Ventilation for Acceptable Indoor Air Quality in Low-Rise Residential Buildings.  
ANSI/ASHRAE 62.2-2013 (read only): [https://ashrae.iwrapper.com/ViewOnline/Standard\\_62.2-2013](https://ashrae.iwrapper.com/ViewOnline/Standard_62.2-2013)
- **Option 3:** ICC International Mechanical Code (ICC IMC 2015), Chapter 4;  
ICC International Mechanical Code 2015, Chapter 4: <https://codes.iccsafe.org/content/IMC2015/chapter-4-ventilation>
- **Option 4:** IAPMO UMC (2015) Uniform Mechanical Code;  
2015 Uniform Mechanical Code: <http://epubs.iapmo.org/UMC/mobile/index.html#p=1>
- **Option 5:** Local codes or standards (if more stringent).

### 2. Air Handling Equipment

Equip air handling equipment with filtration as follows:

- Air handling equipment that provide ventilation air to terminal devices (e.g. central air handler, DOAS, etc.): minimum MERV 13; and
- Single zone terminal devices (e.g. fan-coil): minimum MERV 8.

*Not applicable where **non-ducted** circulating unitary equipment serves only a single zone (e.g. unit heaters, force-flows, mini-split heat pumps).*

### 3. Operations & Maintenance Plan

Specify regular ventilation maintenance and indoor air quality (IAQ) in an Operations & Maintenance (O&M) Plan. Ensure that specific issues (e.g. dirty air filters, dirty air return grills, maintenance of mechanical units, etc.) are identified and a regular maintenance plan is developed for maintaining IAQ goals.

## ENERGY MINIMUM REQUIREMENTS

Building design must achieve greater than 15% projected energy consumption savings over respective established baseline and must meet all three (3) Energy Minimum Requirements.

### 1. Energy Efficient Design

Generate an energy model for the entire building, input energy use and building characteristics into ENERGY STAR Target Finder, and complete one of the following based on ENERGY STAR eligibility:

- **Option 1: ENERGY STAR® Score** - For multifamily properties with 20 or more units. Achieve an ENERGY STAR performance score of 78 or greater in the Target Finder program. See 3.3.1.1.1 for additional guidance.
- **Option 2: EUI Reduction** - If not eligible for an ENERGY STAR Score. Demonstrate the proposed design targets greater than 15% reduction of energy use intensity (EUI) compared to the national median source EUI.

### 2. Energy Efficient Equipment & Products

Where not already covered by Energy Efficient Design, install ENERGY STAR-labeled and/or FEMP-designated energy efficient products and appliances (including clothes washers, dishwashers, and refrigerators), if such products and/or appliances are being provided.

ENERGY STAR Qualified Product Lists: <http://www.energystar.gov>

Federal Energy Management Program (FEMP) Energy and Water Efficient Products: <http://www1.eere.energy.gov/femp>

### 3. Energy Performance Monitoring & Tracking

Confirm that the local utility or onsite master energy meter(s) provide, at a minimum, aggregated whole-project energy consumption data for each energy utility type. Where local utility or current meters do not provide such data install energy meters that do.

Commit to entering energy consumption data into ENERGY STAR Portfolio Manager to track ongoing performance and sharing of that data with Green Building Initiative. Document for future performance verification.

### Required Documentation – upload to Green Globes “v3” Software:

- ☐ Completed Minimum Requirement Survey
- ☐ Construction documents w/ventilation code info
- ☐ ENERGY STAR Portfolio Manager Statement of Energy Design Intent (SEDI), or screenshot of ENERGY STAR Score
- ☐ Energy model outputs

## Exception Policy

GBI reserves the right to issue exceptions to the Minimum Requirements on a case-by-case basis as needed for unique circumstances, Green Globes Multifamily NC projects must still meet the greater than 15% energy consumption savings requirement.

## 3.1 PROJECT MANAGEMENT

### 3.1.1 Integrated Design Process (IDP)

#### 3.1.1.1 Pre-Design Meetings

##### 3.1.1.1.1 Criteria:

Was an integrated design process (IDP) employed, which included a **minimum of five** of the key design disciplines involved in the project?

##### Answers:

- Yes **(3 points)**
- No **(0 points)**

*(check as many key disciplines below as apply)*

- **3.1.1.1.1.1:** Architect?
- **3.1.1.1.1.2:** Building Science or Building Forensics Expert?
- **3.1.1.1.1.3:** Civil Engineer?
- **3.1.1.1.1.4:** Commissioning Agent?
- **3.1.1.1.1.5:** Community Representative(s)?
- **3.1.1.1.1.6:** Contractor?
- **3.1.1.1.1.7:** Electrical Engineer?
- **3.1.1.1.1.8:** Energy Engineer?
- **3.1.1.1.1.9:** Facilities Manager?
- **3.1.1.1.1.10:** Interior Designer?
- **3.1.1.1.1.11:** Landscape Architect?
- **3.1.1.1.1.12:** Lighting Designer/Illuminating Engineer?
- **3.1.1.1.1.13:** Mechanical Engineer – HVAC?
- **3.1.1.1.1.14:** Mechanical Engineer – Plumbing?
- **3.1.1.1.1.15:** Owner's Representative?
- **3.1.1.1.1.16:** Structural Engineer?
- **3.1.1.1.1.17:** Sustainable Design Coordinator?
- **3.1.1.1.1.18:** User Group Representative?
- **3.1.1.1.1.19:** Acoustical Consultant or Acoustician?
- **3.1.1.1.1.20:** Other Key Professional?

##### ToolTip:

Individuals representing key design disciplines should attend a pre-design planning session in the form of a meeting, charrette, or workshop during pre-design of the project. See the References below for suggested responsible parties, sample methods, and examples of IDP pre-design meetings.

##### References:

- *Whole Systems Integrated Process Guide:*  
<http://www.integrativedesign.net/images/WholeSystemIntegration.pdf>
- *ANSI/ASHRAE/IES/USGBC Standard 189.1-2014, Standard for the Design of High-Performance Green Buildings, Appendix F: Integrated Design*
- *ANSI/ASHRAE/USGBC/IES Standard 189.1-2011, Standard for the Design of High-Performance Green Buildings Appendix H: Integrated Design*
- *Better Bricks- Integrated Design and delivery:*



- <http://designsynthesis.betterbricks.com/tools-and-resources>
- IEA Solar Heating and Cooling Task 23- Examples of Integrated Design:  
[http://www.iisbe.org/system/files/Task23\\_CS\\_examples.pdf](http://www.iisbe.org/system/files/Task23_CS_examples.pdf)
- A Whole Systems Approach- Integrated Building Design:  
<http://lj.libraryjournal.com/2011/09/buildings/a-whole-systems-approach-integrated-building-design/#>

### Assessment Guidance:

Ensuring that all goals are established at the beginning of the design process and that all team members are actively involved throughout the entirety of the project is a key factor to designing a sustainable building that meets the client's needs. Moreover, a team effort usually cannot function effectively without a designated leader. Since commercial interior projects are typically smaller in scope, it is not unreasonable to have the designated project manager, typically with the architectural design firm, also function as the sustainability coordinator or green facilitator. However, as with many larger projects, it is entirely appropriate to have a separately appointed sustainability coordinator, including an outside third-party professional. This individual will typically call and run the project meetings that address sustainable design and construction; guide the sustainability discussion and decision-making activities among the various disciplines and stakeholders; maintain minutes and a log of inquiries, follow-up and decisions; function as the focal point of project communications related to sustainability; and be the most efficient team member to complete the Green Globes online program and follow-up activities. It is imperative that project team members know the basic goals and aspirations for the project and who will be responsible for ensuring that each criterion is fulfilled.

According to the *Whole Systems Integrated Process Guide*, the basic elements of integrated design are:

- Assemble the right team
- Fully engage client in the design decision process
- Align team around basic aspirations, a core purpose, and core values
- Identify key systems to be addressed that will most benefit the environment and project
- Commit to specific measurable goals for key systems
- Optimization of the design of systems
- Follow through during construction process
- Commission the project
- Maintain the system
- Measure performance and respond to feedback – adjust key aspects of the system accordingly

The exact number of “all hands” project meetings that need to occur will vary from project to project, depending on building size, complexity, and desired sustainability goals. The *Whole Systems Integrated Process Guide* suggests at least seven of these meetings or workshops. *ANSI/ASHRAE/IES/USGBC Standard 189.1-2014 Appendix F: Integrated Design* and *ANSI/ASHRAE/USGBC/IES Standard 189.1-2011 Appendix H: Integrated Design* suggests that the design and construction team should use a charrette process to determine the optimal building scheme but does not outline any specific number of meetings. The primary concept that both references have in common is that collaborative meetings with all key design and construction personnel should be held as early as possible in the design process and should continue through building occupancy.

The Green Globes Assessor will look for project meeting minutes and agendas detailing which project members were in attendance and the general goals and outcomes of the meetings. At a minimum, meeting minutes will cover: agenda topics discussed, key decisions or conclusions reached, and action items assigned to whom, to be completed by when. Another valuable document to submit during the Design Review is a list of key project personnel including a description of their major tasks.



### 3.1.1.2 IDP Performance Goals

#### 3.1.1.2.1 Criteria:

Were (qualitative) green design goals established at the pre-design phase for the following:

- **3.1.1.2.1.1:** Site design?
- **3.1.1.2.1.2:** Envelope?
- **3.1.1.2.1.3:** Materials efficiency?
- **3.1.1.2.1.4:** Indoor environment?

#### Answers:

- Yes (**0.5 – 1 points, see table**)
- No (**0 points**)

Quantity of Yes Answers	Points
1	0.5
2	0.5
3	1
4	1

#### ToolTip:

Written performance goals should be established for one or more of the items listed.

#### References:

- *Whole Systems Integrated Process Guide:*  
<http://www.integrativedesign.net/images/WholeSystemIntegration.pdf>
- *ANSI/ASHRAE/IES/USGBC Standard 189.1-2014, Standard for the Design of High-Performance Green Buildings, Appendix F: Integrated Design*
- *ANSI/ASHRAE/USGBC/IES Standard 189.1-2011, Standard for the Design of High-Performance Green Buildings Appendix H: Integrated Design*
- *Whole Building Design Guide (WBDG): Project Planning, Delivery, Controls*  
<http://www.wbdg.org/project/pm.php>
- *ANSI/ASHRAE Standard 55-2010*

#### Assessment Guidance:

The team should begin by reviewing all applicable Green Globes criteria. During “all hands” meetings or design charrettes, the main project designers should systematically identify the performance standards and the associated metrics by which the project success will be judged. Meeting minutes should reflect initial and final performance goals for the sub-criteria listed above. These performance goals should be reflected in the project’s Division 01 specifications (e.g. “Section 01 8113 Sustainable Design Requirements for New Construction and Major Renovations”) and also in the Owner’s Project Requirements document (See 3.1.3 Commissioning).

A distinction between goals and objectives would be that goals are broad, qualitative expressions addressing the sustainability principles that projects are trying to achieve. Performance objectives differ from goals in that they are more specific and focused on setting criteria related to quantitative outcomes.

For goals, you might say: “We will use only energy-efficient light bulbs and fixtures,” or “We want to create an environment where all occupants can do their work in space adequate for their tasks, without feeling cramped or confined.”

Corresponding objectives might be: “We will achieve a lighting power density to meet specific targets for various spaces, in terms of Watts per sq., or in percent of overall energy consumption.”

A performance objective might be to make sure that all work surfaces receive at least 50 lumens per sq. of incident light, or the temperature and humidity must be kept within the 90% comfort zone of *ANSI/ASHRAE Standard 55-2010*.

### 3.1.1.2.2 Criteria:

Were performance objectives (metrics) established at the pre-design phase for the following:

- **3.1.1.2.2.1:** Energy efficiency?
- **3.1.1.2.2.2:** Renewable energy (percentage of total energy)?
- **3.1.1.2.2.3:** Greenhouse gas emissions?
- **3.1.1.2.2.4:** Water conservation, efficiency, and reuse?
- **3.1.1.2.2.5:** Life cycle impact?
  - **ToolTip:** This preliminary step of establishing life cycle impact performance goals during pre-design represents, in part, the beginning of the Building Life Service plan, and goes further with environmental health and external influences on the building life cycle. The following link from the Whole Building Design Guide discusses the broad concept of Risk Management as related to building design and construction, including long term life cycle related issues:  
<http://www.wbdg.org/project/riskmanage.php>.
- **3.1.1.2.2.6:** Construction waste diversion?

### Answers:

- Yes (1 – 2 points, see table)
- No (0 points)

Quantity of Yes Answers	Points
1	1
2	1
3	1.5
4	1.5
5	2
6	2

### ToolTip:

Written performance objectives should be established and clearly documented for one or more of the items listed. All appropriate members of the design team should have buy in to these performance goals. Goals should be numerical (such as percent achieved for construction waste) or quantifiable units, and percent reduction relative to a base (water), as a few examples.

### References:

- *Whole Building Design Guide (WBDG): Risk Management*  
<http://www.wbdg.org/project/riskmanage.php>

### Assessment Guidance:

Document performance project goals in a similar manner as the other IDP items. It is also best management practice to assign an individual of the project team to each performance goal to champion the follow through and implementation.

### 3.1.1.3 IDP Progress Meetings for Design

#### 3.1.1.3.1 Criteria:

Did the integrated design process (IDP) team hold progress meetings prior to the respective completion of the following project phases:

- **3.1.1.3.1.1: At the Concept Design Phase?**
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
  - **ToolTip:** At the Concept Design Phase, the general scope, preliminary design, scale, and relationships among the components of the project are established along with budget and schedule.
- **3.1.1.3.1.2: At the Design Development Phase?**
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
  - **ToolTip:** At the Design Development Phase, enlarged scale drawings, detailed elevations and plans, and design mock-ups should show major elements including mechanical, electrical, structural, telecommunications, plumbing systems, and fire protection.
- **3.1.1.3.1.3: At the Construction Documents Phase?**
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
  - **ToolTip:** At the Construction Documents Phase, finalized drawings and specifications for all components and systems of the building are produced that form the basis for drawing up contracts, obtaining necessary permits, and constructing the project.

#### **ToolTip:**

Agenda items should include the following: Review established (and/or modified) performance goals; Refine language regarding performance goals outcomes into Plans and Specifications; Identify any missing requirements and required steps to correct; establish/track responsibilities for gathering documentation and review operations and maintenance training.

#### **References:**

- *Whole Systems Integrated Process Guide:*  
<http://www.integrativedesign.net/images/WholeSystemIntegration.pdf>
- *ANSI/ASHRAE/IES/USGBC Standard 189.1-2014, Standard for the Design of High-Performance Green Buildings, Appendix F: Integrated Design*
- *ANSI/ASHRAE/USGBC/IES Standard 189.1-2011, Standard for the Design of High-Performance Green Buildings Appendix H: Integrated Design*
- *Whole Building Design Guide (WBDG): Project Planning, Delivery, Controls*  
<http://www.wbdg.org/project/pm.php>

#### **Assessment Guidance:**

During the Design Review and/or Onsite Assessment, the Assessor will be looking for project meeting minutes and agendas detailing the project stage and which project members were in attendance. Project Managers should maintain an electronic meeting log to organize and efficiently present this information for review.

### 3.1.1.3.2 Criteria:

Is there a requirement that the integrated design and delivery team hold progress meetings prior to the completion of the following project milestones:

- **3.1.1.3.2.1:** Pre-Construction?
- **3.1.1.3.2.2:** 25% Completion of budget or schedule?
- **3.1.1.3.2.3:** 50% Completion of budget or schedule?
- **3.1.1.3.2.4:** Substantial Completion?

### Answers:

- Yes (**1 – 1.5 points, see table**)
- No (**0 points**)

Quantity of Yes Answers	Points
1	1
2	1
3	1.5
4	1.5

### ToolTip:

This is verified at the Onsite Assessment.

### Assessment Guidance:

During the Onsite Assessment, the Assessor will be looking for project meeting minutes and agendas detailing the project stage and which project members were in attendance. Project Managers should maintain an electronic meeting log to organize and efficiently present this information for review.

IDP progress meeting agendas should include the following topics:

- Introduction of new team members to the overall sustainable strategies that have been incorporated into the project;
- Review of established (and/or modified) performance goals;
- Integration of language regarding performance goals and acceptable outcomes into project documents (plans and specifications);
- Identification of missing requirements and establishment of required steps to correct;
- Modification, if necessary, of established performance goals/requirements;
- Establishment/tracking of responsibilities for gathering documentation;
- Operations and maintenance training.

## 3.1.1.4 Capital Asset Plan & Business Case Summary

### 3.1.1.4.1 Criteria:

For Federal building projects, did the integrated design process integrate the use of OMB's A-11, Section 7, Exhibit 300: *Capital Asset Plan and Business Case Summary*?

### Answers:

- Yes (**0 points**)
- No (**0 points**)
- N/A

This criterion is not necessary for certification by Green Globes.

**ToolTip:**

Guidance for OMB's A-11, Section 7, Exhibit 300: Capital Asset Plan and Business Case Summary can be found online at [http://www.whitehouse.gov/sites/default/files/omb/assets/egov\\_docs/fy14\\_guidance\\_on\\_exhibits\\_53\\_and\\_300.pdf](http://www.whitehouse.gov/sites/default/files/omb/assets/egov_docs/fy14_guidance_on_exhibits_53_and_300.pdf). This criterion is for Federal buildings only and is not required for Green Globes certification. Mark "N/A" for non-Federal building projects.

**References:**

- OMB's A-11, Section 7, Exhibit 300: Capital Asset Plan and Business Case Summary  
[http://www.whitehouse.gov/sites/default/files/omb/assets/egov\\_docs/fy14\\_guidance\\_on\\_exhibits\\_53\\_and\\_300.pdf](http://www.whitehouse.gov/sites/default/files/omb/assets/egov_docs/fy14_guidance_on_exhibits_53_and_300.pdf)

## 3.1.2 Environmental Management During Construction

### 3.1.2.1 Environmental Management System (EMS)

#### 3.1.2.1.1 Criteria:

Is there a requirement that the General Contractor must document the following elements as part of their Environmental Management System (EMS):

- **3.1.2.1.1.1:** General Contractor's Environmental Policy?
  - **ToolTip:** This is a statement by the General Contractor's organization that outlines intentions and principles regarding its overall environmental performance. It provides the overall directive and basis to set environmental objectives and targets and develop action plans. It must be communicated to all employees and sub-contractors and displayed on notice boards throughout the construction sites. It should also be available to the public.
- **3.1.2.1.1.2:** Regulatory Compliance and Training?
  - **ToolTip:** The Contractor should keep copies of regulatory requirements as well as records showing that training has been provided for relevant regulatory requirements.
- **3.1.2.1.1.3:** Environmental Risk Assessment that shows sensitive environmental areas and ranks potential risks that may arise from the construction?
  - **ToolTip:** There should be documentation that identifies sensitive environmental areas; and possible risks on the environment and adjacent land from construction in terms of: air, natural waterways, topography, vegetation, noise and pollution. Ranking is a function of probability and severity of impact.
- **3.1.2.1.1.4:** Environmental Risk Management Strategies?
  - **ToolTip:** Risk management options should be selected in order of preference in terms of **avoiding** risk wherever possible; and where this is not possible **reducing** risk; or, as a last resort, **controlling** risk. Major control structures should be shown (e.g. erosion control, site run-off measures, spill response, tree protection). Installation of control structures should occur before other construction activities commence.
- **3.1.2.1.1.5:** Environmental Management Roles, Responsibilities and Reporting Structure for the construction phase?
  - **ToolTip:** Outline the Reporting Structure for Environmental Management at the Construction Phase. List the roles of the: i) Client's Project Environmental Manager, ii) the Contractor's Project Environmental Manager, iii) the Contractors Site Environmental Representative, and iv) the Site Foreman.

- **3.1.2.1.1.6:** Site and Work Instructions for site personnel outlining environmental procedures during construction?
  - **ToolTip:** These should describe, in general terms, the required site best practices, and provide detailed instructions to deal with environmental incidents, adverse weather conditions and complaints. The Site Instructions should relate to the Environmental Inspection Checklists.
- **3.1.2.1.1.7:** Environmental Inspection Checklists?
  - **ToolTip:** These serve to establish compliance with the documented procedures contained in the Site and Work Instruction, identify departure from procedures, and record corrective steps that are being taken.
- **3.1.2.1.1.8:** Records of Compliance?
  - **ToolTip:** These records show that inspections have taken place and that corrective measures have occurred as necessary. They provide a record of site conditions and activities and provide a mechanism by which the Contractor can establish the effectiveness of its Environmental Management Plan.

#### Answers:

- Yes (1 – 2 points based upon the number of Yes answers, see table)
- No (0 points)

Quantity of Yes Answers	Points
1	1
2	1
3	2
4	2
5	2
6	3
7	3
8	3

#### ToolTip:

This is verified at the Onsite Assessment. An EMS is a framework that helps the General Contractor to achieve their corporate environmental goals through consistent control of their operations. Part of the EMS is an Environmental Management Plan (EMP) which deals specifically with this project.

#### References:

- U.S. Environmental Protection Agency (EPA), *Guide to Developing an Environmental Management System*: <http://www.epa.gov/ems/implement.html>
- ISO 14001:2004 Standard

#### Assessment Guidance:

According to the EPA, an EMS is “a set of processes and practices that enable an organization to reduce its environmental impacts and increase its operating efficiency.”<sup>4</sup> While the elements included in an EMS can vary from organization to

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<sup>4</sup> “Environmental Management System (EMS),” United States Environmental Protection Agency, last modified April 10, 2013, <http://www.epa.gov/ems>.



organization, most EMS models are based on the ISO 14001:2004 Standard. The four fundamental elements suggested by the Green Globes criteria are an action plan (or environmental management program), training and awareness, communication, and emergency preparedness and response.

The EMS action plan should be prepared after the company's environmental objectives and targets have been established. This plan should address how the organization will incorporate its goals and policies into feasible, specific actions and explain how these actions will accomplish the objectives and targets. Typically, the plan will include the following for each goal:

- Who will be responsible for each goal?
- How will the goal be accomplished?
- When will the goal be accomplished? What is the timeframe?

Other items that could be included in the EMS are:

- General Contractor's environmental policy
- Provisions to ensure regulatory compliance on the construction site
- Environmental risk assessment that shows sensitive environmental areas and ranks potential risks that may arise from the construction
- Strategies to reduce all significant environmental risks from construction activity
- Environmental management roles and responsibilities for the construction phase
- Site and work instructions for site personnel outlining environmental procedures during construction
- Environmental inspection checklists
- Records of compliance

An EMS cannot be effective if only a few employees know about it. For this reason, an outline of the training offered should be detailed in the EMS. The training should be available and specifically tailored to each level of personnel, addressing their responsibilities and any consequences for not adhering to the system. Communication of the EMS internally and externally to the organization is important. A two-way system of communicating all environmental matters should be established. The EMS should include procedures for communicating internally between levels and functions within the company and externally with the customers and community.

Projects should include an Emergency Response Plan in the Division 01 specifications and this information should be reflected in the General Contractor's EMS. This Emergency Response Plan should pertain to environmental emergency response during the construction phase. Additional information should include up-to-date contacts to report the emergency and obtain assistance promptly and a site map showing the location of environmentally significant features and equipment. This can help plan emergency responses and is helpful for emergency crews.

The General Contractor will be the typical responsible party for handling these criteria, although clients with several buildings or campuses should standardize an EMS specific to their site's needs and types of projects. Additional information can be found at EPA's *Guide to Developing an Environmental Management System* <http://www.epa.gov/ems/implement.html>.

During the Design Review, the Assessor will need to be provided with either the General Contractor's EMS or the Client's EMS.

### 3.1.2.2 Clean Diesel Practices

#### 3.1.2.2.1 Criteria:

Is there a requirement that the General Contractor must supplement mandatory regulatory requirements by implementing one or more of the following "clean diesel" strategies:

- **3.1.2.2.1.1:** A vehicle "idling-reduction" directive?
  - **Answers:**

- Yes **(0.5 points)**
  - No **(0 points)**
- **ToolTip:** Limit idling to no more than 3 minutes.
- **3.1.2.2.1.2: Use of clean fuels?**
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
  - **ToolTip:** For example, ultra-low sulfur diesel (ULSD) fuel, biodiesel blends, liquid petroleum gas (LPG), compressed natural gas (CNG), and liquefied natural gas (LNG).
- **3.1.2.2.1.3: Engine upgrades that reduce emissions?**
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** For example, diesel particulate filters (DPFs) diesel oxidation catalysts (DOCs), crankcase emission control devices, engine component upgrades. Where engines are equipped with after-treatment technologies as part of their originally certified emission control system, mark “N/A”.
- **3.1.2.2.1.4: Engine maintenance records?**
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
  - **ToolTip:** Proper engine maintenance is necessary for optimum fuel economy and extended engine life as well as to control emissions. Keeping records ensures tracking and scheduling as recommended by the manufacturer – important also for warranty and retrofit purposes.

**ToolTip:**

This is verified at the Onsite Assessment. Clean Diesel strategies should be included the General Contractors' Environmental Management System as part of the Site and Work Instructions.

**References:**

- *American Transportation Research Institute (ATRI)- Idling Regulations Compendium:*  
<http://atri-online.org/2013/02/20/idling-regulations-compendium/>

**Assessment Guidance:**

In order to reduce construction workers' and the public's exposure to diesel exhaust fumes, project site owners and construction companies should encourage clean diesel practices as part of the site's regulatory requirements. These requirements should address, at minimum, the following items:

- Idle reduction strategies. Most truckers idle their engines to maintain temperatures in the cabin, keep the engine warm, and/or power appliances. Idling a diesel engine to power cab amenities consumes fuel, increases fuel cost, generates emissions, and increases pollution. It also shortens the life of the engine by increasing wear and maintenance costs. Two ways to reduce the impact from engine idling are through driver behavioral changes and through advanced technology for the vehicles/equipment. Behavioral changes in drivers should be encouraged through driver/operator training or through company incentives. Companies should consider adopting a “no-idling” policy and posting signs in delivery areas. When policies, education, and incentives are not enough, companies should look to technology solutions to further reduce idling. Some of these technology-based solutions include:
  - Auxiliary power units mounted externally on the cab to provide power for air conditioning, heating, and miscellaneous appliances in the cab and sleeper.

- Automatic engine shutdown and startup systems that automatically start and stop the engine in order to maintain battery charge or cab/sleeper temperature.
- Heaters mounted in the cab to maintain a minimum temperature in the cab during the winter that do not rely on engine idling.
- Battery air conditioning systems that operate independently of the cab's main system.
- Auxiliary power sources that allow trucks to shut off the engine and plug into an electrical outlet that provides power for heating, air conditioning, lights, and other accessories.
- Thermal storage systems that collect heat energy as the truck is driven and then use this stored energy to provide heat when the engine is off.

For more information, visit [American Transportation Research Institute \(ATRI\)- Idling Regulations Compendium](#).

- Use of clean/alternative fuels. Companies can reduce emissions from truck fleets by using cleaner fuels (biodiesel, emulsified diesel, natural gas, propane, Ultra-Low Sulfur Diesel, etc.). Some engines will need to be modified to run on alternative fuels, so a cost/benefit analysis should be performed to determine which alternative fuel is the most environmentally and economically friendly option.
- Engine retrofits/repower. Typical diesel engines can be retrofitted with exhaust after-treatment devices to reduce emissions without impacting the operation of the engine. Some examples of retrofit devices include lean NO<sub>x</sub> catalysts, exhaust gas recirculation, diesel particulate filters, diesel oxidation catalysts, selective catalytic reduction and closed crankcase ventilation. Repowering a vehicle includes replacing the engine of the truck with a new engine that has been certified to cleaner emissions standards.

These requirements should be included in the General Contractor's EMS, the project specifications, or other environmental requirement document. The document that best covers all freight strategies should be included in the Design Review documentation submitted to the Assessor. Additionally, photographs can be taken and shown during the Onsite Assessment confirming usage and placement of any "no idling" signs.

### 3.1.2.3 Building Materials and Building Envelope

#### 3.1.2.3.1 Criteria:

Is there a requirement for the following construction best-practices to protect building materials and control mold:

- **3.1.2.3.1.1:** Building materials made of organic material or those that could absorb moisture are protected in transit and at the construction site from contact with moisture and from collecting organic matter such as leaves, soil or insects?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
  - **ToolTip:** For example, wood or plasterboard.
- **3.1.2.3.1.2:** The building envelope will be weather-tight and permitted to dry before installation of interior walls, wood floors, ceilings, or HVAC systems?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
  - **ToolTip:** "Building envelope" means the elements of a building that separate the interior spaces from the outside, such as walls, roofs, floors, doors, and fenestration. This is verified at the Onsite Assessment. The measures should be included in the General Contractors' Environmental Management System as part of the Site and Work Instructions.

#### **ToolTip:**

This is verified at the Onsite Assessment. The measures should be included in the General Contractors' Environmental Management System as part of the Site and Work Instructions.

### Recommended Documentation:

- Construction documents;
- Manufacturer's specifications, cut sheets and performance documentation;
- Photographs of protected building materials.

### Assessment Guidance:

Occupants often prefer working or living in a sustainable building for the benefits that come from good Indoor Air Quality (IAQ). Enhanced IAQ has been shown to reduce sick building syndrome and improve quality of life for building occupants. While many IAQ management practices apply to the occupied building after construction is complete, there are several initiatives that the contractors can implement during construction in order to reduce contaminants in the building. Two of these efforts are:

- Protecting building materials
- Ensuring a weather-tight envelope is complete prior to installing interior building systems

Building materials, especially those with absorptive properties, should be protected from moisture and airborne contaminants en route to the building site and during the entire construction phase. If these materials (drywall, acoustic ceiling tile, insulation, etc.) are exposed to rain, dust, or other construction particulates, they will absorb these contaminants and emit them over time following installation and thereby compromising the air quality within the building. These materials should be kept off the ground in a protected and isolated storage area.

Along with protecting building materials from contaminants, the interior building systems that affect indoor air quality (HVAC, flooring, interior walls, ceilings, etc.) also need to be protected. By ensuring that the entire envelope of the building (exterior walls, roofs, doors, windows, etc.) is weather-tight when completely installed, there is a reduced risk of exterior contaminants (e.g. water, dust, fuel fumes and biological agents) infiltrating the interior systems that are eventually exposed to occupants.

Even if all materials are adequately protected and interior systems are not installed prior to envelope completion, all materials and systems should be cleaned and checked for excess moisture that may contribute to mold and mildew development in the building.

During the Design Review, the Assessor will be looking for an Indoor Environmental Quality Plan that will address the above sub-criteria and, if applicable, the criteria in 3.1.2.4 IAQ During Construction, 3.7.1 Ventilation and, 3.7.2 Source Control and Measurement of Indoor Pollutants. They may also request photographs of protected building materials.

## 3.1.2.4 IAQ During Construction

### 3.1.2.4.1 Criteria:

Is there a requirement for either one of the following best-practices to maintain good indoor air quality:

- The area under construction is to be flushed with 100% outdoor air for 14 consecutive days prior to occupancy, and filters changed after flush out but before it is occupied?
- or
- Baseline Indoor Air Quality testing gives acceptable results as per U.S. *Environmental Protection Agency (EPA) Testing for Indoor Air Quality, Section 01 81 09 (December 2007)*?

### Answers:

- Building flushed 14 days + filters changed **(2 points)**
- IAQ test yields acceptable results **(2 points)**
- No **(0 points)**

### ToolTip:

This is verified at the Onsite Assessment. The measures should be included in the General Contractors' Environmental Management System as part of the Site and Work Instructions.

### References:

- U.S. Environmental Protection Agency (EPA) *Testing for Indoor Air Quality: Section 01 81 09 (December 2007)*
- California Office of Environmental Health Hazard- *Assessment list of Chronic Reference Exposure Levels:*  
<http://oehha.ca.gov/air/allrels.html>

### Assessment Guidance:

Despite construction IAQ best management practices, the indoor environment of any building will contain pollutants and chemicals resulting from the construction process. When the building is ready for occupancy, it is good practice to ensure airborne contaminants have been evacuated from the building. This can be done in two ways:

- Performing a building flush-out
- Indoor Air Quality testing

A building flush-out requires the contractor to run the HVAC system at 100% outdoor air for at least 14 consecutive days in order to dilute and remove off-gassed contaminants from the structure. If the HVAC system has been running during construction, the filters should be changed prior to flush-out and again immediately after the flush-out is complete. There should be brand new filters in all HVAC systems when the building is ready for occupancy. The flush-out should be performed after testing and balancing of the HVAC systems and all commissioning functional tests have been completed, if possible. During the flush-out, it is recommended that the interior conditions remain in an acceptable temperature and humidity range.

If the HVAC system is unable to perform a flush-out due to physical constraints or weather at the time the flush-out would be performed, or if the construction schedule cannot allocate 14 days for a flush-out, then IAQ testing may be performed to ensure major contaminants are below acceptable levels before occupancy. Green Globes requires that the IAQ testing be performed in accordance with the EPA's *Testing for Indoor Air Quality-Section 01 81 09 (December 2007)* document, which is written in a style that allows for incorporation into the Division 01 specifications. The EPA calls for testing to be performed after HVAC system verification by an independent contractor with a minimum of 5 years of experience. A test plan should be written prior to start of testing, and a final report shall be submitted stating concentrations of targeted pollutants including (but not limited to):

- Formaldehyde
- Volatile organic compounds (VOCs)
- Mold and mildew
- Carbon monoxide
- Other compounds applicable to the project as found on the *California Office of Environmental Health Hazard Assessment's list of Chronic Reference Exposure Levels:* <http://oehha.ca.gov/air/allrels.html>

Similar to the flush-out procedure, IAQ testing should be performed after testing and balancing of the HVAC systems and all commissioning tests have been completed, if possible. The testing should be performed under normal HVAC operating conditions.

During the Design Review, the Assessor will be looking for any IAQ requirements in the construction specifications or project manual. Either the requirements for the Indoor Air Quality/Indoor Environmental Quality Plan or for the Baseline Indoor Air Quality Test should be included in the Division 01 specifications.

#### 3.1.2.4.2 Criteria:

Where parts of the building will be **occupied during construction**, are one or more of the following five basic strategies specified per SMACNA's *IAQ Guidelines for Occupied Buildings Under Construction* to control dust, odors, or irritants:



- **3.1.2.4.2.1: HVAC protection**
  - **ToolTip:** Mark “N/A” where the building is entirely unoccupied during construction.
- **3.1.2.4.2.2: Source control**
  - **ToolTip:** Mark “N/A” where the building is entirely unoccupied during construction or where the source of pollution is far away from occupied spaces.
- **3.1.2.4.2.3: Pathway interruption**
  - **ToolTip:** Mark “N/A” where the building is entirely unoccupied during construction.
- **3.1.2.4.2.4: Housekeeping**
  - **ToolTip:** Mark “N/A” where the building is entirely unoccupied during construction.
- **3.1.2.4.2.5: Scheduling**
  - **ToolTip:** Mark “N/A” where the building is entirely unoccupied during construction.

#### Answers:

- Yes (1 – 3 points, see table)
- No (0 points)
- N/A

Quantity of Yes Answers	Points
1	1
2	1
3	1
4	2
5	3

#### ToolTip:

This is verified at the Onsite Assessment. The measures should be included in the General Contractors' Environmental Management System as part of the Site and Work Instructions. Mark “N/A” where the building will not be occupied during construction.

#### References:

- *SMACNA IAQ Guidelines for Occupied Buildings Under Construction*
- *South Coast Air Quality Management District (SCAQMD)- Rule 1168*

#### Assessment Guidance:

Sources of air pollution are varied and include emissions/off-gassing from building materials or chemicals; outdoor sources like moisture, pesticides, and vehicle emissions; and HVAC and construction equipment. As mentioned in 3.1.2.3, an IAQ Management Plan should be developed for the project that includes comprehensive procedures for optimizing IAQ during and after construction. If the project has developed an Environmental Management Systems and plan, then contractor’s responsibilities for control and mitigation of pollutants would likely be addressed for criterion 3.1.2.4.2. Buildings pursuing Green Globes certification should employ an all-inclusive IAQ Management Plan that includes, at minimum, the following topics:

- **HVAC Equipment Protection.** Best management practices for HVAC equipment and system components during construction include, but are not limited to, the following strategies:
  - Ventilate the project site with temporary exhaust until the HVAC system is substantially installed



- During heavy construction periods, shut down the return side of the HVAC system and utilize temporary exhaust to increase the amount of outside air in order to dilute construction area airborne pollutants
- Shutting down the return side of the HVAC system during heavy construction activities
- Replace the HVAC filters at frequent intervals throughout the construction process, before flush-out or IAQ testing, and again before occupancy
- Ductwork inlets and outlets should be covered at both ends (shrink-wrapped in plastic) when not in use
- Equipment returns should be kept wrapped until final installation of the finish grates

Pictures should be taken at regular intervals throughout the project to document adherence to the HVAC protection requirements outlined in the IAQ Management Plan.

- Source Control. Materials and finishes used in buildings are one of the primary sources of emissions. These emissions are mainly reported in the form of Volatile Organic Compounds (VOCs). VOCs are compounds that contain carbon and off-gas chemicals such as formaldehyde (most common), alcohols, propane, acetone, and halo-generated hydrocarbons (methyl chloroform, methylene chloride). The best strategy to reduce the level of off-gassing after the building is occupied is to specify products that contain low levels of VOCs or none at all. When low-VOC emitting materials are specified and installed properly, VOC levels will be substantially reduced or even eliminated. The IAQ Management Plan should address acceptable VOC levels for adhesives, sealants, finishes, paints, particleboard and plywood (containing urea formaldehyde), insulation, floor and wall coverings, and ceiling tiles. For many building materials there are third-party certification programs like The Carpet and Rug Institute's Green Label Indoor Air Quality Test Program or Green Seal Standard GS-11 that owners and architects can specify to ensure building materials and components are low-VOC. Further requirements for adhesives and sealants are listed in the *South Coast Air Quality Management District (SCAQMD) Rule 1168*.
- Pathway Interruption. The IAQ Management Plan should provide for temporary barriers to isolate areas under construction from substantially completed, cleaned, or occupied areas. When possible, construction areas should be ventilated directly to the outdoors, when installation of VOC-emitting materials (sealants, adhesives, coatings, etc.) and/or mostly dusty operations are being performed.
- Housekeeping. The Housekeeping section should outline procedures to ensure that all materials stored onsite do not get contaminated by dirt or other particulate matter that is present on a construction site. This section should also address 3.1.2.3. Additionally, an overall jobsite maintenance program should be developed that includes the storage and protection of building materials in a dry, clean location. Additional requirements for this section could include using HEPA vacuums for cleanup and training of all construction staff on project housekeeping requirements.
- Scheduling. Construction operations and scheduling should be sequenced so that absorptive materials (gypsum board, ceiling tile, carpeting, etc.) are installed only after all applications of wet and odorous materials have been completed.

The IAQ Management Plan should be composed prior to start of construction (typically at the Pre-Construction Meeting) and should be documented or referenced in the project manual. During the Design Review, the Assessor will be looking for IAQ construction procedures in the Indoor Air Quality/Indoor Environmental Quality Plan or in the Division 01 specifications.

## 3.1.3 Commissioning

### 3.1.3.1 Pre-Commissioning

#### 3.1.3.1.1 Criteria:

Is there a requirement for the Commissioning Agent to document the "Owner's Project Requirements" for building systems as per *ASHRAE Guideline 0-2005: The Commissioning Process, Annexes I and J* (or more recent version)?

#### Answers:

- Yes (1 point)

- No (0 points)

**ToolTip:**

This is verified at the Onsite Assessment. The format should include: Objectives, Functional Uses, Occupancy Requirements, Budget Considerations and Limitations, Performance.

**References:**

- *ASHRAE Guideline 0-2005: The Commissioning Process, Annexes I and J*
- *ASHRAE Standard 202-2013: Commissioning Process for Buildings and Systems*
- *NIBS Guideline 3-2012: Building Enclosure Commissioning Process BECx*
- *Whole Building Design Guide (WBDG): Building Commissioning*  
<http://www.wbdg.org/project/buildingcomm.php>

**Assessment Guidance:**

The Owner's Project Requirements (OPR) should include a comprehensive breakdown of performance requirements for all building systems and what, if any, systems should be included in any commissioning activity. The commissioning scope of work outlined by the OPR typically includes:

- Mechanical/HVAC systems
- Plumbing domestic hot water/hot water return systems (especially if complex)
- Temperature controls/Building Automation Systems (BAS)
- Lighting/daylighting systems and controls
- Emergency power/power distribution systems
- Specialty electrical systems (fire alarm, voice/data, etc.)
- Renewable energy systems, if applicable
- Building envelope
- Conveying systems (elevators, escalators, etc.)
- Structural systems
- Fire protection systems
- Building interior systems

While developing the OPR, the owner should also identify the commissioning scope and budget. When complete, the OPR should be distributed to all project team members and should also be included post-construction in the Operations and Maintenance manual (see 3.1.3.4 Operations and Maintenance Manual).

**3.1.3.1.2 Criteria:**

Is there a requirement to document the building's "Basis of Design" for building systems as per *ASHRAE Guideline 0-2005 Annex K* (or more recent version)?

**Answers:**

- Yes (1 point)
- No (0 points)

**ToolTip:**

This is verified at the Onsite Assessment. The Basis of Design document records the major thought processes and assumptions behind design decisions made to meet the Owner's Project Requirements.

**References:**

- *ASHRAE Guideline 0-2005: Annex K*
- *ASHRAE Standard 202-2013: Commissioning Process for Buildings and Systems*

- *NIBS Guideline 3-2012: Building Enclosure Commissioning Process BECx*

### **Assessment Guidance:**

After the design team has received the OPR, they should develop a Basis of Design (BOD) specific to each trade. Each trade's BOD should document all assumptions, performance criteria, and standards referenced in their design. The Basis of Design can be a dynamic document that is updated throughout the design phases as elements change. *ASHRAE Guideline 0-2005, Annex K* lists common elements found in BOD documents.

### **3.1.3.1.3 Criteria:**

Is there a requirement for a Commissioning Authority with technical credentials as per *ASHRAE Guideline 0-2005* (or more recent version), to lead the commissioning team, coordinate the commissioning process, and report directly to the owner?

### **Answers:**

- Yes **(1 point)**
- No **(0 points)**

### **ToolTip:**

This is verified at the Onsite Assessment.

### **References:**

- *ASHRAE Guideline 0-2005: The Commissioning Process*
- *ASHRAE Standard 202-2013: Commissioning Process for Buildings and Systems*
- *NIBS Guideline 3-2012: Building Enclosure Commissioning Process BECx*

### **Assessment Guidance:**

Guideline 0 defines commissioning as “a quality-oriented process for achieving, verifying, and documenting that the performance of facilities, system, and assemblies meets defined objectives and criteria.” The commissioning process is performed to ensure that the building operates as required by the project documents, the Basis of Design (BOD) and the Owner's Project Requirements (OPR). This process is becoming an increasingly important part of new construction projects since 20% of energy used in average commercial buildings is wasted due to poorly operated building systems<sup>5</sup>. *ASHRAE Guideline 0-2005 - The Commissioning Process* is a comprehensive technical guide used to standardize the commissioning process. Guideline 0 is also a part of the National Institute of Building Sciences (NIBS) total building commissioning guidance series. The document provides procedures for commissioning a project beginning in pre-design (Article 5) and continues through design (Article 6) and construction (Article 7) of the facility. Most commissioning projects also include a post-construction/occupancy phase as well.

The pre-design phase of the project should include four key commissioning items: The OPR, the BOD, selection of the Commissioning Authority (CxA), and the development of the Commissioning Plan by the CxA.

The Building Commissioning Association defines the CxA as “an objective, independent advocate of the owner who leads, plans, schedules, and coordinates the commissioning team. If the CxA's firm has other project responsibilities, or is not under direct contract to the owner, a conflict of interest exists. Wherever this occurs, the CxA discloses, in writing, the nature of the conflict and the means by which the conflict shall be managed.” It is important to note that Green Globes

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<sup>5</sup> “Continuous Commissioning,” Texas A&M Energy Systems Laboratory, accessed May 1, 2013, <http://www-esl.tamu.edu/continuous-commissioning>.

does not require a third-party CxA. The CxA's first responsibility is to develop the first draft of the Commissioning Plan. The Commissioning Plan should include a breakdown of the project's Commissioning Team, identifying roles and responsibilities, establish a final list of systems and equipment to be commissioned, establish the process in which the systems will be commissioned, and provide examples of sample commissioning documentation. The Commissioning Plan can be incorporated into the Division 01 project specifications, or it can be a separate document distributed to all project team members.


The design and construction phases of commissioning are covered under 3.1.3.2 Whole Building Commissioning. The Assessor will look for the Commissioning Plan during the Onsite Assessment.

### 3.1.3.2 Whole Building Commissioning

#### 3.1.3.2.1 Criteria:

Is there a requirement that commissioning will be conducted in accordance with *ASHRAE Guideline 0-2005: The Commissioning Process: Articles 5, 6 and 7*, (or more recent version) for the following:

- **3.1.3.2.1.1:** HVAC&R systems and their controls?
  - **Answers:**
    - Yes **(4 points)**
    - No **(0 points)**
- **3.1.3.2.1.2:** Building envelope?
  - **Answers:**
    - Yes **(3 points)**
    - No **(0 points)**
  - **ToolTip:** Roofing assemblies, waterproofing assemblies, fenestrations and doors and cladding/skin.
- **3.1.3.2.1.3:** Structural systems?
  - **Answers:**
    - Yes **(2 points)**
    - No **(0 points)**
- **3.1.3.2.1.4:** Fire protection system?
  - **Answers:**
    - Yes **(2 points)**
    - No **(0 points)**
- **3.1.3.2.1.5:** Plumbing system?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
  - **ToolTip:** This involves spot check and verification that the flows are accurate for the different fittings, fixtures, and appliances.
- **3.1.3.2.1.6:** Electrical system?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
- **3.1.3.2.1.7:** Lighting system and their controls?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**

**3.1.3.2.1.8:** Building automation systems? 

- **Answers:**

- Yes **(1 point)**
  - No **(0 points)**
  - N/A
- **ToolTip:** Mark “N/A” where building automation systems are not within the scope of the project.
- **3.1.3.2.1.9:** Elevating and conveying systems?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** Mark “N/A” where there are no elevating systems.
- **3.1.3.2.1.10:** Mark N/A for Green Globes Multifamily for New Construction

## References:

- *ASHRAE Guideline 0-2005: The Commissioning Process, Articles 5, 6, and 7*
- *ASHRAE Standard 202-2013: Commissioning Process for Buildings and Systems*
- *NIBS Guideline 3-2012: Building Enclosure Commissioning Process BECx*
- *Guideline 1.1 – HVAC&R Technical Requirements for The Commissioning Process*
- *Building Commissioning Association*  
<http://www.bcx.org>
- *AABC Commissioning Group*  
<http://www.aabc.com/commissioning>

## Assessment Guidance:

During the design phase, the CxA should review the OPR, design documents and any Basis of Design (BOD) documents assembled by the design team. The design document reviews focus on the “big picture”, focusing on operability, accessibility, maintainability, efficiency, coordination between systems and controls. Approximately one-third of commissioning field problems can be traced back to design, so this process is key. At this time, the CxA should also help prepare commissioning related specifications for the design team, develop pre-functional checklists and functional performance tests for all equipment to be commissioned, and finalize the Commissioning Plan. Specification sections related to commissioning are typically included in the Division 01 sections (listing checklists, prerequisites to testing, testing requirements and reports) and also in individual sections in Divisions 02 through 48 (stating which systems are to be commissioned and requirements for contractors to complete checklists and performance tests). The CxA will also develop training and systems manual requirements.

The construction phase is where the largest amount of commissioning work takes place. The CxA’s activities will include:

- Reviewing submittals against the Commissioning Plan, OPR, and BOD
- Revise the OPR, Commissioning Plan and schedule, if necessary
- Document construction observations on site and compile these into a commissioning issues log and photo log
- Review pre-functional test checklists completed by contractors
- Conduct Functional Performance Testing of equipment and systems
- Develop a systems manual that includes operations and maintenance manuals for commissioned equipment

During this time, the CxA might also meet with the designers and contractors to review complex systems such as the BAS and sequence of operations. Once all the above activities are complete, the CxA will develop and distribute the Commissioning Report.

More information on commissioning can be found at *ASHRAE Guideline 0-2005 – The Commissioning Process* and *Guideline 1.1 – HVAC&R Technical Requirements for The Commissioning Process*, *Building Commissioning Association* (<http://www.bcx.org>) and the *AABC Commissioning Group* (<http://www.aabc.com/commissioning>).



The Assessor will look for a final Commissioning Report. Other documents that should be submitted before or during the Onsite Assessment include any commissioning issues logs. If these tasks have not been completed prior to the Onsite Assessment, projects should submit the most recent copy of the Commissioning Plan.

### 3.1.3.2.2 Criteria:

Is there a requirement to field-test partitions for noise isolation?

#### Answers:

- Yes (1 point)
- No (0 points)

#### ToolTip:

Conduct field testing of partitions for noise isolation according to *ASTM E 336-07*, determined by *ASTM E 413-04*, and rated for not less than two-thirds of the indicated STC value.

#### References:

- *ASTM E 336-07: Standard Test Method for Measurement of Airborne Sound Attenuation between Rooms in Buildings*
- *ASTM E 413-10: Classification for Rating Sound Insulation*

#### Assessment Guidance:

Majority of the sub-criteria systems listed in 3.1.3.2.1 will be typical for most commissioning requirements. However, this criterion requires some non-standard project actions. First, an Acoustical Consultant or Acoustician should be included on the design team or the architect should be familiar with the acoustical properties of their wall designs. Next, during the design phase, the interior partitions will need to be evaluated to determine their sound transmission class (STC) rating. An STC rating quantifies sound isolation between partitions installed in the interior of a building. These ratings should be documented on the project drawings and/or specifications for each type of interior partition on the project.

During Functional Performance Testing, the CxA should either perform or hire a subcontractor to perform the field testing of each type of partition in accordance with *ASTM E366-07: Measurement of Airborne Sound Insulation in Buildings*. With the results of the field test, the field sound transmission class (FSTC) value will be calculated by following the procedures of *ASTM E413-04: Classification for Rating Sound Insulation*. To comply with the Green Globes sub-criteria, all FSTC values must be not less than two-thirds the design STC rating.

The Assessor will look for the field testing results during the Onsite Assessment. These can be included in the final Commissioning Report or as a separate document.

### 3.1.3.2.3 Criteria:

Is there a requirement that the building system commissioning will be conducted in accordance with *ASHRAE Guideline 0-2005: The Commissioning Process, Annex L* (or more recent version)?

#### Answers:

- Yes (1 point)
- No (0 points)

#### ToolTip:

This annex provides guidance on writing specifications for the commissioning activities that are to be performed by construction contractors. A specification guide is included with the assumption that the construction contractor is



involved only during the construction phase and for the correction and warranty period. This is verified at the Onsite Site Assessment. Where no commissioning is to be done, mark “no.”

**References:**

- *ASHRAE Guideline 0-2005: The Commissioning Process, Annex L*
- *ASHRAE Standard 202-2013: Commissioning Process for Buildings and Systems*
- *NIBS Guideline 3-2012: Building Enclosure Commissioning Process BECx*

**Assessment Guidance:**

This criterion should be included in the project specifications and/or the Commissioning Plan. The Assessor will look at these documents to determine compliance.

### 3.1.3.3 Training

#### 3.1.3.3.1 Criteria:

Is there a requirement that there will be training for the building operators on the systems listed above in accordance with *ASHRAE Guideline 0-2005: Article 7.2.14* (or more recent version)?

**Answers:**

- Yes **(1 point)**
- No **(0 points)**

**References:**

- *ASHRAE Guideline 0-2005: Article 7.2.14*
- *ASHRAE Standard 202-2013: Commissioning Process for Buildings and Systems*
- *NIBS Guideline 3-2012: Building Enclosure Commissioning Process BECx*

**Assessment Guidance:**

Before building occupancy, the CxA will also provide systems training to the building staff. Training should identify the end user maintenance personnel, provide the end user with a “refresher” on building equipment and provide the owner and maintenance personnel with a full understanding of system equipment and design. It is recommended that this training be recorded on video recorded so the information can easily be shared with new maintenance personnel. *ASHRAE Guideline 0-2005 Article 7.2.14* requires that this training be verified by conducting a random evaluation/test of 5-10% of the trained employees. The test should measure whether the training provided the tools necessary for the staff to either know all the system operations or know where to find information if it is not known and understand how to troubleshoot and resolve any system’s problems.

The Assessor will look for a final Commissioning Plan including training agenda. The Commissioning Report and sign-in sheets verifying systems training should be provided if commissioning is complete by the time of the Onsite Assessment.

### 3.1.3.4 Operations and Maintenance Manual

#### 3.1.3.4.1 Criteria:

Is there a requirement to develop an Operations and Maintenance (O&M) Manual and/or CMMS that contains descriptions and information on the continuous tasks related to the systems and to each piece of equipment, which are necessary to operate the building efficiently?

**Answers:**

- There is/will be a complete, user-friendly O&M manual **(6 points)**
- O&M Manual meets some, but not all requirements **(3 points)**

- There is/will be a complete CMMS **(6 points)**
- CMMS meets some, but not all requirements **(3 points)**
- No **(0 points)**

### ToolTip:

This is verified at the Onsite Assessment. A “CMMS” is defined as a computerized maintenance management system. Review the Assessment Guidance below for a list of what must be included within an O&M Manual and/or CMMS.

### References:

- *ANSI/ASHRAE Standard 62.1-2010: Ventilation of Acceptable Indoor Air Quality*
- *U.S. Environmental Protection Agency (EPA) -Greening Your Purchase of Cleaning Products, A Guide for Federal Purchasers:*  
<http://www.epa.gov/epp/pubs/cleaning.htm>

### Assessment Guidance:

Close-out documents for typical new construction projects include what may be often be referred to as an Operations and Maintenance (O&M) Manual. O&M Manuals for green and sustainable buildings need to encompass all the operating aspects of the building that have an impact on its surrounding environment and occupants. Simply because a building was built green does not mean it will operate in an environmentally-friendly fashion unless thorough operating procedures are in place as soon as the building is occupied. Conventional practices may provide O&M Manuals that include mainly HVAC equipment. Manuals of this type are useful but are not sufficient to ensure the building staff can successfully operate the building post-construction. This criterion is meant to address the building’s overall operating procedures, not solely the engineered systems.

For buildings pursuing Green Globes certification, the O&M manual should include at least 12 of the items listed below. Operating plans, policies, and protocols for a variety of building aspects should allow the building engineers and managers to run the building as it was designed, continually optimizing the efficiency, and reaping the benefits of the installed systems and prescribed practices.

### Engineered Building Systems

- Calibration Strategy for Outdoor and Exhaust Air Dampers
  - Clearly define when and how all HVAC dampers will be calibrated to ensure proper air flow both in and out of the building and ensure that full closure is achieved, when appropriate.
- Schedule for HVAC and filter maintenance
  - A comprehensive maintenance schedule should be made that includes manufacturer-recommended maintenance for all major HVAC equipment.
  - A filter replacement schedule should be developed and posted to ensure continued clean air for occupants.
- Cooling Tower Operating Maintenance
  - If the project includes a cooling tower system, the HVAC maintenance vendor should be signed to an agreement detailing all preventative maintenance.
  - In-house staff may also provide the maintenance if a plan is in place.
- Frost Mitigation Strategy for Ventilation Heat Recovery
  - If the project includes a ventilation heat recovery system, a frost mitigation strategy should be included in the Basis of Design as part of the commissioning process. If no commissioning is being pursued for the project, the HVAC design engineer should develop this strategy as part of the controls sequence of operations.
- Carbon Dioxide Monitoring Protocol
  - Refer to 3.7.1.4 CO<sub>2</sub> Sensing and Ventilation Control Equipment.
  - The CO<sub>2</sub> Monitoring should contain the following:

- The maximum acceptable differential between indoor and outdoor CO<sub>2</sub> concentrations as recommended by the lower of *ANSI/ASHRAE Standard 62.1-2010* or the authority having jurisdiction;
  - The documentation of an alarm condition, diagnosis of the condition and documentation of any remediation necessary.
- Carbon Monoxide Monitoring Protocol
  - Refer to 3.7.2.4 Carbon Monoxide Monitoring.
  - The Carbon Monoxide Monitoring Protocol should contain the following:
    - Instructions for review, follow-up and remediation.
- Energy Metering Reporting Plan
  - Refer to 3.3.3 Metering, Measurement, and Verification.
- Water Efficiency Measurement and Verification Plan
  - Refer to 3.4.7 Metering.

### General Building

- Food and Material Waste Reduction Plan
  - Refer to 3.5.4 Waste.
- Waste Minimization Plan
  - Refer to 3.5.4 Waste.
- General Housekeeping
  - A general housekeeping, or green cleaning, policy should be developed that contains all sustainable cleaning products, indoor janitorial equipment, and cleaning procedures (for use by both in-house staff and out-sourced service providers).
  - The policy should include specifications for sustainable cleaning materials, janitorial paper products, trash bags, and floor care products (e.g. Green Seal, Environmental Choice, or EPA labeled products, recycled content paper products and trash bags).
  - The policy should address cleaning equipment that is quiet, high-efficient, low emissions, ergonomically designed, and has safeguards to protect building elements. Equipment should be tested by the Carpet and Rug Institutes “Green Label” or “Seal of Approval” programs. Owners should work with janitorial vendors to ensure all facets of the green housekeeping policy are incorporated into the daily cleaning routine.
  - The policy should assign control for all high level chemical disinfectants and sterilants.
  - For more information, review EPA’s *Greening Your Purchase of Cleaning Products, A Guide for Federal Purchasers*: <http://www.epa.gov/epp/pubs/cleaning.htm>
- Integrated Pest Management Plan
  - Refer to 3.7.2.8 Pest and Contamination Control.
- Chemical Management and Minimization Policy
  - Establish a policy that minimizes the use and storage of harmful chemicals. The policy should regulate which chemicals can be used on site specifying low VOC, non-toxic, and Green Seal products where possible.
  - It should also cover purchasing, ordering, receiving, handling, storage, and disposal of high hazard substances and the process for properly ventilating chemical storage areas (air monitoring). All chemicals should be properly labeled and only used per manufacturer’s recommendations. No chemicals shall be used for purposes other than originally specified.
  - The policy should also address staff training/ education and employee health monitoring, as appropriate, with special consideration for chemicals that have been identified as posing increased risk for occupational and community exposure.
- Low-Impact Site and Green Building Exterior Management Plan
  - Establish a plan that addresses building exterior management practices that have a low environmental impact and preserve the surrounding ecology. This plan should include:
    - Maintenance equipment.
    - Chemical/fertilizer/snow removal practices.

- Building/exterior products and practices as they relate to cleaning, painting, or sealing.
- It can also include landscape waste, plantings, and exterior pest control, although those areas might also be addressed under other policies (i.e. 3.7.2.8 Pest and Contamination Control or 3.5.4 Waste).
- A narrative should be included that gives an overview of the organizational management plan that highlights all included topics and quarterly reporting requirements. The narrative should also include a requirement for quartering reporting over a specified period.
- Site Maintenance Contract
  - The Site Maintenance Contract should include the following:
    - Site map to identify locations for meters, controllers, valves, filters, hose bibs, back flow prevention devices, and water sources;
    - Identification of site square footage of each irrigated landscape zone to use in the formulation of a site water budget by a certified or degreed irrigation designer or auditor;
    - Requirement that a certified or degreed irrigation designer or auditor check irrigation system by turning it on manually to inspect for leaks, breaks, overspray, etc. every month or more, if possible;
    - Description of actions to be taken to quickly find and fix irrigation to avoid substantial loss of water;
    - Requirement to use mulch and to renew mulch on an annual basis or as needed;
    - Requirement to grass-cycle with every mowing, if turf is used on site;
    - Requirement to use mulching mowers and to leave grass clippings on the site, instead of removing clippings and taking to the landfill;
    - Requirement for use of organic fertilizers;
    - Limitation on the use of non-organic herbicides and pesticides and that they only be applied by certified applicators;
    - Requirement that maintenance contractors are certified landscape professionals accredited by a local water provider and/or university;
    - Requirement that plant replacements be done within an approved or provided plant list, or in the context of the site goals for efficiency;
    - Requirement that “Extra” work be spelled out in the contract and agreed to by owner, manager and contractors.
  - Operating Schedule for all EPA WaterSense/Smart Water Application Technology (SWAT) smart controllers (ET or soil moisture sensors) and automatic rain shut off devices
    - Refer to 3.4.8 Irrigation.
    - When water-efficient irrigation systems are included in the project, the Landscaping designer should include controls information on their drawings or specifications detailing the irrigation operating schedule.

All management plans and policies should include who the responsible parties are, including any outside vendors, what actions will be taken as part of the plan, why the actions are environmentally preferable versus standard operating procedures and any tracking or verifying documentation that will be required. The Assessor will look for a final Operations and Maintenance Manual that clearly notes each of the site management items it addresses. The Assessor will also be checking to ensure each management plan or policy is complete.

## 3.2 SITE

### 3.2.1 Development Area

#### 3.2.1.1 Urban Infill and Urban Sprawl

##### 3.2.1.1.1 Criteria:

Is the project located within 0.5 mi (0.8 km) of a commercial zone?

##### Answers:

- Yes (5 points)
- No (0 points)

##### Assessment Guidance:

Identifying where a project will be built is one of the first steps in the conceptual design process. Sustainable buildings can be found on all types of land, although every effort should be made to avoid building on ecologically valuable land. Typically, this includes wetlands or wildlife corridors that should be preserved so as to not disturb local ecosystems. It also includes other areas of local importance like farmland, parkland, or other areas noted for local environmental beauty. Those types of site are commonly referred to as a greenfield site. For this Green Globes criterion, projects should vet their options for the project site and pick a location that does not increase urban sprawl. Urban sprawl negatively affects the local environment by causing more stress on the existing utilities (especially water) and it reduces available areas of wildlife habitat and can cause an increase of pollution due to longer commutes. By picking a location that is in a commercial zone or close to an existing commercial zone, the project will likely be creating buildings that cut down on automobile use, save energy, and promote well-designed, walkable neighborhoods.

During the Design Review, the client should submit verification of the site conditions prior to project start. This can be in the form of Civil Engineer's drawings, existing satellite photos, geotechnical reports, etc. These items can be included as a separate item or integrated into the design drawings.

##### 3.2.1.1.2 Criteria:

Is the building being constructed on a previously developed site served by existing utilities for at least a full year before construction?

##### Answers:

- Yes (5 points)
- No (0 points)

##### ToolTip:

Site must have been served by utilities (electric power, water, and sewer) for at least a full year before construction began.

##### Assessment Guidance:

This criterion calls for a project to be located on a site that does not require the addition of transportation and utility infrastructure. Additionally, the requirements dictate that an existing infrastructure must have been in place for at least a year prior to the construction of the project. During the Design Review, the client should submit verification of the site's utility conditions prior to project start.



This can be in the form of Civil or MEP Engineer's drawings showing existing utility lines, or other documents describing the existing conditions prior to the registered project's construction. Urban infill projects or buildings built in place of demolished structures also qualify for this criterion.

### 3.2.1.2 Greenfields, Brownfields, and Floodplains

#### 3.2.1.2.1 Criteria:

Is the building being constructed on a remediated brownfield or remediated Superfund site?

##### Answers:

- Yes (10 points)
- No (0 points)

##### ToolTip:

A brownfield site is an abandoned, idle, or underutilized commercial or industrial property where past actions have caused known or suspected environmental contamination, but where this is an active potential for redevelopment.

##### References:

- *US Environmental Protection Agency (EPA) Superfund, Cleaning up the Nation's Hazardous Wastes Sites*  
<http://www.epa.gov/superfund/>

##### Assessment Guidance:

A list of EPA's recognized Superfund sites can be found here: <http://www.epa.gov/superfund/>. It is important to note that a brownfield sites can be covered by Superfund programs but can also be redeveloped separately from the government in private initiatives. Sites that qualify for this Green Globe's criteria must have a geotechnical report or Environmental Assessment that states that the site was contaminated, the extent of the contamination, the remediation strategy, and final results of post-remediation soil borings. A narrative should be included in the project documents that summarizes the geotechnical report and also gives a site map showing which areas were remediated as a portion of the entire project site boundaries. In order to qualify, it is not necessary that that the current project was responsible for remediating the area.

For the Design Review, documentation should be submitted to the Assessor either under separate cover or included in the project documents that show the site was a brownfield or Superfund site and has since been remediated.

#### 3.2.1.2.2 Criteria:

Does the project location avoid sensitive sites (i.e. land that was farmland, a public park, a wooded area, prairie, wetland, wildlife corridor, or recreational area) for at least three years prior to time of purchase or from the beginning of project?

##### Answers:

- Yes (6 points)
- No (0 points)

##### ToolTip:

Ensure that any necessary Environmental Assessments have been carried out.

##### Assessment Guidance:

The verification for this criterion might be covered in other Section 3.2 documentation or a separate document detailing the history of the project site should be submitted to the Assessor for the Design Review.



### 3.2.1.2.3 Criteria:

Is all habitable space located higher than the 100-year flood plain?

#### Answers:

- Yes **(4 points)**
- No **(0 points)**

#### ToolTip:

A “100-year floodplain” is the geographic extent of the flooded area expected to be equaled or exceeded every 100 years on average, as identified on a flood-risk map approved by municipal, provincial or federal government or land use plan, interim control by-law or municipal planning by-law. Where there is inconsistency between maps, the most recent map or the most recent flood elevation (whichever is greater) should be used to delineate the extent of the floodplain. Any construction at a level below the 100-year floodplain must be compliant with *Federal Emergency Management Agency (FEMA) Technical Bulletin 2/2008*.

#### References:

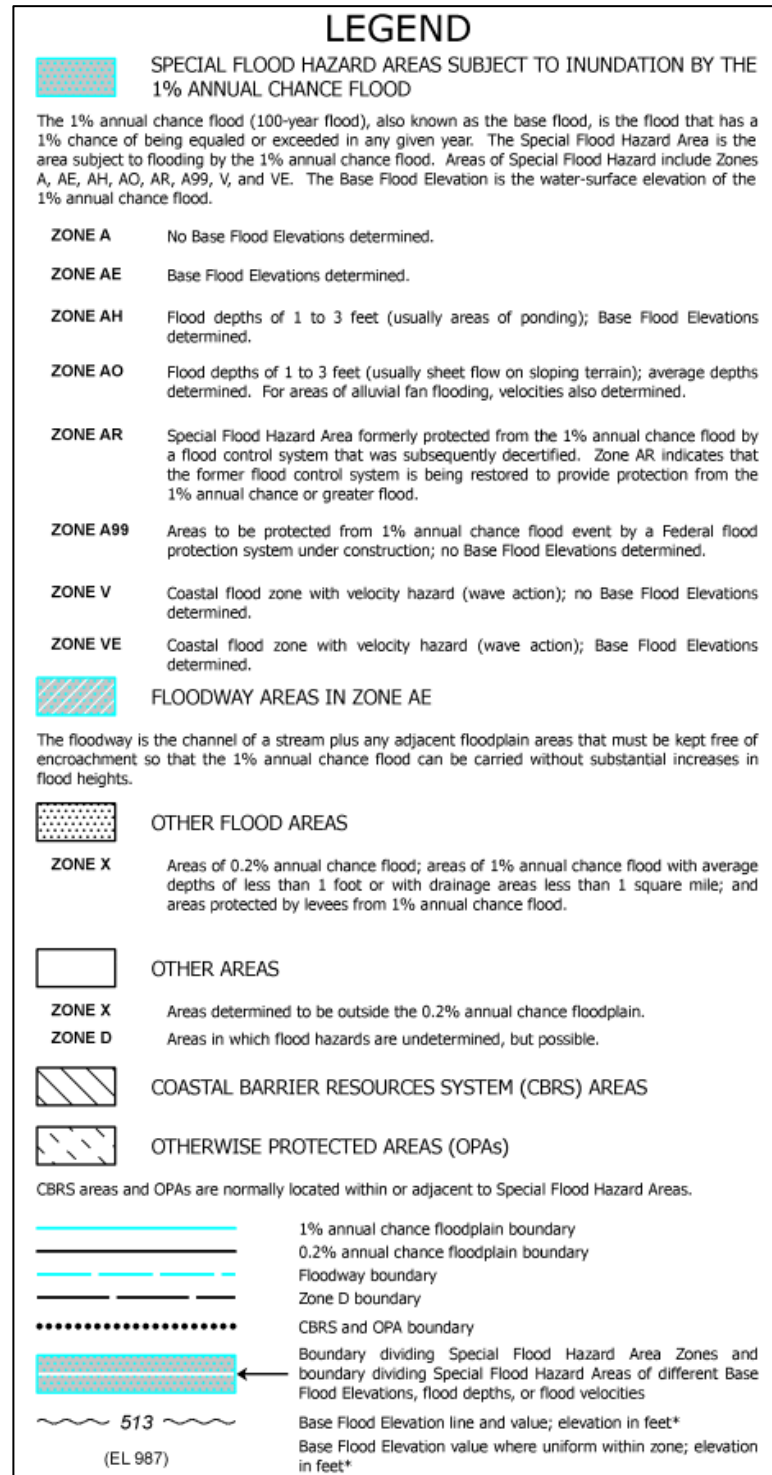
- *Federal Emergency Management Agency (FEMA) Technical Bulletin 2/2008*
- *FEMA- Flood Map Service Center:*  
<https://msc.fema.gov/portal>
- *FEMA Flood Insurance Rate Maps (FIRMs):*  
<https://www.fema.gov/floodplain-management/flood-insurance-rate-map-firm>
- *National Flood Insurance Program (NFIP):*  
<http://www.floodsmart.gov>

#### Assessment Guidance:

FEMA conducts studies and issues flood insurance maps to identify a community’s flood risk level. Since changing weather patterns, erosion, and development can affect floodplain boundaries, FEMA must constantly update the risk levels for each area. Early in the conceptual design phase, the latest FEMA maps should be consulted to determine risk level for the prospective project site. More information can be found at the *National Flood Insurance Program (NFIP)* and the *Federal Emergency Management Agency (FEMA) Flood Map Service Center*. The following three figures show the information available on the *FEMA Flood Insurance Rate Maps (FIRMs)*. These maps help determine if the area of the project is in an AE zone (designated by the blue shaded areas) that is subject to a 100-year flood. Figure 3.2.1.2.3-C shows the Base Flood elevation line with elevation listed in feet.

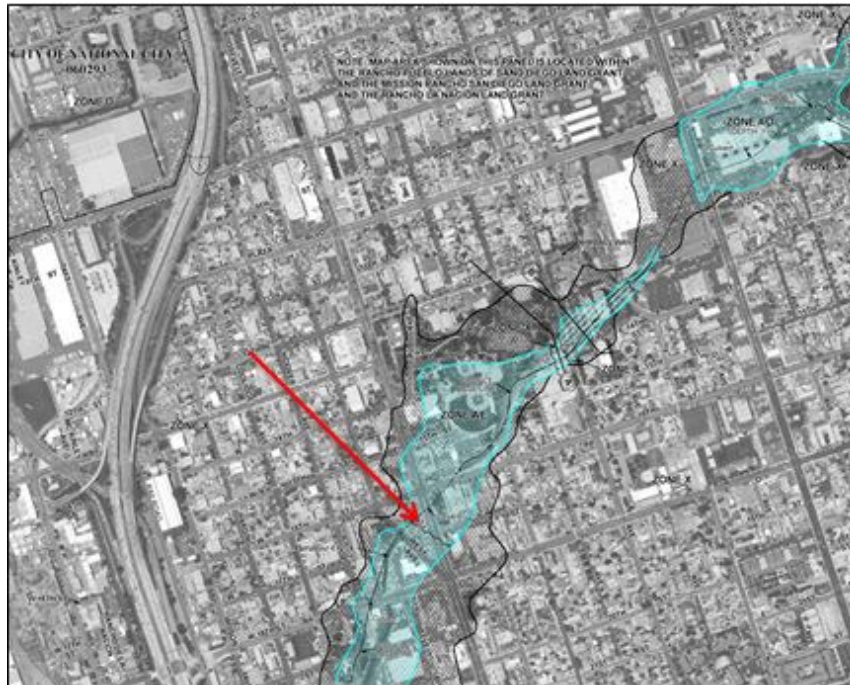
[illegible]

**Figure 3.2.1.2.3-B: FEMA Flood Insurance Rate Map Legend**





**Figure 3.2.1.2.3-C: FIRMette showing floodplain areas and elevation**



The Civil Engineer's topography plans for the final project site should highlight any areas below the area's 100-year floodplain. For these areas, FEMA's *Technical Bulletin 2/2008: Flood Damage-Resistant Materials Requirements* should be followed. This document provides guidance on the use of flood-damage resistant construction materials for buildings located in a floodplain area. The document should be used to specify and detail all dry flood proof building materials and components located below the 100-year floodplain. The flood proof materials must be located from the lowest point in the building up to the 1% flood elevation.

During the Design Review, the client should submit the Civil Engineer's design drawings, a floodplain map of the region highlighting the project area, and details showing which materials are used in below-grade building components.

## 3.2.2 Ecological Impacts

### 3.2.2.1 Site Disturbance and Erosion

The first two criteria are two paths for assessing erosion and sedimentation:

- **Path A: Erosion and Sedimentation Control Plan** – 5 points
- **Path B: Erosion and Sedimentation Control Specifications** – 5 points

Points cannot be combined between paths. Please review and select one of the two pathways below.

#### 3.2.2.1.1 Path A: Erosion and Sedimentation Control Plan

##### 3.2.2.1.1.1 Criteria:

Is there an Erosion and Sedimentation Control Plan, signed and stamped by a Professional Engineer?

**Answers:**

- Yes (5 points)
- No (0 points)

**ToolTip:**

This will undergo final verification during the Onsite Assessment. The Erosion and Sedimentation Control Plan should meet or exceed all requirements outlined by the U.S EPA's *Pollutant Discharge Elimination System (NPDES) Permit Programs* and be fully implemented by the general contractor. More information can be found at the EPA's –*Erosion and Sediment Control*: <http://water.epa.gov/polwaste/nps/erosion.cfm>

**References:**

- U.S. Environmental Protection Agency (EPA) *National Pollutant Discharge Elimination System (NPDES) Permit Programs*:  
[http://www.epa.gov/region1/npdes/permits/permit\\_final\\_ms4.pdf](http://www.epa.gov/region1/npdes/permits/permit_final_ms4.pdf)
- U. S. Environmental Protection Agency (EPA) *Erosion and Sediment Control*:  
<http://water.epa.gov/polwaste/nps/erosion.cfm>

**Assessment Guidance:**

Sustainable buildings should minimize the soil losses associated with sediment and erosion on the project site. According to the EPA “erosion and sediment controls are the structural and non-structural practices used during the construction process to keep sediment in place (erosion control) and to capture any sediment that is moved by stormwater before it leaves the site (sediment control).”<sup>6</sup> Most projects will incorporate an Erosion and Sediment Control Plan in the project specifications and the Civil Engineer’s drawings. In addition to the control measures listed in the ToolTip above, the project should address ways to minimize site disturbance, not solely control runoff. The project should be designed to fit the site’s existing topography, drainage patterns, and natural soils and vegetation. Efforts should be made to reduce the duration of bare-area exposure by scheduling construction such that bare areas of the site are exposed only during the dry season or for short periods of time.

The EPA recommends a number of best management practices (BMPs) for an effective Erosion and Sediment Control Plan and outlines some requirements for the plan. To comply, the project’s Erosion and Sediment Control Plan should include:

- Area of disturbance
- Summarize design requirements that include amount, frequency, intensity, and duration of precipitation
- Stormwater runoff and run-on at the site, including expected flow and any controls to minimize peak and total stormwater volume
- Information on soils present on the site
- Description of stormwater discharge areas to maximize infiltration and increase sediment removal
- Summarize installation of stormwater controls for each phase of earth disturbance; include good engineering practice and adherence to manufacturer’s specifications
- Plans for erosion and sediment control maintenance during construction including inspection and repair schedules

The EPA also lists a number of control categories that are applicable to all sites. Some of these include:

- Provide natural buffers when surface water is located within 50 feet of the project’s earth disturbance
- Install perimeter controls
- Minimize sediment track-out

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<sup>6</sup> “*Developing Your Stormwater Pollution Prevention Plan: A Guide for Construction Sites*”, United States Environmental Protection Agency, accessed February 25, 2015 [http://www.epa.gov/npdes/pubs/sw\\_swppp\\_guide.pdf](http://www.epa.gov/npdes/pubs/sw_swppp_guide.pdf)



- Control discharges from stockpiled sediment or soil
- Minimize dust
- Minimize disturbance to steep slopes
- Preserve topsoil
- Minimize soil compaction
- Protect storm inlets

### 3.2.2.1.2 Path B: Erosion and Sedimentation Control Specifications

#### 3.2.2.1.2.1 Criteria:

In the absence of an Erosion and Sedimentation Control Plan by a Professional Engineer, do the specifications require that the General Contractor will implement the following best practices for erosion and sediment control during construction:

- **3.2.2.1.2.1.1:** Silt fences will be installed or fiber socks filled with compost/wood chips around the construction site and maintained throughout construction?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
- **3.2.2.1.2.1.2:** Gravel pads will be placed at all site entries and cleaned throughout construction?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
- **3.2.2.1.2.1.3:** Riprap will be placed around all storm sewer outlets and silt and debris removed after each 24-hour rainfall of 0.2 in (5 mm) or more?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
- **3.2.2.1.2.1.4:** Disturbed soil will be corrected using erosion control mats or mulched and seeded within 90 days of being disturbed?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
- **3.2.2.1.2.1.5:** During dry days, dust will be controlled by wetting the soil each day for 15 to 30 minutes before construction activities begin and again after construction activities are done for the day?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**

#### ToolTip:

This will undergo final verification during the Onsite Assessment. Mark “no” where there is an Erosion and Sedimentation Control Plan signed and stamped by a Professional Engineer.

#### Assessment Guidance:

This path allows an itemized approach to earn the points where a stamped document is not provided by the civil engineer.

### 3.2.2.1.3 Criteria (answer the following question regardless of the Path chosen above):

Is there a requirement that construction activities will be located in such a way to limit disturbance to the site?

#### Answers:

- Yes (3 points)
- No (0 points)

#### ToolTip:

Construction activity should not extend beyond 40 ft. (12.2 m) of the building footprint; and not beyond 5 ft. (1.5 m) of parking lots, roadways, sidewalks, and utility right-of-ways. Exceptions apply where the intent of the construction activities is to specifically improve the natural integrity of the site e.g.: removing invasive plant species, replacing existing hardscapes with vegetation, restoring prairie or wetlands, or increasing onsite water retention by building rain gardens, swales, retention ponds, or berms.

#### Assessment Guidance:

Projects should restrict work in areas that are not part of the building footprint or associated ancillary spaces (parking lots, walkways, utility right-of-ways, etc.). This will prevent the project from disturbing any unnecessary spaces and topographies not associated with the project. The only exception is when the project will be modifying these areas for the betterment of the local environment. Green Globes awards points when the project improves adjacent spaces by implementing the sub-criterion above.

## 3.2.2.2 Tree Integration

### 3.2.2.2.1 Criteria:

Are the following integrated into the landscape plan:

- **3.2.2.2.1.1: Large trees?**
  - **Answers:**
    - Yes (2 points)
    - No (0 points)
    - N/A
  - **ToolTip:** Mark "N/A" where there are no large trees existing, adaptive, or native to the ecosystem. "Large tree" means a diameter greater than 12 in. (30 cm) as measured at 5 ft. (1.4 m) above the ground or as per municipal regulations, whichever is more stringent.
- **3.2.2.2.1.2: Clusters of trees?**
  - **Answers:**
    - Yes (2 points)
    - No (0 points)
    - N/A
  - **ToolTip:** Mark "N/A" where there are no clusters of trees existing on site, or adaptive or native to the ecosystem.
- **3.2.2.2.1.3: Undergrowth?**
  - **Answers:**
    - Yes (1 point)
    - No (0 points)
    - N/A
  - **ToolTip:** Mark "N/A" where is no undergrowth existing on site, or adaptive or native to the ecosystem.

**ToolTip:**

Trees and undergrowth integrated into the landscape plan must be existing on site or adapted or native to the ecosystem. This will undergo final verification during the Onsite Assessment.

### 3.2.2.3 Tree Preservation

Green Globes provides two paths for assessing tree preservation:

- **Path A: Tree Preservation Plan** – 4 points
- **Path B: Tree Protection Specifications** – 4 points

Points cannot be combined between paths. Please review and select one of the two pathways below.

#### 3.2.2.3.1: Path A: Tree Preservation Plan

##### 3.2.2.3.1.1 Criteria:

Is there a Tree Preservation Plan by a certified Arborist?

**Answers:**

- Yes **(4 points)**
- No **(0 points)**
- N/A

**ToolTip:** Mark “N/A” where there are no trees on the site.

##### Assessment Guidance:

Landscaping or Civil Engineering plans should be submitted as part of the Design Review for the Assessor to clearly see if any existing trees will remain and how those trees will be protected during construction. If a tree preservation plan was compiled by a certified arborist, this document should be incorporated into the project manual or submitted as a separate document to the Assessor.

#### 3.2.2.3.2: Path B: Tree Protection Specifications

##### 3.2.2.3.2.1 Criteria:

In the absence of Tree Preservation Plan by a certified Arborist, do the specifications require that the General Contractor will implement the following best practices for tree protection during construction:

- **3.2.2.3.2.1.1:** Tree protection barriers will enclose a minimum Tree Protection Zone (TPZ) around the trees and shrubs that are to be retained on the site?
  - **Answers:**
    - Yes **(2 points)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** The fences must enclose an area equal to or greater than the minimum required Tree Protection Zone (TPZ) determined by the diameter of the tree **or** according to relevant municipally-defined tree protection zone, whichever is more stringent. Diameter of the tree is measured at 5 ft. (1.4 m) above the ground. Mark “N/A” where there are no trees on the property.
- **3.2.2.3.2.1.2:** Root protection will be installed to protect tree roots from compaction during construction?
  - **Answers:**

- Yes **(1 point)**
- No **(0 points)**
- N/A
- **ToolTip:** Root protection should consist of a combination of filter fabric, clear crushed stone (half to three quarter inch diameter) placed in a layer 6 in. (15 cm) deep, and steel plating or other material. Mark “N/A” where there are no trees on the property.
- **3.2.2.3.2.1.3:** Sediment control barriers will be provided where some fill or excavate will be temporarily located near a TPZ?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** Mark “N/A” where there are no trees on the property.

**ToolTip:**

This will undergo final verification during the Onsite Assessment. Mark “N/A” for the following responses where there are no trees on the property. Mark “no” where there is a Tree Preservation Plan by a certified Arborist.

### 3.2.2.4 Heat Island Effect

#### 3.2.2.4.1 Criteria:

What percentage by area of the roof is vegetated, and/or has a high Solar Reflectance Index (SRI) as prescribed based on the slope of the roof?

**Answers:**

- > 70% **(6 points)**
- 56 - 70% **(4 points)**
- 40 - 55% **(2 points)**
- < 40% **(0 points)**
- N/A

**ToolTip:**

Calculate the percentage of roof area that will be vegetated, have a high SRI or a combination thereof. For a low slope roof, the SRI should be at least 78. For a steep slope roof, the SRI should be at least 29. “Low sloped” roof means a surface slope less than 3 in/ft. (7.6 cm/m) and “steep sloped” roofs means a surface slope greater than or equal to 3 in/ft. (7.6 cm/m) (9.5 - 22.6 degrees). Vegetated roofing must comply with *ASTM E2400-06: Standard Guide for Selection, Installation, and Maintenance of Plants for Green Roof Systems*. Please refer to the Green Globes for New Construction Overview, Additional Information of this document for more information on climate zone definitions. Mark “N/A” for climate zones 6, 7 and 8.

**References:**

- *ASTM E2400-06: Standard Guide for Selection, Installation, and Maintenance of Plants for Green Roof Systems*

**Assessment Guidance:**

Urban heat islands are caused by decrease in site vegetation and an increase in dark, heat-absorbing materials like asphalt and black roof membranes on buildings. The heat attracted can cause cities to be 2-10°F higher than the surrounding rural

areas<sup>7</sup>. This in turn creates higher cooling loads for these urban buildings in comparison to their rural counterparts. Heat islands can be reduced if buildings install roofs that have a high-albedo (high reflectance) and are emissive (able to release absorbed heat) reducing the solar heat absorbed into the roofing materials. Another way to decrease heat island effect is to plant vegetation on roofs and shade trees in areas with dark paved surfaces.

For this Green Globes criterion, the project should initially establish which climate zone it falls into. This information will be used for in this section and in the Energy section. Climate zones are defined in ASHRAE, IECC and IgCC literature. Next, the architect and owner should work out slopes for each type of roof and their respective areas. Then, the architect can decide on roofing materials and obtain the performance information for these materials. Solar Reflectance (SR) and Solar Reflectance Index (SRI) can both be used to measure the material's ability to reflect solar energy. The difference is that SRI takes into account solar reflectance and emissivity of the material. To qualify for points in this criterion the roof slopes, areas and combinations of thermal properties, and green roof area need to comply with one of the three sub-criteria listed above.

For the Design Review, the Assessor should be presented with the roofing specifications, architectural plans showing roof slope and architectural/landscape plans that show any green/eco roof areas in relation to total roof area. The roofing contractor for the project should be chosen based on familiarity with installing vegetated roof systems.

#### 3.2.2.4.2 Criteria:

What percentage (by area) of paved surfaces have a high SRI?

##### Answers:

- = 50% + **(2 points)**
- 25 - 49% **(1 point)**
- < 25% **(0 points)**
- N/A (more than 70% of the site is paved)
- N/A (climate zone)

##### ToolTip:

"High SRI" means at least 25. Paved surfaces include parking lots, sidewalks, and driveways outside of the building footprint. Mark "N/A" where more than 70% of the site is unpaved. Mark "N/A" for climate zones 6, 7 and 8. Please refer to the Green Globes for New Construction Overview, Additional Information, of this document for more information on climate zone definitions.

##### Assessment Guidance:

Projects should determine the post-development percent of project boundary area (minus building footprint) that will be paved and list specified materials and their respective SRI for each paved area.

#### 3.2.2.4.3 Criteria:

What percentage (by area) of paved surfaces outside of the building footprint will be shaded by trees within 15 years?

##### Answers:

- = 50% + **(3 points)**
  - 25 - 49% **(2 points)**
- 

<sup>7</sup> Sustainable Construction. Kilbert, Charles J.pg160



- < 25% **(0 points)**
- N/A

**Assessment Guidance:**

Projects should determine the post-development percent of project boundary area (minus building footprint) that will be paved and have the landscape architect or arborist estimate what the shading area of trees will be at project completion and with 15 years growth.

**3.2.2.4.4 Criteria:**

Do at least 75% of opaque wall surfaces (by area) on the east and west have an SRI of 29 or greater?

**Answers:**

- Yes **(2 points)**
- No **(0 points)**
- N/A

**ToolTip:**

Mark "N/A" for climate zones 6, 7 and 8.

**References:**

- *ASTM E1980-11, Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces*

**Assessment Guidance:**

Projects should determine the opaque wall areas for the East and West sides of the structure (not including windows or glazing but including solid opaque doors) and list specified materials and their respective SRI for each surface type.

**3.2.2.5 Bird Collisions**

**3.2.2.5.1 Criteria:**

Are the following measures required to help ensure that birds perceive windows as being a solid object:

- **3.2.2.5.1.1: Visual markers**
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
  - **ToolTip:** Features or patterns that are no more than 11 in. (28 cm) apart, up to at least 39 ft. (12 meters) above grade. Examples are mullions, fritted glass, decorative grilles and louvers or artwork.
- **3.2.2.5.1.2: Avoidance of reflections?**
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
  - **ToolTip:** Reflections can be avoided by internal screens, awnings, overhangs and sunshades or by angling the glass downward (minimum 20°).

**ToolTip:**

Birds crash into glass because it appears invisible. They may also be attracted to the reflections of the landscape (trees, sky, clouds, etc.) on the glass surface, greenery inside the building, or a landscape on the other side of the building as

viewed through two windows on opposite facades. Two ways to help birds perceive windows as being solid are by providing visual markers or by avoidance of reflections.

### References:

- *New York City Audubon: Bird Safe Building Guidelines:*  
<http://www.nycaudubon.org/our-publications/bird-safe-buildings-guidelines>
- *Chicago's Bird-Safe Building Design Guide for New Construction and Renovation*  
<http://chicagobirder.org/wp-content/uploads/2013/05/ChicagoBirdSafeDesignGuide.pdf>
- *International Dark-Sky Association*  
<http://www.darksky.org/outdoorlighting/mlo>  
<http://www.darksky.org/lighting-codes/list-of-lighting-ordinances>

### Assessment Guidance:

The area of glazing on a façade is the strongest predictor of threat to birds, with lighting also playing a crucial role. To make any building bird friendly some design considerations need to be taken into account:

- Ensure exposed façade material, especially above 40 feet, is specified to deter bird collisions. Materials should not be highly reflective or mostly transparent.
- Outside lighting is shielded and directed to minimize attracting nocturnal migrating birds.
- Interior lighting is turned off at night or windows are shaded to prevent light trespass that can attract nocturnal migrating birds.
- Do not create transparent/ fully glazed passageways or corridors that allow an unobstructed view from one side to the other.
- Ensure that atriums and courtyards are designed in ways that do not allow birds to become trapped within.

Ideally, a bird-friendly building would only incorporate small expanses of glazing, but this would not allow for daylighting to be utilized and would not provide views to outside spaces from interior offices. Designers need to balance between the desire for natural daylight in buildings and the desire to not pose a threat to migratory birds. The best way to achieve this compromise is to carefully plan all exterior glazing areas and avoiding fully glazed passageways and corridors (see Figure 3.2.2.5.1: Example of fully glazed passageway). When large expanses of glazing or curtain wall systems are desired, then the glazing itself should be specified with low-reflectivity (0 to 10%). Opaque, etched, stained, frosted glass, and glass block are also good options to reduce or eliminate bird collisions.

**Figure 3.2.2.5.1: Example of fully glazed passageway**



## 3.2.3 Stormwater Management

### 3.2.3.1 Criteria:

Is there a Stormwater Management Report by a Civil Engineer that shows that:

- **3.2.3.1.1:** The project meets municipal and/or local watershed flood and erosion control targets (i.e. post to pre-control)?
  - **Answers:**
    - Yes **(5 points)**
    - No **(0 points)**
  - - N/A
  - **ToolTip:** Stormwater quantity control measures include Stormwater Management (SWM) bio-retention areas and ponds, permeable, porous paving, green roofs, and rain cisterns). Mark “not applicable” in the case of a renovation that does not change the building footprint.
- **3.2.3.1.2:** The project meets municipal and/or local watershed water quality control targets (80% TSS removal)?
  - **Answers:**
    - Yes **(5 points)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** Mark “not applicable” in the case of a renovation that does not change the building footprint.
- **3.2.3.1.3:** The site will retain at least 50% of the total average annual rainfall volume as per a Site Water Balance Assessment, to be included in the Stormwater Management Report?
  - **Answers:**
    - Yes **(5 points)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** Onsite runoff retention includes the implementation of infiltration, evapo-transpiration, and rainwater reuse practices. Mark “not applicable” in the case of a renovation that does not change the building footprint.

### ToolTip:

Mark “N/A” in the case of a renovation that does not change the building footprint.

### References:

- *Energy Independence and Security Act (EISA), Section 438*
- *U.S. Environmental Protection Agency (EPA) National Stormwater Calculator:*  
<http://www.epa.gov/nrmrl/wswrd/wq/models/swc/>

### Assessment Guidance:

The Assessor may request to see roofing plans, percolation test results, area rainfall charts, and the storm water discharge plan.

Additionally, the EPA’s *National Stormwater Calculator* (<http://www.epa.gov/nrmrl/wswrd/wq/models/swc/>) helps property owners, developers, builders, landscapers and urban planners make informed land-use decisions to protect local waterways from pollution caused by stormwater runoff. Preventing stormwater runoff, which can impact drinking water resources and local ecosystems, protects people’s health and the environment.

The Calculator is phase I of the Stormwater Calculator and Climate Assessment Tool package announced in the President's Climate Action Plan released in June, 2013. It is a desktop application that estimates the amount of stormwater runoff from a specific site, based on local soil conditions, slope, land cover, and historical rainfall records. Users can enter any U.S. location and select different scenarios to learn how specific green infrastructure changes, including inexpensive changes like rain barrels and rain gardens, can prevent pollution. This information helps users determine how adding green infrastructure can be one of the most cost-effective ways to reduce stormwater runoff.

### 3.2.3.2 Criteria:

Is the site boundary farther than 100 ft. (30.5 m) from a natural body of water?

#### Answers:

- Yes **(3 points)**
- No **(0 points)**
- N/A

#### ToolTip:

A "natural body of water" means an ocean, lake, river, stream, estuary, or wetland. Mark "N/A" where the body of water is a retention pond or restored wetland, where there are natural or man-made features that receive all storm water runoff, and/or where site boundaries have permanent continuous earth or concert berms at least 16 in. (40.6 cm) higher than surrounding grade to prevent run-off.

#### Assessment Guidance:

In order to prevent storm water runoff from entering natural sources of water, the project boundary should be located more than 100ft from oceans, lakes, rivers, etc. or have a permanent berm that is at least 16 inches higher than grade. The exceptions are granted where the water will runoff into a man-made water feature of retention pond that service the project. Also, storm water does not need to be prevented from entering into restored wetlands.

During Design Review, the Assessor will be looking for the project site plan and the civil and/or landscaping drawings indicating drainage. The project site plan should include distance to any nearby bodies of water. The civil/landscaping plans should accurately show storm water discharges (when not connected to a city storm sewer main) and any berms located on the project site.

## 3.2.4 Landscaping

### 3.2.4.1 Criteria:

Is there a Landscape and Irrigation Plan developed by a Landscape Architect, certified horticulturalist, or certified irrigation professional?

#### Answers:

- Yes **(6 points)**
- No **(0 points)**
- N/A

#### ToolTip:

Mark "N/A" where there is no room for landscaping.

## References:

- U. S. Environmental Protection Agency (EPA) WaterSense Program, Landscape Irrigation Professionals: [http://www.epa.gov/watersense/outdoor/irrigation\\_professionals.html](http://www.epa.gov/watersense/outdoor/irrigation_professionals.html)
- U. S. Environmental Protection Agency (EPA) WaterSense Certified Professionals in Action: [http://www.epa.gov/watersense/outdoor/partners\\_action.html](http://www.epa.gov/watersense/outdoor/partners_action.html)

## Assessment Guidance:

A Landscape and Irrigation Plan should ensure that the project's landscapes are successfully established and function well at start-up and over time. The plan is intended to focus more on safety and environmental goals than the project's landscaping aesthetics. Elements in a typical Landscape and Irrigation Plan include:

- An outline of the overall landscaping and irrigation plan including general types of plantings and soils used
- An overall plan showing areas of interest or key items
- Landscape maintenance schedules
  - Plant care and pruning
  - Fertilizer types and usage
  - Mulch and turf care
- Pest management as it pertains to the specific plantings and soils used on the project
- Irrigation inspection and maintenance schedules
- Area of landscaping that require special attention
  - Green/vegetated/eco roofs
  - Rain gardens
  - Right-of-way plantings

For all policies and plans, clients should review all Green Globes criteria being pursued and combine documentation where appropriate. For example, fertilizer types and usage can also be a part of the Site Maintenance Contract in 3.1.3.4 Operations and Maintenance Manual. Also, integrated pest management is referred to in a number of Green Globes criteria such as 3.7.2.8 Pest and Contamination Control.

Projects should consider requiring the landscaping irrigation contractor be certified by a WaterSense labeled program as a WaterSense Irrigation Partner or similar type of professional certification program. For more information see *EPA-Water Sense, Landscape Irrigation Professionals* and *EPA- Water Sense, Certified Professionals in Action*.

The final Landscaping and Irrigation Plan should be included in the documentation to the Assessor. If any of the elements of this plan are covered by other project plans or policies, include a note that refers to where these criteria can be found.

### 3.2.4.2 Criteria:

Does the Landscape and Irrigation Plan include the following:

- **3.2.4.2.1:** Soil type, drainage, and light conditions?
  - **Answers:**
    - Yes **(2 points)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** Mark "N/A" where there is no room for landscaping.
- **3.2.4.2.2:** Structural limitations (e.g. shading, utilities, overhangs, lights) that would impact the location and growth of plants?
  - **Answers:**
    - Yes **(1 point)**



- No **(0 points)**
- N/A
- **ToolTip:** Mark “N/A” where there is no room for landscaping.

#### References:

- *Florida Yards and Neighborhood's Program, A Guide to Florida Friendly Landscaping: Florida yards and Neighborhoods Handbook*
- Cooperative Extension Research, Education and Extension Service (USDA CSREES)- Local Cooperative Extension System Offices:  
<http://www.csrees.usda.gov/Extension/>
- State and local university or college landscape reference guide

#### 3.2.4.3 Criteria:

Does the plant palette include the following?

- **3.2.4.3.1:** Minimum of 50% of the vegetated area covered with plants that are drought-tolerant?
  - **Answers:**
    - Yes, by > 75% **(3 points)**
    - Yes, by 50 - 74% **(2 points)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** At least 50% of the vegetated area should be covered with plants listed as being highly tolerant or moderately tolerant to drought. Mark “N/A” where there is no room for landscaping.
- **3.2.4.3.2:** Minimum of 50% of vegetated area covered with plants (new or salvaged plantings) that are native and non-invasive?
  - **Answers:**
    - Yes, by > 75% **(4 points)**
    - Yes, by 50 - 74% **(2 points)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** New or salvaged plants should be selected from a local or regional plant list such as from a university, water agency, or nursery growers association, and cover at least 50% of the vegetated area. Mark “N/A” where there is no room for landscaping.
- **3.2.4.3.3:** Minimal turf grass?
  - **Answers:**
    - Yes **(3 points)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** “Minimal turf grass” means that turf grass is limited to within 20 ft. (6.1 m) of buildings and does not extend beyond 5 ft. (1.5 m) from parking lots, driveways, walkways, rain gardens, swales, and retention ponds. Mark “N/A” where there is no room for landscaping.

#### References:

- *WeedUS – Database of Plants Invading Natural Areas in the United States*
- State and local university or college landscape reference guide
- State or local agency landscaping reference guide

### Assessment Guidance:

The landscape architect should provide a narrative that outlines all specified plantings and their applicability to this criterion. All documentation for these criteria should be compiled for the Design Review.

#### 3.2.4.4 Criteria:

Is there a requirement that landscaped areas will be installed with the following:

- **3.2.4.4.1:** At least 6 in. (15.2 cm) of soil; aerated, tilled and/or broken up?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** Consult local government and/or agency and/or university landscape reference guides. Mark “N/A” where all of the landscaping is a preserved naturalized area or where there is no room for landscaping.
- **3.2.4.4.2:** Organic mulch as per best practices?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** Comply with any applicable local standards. “Best practices” means 3 - 4 in. (7.6 - 10.2 cm) deep around plants and trees, and 2 in (5.1 cm) clear “breathing room” around each plant in order not to rot the stem. Mark “N/A” where all of the landscaping is a preserved naturalized area or where there is no room for landscaping.

### ToolTip:

Consult local government and/or agency and/or university landscape reference guides. Mark “N/A” where all of the landscaping is a preserved naturalized area or where there is no room for landscaping. For more information, see *EPA-GreenScapes* (<http://www.epa.gov/epawaste/conserve/tools/greenscapes/>).

### References:

- U.S. Environmental Protection Agency (EPA)- *GreenScapes*  
<http://www.epa.gov/epawaste/conserve/tools/greenscapes/>

### Assessment Guidance:

The landscape architect should include these requirements on the project drawings, project specifications, Landscape and Irrigation plan, or in a separate narrative.

#### 3.2.4.5 Criteria:

Does the Landscape Design show that plants are located on the site as follows:

- **3.2.4.5.1:** Plants with similar water requirements are grouped together?
  - **Answers:**
    - Yes **(2 points)**
    - No **(0 points)**
    - N/A

- **ToolTip:** Mark “N/A” where all of the landscaping is a preserved naturalized area or where there is no room for landscaping.
- **3.2.4.5.2:** Plants are spaced to allow for maturation at a 5-year growth rate?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** Mark “N/A” where all of the landscaping is a preserved naturalized area or where there is no room for landscaping.

#### **Assessment Guidance:**

The landscape architect should include these requirements in the Landscape and Irrigation plan or in a separate narrative for the Design Review by the Assessor.

#### **3.2.4.6 Criteria:**

Is there a requirement that 15% of planned impervious walkways, patios, and driveways will be installed with pervious materials?

#### **Answers:**

- Yes **(4 points)**
- No **(0 points)**
- N/A

#### **ToolTip:**

“Pervious materials” include clay or concrete pavers with pervious joints/openings, bricks, gravel, turf-block, mulch, and pervious concrete. Mark “N/A” where there are no impervious walkways, patios, or driveways.

#### **Assessment Guidance:**

Incorporating pervious materials in site hardscapes allows storm water to flow through the material and be recaptured in the subsoil. This will help decrease storm water runoff and the need for irrigation. Materials can be pervious due to their porous nature or by large spaces in the material. Pervious cement concrete and pavers, porous asphalt concrete, gravel pavers, grass pavers, variations on grids and blocks, and loose aggregate. These pervious surfaces can be used in a variety of low-vehicle traffic areas including driveways, patios, walkways, emergency vehicle access ways, alleys, and highway shoulders. However pervious surfaces should not be used when the surface grade exceeds 5%. Areas with moderate to high vehicle traffic can incorporate some pervious materials, but these systems should be well designed and only utilized under the right circumstances. For colder climates, freeze/thaw or shrink/swell (for clay) properties of pervious pavers should be taken into consideration.

For the Design Review, a site plan should be provided showing all hardscape areas, and which areas will be outfitted with pervious materials. All pervious materials and their performance properties should be listed in the appropriate specifications section.

### **3.2.5 Exterior Light Pollution**

Green Globes provides two paths for assessing exterior light pollution:

- **Path A: Lighting Design Performance** – 7 points
- **Path B: Prescriptive Lighting Requirements** – 7 points

Points cannot be combined between paths. Please review and select one of the two pathways below.

### 3.2.5.1 Path A: Lighting Design Performance

#### 3.2.5.1.1 Criteria:

Is there a lighting design by an Engineer or Lighting Professional that meets all the performance requirements of the *IDA - IES Model Lighting Ordinance*?

#### Answers:

- Yes **(7 points)**
- No **(0 points)**
- N/A

#### ToolTip:

Mark "N/A" where there is no exterior lighting.

#### References:

- *IDA – IES Model Lighting Ordinance (MLO)*  
[http://www.ies.org/PDF/MLO/MLO\\_FINAL\\_June2011.pdf](http://www.ies.org/PDF/MLO/MLO_FINAL_June2011.pdf)

#### Assessment Guidance:

The *IDA - IES Model Lighting Ordinance (MLO)* was created to reduce light pollution and glare and lower excessive light site levels. The MLO uses lighting zone (designated LZ0 to LZ4) which allows the AHJ to "vary the stringency of lighting restrictions according to the sensitivity of the area as well as accommodating community intent"<sup>8</sup>. These zones and their descriptions can be found in the table below:

**Table 3.2.5.1.1: Lighting Zone Recommended Use**

Lighting Zone	Recommended Use or Areas
<b>LZ0: No ambient lighting</b>	LZ0 should be applied to areas in which permanent lighting is not expected and, when used, is limited in the amount of lighting and the period of operation. LZ0 typically includes undeveloped areas of open space, wilderness parks and preserves, areas near astronomical observatories, or any other area where the protection of a dark environment is critical.
<b>LZ1: Low ambient lighting</b>	LZ1 pertains to areas that desire low ambient lighting level. These typically include single and two family residential communities, rural town centers, business parks, and other commercial or industrial storage areas typically with limited nighttime activity.
<b>LZ2: Moderate ambient lighting</b>	LZ2 pertains to areas with moderate ambient light levels. These typically include multifamily residential uses, institutional residential uses, schools, churches,

<sup>8</sup> IDA and IESNA, *Model Lighting Ordinance User's Guide*, 2011.

Lighting Zone	Recommended Use or Areas
	hospitals, hotels/motels, commercial areas with evening activities and mixed-use development with a predominance of residential uses.
<b>LZ3: Moderately high ambient lighting</b>	LZ3 pertains to areas with moderately high lighting levels. These typically include commercial corridors, high intensity suburban commercial areas, town centers, industrial uses, regional shopping malls, etc.
<b>LZ4: High ambient lighting</b>	LZ4 pertains to areas of very high ambient lighting levels. This category should only be used for special cases and is not appropriate for most cities. LZ4 may be used for extremely unusual installations such as high density entertainment districts and heavy industrial uses.

The MLO requirements are then broken down into a prescriptive path and a performance path for non-residential lighting. The prescriptive path sets limits on total site lumens (Table A and Table B), specifies the ratings and installation requirements for all luminaires (Table C), and specifies light shielding. The performance path to compliance specifies that the total installed luminaire lumens of all lighting systems on the site shall not exceed the allowed total initial site lumens per Tables D and E of the MLO. The performance method also requires that luminaires need to be rated using one of two options; the design complies if the total lumens on the inside surface of the virtual enclosure are less than 15% of the total site lumen limit and the maximum vertical illuminance on any vertical surface is less than the allowed maximum illuminance per Table F in the MLO.

For residential lighting, all outdoor luminaires shall be fully shielded and shall not exceed the allowed lumen output in Table G, row 2 of the MLO. Also, landscape lighting shall comply with Table G and shall not be aimed onto adjacent properties.

Existing buildings that are not modifying the exterior lighting design shall comply with Part VII of the MLO.

During the Design Review or Onsite Assessment, the lighting designer shall provide a narrative that will describe which lighting zone the property falls under, the path taken for compliance to the MLO, and cut-sheets and calculations showing compliance to each applicable section.

### 3.2.5.2 Path B: Prescriptive Lighting Requirements

#### 3.2.5.2.1 Criteria:

Is there a requirement that the exterior lighting will not exceed prescribed values for the amount of light per unit of area?

#### Answers:

- Yes (1.5 points)
- No (0 points)
- N/A

#### ToolTip:

Prescribed values of light per unit of area, given in lumens/square foot or, in the case of parking lots, lumens/parking site. The values are found in Tables A and B of the *IDA - IES Model Lighting Ordinance (MLO)*. Information for the basis of lighting design must be provided during assessment.

#### References:

- *IDA – IES Model Lighting Ordinance (MLO), Tables A and B*



[http://www.ies.org/PDF/MLO/MLO\\_FINAL\\_June2011.pdf](http://www.ies.org/PDF/MLO/MLO_FINAL_June2011.pdf)

### Assessment Guidance:

During the Design Review or Onsite Assessment, the lighting designer shall provide a narrative that will describe which lighting zone the property falls under and calculations showing compliance to Table A and Table B.

#### 3.2.5.2.2 Criteria:

Is there a requirement that exterior lighting trespass will not exceed prescribed BUG ratings as per *IDA – IES Model Lighting Ordinance (MLO), Table C* for the following:

- **3.2.5.2.2.1: Backlight trespass**
  - **Answers:**
    - Yes **(1.5 points)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** “Backlight trespass” means the light directed in back of the mounting pole; See MLO Table C1 for recommended values. Backlight ratings are designated based on the location of the luminaire with respect to the property line. A high Backlight rating luminaire maximizes the spread of light, and is effective and efficient when used far from the property line. When luminaires are located near the property line, a lower B rating is recommended to prevent unwanted light from interfering with neighboring properties. The distance from the property line is measured as a multiple of the height at which the light is mounted. For property lines that abut public walkways, bikeways, plazas, and parking lots, the property line may be considered to be 5 feet beyond the actual property line for purpose of determining compliance with this section. For property lines that abut public roadways and public transit corridors, the property line may be considered to be the centerline of the public roadway or public transit corridor for the purpose of determining compliance with this section. To be considered 'ideally oriented', the luminaire must be mounted with the backlight portion of the light output oriented perpendicular and towards the property line of concern. Mark “N/A” where there is no exterior lighting.
- **3.2.5.2.2.2: Uplight trespass**
  - **Answers:**
    - Yes **(1.5 points)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** “Uplight trespass” means light directed above the horizontal plane of the luminaire See MLO Table C2 for recommended values. BUG requires downlight only in Lighting Zones 0, 1 and 2, but allows a minor amount of uplight in Lighting Zones 3 and 4. In lighting zones 3 and 4, the amount of allowed uplight is enough to permit the use of very well shielded luminaires. Mark “N/A” where there is no exterior lighting.
- **3.2.5.2.2.3: Glare**
  - **Answers:**
    - Yes **(1.5 points)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** “Glare” means the amount of light emitted from the luminaire at angles from unshielded light source. As with Backlight values, Glare values are also designated based on the location of the luminaire with respect to the property line. Mark “N/A” where there is no exterior lighting.

**ToolTip:**

“BUG” stands for three types of light trespass: “Backlight”, i.e. the light directed in back of the mounting pole; “Uplight trespass” i.e. light directed above the horizontal plane of the luminaire; and “Glare”, the amount of light emitted from the luminaire at angles known to cause glare. Prescribed values depend on the Lighting Zone (LZ) of the site and are found in Table C of the *IDA - IES Model Lighting Ordinance (MLO)*. BUG ratings are provided by manufacturers of luminaires. For example, a lamp that is rated B2-U1-G2 means that it emits acceptable Background light for LZ2, acceptable Uplight for a LZ1 and acceptable Glare for a LZ2. This light would not be recommended for a LZ1 because the Background and Glare values are too high. Mark “N/A” where there is no exterior lighting.

**References:**

- *IDA – IES Model Lighting Ordinance (MLO), Tables C, C1, C2*  
[http://www.ies.org/PDF/MLO/MLO\\_FINAL\\_June2011.pdf](http://www.ies.org/PDF/MLO/MLO_FINAL_June2011.pdf)

**Assessment Guidance:**

During the Design Review or Onsite Assessment, the lighting designer shall provide a narrative that will describe which lighting zone the property falls under and cut-sheets for all luminaires showing compliance to Table C-1, C-2 and C-3.

**3.2.5.2.3 Criteria:**

Will parking lot lighting have no light emitted above 90 degrees?

**Answers:**

- Yes **(1 point)**
- No **(0 points)**
- N/A

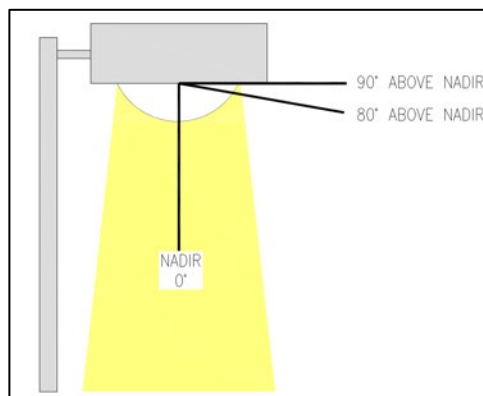
**ToolTip:**

Exceptions may apply for ornamental lighting. Ornamental parking lighting shall be permitted by special permit only, and shall meet the requirements of Table C-1 for Backlight, Table C-2 for Uplight, and Table C-3 for Glare, without the need for external field-added modifications. Mark “N/A” where there is no parking lot lighting.

**Assessment Guidance:**

IESNA defines full cutoff fixtures as those with zero candelas measured at or above 90° above nadir and the candelas measured above 80° above nadir is limited to 10% of the lamp lumens. Designers should look for Dark Sky Compliant fixtures with product submittal sheets that specifically list “full cutoff” or “fully shielded.” By ensuring all exterior lights comply with these requirements, glare and skyglow can be mitigated.

**Figure 1.2.5.2.3: IESNA Cutoff Classification Angles**



## 3.3 ENERGY

To be certified through Green Globes Multifamily for New Construction, projects must achieve all Ventilation and Energy Minimum Requirements. In addition, projects must also achieve a minimum 35% total score out of all applicable points in the Green Globes Multifamily program. Minimum Requirements must be met to be eligible for the program but are separate from the criteria used in the assessment.

### ENERGY MINIMUM REQUIREMENTS

Building design must achieve greater than 15% projected energy consumption savings over respective established baseline and must meet all three (3) Energy Minimum Requirements.

#### 1. Energy Efficient Design

Generate an energy model for the entire building, input energy use and building characteristics into ENERGY STAR Target Finder, and complete one of the following based on ENERGY STAR eligibility:

- **Option 1: ENERGY STAR® Score** - For multifamily properties with 20 or more units. Achieve an ENERGY STAR performance score of 78 or greater in the Target Finder program. See 3.3.1.1.1 for additional guidance.
- **Option 2: EUI Reduction** - If not eligible for an ENERGY STAR Score. Demonstrate the proposed design targets greater than 15% reduction of energy use intensity (EUI) compared to the national median source EUI.

#### 2. Energy Efficient Equipment & Products

Where not already covered by Energy Efficient Design, install ENERGY STAR-labeled and/or FEMP-designated energy efficient products and appliances (including clothes washers, dishwashers, and refrigerators), if such products and/or appliances are being provided.

ENERGY STAR Qualified Product Lists: <http://www.energystar.gov>

Federal Energy Management Program (FEMP) Energy and Water Efficient Products: <http://www1.eere.energy.gov/femp>

#### 3. Energy Performance Monitoring & Tracking

Confirm that the local utility or onsite master energy meter(s) provide, at a minimum, aggregated whole-project energy consumption data for each energy utility type. Where local utility or current meters do not provide such data install energy meters that do.

Commit to entering energy consumption data into ENERGY STAR Portfolio Manager to track ongoing performance and sharing of that data with Green Building Initiative. Document for future performance verification.

#### Required Documentation – upload to Green Globes “v3” Software:

- ☐ Completed Minimum Requirement Survey
- ☐ ENERGY STAR Portfolio Manager Statement of Energy Design Intent (SEDI), or screenshot of ENERGY STAR Score
- ☐ Energy model outputs

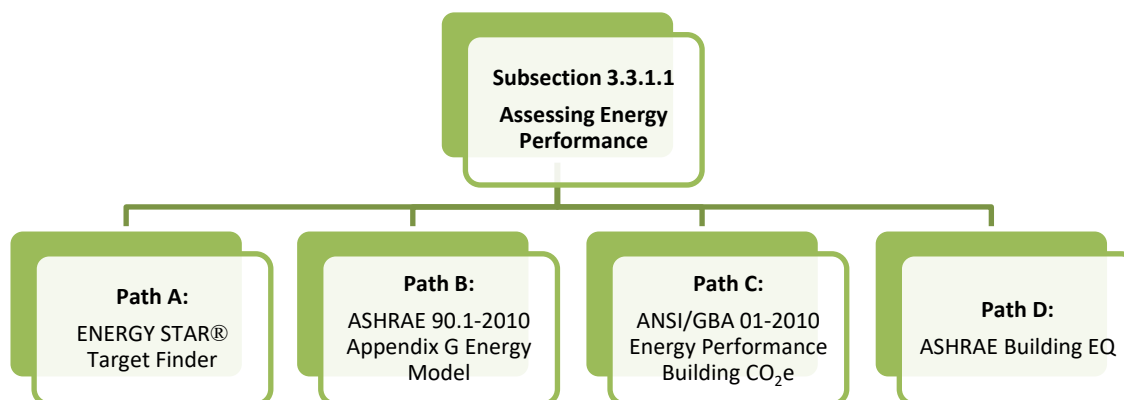
### 3.3.1 Energy Performance

#### 3.3.1.1 Assessing Energy Performance

Green Globes provides four paths for assessing energy performance.

Each path requires energy design modeling to establish the proposed energy performance (energy use) for a building.

- **Path A: ENERGY STAR® Target Finder** – 100 points
- **Path B: ASHRAE 90.1-2010, Appendix G** – 100 points
- **Path C: ANSI/GBA 01-2010 Energy Performance Building Carbon Dioxide Equivalent (CO<sub>2</sub>e) Emissions** – 100 points, plus 50 bonus points
- **Path D: ASHRAE Building Energy Quotient (Building EQ)** – 100 points, plus 25 bonus points



There are four energy performance options in Green Globes for New Construction: Paths A, B, C, and D. Energy modeling is required for all four of these Paths. For Paths A, C, and D, results of the energy model are used as inputs to ENERGY STAR Target Finder or Building EQ to determine a benchmark baseline for a building. Only recently has “multifamily” become one of the building types benchmarked within ENERGY STAR. For Paths A, C, and D, Target Finder may be used to establish a benchmark (or baseline) for energy performance credit. Points cannot be combined between Paths.

#### 3.3.1.1.1 Path A: ENERGY STAR® Target Finder

##### 3.3.1.1.1.1 Criteria:

Input the energy performance as the ENERGY STAR® percentile score derived from the Target Finder program.

##### Answer:

- [numerical text field] % (0 - 100 points, see table)

**Table 3.3.1.1.1.1: Path A Point Distribution**

ENERGY STAR® Score	Points	ENERGY STAR® Score	Points
100	100	86	76
99	100	85	76
98	100	84	68
97	100	83	68

ENERGY STAR® Score	Points
96	100
95	100
94	100
93	92
92	92
91	92
90	84
89	84
88	84
87	76

ENERGY STAR® Score	Points
82	68
81	60
80	60
79	60
78	52
77	52
76	52
75	44
74 - 0	0

### ToolTip:

Points are awarded on a scale based on the ENERGY STAR® energy performance score of 75% - 100%. For those buildings that do not conform to ENERGY STAR® award program occupancy types, please complete one of the other Energy Performance Paths. See Table 3.3.1.1.1.1 for a breakdown of points awarded for ENERGY STAR® ratings.

### References:

- ANSI/ASHRAE/IES Standard 90.1-2010, Path A, Appendix G
- CBECS Building Type Definitions:  
<http://www.eia.gov/consumption/commercial/building-type-definitions.cfm>

### Assessment Guidance:

For full credit, Path A requires the development of one energy design model for the proposed building (an energy model for a base building is not required). The whole building's energy usage information (EUI) from the model is input into the ENERGY STAR Target Finder program, which compares the building's energy usage versus peer buildings. To construct the proposed building's energy model for Path A, ANSI/ASHRAE/IES Standard 90.1-2010, Appendix G should be used as an overall guide

The CBECS database, which ENERGY STAR utilizes, accommodates more than 80 different building types that are subdivided into dozens more subcategories of building types. Users can verify whether a particular commercial building type is currently included in the ENERGY STAR database at <http://www.eia.gov/consumption/commercial/building-type-definitions.cfm>. Green Globes Energy Performance Path A is applicable only to building types included in the ENERGY STAR program. Therefore, Path B or Path D should be utilized for buildings not accommodated by ENERGY STAR.

Suggested documentation for Path A includes a description of the computer software program used to provide the energy modeling results, a narrative describing the energy efficiency measures included in the project, a summary of energy end-uses, and monthly energy consumption and cost values. The narrative should also include the Target Finder results, including the EUIs and normalization factors.

Other approaches in the development of the energy usage information entered into Target Finder may be considered by the Green Globes Assessor for some level of credit based upon the assessors' overall professional judgment.

### 3.3.1.1.2 Path B: ANSI/ASHRAE/IES Standard 90.1-2010, Appendix G

#### 3.3.1.1.2.1 Criteria:

Input the energy performance as the percentage value compared to the reference base building, per ANSI/ASHRAE/IES Standard 90.1-2010, Appendix G.



**Answer:**

- [numerical text field] % (0 - 100 points, see table)

**Table 3.3.1.1.2.1: Path B Point Distribution**

% Energy Savings	Points	% Energy Savings	Points
50	100	26	52
49	98	25	50
48	96	24	48
47	94	23	46
46	92	22	44
45	90	21	42
44	88	20	40
43	86	19	38
42	84	18	36
41	82	17	34
40	80	16	32
39	78	15	30
38	76	14	28
37	74	13	26
36	72	12	24
35	70	11	22
34	68	10	20
33	66	9	18
32	64	8	16
31	62	7	14
30	60	6	12
29	58	5	10
28	56	4 - 0	0
27	54		

**ToolTip:**

For Path B: *ANSI/ASHRAE/IES Standard 90.1-2010*, points are awarded based on 5% - 50% (or higher) energy performance values over the base building. See Table 3.3.1.1.2.1 for a breakdown of points awarded for Path B.

**References:**

- *ANSI/ASHRAE/IES Standard 90.1-2010, Appendix G*

**Assessment Guidance:**

*ANSI/ASHRAE/IES Standard 90.1-2010, Appendix G* offers a robust energy usage comparison for any type of building.

**Designers should note that this path requires two energy models to be built and examined: baseline and proposed.** For larger projects (i.e. those over 75,000 square feet), the extra effort of making two models as opposed to one may not be a deterrent.

For the Design Review, the Assessor should receive a summary of the baseline and proposed energy model inputs and outputs. The modeling report should include descriptions of building envelope parameters, HVAC system parameters, lighting power densities, schedules for internal gains and HVAC equipment, basis of utility rates, etc. The narrative should also describe the savings by end-use with a justification for the results based on the efficiencies in the proposed case.

Project teams may find this path to be economical if the modeling can be leveraged for analysis of design options throughout all stages of the project.

### 3.3.1.1.3 Path C: ANSI/GBI 01-2010 Energy Performance Building Carbon Dioxide Equivalent Emissions

#### 3.3.1.1.3.1 Criteria:

Input the energy performance as a reduction of Carbon Dioxide Equivalent (CO<sub>2</sub>e) Emissions based on the *ANSI/GBI 01-2010 Energy Performance Building Carbon Dioxide Equivalent (CO<sub>2</sub>e) Emissions protocol*.

#### Answer:

- [numerical text field] (0 - 100 + 50 bonus points, see table)

100 points maximum with 50 possible Bonus Points. Bonus points count toward the final score/rating, but are not counted against the total *applicable* points. *E.g. if awarded 45 bonus points, a project would receive an additional 4.5% towards their final Green Globes score; but if no bonus points are achieved they are not counted against the final score.*

50% = 100 points, 1-49% = 0 points. Bonus Points: 1 point is awarded for every 1% achieved over 50% reduction. 100% = 150 points, 99% = 149 points . . . 51% = 101 points.

**Table 3.3.1.1.3.1-A: Path C Point Distribution**

Preliminary Score %	Points	Preliminary Score %	Points
1 – 49	0	75	125
50	100	76	126
51	101	77	127
52	102	78	128
53	103	79	129
54	104	80	130
55	105	81	131
56	106	82	132
57	107	83	133
58	108	84	134
59	109	85	135
60	110	86	136
61	111	87	137
62	112	88	138
63	113	89	139
64	114	90	140
65	115	91	141
66	116	92	142
67	117	93	143
68	118	94	144
69	119	95	145
70	120	96	146
71	121	97	147
72	122	98	148
73	123	99	149
74	124	100	150

### ToolTip:

After calculation, *preliminary* points are awarded according to Table 3.3.1.1.3.1, which should be entered into the Green Globes online survey for Path C. Up to 50 bonus points can be awarded for high achieving buildings.

### References:

- *ANSI/GBI 01-2010 Energy Performance Building Carbon Dioxide Equivalent (CO<sub>2</sub>e) Emissions protocol*
- *International Energy Conservation Code (IECC) 2009, Section 506*
- *ANSI/ASHRAE/IES Standard 90.1-2010, Appendix G, Section G2.2.*

### Assessment Guidance:

**Projects pursuing this path will calculate the preliminary score using both the ENERGY STAR® Target Finder and the energy design model results for the proposed building.** Since Target Finder has to be used, the same restriction on applicable building types applies to this path as well as Path A. The current list of Target Finder applicable building types includes:

- Bank/financial Institutions
- Courthouses
- Data Centers
- Hospitals (General Medical and Surgical)
- Hotels/Motels
- Houses of Worship
- K-12 Schools
- Medical Offices
- Office buildings
- Residential Halls/Dormitories
- Retail Stores
- Senior Care
- Supermarkets/Grocery Stores
- Warehouses (Refrigerated and Unrefrigerated)

For buildings seeking Green Globes certification that are not included in the list above, Path B or Path D should be utilized.

The following formula is used to calculate percent reduction in CO<sub>2</sub>e:

Percent reduction in

$$CO_2e = 100 \times \left(1 - \frac{PER}{BER}\right)$$

where:

- The Baseline Equivalent Emission (BER) Rate is the baseline building's carbon dioxide equivalent emission rate.
- PER is the proposed building's carbon dioxide equivalent emission rate.
- PER is less than BER.

### Baseline Equivalent Emission Rate (BER) Calculations

BER is calculated using the following formula:

BER = (baseline Energy Use Intensity (EUI)) X product of [(percentage of each fuel in the annual energy fuel mix for the planned building type and location) X (CO<sub>2</sub>e Emission Factor for each fuel)], where:

- The baseline building's site Energy Use Intensity (EUI) is determined using ENERGY STAR® Target Finder.
- The baseline building's site EUI is 50% better than the Energy Performance Rating (Target Finder) score of 50.

- The annual energy fuel mix for the baseline building is determined from DOE-EIA and reported at the top of Target Finder's Results page.
- The CO<sub>2</sub>e emission factor for each fuel in the baseline building's annual energy fuel mix can be found in the table below.

#### Proposed Equivalent Emission Rate (PER) Calculations

PER is calculated using the following formula:

PER = (proposed EUI) X product of [(percentage of each fuel in the annual energy fuel mix for the proposed building) X (CO<sub>2</sub>e Emission Factor for each fuel)], where:

The proposed building's Energy Use Intensity (EUI) is calculated using a computer-based simulation program that conforms to the requirements outlined in Section 506 of the *2009 International Energy Conservation Code (IECC)* or *ANSI/ASHRAE/IES Standard 90.1-2010, Appendix G, Section G2.2*.

Proposed Building's Equivalent Emission Rate (PER) shall be determined by performing a EUI calculation for the proposed building using the energy performance requirements specified by Table G3.1 Modeling Requirements for Calculating Proposed and Baseline Building Performance in *ANSI/ASHRAE/IES Standard 90.1-2010*. Only the Proposed Building Performance column shall be used for modeling the PER.

- The annual energy fuel mix planned for the proposed building is what is to be used for this calculation.
- The CO<sub>2</sub>e emission factor for each fuel in the proposed building's annual energy fuel mix can be found in the table below.

#### For Design R



Review, the Assessor should receive the proposed energy model's inputs and outputs, a printout of the Target Finder results and PER, BER, and CO<sub>2</sub>e emission reduction calculations.

**Table 3.3.1.1.3.1-B: Path C CO<sub>2</sub>e Emissions Factors**

Fuel	CO <sub>2</sub> e Emission Factor kg/kWh (lb/kWh)
Biomass	0.026 (0.057) <sup>2</sup>
Coal (bituminous)	0.373 (0.822) <sup>1</sup>
Coal (lignite)	0.585 (1.289) <sup>1</sup>
Fuel oil (residual)	0.311 (0.686) <sup>1</sup>
Fuel oil (distillate)	0.299 (0.660) <sup>1</sup>
Gasoline	0.326 (0.719) <sup>1</sup>
Grid-delivered electricity	0.758 (1.670) <sup>1</sup>
<i>Grid- displaced electricity</i> <sup>3</sup>	-0.833 (-1.835) <sup>1</sup>
LPG	0.274 (0.602) <sup>1</sup>
Natural gas	0.232 (0.510) <sup>1</sup>
<i>Off-site renewable electricity</i> <sup>4</sup>	-0.758 (-1.670) <sup>1</sup>
<i>Waste heat</i> <sup>5</sup>	0.019 (0.042) <sup>2</sup>

<sup>1</sup> Deru, M., P. Torcellini. 2007. Source Energy and Emissions Factors for Energy Use in Buildings. NREL/TP-550-38617, June 2007. Golden, CO. National Renewable Energy Laboratory.

<sup>2</sup> L2A Conservation of Fuel and Power in New Buildings other than Dwellings. April 2006. Office of the Deputy Prime Minister, United Kingdom.

<sup>3</sup> *Grid displaced electricity* comprises all electricity generated at the building site by, for example PV panels, wind-power, combined heat and power systems (CHP), etc. The associated CO<sub>2</sub>e emissions are subtracted from the total CO<sub>2</sub>e emissions for the building before determining the PER. CO<sub>2</sub>e emissions arising from fuels used by the building's power generation system (e.g., to power the CHP plant) must be included in the building's CO<sub>2</sub>e emission calculations.

<sup>4</sup> The associated CO<sub>2</sub>e emissions from off-site renewable electricity (e.g., using *renewable energy certificates (RECs)* or "greenpower") are subtracted from the total CO<sub>2</sub>e emissions for the building before determining the PER. Contracts must have a duration of at least three years. Only 25% of off-site renewable electricity can be credited to the proposed building's CO<sub>2</sub>e calculation.

<sup>5</sup> This includes *waste heat* from industrial processes and power stations rated at more than 10MWe and with a power efficiency of greater than 35%.



### 3.3.1.1.4 Path D: ASHRAE Building Energy Quotient (Building EQ)

#### 3.3.1.1.4.1 Criteria:

Input the energy performance as per the ASHRAE Building Energy Quotient (Building EQ) rating program for an 'As Designed' assessment.

#### Answers:

- Building EQ Performance Score of Zero (Zero Net Energy) **(100 points + 25 bonus points)**
- Building EQ Performance Score from 1 to 25 **(100 points)**
- Building EQ Performance Score from 26 – 55 **(60 points)**
- Building EQ Performance Score from 56 – 85 **(30 points)**

100 points maximum with 25 possible bonus points. Bonus points count toward the final score/rating, but are not counted against the 1,000 overall points total. *E.g. if awarded 25 bonus points, a project would receive an additional 2.5% towards their final GREEN GLOBES score; but if no bonus points are achieved they are not counted against the final score.*

#### References:

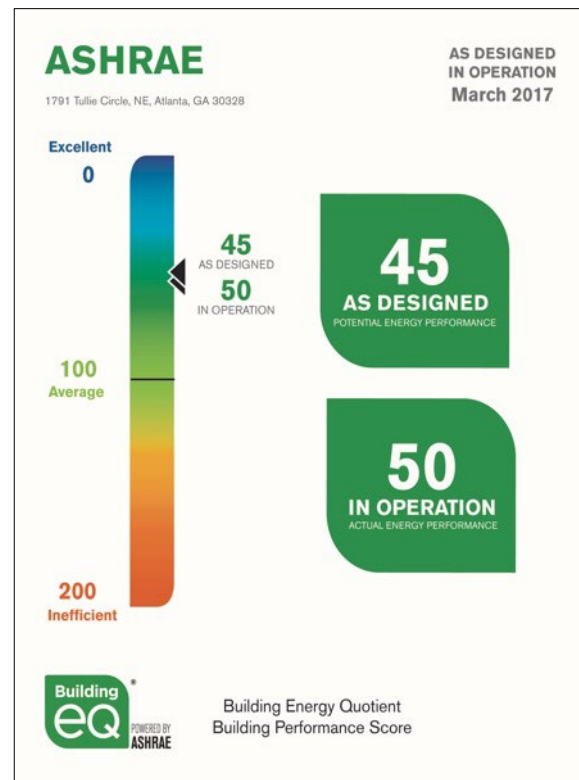
- *Building Energy Quotient (Building EQ)-ASHRAE's Building Energy Labeling Program: program materials*  
[www.ashrae.org/BuildingEQ](http://www.ashrae.org/BuildingEQ)

#### Assessment Guidance:

**Path D requires Building EQ certification based on an energy design model for the proposed building based on as-built conditions.** Building EQ is an ASHRAE building energy labeling program that zeros in on opportunities in commercial buildings to lower building energy use (and operating costs) and increase value. The rating uses an easily understood scale that is designed to provide increased differentiation of high performance buildings. The rating has 2 parts: An In Operation (operational, for existing buildings only) and an As Designed (asset, for new construction/major renovation) rating. The As Designed rating was launched in May 2013.

The As Designed rating is based on simulated energy use for a “standardized” building and is independent of operational and occupancy variables. The candidate building is compared to a baseline building of the same type. The baseline building is the median of similar buildings in the existing building stock as defined by the CBECS database. The As Designed Rating is applicable to constructed buildings including those that have been operating for less than 1 year. The As Designed rating measures the as-built conditions of the building using a standardized model that neutralizes operating conditions thus allowing the energy efficiency of different buildings to be compared without the effects of the current occupancy and operation.

The As Designed rating is helpful to tenants who may wish to compare multiple buildings with varied tenants or to compare buildings with operations that are different from how they intend to use the building. With the introduction of



**Figure 3.3.1.1.4.1: ASHRAE Building EQ Rating Scale**

the As Designed rating, a building owner can now compare their building's actual energy performance with the building's design potential. This provides an additional layer of information for owners, tenants, and developers. The Building EQ rating As Designed requires the use of a credentialed provider so the building knows that the rating is being conducted by someone who is knowledgeable in the area of energy modeling.

Projects pursuing the As Designed rating will need to engage the services of a credentialed professional which is either an ASHRAE-certified Building Energy Modeling Professional (BEMP) or a Professional Engineer (P.E.) licensed in the jurisdiction where the building is located. The credentialed provider will develop the standardized energy model for the project building based on the building drawings and a site survey document substantive as built conditions. The credentialed provider will then input the information based on the project building's standardized energy model into the Building EQ Portal and submit the project for ASHRAE for review and approval.

Not all types of buildings are applicable for the Building EQ As Designed label. To determine if the project building type is offered visit the Building EQ Portal: [www.ashrae.org/BuildingEQ](http://www.ashrae.org/BuildingEQ)

It is important to note that since the energy model created for this path needs to be based on as-built conditions, this path's documentation will be part of the Onsite Assessment. Since this subsection is worth 100 points, it is recommended that the credentialed provider be engaged to create preliminary energy models during the design development phase as well as the final as-built model. This will allow the design team to more accurately predict the anticipated score for this Sub-criterion.

Additionally the timing of the Building EQ evaluation may result in the Onsite Assessment being delayed relative to other Green Globes projects.

For compliance with this path, the final Building EQ label documentation should be sent to the Assessor before or during the Onsite Assessment .

Green Globes registration does not include Building EQ registration fees or fees for the credentialed provider's professional service if these are in addition to the scope of the design project.

### **3.3.1.1.5 Additional Guidance for Multi-Unit Residential Buildings (MURBs)**

Multi-Unit residential buildings may use various energy performance paths depending upon the project.

#### **Path A – ENERGY STAR Target Finder**

The ENERGY STAR program is best used to assess energy performance for projects that meet the Target Finder criteria. Projects should be mid-size and larger with 20 units or more. This path requires an energy model which provides a single-model demonstration of savings.

#### **Path B – ASHRAE 90.1-2010, Appendix G**

ASHRAE 90.1-2010, Appendix G fits all multi-unit residential projects. This path requires two energy models, and can be used to calculate energy performance points for low rise MURBs of 3 stories or less even though it is not used for code compliance purposes. Proposed model and baseline model requirements may be substituted from ASHRAE 90.2 Section 8 to model buildings that are not included in the scope of ASHRAE 90.1.

#### **Path C – Building Carbon Dioxide Equivalent CO<sub>2</sub>e Emissions (ANSI/GBI 01-2010)**

The CO<sub>2</sub>e path uses the same criteria as ENERGY STAR Target Finder.

#### **Path D – ASHRAE Building Energy Quotient (Building EQ)**

The ASHRAE Building EQ method is best used to assess energy performance for buildings that have 5 units or more. Projects may benefit from this path where energy saving strategies exceed the rating scale for Target Finder or Appendix G.

### 3.3.1.2 Benchmarking Energy Performance

#### 3.3.1.2.1 Criteria:

Is there a program or policy in place to compare actual performance data from the first year of operation with the energy design target?

#### Answers:

- Yes **(0 points)**
- No **(0 points)**

This criterion is not necessary for certification by Green Globes.

#### References:

- ENERGY STAR® *Portfolio Manager*:  
<https://portfoliomanager.energystar.gov/pm/login.html>

#### ToolTip:

Federal projects are encouraged to:

- Enter first year performance data into ENERGY STAR® Portfolio Manager for building types covered by ENERGY STAR® after the first year of operation.
- Verify that the building performance meets or exceeds the design target, or that actual energy use is within 10% of the design energy budget for all other building types.

For other building and space types, use an equivalent benchmarking tool such as the Labs21 benchmarking tool for laboratory buildings.

#### Assessment Guidance:

Projects can utilize the ENERGY STAR® Portfolio Manager or other third-party tools to continually track energy usage data. Projects should check with their utility providers to see if they offer integration with their utility accounts to facilitate automated uploads. If the client does not desire to use the free ENERGY STAR® Portfolio Manager tool, paid services are also available for certain building types.

## 3.3.2 Energy Demand

### 3.3.2.1 Passive Demand Reduction

#### 3.3.2.1.1 Criteria:

Does a minimum of 20% of the building envelope gross wall area have either of the following:

- A minimum heat capacity of 7 Btu/ft<sup>2</sup> °F (143 kJ/m<sup>2</sup>K)?
- A minimum heat capacity of 5 Btu/ft<sup>2</sup> °F (102 kJ/m<sup>2</sup>K), provided the walls have a material unit weight equal to or less than 120 lb/ft<sup>3</sup> (1920 kg/m<sup>3</sup>)?

#### Answers:

- Minimum capacity of 7 Btu/ft<sup>2</sup> °F **(3 points)**
- Minimum capacity of 5 Btu/ft<sup>2</sup> °F **(3 points)**
- No **(0 points)**
- N/A

**ToolTip:**

As per ANSI/ASHRAE/IES Standard 90.1-2010. Mark "N/A" for Climate Zones 6-8.

**References:**

- ANSI/ASHRAE/IES Standard 90.1-2010
- ASHRAE Fundamentals Handbook, 2009, Chapter 6
- California Title 24, Joint Appendix JA4-2008  
[http://www.energy.ca.gov/title24/2008standards/rulemaking/documents/pre-15-day\\_language/appendices/joint\\_appendices/JA%204%20-%20U-Factors%20-%20Rev%2014-15-day-1.pdf](http://www.energy.ca.gov/title24/2008standards/rulemaking/documents/pre-15-day_language/appendices/joint_appendices/JA%204%20-%20U-Factors%20-%20Rev%2014-15-day-1.pdf)

**Assessment Guidance:**

Thermal mass is the ability of a building component (envelope, interior walls, floor slabs, etc.) to absorb and store heat. When this strategy is utilized effectively, it can smooth out temperature variations within a building, thus reducing the peak electrical demand and consumption associated with cooling loads. Materials with good thermal mass have a high density and good thermal conductivity. In general, the denser a material is, the higher its thermal mass. For example, concrete has high thermal mass, brick has a lower thermal mass, and insulation has almost none. Good thermal conductivity is important if the material is to perform in this manner, as the material must allow heat to flow through it.

The heat capacity of an object is equal to the combined product of the object's specific heat, its density and its thickness. It is defined as the amount of BTU that must be added to 1 ft<sup>2</sup> of surface area to uniformly elevate the temperature of the construction by 1°F. For walls with multiple layers, the overall heat capacity is equal to the sum of the heat capacities for each individual layer. Heat capacity can be approximated by multiplying the weight of a square foot of the wall, roof, or floor by 0.2 (inch-pound units). For example, a wall with a surface density of 100 lb/ft<sup>2</sup> has a heat capacity of approximately 20 Btu/ft<sup>2</sup> °F<sup>9</sup>. Heat capacity data for common envelope assemblies can be found in the following reference documents:

- ASHRAE Fundamentals Handbook, 2009, Chapter 6 lists specific heat and density for common building materials
- The California Title 24- Joint Appendix JA4-2008 can be found here:  
[http://www.energy.ca.gov/title24/2008standards/rulemaking/documents/pre-15-day\\_language/appendices/joint\\_appendices/JA%204%20-%20U-Factors%20-%20Rev%2014-15-day-1.pdf](http://www.energy.ca.gov/title24/2008standards/rulemaking/documents/pre-15-day_language/appendices/joint_appendices/JA%204%20-%20U-Factors%20-%20Rev%2014-15-day-1.pdf)

There have been some recent developments in the application of thermal mass storage via bio-based phase-change materials. These materials generally use a bio-based substance that absorbs and releases heat at a given temperature – similar to the heat released or consumed by water undergoing a phase change at 32°F. Projects wishing to utilize this method to increase thermal mass in the building should discuss the proposal with the Assessor prior to the Design Review.

During the Design Review, a list of all envelope assemblies and their respective square footage (or % of envelope) and heat capacity should be submitted to the Assessor for review. In addition, they will be looking for Energy simulation program results.

**3.3.2.1.2 Criteria:**

Do mass walls that are used as interior partitions, and constituting 20% of the building envelope gross area, have either of the following:

- A minimum heat capacity of 7 Btu/ft<sup>2</sup> °F (143 kJ/m<sup>2</sup>K)?

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<sup>9</sup> [http://advancedbuildings.net/files/advancebuildings/Envelope-General\\_0.pdf](http://advancedbuildings.net/files/advancebuildings/Envelope-General_0.pdf)

- A minimum heat capacity of 5 Btu/ft<sup>2</sup> °F (102 kJ/m<sup>2</sup>K), provided the walls have a material unit weight not greater than 120 lb/ft<sup>3</sup> (1900 kg/m<sup>3</sup>) with the portion of the wall with the greatest heat capacity exposed to conditioned air?

**Answers:**

- Minimum capacity of 7 Btu/ft<sup>2</sup> °F **(3 points)**
- Minimum capacity of 5 Btu/ft<sup>2</sup> °F **(3 points)**
- No **(0 points)**  
N/A

**ToolTip:**

Mark “no” where mass walls do not constitute 20% of the building envelope gross area. Insulating material or wallboard cannot be used as an interior finish on these walls. Mark “N/A” for Climate Zones 6-8

**Assessment Guidance:**

See Assessment Guidance for Criteria 3.3.2.1.1. For all interior partitions the same procedure and documentation should be applied.

The assessor may determine that this criterion is not applicable if the building has continuously operating HVAC systems.

**3.3.2.1.3 Criteria:**

Are 50% of return air plenums located directly in contact with a floor or wall having either of the following:

- A heat capacity of at least 7 Btu/ft<sup>2</sup> °F (143 kJ/m<sup>2</sup>K)?
- A heat capacity of 5 at least Btu/ft<sup>2</sup> °F (102 kJ/m<sup>2</sup>K), provided the wall or floor has a material unit weight equal to or less than 120 lb/ft<sup>3</sup> (1900 kg/m<sup>3</sup>)?

**Answers:**

- Minimum capacity of 7 Btu/ft<sup>2</sup> °F **(3 points)**
- Minimum capacity of 5 Btu/ft<sup>2</sup> °F **(3 points)**
- No
- N/A

**ToolTip:**

Mark “N/A” for Climate Zones 6-8.

**Assessment Guidance:**

See Assessment Guidance for Criteria 3.3.2.1.1. For all floors and walls that contact return air plenums the same procedure and documentation should be applied.

Points will also be awarded when buildings are configured with ducted returns.

**3.3.2.1.4 Criteria:**

Is there a thermal energy storage system that is capable of offsetting the peak cooling demand by more than 30%?

**Answers:**

- > 50% **(10 points)**
- 41 - 50% **(7 points)**
- 31 - 40% **(4 points)**



- No (0 points)
- N/A

### ToolTip:

Mark “N/A” for Climate Zones 6-8.

### References:

- *ASHRAE Guideline 4*
- *ASHRAE’s New Design Guide for Cool Thermal Storage*
- *ASHRAE HVAC Systems and Equipment Handbook, 2012 version, Chapter 51*

### Assessment Guidance:

During periods of warmer weather air conditioning adds a significant increase to the electric utility’s peak load. Thermal energy storage (TES) is a system that separates the times of heating or cooling generation from the time of its use. A TES system can meet the same cooling/heating load as a non-storage system over a given period of time with smaller capacity primary equipment. The net effect is that electrical demands for air conditioning are leveled over a 24 hour period or shifted entirely to off-peak periods (generally 10 p.m.- 9 a.m.). This criterion only addresses TES for cooling at this time.

Proper sizing is essential for TES systems and designers must calculate an accurate load profile for the building and the HVAC systems. TES systems are applicable in most commercial and industrial facilities but certain criteria must be met for economic feasibility. The primary requirement is that the maximum cooling load should be significantly higher than the average load. They may also be appropriate where redundant cooling capacity is desired or where more chiller capacity is needed for an existing system. Cooling TES options include (but are not limited to):

- Chilled water tank storage systems
- Low-temperature fluid (phase change material) tank storage systems
- Thermal storage in aquifers
- Ice storage systems

Some pros and cons of each type are listed below in Table 3.3.2.1.4: TES System Comparisons.

**Table 3.3.2.1.4: TES System Comparisons**

Thermal Storage Systems	Pros	Cons
<b>Chilled water tank storage</b>	<ul style="list-style-type: none"> <li>• Requires large storage tanks, which tend to be less expensive per unit volume as the size increases</li> <li>• Good for very large storage systems (i.e. institutional campus)</li> </ul>	<ul style="list-style-type: none"> <li>• Need exterior or underground location for large tank</li> </ul>
<b>Low-temperature fluid/Phase change material/eutectic salts tank storage</b>	<ul style="list-style-type: none"> <li>• 47°F phase change point allows use of standard chilling equipment</li> <li>• Can be used with ice to reduce freezing temperature to 28°F and 12°F in ice tanks</li> <li>• Good for low temperature air conditioning or some food processing applications</li> </ul>	<ul style="list-style-type: none"> <li>• Storage medium (phase change material) cannot be the same as the heat transfer medium.</li> <li>• Material is highly corrosive</li> </ul>

<b>Thermal storage in aquifers</b>	<ul style="list-style-type: none"> <li>Nature provided heat sink/source</li> </ul>	<ul style="list-style-type: none"> <li>Capacity is limited on thickness and porosity of aquifer</li> </ul>
<b>Ice storage</b>	<ul style="list-style-type: none"> <li>Utilizes large amount of energy in phase change – so system is compact for amount of energy stored</li> <li>Typically seen as more economical than water storage</li> <li>Good for small and moderate size thermal storage systems</li> </ul>	<ul style="list-style-type: none"> <li>Requires more insulation than chilled water storage</li> <li>Chillers typically operate less efficiently as leaving water temperature is reduced</li> </ul>

TES operating strategies are usually classified as full storage (load shifting) or partial (load leveling) storage. Strategies for operation at less than design loads include chiller priority and storage priority control. For this criterion, the partial storage must equate to at least 30% load transferred from on-peak cooling periods.

For more information, see *ASHRAE Guideline 4*, *ASHRAE's New Design Guide for Cool Thermal Storage* and the *ASHRAE HVAC Systems and Equipment Handbook, 2012 version, Chapter 51*.

For the Design Review the HVAC designer should put together a narrative explaining the thermal storage system design, including the load profiles showing a cooling peak demand reduction of 30% or over.

### 3.3.2.2 Power Demand Reduction

#### 3.3.2.2.1 Criteria:

What is the modeled building's monthly power demand factor (lowest monthly kW demand ÷ peak monthly kW demand)?

#### Answers:

- > 85% **(8 points)**
- 80 - 85% **(6 points)**
- 75 - 79% **(4 points)**
- < 75% **(0 points)**
- N/A

#### ToolTip:

Mark "N/A" for Climate Zones 6 – 8.

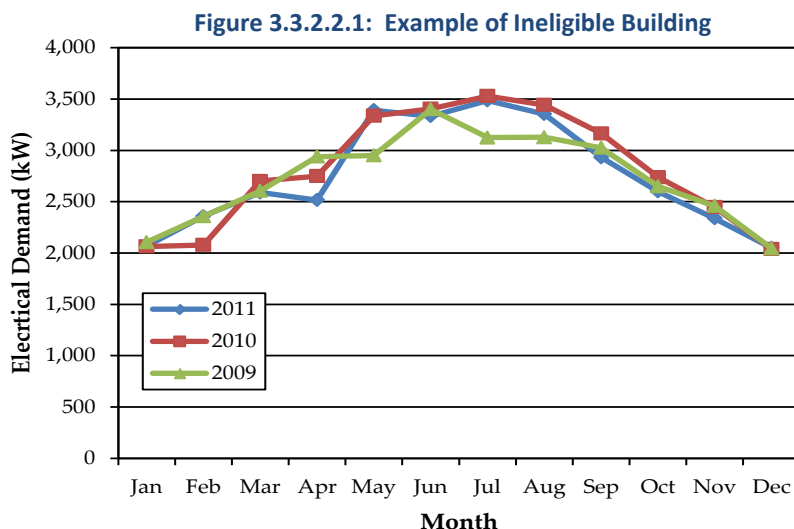
#### References:

- ANSI/GBI Standard 01-2010 Section 8.2.3 Power Demand Reduction*

#### Assessment Guidance:

The intent of this criterion is to reward projects that are able to minimize peak monthly demand and “flatten” the monthly load profiles of their building's electricity usage. Additionally, depending on the rate structure provided by the project's electric utility provider, this load “flattening” can potentially decrease the utility bill. Use of natural gas equipment to provide heating and cooling will also help provide a flat demand profile throughout the year. See Figure 3.3.2.2.1: Example of Ineligible Building for an illustration of a building that achieves a percentage of 59% and thus will not earn points for this criterion.

Along with building in climate zones 6 through 8, other buildings can be classified as N/A for this criterion. Buildings with high-base loads like hospitals and laboratories could be considered non-applicable as well as buildings with campus/district heating and/or cooling since the building itself may not have any sensitivity to extreme heat and cooling as related to the electricity demand.



### 3.3.2.2.2 Criteria:

Is there an Energy Management System designed to reduce power demand below the non-reduced peak?

*Or*

Will power demand be controlled by the electric utility as per a load shedding agreement between the building owner and the utility?

#### Answers:

- > 30% reduction below non-reduced peak **(8 points)**
- 25 - 30% reduction below non-reduced peak **(7 points)**
- 20 - 24% reduction below non-reduced peak **(6 points)**
- 15 - 19% reduction below non-reduced peak **(4 points)**
- < 15% reduction below non-reduced peak **(0 points)**
- Power demand will be controlled by the electric utility **(8 points)**
- No **(0 points)**

#### ToolTip:

This will be verified during the Onsite Assessment.

#### Assessment Guidance:

For buildings choosing the Energy Management System path, they shall have the ability to automatically reduce total electrical demand during peak power periods. This will help manage utility grid demand by having the building respond to critical peak periods (either building peak or system peak) with equipment and design strategies able to reduce electrical demand. The building should include an interface to the utility capable of responding to real-time signals which identify critical peak power periods. The building should respond to this signal by utilizing one or more of the following strategies:

- Reduce mechanical equipment power demand
- Reduce lighting equipment power demand without compromising necessary illumination in critical areas. Critical areas include spaces within the building that host tasks requiring a moderate to high degree of visual acuity.
- Thermal energy storage
- Reduce other non-essential loads

For buildings choosing the load shedding agreement path, the project's utility company may provide load shedding agreements with specific high-use industrial consumers to turn off equipment at times of system-wide peak demand.

Both of these criteria require that the project have enough non-essential loads to be able to reduce the peak by 15% or more.


For the Design Review, the Assessor should receive power demand factor calculations and a narrative describing either the Energy Management System's load shedding program or the load shedding agreement with the utility.

### 3.3.3 Metering, Measurement and Verification

#### 3.3.3.1 Metering

##### 3.3.3.1.1 Criteria:

Is there metering (at the building level) for the following:






- **3.3.3.1.1.1: Electricity?**
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
- **3.3.3.1.1.2: Heating fuels?**
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** Mark "N/A" where there are no heating fuels.
- **3.3.3.1.1.3: Steam?** 
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** Mark "N/A" where there is no steam.
- **3.3.3.1.1.4: Other?**
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
    - N/A
  - **3.3.3.1.1.4.1: Describe:** [text field] **(1 point)**

### Assessment Guidance:

Additional utilities that count for building-level metering include chilled or hot water for campus/district systems. During the Design Review, the Assessor will review the mechanical and electrical plans. These plans should clearly show what utilities will be metered.

#### 3.3.3.1.2 Criteria:

Is there sub-metering installed for the following systems:





- **3.3.3.1.2.1:** Mark N/A for Green Globes Multifamily for New Construction
- **3.3.3.1.2.2:** Mark N/A for Green Globes Multifamily for New Construction
- **3.3.3.1.2.3:** Major electric HVAC equipment 5 HP or greater? 
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** “Major HVAC equipment” include chillers, cooling towers, AHU fans, and pumps.
- **3.3.3.1.2.4:** Chilled water generation? 
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
    - N/A
- **3.3.3.1.2.5:** Onsite renewable energy power generation? 
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
    - N/A
- **3.3.3.1.2.6:** Heating water or steam generation? 
  - **Answers:**
    - Yes **(0.5 point)**
    - No **(0 points)**
    - N/A
- **3.3.3.1.2.7:** Mark N/A for Green Globes Multifamily for New Construction
- **3.3.3.1.2.8:** Critical HVAC controls? 
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** “Critical HVAC controls” include scheduling, economizer operation, and temperature resets.



### 3.3.3.2 Measurement and Verification

#### 3.3.3.2.1 Criteria:

Does the Energy Metering Reporting Plan include the following monitoring protocols (e.g. daily, monthly, seasonal, by floor, etc.)?

- **3.3.3.2.1.1:** Mark N/A for Green Globes Multifamily for New Construction
- **3.3.3.2.1.2:** Mark N/A for Green Globes Multifamily for New Construction
- **3.3.3.2.1.3:** Major electric HVAC equipment 5 HP or greater: seasonal peak demand and month consumption? 
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** “Major HVAC equipment” include chillers, cooling towers, AHU fans, and pumps.
- **3.3.3.2.1.4:** Chilled water generation: seasonal peak output and monthly consumption? 
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
    - N/A
- **3.3.3.2.1.5:** Onsite renewable energy power generation: monthly peak output, monthly production and site-specific weather characteristics? 
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** “Site specific weather characteristics” include irradiance, wind, and temperature.
- **3.3.3.2.1.6:** Heating water or steam generation: seasonal peak and monthly consumption? 
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
    - N/A
- **3.3.3.2.1.7:** Mark N/A for Green Globes Multifamily for New Construction
- **3.3.3.2.1.8:** Mark N/A for Green Globes Multifamily for New Construction

## 3.3.4 Building Opaque Envelope

### 3.3.4.1 Thermal Resistance and Transmittance

#### 3.3.4.1.1 Criteria:

Do the thermal resistance (R/RSI) **or** the thermal transmittance (U- /C- /F-factor) values for all the opaque elements of the building envelope meet or exceed the requirements per Green Globes Multifamily for New Construction Technical Manual Table 3.3.4.1.1-A: Insulation Minimum R-values, **or** meet or do not exceed Table 3.3.4.1.1-B: Maximum Assembly U-factors, C-factors, and F-factors?

#### Answers:

- Meets or exceeds R-values **(10 points)**
- Meets or does not exceed U-, C-, or F-factors **(10 points)**
- No **(0 points)**

#### ToolTip:

Requirements must be appropriate to the climate zone. The rated R-value of the insulation in the framing cavities and the continuous insulation (c.i.) uninterrupted by framing, where indicated, must meet or exceed the required values in Table 3.3.4.1.1-A. In calculating the R-value of a multi-layered installation, the R-values of the individual layers are added.

U-, C-, or F-factors refer to the heat transmission in a unit of time through a unit of area for the entire assembly of all the elements of construction and the boundary films, induced by a unit temperature difference between the environmental conditions on each side. The units for U- and R-values are inch/pound.

**Table 3.3.4.1.1-A: Insulation Minimum R-values**

CLIMATE ZONE	1	2	3	4	5	6	7	8
<b>Opaque Elements</b>								
<b>Roofs</b>								
Insulation above Deck	R-15.0 ci	R-15.0 ci	R-20.0 ci	R-20.0 ci	R-20.0 ci	R-20.0 ci	R-20.0 ci	R-30.0 ci
Metal Building	R-19.0	R-13.0 + R-13.0ci	R-13.0 + R-13.0ci	R-13.0 + R-19.0ci	R-13.0 + R-19.0ci	R-13.0 + R-19.0ci	R-30.0 + R-10.0 ci	R-30.0 + R-10.0 ci
Attic and Other	R-30.0	R-38.0	R-38.0	R-38.0	R-38.0	R-38.0	R-60.0	R-60.0
<b>Walls Above Grade</b>								
Mass	NR	R-7.6 ci	R-9.5 ci	R-11.4 ci	R-11.4 ci	R-11.4 ci	R-15.2 ci	R-15.2 ci
Metal Building	R-16.0	R-16.0	R-6.0 + R-13.0ci	R-6.0 + R-13.0ci	R-13.0 + R-13.0ci	R-13.0 + R-13.0ci	R-13.0 + R-13.0ci	R-13.0 + R-16.0ci
Steel Framed	R-13.0	R-13.0	R-13.0 + R-3.8 ci	R-13.0 + R-7.5 ci	R-13.0 + R-7.5 ci	R-13.0 + R-7.5 ci	R-13.0 + R-7.5 ci	R-13.0 + R-21.6 ci
Wood Frame & Other	R-13.0	R-13.0	R-13.0	R-13.0+ R-3.8 ci or R-19.0	R-13.0+ R-3.8 ci or R-19.0	R-13.0+ R-3.8 ci or R-19.0	R-13.0 + R-7.5 ci or R-20.0 + R-2.5 ci	R-13.0 + R-10.0 ci or R-20.0 + R-5.0 ci
<b>Walls Below Grade</b>								
Below Grade Wall	NR	NR	NR	NR	R-7.5 ci	R-7.5 ci	R-7.5 ci	R-15.0 ci
<b>Floors</b>								
Mass	NR	R-6.3 ci	R-8.3 ci	R-8.3 ci	R-10.4 ci	R-10.4 ci	R-12.5 ci	R-16.7 ci
Steel Joist	R-19.0	R-19.0	R-19.0	R-30.0	R-30.0	R-30.0	R-38.0	R-38.0
Wood Frame & Other	R-19.0	R-19.0	R-30.0	R-30.0	R-30.0	R-30.0	R-30.0	R-30.0
<b>Slab-On-Grade Floors</b>								
Unheated	NR	NR	NR	NR	NR	R-10.0 for 24 in.	R-15.0 for 24 in.	R-20.0 for 24 in.
Heated	R-7.5 for 12 in.	R-7.5 for 12 in.	R-7.5 for 12 in.	R-7.5 for 24 in.	R-10.0 for 36 in.	R-10.0 for 36 in.	R-20.0 for 36 in. + R-5.0 ci below	R-20.0 for 36 in. + R-5.0 ci below
<b>NR – No Requirement</b> <b>CI – Continuous Insulation</b>								

**Table 3.3.4.1.1-B: Maximum Assembly U-factors, C-factors and F-factors**

CLIMATE ZONE	1	2	3	4	5	6	7	8
<b>Opaque Elements</b>								
<b>Roofs</b>								
Insulation above Deck	U-0.063	U-0.063	U-0.048	U-0.048	U-0.048	U-0.048	U-0.048	U-0.032
Metal Building	U-0.065	U-0.055	U-0.055	U-0.049	U-0.049	U-0.049	U- 0.028	U- 0.028
Attic and Other	U-0.034	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.017	U-0.017
<b>Walls Above Grade</b>								
Mass	U-0.580	U-0.123	U-0.104	U-0.090	U-0.090	U-0.090	U-0.071	U-0.071
Metal Building	U-0.093	U-0.093	U- 0.070	U- 0.070	U-0.057	U-0.057	U-0.057	U-0.055
Steel Framed	U-0.124	U-0.124	U-0.084	U-0.064	U-0.064	U-0.064	U-0.064	U- 0.040
Wood Frame & Other	U-0.089	U-0.089	U-0.089	U-0.064	U-0.064	U-0.064	U-0.051	U-0.045
<b>Walls Below Grade</b>								
Below Grade Wall	C-1.140	C-1.140	C-1.140	C-1.140	C-0.119	C-0.119	C-0.119	C-0.063
<b>Floors</b>								
Mass	U- 0.332	U-0.107	U- 0.087	U- 0.087	U-0.074	U-0.074	U-0.064	U-0.051
Steel Joist	U-0.052	U-0.052	U-0.052	U-0.038	U-0.038	U-0.038	U-0.032	U-0.032
Wood Frame & Other	U-0.051	U-0.051	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033
<b>Slab-On-Grade Floors</b>								
Unheated	F-0.730	F-0.730	F-0.730	F-0.730	F-0.730	F-0.540	F-0.520	F-0.510
Heated	F-1.020	F-1.020	F-1.020	F-0.950	F-0.840	F-0.840	F- 0.373	F- 0.373
<b>Opaque Doors</b>								
Swinging	U-0.700	U-0.700	U-0.700	U-0.700	U-0.700	U-0.700	U-0.600	U-0.500
Non-Swinging	U-1.450	U-1.450	U-1.450	U-0.500	U-0.500	U-0.500	U-0.500	U-0.500

## References:

- ANSI/ASHRAE/IES Standard 90.1-2010, Appendix A, section A4 and Appendix A, Table A6

## Assessment Guidance:

A list of thermal resistance or transmittance values for each opaque element of the building envelope shall be provided as either part of the energy model documentation for 3.3.1 Energy Performance or a separate document shall be provided to the Assessor for the Design Review.

The C-factor is used to represent the thermal conductance for walls below grade and the F-factor indicated the heat loss factor for slab-on-grade floors. In contrast to the U-factor for above grade walls, the C-factor for below grade walls does not include the R-values for exterior or interior air films or for soil. Assembly C-factors for below grade walls shall be calculated per Appendix A, section A4 in ANSI/ASHRAE/IES Standard 90.1-2010. Assembly F-factors for slab-on-grade floors can also be found in Appendix A, in Table A6.3 in ANSI/ASHRAE/IES Standard 90.1-2010.

### 3.3.4.2 Orientation

#### 3.3.4.2.1 Criteria:

Is the building oriented such that the ratio of the north/south fenestration area to the east/west fenestration area was between 1.25 and 2.00?

#### Answers:

- 2.00 (5 points)
- 1.85 - 1.99 (4 points)
- 1.70 - 1.84 (3 points)
- 1.55 - 1.69 (2 points)
- 1.40 - 1.54 (1 point)
- 1.25 - 1.39 (0.5 points)
- No (0 points)
- N/A

#### ToolTip:

“Fenestration” means all areas including frames in the building envelope that transmit lighting including windows, translucent panels, clerestory windows, skylights and glass block walls. For doors where the glazed vision area is less than 50% of the door area, the fenestration area is the glazed vision area. For all other doors, the fenestration area is the door area including frames. The gross exterior wall is measured horizontally from the exterior surface; it is measured vertically from the top of the floor to the bottom of the roof. Where site factors do not allow or favor orientation adaption, mark “N/A”.

#### Assessment Guidance:

Buildings where this can be considered N/A would be existing buildings undergoing major renovations that have only minor changes to the existing shell and buildings in dense urban areas where constraints on orientation are made by adjacent existing buildings. The Design Review documentation should include the fenestration ratios for north/south and east/west orientations.

### 3.3.4.3 Fenestration Systems

#### 3.3.4.3.1 Criteria:

Is the thermal transmittance (U-factor) of the building's fenestration system less than or equal to the values in Table 3.3.4.3: Building Envelope Requirements?

#### Answers:

- Yes (8 points)
- No (0 points)

#### ToolTip:

Calculate the overall values based on a weighted area average of the assemblies.

#### References:

- ISO 15099 Standard
- WINDOW 6.3, <http://windows.lbl.gov/software/window/window.html>



**Table 3.3.4.3: Building Envelope Requirements**

CLIMATE ZONE	1	2	3	4 (Except Marine)	5 (And Marine 4)	6	7	8
<b>Framing materials other than metal with or without metal reinforcement or cladding</b>								
<i>U-factor</i>	1.20	0.75	0.65	0.40	0.35	0.35	0.30	0.30
<b>Metal framing with or without thermal break</b>								
Curtain / Storefront <i>U-factor</i>	1.20	0.70	0.60	0.50	0.45	0.45	0.40	0.40
Entrance Door U	1.20	1.10	0.90	0.85	0.80	0.80	0.75	0.75
All Other <i>U-Factor</i> <sup>a</sup>	1.20	0.75	0.65	0.55	0.50	0.50	0.45	0.45
<b>Skylights (3% maximum)</b>								
<i>U-factor</i>	0.75	0.75	0.65	0.60	0.60	0.60	0.60	0.50
<b>SHGC-All Frame Types</b>								
SHGC: North <sup>b</sup>	0.45	0.45	0.45	0.50	0.50	0.50	0.65	NR
SHGC: E, S & W PF < 0.25	0.25	0.25	0.25	0.40	0.40	0.40	0.50	NR
SHGC: E, S & W 0.25 ≤ PF < 0.5	0.30	0.30	0.30	0.50	0.50	0.50	NR	NR
SHGC: E, S & W PF ≥ 0.5	0.40	0.40	0.40	0.65	0.65	NR	NR	NR
<b>Skylights (3% maximum)</b>								
SHGC	0.20	0.20	0.30	0.40	0.40	0.50	0.60	NR
NR = No requirement. PF = <i>Projection factor</i> a. All other includes operable windows, fixed windows and non-entrance doors. b. North-Facing within 45 degrees of true north (Northern Hemisphere).								

### Assessment Guidance:

A list of thermal transmittance values for each type of building fenestration system shall be provided as either part of the energy model documentation for 3.3.1 Energy Performance or as a separate document shall be provided to the Assessor for Design Review.

When window assembly thermal transmittance values are not available, projects shall use a program such as WINDOW 6.3 which provides heat transfer analysis consistent with *ISO 15099 Standard*. The free program can be found here: <http://windows.lbl.gov/software/window/window.html>. Calculations performed by hand or through another third-party software shall ensure that framing and edge-of-glass contributions are included in the overall U-factor.

### 3.3.4.3.2 Criteria:

Is the Solar Heat Gain Coefficient (SHGC) of the building's fenestration system less than or equal to the values in Table 3.3.4.3: Building Envelope Requirements?

#### Answers:

- Yes (8 points)
- No (0 points)

**ToolTip:**

Calculate the overall values based on a weighted area average of the assemblies.

**Assessment Guidance:**

A list of SHGC values for each type of building fenestration system shall be provided as either part of the energy model documentation for 3.3.1 Energy Performance or a separate document shall be provided to the Assessor for Design Review.

## 3.3.5 Lighting

### 3.3.5.1 Total Lighting Power Density

#### 3.3.5.1.1 Criteria:

Is the total lighting power density (LPD) of the building at or below the allowed lighting power density given in Green Globes Multifamily for New Construction Technical Manual, Table 3.3.5.1-A: Building Area Method or Table 3.3.5.1-B: Space-by-Space Method?

**Answers:**

- Yes, Building Area Method **(10 points)**
- Yes, Space-by-Space Method **(10 points)**
- No **(0 points)**

**ToolTip:**

Lighting power density for connected lighting circuits is the energy use (in watts) per square foot for lighting. The values in these tables are adapted directly from *ANSI/ASHRAE/IESNA Standard 90.1-2010* and addendum (Table 3.3.5.1.1-A and Table 3.3.5.1.1-B). Provide calculations to the Green Globes Assessor for verification.

**References:**

- *ANSI/ASHRAE/IES Standard 90.1-2010*

**Table 3.3.5.1.1-A: Building Area Method**

Building Type	LPD (W/m <sup>2</sup> )	LPD (W/ft <sup>2</sup> )
Automotive Facility	8.83	0.82
Convention Center	11.63	1.08
Court House	11.30	1.05
Dining: Bar Lounge/Leisure	10.66	0.99
Dining: Cafeteria/Fast Food	9.69	0.90
Dining: Family	9.58	0.89
Dormitory	6.57	0.61
Exercise Center	9.47	0.88
Fire Station	7.64	0.71
Gymnasium	10.76	1.00
Health Care-Clinic	9.36	0.87
Hospital	13.02	1.21
Hotel	10.76	1.00
Library	12.70	1.18
Manufacturing Facility	11.95	1.11
Motel	9.47	0.88
Motion Picture Theater	8.93	0.83
Multi-Family	6.46	0.60
Museum	11.41	1.06
Office	9.69	0.90
Parking Garage	2.69	0.25
Penitentiary	10.44	0.97
Performing Arts Theater	14.96	1.39
Police Station	10.33	0.96
Post Office	9.36	0.87
Religious Building	11.30	1.05
Retail	15.07	1.40
School/University	10.66	0.99
Sports Arena	8.40	0.78
Town Hall	9.90	0.92
Transportation	8.29	0.77
Warehouse	7.10	0.66
Workshop	12.92	1.20

**Table 3.3.5.1.1-B: Space-by-Space Method**

Common Space Types	LPD (W/m <sup>2</sup> )	LPD (W/ft <sup>2</sup> )
<b>Office-Enclosed</b>	11.95	1.11
<b>Office-Open Plan</b>	10.55	0.98
<b>Conference/Meeting/Multipurpose</b>	13.24	1.23
<b>Classroom/Lecture/Training</b>	13.35	1.24
<i>For Penitentiary</i>	14.42	1.34
<b>Lobby</b>	9.69	0.90
<i>For Elevator</i>	6.89	0.64
<i>For Hotel</i>	11.41	1.06
<i>For Performing Arts Theater</i>	21.53	2.00
<i>For Motion Picture Theater</i>	5.60	0.52
<b>Audience/Seating Area - Permanent</b>	8.83	0.82
<i>For Auditorium</i>	8.50	0.79
<i>For Gymnasium</i>	4.63	0.43
<i>For Exercise Center</i>	8.50	0.79
<i>For Convention Center</i>	8.83	0.82
<i>For Penitentiary</i>	4.63	0.43
<i>For Religious Building</i>	16.47	1.53
<i>For Sports Arena</i>	4.63	0.43
<i>For Performing Arts Theater</i>	26.16	2.43
<i>For Motion Picture Theater</i>	12.27	1.14
<i>For Transportation</i>	5.81	0.54
<b>Atrium – First 40 ft. in height</b>	0.32	0.03 per ft.
<b>Atrium – Height above 40 ft.</b>	0.22	0.02 per ft.
<b>Lounge/Recreation</b>	7.86	0.73
<b>Dining Area</b>	7.00	0.65
<i>For Penitentiary</i>	11.52	1.07
<i>For Hotel</i>	8.83	0.82
<i>For Motel</i>	9.47	0.88
<i>For Bar Lounge/Leisure Dining</i>	14.10	1.31
<i>For Family Dining</i>	9.58	0.89
<b>Food Preparation</b>	10.66	0.99
<b>Laboratory for Classrooms</b>	13.78	1.28
<b>Laboratory for Medical/Industrial</b>	19.48	1.81
<b>Restrooms</b>	9.36	0.98

Common Space Types	LPD (W/m <sup>2</sup> )	LPD (W/ft <sup>2</sup> )
Dressing/ Fitting Room	9.36	0.87
Dressing Room/Performing Arts	4.31	0.40
Locker Room	8.07	0.75
Stairway	7.43	0.69
Storage	6.78	0.63
Electrical/Mechanical	10.23	0.95
Workshop	17.11	1.59

Building Specific Space Types	LPD (W/m <sup>2</sup> )	LPD (W/ft <sup>2</sup> )
<b>Gymnasium/Exercise Center</b>		
<i>Playing Area</i>	12.92	1.20
<i>Exercise Area</i>	7.75	0.72
<b>Courthouse/Police Station/Penitentiary</b>		
<i>Courtroom</i>	18.51	1.72
<i>Confinement Cells</i>	11.84	1.10
<i>Judges Chambers</i>	12.59	1.17
<b>Fire Stations</b>		
<i>Fire Station Engine Room</i>	6.03	0.56
<i>Sleeping Quarters</i>	2.69	0.25
<b>Post Office – Sorting Area</b>	10.12	0.94
<b>Convention Center – Exhibit Space</b>	15.61	1.45
<b>Library</b>		
<i>Card File and Cataloging</i>	7.75	0.72
<i>Stacks</i>	18.41	1.71
<i>Reading Area</i>	10.01	0.93
<b>Hospital</b>		
<i>Corridor/Transition</i>	9.58	0.89
<i>Emergency</i>	24.33	2.26
<i>Recovery</i>	12.38	1.15
<i>Lounge/Recreation</i>	11.52	1.07
<i>Nurse Station</i>	9.36	0.87
<i>Exam/Treatment</i>	17.87	1.66
<i>Pharmacy</i>	12.27	1.14
<i>Patient Room</i>	6.67	0.62
<i>Operating Room</i>	20.34	1.89
<i>Nursery</i>	9.47	0.88



<i>Medical Supply</i>	13.67	1.27
<i>Physical Therapy</i>	9.80	0.91
<i>Radiology/Imaging</i>	14.21	1.32
<i>Laundry – Washing</i>	6.46	0.60
<b>Automotive – Service/Repair</b>	7.21	0.67
<b>Manufacturing</b>		
<i>Extra High Bay (&gt;50 ft. Floor to Ceiling Height)</i>	11.30	1.05
<i>High Bay (25 - 50 ft. Floor to Ceiling Height)</i>	13.24	1.23
<i>Low Bay (&lt;25 ft. Floor to Ceiling Height)</i>	12.81	1.19
<i>Detailed Manufacturing</i>	13.89	1.29
<i>Equipment Room</i>	10.23	0.95
<i>Corridor/Transition</i>	4.41	0.41
<b>Hotel/Motel Guest Rooms</b>	11.95	1.11
<b>Highway Lodging Guest Rooms</b>	8.07	0.75
<b>Dormitory – Living Quarters</b>	4.09	0.38
<b>Museum</b>		
<i>General Exhibition</i>	11.30	1.05
<i>Restoration</i>	10.98	1.02
<b>Bank/Office – Banking Activity Area</b>	14.85	1.38
<b>Religious Buildings</b>		
<i>Worship Pulpit, Choir</i>	16.47	1.53
<i>Fellowship Hall</i>	6.89	0.64
<b>Retail</b>		
<i>Sales Area</i>	18.08	1.68
<i>Mall Concourse</i>	11.84	1.10
<i>Dressing/Fitting Room</i>	9.36	0.87
<b>Sports Arena</b>		
<i>Ring Sports Arena</i>	28.85	2.68
<i>Court Sports Arena – Class 4</i>	7.75	0.72
<i>Court Sports Arena – Class 3</i>	12.92	1.20
<i>Court Sports Arena – Class 2</i>	20.67	1.92
<i>Court Sports Arena – Class 1</i>	32.40	3.01
<b>Warehouse</b>		
<i>Fine Material Storage</i>	10.23	0.95
<i>Medium/Bulky Material Storage</i>	6.24	0.58
<b>Parking Garage – Garage Area</b>	2.05	0.19
<b>Transportation</b>		
<i>Airport – Concourse</i>	3.88	0.36

<i>Air/Train/Bus – Baggage Area</i>	8.18	0.76
<i>Terminal – Ticket Counter</i>	11.63	1.08

#### Assessment Guidance:

The values in the tables are from the *ANSI/ASHRAE/IESNA Standard 90.1-2010*.

LPD calculations and results shall be provided to the Assessor for Design Review. Such calculations are typically included with permit set drawings and specifications.

### 3.3.5.2 Interior Automatic Light Shutoff Controls

#### 3.3.5.2.1 Criteria:

How many light fixtures have time-scheduling devices and/or individual occupant-sensing devices?

#### Answers:

- More than 50% **(3 points)**
- 30% - 50% **(2 points)**
- 10% - 29% **(1 point)**
- Less than 10% **(0 points)**
- No **(0 points)**
- N/A

#### ToolTip:

Time-scheduling devices must control zones no more than 25,000 ft<sup>2</sup> (2,320 m<sup>2</sup> per floor). There must be manual override switching devices that control zones no more than 5,000 ft<sup>2</sup> (465 m<sup>2</sup>), and these must allow lighting to stay on for no more than two hours. Individual occupant-sensing devices must control zones no more than 2,500 ft<sup>2</sup> (232 m<sup>2</sup>) in spaces smaller than 10,000 ft<sup>2</sup> (930 m<sup>2</sup>). For spaces that are larger than 10,000 ft<sup>2</sup> (930 m<sup>2</sup>), the control zones must be no greater than 10,000 ft<sup>2</sup> (930 m<sup>2</sup>). The occupant-sensing devices should also turn off all lighting in controlled areas within 30 minutes of all occupants leaving the area. Mark "N/A" for a building that is less than 5,000 ft<sup>2</sup> (465 m<sup>2</sup>).

#### Assessment Guidance:

Time scheduling controls can be provided via a centralized system or via a digital fully-addressable system. Centralized controls can be used to automatically turn on, turn off, and/or dim lighting at specific times. Centralized control strategies can also integrate lighting controls with other building systems such as mechanical or security systems. A digital fully-addressable lighting control system can speak to an individual ballast or groups of ballasts. These systems are local, or integral, to the luminaire itself and are not housed in a central cabinet. The "control wiring" is independent of the "power wiring" and generally provides the highest degree of flexibility. When space configuration or occupant needs change, the system can respond by reassigning the ballasts accordingly. They can integrate with building automation or energy management system.

For the Design Review, the project manager can submit the electrical engineer's lighting plans as long as there is sufficient controls information listed or noted on the plan. In lieu of controls information on the drawings, a separate lighting controls plan should be created that outlines different lighting controls zones and the control strategy used in each.

### 3.3.5.3 Light Reduction Controls

#### 3.3.5.3.1 Criteria:

How many light fixtures have lighting controls that can reduce the lighting load by at least 50% from full lighting using any of the following technologies:

- Dual switching of alternate rows or luminaires?
- Switching of individual lamps independently of adjacent lamps within a luminaire?
- Switching of each lamp or luminaire?
- Occupancy sensors within the space?

**Answers:**

- More than 50% **(4 points)**
- 30% - 50% **(3 points)**
- 10% - 29% **(2 points)**
- Less than 10% **(0 points)**
- No **(0 points)**
- N/A

**ToolTip:**

This is based upon total light fixtures that have controls. For example, if a 2,000 sf tenant space on a floor has sensors and lighting fixtures throughout, then 50% of the light fixtures would be controlled by sensors, apportioned by total connected kW load. Dual switches allow occupants to control a light from more than one place. A luminaire is defined as the lighting unit consisting of a lamp or lamps, while the lamp is the actual light source. Mark "N/A" for spaces that use less than 0.5 W/ft<sup>2</sup> (0.1 W/m<sup>2</sup>). Overall, the total connected lighting load (in kW) would need to be controllable so that the lighting energy across all fixtures can be reduced by at least half.

**Assessment Guidance:**

For Design Review, the project manager can submit the electrical engineer's lighting plans as long as there is sufficient controls information listed or noted on the plan. If there is insufficient information, then a lighting controls plan should be created that outlines different lighting controls zones and the control strategy used in each.

### 3.3.5.4 Daylighting

#### 3.3.5.4.1 Criteria:

Are the regularly occupied side-lit daylighted areas (vertical fenestration) and the top-lit daylighted areas (skylights) equal to at least 10% of the net building area?

**Answers:**

- Yes **(3 points)**
- No **(0 points)**
- N/A

**ToolTip:**

"Net building area" means the area of all interior spaces as measured to the predominant interior surface of the outside and excluding mechanical, elevator and utility shafts but ignoring protrusions caused by structural elements. Do not include in the calculation parts of the building whose function would be compromised by daylighting e.g. projection rooms. Mark "N/A" for buildings that would be functionally compromised by daylighting.

#### 3.3.5.4.2 Criteria:

- Mark N/A for Green Globes Multifamily for New Construction

#### 3.3.5.4.3 Criteria:

What percentage of the roof consists of skylights?

##### Answers:

- ≥ 5% **(2 points)**
- 4 - < 5% **(1.5 points)**
- 3 - < 4% **(1 point)**
- 2 - < 3% **(0.5 points)**
- < 2% **(0 points)**
- N/A

##### ToolTip:

Mark "N/A" if the building is located in Climate Zones 7 or 8.

### 3.3.5.5 Controls for Daylighted Zones

#### 3.3.5.5.1 Criteria:

Mark N/A for Green Globes Multifamily for New Construction

#### 3.3.5.5.2 Criteria:

Mark N/A for Green Globes Multifamily for New Construction

### 3.3.5.6 Exterior Luminaires and Controls

#### 3.3.5.6.1 Criteria:

Do exterior luminaires have lamps with an initial system efficacy of at least 60 lumens per watt?

##### Answers:

- Yes **(1 point)**
- No **(0 points)**
- N/A

##### ToolTip:

T-5 and T-8 fluorescent lamps limited to 80 picograms per lumen hour. Mark "no" if a Mercury Vapor lamp source is used. Mark "N/A" where there are no exterior luminaires.

##### Assessment Guidance:

For this criterion, below is a table listing the average lumens per watt for different types of lamps<sup>10</sup>.

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<sup>10</sup> Values obtained from "Lumens-Per-Watt Comparison, Madison Gas and Electric, Copyright © 2015, <http://www.mge.com/home/appliances/lighting/comparison.htm> for more information.

**Table 3.3.5.6.1: Average Lumens Per Watt**

Type of lamp	Average lumens per watt
Incandescent	10-17
Halogen A-line	12-22
White LED	20-60
Mercury Vapor	25-60
Linear Fluorescent	30-110
Compact Fluorescent	40-70
High Pressure Sodium	50-140
Metal Halide	70-115

Manufacturer's product cut-sheets should be provided for each type of exterior luminaire should be provided to the Assessor during the Design Review.

### 3.3.5.6.2 Criteria:

Were LED lamp sources used for all exterior lighting?

#### Answers:

- Yes **(1 point)**
- No **(0 points)**
- N/A

#### ToolTip:

Mark "N/A" where there are no exterior luminaires.

### 3.3.5.6.3 Criteria:

Are lamps specified that have low or no mercury content?

#### Answers:

- Yes **(1 point)**
- No **(0 points)**
- N/A

#### ToolTip:

Mark "N/A" where there are no exterior luminaires.

#### Assessment Guidance:

Mercury content in lamps typically reported in milligrams. The largest factors contributing to mercury content in the lamps are the shape (avoid non-standard shapes), the size (avoid non-standard sizes), and the manufacturer. Not all lamps contain mercury; mercury-free lamps include incandescent, halogen, low pressure sodium, and LEDs.

It is important to note that not all lamps marked as compliant with the EPA's Toxicity Characteristic Leaching Procedure, (TCLP) are not necessarily low mercury since some lamps contain additives in end-caps to prevent mercury from leaching during the test. Also, not all high-efficiency lamps have low mercury content. Each lamp specification should be written to ensure low mercury levels for each lamp type.

Mercury content, for Green Globes purposes, should be kept to the following limits for each type of lamp:

**Table 3.3.5.6.3: Lamp Mercury Content**

Lamp type	Mercury Content
<b>Compact Fluorescents<sup>11</sup></b>	4 mg or less
<b>T8 and T12 lamps<sup>12</sup></b>	5-8 mg or less

Another way to comply with this criterion is to select lamps based on the mercury content index. This number shows how much mercury is in a particular bulb in relation to the amount of light the bulb produces over its life. This number is specific for each manufacturer and model number. The aim is to use bulbs with the lowest level of mercury per lumen-hour possible. For compliance with this criterion, all individual lamps or the total average of all lamps on the project should have mercury content of 90 picograms per lumen-hour or less.

For Design Review, the lighting designer or electrical engineer should put together a list of all lamps specified on the project. Either each lamp must have a mercury content less than that listed above, 90 picograms per lumen-hour or less, or the weighted average of all lamps should be less than or equal to 90 picograms per lumen-hour.

### 3.3.5.6.4 Criteria:

Will one of the following controls be installed for exterior lighting:

- Lighting designated for dusk-to-dawn controlled by a photo sensor or astronomical time switch with 10-hour backup?
- Lighting not designated for dusk-to-dawn controlled by a time switch with 10-hour backup?

#### Answers:

- Photo sensor or astronomical time switch **(2 points)**
- Time switch **(1 point)**
- No **(0 points)**
- N/A

#### ToolTip:

Mark "N/A" where there are no exterior luminaires.

#### Assessment Guidance:

For Design Review, provide electrical exterior/site lighting plans and specifications for time switch/photo sensor used.

<sup>11</sup> "Frequently Asked Questions Information on Compact Fluorescent Light Bulbs (CFLs) and Mercury", ENERGY STAR®, last modified November 2010, [http://www.energystar.gov/ia/partners/promotions/change\\_light/downloads/Fact\\_Sheet\\_Mercury.pdf](http://www.energystar.gov/ia/partners/promotions/change_light/downloads/Fact_Sheet_Mercury.pdf)

<sup>12</sup> "Remediation of Indoor Airborne Mercury Released from Broken Fluorescent Lamps", T.M. Chandrasekhar, Ph.D. Florida Department of Environmental Protection Bureau of Laboratories, last modified June 15, 2007, [http://www.dep.state.fl.us/waste/quick\\_topics/publications/shw/mercury/Mercury\\_CFL\\_Dynamics-final.pdf](http://www.dep.state.fl.us/waste/quick_topics/publications/shw/mercury/Mercury_CFL_Dynamics-final.pdf)



### 3.3.6 HVAC Systems and Controls

#### 3.3.6.1 Building Automation System (BAS)

##### 3.3.6.1.1 Criteria:

Is there a central Building Automation System (BAS) that encompasses all systems that affect building energy performance, lighting, and thermal comfort?

##### Answers:

- Yes (10 points)
- No (0 points)

##### Assessment Guidance:

For this criterion the BAS should control and/or monitor all major systems that affect energy usage, lighting and thermal comfort. Small, constant systems like single toilet exhausts and plug loads need not be controlled by the BAS, though the BAS should carry the necessary fault alarms for building systems.

#### 3.3.6.2 Cooling Equipment

##### 3.3.6.2.1 Criteria:

Does the cooling equipment base efficiency meet *ANSI/ASHRAE/IES Standard 90.1-2010* efficiency requirements with respect to COP, EER and SEER?

(Refer to Table 3.3.6.2.1: Cooling Equipment Base Efficiency, to determine the points awarded)

##### Answers:

- Yes (Points manually entered in 3.3.6.2.1.1)
- No (0 points)
- N/A

##### ToolTip:

Refer to Table 3.3.6.2.1: Cooling Equipment Base Efficiency to determine the points awarded. For multiple pieces of equipment, calculate overall values based on a weighted area average of the capacity of the equipment. Some water chiller equipment efficiency is presented in kW/TR units. To convert to COP, divide 3.516 by the kW/TR [COP = 3.516 / (kW/TR)]. Mark "N/A" where there is no mechanical cooling.

##### References:

- *ANSI/ASHRAE/IES Standard 90.1-2010*

##### 3.3.6.2.1.1 Sub-Criteria:

Input points awarded per Table 3.3.6.2.1: Cooling Equipment Base Efficiency:

##### Answers:

- [numerical text field] points

Points are entered into the numerical text field for 3.3.6.2.1 per the table below:

**Table 3.3.6.2.1: Cooling Equipment Base Efficiency**

COP	EER	SEER	Points
≥ 2 to <3	≥ 6.8 to <10.2	≥ 10 to <13	1
≥ 3 to <4	≥ 10.2 to <13.7	≥ 13 to <16	2
≥ 4 to <5	≥ 13.7 to <17	≥ 16 to <20	3
≥ 5 to <6	≥ 17 to <20	≥ 20 to <23	4
≥ 6	≥ 20	≥ 23	5
Enter the appropriate points into the 3.3.6.1.1.2 field on the Green Globes survey.			
Some water chiller equipment efficiency is presented in kW/TR units. To convert to COP, divide 3.516 by the kW/TR [COP = 3.516 / (kW/TR)]			

### Assessment Guidance:

The above table is only for cooling equipment efficiencies and does not include heat pumps (see

3.3.6.4 Heat Pumps). The table above should be used for full load efficiency values only for all new cooling equipment on the project. If the project has existing to remain cooling equipment, that equipment can either be included in all Green Globes criteria or none.

#### Example 1 (Small, packaged rooftop unit):

The project is an existing building in an urban setting that is undergoing major renovations. Part of the renovations is to install a new, packaged rooftop unit with DX cooling and gas heat, 12,000 CFM supply and VFDs on the supply and exhaust fans. The unit's EER is 10.2. Table 3.3.6.2.1 then allocates 2 points for this piece of cooling equipment.

#### Example 2 (Chiller Plant):

The project is a new hospital building with a central plant. The central plant consists of 3 centrifugal, water cooled chillers. Each chiller is 725 tons, with 421 kW and an NPLV of 0.487. Given the COP formula in the tool tip, the COP for one of these chillers is 6.06. Table 3.3.6.2.1 then allocates 5 points for this piece of cooling equipment.

### 3.3.6.2.2 Criteria:

Does the cooling equipment base efficiency **exceed** ANSI/ASHRAE/IES Standard 90.1-2010 or ANSI/ASHRAE/IESNA Standard 90.1-2007 with respect to:

- Seasonal energy efficiency ratio (SEER)?
- or
- Integrated part-load value (IPLV)?

AND

- The Coefficient of performance (COP)?
- or
- Energy efficiency ratio (EER)?

### Answers:

- Yes (Points manually entered in 3.3.6.2.2.1)
- No (0 points)
- N/A

### ToolTip:

Refer to Table 3.3.6.2.2: Incremental Cooling Equipment Efficiency Improvement to determine the points awarded. Check rows to locate the value for the seasonal energy efficiency ratio (SEER) or integrated part-load value (IPLV). Check columns to locate the value for the coefficient of performance (COP) or energy efficiency ratio (EER). For multiple pieces of equipment, calculate overall values based on a weighted area average of the capacity of the equipment. Some water chiller equipment efficiency is presented in kW/TR units. To convert to COP, divide 3.516 by the kW/TR [COP = 3.516 / (kW/TR)]. Mark "N/A" where there is no mechanical cooling.

### References:

- ANSI/ASHRAE/IES Standard 90.1-2010
- ANSI/ASHRAE/IESNA Standard 90.1-2007

### 3.3.6.2.2.1 Sub-Criteria:

Input points awarded per Table 3.3.6.2.2: Incremental Cooling Equipment Efficiency Improvement:

### Answers:

- [numerical text field] points

Points are entered into the numerical text field for 3.3.6.2.2 per the table below.

**Table Incremental Cooling Equipment Efficiency Improvement**

ASHRAE 90.1 efficiency requirements (Path B where applicable) used as baseline			Incremental Seasonal or Part Load Efficiency Improvement [Part Load Value <IPLV or NPLV> or Seasonal Energy Efficiency Ratio <SEER>						
Maximum 6 points or N/A			SEER	0 to <1	≥ 1 to <1.5	≥ 1.5 to <2	≥ 2 to <2.5	≥ 2.5 to <3	≥ 3
			IPLV [EER]	0 to <1	≥ 1 to <1.5	≥ 1.5 to <2	≥ 2 to <2.5	≥ 2.5 to <3	≥ 3
			IPLV [COP]	0 to <0.4	≥ 0.4 to <0.5	≥ 0.5 to <0.6	≥ 0.6 to <0.7	≥ 0.7 to <0.8	≥ 0.8
Incremental Full Load Efficiency Improvement	EER	COP							
	0 to <1	0 to <0.2		0*	1	1.5	2	2.5	3
	≥ 1 to <1.5	≥ 0.2 to <0.4		1	1.5*	2	2.5	3	4
	≥ 1.5 to <2	≥ 0.4 to <0.6		1.5	2	2.5*	3	4	5
	≥ 2 to <2.5	≥ 0.6 to <0.7		2	2.5	3	4*	5	6
	≥ 2.5 to <3	≥ 0.7 to <0.8		2.5	3	4	5	6*	7
	≥ 3	≥ 0.8		3	4	5	6	7	8*
<b>Notes:</b> * If only the Full Load Efficiency is required by 90.1 for minimum efficiency, then the Seasonal or Part Load Efficiency is assumed to have a similar incremental improvement. The reverse is the case if only the Seasonal or Part Load Efficiency is required by 90.1 for minimum efficiency. Some water chiller equipment efficiency is presented in kW/TR units. To convert to COP, divide 3.516 by the kW/TR: COP = 3516 / (kW/TR)									
N/A for buildings with no cooling requirements									

### Assessment Guidance:

The above table is only for cooling equipment efficiencies and does not include heat pumps (see 3.3.6.4 Heat Pumps). The table above should be used for both the full load and part load efficiency values for all new cooling equipment on the project. If the project has existing to remain cooling equipment, that equipment can either be included in all Green Globes criteria or none.

The full and part load efficiency values for each piece of equipment should be compared to the minimum efficiency required by ANSI/ASHRAE/IES Standard 90.1-2010 or ANSI/ASHRAE/IESNA Standard 90.1-2007 – **not** the efficiencies listed in Sub-criteria 3.3.6.2.1. The difference (improvement) between the minimum ASHRAE required efficiencies (full and part load) and the actual specified efficiencies (full and part load) shall be used to determine point allocation for this criterion.

Example 1 (Small, packaged rooftop unit):

The project is an existing building in an urban setting that is undergoing major renovations. Part of the renovation is to install a new, packaged rooftop unit with DX cooling and gas heat, 50 tons capacity, 12,000 CFM maximum supply air and VFDs on the supply and exhaust fans. The unit's EER is 10.2.

ASHRAE 90.1-2010 Table 6.8.1A lists the minimum efficiency requirements for electrically operated unitary air conditioners and condensing units. For an air-cooled air conditioner with 600,000 Btu/hr capacity and natural gas heating, the minimum efficiency is listed as 9.8 EER. Therefore, the improvement is equal to 0.4.

Table 3.3.6.2.2 then allocates 0 points for this piece of cooling equipment since the specified EER improvement over ASHRAE is 0.4 and the note in Table 3.3.6.2.2 explains that for equipment that has only a full load efficiency requirement listed in *ANSI/ASHRAE/IES Standard 90.1-2010* then the seasonal or part load efficiency is assumed to have a similar incremental improvement.

Example 2 (Chiller Plant):

The project is a new hospital building with a central plant. The central plant consists of 3 centrifugal, water cooled chillers. Each chiller is 725 tons, with 421 kW and an NPLV of 0.487. The flow through the chiller is 2.2 gpm/ton and it has design conditions of 42°F leaving evaporator water temperature and 85°F entering condenser water temperature and 97.9°F leaving condenser water temperature. Given the COP formula in the tool tip, the COP for one of these chillers is 6.06.

ASHRAE 90.1-2010 Table 9.8.1C lists the minimum full and part load efficiency requirements for water chilling packages. There are two paths for efficiency requirements; Green Globes requires project use Path B.

For a 725 ton, water-cooled, electrically operated, centrifugal chiller the Path B efficiency requirements are:

- Full load kW/ton  $\leq 0.590$
- IPLV  $\leq 0.400$

Projects should note these efficiency requirements are based on chillers that are designed to operate at AHRI Standard 550/590 test conditions of 44°F leaving chilled-fluid temperature and 85°F entering condenser fluid temperature with 3 gpm/ton condenser fluid flow. When the equipment is not designed for operation at these conditions (like our example chiller), then the maximum full-load kW/ton and NPLV ratings given in Table 9.8.1C need to be modified per the adjustment factor calculated per *ANSI/ASHRAE/IES Standard 90.1-2010 Section 6.4.1.2.1*.

Given our example lift (difference between the condenser and evaporator leaving water temperature) is 55.9°F, the *ANSI/ASHRAE/IES Standard 90.1-2010 Section 6.4.1.2.1* adjustment factor for our chiller would be 0.8965. Therefore the adjusted maximum values are:

- Full load kW/ton  $\leq 0.658$  [which equates to COP  $\geq 5.34$ ]
- NPLV  $\leq 0.446$

Our example chillers incremental improvement for the COP = 0.72 and for the NPLV = 0 (NPLV of chiller is higher than ASHRAE requirement).

Table 3.3.6.2.2 then allocates 2.5 points for this piece of cooling equipment.

### 3.3.6.3 Cooling Towers

#### 3.3.6.3.1: Will any of the following measures be used in cooling towers to reduce fan energy consumption:



- Two speed fans?
- Variable speed fans?

- Other measures?

**Answers:**

- Yes **(4 points)**
- No **(0 points)**
- N/A

**ToolTip:**

Mark “N/A” if there is no cooling tower.

**3.3.6.3.2:** Is there a waterside economizer system with capacity to use outdoor air for cooling water?



**Answers:**

- Yes **(4 points)**
- No **(0 points)**
- N/A

**ToolTip:**

In lieu of a mechanical chilled water system. Mark “N/A” if there is no mechanical cooling

### 3.3.6.4 Heat Pumps

#### 3.3.6.4.1 Criteria:

What percentage does the heating efficiency for heat pump applications exceed *ANSI/ASHRAE/IESNA STANDARD 90.1-2010*, *ANSI/ASHRAE/IESNA Standard 90.1-2007*, or *International Energy Conservation Code (IECC) 2009* requirements for one of the following:

- Heating Seasonal Performance Factor (HSPF)?
- Coefficient of Performance (COP)?

**Answers:**

- $\geq 15\%$  **(6 points)**
- 13 - 14% **(5 points)**
- 11 - 12% **(4 points)**
- 9 - 10% **(3 points)**
- 7 - 8% **(2 points)**
- 5 - 6% **(1 point)**
- $< 5\%$  **(0 points)**
- No **(0 points)**
- N/A

**ToolTip:**

Values are for 47° degree Entering Air Temperature (EAT) or 68° Entering Water Temperature (EWT). For multiple pieces of equipment, the percentage improvement is the weighted average improvement based on equipment capacity. Mark “N/A” if there are no heat pump applications.

**References:**

- *ANSI/ASHRAE/IESNA Standard 90.1-2010*

- *ANSI/ASHRAE/IESNA Standard 90.1-2007*
- *International Energy Conservation Code (IECC) 2009*

### 3.3.6.5 Heating Equipment

#### 3.3.6.5.1 Criteria:

What percentage does the heating equipment exceed *ANSI/ASHRAE/IESNA Standard 90.1-2010*, *ANSI/ASHRAE/IESNA Standard 90.1-2007*, or *International Energy Conservation Code (IECC) 2009* for one of the following:

- Annual fuel utilization efficiency (AFUE)?
- Thermal efficiency ( $E_T$ )?
- Combustion Efficiency ( $E_C$ )?

#### Answers:

- $\geq 15\%$  **(8 points)**
- 13 - 14% **(7 points)**
- 11 - 12% **(6 points)**
- 9 - 10% **(5 points)**
- 7 - 8% **(4 points)**
- 5 - 6% **(3 point)**
- 3 - 4% **(2 points)**
- 1 - 2% **(1 points)**
- No **(0 points)**
- N/A

#### ToolTip:

Heating control specifications should indicate that the hydronic system temperatures are conducive to the efficiency claimed. For multiple pieces of equipment, calculate the percentage improvement as the weighted average improvement based on equipment capacity. Heating control specifications indicated hydronic system temperatures conducive to the efficiency claimed? Mark "N/A" if there is no heating.

#### References:


- *ANSI/ASHRAE/IESNA Standard 90.1-2010*
- *ANSI/ASHRAE/IESNA Standard 90.1-2007*
- *International Energy Conservation Code (IECC) 2009*

#### Assessment Guidance:

ASHRAE denotes which type of heating efficiency is used to evaluate performance for different types of equipment. The above efficiencies are not choices: only one type will apply to each type of heating equipment.

### 3.3.6.6 Condensate Recovery

#### 3.3.6.6.1 Criteria: Are steam heating systems (including district systems) equipped to recover and return condensate

(excluding trap losses)? 

#### Answers:

- $> 80\%$  condensate return **(3 points)**



- 65 - 79% **(2 points)**
- 50 - 64% **(1 point)**
- < 50% **(0 points)**
- No **(0 points)**
- N/A


**ToolTip:**

Mark "N/A" where there is no steam heating.

**Assessment Guidance:**

The project's mechanical plans should be submitted to show if a condensate return system is included in the steam heating system design. Typically, when a condensate return system is included, it is designed for 100% recovery, even though the actual recovery can be around 80-90% (not including system losses).

### 3.3.6.7 Steam Traps


**3.3.6.7.1 Criteria:** Are all steam trap designs sealed/stamped by a Professional Engineer? 

**Answers:**

- Yes **(1 point)**
- No **(0 points)**
- N/A

**ToolTip:**

Mark "N/A" if there are no steam traps.

**3.3.6.7.2 Criteria:** Are there isolation valves to allow all steam traps to be isolated for repairs? 

**Answers:**

- Yes **(1 point)**
- No **(0 points)**
- N/A

**ToolTip:**

Mark "N/A" if there are no steam traps.

**Assessment Guidance:**

For new construction projects, isolation valves should be included for all steam traps. In major renovation projects, however, this might not be the case for the existing system. Depending on the existing steam system's age, it may or may not have any isolation valves. Major renovation projects should verify that all existing traps have isolation valve and add additional if necessary. During the Design Review, provide the mechanical design plans and details showing isolation valves for all new or existing steam traps.

### 3.3.6.8 Domestic Hot Water Heaters

**3.3.6.8.1 Criteria:**

Do all domestic hot water heaters meet the efficiency requirements of *ANSI/ASHRAE/IESNA STANDARD 90.1-2010*, *ANSI/ASHRAE/IESNA STANDARD 90.1-2007*, or *International Energy Conservation Code (IECC) 2009*?

**Answers:**

- Yes **(2 points)**
- No **(0 points)**
- N/A

**ToolTip:**

Mark "N/A" if there are no domestic hot water heaters.

**References:**

- *ANSI/ASHRAE/IESNA Standard 90.1-2010*
- *ANSI/ASHRAE/IESNA Standard 90.1-2007*
- *International Energy Conservation Code (IECC) 2009*

**Assessment Guidance:**

This criterion is also considered N/A when the central boilers are used to produce domestic hot water via a heat exchanger.

**3.3.6.8.2 Criteria:**

Are all domestic hot water heaters equipped with intermittent electrical igniters and low NO<sub>x</sub> burners?

**Answers:**

- Yes **(1 point)**
- No **(0 points)**
- N/A

**ToolTip:**

Mark "N/A" if there are no domestic hot water heaters.

**Assessment Guidance:**

Natural gas water heaters can have electric ignition instead of a constantly burning pilot light. The electric ignition can be of the intermittent type that will only light the pilot (and then main burners) when the system calls for heat. This saves on auxiliary natural gas usage.

When fossil fuels are burned, nitric oxide and nitrogen dioxide are produced. These pollutants initiate reactions which result in the production of ozone and acid rain. The nitrous oxides (NO<sub>x</sub>) come from two sources: high-temperature combustion (thermal NO<sub>x</sub>) and nitrogen bound to the fuel (fuel NO<sub>x</sub>). For clean-burning fuels like natural gas, fuel NO<sub>x</sub> generation is insignificant. Almost all water heater manufacturers offer models with low NO<sub>x</sub> or ultra-low NO<sub>x</sub> burners. During the Design Review, provide specifications and/or product submittals showing all non-electric domestic water heaters have intermittent electrical igniters and have low-NO<sub>x</sub> burners.

This criterion is also considered N/A when the central boilers are used to produce domestic hot water via a heat exchanger.

### 3.3.6.9 Variable Speed Control of Pumps



**3.3.6.9.1:** What percentage of the connected hydronic pumping power is provisioned with variable speed control?

**Answers:**

- > 75% **(6 points)**
- 74 - 75% **(5 points)**
- 55 - 73% **(4 points)**
- 35 - 54% **(3 points)**
- 15 - 34% **(2 points)**
- < 15% **(0 points)**
- No **(0 points)**
- N/A

**ToolTip:**

Calculate percentage in terms of pumping power. Do not include pumps less than 3hp. Mark "N/A" where there is no hydronic system.

**Assessment Guidance:**

The percentages listed above are the total percent of equipment (by horse power) that is equipped with variable speed control.

## 3.3.7 Other HVAC Systems and Controls

### 3.3.7.1 Minimizing Reheat and Re-cool

**3.3.7.1.1 Criteria:**

Does the HVAC design minimize or eliminate re-heat and re-cool?

**Answers:**

- Eliminates re-heat and re-cool **(6 points)**
- Minimizes re-heat and re-cool **(3 points)**
- No **(0 points)**
- N/A

**ToolTip:**

A system that minimizes re-heat and re-cool would consist of controls that automatically re-set the main supply air temperature on central multiple zone HVAC systems, such as VAV, to minimize reheat and re-cool. A system that eliminates reheat and re-cool would consist of thermal and ventilation compartmentalization, with heating, cooling, and ventilation provided independently for each zone (e.g. fan coil systems, distributed heat pumps, single zone systems). Mark "N/A" where there is no mechanical cooling.

**3.3.7.1.1.1 Sub-Criteria:**

Describe the HVAC design utilized.

**Answers:**

- [text field] **(0 points)**

### **Assessment Guidance:**

To minimize re-heat and re-cool, projects should employ a control strategy that resets cooling supply air temperature in shoulder and cool weather seasons. This temperature setpoint may float between the range of 55°F to 65°F in cooler seasons while still meeting cooling demand in the building. During the reset mode, the project should use demand-based controls that use the warmest central supply air temperature setting that will satisfy all zones in cooling, thus reducing the need for reheat. In the warmest months, the advantages of supply air temperature reset are minute so a single setpoint is the most effective.

Other zonal systems that can be included for this criterion are variable refrigerant flow (VRF) systems and chilled beams. Projects should be careful when designing their projects around this criterion. It is important to note that the compartmental system can affect other Green Globes criteria. For example, there is often an energy benefit in shifting to hydronic systems in lieu of air based systems. Also, the filtration requirement (see 3.7.1.5 Air Handling Equipment) may be important when zonal systems can't manage the static pressure.

## **3.3.7.2 Air Economizers**

### **3.3.7.2.1 Criteria:**

Are there air economizers with a mode that uses outdoor air for cooling in place of mechanical cooling?

#### **Answers:**

- Yes **(1 point)**
- No **(0 points)**

### **3.3.7.2.2 Criteria:**

Are there controls to shut outdoor air and exhaust air dampers during periods when the system is not operating?

#### **Answers:**

- Yes **(1 point)**
- No **(0 points)**

### **3.3.7.2.3 Criteria:**

Are the dampers in the air handling system "low leakage"?

#### **Answers:**

- Yes **(1 point)**
- No **(0 points)**
- N/A

#### **ToolTip:**

"Low leakage" means dampers with leakage rates of less than 5% of design flow for air handling systems using outside air at a rate of 1,000 ft<sup>3</sup> per minute (28.3 m<sup>3</sup> per minute) or greater. Mark "N/A" where there are no air dampers.

### **Assessment Guidance:**

This criterion's 5% leakage rate requirement should be included in the project specifications and will be reviewed during the Onsite Assessment by the Assessor. If this requirement is not called out in the specifications, then damper submittals should be provided to the Assessor for review.

### 3.3.7.3 Fans and Ductwork

#### 3.3.7.3.1 Criteria:

Does the duct distribution system comprise the following:

- **3.3.7.3.1.1:** Diffusers and registers sized with a full flow pressure drop no greater than 0.01 in (0.03 cm) of water column?
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
    - N/A
- **3.3.7.3.1.2:** Noise criteria (NC) of 35 or less?
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
    - N/A
- **3.3.7.3.1.3:** Supply and return ductwork with a pressure drop no greater than 0.1 in (0.3 cm) of water column per 100 lineal feet (30.5 lineal meters)?
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
    - N/A

#### ToolTip:

Mark "N/A" where there is no ductwork.

#### Assessment Guidance:

During Design Review, either the Basis of Design document (see 3.1.3.1 Pre-Commissioning) or the project specifications will be checked for these design criteria. For engineered ductwork sizes, these design criteria should be included in the basis of design document or included in the specifications. For contractor selected ductwork, these criteria should be found in either the specifications or as a note on the design drawings.

#### 3.3.7.3.2 Criteria:

Are there the following requirements for flexible duct work:

- **3.3.7.3.2.1:** Flexible ductwork is no longer than 5 ft. (1.5 m) when fully stretched?
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
    - N/A
- **3.3.7.3.2.2:** The use of flexible ductwork is limited to only connections between duct branches and diffusers, and connections between duct branches and variable air volume terminal units?
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
    - N/A
- **3.3.7.3.2.3:** Durable elbow support is provided when flexible ductwork is used as an elbow?
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**

- N/A

**ToolTip:**

Mark “N/A” where there is no ductwork.

**References:**

- *SMACNA HVAC Duct Construction Standards - Metal and Flexible*

**Assessment Guidance:**

All flexible ductwork should comply with SMACNA’s *HVAC Duct Construction Standards - Metal and Flexible*. During Design Review review, the mechanical design drawings, details, and specifications will be checked to ensure the above sub-criteria being sought are included clearly in the contract documents.

**3.3.7.3.3 Criteria:**

Are the duct joints sealed and have the seams been leak-tested and found to have an overall leak rate that does not exceed 5%?

**Answers:**

- Yes **(1 point)**
- No **(0 points)**
- N/A

**ToolTip:**

This will be verified during the Onsite Assessment. Contractor must confirm that duct joints are sealed and seams have been leak-tested at the rated pressure. Mark “N/A” where there is no ductwork.

**Assessment Guidance:**

During Design Review, either the Basis of Design document (see 3.1.3.1 Pre-Commissioning) or the project specifications will be checked for this requirement.

**3.3.7.3.4 Criteria:**

Do motors for fans meet NEMA's Premium® “Energy Efficiency Motor Program”?

**Answers:**

- Yes **(1 point)**
- No **(0 points)**
- N/A

**ToolTip:**

This applies to motors equal to or greater than 1 hp. Mark “N/A” where there are no motors equal to or greater than 1 hp.

**3.3.7.3.5 Criteria:**

Are variable speed fans controlled by a duct pressure set-point or an energy management control system?

**Answers:**

- Yes **(2 points)**




- No (0 points)

**Assessment Guidance:**

Projects pursuing this criterion should allow the HVAC fan motor speed to vary while the system maintains any indoor air quality requirements stipulated by other codes or Green Globes criteria.

### 3.3.7.4 Demand Controlled Ventilation

#### 3.3.7.4.1 Criteria:

Are there occupancy and/or CO2 sensors to control ventilation rates in regularly occupied spaces that may experience frequent variations in the number of occupants? 

**Answers:**

- Yes (4 points)
- No (0 points)
- N/A

**ToolTip:**

The controls must be able to maintain compliance with applicable ventilation standards. Regularly occupied spaces do not include ancillary spaces such as corridors, lobbies, washrooms, storage, etc. "Frequent variations in the number of occupants", means predicted variances of 30% or more from the design occupancy for a minimum of 30% of normally occupied hours. Mark "N/A" if spaces meeting this criterion represent less than 40% of the total design ventilation volume of the building.

#### 3.3.7.4.2 Criteria:

Are the CO2 sensors capable of maintaining calibration within 2% for a one year period of operation? 

**Answers:**

- Yes (1 point)
- No (0 points)
- N/A

**ToolTip:**

Mark "N/A" if spaces meeting this criterion represent less than 40% of the total design ventilation volume of the building.

**Assessment Guidance:**

CO<sub>2</sub> sensing is used in building control strategies to optimize ventilation by approximating the level of occupancy in a space; this is commonly referred to as Demand Controlled Ventilation (DCV). The levels of CO<sub>2</sub> concentrations in the space are used in a mathematical formula that allows the system to modulate ventilation rates when the spaces have intermittent occupancy. Mechanical designers should be careful to ensure that the outdoor air intake rates never fall below those needed for proper building pressurization.

#### 3.3.7.4.3 Criteria:

Do the ventilation heat recovery systems include the following:

- **3.3.7.4.3.1:** Pressure-drop impact on fan power?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
    - N/A
- **3.3.7.4.3.2:** Bypass for economizer operation, if applicable?
  - **Answers:**
    - Yes **(2 points)**
    - No **(0 points)**
    - N/A
- **3.3.7.4.3.3:** MERV 13 Filtration?
  - **Answers:**
    - Yes **(2 points)**
    - No **(0 points)**
    - N/A

**ToolTip:**

Mark “N/A” for heating systems in *climate zones* 1 through 3, and cooling systems in *climate zones* 3c, 4c, 5b, 5c, 6b, 7 and 8. For all other *climate zones*, where there is no ventilation heat recovery, mark “no.”

### 3.3.7.5 Variable Refrigerant Flow Systems

#### 3.3.7.5.1 Criteria:

Does the HVAC design utilize Variable Refrigerant Flow (VRF) system technology?

**Answers:**

- Yes **(6 points)**
- No **(0 points)**
- N/A

**ToolTip:**

Mark as “N/A” if design teams have evaluated and rejected the VRF (or VRV) option after considering costs and energy losses associated with zoning, capacity and managing cooling/heating diversity, ease of retrofit or installation, duct minimization, and additional piping and controls for use of secondary fluids.

### 3.3.8 Other Energy Efficient Equipment and Measures

#### 3.3.8.1 Elevators and Escalators

##### 3.3.8.1.1 Criteria:

Are there regenerative braking elevators?

**Answers:**

- Yes **(3 points)**
- No **(0 points)**
- N/A

**ToolTip:**

Mark “N/A” where there are no elevators.

**Assessment Guidance:**

Regenerative elevators save energy because the motor acts as a generator and when the car goes down it pumps current back into the electrical network. Typically this regenerated energy will be absorbed by local electric loads before it reaches the building meter. According to ThyssenKrupp, elevators with regenerative drive systems save up to 50% energy over conventional systems<sup>13</sup>. These types of elevators are not typically used in low-rise buildings (5 stories or less).

**3.3.8.1.2: Mark N/A for Green Globes Multifamily for New Construction**

**3.3.8.2 Other Energy Efficient Equipment**

**3.3.8.2.1 Criteria:**

Is the building’s energy efficiency increased through the use of one or more of the following energy efficient equipment:

- **3.3.8.2.1.1:** Energy efficient lighting fixtures, lamps, and ballasts?
  - **Answers:**
    - Yes **(2 points)**
    - No **(0 points)**
- **3.3.8.2.1.2:** Energy efficient motors?
  - **Answers:**
    - Yes **(2 points)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** Mark “N/A” for system models – those with integral motors (e.g. rooftop HVAC units, pumps, or fans) – that do not come packaged with energy-efficient motors.
- **3.3.8.2.1.3:** Others?
  - **Answers:**
    - Yes **(2 points)**
    - No **(0 points)**
  - **ToolTip:** “Other” energy efficient equipment includes any equipment or appliance that consumes electricity or gas and is not addressed elsewhere in Green Globes for New Construction.

**ToolTip:**

This criterion applies to plug-in equipment and fixed building equipment. For plug in equipment, preference should be given to ENERGY STAR® and *Federal Energy Management Program (FEMP)* designated energy efficient equipment. Examples include: high efficiency product refrigeration equipment, hand dryers, diffusers, computer and reproduction equipment, etc. Any equipment addressed for energy efficiency elsewhere in Green Globes for New Construction is ineligible for points under this criterion.

**References:**

- ENERGY STAR *Qualified Product Lists:*  
[http://www.energystar.gov/index.cfm?c=product\\_specs.pt\\_product\\_prod\\_list](http://www.energystar.gov/index.cfm?c=product_specs.pt_product_prod_list)
- *Federal Energy Management Program (FEMP)-Energy and Water Efficient Products:*

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<sup>13</sup> ThyssenKrupp Elevator, visited on April 22, 2013, <http://sustainability.thyssenkrupp-elevator.com/en/products/drive-systems/>

<http://energy.gov/eere/femp/energy-and-water-efficient-products>

#### 3.3.8.2.1.3.1 Sub-Criteria:

Describe other energy efficient products (if any):

##### Answers:

- [text field] (0 points)

##### References:

- ENERGY STAR *Qualified Product Lists*:  
[http://www.energystar.gov/index.cfm?c=product\\_specs.pt\\_product\\_prod\\_list](http://www.energystar.gov/index.cfm?c=product_specs.pt_product_prod_list)
- *Federal Energy Management Program's (FEMP) -Guide for Federal Purchasers and Specifiers.*:  
[http://energy.gov/sites/prod/files/2013/10/f3/buyer\\_overview.pdf](http://energy.gov/sites/prod/files/2013/10/f3/buyer_overview.pdf)

##### Assessment Guidance:

Process energy, often referred to as plug loads, can be a significant contributor to a building's overall energy use. Projects should look to install ENERGY STAR® vending machines, computers, printers, televisions, servers, UPS, and other appliances. Additionally, this criterion can be used for any other HVAC or lighting energy efficiency measure that has not already been covered by Green Globes criteria. For information, see *ENERGY STAR Qualified Product Lists* and the *Federal Energy Management Program's (FEMP) -Guide for Federal Purchasers and Specifiers*.

### 3.3.9 Renewable Sources of Energy

#### 3.3.9.1 Onsite Renewable Energy:

##### 3.3.9.1.1 Criteria:

Has a Study been conducted to determine the technical feasibility and life-cycle cost effectiveness of onsite renewable energy?

##### Answers:

- Yes (9 points)
- No (0 points)

##### ToolTip:

Review feasibility study findings and the construction documents for use of renewable energy technology such as wind, biomass, geothermal, photovoltaics, solar, etc.

For Federal building projects, meet at least 30% of the hot water demand through the installation of solar hot water heaters, in addition to implementing renewable energy generation projects for agency use, when lifecycle cost effective.

##### References:

- Guide to Integrating Renewable Energy in Federal Construction:  
<http://energy.gov/eere/femp/downloads/guide-integrating-renewable-energy-federal-construction>
- Clean Energy in My State:  
<http://apps1.eere.energy.gov/states/>
- Building Life Cycle Cost Programs:  
<http://energy.gov/eere/femp/building-life-cycle-cost-programs>

### Assessment Guidance:

For Federal building projects, this criterion is applicable for any solar domestic or service hot water application. Solar domestic water heating systems, can efficiently serve up to 80% of hot water needs—with minimal operation and maintenance (O&M) expense. Federal facilities generally use the rule of thumb that a solar water heating installation will pay for itself within 10 to 15 years when installed against electricity<sup>14</sup>. Solar domestic water heating systems are most effective when the hot water load is constant throughout the day and year.

The *Office of Energy Efficiency & Renewable Energy (EERE)* website includes the comprehensive Guide to Integrating Renewable Energy in Federal Construction, which includes guidance on renewable energy feasibility studies, life-cycle cost analysis of renewable energy, and assessment of renewable energy options. This information is directed toward federal managers, thus constituting an official procedure for determining the feasibility of incorporating renewable energy in a building project. Links to this guide can be found in the Reference Section below.

### Supporting Documentation:

- Onsite renewable energy feasibility studies

#### 3.3.9.1.2 Criteria:

Were the recommendations of the Feasibility Study implemented?

#### Answers:

- Yes **(23 points)**
- Partially **(11 points)**
- Feasibility study completed & not lifecycle cost effective **("N/A")**
- No **(0 points)**

#### ToolTip:

If not Feasibility Study has been completed, mark "no." Where a Feasibility Study has been done, which recommends "no renewable energy," mark "yes."

#### 3.3.9.2 Off-Site Renewable Energy

##### 3.3.9.2.1 Criteria:

Has the building owner committed to sign a contract to purchase either certified "green" power or certified renewable energy certificates (RECs) with a minimum three-year commitment; and if so, for what percentage of total electrical consumption of the building?

#### Answers:

- ≥ 40% **(18 points)**
  - 20 - 39% **(14 points)**
  - 10 - 19% **(10 points)**
  - < 10% **(0 points)**
  - No **(0 points)**
- 

<sup>14</sup> "Solar Water Heating", Whole Building Design Guide (WBDG), last modified August 24, 2012, <http://www.wbdg.org/resources/swheating.php>

### **Assessment Guidance:**

“Renewable Energy Certificates (RECs), also known as Green tags, Renewable Energy Credits, Renewable Electricity Certificates, or Tradable Renewable Certificates (TRCs), are tradable, non-tangible energy commodities that represent proof that 1 megawatt-hour (MWh) of electricity was generated from an eligible renewable energy resource (renewable electricity).<sup>15</sup>” RECs incentivize carbon-neutral renewable energy by providing a production subsidy to electricity generated from renewable sources. RECs are offsets and are paid in addition to the building’s normal energy bill from the utility company. The quantity of RECs purchased are equal to a percentage of the building’s predicted energy usage from the proposed energy model created in 3.3.1 Energy Performance.

Alternately, if applicable to the project’s state, an owner can choose to purchase “green” power from a retail electric supplier (RES) or their regulated utility. The term “green power” generally refers to electricity supplied in whole or in part from renewable energy sources, such as wind and solar power, geothermal, hydropower, and various forms of biomass. The RES or regulated utility will typically offer “green pricing programs.” According to the US DOE “green” pricing programs “refers to an optional utility service that allows customers to support a greater level of utility investment in renewable energy by paying a premium on their electric bill to cover any above-market costs of acquiring renewable energy resources.” Some “green power” programs offer to purchase RECs for the client to offset any energy used from the utility that was not produced via renewable energy sources. The difference between this and not purchasing the RECs through the utility is that the REC purchasing contract is typically signed and paid before actual energy usage is known, whereas if the utility purchases the RECs, the quantity will be based on the actual energy usage used by the client during the specified time frame.

For the Onsite Assessment, the predicted annual energy usage calculated from 3.3.1 Energy Performance should be used to negotiate any “green” power or REC contracts. The executed agreements should be provided to demonstrate compliance.

## **3.3.10 Energy Efficient Transportation**

### **3.3.10.1 Criteria:**

Is the site located within 0.25 mi (0.4 km) of a public transportation facility such as a public bus stop or train-stop?

#### **Answers:**

- Yes (10 points)
- No (0 points)

#### **ToolTip:**

Review the location and the site plan to verify that there is good access to public transport systems.

### **Assessment Guidance:**

Projects should investigate public transportation access to the potential project sites. If no public transit stop exists, talk to the local transit authority to investigate ways to add a bus or train stop. Larger complexes can also institute their own shuttle bus system that provides a way for commuters or guests to get from the site to a nearby public transportation facility.

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<sup>15</sup> Renewable Energy Certificate (United States). (n.d.). In Wikipedia. Retrieved February 11, 2014, from [http://en.wikipedia.org/wiki/Renewable\\_Energy\\_Certificate\\_%28United\\_States%29](http://en.wikipedia.org/wiki/Renewable_Energy_Certificate_%28United_States%29)



The Assessor may request to review site civil plans and existing site civil plans; site plans that show the building, parking, street access, etc. and civil engineering plans that show topography, drainage and infrastructure.

### 3.3.10.2 Criteria:

Will there be designated preferred parking for car/van pooling, and shelter from weather for persons waiting for a lift?

#### Answers:

- Yes (2 points)
- No (0 points)

#### ToolTip:

Review the site plan to verify that it includes space for preferred parking for car-van pooling, and shelter from weather for persons waiting for a ride.

### 3.3.10.3 Criteria:

Are there alternative fuel re-fueling facilities or electric charging stations on site or in the general vicinity?

#### Answers:

- Yes (5 points)
- No (0 points)
- N/A

#### ToolTip:

Review the site plan to verify that alternative-fuel re-fueling facilities are reasonably accessible. For verification purposes, the piping and dispensing facilities must be in place to be awarded points. Where this strategy is not appropriate, mark "N/A".

#### Assessment Guidance:

Alternative-fuel vehicles can run on a number of fuels beside petrol or diesel including electric power, biodiesel, ethanol or bio-alcohol, hydrogen, compressed natural gas, liquefied natural gas, and liquefied petroleum gas (LPG). Currently, electric and ethanol are the most common re-fueling facilities, with electric charging stations becoming more prevalent.

Projects where an electric charging station might not be appropriate can include multi-family housing buildings where it would be difficult to install the infrastructure required to recoup the installation and properly allocate usage costs. Also, a client can mark "N/A" where projects will have no parking associated with their building.

### 3.3.10.4 Criteria:

Is the site located within 0.25 mi (0.4 km) of a public bicycle path, multi-user path, or on a road with an existing dedicated bicycle lane?

#### Answers:

- Yes (3 points)
- No (0 points)

#### Assessment Guidance:

The Assessor may request to review site civil plans and existing site civil plans; site plans that show the building, parking, street access, etc. and civil engineering plans that show topography, drainage and infrastructure.

### 3.3.10.5 Criteria:

Is there sheltered bicycle parking for:

- At least 5% of the maximum number of office building occupants?
- or
- At least 50% of units in a multi-family residential building?

#### Answers:

- Yes **(3 points)**
- No **(0 points)**

#### Assessment Guidance:

Projects pursuing this criterion should provide a narrative that states the total expected full-time building occupants.

### 3.3.10.6 Criteria:

Is the building's walkability index greater than 75%?

#### Answers:

- Yes **(1 point)**
- No **(0 points)**

#### ToolTip:

Check the walkability score by entering the building's address into the *Walk Score* website, [www.walkscore.com](http://www.walkscore.com).

#### References:

- *Walk Score*:  
<https://www.walkscore.com/>

## 3.4 WATER

### 3.4.1 Water Consumption

#### 3.4.1.1 Criteria:

Using the Green Globes Water Consumption Calculator, is the projected water consumption of the building less than the given baseline?

#### Answers:

- $\geq 40\%$  **(24 points)**
- 35 - 39% **(18 points)**
- 30 - 34% **(12 points)**
- 25 - 29% **(6 points)**
- $< 25\%$  **(0 points)**

#### ToolTip:

The Green Globes Water Consumption Calculator provides a value for a baseline scenario and a value for the performance of the building. Where the projected performance is better than the baseline, points are awarded based on the % difference.

#### Assessment Guidance:

The Green Globes Water Consumption Calculator is designed to provide the user with a simple and standard means of determining expected indoor water use on a proposed project and compare that use against a baseline water consumption profile of the building.

The calculator's water consumption thresholds for individual water-consuming items are based either upon (1) the maximum water use as defined in various ASME/ANSI national plumbing standards or (2) in the absence of a provision in the prevailing standards, common practice in the field of new construction. Where the various national plumbing codes are more stringent than the national standard, the code-mandated thresholds are used for the baseline.

The following indoor fixtures, fixture fittings, and appliances are accounted for in the calculator:

#### Plumbing Fixtures and Fixture Fittings

- Toilets
- Urinals
- Residential showerheads
- Residential kitchen faucets
- Residential lavatory faucets
- Commercial lavatory faucets

#### Appliances

- Residential dishwaters
- Residential clothes washers

The daily (or annual) per person use of the above fixtures and appliances is based upon studies conducted and documented by water efficiency professionals and others<sup>16</sup>. Appliance use (full cycles per year) are based upon studies

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<sup>16</sup> Two such documents are the *Handbook of Water Conservation*, by Amy Vickers and the *Residential End Uses of Water Study*, by Aquacraft, Inc. for the American Water Works Association Research Foundation (1999).

and publications of the ENERGY STAR® Program. The project proponent is allowed to vary these figures based upon expected real world applications.

The calculator requires the user to enter specific building data into the following fields of variables:

Proposed Building Physical and Occupancy Factors

- Building gross square footage
- Building net usable square footage
- Total expected occupancy count and male/female ratio
- Net usable square feet per person (for non-residential)
- Work or occupancy days per year (for non-residential)
- Number of residential dwelling units
- Water factor for residential dishwashers
- Water factor for residential clothes washers (if installed)

Personal Usage (residential)

- Daily flush fixture usage
- Daily usage of residential lavatory faucets
- Daily usage of residential kitchen faucets
- Residential showerhead usage (minutes per shower)

The calculator determines the water use by the proposed building's plumbing fixtures, fixtures fittings, and appliances and totals that water use to compare it with the baseline condition.

### 3.4.1.2 Criteria:

Are any following plumbing fixtures and fittings certified as being compliant with the requirements of the U.S. EPA's WaterSense Program?

- **3.4.1.2.1:** Toilets (Maximum effective flush volume 1.28 gallons)?
  - **Answers:**
    - Yes **(2 points)**
    - No **(0 points)**
- **3.4.1.2.2:** Mark N/A for Green Globes Multifamily for New Construction
- **3.4.1.2.3:** Showerheads (Maximum effective flow rate 2.0 gallons per minute)?
  - **Answers:**
    - Yes **(2 points)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** Mark "N/A" where there are no showers.
- **3.4.1.2.4:** Residential lavatory faucets (Maximum flow rate 1.5 gallons per minute)?
  - **Answers:**
    - Yes **(2 points)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** Mark "N/A" where there are no residential lavatory faucets.
- **3.4.1.2.5:** Residential kitchen faucets (Maximum flow rate 2.2 gallons per minute)?
  - **Answers:**
    - Yes **(2 points)**
    - No **(0 points)**
    - N/A

- **ToolTip:** Mark “N/A” where there are no residential kitchen faucets.

#### 3.4.1.2.6: Mark N/A for Green Globes Multifamily for New Construction

### References

- *The green Spotlight- Switch to High-Efficiency Plumbing Fixtures to Save Water, Energy, and Money, August 25, 2010:*  
<http://www.thegreenspotlight.com/2010/08/high-efficiency-water-saving-plumbing-fixtures/>
- U.S. Environmental Protection Agency (EPA)- WaterSense Program:  
[http://www.epa.gov/watersense/product\\_search.html](http://www.epa.gov/watersense/product_search.html)

### Assessment Guidance:

Plumbing engineers and architects for the project should specify plumbing fixtures that comply with the WaterSense program. WaterSense is a program that partners with the U.S. EPA in hopes to reduce water usage by providing information on water-efficient fixtures, new homes and services. WaterSense created a certification program that provides third-party validation that plumbing fixtures utilize at least 20% less water than the average peer product without sacrificing performance. Products that go through this certification can display the WaterSense label.



Currently, not all plumbing products can be certified through WaterSense. The following items can be found with the label:

- Bathroom lavatory faucets and accessories
- Showerheads
- Toilets
- Urinals
- Weather-based irrigation controllers (see 3.4.8 Irrigation)

Designers can verify with their fixture manufacturers which of their products have the label or can check online at [http://www.epa.gov/watersense/product\\_search.html](http://www.epa.gov/watersense/product_search.html).

Early in the green building timeline, some building engineers were hesitant about using lower flow fixtures, especially toilets. It was feared the performance would not be comparable to its higher flow counterpart and that plumbing drain lines would get clogged more frequently. Unfortunately there was not sufficient industry data at the time to prove performance in existing buildings would not suffer. Finally, a study was conducted by the Plumbing Efficiency Research Coalition and a report released in November 2012. This report concluded that the use of 1.28 gallons per flush (gpf) toilets perform similar to 1.6 gpf when all other factors, including pipe slope, are considered.

Large advances have been made in plumbing fixture design and users can be more confident that the low-flow/high efficiency products on today's market have been tried and tested. However, this is not to say that all products perform alike. Designers should carefully consider which products to use and weigh the anticipated use, ease of maintenance, warranties, and published performance criteria for all fixtures. Once a decision has been made, the required maximum flow and flush rates should be called out for the project on the design drawings (in a plumbing fixture schedule) or in the specifications.

To avoid performance and maintenance problems, it is important to adhere to manufacturer recommendations and guidelines for the installation and operation of lowflow fixtures and connected plumbing components. When specifying lower flow fixtures, there are some recommended design tips that should be considered to ensure the plumbing drainage system is easy to maintain and kept clear of blockages. For example, drain lines for low flow toilets should be sloped at 2% (standard is 1%). Also, toilets should be placed at the end of the drain line, with low flow urinals and lavatory faucets placed closer to the riser.

Waterless urinals are available for even greater water savings but some authorities having jurisdiction do not allow their use and they should only be used in applications where the special trap fluid will be adequately maintained.

Public lavatory faucets should be kept to 0.5 gallons per minute or less and metering faucets with a flow rate of less than 0.25 gallons per 10 second cycle.

For the review, the Green Globes Assessor will be looking for published fixture flush and flow rates for all plumbing fixtures utilized in the design. The Assessor will also verify that these fixtures were installed during Onsite Assessment with spot checking.

#### **3.4.1.3 Criteria:**

If any water fixtures not addressed by the WaterSense program requirements were used in the project design, were projected consumption rates for these fixtures determined and entered into the Green Globes Water Consumption Calculator?

**Answers:**

- Yes **(2 points)**
- No **(0 points)**
- N/A

**ToolTip:**

Mark "N/A" where there are no plumbing fixtures and fittings not addressed by the WaterSense program requirements.

#### **3.4.1.4 Criteria:**

Are residential clothes washers ENERGY STAR® labeled with a maximum water factor of 6.0 gal/ft<sup>3</sup> (23 L/m<sup>3</sup>) per full cycle?

**Answers:**

- Yes **(2 points)**
- No **(0 points)**
- N/A

**ToolTip:**

Mark "N/A" where there are no clothes washers.

**Assessment Guidance:**

For Design Review, the Assessor will be looking for published water use rates and ENERGY STAR® labeling for all clothes washers in the design. The Assessor will also verify that these fixtures were installed during Onsite Assessment with spot checking.

#### **3.4.1.5 Criteria:**

Are residential dishwashers ENERGY STAR® labeled with a maximum water factor of 5.8 gal/ft<sup>3</sup> (22 L/m<sup>3</sup>) per full cycle?

**Answers:**

- Yes **(2 points)**
- No **(0 points)**
- N/A



**ToolTip:**

Mark "N/A" where there are no dishwashers

**Assessment Guidance:**

For Design Review the Assessor will be looking for published water use rates and ENERGY STAR® labeling for all residential dishwashers in the design. The Assessor will also verify that these fixtures were installed during the Onsite Assessment with spot checking.

## 3.4.2 Cooling Towers

### 3.4.2.1 Criteria:

Do cooling towers minimize the amount of make-up water by achieving one of the following:

- A minimum of 5 cycles of concentration for makeup water having less than or equal to 200 ppm (200 mg/L) total hardness as calcium carbonate or 3.5 cycles for makeup water with more than 200 ppm (200 mg/L) total hardness as calcium carbonate?
- or*
- A minimum discharge conductivity of 1500 micromhos/cm or maximum of 150 ppm (150 mg/L) of silica measured as silicon dioxide?

**Answers:**

- Meets minimum cycles of concentration **(2 points)**
- Meets minimum discharge conductivity **(2 points)**
- No **(0 points)**
- N/A

**ToolTip:**

"Make-up water" means the amount of water needed to replace water lost in a cooling tower due to evaporation (the primary function of the tower), drift (water that is carried away as mist or small droplets), and blowdown (water that must be removed and replaced in order to control the amount of dissolved minerals that builds up). "Concentration cycles" means the ratio of the concentration of dissolved solids (or conductivity) in the blowdown water compared to the make-up water. The higher the concentration cycle the less make-up water is needed. Mark "N/A" where there are no wet-cooling towers.

**Assessment Guidance:**

The Assessor may request to review the performance documentation for cooling equipment, makeup meter, blowdown meter, drift eliminators, conductivity controllers and wet/dry cooling towers as well as plumbing plans.

### 3.4.2.2 Criteria:

Do cooling towers exceed the minimum water quality criteria above (3.4.2.1) by 20% or more?

**Answers:**

- Yes **(1 point)**
- No **(0 points)**
- N/A

### 3.4.2.3 Criteria:

Are there flow meters on the make-up and blowdown lines, and conductivity controllers?

#### Answers:

- Yes **(1 point)**
- No **(0 points)**
- N/A

#### ToolTip:

Flow meters make it possible to check the ratio of make-up flow to blow-down flow. Where make-up water is greater than blowdown, this may indicate that there is a leak in the system. Conductivity controllers continuously monitor the ratio of the conductivity of the cooling tower water and the make-up water, and automatically discharge water when the maximum concentration cycle is point is reached. Mark "N/A" where there are no wet-cooling towers.

### 3.4.2.4 Criteria:

What percentage of cooling consists of dry cooling?

#### Answers:

- 75 - 100% dry cooling **(3 points)**
- 51 - 74% dry cooling **(2 points)**
- 21 - 50% dry cooling **(1 point)**
- < 21% dry cooling **(0 points)**
- N/A

#### ToolTip:

Dry cooling does not use evaporative cooling of a working fluid (usually water). Instead, heat is transferred through a surface that separates the working fluid from ambient air such as in a tube to air heat exchanger that uses convective heat transfer. Mark "N/A" where there is a good reason why air cooling is not appropriate.

### 3.4.2.5 Criteria:

Are cooling tower(s) equipped with drift eliminators that achieved an efficiency of 0.001% or less for **counterflow** systems?

or

0.005% or less for **crossflow** systems?

#### Answers:

- Yes (counterflow) **(2 points)**
- Yes (crossflow) **(2 points)**
- No **(0 points)**
- N/A

#### ToolTip:

"Drift" means the quantity of water that may be carried from the tower as mist or small droplets. Drift loss is small compared to evaporation and blowdown. Drift is controlled with baffles and drift eliminators. In crossflow cooling, the air

travels horizontally across the direction that the medium is falling. In counterflow cooling, the air travels upward in the opposite direction that the cooling medium is falling. Mark "N/A" where there are no wet-cooling towers.

### 3.4.3 Boilers and Water Heaters

#### 3.4.3.1 Criteria:

Do boilers and/or water heaters have the following features:

- **3.4.3.1.1:** Boilers and water heating systems of 50 bhp and above have a boiler feed makeup meter?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** Mark "N/A" where boilers are less than 50 boiler horsepower (BHP).
- **3.4.3.1.2:** Boiler systems with over 50 bhp have condensate return systems?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** Mark "N/A" where there will be no steam boilers or where steam boilers are less than 200 boiler horsepower (BHP).
- **3.4.3.1.3:** Boilers have conductivity controllers?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** Mark "N/A" where boilers are less than 50 boiler horsepower (BHP).
- **3.4.3.1.4:** Steam boilers have conductivity meters?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** Mark "N/A" where there will be no steam boilers or for steam boilers less than 200 boiler horsepower (BHP).

### 3.4.4 Water Intensive Applications

#### 3.4.4.1 Commercial Food Service Equipment


##### 3.4.4.1.1 Criteria:

Do food services avoid water intensive equipment as follows:

- **3.4.4.1.1.1:** Mark N/A for Green Globes Multifamily for New Construction
- **3.4.4.1.1.2:** Mark N/A for Green Globes Multifamily for New Construction

#### 3.4.4.1.2 Criteria:

Do the following appliances meet the prescribed limits for water usage:

- **3.4.4.1.2.1:** Combination ovens consuming 0 gal/hr. (39L/hr.) or less? 

- **Answers:**

- Yes **(1 point)**
- No **(0 points)**
- N/A

**ToolTip:** Mark "N/A" where there are no combination ovens.

- **3.4.4.1.2.2:** Pre-rinse spray valves for dish-rinsing consuming 1.5 gal/min (5.7 L/min) or less? 

- **Answers:**

- Yes **(1 point)**
- No **(0 points)**
- N/A

**ToolTip:** Mark "N/A" where there is no pre-rinsing.

- **3.4.4.1.2.3:** Boilerless/connectionless food steamers consuming less than 2 gal/hr. (7.5 L/hr.) or less? 

- **Answers:**

- Yes **(1 point)**
- No **(0 points)**
- N/A

- **ToolTip:** Mark "N/A" where there are no food steamers.

- **3.4.4.1.2.4:** Mark N/A for Green Globes Multifamily for New Construction

#### 3.4.4.2 Laboratory and Medical Equipment

##### 3.4.4.2.1 Criteria:

Are steam sterilizers equipped with the following:

- **3.4.4.2.1.1:** Mark N/A for Green Globes Multifamily for New Construction
- **3.4.4.2.1.2:** Mark N/A for Green Globes Multifamily for New Construction

**3.4.4.2.2:** Mark N/A for Green Globes Multifamily for New Construction

**3.4.4.2.3:** Mark N/A for Green Globes Multifamily for New Construction

**3.4.4.2.4:** Mark N/A for Green Globes Multifamily for New Construction

**3.4.4.2.5:** Mark N/A for Green Globes Multifamily for New Construction

#### 3.4.4.3 Laundry Equipment

##### 3.4.4.3.1 Criteria:

Do coin or card-operated laundromat machines meet the prescribed water factor (WF) performance as follows (if applicable):

- Single-load, soft- or hard-mounted laundromat washing machines with a WF of 8 gal/ft<sup>3</sup> or less?  
*and/or*
- Multi-load washing machines with a WF of 9.5 gal/ft<sup>3</sup> or less?

**Answers:**

- Yes **(2 points)**
- No **(0 points)**
- N/A

**ToolTip:**

“Water Factor (WF)” means volume of water per unit of capacity of the washing machine (in L/m<sup>3</sup> or gal/ft<sup>3</sup>) for a full cycle. “Soft-mount” means not bolted to the floor. “Hard-mount” means bolted to the floor. “Single load” means up to 22 lbs. (10 kg). “Multi-load washing machine” means a washer that can take over 22 lbs. (10 kg) per load. Mark “N/A” where there are no coin- and card-operated machines.

**References:**

- ENERGY STAR- What are “Modified Energy Factor” and “Water Factor” on ENERGY STAR qualified clothes washers list?  
<http://energystar.supportportal.com/link/portal/23002/23018/Article/22026/What-are-Modified-Energy-Factor-and-Water-Factor-on-the-ENERGY-STAR-qualified-clothes-washers-list>

**Assessment Guidance:**

If the WF value is not displayed on the affixed nameplate, or is not assessable, provide the relevant manufacturer’s documentation.

**3.4.4.3.2:** Mark N/A for Green Globes Multifamily for New Construction

**3.4.4.4 Special Water Features**

**3.4.4.4.1 Criteria:**

Do special water features (e.g. swimming pools, spas, ornamental fountains, water playscapes, etc.) filter and re-circulate water for reuse within the system?

**Answers:**

- Yes **(2 points)**
- No **(0 points)**
- N/A

**ToolTip:**

Mark “N/A” where there are no special water features.

**3.4.4.4.2 Criteria:**

Do special water features use alternate sources of water for makeup water?

**Answers:**

- Yes **(1 point)**

- No **(0 points)**
- N/A

**ToolTip:**

Mark "N/A" where there are no special water features or where alternate sources of water would be unsuitable.

**References:**

- *Extension America's Research-based Learning Network - Water Features, Conserving Water*  
[http://www.extension.org/pages/62440/water-features:-conserving-water#.U63zEZ3n9\\_8](http://www.extension.org/pages/62440/water-features:-conserving-water#.U63zEZ3n9_8)

**Assessment Guidance:**

See 3.4.6 Alternate Sources of Water for potential alternative sources of non-potable water. When utilizing alternative sources of water for special water feature makeup, be sure to consult with the water feature designer for any special water filtration or treatment systems that will be needed.

## 3.4.5 Water Treatment

### 3.4.5.1 Criteria:

Are filtration systems equipped with pressure drop gauges that allow backwash to be based on pressure drop and not on timers?

**Answers:**

- Yes **(1 point)**
- No **(0 points)**
- N/A

**ToolTip:**

Mark "N/A" where there is no water treatment system.

**Assessment Guidance:**

Typically, water filtration systems will backwash on a time-dependent basis but this method can waste water when the filter is backwashed prematurely. These same filters can be fitted with pressure gauges that will monitor the pressure drop through the filter and utilize this measurement for the frequency of backwash.

### 3.4.5.2 Criteria:

Is reverse osmosis provided that achieves one of the following:

- Rejects less than 70% of feedwater volume for a system that produces less than 100 gal. (380 L) per day?
- or
- That rejects less than 60% of feedwater for a system that produces more than 100 gal. (380 L) per day?

**Answers:**

- Rejects < 70%, and less than 100 gal. per day are produced **(1 point)**
- Rejects < 60%, and more than 100 gal. per day are produced **(1 point)**
- No **(0 points)**
- N/A

**ToolTip:**

Mark "N/A" where there is no water treatment system.



### **Assessment Guidance:**

Reverse Osmosis (RO) is a type of treatment that removes dissolved solids from the source water. This water can then be used for medical or laboratory purposes. Unfortunately the RO process for purifying the water results in significant amounts of water usage. For typical RO systems almost four gallons of water go down the drain for every one gallon of pure water produced. That equates to an efficiency of only 20%. Newer RO technology allows for machines to have up to 80% efficiency through the use of high efficiency membranes and advanced pumping technology. Projects should incorporate RO systems that meet demand with a minimum 60% efficiency. During the Design Review the RO system(s) performance specifications should be included in the contract documents sent to the Assessor.

#### **3.4.5.3 Criteria:**

Are water softeners equipped with recharge controls based on volume of water treated or hardness, and not on timers?

#### **Answers:**

- Yes **(1 point)**
- No **(0 points)**
- N/A

#### **ToolTip:**

Mark "N/A" where there is no water treatment system.

### **Assessment Guidance:**

A water softener must recharge intermittently to flush away hard minerals that collect from the water supply. Water softeners frequency of recharge can be based on a time interval, measured levels of hardness or volume of water treated. Having the water softener regeneration cycle based on actual performance conditions (hardness or water volume) will save water and salt. Projects should specify water softeners with built-in automation technology that sets the regeneration cycle based on these parameters.

## **3.4.6 Alternate Sources of Water**

#### **3.4.6.1 Criteria:**

What percentage of water for non-potable uses will be harvested onsite or reclaimed?

#### **Answers:**

- > 50% **(5 points)**
- 25 - 50% **(3 points)**
- 10 - 24% **(1 point)**
- < 10% **(0 points)**

#### **ToolTip:**

"Water for non-potable uses" refers to water used in building applications, i.e. toilets flushing or irrigation but not suitable for drinking. "Onsite harvested water" includes rain and storm water. "Reclaimed water" includes air conditioner condensate, cooling tower blowdown, foundation drain water, greywater, pass-through cooling water, recycled, treated wastewater, swimming pool filter or backwash water. Onsite sources and reclaimed sources can be combined in a building for non-potable water use.

### **Assessment Guidance:**

Recycling alternate sources of water to be used in the building's non-potable applications is the best way to reduce fresh/potable water usage and wastewater generation. Non-potable water applications that could use this reclaimed water include:

- Flushing building toilets and urinals
- Irrigation
- Cooling water for power plants or oil refineries
- Industrial processes
- Concrete mixing
- Dust control

It is important in the early stages of design to review the quality and amount of the water to be recycled, as these impact the available uses and treatment. All projects incorporating reclaimed/recycled water should ensure compliance with the EPA's *Guidelines for Water Reuse*. Local authorities having jurisdiction will have standards that reclaimed water must be treated and filtered to in order to be reused. Reclaimed water is often distributed with a dual piping network that keeps reclaimed water pipes completely separate from potable water pipes. In the United States, reclaimed water is always distributed in purple pipes to distinguish it from fresh/potable water.

Air conditioning condensate does not contain soaps, chlorine or other chemicals so it is typically considered a very clean source of reclaimed water. While most gray water is alkaline, air conditioner condensate is neutral. It should not be used for applications where the pH balance of the water is vital, such as aquariums. Air conditioning condensate, though clean, is not safe for consumption without special filtering and treatment.

Cooling tower blowdown water tends to have very high hardness and total suspended solids levels, which can lead to scaling in the reclaimed water system and downstream components. To counteract this, the captured blowdown water will need to be diluted, possibly with another source such as harvested rainwater, or treated to neutralize it. One benefit of using cooling tower (and air conditioning condensate) water is that these sources are more consistent and over time will produce far more volume than other sources, like rainwater.

Foundation drain water, also called subsoil drainage water, will vary from project to project, with projects that have high subsoil water conditions having the most practical use for capturing and recycling this water. Since this water has already been pre-filtered by the earth, it is fairly clean. Additional equipment will be needed to capture and pump this recycled water to a designated area.

Gray water is reusable wastewater from residential, commercial and industrial lavatories/sinks, bath tub shower drains, and clothes washing equipment drains. Gray water is reused onsite, typically for landscape irrigation. Facilities that recycle shower and bathtub water should use non-toxic and low- sodium soap and personal care products to protect vegetation when reusing gray water for irrigation.

Rainwater has virtually no hardness, very low total suspended solids, and tends to be acidic in the United States. It is the most common type of water recycled and the fundamental components of a reclamation system include catchments, capture, treatment, and reuse of direct precipitation. A typical rainwater harvesting system consists of a catchments surface for the rainwater (roofs, gutters, awnings, etc.), a conveyance system to transfer the rainwater to the collection cistern, and finally a treatment system. The treatment system will depend on the quality of the water captured and any special local code requirements. One of the disadvantages of rainwater is the inconsistency in volume. Because of this, it is sometimes necessary to supplement this non-potable water with another reclaimed source.

Municipalities can also reclaim wastewater and use it for non-potable uses such as irrigation for municipal gardens, dust control, recharging groundwater aquifers, and fire protection. This water is sometimes sold to citizens at a discount rate to encourage its use. Projects should check with their municipality to see if reclaimed water is available for use.

Other areas where water that is typically used once and deposited down the drain (such as industrial process water, pass-through cooling water and swimming pool filter backwash water) should be investigated for potential reuse. The chemical composition of the waste water should be examined to determine what application is appropriate for the reuse. For example, swimming pool filter backwash when reused can be put back into the pool system since little treatment will be necessary beyond particulate removal.

All alternative sources of water that a project plans to recycle should be thoroughly designed and documented on the plumbing designer's drawings and specifications. Any piping details and sequence of operations to run the system should also be shown on the drawings and presented to the Assessor during the Design Review. The Onsite Assessment will verify the system was installed as designed and is functioning properly.

### 3.4.7 Metering

#### 3.4.7.1 Criteria:

Is there sub-metering for all water-intensive indoor applications such as commercial kitchens, commercial laundry, labs, pools, spas, etc.?

##### Answers:

- Yes (3 points)
- No (0 points)
- N/A

##### ToolTip:

Mark "N/A" where there are no water-intensive applications.

##### Assessment Guidance:

Where sub-meters are installed, they should either report automatically to the building automation system (see sub-criteria 3.4.7.3) or a schedule should be implemented to have the building engineers record the meter values on a regular basis.

#### 3.4.7.2 Criteria:

Is the potable water that is used for irrigation sub-metered?

##### Answers:

- Yes (3 points)
- No (0 points)
- N/A

##### ToolTip:

Mark "N/A" where there is no irrigation.

##### Assessment Guidance:

Where sub-meters are installed, they should either report automatically to the building automation system (see sub-criteria 3.4.7.3) or a schedule should be implemented to have the building engineers record the meter values on a regular basis.

#### 3.4.7.3 Criteria:

Are all water meters and sub-meters linked to a Meter Data Management System to store and report water consumption data?

##### Answers:

- Yes (3 points)

- No (0 points)

**ToolTip:**

The system should be capable to store and report water meter and sub-meter data, and calculate hourly, daily, monthly and annual water consumption for each meter or sub-meter.

**Assessment Guidance:**

The Water Efficiency Measurement and Verification Plan should include monthly reports (annual, monthly, hourly, and daily) of calculated water consumption data from whole building metering or sub-metering for the following building systems, where applicable:

- Potable irrigation
- Cooling towers/boiler makeup
- Waste water
- Chilled/hot water loop makeup
- Laboratory water
- Commercial kitchen water use
- Water features makeup water

The Meter Data management system can be integrated into the building automation system (BAS) to streamline the building's data tracking. All meters and submeters should be shown on the plumbing design drawings and the meters themselves should be specified to ensure they are appropriate for each applications minimum and maximum flow rate. On a monthly or annual basis all the metering data should be analyzed and compared to predicted values to troubleshoot any areas with greater than predicted demand. These systems should then be checked for leaks or malfunctioning equipment.

**3.4.7.4 Criteria:**

Are chilled or hot water loops equipped with makeup meters?

**Answers:**

- Yes (2 points)
- No (0 points)
- N/A

**ToolTip:**

Mark "N/A" where there are no chilled or hot water loops.

**Assessment Guidance:**

Installing meters on make-up lines to recirculating closed water loop heating and cooling systems allows leaks to easily be detected. Where sub-meters are installed on makeup feed lines, they should either report automatically to the building automation system (see sub-criteria 3.4.7.3) or a schedule should be implemented to have the building engineers record the meter values on a regular basis.

## 3.4.8 Irrigation

**3.4.8.1 Criteria:**

What percentage of exterior vegetated space does not require irrigation?

**Answers:**

- ≥ 75% (14 points)

- 50 - 74% **(11 points)**
- 25 - 49% **(8 points)**
- < 25% **(0 points)**
- N/A

**ToolTip:**

"Exterior vegetated space" means outside the building footprint and paved areas. Mark "N/A" where there is no vegetated space and therefore no need for irrigation.

**3.4.8.2 Criteria:**

Does the irrigation system include any of the following features:

- **3.4.8.2.1:** Gutter downspouts directed into planted areas or other landscape features?  
*Or*  
Onsite cisterns and/or rainwater harvesting system, or reclaimed water system?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** Mark "N/A" where there is no irrigation.
- **3.4.8.2.2:** Drip or low-volume irrigation?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** Mark "N/A" where there is no irrigation.
- **3.4.8.2.3:** EPA WaterSense/Smart Water Application Technology (SWAT), smart controllers (ET, rain sensors, or soil moisture sensors), and automatic rain shut off devices?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** Mark "N/A" where there is no irrigation.
- **3.4.8.2.4:** Capability to regulate precipitation rates on sprinkler heads for differing hydrozones?
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** Mark "N/A" where there is no irrigation.
- **3.4.8.2.5:** Swing joints or flex pipes used on all in-ground irrigation heads?
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** Mark "N/A" where there is no irrigation.

**Assessment Guidance:**

Using swing joints or flex pipes for irrigation heads is a more durable solution than standard plastic risers. Swing joint assemblies help protect sprinklers and rotors from damage. They provide flexibility so that pipes or risers do not break when a sprinkler head experiences impact from vehicle or pedestrian traffic. Flexible pipes are encouraged where freezing is likely to occur. Using both of these methods aim in water savings by ensuring no sprinkler heads will break causing spillage and wasted water.



## 3.5 MATERIALS AND RESOURCES

### 3.5.1 Building Core and Shell

Green Globes provides two paths for assessing building core and shell:

- **Path A: Performance Path** – 33 points
- **Path B: Prescriptive Path** – 20 (out of 33) points

Points cannot be combined between paths. Please review and select the appropriate pathway for the project.

#### 3.5.1.1 Path A: Performance Path for Building Core and Shell

##### 3.5.1.1.1 Criteria:

Was the Athena Impact Estimator for Buildings (Version 4.2 or later) used during design to evaluate a **minimum of two** different core and shell designs, based on life cycle assessment (LCA) in compliance with the assessment guidance and resulting in selection of the building core and shell with the least anticipated environmental impact?

or

Was another LCA tool used during design to evaluate a **minimum of two** different core and shell designs, based on life cycle assessment (LCA) in compliance with the assessment guidance and resulting in selection of the building core and shell with the least anticipated environmental impact?

##### Answers:

- Yes – LCA comparison with the Athena Impact Estimator **(33 points)**
- Yes – LCA comparison with an alternate tool **(33 points)**
- No **(0 points)**

If Path A: Performance Path for Building Core and Shell is selected, Path B and its associated points cannot also be selected and awarded – only one path will be awarded points.

##### ToolTip:

The building core and shell with the least anticipated environmental impact of the two alternative building designs must be implemented for potentially receiving full credit.

If not using the Athena Impact Estimator for Buildings, the LCA comparison must conform to *ISO 14040:2006* and *ISO 14044:2006*. Examples of LCA tools to complete assessment for core and shell evaluation include GaBi Software, SimaPro, and CMLCA. Compliance will be verified during the IOnsite Assessment by your assigned Green Globes Assessor.

The Athena Impact Estimator for Buildings and supporting literature are available for free at <http://calculatelca.com/software/impact-estimator/>. Supporting literature includes the Impact Estimator user manual and a guideline for whole-building LCA comparisons.

##### References:

- *ISO 14040:2006 Environmental Management – Life Cycle Assessment – Principles and Framework*
- *ISO 14044:2006: Environmental Management – Life Cycle Assessment – Requirements and Guidelines*
- The Athena Impact Estimator for Buildings (Version 4.2 or later): <http://calculatelca.com/software/impact-estimator/>
- GaBi Software Building LCA: <http://www.gabi-software.com/america/solutions/building-lca/>

- SimaPro Sustainability Life Cycle Assessment Carbon Footprinting: <http://www.simapro.co.uk/>
- CMLCA Scientific Software for LCA: <http://www.cmlca.eu/>

### Assessment Guidance:

At least two alternative design options for the project building should be evaluated using an LCA tool. A small narrative should accompany the LCA results to demonstrate to the Assessor how LCA influenced the design process. The intent of this criterion is for this LCA comparison to occur prior to the *Construction Document Phase*. Therefore, this documentation should be provided during the Design Review.

LCA results must be shown for the design options, which will typically include a proposed final design (the “least anticipated environmental impact” option) and a reference design that reflects typical practice or an earlier design iteration. Multiple alternative designs may be evaluated, but only the proposed final design and the reference design need to be submitted—a minimum of two designs.

**Figure 3.5.1.1-A: Example of reference design versus final design results comparison**

Impacts	Units	Reference Design	Final Design	% Change Final Design
GWP	Kg CO <sub>2</sub> eq	384,786	338,612	-12%
Acidification	Kg SO <sub>2</sub> eq	3,231	3,199	-1%
Eutrophication	Kg N eq	44.1	45.9	+4%
Ozone	Kg CFC-11 eq	0.00034	0.00034	0%
Smog	Kg O <sub>3</sub> eq	10,820	9,738	-10%
Fossil Fuel	MJ	6,560,563	5,576,479	-15%

The assessment must report the following life cycle impact indicators:

- Global warming potential (GWP)
- Acidification potential
- Eutrophication potential
- Ozone depletion potential (ODP)
- Smog potential
- Fossil fuel use

The proposed final design of the building core and shell with the least anticipated environmental impact must achieve one of the following performance targets compared to the reference building:

1. A minimum 10% reduction for at least three impact indicators, one of which must be global warming potential. No more than one impact indicator can exceed the reference building result.
2. A minimum of 15% reduction for at least two impact indicators, one of which must be global warming potential. No more than one impact indicator can exceed the reference building result.
3. A minimum 20% reduction for global warming potential. No more than one impact indicator can exceed the reference building result.

The scope and boundary of the LCA must include the following:

- Building components that must be included in the LCA are the complete building structure, envelope, foundation, and footings. Below grade or an attached parking garage shall also be included. Surface parking, excavation and other site development work, and HVAC, plumbing and electrical components shall be excluded. If data does not exist for any mandatory components, either choose a reasonable substitute material as a proxy, or omit the component—provided this does not disrupt comparability of the design options—and in both cases,

explain the approach in the project narrative. Operating energy may be included provided energy use is modeled consistently between the buildings.

- The buildings must have the same function and gross floor area, and must be consistent in LCA method with respect to the LCA tool and approach used, assumptions made, boundary, time span and elements included or excluded. If the assessments exclude operating energy, the impact of the envelope on the building heating and cooling loads must be the same.
- If including operating energy, indicate the modeling method used, provide results for all building designs, and a narrative explaining the differences.
- The LCA time span should be equivalent to the expected life of the building, with a minimum of 60 years and a maximum of 120 years, unless otherwise approved by your Green Globes assessor.
- The LCA must minimally be cradle-to-grave, addressing resource extraction, manufacturing, building construction, product replacement, demolition, landfill processes, and transportation in all stages. If the assessments include operating energy, all relevant processes from energy extraction to delivery and consumption must be included.

The submittal package must include the following:

- If using the Impact Estimator, provide the software files for the proposed and reference buildings assessed.
- If using another tool, provide a statement signed by a qualified third-party identifying the LCA tool used, confirming that the comparative LCA complies with ISO standards and with the assessment guidance.
- A report with results:
  - A statement asserting compliance of the “least anticipated environmental impact” building core and shell with the performance targets.
  - A table showing results for the six required impact indicators for all buildings, in absolute numbers, indicating the unit of measure and indicating the percent change against the “least anticipated environmental impact” option.
  - Description of the buildings, and identification of the time period used.
  - Bill of materials for all buildings.
  - Explain assumptions and material substitutions, if appropriate.
  - LCA results for all buildings by life cycle phase.
  - Narrative: as appropriate, describe the process of the LCA, how LCA influenced design decisions, and any other commentary or conclusions.

### 3.5.1.2 Path B: Prescriptive Path for Building Core and Shell

#### 3.5.1.2.1 Criteria:

Based upon the appropriate application and specification of comparable materials and products, what percentage of the products selected for the building core and shell (based upon cost) have:

##### 3.5.1.2.1.1 Sub-criteria:

- **Environmental Product Declarations (EPDs)** that utilize recognized Product Category Rules, conform to ISO standards, and minimally includes cradle-to-gate scope:
  - **Industry Wide (Generic) EPD:** Products specified for the interior fit-out shall include Type III Environmental Product Declaration (EPD)?
- and/or*
  - **Brand Specific EPD:** Products specified for the building core and shell shall include Type III Environmental Product Declaration (EPD), where the EPDs are specific to particular products from identified manufacturers?

*and/or*

- **Third-party certifications** that are based upon a multiple attribute standard(s) developed by a consensus based process from an approved standard development organization? Examples include NSF sustainability assessment standards, UL Environment sustainability standards, Sustainable Minds Transparency Report™ Framework, and other consensus based assessment standards that are multiple attribute-based.

and/or

- **Third-party verified product life cycle assessment** based upon *ISO 14040:2006* and *ISO 14044:2006*, and minimally covers cradle-to-gate scope?

and/or

- **Third-party sustainable forestry certifications?**
  - **ToolTip:** Examples of third-party sustainable forestry certifications include American Tree Farm System (ATFS), Forest Stewardship Council Standard (FSC), and the Sustainable Forestry Initiative Standard (SFIS), amongst others.

### Answers:

- ≥ 40% **(20 points)**
- 25 - 39% **(15 points)**
- 10 - 24% **(10 point)**
- 1 - 9% **(0 points)**
- No **(0 points)**

If Path B: Prescriptive Path for Building Core and Shell is selected, Path A: Performance Path for Building Core and Shell and its associated points cannot also be selected and awarded – only one path will be awarded points.

Path B allows a maximum of 20 points (out of 33 total points possible for Building Core and Shell). The final percentage for awarding of points is tabulated by summing the total percentage of documentation for each item listed for Path B: Prescriptive Path for Building Core and Shell.

Example: If a building project compared and specified 5% of their products that included Environmental Product Declarations (either Industry Wide or Product Specific) they would have 5% of the requirement completed. Then, if the project had 5% that had multiple attribute standards, and another 5% third-party verified product life cycle assessments, the project's core and shell would have a total of 15%, translating to a total of 10 points for Path B: Prescriptive Path for Building Core and Shell.

### ToolTip:

A minimum of 10% (EPDs, third-party certifications, and/or product life cycle assessments) is necessary to be awarded points.

EPDs must conform to *ISO 14040:2006*, *ISO 14044:2006*, *ISO 14025:2006*, and *ISO 21930:2007* or *BS EN 15804:2012 + Amendment 1:2013* (which provides core product category rules (PCR's) for Type III Environmental Product Declarations (EPD's) for any construction product and construction service. "Brand Specific" is manufacturer specific for a product family.

### References:

- See Assessment Guidance for references.

### Assessment Guidance:

Environmental Product Declarations (Type III eco-labels, known as EPDs) are verified documents that report environmental data of products based on life cycle assessment (LCA) and other relevant information in accordance with the international standard *ISO 14025* (Type III eco-labels, known as EPDs). EPDs include quantified environmental information on the life cycle of a product to enable comparisons between products fulfilling the same function. EPDs are

completed in accordance with standard Product Category Rules (PCR) to ensure that EPDs of products produced by different organizations for the same functional use category use the same metrics. The goal is to use EPDs as a transparent tool for comparing products being utilized. EPDs stand apart from Type I and Type II eco-labels for their transparency, for the underlying rigor due to PCRs and ISO LCA standards, and because they are always based on LCA.

If utilizing the EPD criteria, the project must provide comparable product, industry wide EPDs for 10% or more of the products used in the building *core and shell*. There are two EPD options: 1) Industry Wide (Generic) EPDs that are for an entire industry; for example, North American softwood lumber; and 2) Product Specific EPDs that are for brand-name products; for example, Weyerhaeuser 2x4s from a specific mill. Percentage for this criterion is based on cost.

The project can also provide third-party certifications from the examples listed below for 10% or more of the products used in the building's core and shell.

The project can also provide LCA documentation that does not fall under the methods described above or Path A (5.1.1) for 10% or more of the products used in the building core and shell. Documentation must be shown to comply with *ISO 14040* and *14044* and minimally covers cradle-to-gate scope. Cradle to gate is an assessment of a partial product life cycle from cradle (resource extraction) to the factory gate (before it is transported to the consumer). The use phase and disposal phase of the product may be omitted.

Note that the three approaches for evaluating products used in a building's core and shell listed above are not mutually exclusive. The percentages may be a combination of EPDs, multiple attribute certifications and verifications, and individual product life cycle assessments; all utilized to compare products and their impacts to the environment.

#### **EPD Sources:**

EPDs are available from relevant manufacturers and industry associations, some green product directories, and from EPD program operators such as UL Environment, NSF International, and ASTM International.

#### **References (ISO Standards):**

- *ISO 14040:2006 Environmental Management-Life cycle Assessment-Principles and Framework*
- *ISO 14044:2006 Environmental Management- Life Cycle Assessment-Requirements and Guidelines*
- *ISO 14025:2006 Environmental labels and declarations-Type III environmental declarations-Principles and procedures*
- *ISO 21930:2007 Sustainability in Building Construction-Environmental Declaration of Building Products*
- *BS EN 15804:2012 + Amendment 1:2013 Sustainability of construction works-Environmental product declarations*

#### **References (Third-party Certification):**

- *NSF/ANSI 347 Sustainability Assessment for Single Ply Roofing Membranes*
- *UL (STP) 115: Thermal Insulation*
- *American Tree Farm System® (ATFS): 2010-2015 Standards of Sustainability*
- *CAN/CSA-Z809-08 (R2013)- Sustainable Forest Management*
- *FSC-STD-40-004 V2-1 EN: Forest Stewardship Council Standard for Chain of Custody Certification*
- *Sustainable Forestry Initiative Program (SFI)*
- Other consensus-based assessment standards that are multiple attribute and life cycle based

#### **Supporting Documentation:**

- Product comparison documentation
- EPD documentation
- Third-party certification documentation
- LCA documentation
- Sustainable forestry certification documentation



### 3.5.2 Interior Fit-outs (including Finishes and Furnishings)

Green Globes provides two paths for assessing Interior Fit-outs (including finishes and furnishings):

- **Path A: Performance Path for Interior Fit-outs** – 16 points
- **Path B: Prescriptive Path for Interior Fit-outs** – 10 (out of 16) points

Points cannot be combined between paths. Please review and select the appropriate pathway for the project.

#### 3.5.2.1 Path A: Performance Path for Interior Fit-outs

##### 3.5.2.1.1 Criteria:

Was life cycle assessment and relative comparison of **a minimum of two** alternative interior fit-outs (including finishes and furnishings) performed during design, which resulted in the selection of an interior fit-out that has the least anticipated environmental impact based upon comparable applications?

##### Answers:

- Yes **(16 points)**
- No **(0 points)**

If Path A: Performance Path for Interior Fit-outs is selected, Path B and its associated points cannot also be selected and awarded – only one path will be awarded points.

##### ToolTip:

The interior fit-out with the least anticipated environmental impact of the two alternative comparable interior fit-outs must be implemented for potentially receiving full credit. Third-party peer reviewed life cycle assessment must conform to *ISO 14040:2006* and *ISO 14044:2006*.

##### References:

- *ISO 14040:2006 Environmental Management - Life Cycle Assessment - Principles and Framework*
- *ISO 14044:2006 Environmental Management - Life Cycle Assessment - Requirements and Guidelines*
- *ASHRAE Indoor Air Quality Guide: Best Practices for Design, Construction, and Commissioning*  
<https://www.ashrae.org/resources--publications/bookstore/indoor-air-quality-guide>

##### Assessment Guidance:

For core and shell – see 3.5.1.1 Path A: Performance Path for Building .

At least two alternative interior fit-outs for the project building should be evaluated using an LCA tool. A small narrative should accompany the LCA results to demonstrate to the Assessor what type of fit-outs were chosen and when this evaluation took place. The intent of this criterion is for this LCA comparison to occur prior to the Construction Document Phase. Therefore, this documentation should be provided during the Design Review.

The assessor may also request comparisons of alternative interior fit-outs as well as an outline and description of LCA methodology and any software tools utilized.

##### Supporting Documentation:

- Submittal package including software files for the proposed and referenced buildings, or a signed statement from a qualified professional affirming compliance to the assessment guidance for 3.5.2.1.1.



- Report asserting compliance to the building interior fit-out with the least anticipated environmental impact, including performance targets.
- Description of the interior fit-outs, and identification of the time period used.
- Bill of materials for all interior fit-outs.
- Assumptions and material substitutions, if appropriate.
- LCA results for all interior fit-outs by life cycle phase.
- Report with narrative on the LCA process during design.

### 3.5.2.2 Path B: Prescriptive Path for Interior Fit-outs

#### 3.5.2.2.1 Criteria:

Based upon the appropriate application and specification of comparable products, what percentage of the interior fit-out materials and products (including finishes and furnishings) selected (based upon cost) have:

##### 3.5.2.2.1.1 Sub-criteria:

- **Environmental Product Declarations (EPDs)** that utilize recognized Product Category Rules, conform to ISO standards, and minimally includes cradle-to-gate scope:
  - **Industry Wide (Generic) EPD:** Products specified for the interior fit-out shall include Type III Environmental Product Declaration (EPD)?

*and/or*

- **Brand Specific EPD:** Products specified for the interior fit-out shall include Type III Environmental Product Declaration (EPD), where the EPDs are manufacturer specific products?

*and/or*

- **Third-party certifications** that are based upon a multiple attribute standard(s) developed by a consensus based process from an approved standard development organization? Examples include NSF sustainability assessment standards, UL Environment sustainability standards, Sustainable Minds Transparency Report™ Framework, and other consensus based assessment standards that are multiple attribute-based.

*and/or*

- **Third-party verified product life cycle assessment** based upon *ISO 14040:2006* and *ISO 14044:2006*, and minimally covers cradle-to-gate scope?

*and/or*

- **Third-party sustainable forestry certifications?**
  - **ToolTip:** Examples of third-party sustainable forestry certifications include American Tree Farm System (ATFS), Forest Stewardship Council Standard (FSC), and the Sustainable Forestry Initiative Standard (SFIS), amongst others.

### Answers:

- > 39% **(10 points)**
- 25 - 39% **(7 points)**
- 10 - 24% **(5 point)**
- 1 - 9% **(0 points)**
- No **(0 points)**

If Path B: Prescriptive Path for Interior Fit-outs is selected, Path A: Performance Path for Interior Fit-outs and its associated points cannot be selected or awarded – only one path will be awarded points.

Path B allows a maximum of 10 points (out of 16 total possible points for Interior Fit-outs). The final percentage for awarding points is tabulated by summing the total percentage of documentation for each item listed for Path B: Prescriptive Path for Interior Fit-outs.

**Example:** If a building project compared and specified 5% of their products that include Environmental Product Declarations (either Industry Wide or Product Specific) for the interior fit-outs, they would have 5% of the requirement completed. Then, if the project had 5% that had multiple attribute standards, and another 5% third-party verified product life cycle assessments, the project's interior fit-out products would have a total of 15%, translating to a total of 5 points for Path B: Prescriptive Path for Interior Fit-outs. Note that some products may fall into more than one category. If this is the case, then the product may be counted for more than one category.

### ToolTip:

A minimum of 10% (EPDs, third-party certifications, and/or product life cycle assessments) is necessary to be awarded points.

EPDs must conform to *ISO 14040:2006*, *ISO 14044:2006*, *ISO 14025:2006*, and *ISO 21930:2007* or *BS EN 15804:2012 + Amendment 1:2013* (which provides core product category rules (PCR's) for Type III Environmental Product Declarations (EPD's) for any construction product and construction service. "Brand Specific" is manufacturer specific for a product family.

### References:

- ICC Evaluation Service, EPD Index:  
<http://www.icc-es.org/ep/epd-index.shtml>
- ASHRAE-Indoor Air Quality Guide: Best Practices for Design, Construction, and Commissioning:  
<https://www.ashrae.org/resources--publications/bookstore/indoor-air-quality-guide>
- See Assessment Guidance for additional references.

### Assessment Guidance:

Environmental Product Declarations (Type III eco-labels, known as EPDs) are verified documents that report environmental data of products based on life cycle assessment (LCA) and other relevant information in accordance with the international *ISO 14025:2006* (Type III eco-labels, known as EPDs). EPDs include quantified environmental information on the life cycle of a product to enable comparisons between products fulfilling the same function. Type III EPDs are completed in accordance with standard Product Category Rules (PCR) to ensure that EPDs of products produced by different organizations for the same functional use category use the same metrics. The goal is to use EPDs as a transparent tool for comparing products being utilized. EPDs stand apart from Type I and Type II eco-labels for their transparency, for the underlying rigor due to PCRs and ISO LCA standards, and because they are always based on LCA. If utilizing EPD criteria, the project must provide comparable product, industry-wide EPDs for 10% or more of the interior fit-out materials and products (including finishes and furnishings). There are two EPD options: 1) Industry Wide (Generic) EPDs that are for an entire industry; for example, North American softwood lumber; and 2) Product Specific EPDs that are for brand-name products; for example, Weyerhaeuser 2x4s from a specific mill. Percentage for this criterion is based on product cost.

The project can also provide third-party certifications from the examples listed below for 10% or more of the interior fit-out materials and products (including finishes and furnishings).

Additionally, the project can provide LCA documentation that does not fall under the methods described above or Path A for 10% or more of the interior fit-out materials and products (including finishes and furnishings). Documentation must be shown to comply with *ISO 14040:2006* and *ISO 14044:2006* and minimally covers cradle-to-gate scope. Cradle to gate is an assessment of a partial product life cycle from cradle (resource extraction) to the factory gate (before it is transported to the consumer). The use phase and disposal phase of the product may be omitted.

Note that the three approaches for evaluating products used in an interior fit-out listed above are not mutually exclusive. The percentages may be a combination of EPDs, multiple attribute certifications and verifications, and individual product life cycle assessments; all utilized to compare products and their impacts to the environment.

### **EPD Sources:**

EPDs are available from relevant manufacturers and industry associations, some green product directories, and from EPD program operators such as UL Environment, NSF International, and ASTM International.

### **References (ISO Standards):**

- *ISO 14040:2006 Environmental Management-Life cycle Assessment-Principles and Framework*
- *ISO 14044:2006 Environmental Management- Life Cycle Assessment-Requirements and Guidelines*
- *ISO 14025:2006 Environmental labels and declarations-Type III environmental declarations-Principles and procedures*
- *ISO 21930:2007 Sustainability in Building Construction-Environmental Declaration of Building Products*
- *BS EN 15804:2012 + Amendment 1:2013 Sustainability of construction works-Environmental product declarations*

### **References (Third-party Certification):**

- *NSF/ANSI 140: Sustainability Assessment for Carpet*
- *NSF/ANSI 332: Sustainability Assessment for Resilient Flooring*
- *NSF/ANSI 342: Sustainability Assessment for Wallcovering Products*
- *NSF/ANSI 336: Sustainability Assessment for Commercial Furnishings Fabric*
- *Sustainable Minds (SM) Transparency Report™ Program*
- *ANSI/NSC 373: Sustainable Production of Natural Dimension Stone*
- *ANSI/BIFMA e3-2014e: Furniture Sustainability Standard*
- *ANSI A138.1 Green Squared-American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials.*
- *UL 100: Standard for Sustainability for Gypsum Boards and Panels*
- *UL 102: Standard for sustainability for Swinging Door Leafs*
- *UL (STP) 106: Sustainability for Luminaires*
- *UL (STP) 115: Thermal Insulation*

### **References (Sustainable Forestry Certification):**

- *American Tree Farm System® (ATFS): 2010-2015 Standards of Sustainability*
- *CAN/CSA-Z809-08 (R2013)- Sustainable Forest Management*
- *FSC-STD-40-004 V2-1 EN: Forest Stewardship Council Standard for Chain of Custody Certification*
- *Sustainable Forestry Initiative Program (SFI)*
- *Other third-party certification programs recognized by the Programme for Endorsement of Forest Certification (PEFC) - Technical Documentation*

### **Supporting Documentation:**

- Product comparison documentation
- EPD documentation

- Third-party certification documentation
- LCA documentation
- Sustainable forestry certification documentation

### 3.5.3 Reuse of Existing Structures

#### 3.5.3.1 Façades

##### 3.5.3.1.1 Criteria:

What percentage of the façade from an existing building on the site is retained and incorporated in the new design?

##### Answers:

- > 60% **(6 points)**
- 51 - 60% **(5 points)**
- 41 - 50% **(4 points)**
- 31 - 40% **(3 points)**
- 21 - 30% **(2 points)**
- 10 - 20% **(1 point)**
- < 10% **(0 points)**
- N/A

##### ToolTip:

Provide total area of the existing non-structural elements and the area of the non-structural elements that will be retained and incorporated into the new design, not including windows and doors.

Percentage =  $100 \times (A \div B)$ , where:

A = Area of retained facade

B = Total existing building façade area

Mark "N/A" where there is no existing building, where the existing building floor area is less than 1000 ft<sup>2</sup> (93 m<sup>2</sup>), or where it is not justifiably feasible to use existing non-structural elements.

##### Assessment Guidance:

If the construction documents do not indicate calculations for existing versus new façade components, a narrative and separate calculations should be provided under a separate cover and given to the Assessor during the Design Review.

#### 3.5.3.2 Structural Systems

##### 3.5.3.2.1 Criteria:

What percentage of structural systems (e.g. interior walls) from an existing building on the site is retained and incorporated in the new design?

##### Answers:

- > 95% **(6 points)**
- 81 - 95% **(5 points)**
- 66 - 80% **(4 points)**
- 41 - 65% **(3 points)**
- 26 - 40% **(2 points)**

- 10 - 25% **(1 point)**
- < 10% **(0 points)**
- N/A

**ToolTip:**

“Structural systems” means the load-resisting system of a structure (other than the envelope) that transfers loads to the soil or supporting structure through interconnected structural components or members. Provide total volume of the existing structure and the volume that will be retained and incorporated into the new design. Construction documents are recommended to include exterior elevations that note re-use of existing envelope in relationship to areas of new construction, and calculations for existing versus new structural components.

Percentage =  $100 \times (A \div B)$ , where:

A = Total volume of re-used existing structure

B = Total volume of existing structure

Mark “N/A” where there is no existing building, where the existing building floor area is less than 1000 ft<sup>2</sup> (93 m<sup>2</sup>), or where it is not justifiably feasible to use existing structures.

**Assessment Guidance:**

If the construction documents do not indicate calculations for existing versus new structural components, a narrative and separate calculations should be provided under a separate cover and given to the Assessor during the Design Review.

### 3.5.3.3 Non-structural Elements

#### 3.5.3.3.1 Criteria:

What percentage of the existing interior ceilings, interior partitions, and/or demountable walls will be reused within the renovation project?

**Answers:**

- > 95% **(6 points)**
- 81 - 95% **(5 points)**
- 66 - 80% **(4 points)**
- 41 - 65% **(3 points)**
- 26 - 40% **(2 points)**
- 10 - 25% **(1 points)**
- < 10% **(0 points)**
- N/A

**ToolTip:**

Areas are calculated as the projected area of the element (e.g. if an interior partition is re-used, the area is calculated as length x height of the wall).

Percentage =  $100 \times (A \div B)$ , where:

A = Total area of re-used existing interior ceiling, interior partitions, and/or demountable walls

B = Total area of existing interior ceiling, interior partitions, and/or demountable walls

Mark “N/A” where there are no existing interior partitions, demountable walls, and ceilings.

**Assessment Guidance:**

If the construction documents do not indicate calculations for existing versus new interior ceilings, interior partitions, and/or demountable walls, a narrative and separate calculations should be provided under a separate cover and given to the Assessor during the Design Review.

The assessor may also request existing conditions documentation, calculations of quantities, and a space plan for the new building denoting existing interior ceilings, interior partitions, and/or demountable walls reused.

**3.5.3.3.2 Criteria:**

What percentage of the existing furnishings (including systems furniture) will be re-used and/or refurbished for reuse within the renovation project?

**Answers:**

- > 65% **(4 points)**
- 41 - 65% **(3 points)**
- 26 - 40% **(2 points)**
- 10 - 25% **(1 points)**
- < 10% **(0 points)**
- N/A

**ToolTip:**

Areas are calculated as the projected area of the element.

A = Total re-used existing area of furnished space

B = Total area of existing furnished space

Mark "N/A" where there are no existing furnishings or where they are clearly not suitable. Areas are to be used consistently for determining calculations.

**Assessment Guidance:**

If the construction documents do not indicate calculations for existing versus new furnishings (including systems furniture), a narrative and separate calculations should be provided under a separate cover and given to the Assessor during the Design Review.

The assessor may also request existing conditions documentation, a furnishing inventory & furniture budget, and a space plan for the new building denoting reused or refurbished furnishings.

**3.5.3.3.3 Criteria:**

Is there a requirement that the project will incorporate reused and off-site salvaged materials?

**Answers:**

- Yes **(4 points)**
- No **(0 points)**

**ToolTip:**

This will be verified during the Onsite Assessment .



**Assessment Guidance:**

The materials reused in this criterion should be separate from the materials used in 3.5.4.1 Construction Waste. This criterion should not include any reused materials that were included in site or landscaping work.

## 3.5.4 Waste

### 3.5.4.1 Construction Waste

#### 3.5.4.1.1 Criteria:

What percentage of the construction waste, including building demolition waste, will be diverted from the landfill?

**Answers:**

- > 74% **(6 points)**
- 50 - 74% **(4 points)**
- 25 - 49% **(2 points)**
- < 25% **(0 points)**

**ToolTip:**

Develop a waste management/reduction plan and strategy, which should include a waste audit and waste diversion strategy report. In retrofit situations, check that there is an asbestos removal plan; a procedure to minimize the risk of exposure to lead-based paint; instructions for a waste audit; a dismantling and source separation plan; a list of construction materials that are to be source-separated onsite for reuse and recycling; and a contractual means of ensuring that all recyclable materials and equipment are diverted from landfill. At the Construction Documents Phase, provide an estimate of waste diversion, which will be verified during the the Onsite Assessment.

**Assessment Guidance:**

Construction recycling requirements should be discussed with the General Contractor before start of work. Licensed haulers of recyclables should be identified and what materials they will or will not accept. The owner should make the contractor and hauler aware that demolition waste should be tracked separately from construction waste and that the demolition waste should be separated into hazardous and non-hazardous materials. Salvaged materials, intended to be used on this project site or another, shall be kept separate from the recyclables for the hauler.

Hazardous waste by-products of construction include paints, solvents, oils, lubricants, etc. A separate procedure should be developed for disposing and recycling of these wastes. The procedure should conform to all federal, state, and local regulations.

**References:**

- Northeast Recycling Council, *Hauler Terms and Waste Conversion Factors*:  
[http://nerc.org/documents/hauler terms and waste conversion factors.pdf](http://nerc.org/documents/hauler_terms_and_waste_conversion_factors.pdf).

#### 3.5.4.1.2 Criteria:

Is there a requirement to reuse existing onsite materials for site development or landscaping (e.g., crushing concrete for aggregate base or drain rock, shredding vegetative materials for mulch, etc.)?

**Answers:**

- Yes **(1 point)**
- No **(0 points)**
- N/A

**ToolTip:**

Mark "N/A" where there are no existing materials on the site that are suitable for reuse.

**Assessment Guidance:**

The assessor may also request Landscaping and Site Developments Plans showing incorporation of existing onsite materials.

### 3.5.4.2 Operational Waste

#### 3.5.4.2.1 Criteria:

Does the building design address operations-related recycling programs through one or more of the following:

- **3.5.4.2.1.1:** Operational flow for waste handling and storage facilities for recycling?
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
- **3.5.4.2.1.2:** Storage areas for recyclable waste at points of service?
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
- **3.5.4.2.1.3:** Storage areas for recyclable waste at pick-up areas?
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
- **3.5.4.2.1.4:** Operational flow for handling and storage facilities for composting?
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
    - N/A
  - **Tooltip:** Mark "N/A" for buildings that do not have compostable organic waste, and/or have no grounds except minimal hardscape and/or are prohibited to compost on site by the local jurisdiction.

#### 3.5.4.2.2 Criteria:

Indicate total storage area (in ft<sup>2</sup>) for recyclable waste at points of service:

**Answers:**

- [Numerical text field] **(0 points)**

**ToolTip:**

Storage areas must include collection of mixed paper, corrugated cardboard, glass, plastics, and metals. There should be at least 20 ft<sup>2</sup> (1.86 m<sup>2</sup>) of designated storage space for recyclables per 10,000 ft<sup>2</sup> (929 m<sup>2</sup>) of space, or 100 ft<sup>2</sup> (9 m<sup>2</sup>) for buildings greater than 50,000 ft<sup>2</sup> (4,645 m<sup>2</sup>). It should preferably be near to the loading dock. There should also be adequate space for the temporary sorting and storage of recyclables at collection points near the sources of waste - either in each office or on each floor. Chutes may also be used to separate materials. Review the construction documents for details of a recycling system and facilities for handling and storing recyclables.

**Assessment Guidance:**

A Waste Minimization Plan should be developed and should include waste minimization measures through requirements in the following areas:

- Zoning permits

- Conditions, Covenants and Restrictions (deed restrictions) (CC&Rs)
- Lease agreements

When the construction documents do not specifically call out recycling or composting areas, a narrative should be provided to the Assessor explaining the facilities proposed recycling and composting program.

### 3.5.5 Building Service Life Plan

#### 3.5.5.1 Criteria:

Is there a preliminary Building Service Life Plan that includes the expected service life estimates for the following:

- **3.5.5.1.1:** The building?
  - **Answers:**
    - Yes **(2 points)**
    - No **(0 points)**
- **3.5.5.1.2:** The structural systems, building envelope, and hardscape materials that will need to be replaced during the life of the building?
  - **Answers:**
    - Yes **(2 points)**
    - No **(0 points)**
  - **ToolTip:** “Structural systems” means the load-resisting system of a structure that transfers loads to the soil or supporting structure through interconnected structural components or members.
- **3.5.5.1.3:** The mechanical, electrical, plumbing, and energy generation systems that will require inspection and/or replacement during the service life of the building?
  - **Answers:**
    - Yes **(2 points)**
    - No **(0 points)**

#### ToolTip:

The objective of a “Building Service Life Plan” is to provide reasonable assurance that the new building will be serviceable for an estimated period of time as a result of using quality systems and components that are properly installed and well maintained. The preliminary Building Service Life Plan will be reviewed and updated at the Construction Phase. *CSA S478-95 (R2007): Guideline on Durability in Buildings* outlines how to develop and implement a Building Durability Plan.

#### References:

- *CSA S478-95 (R2007): Guideline on Durability in Buildings*
- *ANSI/ASHRAE/USGBC/IES Standard 189.1-2009: Section 505, Paragraph 10.3.2.3*
- *Whole Building Design Guide (WBDG):*  
<http://www.wbdg.org/tools>

#### Assessment Guidance:

A Building Service Life Plan (BSLP) should include the following:

- Service life estimates for structural, building envelope and hardscape materials that need to be replaced during the life of the building (not including mechanical and electrical assemblies)
- Expected service life for building assemblies and materials that require inspection and/or need to be replaced during the service life of the building, where service life was based on the following:
  - temporary buildings < 10 years

- medium-life buildings e.g. industrial and parking structures > 25 years
  - long life building types > 50 years
- Documentation of the project design service life, the basis for determination and the following details for each assembly or component used in the building:
  - building assembly and material description
  - design service life in years
  - predicted service life in years
  - effects of failure
  - maintenance frequency and maintenance access

It should be noted that a Building Service Life Plan is not the same as a LCA (see 3.5.1 Building ). The BSLP should examine the full life cycle of the building and its components and provide guidance to help realize the LCA projections. By analyzing the maintenance, repair, and replacement costs for the building and components design life, BSLPs can encourage durability, interoperability, adaptability, reuse, and recyclability.

Other references for building a BSLP can be found in the International *Green Construction Code (IgCC) Section 505*, *ANSI/ASHRAE/USGBC/IES Standard 189.1-2009 Paragraph 10.3.2.3*, and in the *Whole Building Design Guide (WBDG)* – <http://www.wbdg.org/tools>.

### 3.5.5.2 Criteria:

Is there a schedule for maintenance, repair, and replacement for each building element, including the building fit-out (as applicable) for the duration of the building design life?

#### Answers:

- Yes **(1 point)**
- No **(0 points)**

#### ToolTip:

This plan and policy may be specific for the space being assessed or part of an overall building document. The objective of a “Building Service Life Plan” is to provide reasonable assurance that the new building will be serviceable for the estimated period of time as a result of using quality systems and components that are properly installed and well maintained. *CSA S478-95 (R2007): Guideline on Durability in Buildings* outlines how to develop and implement a Building Durability Plan.

#### Assessment Guidance:

A Building Service Life Plan (BSLP) should include the following:

- Expected service life for building assemblies and materials that require inspection and/or need to be replaced during the service life of the interior fit-out, where service life was based on the following:
  - Temporary interior fit-outs < 3 years
  - Medium-life interior fit-out 3 - 10 years
  - Long life interior fit-out types > 10 years
- Documentation of the project design service life, the basis for determination and the following details for each assembly or component used in the interior fit-out:
  - Interior fit-out and material description
  - Design service life in years
  - Predicted service life in years
  - Effects of failure
  - Maintenance frequency and maintenance access

It should be noted that a Building Service Life Plan is not the same as an LCA. The BSLP should examine the full life cycle of the building and its components and provide guidance to help realize the LCA projections. By analyzing the maintenance, repair, and replacement costs for the interior fit-out components’ design life, BSLPs can encourage durability, interoperability, adaptability, reuse, and recyclability.

## 3.5.6 Resource Conservation

### 3.5.6.1 Minimized Use of Raw Materials

#### 3.5.6.1.1 Criteria:

Does the design specify the use of prefabricated, preassembled, and/or modular products?

#### Answers:

- Yes **(2 points)**
- No **(0 points)**

#### ToolTip:

Benefits include easier onsite storage, and less waste, onsite dust, and noise.

#### 3.5.6.1.2 Criteria:

Does the building design use materials efficiently and/or minimizes the use of raw materials as compared with typical construction practices?

##### Answers:

- Yes **(1 point)**
- No **(0 points)**

##### ToolTip:

“Efficient use of resources” includes the following products:

Wood and steel framing: OVE uses engineering principles to minimize material usage while meeting model building code structural performance requirements. This reduces construction waste, maximizes material usage and saves cutting and waste materials.

Post-tension concrete is reinforced by inserting cables as the concrete is cast, then hydraulically tensioning the cables after the concrete has hardened – conferring high strength and stability. This saves material because post-tensioned concrete slabs can be thinner and longer without risk to their strength or structural integrity, since the cables inside help stabilize them. Mark “N/A” where this is justifiably not suitable for the project.

An open web steel joist is a lightweight steel truss, consisting of parallel chords and a triangulated web system, which spans between bearing points. Benefits include reduced amount of material used, structural weight, and the possibility of mechanical and plumbing pipes to pass through, which means that the overall building height can be reduced. Mark “N/A” where this is justifiably not suitable for the project.

Castellated and cellular steel beams (ref: CMC Steel Products) are lighter, without sacrificing strength, meaning reduced column and footing sizes. Web openings allow mechanical, electrical and plumbing to pass through, which means that the overall building height can be reduced. Mark “N/A” where this is justifiably not suitable for the project.

Composite steel/concrete structures are stronger and more flexible, which results in a reduction in the amount of structural steel needed, and therefore reduced weight, and reduced cost for foundation. Where shallower beams can be used, this can reduce the building height. Increased span lengths are also possible. Mark “N/A” where this is justifiably not suitable for the project.

#### 3.5.6.1.3 Criteria:

Give examples of products used that will result in minimal use of raw materials compared to typical construction practices:

##### Answers:

- [Text field] **(0 points)**

##### Assessment Guidance:

By choosing materials and assemblies that are engineered or whose design is optimized to use fewer raw materials than is typical for a given type of construction, resources can be conserved. In like manner, by using assemblies that can perform multiple functions, the use of additional resources is avoided.

Examples of efficient designs that typically minimize the use of raw materials include but are not limited to:

- optimum value engineered (OVE) wood framing [reference: AF&PA Wood Frame Construction Manual]



- optimum value engineered (OVE) cold formed steel framing
- post-tensioned concrete floors
- modular sizing of openings in walls
- open web steel joists [reference: SJI standards]
- castellated and cellular steel beams [reference: CMC Steel Products]
- composite steel/concrete floors [reference: AISC 360 standard]

The assessor may also request a letter from the architect or comparable building data from any life cycle analysis completed.

### 3.5.6.2 Multi-Functional Assemblies

#### 3.5.6.2.1 Criteria:

Does the design incorporate assemblies that perform multiple functions?

**Answers:**

- Yes **(1 point)**
- No **(0 points)**

**ToolTip:**

For example, a curtain wall that serves multiple functions of day lighting, insulation, and vapor barrier; systems that can deliver heating and cooling by the same process; and use of a roof shingle that is also a solar collector.

#### 3.5.6.2.2 Criteria:

Give examples of assemblies that perform multiple functions:

**Answers:**

- [Text field] **(0 points)**

**Assessment Guidance:**

Examples of multi-functional assemblies that typically minimize the use of raw materials include but are not limited to the following:

- Floor panels fitted together to define a raised floor capable of accommodating wires/cables accessible through openings in the floor panel.
- A wall constructed of insulating blocks with intersecting horizontal and vertical channels that are filled with concrete and reinforcement to produce an insulated, loadbearing wall.
- Roofing tiles used in the construction of multi-functional roofs are fit together to define an internal cavity which can be sealed to maintain a gas, liquid and/or other material therein. Filling materials include such things as fire retardants, colored materials, heatable liquid, or other materials to provide different functional aspects for a roof made from the tiles.
- Interior loadbearing masonry walls that provide structure, final finish, acoustic insulation, and fire resistance without need for special detailing or design.

### 3.5.6.3 Deconstruction and Disassembly

#### 3.5.6.3.1 Criteria:

Does the building design facilitate future deconstruction, demounting and disassembly; and re-configuration?

**Answers:**

- Yes (2 points)
- No (0 points)

**ToolTip:**

Design for Disassembly is a technique that involves designing a product to be disassembled for easier maintenance, repair, recovery and reuse of components/materials without substantial damage to the materials or their surroundings.

**References:**

- ASTM E1692-95a (2012)
- CSA Z782-06: Guideline for Design for Disassembly and Adaptability in Buildings

**Assessment Guidance:**

Some examples of ways to design for disassembly include:

- Coordinate with Architect regarding structural, cladding and detailing materials, and fastening systems to facilitate building disassembly.
  - To ease future disassembly, use bolt and nut fasteners before screws, screws before nails, nails before strippable adhesives, and strippable adhesives before permanent glues, such as contact cement or epoxy. Use standard fasteners easily found during future disassembly: trim, for example, can be used to hide fasteners for a cleaner look.
- Check for standard sized construction materials and minimal use of adhesives, to promote reuse.
- Building assemblies should use mechanical connections in lieu of chemical, where possible.
- Utilize modular components and systems where possible.
- In commercial applications, consider demountable partition systems that can be moved as interior uses change.
- Separate the structure from the cladding
- Minimize the number of different types of components.
- Provide permanent identification for each component.

**3.5.6.3.2 Criteria:**

Give examples of incorporated building systems that are easily disassembled:

**Answers:**

- [Text field] (0 points)

## 3.5.7 Building Envelope – Roofing/Opening

### 3.5.7.1 Roofing Membrane Assemblies and Systems

**3.5.7.1.1 Criteria:**

Is there a requirement that roofing membrane assemblies and systems are to be:

- **3.5.7.1.1.1:** Installed as per manufacturers' instructions and recommendations?
  - **Answers:**
    - Yes (1.5 points)
    - No (0 points)
    - N/A
- **3.5.7.1.1.2:** Field-inspected by a roofing system manufacturer's technical personnel or RCI-certified third-party roofing inspector as per the prescribed industry protocol?

- **Answers:**
  - Yes **(1.5 points)**
  - No **(0 points)**
  - N/A
- **ToolTip:** Final verification will be during the Onsite Assessment. Acceptable “industry protocols” include: *ARMA/NRCA: Manual of Roof Inspection and Maintenance of Built-Up and Modified Bitumen Roof Systems: A Guide for Building Owners*; and *SPRI/NRCA: Manual of Roof Inspection, Maintenance and Emergency Repair for Existing Single-Ply Roofing Systems*; and *NRCA Roofing and Waterproofing Manual*.

**ToolTip:**

Mark “N/A” only where there is an existing roofing assembly being integrated, as in the case of a retrofit.

**Assessment Guidance:**

Roofing Consultants Institute (RCI) is an international association of building envelope consultants. They offer a Registered Roof Observers (RRO) certification. RRO certified roof inspectors can perform evaluations on existing roofs, prepare construction documents, perform forensic inspections, and monitor roof construction to ensure the roof is built to code and specification.

### 3.5.7.2 Flashings

#### 3.5.7.2.1 Criteria:

Is there a requirement that building envelope flashings and sheet metal assemblies are to be:

- **3.5.7.2.1.1:** Installed as per prescribed industry best practice?
  - **Answers:**
    - Yes **(1.5 points)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** “Prescribed industry best practice” is SMACNA’s *Architectural Sheet Metal Manual*.
- **3.5.7.2.1.2:** Inspected as per prescribed industry protocol?
  - **Answers:**
    - Yes **(1.5 points)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** Final verification during the Onsite Assessment. “Prescribed industry protocol” is *NIBS Guideline 3-2006: Annex M.1 Construction & Industry Checklist M.1-4 for Flashing and Sheet Metal* (or more recent version).

**ToolTip:**

Building envelope flashings and sheet metal assemblies include, but are not limited to the following: gutters and downspouts; copings; scuppers; through wall flashing and associated end dams; reglets and counterflashing; and equipment support flashings, openings flashings, and roof edge flashings. Mark “N/A” only where there are no newly installed building envelope flashings and sheet metal assemblies, as in the case of a retrofit.

**References:**

- *SMACNA Architectural Sheet Metal Manual*.
- *ASHRAE Guideline 0-2005: The Commissioning Process*
- *ASHRAE Standard 202-2013: Commissioning Process for Buildings and Systems*
- *NIBS Guideline 3-2006: Annex M.1 Construction & Industry Checklist M.1-4 for Flashing and Sheet Metal*.
- *NIBS Guideline 3-2012: Building Enclosure Commissioning Process BECx*

### Assessment Guidance:

The following checklist items do not reflect the entire list in the *NIBS Guideline 3-2006 Appendices*. In developing checklists for specific projects, the use is encouraged to use the formats recommended in *ASHRAE Guideline 0-2005* (or more recent version). Field inspection should be outlined in the project specifications and could be included in the commissioning scope of work. *NIBS guideline 3-2006 Checklists M.1-4 for Flashing and Sheet Metal* includes items such as:

- Verify delivered material is of approved type, shape, gauge, metal, fabrication, and priming, as required, and all accessories are provided.
- Verify isolation provisions are made for dissimilar metals. Do not allow copper and aluminum flashings to be in contact with each other or with ferrous metal. Copper or aluminum flashings are to be fastened with non-ferrous nails or screws. Ferrous equipment bases are not to be set on copper flashings. Verify that flanges embedded in plastic cement or asphalt are asphalt primed.
- Verify expansion joints are provided and installed as required or as specified. Note location of joints with respect to drains, downspouts, scuppers, corners, and other outlets.
- Verify flashing does not interfere with structural requirements.
- Generally see that edge metal is lapped a minimum of 4 inches with 12 inches staggered nailing or fastening through the back flange unless otherwise required.
- Verify all edge metal laps are coated with sealant on horizontal flange and vertical rise.
- Verify that coating covers the entire lap and is sandwiched between.
- Verify lengths are as long as practical or specified.
- Verify installation is coordinated with roofing and/or siding installation.
- Verify that a nailer or cant strip is provided for fastening flashing to roof deck is of proper material, well secured, and allows venting if required or specified.
- Verify flashing is embedded and installed over roof membrane assembly with additional roofing membrane material.
- Verify method of anchoring lower edge of fascia is as required. Observe alignment and stiffness.
- Verify gravel stops are flush with deck unless otherwise required.
- Verify gutters are adequately supported and allow for movement. Observe attachment size, type, location, and spacing of hangers and supports.
- Verify base flashing extends upward sufficiently, that flange is properly secured and embedded at least 4 inches in roofing membrane and it is installed similarly to gravel stops. Verify mopped felt or suitable membrane covering flashings or cleats are provided. It is good practice to cover as much metal as practical to avoid movement from temperature variations.
- Verify louvers and vents have adequate flanges and connections for anchorage and flashings are watertight against driving rains after installation. Verify insect screen, bird screen, and shutters are provided as required.
- Construct mock-ups and field water test.

### 3.5.7.3 Roof and Wall Openings

#### 3.5.7.3.1 Criteria:

Is there a requirement that all products for roof and wall openings (doors, windows, skylights etc.) are to:

- **3.5.7.3.1.1:** Comprise moisture management design that meets industry prescribed performance requirements?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** “Prescribed performance requirements” for design pressure should be in accordance with *AAMA/WDMA/CSA 101/I.S.2/A440-08* (or more recent version). Mark “N/A” only where there are no newly installed roof and wall openings, as in the case of a retrofit.

- **3.5.7.3.1.2:** Be installed as per prescribed industry best practice?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** “Prescribed industry best practice” is *ASTM E2112–07* (or more recent version) or *CMHC Flashings: Best Practice Guide*. Mark “N/A” only where there are no newly installed roof and wall openings, as in the case of a retrofit.
- **3.5.7.3.1.3:** Be inspected as per the prescribed industry protocol, including field testing with respect to water penetration?
  - **Answers:**
    - Yes **(2 points)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** Final Verification at the post-construction Phase. “Prescribed industry protocol” is *NIBS Guideline 3-2006: Annex M.1 Construction & Industry checklists M.1-7 for Windows and M.1-8 Skylights* (or more recent version). Field testing for water penetration should consist of a minimum of 3 units per 100 of each type (doors, windows, skylights, in accordance with the following: *ASTM E1105-2000*; and by applying the same test pressures required to determine compliance with specified requirements of *AAMA/WDMA/CSA 101/I.S.2/A440-08* field testing. “Design Pressure” means the wind load pressure a product is rated to withstand. Mark “N/A” only where there are no newly installed roof and wall openings, as in the case of a retrofit.

## References:

- *AAMA/WDMA/CSA 101/I.S.2/A440-08: NAFS-North American Fenestration Standard/Specification for windows, doors, and skylights*
- *ASTM E1105-2000*
- *ASTM E283-04 (2012)*
- *ASHRAE Guideline 0-2005: The Commissioning Process*
- *ASHRAE Standard 202-2013: Commissioning Process for Buildings and Systems*
- *ASTM E2112–07: Best Practice Guide*
- *CMHC Flashings: Best Practice Guide*
- *NIBS Guideline 3-2006: Annex M.1 Construction & Industry Checklists M.1-7 for Windows and M.1-8 Skylights*
- *NIBS Guideline 3-2012: Building Enclosure Commissioning Process BECx*

## Assessment Guidance:

**3.5.7.3.1.1** - *AAMA/WDMA/CSA 101/I.S.2/A440-08* standard applies to testing and rating of windows, door, and skylights. It does not apply to testing of interior windows and door, curtain wall and storefront systems, revolving doors, or commercial entrance systems. All applicable windows, doors, and skylights should have in their specification section, a requirement to be testing to this standard. The results of these tests should be included in submittal documents, showing compliance to the specifications. These specifications and submittals should be furnished to the Assessor during the Design Review or Onsite Assessment for review.

**3.5.7.3.1.2** – For this sub-criteria, projects can either specify that all exterior windows, door and skylights be installed to comply with *ASTM E2112–07* or the *CMHC Flashings: Best Practice Guide*. *ASTM E2112* details requirements that will help to accomplish the installation of fenestration products in an effective manner. Actual conditions in buildings vary greatly and, in some cases, substantial additional precautions may be required. In the event that the manufacturer's installation instructions provided with the product conflict with requirements of this practice, the manufacturer's instructions shall prevail. CMHC's series of Best Practice Guides on building technology offer user-friendly, detailed information based on sound research and practical experience.



**3.5.7.3.1.3** - The following checklist items do not reflect the entire list in the *NIBS Guideline 3-2006 Appendices*. In developing checklists for specific projects, the use is encouraged to use the formats recommended in *ASHRAE Guideline 0-2005*. Field inspection should be outlined in the project specifications and could be included in the commissioning scope of work. *NIBS guideline 3-2006* checklists *M.1-7 for Windows* and *M.1-8 Skylights* includes items such as:

For windows:

- Verify hardware is of required type, metal, finish, and function.
- Verify special items are furnished, such as window cleaner's bolts, pull-down hooks, poles, special mullions, and trim.
- Verify required type of glazing beads or stops are provided and are suitable to receive glass and glazing thicknesses. Verify method of fastening is as required.
- Verify windows are set plumb, square, and level in alignment and at proper location and elevation.
- Verify windows have provision for suitable anchorage, and it is provided during installation.
- Verify windows are adequately braced where "built in".
- Verify windows are sealed as required for metal-to-metal surfaces and other surfaces.
- Observe that solid grouting, caulking and backup are provided if required.
- Verify finish is protected and maintained during and after installation. Observe that protection against cement, plaster, acids, and other harmful materials is provided.
- Verify windows are installed to be weather tight. Observe that weeps are provided, if required, and are maintained in a clean condition.
- Verify windows are properly adjusted for tolerance, clearance, and operation before glazing.
- Verify type of sealant is as required and applied in accordance with instructions.
- Verify cleaning of metals and glass is properly performed.
- Verify that screens of proper type, mesh, and size are provided, if required and suit installation.
- Test operable windows for hardware and friction adjustment and ease of operation on completion of installation.
- Perform field water test/ hose testing of flashings, end dams, and sub sills prior to window installation.

For skylights:

- Verify schedule for installation / weather factors.
- Prior to installation, verify support and adjacent construction are properly prepared to receive the work.
- Verify all materials are free from defects and/or damage prior to installation.
- Verify system is plumb and true in relation to established lines and approved shop drawings.
- In a pressure plate system, verify horizontal pressure plates are embedded in silicone, not simply caulked around.
- Verify protection of completed work from abuse and foreign matter.
- Confirm anchorage of skylight to structure is in accordance with approved shop drawings.
- Verify retainer bars are attached with gasketed stainless steel fasteners spaced at a maximum of 9" on center.
- If glass used is heat strengthened or tempered on the interior side, verify a screen has been installed within 100 mm or 4" of the glass.
- Ensure glass is resting evenly on setting blocks to avoid shear action.
- Verify sheet metal flashing ends overlap a minimum of 6" – 8" and set in full bed of sealant.
- Ensure flashing details should meet the standards of the National Roofing Contractors Association and/or SMACNA.
- Field water test – flashings and end dams prior to installation of the skylight
- Verify no water penetration when tested in accordance with the specifications. Water penetration is defined as the appearance of uncontrolled water- other than condensation- on the interior surface of any part of the skylight.
- Air infiltration shall be limited to the specified allowance. *ASTM E283-04(2012)* allows an infiltration rate of 0.23 cfm/m or 0.50 cfm/ft. under 11kPa or 1.57 psi of pressure.



## 3.5.8 Envelope – Foundation, Waterproofing

### 3.5.8.1 Foundation Systems

#### 3.5.8.1.1 Criteria:

Is there a requirement that newly installed foundation systems for conditioned spaces are to:

- **3.5.8.1.1.1:** Be constructed with slab-on-ground vapor retarders conforming to prescribed industry best practices?
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** “Prescribed industry best practices” are *ASTM E1745-11*, and/or *CMHC Best Practice Guide*, and/or *Building Science.com - Best Practices*; and *American Concrete Institute 302.2R-06: Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials*. Mark “N/A” only where there are no newly installed foundation systems, as in the case of a retrofit.
- **3.5.8.1.1.2:** Be constructed such that all slabs on grade will be positioned directly over vapor retarders and capillary-break base courses?
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** Mark “N/A” only where there are no newly installed foundation systems, as in the case of a retrofit.
- **3.5.8.1.1.3:** Undergo field-inspection of all vapor retarder and waterproofing assemblies as per prescribed industry protocol?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** Final verification during the Onsite Assessment. “Prescribed industry protocol” is *NIBS Guideline 3-2006: Annex M.1 Construction & Industry Checklist M.1-1 for Waterproofing* (or more recent version). Mark “N/A” only where there are no newly installed foundation systems, as in the case of a retrofit.

#### References:

- *ASTM E1745-11: Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs*
- *CMHC Best Practice Guide*
- *Building Science Corporation- Best Practices*  
<http://www.buildingscience.com/>
- *American Concrete Institute 302.2R-06: Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials*
- *NIBS Guideline 3-2006: Annex M.1 Construction & Industry Checklist M.1-1 for Waterproofing*
- *NIBS Guideline 3-2012: Building Enclosure Commissioning Process BECx*
- *ACI 302.2R-06: Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials*
- *ACI 302.1R: Guide for Concrete Floor and Slab Construction*

- *ACI 360R: Design of Slabs-on-Ground*
- *ASHRAE Guideline 0-2005: The Commissioning Process*
- *ASHRAE Standard 202-2013: Commissioning Process for Buildings and Systems*

### **Assessment Guidance:**

Projects that have moisture sensitive flooring materials should consult *ACI 302.2R-06: Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials*. Moisture sensitive flooring materials include sheet rubber, epoxy coatings, vinyl composition tile, sheet vinyl, carpet, athletic flooring, laminates, and hardwood. Since this guide is specific to floor moisture problems and solutions, projects can also refer to the most current editions of both *ACI 302.1R: Guide for Concrete Floor and Slab Construction*, and *ACI 360R: Design of Slabs-on-Ground*, for general information. These two documents contain guidance on floor design and construction that is needed to achieve successful floor covering performance.

Liquid water and water vapor can be wicked up through concrete slabs by capillary action. This water can cause the failure of flooring adhesives, gypsum board, carpet, and other flooring. In addition to failure, this water penetration can result in mold growth which can negatively affect indoor air quality. A gravel layer beneath the slab provides a capillary break to prevent water and water vapor from penetrating the porous concrete. This gravel base should then be covered with the vapor retarder. The U.S. Environmental Protection Agency, through the Indoor airPLUS program, has outlined a general approach for constructing a capillary break:

“Preparations for pouring a concrete slab should include making sure the soil that will be beneath this level so that when the gravel is added, a consistent 4-in. minimum thickness is maintained. Polyethylene sheeting is then placed over the entire gravel area and touches each perimeter wall. Lengths of sheeting laid side-by-side must overlap at least 6-in. (12-in. overlaps are often easier because it can be difficult to cut long lengths of polyethylene in straight lines) and the two sheet surfaces sealed or taped together. A continuous bead of acoustical sealant, butyl rubber or butyl acrylic caulk forms the most durable bond. Seams may also be sealed with tape manufactured to seal or patch polyethylene, such as some builder’s tapes and tapes used to repair polyethylene greenhouses. The final step is to pour the concrete slab over the sealed polyethylene sheeting.”<sup>17</sup>

The following checklist items do not reflect the entire list in the *NIBS Guideline 3-2006 Appendices*. In developing checklists for specific projects, the use is encouraged to use the formats recommended in *ASHRAE Guideline 0-2005*. Field inspection should be outlined in the project specifications and could be included in the commissioning scope of work.

*NIBS Guideline 3-2006 Annex M1.1 – Waterproofing Checklist* includes items such as:

- Verify exposed areas have been masked to protect adjacent work and property.
- Verify that acceptable weather conditions are present for application (above 40°F, not damp or foggy, depending on material used)
- Provide applicator with substrates free of standing water, dirt and debris, loose material, voids, and protrusions or deformations that may inhibit application or performance of waterproofing. If waterproofing application will be setup on bare ground, provide sub grades that are stable, smoothed, and compacted to minimum 85 percent modified proctor density.
- If waterproofing will be installed on earth retaining system, fill gaps and voids in earth retaining system to conform to waterproofing manufacturer's requirements; remove nails in wood lagging.
- If waterproofing will be installed on concrete and/or masonry, provide substrates that are free of voids deeper than 3/8" and free of surface protrusions more than 1/4" above the surface.
- If waterproofing will be installed on concrete footings, provide wood float or better finish to surfaces scheduled to receive the vapor-protective waterproofing.

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<sup>17</sup> Technical Guidance to Indoor airPLUS Construction Specifications” United States Environmental Protection Agency, accessed February 26, 2015, [http://www.epa.gov/indoorairplus/technical/moisture/1\\_2.html](http://www.epa.gov/indoorairplus/technical/moisture/1_2.html)

- If waterproofing will include bentonite water stop strips, provide concrete surfaces as required for that installation.
- Verify laps between membrane sheets are consistent with approved details (flashings, changes of plane in membrane showing overlap, etc.).
- Verify joinery between each day's work is adequate.
- Verify that interstitial moisture is not present.
- Verify that stored materials are protected against moisture.
- Verify that membrane is applied smooth without buckles or "fish mouths".
- Rigidly install penetrations of vapor-protective waterproofing for detailing procedures.
- Take appropriate protective measures to ensure that finished work is not penetrated or damaged by other trades.
- Verify that proper ventilation is being maintained during application of waterproofing utilizing chemicals and solvents.
- Verify that subcontractor has properly disposed of excess materials in compliance with EPA and OSHA requirements.
- Ensure pipes, ducts, conduits, and other items penetrating membrane are watertight.
- Verify proper coverage and quantities of materials such as mil thickness.
- Verify protective covering is provided and installed as required, backfilling takes place immediately, and the covering remains in place during backfilling.
- Perform field water testing of the completed installation wall penetrations prior to backfill operations

Project specifications and architectural sections/details will be reviewed during the Design Review to confirm compliance with the above sub-criteria. Architectural details should include specific construction details for the slab, capillary break, and vapor retarder. For the specifications, the vapor retarders should reference at least one of the Tooltip mentioned standards or best practices and the aggregate/gravel base should be specified. If using an aggregate base, consider using recycled aggregate when appropriate.

### 3.5.8.1.2 Criteria:

Is there a requirement for the following damp-proofing measures to be applied to all newly installed foundation walls in contact with grade:

- **3.5.8.1.2.1:** 5% slope grade away indicated from the building for at least 10 ft. (3.05 m)?
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** Final verification during the Onsite Assessment. Directs water away from the building and reduces the risk of water penetration through foundation system. Mark "N/A" only where there are no newly installed foundation walls, as in the case of a retrofit.
- **3.5.8.1.2.2:** Roof drainage to be directed at least 3 ft. (0.9 m) beyond the building overhang?
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** Mark "N/A" only where there are no newly installed foundation walls, as in the case of a retrofit.
- **3.5.8.1.2.3:** A foundation drainage system?
  - **Answers:**
    - Yes **(1 point)**

- No (0 points)
- N/A
- **ToolTip:** Mark “N/A” only where there are no newly installed foundation walls, as in the case of a retrofit.

### Assessment Guidance:

For projects pursuing the above sub-criteria, the architect, plumbing designer, and civil engineer need to coordinate:

- Slope of grade from building exterior to 10 feet from foundation wall
- Roof drainage discharge locations (including emergency/secondary roof drainage discharge locations)
- Sub-soil/foundation drainage system (will require sump pump, settling basin, sub-soil drainage piping and interior waste piping)

Sub-criteria 3.5.8.1.2.2 and 3.5.8.1.2.3 should be shown on the plumbing design drawings. Sub-criteria 3.5.8.1.2.1 can be shown on the civil drawings. These items will be checked during the Stage I review.

## 3.5.8.2 Below Grade Wall Slabs and Above Grade Horizontal Assemblies

### 3.5.8.2.1 Criteria:

Is there a requirement that waterproofing membrane assemblies are to:

- **3.5.8.2.1.1:** Be provided at all below grade slabs and foundation/basement walls that are subject to hydrostatic pressures?
  - **Answers:**
    - Yes (1 point)
    - No (0 points)
    - N/A
  - **ToolTip:** Mark “N/A” only where there are no newly installed waterproofing membrane assemblies, as in the case of a retrofit.
- **3.5.8.2.1.2:** Be installed as per the manufacturer’s requirements, and field-inspected as per prescribed industry protocol?
  - **Answers:**
    - Yes (1 point)
    - No (0 points)
    - N/A
  - **ToolTip:** Final verification during the Onsite Assessment. “Prescribed industry protocol” is *NIBS Guideline 3-2006: Annex M.1 Construction & Industry Checklist M.1-1 for Waterproofing* (or more recent version) and *ASTM D5957 – 98 (05) Standard Guide for Flood Testing Horizontal Waterproofing Installation*. Mark “N/A” only where there are no newly installed waterproofing membrane assemblies, as in the case of a retrofit.

### ToolTip:

Horizontal assemblies apply to assemblies of building materials used in horizontal applications such as parking garages, and plaza deck-type applications over habitable spaces or on elevated structures, but not intended for use on building roofing systems.

### References:

- *NIBS Guideline 3-2006: Annex M.1 Construction & Industry Checklist M.1-1 for Waterproofing*
- *NIBS Guideline 3-2012: Building Enclosure Commissioning Process BECx*
- *ASTM D5957 – 98 (05) Standard Guide for Flood Testing Horizontal Waterproofing Installation*
- *ASHRAE Guideline 0-2005: The Commissioning Process*

- *ASHRAE Standard 202-2013: Commissioning Process for Buildings and Systems*

### Assessment Guidance:

The following checklist items do not reflect the entire list in the *NIBS Guideline 3-2006 Appendices*. In developing checklists for specific projects, the use is encouraged to use the formats recommended in *ASHRAE Guideline 0-2005*. Field inspection should be outlined in the project specifications and could be included in the commissioning scope of work.

*NIBS guideline 3-2006 Annex M1.1 – Waterproofing Checklist* includes items such as:

- Verify exposed areas have been masked to protect adjacent work and property.
- Verify that acceptable weather conditions are present for application (above 40°F, not damp or foggy, depending on material used)
- Provide applicator with substrates that are free of standing water, dirt and debris, loose material, voids, and protrusions or deformations, which may inhibit application or performance of waterproofing. If waterproofing application will be setup on bare ground, provide sub grades that are stable, smoothed, and compacted to minimum 85 percent modified proctor density.
- If waterproofing will be installed on earth retaining system, fill gaps and voids in earth retaining system to conform to waterproofing manufacturer's requirements; remove nails in wood lagging.
- If waterproofing will be installed on concrete and/or masonry, provide substrates that are free of voids deeper than 3/8" and free of surface protrusions more than 1/4" above the surface.
- If waterproofing will be installed on concrete footings, provide wood float or better finish to surfaces scheduled to receive the vapor-protective waterproofing.
- If waterproofing will include bentonite water stop strips, provide concrete surfaces as required for that installation.
- Verify laps between membrane sheets are consistent with approved details (flashings, changes of plane in membrane showing overlap, etcetera).
- Verify joinery between each day's work is adequate.
- Verify that interstitial moisture is not present.
- Verify that stored materials are protected against moisture.
- Verify that membrane is applied smooth without buckles or "fish mouths".
- Rigidly install penetrations of vapor-protective waterproofing for detailing procedures.
- Take appropriate protective measures to ensure that finished work is not penetrated or damaged by other trades.
- Verify that proper ventilation is being maintained during application of waterproofing utilizing chemicals and solvents.
- Verify that subcontractor has properly disposed of excess materials in compliance with EPA and OSHA requirements.
- Ensure pipes, ducts, conduits, and other items penetrating membrane are watertight.
- Verify proper coverage and quantities of materials such as mil thickness.
- Verify protective covering is provided and installed as required and backfilling takes place immediately, and the covering remains in place during backfilling.
- Perform field water testing of the completed installation wall penetrations prior to backfill operations

*ASTM D5957 – 98 (05)* can also be referenced in the specifications where field verification is required. This standard provides the user with a method for testing the water-tightness of waterproofing installations applied to horizontal surfaces having a slope not greater than 2 % slope (1/4 in. per ft). This standard is not intended for use on those waterproofing installation applications that are for long-term water storage or continuously submerged environments, such as swimming pools, fountains, tank liners with hydrostatic pressure, or water storage units (storage period greater than 48 h).

Project specifications and architectural sections/details will be reviewed during the Design Review to confirm compliance with the above sub-criteria. Architectural details should include specific construction details for the assemblies, capillary breaks, and vapor retarders. For the specifications, the field installation verification should reference at least one of the



Tooltip mentioned standards or best practices and the aggregate/gravel base should be specified. If using an aggregate base, consider using recycled aggregate when appropriate.

## 3.5.9 Envelope – Cladding

### 3.5.9.1 Exterior Wall Cladding Systems

#### 3.5.9.1.1 Criteria:

Is there a requirement to install cladding systems as per industry best practices for one of the following:

- Exterior Insulation Finishing Systems (EIFS) installed as water-managed systems in accordance with the manufacturers' requirements?
- or*
- Aluminum framed glazing systems installed in accordance with the manufacturer's requirements and warranted by the manufacturer for the intended purpose?
- or*
- Masonry veneer cladding installed in accordance with industry technical notes and bulletins?
- or*
- Architectural precast concrete cladding systems that incorporate pressure equalized two stage joints between precast concrete panels and adjacent cladding assemblies?

#### Answers:

- Yes, EIFS cladding **(1 point)**
- Yes, aluminum framed glazing **(1 point)**
- Yes, masonry veneer cladding **(1 point)**
- Yes, precast concrete cladding **(1 point)**
- No **(0 points)**
- N/A

#### ToolTip:

Mark "N/A" only where there are no newly installed exterior wall cladding systems such as those as described.

#### 3.5.9.1.2 Criteria:

Is there a requirement to inspect the cladding installation as per the appropriate prescribed industry protocols for one of the following:

- EIFS cladding systems?
- or*
- Aluminum framed glazing systems?
- or*
- Masonry veneer cladding?

#### Answers:

- Yes, EIFS cladding **(1 point)**
- Yes, aluminum framed glazing **(1 point)**
- Yes, masonry veneer cladding **(1 point)**
- No **(0 points)**
- N/A



### ToolTip:

Final verification will occur during the Onsite Assessment. Mark “N/A” only where there are no newly installed exterior wall cladding systems such as those as described.

“Prescribed industry protocol” means:

- **EIS cladding systems:** *NIBS Guideline 3-2006: Annex M.1 Construction & Industry Checklist M.1-2 for EIFS* (or more recent version).
- **Aluminum framed glazing systems:** *NIBS Guideline 3-2006: Annex M.1 Construction & Industry Checklist M.1-6 for Entrances and Storefronts and M 1-10 for Glazed Curtain Walls* (or more recent version).
- **Masonry veneer cladding:** *NIBS Guideline 3-2006: Annex M.2 Example Construction Checklist for Building Envelope System for Brick* (or more recent version).

### References:

- *NIBS Guideline 3-2006: Annex M.1 Construction & Industry Checklist M.1-2 for EIFS*
- *NIBS Guideline 3-2006: Annex M.1 Construction & Industry Checklist M.1-6 for Entrances and Storefronts and M 1-10 for Glazed Curtain Walls*
- *NIBS Guideline 3-2006: Annex M.2 Example Construction Checklist for Building Envelope System for Brick*
- *NIBS Guideline 3-2006: Annex M.2 Example Construction Checklist for Building Envelope System Joint Sealants*
- *NIBS Guideline 3-2006: Annex M.1 Construction & Industry Checklist M.1-5 for Joint Sealers*
- *ASHRAE Guideline 0-2005: The Commissioning Process*
- *ASHRAE Standard 202-2013: Commissioning Process for Buildings and Systems*
- *NIBS Guideline 3-2012: Building Enclosure Commissioning Process BECx*

### Assessment Guidance:

The following checklist items do not reflect the entire list in the *NIBS Guideline 3-2006 Appendices*. In developing checklists for specific projects, the use is encouraged to use the formats recommended in *ASHRAE Guideline 0-2005*. Field inspection should be outlined in the project specifications and could be included in the commissioning scope of work.

**EIFS Cladding Systems** - *NIBS Guideline 3-2006 Annex M1.2 – EIFS Checklist* includes items such as:

- Verify flashing has been installed at windows- head, sills, jambs, doors, roof, louvers, and parapets.
- Mesh may not be stapled. It is to be embedded in the PB base coat.
- Must tent and heat if under 40 degrees for 24 hours. Check the manufacturer’s recommendations from specific systems and their individual product components. Proper storage of materials is critical.
- Must install the expansion joints out to edge, they should not be built over.
- Every 75 lineal feet needs a control joint.
- Back wrapping is required for all EIFS.
- EIFS must not be installed below grade.
- Ganged penetrations are preferred in lieu of multiple close-together penetrations that will weaken the EIFS.
- Warranty must be identified in bid documents.
- Expansion joints are required at all floor lines.
- Sealant joints must be made to the base coat, never to the finish topcoat.
- Materials for a wall system must be sourced from an assembly of a system with specifically lab-tested materials. Materials must be a tested system.

There are additional installing checklist items for Type PB EIFS. There are also checklist items for sealants within the EIFS. NIBS also includes the following plan and specification items that should be checked prior to bid:

- Subcontractor site-specific safety plan to be submitted for approval – including hoisting, MSDS, aerial access, operation by qualified personnel, stages, scaffolding, and design by professional engineer (P.E.).
- Dew Point Analysis conducted by A/E to determine if or where the dew point occurs in the wall system.
- Require that the both the plans and contract specifications are in concert with the EIFS manufacturer specifications and with the detailed drawings for the wall system to be constructed.

- Require that the shop drawings submitted be in accordance with EIFS manufacturer specifications and detailed system drawings.
- Require that the shop drawings be detailed so that water penetration shall be prevented and so that damage will not occur to the composite wall assembly.
- Proper substrate as recommended by EIFS manufacturer.
- Proper flashing, trim, and accessories are specified and detailed in accordance with architect and EIFS manufacturer.
- Minimum thickness is ¾" foam, maximum 4" foam.
- Expansion joints properly located in accordance to EIFS manufacturer specifications and details. Shop drawings to include isometrics of the expansion joints, penetrations, terminations, flashings, end dams, fenestration openings – windows, doors, louvers, penetrations
- Minimum width of expansion joint is specified and detailed in accordance with EIFS manufacturer and sealant manufacturer to allow for bond breaker/backer rod and the appropriate sealant contour.
- Proper shop drawing detailing to prevent water penetration at dissimilar materials.
- Proper shop drawing detailing of windows, including head and sill flashings, to prevent water penetration.
- Drip details specified as required by EIFS manufacturer and contract documents.
- EIFS should not be used as a parapet cap or windowsill.
- Parapet is detailed to prevent water penetration and in accordance with EIFS manufacturer for flashing.
- Proper transition from EIFS to roof base flashing to prevent water penetration in accordance with EIFS manufacturer.
- Proper termination at concrete.
- Proper termination above grade.
- Proper detailing at foundation.

**Aluminum Framed Glazing Systems**— *NIBS Guideline 3-2006: Annex M.1 Construction & Industry Checklist M.1-6 for Entrances and Storefronts and M 1-10 for Glazed Curtain Walls* includes items such as:

For entrances and storefronts:

- Field measure prior to installation.
- Cross-reference all related submittals, as well as specifications and plans.
- Know where interior items intersect storefront glazing and how it will be handled.
- Copy all information to all subcontractors involved.
- Be aware of surrounding materials and the connections to the doors and frames.
- Follow all manufacturers' instructions.
- Secure approval for all mock-ups or irregular instances ahead of time by the Architect.
- RFI any discrepancies immediately.
- Provide dollars to cover the cost for the extra care and handling involved in this section.
- Consider other trades when scheduling the installation.
- Allow for proper protection of the glazing from other trades.
- Verify components or pre-assembled panels are checked for shipping damage after uncrating and that size, shape, thickness of metal extrusions, or parts match full size details, when available. Check that gauges, patterns, and colors are as approved and match samples.
- Verify protective coating and/or lacquers are provided to proper thickness.
- Verify shop-applied sealant is provided at shop-assembled joints as required.
- Verify field-applied sealant is provided as required.
- Verify color matches between panels and parts are within specified range.
- Verify dissimilar metals and materials are isolated; for example, aluminum, in contact with other metals and cementitious surfaces, may require nylon, polystyrene or pressure tape, separators, or stainless steel bolts.
- Verify field-applied sealant is of proper type and color and applied where required. Verify sealant joint widths are correct.
- Verify expansion joints are provided between units as required.

- Verify weep holes and drainage systems are provided and are clean before and after erection.
- Verify installation tolerances are maintained regarding horizontal and vertical alignment and plumbness.
- Verify reveals are of consistent size and alignment.
- Verify anchorage to structure is secure for transfer of wind load and is required and permanently tightened after alignment.
- Verify hardware provisions have been coordinated.
- Verify electric or pneumatic outlets and locations, if required, are provided.
- Verify exterior is maintained reasonably clean after installation. Clear all cementitious materials from surfaces.
- Verify final cleaning is performed as required.
- Verify doors, openings and space at doors allow for accessibility requirements. (ADA)
- Conduct water test (hose test) of the installed assembly.
- Obtain manufacturer's touch-up painting procedures
- Field test water thresholds, flashings, and end dams.

For glazed curtain wall systems:

- Verify components or pre-assembled panels are checked for shipping damage after uncrating. Verify size, shape, and thickness of metal extrusions or parts match full size details when available. Check that gauges, patterns, and colors are as approved and match samples.
- Verify protective coating and/or lacquers are provided to proper thickness.
- Verify joint sealer is provided at shop-assembled joints as required.
- Verify shop-applied sealant is provided as and where required, including per the Laboratory tested mock up.
- Verify sound deadening material and/or insulation is provided as required.
- Verify color matches between panels and parts are within specified range.
- Ensure dissimilar metals and materials are isolated; for example, aluminum, in contact with other metals and cementitious surfaces, may require nylon, polystyrene, or pressure tape, separators or stainless steel bolts.
- Verify field-applied sealant is of proper type and color and applied where required.
- Verify expansion joints are provided between units as required.
- Verify weep holes and drainage systems are provided and are clean before and after erection.
- Verify erection tolerances are maintained regarding horizontal and vertical alignment and plumbness.
- Verify reveals and align are of consistent size.
- Verify anchorage to structure is secure for transfer of wind load and is required and permanently tightened after alignment.
- Verify debris, such as spray fireproofing, is removed from within curtain wall sections after erection.
- Verify exterior is maintained reasonably clean after installation, especially free from cementitious materials.
- Verify final cleaning is performed as required.
- Obtain manufacturer's installation instructions.
- Obtain manufacturer's cleaning instructions and touch up painting instructions.
- Obtain warranty.
- Perform field water testing (of the flashings, end dams, sub sills prior to installation) per the project specifications.

**Masonry Veneer Cladding** – *NIBS Guideline 3-2006: Annex M.2 Example Construction Checklist for Building Envelope System for Brick* includes items such as:

- Brick color and texture matches mock-up
- Anchors are properly installed
- Rigid insulation is securely bonded to CMU
- Rigid insulation joints are tightly butted to minimize moisture collection between joints
- Flashing is installed in accordance with contract documents
- Mortar color matches mock-up
- Anchors and attachments are in good condition and correctly spaced

- Brick is within 1/4" of plumb in 10' and within 3/8" per floor and within 1/2" from base to roof line
- Control joints are 25' or less apart UMC
- Sufficient clearance between non grouted components to allow for proper backing rod and sealant installation
- Cavity weep tubes are installed at sills, relieving angles, door and window heads, and imbed joints
- Horizontal weeps are at 2' centers or less, vertical cavity weeps at 20' or less
- Weep holes are open and free of debris

### 3.5.9.1.3 Criteria:

Are joint sealers to be installed as per prescribed industry best practice, and field-inspected as per prescribed industry protocol?

#### Answers:

- Yes **(1 point)**
- No **(0 points)**

#### ToolTip:

Final verification will occur during the Onsite Assessments. "Prescribed industry best practice" is *NIBS Guideline 3-2006: Annex M.2 Example Construction Checklist for Building Envelope System Joint Sealants* (or more recent version). "Prescribed industry protocol" is *NIBS Guideline 3-2006: Annex M.1 Construction & Industry Checklist M.1-5 for Joint Sealers* (or more recent version).

#### References:

- *NIBS Guideline 3-2006: Annex M.2 Example Construction Checklist for Building Envelope System for Brick*
- *NIBS Guideline 3-2006: Annex M.1 Construction & Industry Checklist M.1-5 for Joint Sealers*
- *ASHRAE Guideline 0-2005: The Commissioning Process*
- *ASHRAE Standard 202-2013: Commissioning Process for Buildings and Systems*
- *NIBS Guideline 3-2012: Building Enclosure Commissioning Process BECx*

#### Assessment Guidance:

The following checklist items do not reflect the entire list in the *NIBS Guideline 3-2006 Appendices*. In developing checklists for specific projects, the use is encouraged to use the formats recommended in *ASHRAE Guideline 0-2005*. Field inspection should be outlined in the project specifications and could be included in the commissioning scope of work.

*NIBS Annex M1.5 Joint Sealers Checklist* includes items such as:

- Verify product specified is appropriate to site conditions.
- Verify subcontractor is authorized by manufacturer to apply product.
- Is product compatible with substrate?
- Has surface been properly prepared?
- Is primer being used when required?
- Is the proper sealant installation technique being used including application, bond breakers, field-testing, storage, shelf life, etc.?
- Depth should never be larger than width of caulk joint.
- General rule: acid cure sealants are generally compatible with clear glass, metals, plastics, and painted surfaces (primer may be needed). These types of sealants release acetic acid during cure. Not compatible with concrete, limestone, marble, lead, zinc, or substrates attacked by acetic acid.
- Open cell backer rod must be removed if rained on.
- Verify exposed areas have been masked to protect adjacent work and product.

### 3.5.9.2 Rainscreen Wall Cladding

#### 3.5.9.2.1 Criteria:

Do the construction documents indicate that exterior rainscreen wall cladding systems specified over framed walls are to be installed with the following:

- **3.5.9.2.1.1: A primary and secondary line of defense?**
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
    - N/A
- **3.5.9.2.1.2: An air barrier?**
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
    - N/A
- **3.5.9.2.1.3: A means for incidental bulk water intrusion to escape the cladding system assembly?**
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
    - N/A

#### **ToolTip:**

Mark "N/A" where there is no newly installed rainscreen wall cladding, as in the case of a retrofit.

#### **Assessment Guidance:**

Rainscreen cladding product details should be submitted showing a primary cladding material that protects against water intrusion, an air cavity, and a secondary weather barrier. This secondary barrier can include an air barrier and an insulating layer. In order to bulk water intrusion to escape the cladding system, the cavity between claddings should have protected openings on the top and bottom of the wall to promote convective airflow, allowing moisture to quickly drain or evaporate. Pressure-equalized cladding assemblies should be used in climates with an annual precipitation of 60 inches or more.

#### 3.5.9.2.2 Criteria:

Are rainscreen cladding assemblies required to pass requirements of AAMA 508-07 laboratory-testing?

#### **Answers:**

- Yes **(0.5 points)**
- No **(0 points)**
- N/A

#### **ToolTip:**

Applies to both pressure-equalized and non-pressure equalized cladding assemblies. Mark "N/A" where there is no newly installed rainscreen system, as in the case of a retrofit.

#### **References:**

- AAMA 508-07: *Voluntary Test Method and Specification for Pressure Equalized Rain Screen Wall Cladding Systems*



- *ASTM E330/E330M-14 Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference*
- *ASTM E331-00(2009 Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference*
- *ASTM E283-04(2012) Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen*

#### **Assessment Guidance:**

Rainscreen cladding assemblies should be specified to meet the requirements of AAMA 508-07 and the submittals for the products should indicate the systems were tested and complied with the referenced standard. Other rain screen standards include *ASTM E330/E330M-14*, *ASTM E331-00(2009)*, *ASTM E283-04(2012)*, etc. However, AAMA 508-07 is a voluntary standard that tests the ability of the wall system, its components and extrusions and quantified the actual performance. Properly designed rain screen attachment systems and claddings should have high venting and drying capabilities. Pressure-equalized systems minimize the amount of water that enters the system, effectively draining or drying out any water that does enter and also maintains constant and uniform pressure throughout the compartments.

### **3.5.10 Envelope - Barriers**

#### **3.5.10.1 Air Barriers**

##### **3.5.10.1.1 Criteria:**

Do the construction documents indicate that a continuous air barrier will be installed according to the following practices:

- **3.5.10.1.1.1:** The air barrier material of each assembly detail shows an airtight and flexible joint between the air barrier material and adjacent assemblies?
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** Make connections between foundation and walls; walls and windows or doors; different wall systems; wall and roof; wall and roof over unconditioned space; walls, floors and roof across construction, control, and expansion joints; walls, floors, and roof to utility, pipe, and duct penetrations. Mark "N/A" where there is no newly installed air barrier, as in the case of a retrofit.
- **3.5.10.1.1.2:** The air barrier is designed to withstand positive and negative combined design wind, fan and stack pressures on the air barrier without damage or displacement?
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** Mark "N/A" where there is no newly installed air barrier, as in the case of a retrofit.
- **3.5.10.1.1.3:** The air barrier is designed to withstand movement in the structure and not displace materials under full load?
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** Mark "N/A" where there is no newly installed air barrier, as in the case of a retrofit.



- **3.5.10.1.1.4:** Air barrier connection details are shown between: foundation and walls; walls and windows or doors; different wall systems; wall and roof; wall and roof over conditioned space or wall and ceiling under unconditioned space; walls, floors, and roof across construction, control, and expansion joints; walls, floors, and roof to utility, pipe, and duct penetrations?
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
    - N/A
  - **ToolTip:** Mark “N/A” where there is no newly installed air barrier, as in the case of a retrofit.

**ToolTip:**

See *CMHC Best Practice Guide* or [Buildingscience.com](http://Buildingscience.com) for air barrier design and installation.

**References:**

- *CMHC Best Practices Guide*
- *Building Science Corporation- Best Practices*  
<http://www.buildingscience.com/>

**Assessment Guidance:**

Air barriers should be designed and installed to reduce the uncontrolled air movement through the building’s envelope. All air barrier details should be shown on the architect’s design drawings and all air barrier products and construction methods should be thoroughly detailed in the project’s Division 07 specifications.

**3.5.10.1.2 Criteria:**

Do the construction documents indicate compliance of the continuous air barrier for the opaque building envelope was demonstrated using one of the following strategies:

- **Materials** tested in accordance with *ASTM E2178-11 Standard Test Method for Air Permeance of Building Materials* and determined that the air permeability of individual materials did not exceed 0.02 L/s·m<sup>2</sup> under a pressure differential of 75 Pa (0.004 cfm/ft<sup>2</sup> @ 0.3 in. w.g. (1.6 psf)). When all joints are sealed, materials meet this requirement?
- or
- **Assemblies** tested in accordance with *ASTM E2357-11 Standard Test Method for Determining Air Leakage of Air Barrier Assemblies*, or *ASTM E1677-11 Standard Specification for Air Barrier (AB) Material or System for Low-Rise Framed Building Walls*, and determined that the average air leakage did not exceed 0.2 L/s·m<sup>2</sup> under a pressure differential of 75 Pa (0.04 cfm/ft<sup>2</sup> @ 0.3 in. w.g. (1.6 psf)). Concrete masonry walls that are sealed and painted do not have to be tested. When all joints are sealed, assemblies meet this requirement?
- or
- **Building** tested with *ASTM E779-03 Standard Test Method for Determining Air Leakage Rate by Fan Pressurization* or an equivalent approved method and determined that the air leakage rate of the building envelope did not exceed 2.0 L/s·m<sup>2</sup> under a pressure differential of 75 Pa (0.4 cfm/ft<sup>2</sup> @ 0.3 in. w.g. (1.6 psf))?

**Answers:**

- Yes, materials testing **(2 points)**
- Yes, assemblies testing **(2 points)**
- Yes, building testing **(2 points)**
- No **(0 points)**
- N/A

**ToolTip:**

“Materials” include plywood, exterior and interior gypsum wallboard, plaster, concrete, and steel. “Assemblies” can be constructed of plywood, exterior and interior gypsum wallboard, plaster, concrete, steel, and painted or sealed concrete masonry walls. Building testing must be for the completed building. Mark “N/A” where there is no newly installed air barrier, as in the case of a retrofit.

**References:**

- *ASTM E2178-11 Standard Test Method for Air Permeance of Building Materials*
- *ASTM E2357-11 Standard Test Method for Determining Air Leakage of Air Barrier Assemblies*
- *ASTM E1677-11 Standard Specification for Air Barrier (AB) Material or System for Low-Rise Framed Building Walls*
- *ASTM E779-03 Standard Test Method for Determining Air Leakage Rate by Fan Pressurization*

**Assessment Guidance:**

The above strategies should be thoroughly detailed in the project’s Division 07 specifications for the Design Review by the Assessor. Each standard should be listed along with its specific performance requirements.

### 3.5.10.2 Vapor Retarders

#### 3.5.10.2.1 Criteria:

Do the construction documents indicate that the interior side of framed walls in Climate Zones 5, 6, 7, 8 and Marine 4 are installed with a Class I or II vapor retarder that is in accordance with the *International Energy Conservation Code (IECC) 2012*, *International Energy Conservation Code (IECC) 2007 Supplement*, or *International Building Code® (IBC) 2009 Section 1405.3*?

**Answers:**

- Yes **(1 point)**
- No **(0 points)**
- N/A

**ToolTip:**

Mark “N/A” for other Climate Zones, or where there will be no newly installed framed walls.

**References:**

- *International Energy Conservation Code (IECC) 2012*
- *International Energy Conservation Code (IECC) 2007 Supplement*
- *International Building Code® (IBC) 2009 Section 1405.3*

**Assessment Guidance:**

Vapor retarders are classified by their performance to *ASTM E-96 Test Method A* by the *International Building Code® (IBC)*. There are three classes of vapor retarders. Class I retarders have a permeance of 0.1 perm or less and are thus considered impermeable. Class I retarders are often also called vapor barriers. Class II and III vapor retarders are considered semi-impermeable. Class II retarders have a permeance level greater than 0.1 perm and less than or equal to 1 perm. The IBC’s examples of Class I and II vapor retarders are as follows:

- Class I = sheet polyethylene, perforated aluminum foil
- Class II = kraft-faced fiberglass batt insulation or paint with the appropriate permeance rating

In order to comply with the *IECC 2012* the vapor retarder for crawl space walls needs to meet the criteria for 3.5.10.2.3.

If the project is following *2009 IBC* there are three exceptions to installing Class I or II vapor retarders to the interior side of frame walls:

- Basement walls

- Below-grade portion of any wall
- Construction where moisture or its freezing will not damage the materials (if choosing this exception, a narrative should be provided explaining why freezing will not damage the materials)

#### 3.5.10.2.2 Criteria:

Do the construction documents indicate that the walls of unvented crawl spaces must have insulation that is permanently fastened to the wall, extends downward from the floor to the finished grade level, and then vertically and/or horizontally for at least an additional 24 inches (60.9 cm)?

##### Answers:

- Yes **(1 point)**
- No **(0 points)**
- N/A

##### ToolTip:

Mark "N/A" only where there are no unvented crawl spaces.

#### 3.5.10.2.3 Criteria:

Do the construction documents indicate that exposed earth in unvented crawl space foundations must be covered with a continuous Class I vapor retarder, and installed with the following strategies:

- All joints of the vapor retarder are overlapped by 6 in (15.2 cm) and are sealed or taped?  
*and*
- The edges of the vapor retarder extend at least 6 in (15.2 cm) up the stem wall and are attached to the stem wall?

##### Answers:

- Yes **(1 point)**
- No **(0 points)**
- N/A

##### ToolTip:

Mark "N/A" only where there are no unvented crawl spaces.

##### Assessment Guidance:

All vapor retarder/barrier details should be shown on the architect's design drawings for both 3.5.10.2.2 and 3.5.10.2.3. If a project is attempting sub-criteria 3.5.10.2.2, these installation requirements should be listed on the above mentioned details or in the Division 07 specifications.

## 3.6 EMISSIONS AND OTHER IMPACTS

### 3.6.1 Heating

Green Globes provides two paths for assessing heating:

- **Path A: District Heating** – 18 points
- **Path B: Low Emission Boilers and Furnaces** – 18 points

Points cannot be combined between paths. Please review and select the appropriate pathway for the project.

#### 3.6.1.1 Path A: District Heating

##### 3.6.1.1.1 Criteria:

Is district heating being used?

##### Answers:

- Yes **(18 points)**
- No **(0 points)**
- N/A

If Path A: District Heating is selected, Path B: Low Emission Boilers and Furnaces and its associated points cannot also be selected and awarded – only one path will be awarded points.

##### ToolTip:

Mark “N/A” where district heating is not available *and* if there are no boilers or furnaces. If district heating is not available but there are boilers and furnaces, complete Path B: Low Emission Boilers and Furnaces.

##### 3.6.1.1.1.1 Sub-Criteria:

Describe the type of district heating being used:

##### Answers:

- [Text field] **(0 points)**

##### Assessment Guidance:

A district heating system consists of a heating production plant and a transport network. The district heating system will provide thermal energy to more than one building at the same time. This district heating system can produce steam, heating hot water, or domestic hot water. District heating plants can provide higher efficiencies and improved pollution control than localized boilers.

Using non-fossil fuels to produce the steam/hot water is becoming more common in other countries. Denmark and Germany utilize a number of solar powered district heating plants. The solar district heat system will consist of solar thermal collectors and a thermal storage system. These systems usually include interseasonal thermal energy storage to keep the heat output consistent. Additional ways to power the district heating plant would be biofuel/bio mass, geothermal or wind. Of these, biofuel and geothermal are utilized more. Biofuel boilers can run on wood pellets, cordwood, or a combination. They can also burn biodiesel or bioethanol.

Where the project is pursuing certification for only one building served by an existing district heating plant, if the project elects to earn points for this criterion from the existing plant equipment – this plant equipment will be included in the

Green Globes scope for all relevant criteria. If the project does not elect to earn points for this criterion for existing equipment, the equipment is “N/A” for other relevant criteria.

### 3.6.1.2 Path B: Low Emission Boilers and Furnaces

#### 3.6.1.2.1 Criteria:

Are there low or ultra-low NO<sub>x</sub> emission boilers and furnaces?

##### Answers:

- Ultra-low NO<sub>x</sub> emission boilers & furnaces **(9 points)**
- Low NO<sub>x</sub> emission boilers & furnaces **(7 points)**
- No **(0 points)**
- N/A

##### ToolTip:

“Ultra-low” means NO<sub>x</sub> emissions that do not exceed 0.01 g/L (12 ppm). “Low” means NO<sub>x</sub> emissions that do not exceed 0.03 g/L (30 ppm). All values corrected to 3% O<sub>2</sub>. See *CCME Guideline for Emissions from Boilers and Heaters* and *Rule 1146.2 South Coast Air Quality Management District*. Mark “N/A” if there are no boilers or furnaces **and** where district heating is not available or applicable. If there are no boilers and furnaces, but district heating is available and applicable, complete Path A: District Heating.

##### References:

- *South Coast Air Quality Management District (SCAQMD)- Rule 1146.2*
- *CCME Guideline for Emissions from Boilers and Heaters*

##### Assessment Guidance:

Government authorities have enacted legislation to reduce emissions in recent years, particularly NO<sub>x</sub> and CO emissions. Innovations in technology continue to concentrate effort on lowering emissions and raising efficiency.

Boilers and heaters that could be included in a project that do not need to comply with the above emissions limits are:

- Pyrolysis heaters in the petrochemical sector
- Steam reformer heaters in the refining sector
- Steam cracking heaters in the refining sector
- Coke ovens, blast furnaces, and reheat furnaces in the steel sector
- By-product fuel boilers
- Coal-fired boilers and heaters
- Chemical recovery boilers

For all applicable boilers and furnaces, the product’s emissions, in grams per liter, should be listed on the submittal or performance data sheet. This information should be included in the project manual and/or documents and should be presented to the Assessor for the Design Review.

#### 3.6.1.2.2 Criteria:

Are there low or ultra-low CO emission boilers and furnaces?

##### Answers:

- Ultra-low CO emission boilers and furnaces **(9 points)**
- Low CO emission boilers and furnaces **(7 points)**
- No **(0 points)**
- N/A

**ToolTip:**

“Ultra-low” means CO emissions that do not exceed 0.05 g/L (400 ppm). “Low” means CO emissions that do not exceed 0.1 g/L (100 ppm). All values corrected to 3% O<sub>2</sub>. See *CCME Guideline for Emissions from Boilers and Heaters* and *Rule 1146.2 South Coast Air Quality Management District*. Mark “N/A” if there are no boilers or furnaces *and* where district heating is not available or applicable. If there are no boilers and furnaces, but district heating is available and applicable, complete Path A: District Heating.

**References:**

- *South Coast Air Quality Management District (SCAQMD)- Rule 1146.2*
- *CCME Guideline for Emissions from Boilers and Heaters*

**Assessment Guidance:**

Low or Ultra-low NO<sub>x</sub> boilers and furnaces do not necessarily also comply for low or ultra- low CO emissions. Certain NO<sub>x</sub> reduction techniques can weaken boiler performance, while others can improve performance. Aspects of the boiler performance that could be affected include CO emissions. For all applicable boilers and furnaces, the product’s emissions, in grams per liter, should be listed on the submittal or performance data sheet. This information should be included in the project manual and/or documents and should be presented to the Assessor for the Design Review.

## 3.6.2 Cooling

### 3.6.2.1 Criteria:

In the case of a retrofit, is the cooling equipment new or existing?

**Answers:**

- New **(0 points)**
- Existing **(0 points)**
- No mechanical cooling **(0 points)**
- N/A

**ToolTip:**

Informational question only - no points are awarded for the answers here. The ODP for a substance is the measure of its contribution to ozone depletion relative to that of CFC11 - the higher the value, the more damaging it is to the ozone layer. Another concern with regards to refrigerants is their global warming potential (GWP). Any HVAC refrigerant used in the building must comply with the US EPA's *Significant New Alternatives Policy (SNAP) Listing*. Mark “N/A” if this is a new construction building project.

**References:**

- *U.S. Environmental Protection Agency (EPA), Significant New Alternatives Policy (SNAP) Listing*

**Assessment Guidance:**

For major renovation projects with cooling, existing refrigerant to remain should be inventoried and a list of refrigerants made and checked against Green Globes criteria 3.6.2.2 and 3.6.2.3.

- CFC – 11, ODP = 1.0
- CFC – 12, ODP = 0.82
- HCFC – 22, ODP = 0.034
- HCFC – 123, ODP = 0.012
- HFC – 134a, ODP = 0
- HFC – 410a, ODP = 0
- HFC – 407c, ODP = 0



### 3.6.2.2 Ozone-Depleting Potential

#### 3.6.2.2.1 Criteria:

Does cooling equipment (not including portable equipment) use refrigerants that have zero or "near zero" ozone depletion potential (ODP)?

or

Are there no refrigerants?

#### Answers:

- No refrigerants **(10 points)**
- ODP less than or equal to 0.005 **(10 points)**
- ODP less than or equal to 0.01 **(8 points)**
- ODP less than or equal to 0.015 **(6 points)**
- ODP less than or equal to 0.02 **(4 points)**
- ODP less than or equal to 0.025 **(2 point)**
- ODP less than or equal to 0.03 **(1 point)**
- ODP greater than .03 **(0 points)**

#### ToolTip:

Ozone depleting substances (ODS) include CFCs HCFCs, HFCs, PFCs and SF6. "Portable cooling equipment" means equipment with less than 0.5 kg (1 lb.) of refrigerant – for example, refrigerators, temporary cooling equipment. Visit the EPA website for a list of suitable refrigerants. In case of district cooling, check the refrigerant of the central plant. Any HVAC refrigerants used in the building must comply with the US EPA's *Significant New Alternative Policy (SNAP) Listing*. Visit the EPA website for a list of suitable refrigerants: <http://www.epa.gov/ozone/snap/>.

#### References:

- U.S. Environmental Protection Agency (EPA) Ozone Layer Protection - Alternatives/SNAP: <http://www.epa.gov/ozone/snap/>

#### Assessment Guidance:

Current refrigerants with ODP that comply with criterion requirements are as follows:

- HCFC – 123, ODP = 0.012
- HFC – 134a, ODP = 0
- HFC – 410a, ODP = 0
- HFC – 407c, ODP = 0

### 3.6.2.3 Global Warming Potential

#### 3.6.2.3.1 Criteria:

Does cooling equipment (not including portable equipment) use refrigerants that have a low global warming potential (GWP<sub>100</sub>)?

or

Are there no refrigerants?

#### Answers:

- No refrigerants **(10 points)**

- GWP<sub>100</sub> less than or equal to 100 **(10 points)**
- GWP<sub>100</sub> less than or equal to 300 **(8 points)**
- GWP<sub>100</sub> less than or equal to 500 **(6 points)**
- GWP<sub>100</sub> less than or equal to 700 **(5 points)**
- GWP<sub>100</sub> less than or equal to 900 **(4 points)**
- GWP<sub>100</sub> less than or equal to 1100 **(3 points)**
- GWP<sub>100</sub> less than or equal to 1300 **(2 points)**
- GWP<sub>100</sub> less than or equal to 1500 **(1 points)**
- GWP<sub>100</sub> greater than 1500 **(0 points)**

**ToolTip:**

“Portable cooling equipment” means equipment with less than 0.5 kg (1 lb.) of refrigerant – for example, refrigerators, temporary cooling equipment. Visit the EPA website for a list of suitable refrigerants. Any HVAC refrigerants used in the building must comply with the US EPA's *Significant New Alternative Policy (SNAP) Listing*. Visit the EPA website for a list of suitable refrigerants: <http://www.epa.gov/ozone/snap/>.

**References:**

- U.S. Environmental Protection Agency (EPA), *Significant New Alternatives Policy (SNAP) Listing*
- U.S. Environmental Protection Agency (EPA) *Ozone Layer Protection- Alternatives/SNAP*:  
<http://www.epa.gov/ozone/snap/>

**Assessment Guidance:**

All refrigerants on the project should be inventoried and a list of refrigerants made and checked against Green Globes criteria.

- CFC – 11, GWP = 4,680
- CFC – 12, GWP = 10,720
- HCFC – 22, GWP = 1,780
- HCFC – 123, GWP = 76
- HFC – 134a, GWP = 1,320
- HFC – 410a, GWP = 2,000
- HFC – 407c, GWP = 1,700

### 3.6.2.4 Leak Detection

#### 3.6.2.4.1 Criteria:

Is there a requirement that equipment installer(s) test remote commercial systems (e.g. supermarket refrigeration) as per *GreenChill Best Practices Guideline Ensuring Leak-Tight Installations of Commercial Refrigeration Equipment*?

**Answers:**

- Yes **(3 points)**
- No **(0 points)**
- N/A

**ToolTip:**

Verify that remote commercial refrigerating system equipment was tested prior to the building's occupancy to guarantee the system is leak tight according to procedures described in *GreenChill Best Practices Guideline for Leak-Tight Installations of Commercial Refrigeration Equipment*. Mark “N/A” if there is no commercial refrigeration.

### References:

- *GreenChill Best Practices Guideline Ensuring Leak-Tight Installations of Commercial Refrigeration Equipment*

### Assessment Guidance:

The project specifications should detail the method in which all commercial refrigerating equipment will be installed and tested for leaks. Testing procedures should not only comply with the GreenChill guide but should also meet local codes and should never exceed system design pressures. If these tests are to be part of the Commissioning scope, projects should include the necessary information for the Commissioning Agent (see 3.1.3.1 Pre-Commissioning).

GreenChill's best practices guide includes all steps for properly leak testing a commercial refrigeration equipment system. It covers the step-by-step process including pre-check, pressure testing, evacuation, charge, and final check. The main aspects of pressure testing should include:

- Utilize dry nitrogen and appropriate tracer gas for pressure testing
- Test branches in segments to reduce time needed to detect leaks but before the final test ensure all valves are open
- Check the piping for leaks, repair leaks, and retest
- Let system stand for 24 hours at 300 psig. Ensure no more than 1 psig pressure change (taking into account ambient air temperature fluctuations)
- Evacuate system if 300 psig pressure holds

It is important to properly evacuate the system before charging with the refrigerant. Vacuum requirements for evacuation should be dictated by the project specifications and should meet code minimum requirements. After charging, a final check should always be performed with a leak detector to confirm no leaks have developed due to vibration or pipes rubbing together.

#### 3.6.2.4.2 Criteria:

Are there refrigerant leak detectors capable of detecting leakage rates down to 2.0% per year for each refrigerant?

### Answers:

- Yes (3 points)
- No (0 points)
- N/A

### ToolTip:

Refrigerant monitors, as required by *ANSI/ASHRAE Standard 15-2010*, are considered safety devices, and are not considered leak detection devices. Any HVAC refrigerants used in the building must comply with the US EPA's *Significant New Alternative Policy (SNAP) Listing*. Mark "N/A" where there are no refrigerants.

### References:

- *ANSI/ASHRAE Standard 15-2010, Safety Standard for Refrigeration Systems*
- *U.S. Environmental Protection Agency (EPA), Significant New Alternatives Policy (SNAP) Listing*

### Assessment Guidance:

For projects with chillers, a leak detection system should be in place that monitors for leaks. This system should be documented in the mechanical drawings and specifications. The Assessor will verify compliance with this criterion during the Design Review.

#### 3.6.2.4.3: Criteria:

Is there an alarm system capable of alerting the building operator to leakage thresholds?

##### Answers:

- Yes (3 points)
- No (0 points)
- N/A

##### ToolTip:

Refrigerant monitors, as required by *ANSI/ASHRAE Standard 15-2010*, are considered safety devices, and are not considered leak detection devices. Mark “N/A” where there are no refrigerants.

##### References:

- *ANSI/ASHRAE Standard 15-2010, Safety Standard for Refrigeration Systems*

##### Assessment Guidance:

For projects with chillers, a leak detection system should be in place that has a leakage alarm. This system should be documented in the mechanical drawings and specifications. The Assessor will verify compliance with this criterion during the Design Review.

### 3.6.3 Janitorial Equipment

#### 3.6.3.1 Criteria:

Are there designated storage areas for hazardous materials / janitorial supplies with full-height, floor-to-floor walls and mechanical ventilation?

##### Answers:

- Yes (3 points)
- No (0 points)
- N/A

##### ToolTip:

Mark “N/A” if janitorial supplies are not kept on site.

##### Assessment Guidance:

Janitorial rooms or closets typically contain cleaning products that have strong, corrosive fumes. In order to maintain good indoor air quality in the building, these spaces should be negatively pressurized via exhaust systems. Also, full-height walls should be installed to prevent any odors or airborne contaminants from crossing into other spaces via the ceiling cavity. If flammable materials are to be kept in this room, the doors and wall should be fire-rated and the outlets should be fire dampered.

Construction documents should note storage rooms with cleaning supplies, partition type, and show that the room will be negatively pressurized with an exhaust rate as required by code or 50 CFM, whichever is more stringent. The make-up air can be either directly supplied into the room or via transfer air from a grille or undercut door. There should be no return from this area.

## 3.7 INDOOR ENVIRONMENT

To be certified through Green Globes Multifamily for New Construction, projects must achieve all Minimum Requirements for Ventilation and Energy. In addition, projects must also achieve a minimum 35% total score out of all applicable points in the Green Globes Multifamily program. Minimum Requirements must be met to be eligible for the program but are separate from the criteria used in the assessment.

**Meet all Ventilation and Energy Minimum Requirements.**

### VENTILATION MINIMUM REQUIREMENTS

Building design must establish and meet minimum indoor air quality performance by meeting all three Ventilation Minimum Requirements listed below.

#### 1. Ventilation Air Quantity

The quantity of ventilation for the building is compliant with one of the following:

- **Option 1:** ANSI/ASHRAE Standard 62.1-2013 Ventilation for Acceptable Indoor Air Quality; ANSI/ASHRAE 62.1-2013 (read only): [https://ashrae.iwrapper.com/ViewOnline/Standard\\_62.1-2013](https://ashrae.iwrapper.com/ViewOnline/Standard_62.1-2013)
- **Option 2 (Lowrise and Midrise Multifamily Only):** ANSI/ASHRAE Standard 62.2-2013 Ventilation for Acceptable Indoor Air Quality in Low-Rise Residential Buildings. ANSI/ASHRAE 62.2-2013 (read only): [https://ashrae.iwrapper.com/ViewOnline/Standard\\_62.2-2013](https://ashrae.iwrapper.com/ViewOnline/Standard_62.2-2013)
- **Option 3:** ICC International Mechanical Code (ICC IMC 2015), Chapter 4; ICC International Mechanical Code 2015, Chapter 4: <https://codes.iccsafe.org/content/IMC2015/chapter-4-ventilation>
- **Option 4:** IAPMO UMC (2015) Uniform Mechanical Code; 2015 Uniform Mechanical Code: <http://epubs.iapmo.org/UMC/mobile/index.html#p=1>
- **Option 5:** Local codes or standards (if more stringent).

#### 2. Air Handling Equipment

Equip air handling equipment with filtration as follows:

- Air handling equipment that provide ventilation air to terminal devices (e.g. central air handler, DOAS, etc.): minimum MERV 13; and
- Single zone terminal devices (e.g. fan-coil): minimum MERV 8.

*Not applicable where **non-ducted** circulating unitary equipment serves only a single zone (e.g. unit heaters, force-flows, mini-split heat pumps).*

#### 3. Operations & Maintenance Plan

Specify regular ventilation maintenance and indoor air quality (IAQ) in an Operations & Maintenance (O&M) Plan. Ensure that specific issues (e.g. dirty air filters, dirty air return grills, maintenance of mechanical units, etc.) are identified and a regular maintenance plan is developed for maintaining IAQ goals.

#### Required Documentation – upload to Green Globes “v3” Software:

- ☐ Completed Minimum Requirement Survey
- ☐ Construction documents w/ventilation code info

## 3.7.1 Ventilation

### 3.7.1.1 Ventilation Air Quantity

#### 3.7.1.1.1 Criteria:

Is the quantity of ventilation air for the building compliant with *ANSI/ASHRAE Standard 62.1-2007*, *ANSI/ASHRAE Standard 62.1-2010*, the *International Code Council International Mechanical Code (ICC IMC)*, *IAPMO UMC (2009): Uniform Mechanical Code*, *ASHRAE Standard 170-2008* (for hospitals or healthcare occupancies), or local codes or standards (if more stringent)?

#### Answers:

- ANSI/ASHRAE Standard 62.1-2010 **(7 points)**
- ICC 2009 **(7 points)**
- IAPMO 2009 **(7 points)**
- ANSI/ASHRAE/ASHE 170-2008 **(7 points)**
- More stringent local code or standard **(7 points)**
- ANSI/ASHRAE Standard 62.1-2007 **(5 points)**
- No **(0 points)**

*If meeting the Minimum Requirements for Ventilation, the project automatically meets 3.7.1.1.1 (per the respective Standard or Code).*

#### 3.7.1.1.2 Criteria:

Do the construction documents indicate the ventilation schedule for all occupied spaces?

#### Answers:

- Yes **(4 points)**
- No **(0 points)**

#### References:

- *ANSI/ASHRAE Standard 62.1-2007*
- *ANSI/ASHRAE Standard 62.1-2010*
- *ICC IMC 2009: 2009 International Code Council (ICC) International Mechanical Code(IMC): section 605*
- *IAPMO 2009 Uniform Mechanical Code: Section 402*
- *ANSI/ASHRAE/ASHE Standard 170-2008*

#### Assessment Guidance:

To comply with *ANSI/ASHRAE Standard 62.1 2007 and 2010*, there are two procedures that can be utilized to meet the standard's requirements for mechanically ventilated spaces (a separate procedure is used for natural ventilation in the 2007 version): the IAQ procedure or the Ventilation Rate Procedure. The Ventilation Rate Procedure is the most commonly used and requires calculating the outdoor air intake rate based on space type/application, occupancy level, floor area, zone distribution effectiveness, and system ventilation efficiency. This procedure shall be permitted to be used for any zone or system. The IAQ procedure is performance based. It determines the outdoor air intake rates and additional system design parameters based on an analysis of contaminant sources, contaminant concentration limits, and level of perceived indoor air acceptability.

*ICC 2009 International Mechanical Code (IMC), Chapter 4 covers code required ventilation. IAPMO 2009 Uniform Mechanical Code (UMC) also covers ventilation requirements in Chapter 4. Both code versions utilize a procedure for*



calculating minimum outdoor air rates that is similar to the Ventilation Rate Procedure of *ANSI/ASHRAE Standard 62.1-2010*.

For any procedure used, it is important to also determine the minimum required exhaust. This exhaust airflow requirement shall be met no matter which above listed method was used to determine minimum outdoor airflow rates. Exhaust rates are given in terms of cfm/ft<sup>2</sup>.

*ANSI/ASHRAE Standard 62.1* 2007 and 2010 have similar paths. At the beginning of the project the HVAC engineer should decide which standard/code will be used to determine the minimum outdoor air rates. The standard/code used and the version should be in the title of the ventilation schedule. Some jurisdictions require that the ventilation schedule, showing room name; number; square footage; occupancy classification; and supply, exhaust, and outdoor airflow, be shown on the construction documents. Other jurisdictions do not require a ventilation schedule, though it is good design practice to have this information on the documents. If a ventilation schedule is not present on the construction documents, a separate calculation will need to be provided to the Assessor during the Design Review to verify compliance with the standard or code required in the project's jurisdiction.

Assessor may also request the following documentation:

- Balancing reports for the ventilation systems
- Ventilation schedules
- Manufacturing specifications for ventilation systems, CO<sub>2</sub> sensing and ventilation control equipment
- Ventilation air quantity design data
- Local ventilation codes or standards

### 3.7.1.2 Air Exchange

Green Globes provides three paths for assessing air exchange:

- **Path A: Mechanical Ventilation Only** – 8 points
- **Path B: Natural Ventilation Only** – 8 points
- **Path C: Combination of Mechanical and Natural Ventilation** – 8 points

Points cannot be combined between paths. Please review and select the appropriate pathway for the project.

#### 3.7.1.2.1 Path A: Mechanical Ventilation Only

##### 3.7.1.2.1.1 Criteria:

Is the zone air distribution effectiveness  $E_z$  value greater than or equal to 0.9 in all regularly occupied spaces, excluding circulation and transitional spaces?

##### Answers:

- Yes **(8 points)**
- No **(0 points)**

If Path A: Mechanical Ventilation Only is selected, Path B and Path C and their associated points cannot also be selected and awarded – only one path will be awarded points.

##### References:

- *ANSI/ASHRAE 62.1-2007 plus addenda*
- *ASHRAE Standard 129-1997 (RA 2002): Measuring Air-Change Effectiveness*

### Assessment Guidance:

For mechanically ventilated buildings the zone air distribution effectiveness ( $E_z$ ) value can be determined from the table below (Table 6-2 from *ANSI/ASHRAE 62.1-2007, plus addenda*) or by *ASHRAE Standard 129-1997 (RA 2002)* for all air distribution configurations except unidirectional flow.

**Table 3.7.1.2.1.1: Air Distribution Effectiveness**

Air Distribution Configuration	$E_z$
Ceiling supply of cool air	1.0
Ceiling supply of warm air and floor return	1.0
Ceiling supply of warm air 15F or more above space temperature and ceiling return	0.8
Ceiling supply of warm air less than 15F above space temperature and ceiling return provided that the 150 fpm supply air jet reaches to within 4.5 ft. of the floor level. <i>Note: For lower velocity supply air, <math>E_z = 0.8</math></i>	1.0
Floor supply of cool air and ceiling return provided that the 150 fpm supply jet reaches 4.5 ft. or more above the floor. <i>Note: Most underfloor air distribution systems comply with this provision.</i>	1.0
Floor supply of cool air and ceiling return, provided low-velocity displacement ventilation achieves unidirectional flow and thermal stratification.	1.2
Floor supply of warm air and floor return.	1.0
Floor supply of warm air and ceiling return.	0.7
Makeup supply drawn in on the opposite side of the room from the exhaust and/or return.	0.8
Makeup supply drawn in near to the exhaust and/or return location.	0.5
<i>"Cool air" is air cooler than space temperature.</i> <i>"Warm air" is air warmer than the space temperature.</i> <i>"Ceiling" includes any point above the breathing zone.</i> <i>"Floor" includes any point below the breathing zone.</i>	

The breathing zone for the above table is considered the region within an occupied space between planes 3 and 72 inches above the floor and more than 2 ft. from the wall or fixed HVAC equipment. For the Design Review, projects should list each regularly occupied zone and its associated air distribution effectiveness associated with the air distribution system in that area.

### 3.7.1.2.2 Path B: Natural Ventilation Only

#### 3.7.1.2.2.1 Criteria:

Are the following conditions met as per *ANSI/ASHRAE Standard 62.1-2010, Section 5.1*:

- **3.7.1.2.2.1.1:** All points within habitable spaces considered to be naturally ventilated are within 25 ft. (7.6 m) of a permanent or operable wall, window or roof opening to the outdoors?
  - **Answers:**
    - Yes (2 points)
    - No (0 points)
- **3.7.1.2.2.1.2:** The unobstructed area of the opening measures at least 4% of the net floor area that is being naturally ventilated?
  - **Answers:**
    - Yes (2 points)
    - No (0 points)

- **3.7.1.2.2.1.3:** Where interior spaces are naturally ventilated through adjoining (perimeter) rooms, the openings between the spaces were designed to have a minimum area of 8% of the net floor area of the interior room and were at least 25 ft<sup>2</sup> (2.3 m<sup>2</sup>)?
  - **Answers:**
    - Yes **(2 points)**
    - No **(0 points)**
- **3.7.1.2.2.1.4:** All operable openings are readily accessible to building occupants?
  - **Answers:**
    - Yes **(2 points)**
    - No **(0 points)**

If Path B: Natural Ventilation Only is selected, Path A and Path C and their associated points cannot also be selected and awarded – only one path will be awarded points.

**References:**

- *ANSI/ASHRAE Standard 62.1-2010, Section 5.1, Section 6.4*

**Assessment Guidance:**

Naturally ventilated buildings should have the openings designed per the sub criteria above. Additional information for designing naturally ventilated spaces can be found in *ANSI/ASHRAE Standard 62.1-2010 Section 6.4*. A ventilation schedule should be provided that lists the occupiable areas, their square footages and the ventilation opening area. The schedule should note which areas, if any, are interior zones ventilated through adjoining rooms.

### **3.7.1.2.3 Path C: Combination of Mechanical & Natural Ventilation**

#### **3.7.1.2.3.1 Criteria:**

Where mechanical ventilation is employed, is the zone air distribution effectiveness  $E_z$  value greater than or equal to 0.9 in all regularly occupied spaces, excluding circulation and transitional spaces?

**Answers:**

- Yes **(4 points)**
- No **(0 points)**

If Path C: Combination of Mechanical & Natural Ventilation is selected, Path A and Path B and their associated points cannot also be selected and awarded – only one path will be awarded points.

**References:**

- *ANSI/ASHRAE 62.1-2007 plus addenda*
- *ASHRAE Standard 129-1997 (RA 2002)*

**Assessment Guidance:**

For mechanically ventilated buildings the zone air distribution effectiveness ( $E_z$ ) value can be determined from Table 3.7.1.2 above (Table 6-2 from *ANSI/ASHRAE 62.1-2010*) or by *ASHRAE Standard 129-1997 (RA 2002)* for all air distribution configurations except unidirectional flow.

The breathing zone for the above table is considered the region within an occupied space between planes 3 and 72 inches above the floor and more than 2 ft. from the wall or fixed HVAC equipment. For the Design Review, projects should list each regularly occupied zone and its associated air distribution effectiveness associated with the air distribution system in that area.

### 3.7.1.2.3.2 Criteria:

Where natural ventilation is employed, are the following conditions met as per *ANSI/ASHRAE Standard 62.1-2010, Section 5.1*:

- **3.7.1.2.3.2.1:** All points within habitable spaces considered to be naturally ventilated are within 25 ft. (7.6 m) of a permanent or operable wall, window or roof opening to the outdoors?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
- **3.7.1.2.3.2.2:** The unobstructed area of the opening measures at least 4% of the net floor area that is being naturally ventilated?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
- **3.7.1.2.3.2.3:** Where interior spaces are naturally ventilated through adjoining (perimeter) rooms, the openings between the spaces were designed to have a minimum area of 8% of the net floor area of the interior room and were at least 25 ft<sup>2</sup> (2.3 m<sup>2</sup>)?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
- **3.7.1.2.3.2.4:** All operable openings are readily accessible to building occupants?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**

If Path C: Combination of Mechanical & Natural Ventilation is selected, Path A and Path B and their associated points cannot also be selected and awarded – only one path will be awarded points.

### References:

- *ANSI/ASHRAE Standard 62.1-2010, Section 5.1*

### Assessment Guidance:

Naturally ventilated buildings should have the openings designed per the sub criteria above. Additional information for designing naturally ventilated spaces can be found in *ANSI/ASHRAE Standard 62.1-2010 Section 6.4*. A ventilation schedule should be provided that lists the occupiable areas, their square footages and the ventilation opening area. The schedule should note which areas, if any, are interior zones ventilated through adjoining rooms.

## 3.7.1.3 Ventilation Intakes and Exhausts

### 3.7.1.3.1 Criteria:

Are ventilation systems equipped with the following features:

- **3.7.1.3.1.1:** Exhaust outlets and plumbing vent stacks are located at least 20 ft (6.1 m) away from outdoor air intakes?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
- **3.7.1.3.1.2:** Outdoor air intakes are located at least 30 ft (9.1 m) away from sources of pollution?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**

- **ToolTip:** “Sources of pollution” include, but are not limited to, dumpsters, parking areas, driveways, loading docks, natural gas lines, wet cooling towers, garage doors, and garage exhaust outlets.
- **3.7.1.3.1.3:** Outdoor air intakes are protected with 0.3 in (6.4 mm) or smaller mesh screens?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
- **3.7.1.3.1.4:** For each air handling system in single or multiple arrangements, filters are compliant with *ANSI/ASHRAE Standard 62.1-2010*?
  - **Answers:**
    - Yes **(2 points)**
    - No **(0 points)**
- **3.7.1.3.1.5:** Outdoor air inlets and outlets, including louvers and rain hoods, are sized appropriately per *ANSI/ASHRAE Standard 62.1-2010*?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
- **3.7.1.3.1.6:** Except in transfer air ducts, all outdoor air, return air, and supply air ductwork avoids interior liner that could harbor microbial growth and/or erode in the air stream?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
  - **ToolTip:** Interior liner in ductwork, when exposed to a turbulent air stream and changes in temperature and humidity can deteriorate, releasing fibers. The liner can also become a breeding ground for microbes. Particles and fibers released into the air stream are not healthy for occupants. Avoid liner exposed to the air stream for all outdoor air, return air, and supply air systems.
- **3.7.1.3.1.7:** Roof drainage slopes away from outdoor air intakes?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**

#### References:

- *ANSI/ASHRAE Standard 62.1-2010: Sections 5.5 and 5.8*
- *ICC IMC 2009: 2009 International Code Council (ICC) International Mechanical Code (IMC): Section 605*
- *IAPMO Uniform Mechanical Code, Section 402*

#### Assessment Guidance:

Filters in HVAC equipment will remove particulates not desired in the air stream, but will not remove odors that are drawn in through the outdoor air intakes. These odors can come from the plumbing vent stack, building exhaust systems, nearby vehicle exhausts, leaking natural gas pipes, dumpsters, and areas where stagnant water may develop, such as near roof drains and wet cooling towers. To avoid unwanted odors entering the air stream from the exterior, outdoor air intakes for all HVAC equipment should be appropriately located per the sub-criteria above.

Since outdoor air intakes draw air in, they should be outfitted with small mesh screens to prevent insects and birds from being drawn into or develop nests within the HVAC equipment. Horizontal surfaces have the highest risk for bird nesting. These screens should be corrosion resistant.

*ANSI/ASHRAE Standard 62.1-2010* requires that filters be provided upstream of all cooling coils or other devices that are prone to wetted surfaces and are in the supply air stream to occupied areas. The minimum efficiency reporting value (MERV) rating shall be no less than 6 for all HVAC equipment filters. When particulate matter smaller than 2.5

micrometers is expected, MERV 11 or higher filters should be used. Filters should always be replaced or maintained as specified in the building's Operations and Maintenance Manual.

*ANSI/ASHRAE Standard 62.1-2010* also requires that outdoor air intakes should be designed to avoid rain entrainment. This can be accomplished through any of the following:

- Limit water penetration through the intake to 0.07 oz/ft<sup>2</sup> h of inlet area when testing using the rain test apparatus described in Section 58 of *UL 1995*.
- Select louvers that limit water penetration to a maximum of 0.01 oz/ft<sup>2</sup> of louver free area at the maximum intake velocity. This water penetration rate shall be determined for a minimum 15-minute test duration when subjected to a water flow rate of 0.25 gal/min as described under the *Water Penetration Test* in *AMCA 500-L* or equivalent. Manage the water that penetrates the louver by providing a drainage area and/or moisture removal devices.
- Select louvers that restrict wind-driven rain penetration to less than 2.36 oz/ft<sup>2</sup> h when subjected to a simulated rainfall of 3 in. per hour and a 29 mph wind velocity at the design outdoor air intake rate with the air velocity calculated based on louver face area.
- Use rain hoods sized for no more than 500 fpm face velocity with a downward facing intake such that all intake air passes upward through a horizontal plane that intersects the solid surfaces of the hood before entering the system.

Louvers used on the project should be selected to comply with the above requirements. Cut sheet and performance data should be provided during the Design Review for the Assessor to review.

Duct liners that are exposed to the air stream can deteriorate overtime and can contribute to indoor air quality complaints. The change in air turbulence, temperature and humidity can break down the liner's primary seal. To avoid this, duct liners should only be exposed to the air stream in transfer ducts – where deterioration is less likely. Supply, exhaust and return ducts should be wrapped with rigid or flexible insulation.

### 3.7.1.4 CO<sub>2</sub> Sensing and Ventilation Control Equipment

#### 3.7.1.4.1 Criteria:

Do rooms that are occupied by several people (e.g. open offices) and those that have *variable occupancy* (e.g. meeting rooms, assembly areas) have CO<sub>2</sub> sensing and ventilation control equipment?

#### Answers:

- Yes (5 points)
- No (0 points)
- N/A

#### ToolTip:

"Variable occupancy" means a variance of 10% or more from design conditions. Mark "N/A" if there will be no rooms occupied by several people and no rooms with *variable occupancy*.

#### Assessment Guidance:

CO<sub>2</sub> sensing is used in building control strategies to optimize ventilation by approximating the level of occupancy in a space; this is commonly referred to as Demand Controlled Ventilation (DCV) – see **Error! Reference source not found.** The levels of CO<sub>2</sub> concentrations in the space are used in a mathematical formula that allows the system to modulate ventilation rates when the spaces have intermittent occupancy. Mechanical designers should be careful to ensure that the outdoor air intake rates never fall below those needed for proper building pressurization.

Spaces that count toward high and variable occupancy spaces include meeting rooms, assembly areas, churches, theaters, gymnasiums, etc. Installing CO<sub>2</sub> sensors in these areas is very effective in reducing ventilation rates and the energy



associated with tempering the outdoor air. Although less effective, it is still beneficial to install CO<sub>2</sub> monitoring in regularly occupied spaces. Areas with low volumes of intermittent occupancy (office printing rooms, break rooms, storage rooms, etc.) do not need to be provided with CO<sub>2</sub> sensors. CO<sub>2</sub> sensors shall be located in the room between 3 ft. and 6 ft. above the floor or at the anticipated height of the occupants' heads. Demand ventilation controls should maintain CO<sub>2</sub> concentrations less than or equal to 600 ppm plus the outdoor air CO<sub>2</sub> concentration<sup>18</sup> in all rooms with CO<sub>2</sub> sensors.

### 3.7.1.5 Air Handling Equipment

#### 3.7.1.5.1 Criteria:

Are air handling equipment equipped with MERV 13 filtration?

or

Does terminal equipment have the highest filtration level available for the specific equipment under consideration, and main air handlers in terminal systems equipped with MERV 13 filtration?

#### Answers:

- Yes (5 points)
- No (0 points)
- N/A

#### ToolTip:

Only applies for air handling equipment with maximum supply volume greater than 600 ft<sup>3</sup> per minute (17 m<sup>3</sup>/min.); or terminal equipment with a maximum supply volume of 600 ft<sup>3</sup> per minute (17 m<sup>3</sup>/min.) or less, such as fan coils, distributed heat pumps, and fan-powered variable air valve boxes. Mark "N/A" if equipment provides no ventilation air and serves only a single zone.

#### Assessment Guidance:

MERV ratings for filters are also usually specified along with a dust spot efficiency percentage. For MERV 13, this is equivalent to a dust spot efficiency between 80 to 90%, though typically more towards 80%. As the MERV rating increases, so does the dust spot efficiency, up to MERV 15. When projects require the highest efficiency filter for the smallest particle sizes they will look for filters with MERV ratings between 18 and 20. HEPA filters are usually specified when this level of particle sizes need to be filtered from the building air.

The MERV rating of the filters needs to be decided earlier in the design stage since the higher the MERV rating, typically the higher the static pressure associated with that filter. This static pressure will need to be included in the mechanical engineer's calculations and selection criteria for the main air handling equipment. A filter schedule should be included on the design drawings dictating the MERV rating for all air handling equipment that pulls in ventilation/outdoor air.

For projects where the HVAC system comprises fan powered terminal equipment in the space, these units should have a filter on their return air intake. This filter usually comes standard as a MERV 7 or MERV 8 but higher MERV rating filters can be an option. Mechanical engineers should consult the fan coil/fan powered terminal unit/ heat pump manufacturer for options and to verify that the fan motor will be able to handle any additional pressure drop from the higher rated filter. In addition, the air handling unit that provides ventilation air to the spaces also should be equipped with a MERV 13 rating or higher filter.

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<sup>18</sup> As recommended in the "Advanced Energy Design Guide" by ASHRAE.

## 3.7.2 Source Control and Measurement of Indoor Pollutants

### 3.7.2.1 Volatile Organic Compounds

#### 3.7.2.1.1 Criteria:

Is there a requirement that adhesives and sealants (not including carpet adhesives) will comply with prescribed limits of VOCs and/or be certified?

#### Answers:

- Yes (2.5 points)
- No (0 points)

#### ToolTip:

Refer to Table 3.7.2.1.1 (Adhesives and Sealants) for the types of adhesives and sealants and the test methods used to determine VOCs in these products. The “prescribed limits” given in the Table are based on *South Coast Air Quality Management District (SCAQMD) Rule 1168* for volatile organic compounds. “Certified” means compliance with any of the certifications listed in the Assessment Guidance below.

#### References:

- *South Coast Air Quality Management District (SCAQMD)- Rule 1168*
- See Assessment Guidance for additional references

#### Assessment Guidance:

Project specifications should include provisions for limiting VOC content in building materials that emit contaminants that deteriorate the indoor air quality. Most green building projects will incorporate a section in the Division 01 specification that addresses all the environmental requirements, including emissions, of all materials to be used on the project. In order to comply with these criteria, these specifications should include the specific VOC content or emissions criteria for all applicable products. The performance criteria listed in the specification should match the limits in the Table below.

In Table 3.7.2.1.1, percentages are determined by weight (grams / liter). Alternatively, a VOC budget can be used for adhesives and sealants covered in the table. Documentation must demonstrate the overall low-VOC performance has been attained, comparing between a baseline and design case. When the design or actual case is less than the baseline, this criterion is satisfied. The total VOC for the design case is determined by multiplying the volume of the product used by the threshold VOC levels for the baseline case and actual product VOC level for the design case. The baseline cannot be greater than the design case.”

**Table 3.7.2.1.1: Adhesives and Sealants VOC Limits**

Product Area	Product Sub-area	VOC Content <sup>1</sup>	VOC Emissions Criteria <sup>2</sup>
Adhesives – Architectural Applications	Carpet / Carpet Pads	50 g/L	To determine acceptability of the emission results, the estimated building concentrations are compared to ½ their corresponding chronic RELs. The two exceptions to this requirement are (1) formaldehyde for which the calculated building concentration shall not exceed ½ of the indoor REL of 33µg/m³ and (2) acetaldehyde in which the full chronic REL of 9µg/m³ shall not be exceeded.
	Wood Flooring	100 g/L	
	Rubber Flooring	60 g/L	
	Subfloor	50 g/L	
	Ceramic Tile	65 g/L	
	VCT / Asphalt Tile	50 g/L	
	Dry Wall Panel	50 g/L	
	Cove Base	50 g/L	
	Multipurpose Construction	70 g/L	
	Structural Glazing	100 g/L	

Product Area	Product Sub-area	VOC Content <sup>1</sup>	VOC Emissions Criteria <sup>2</sup>
	Single Ply Roof Membrane	250 g/L	
Adhesives – Substrates	Metal to Metal	30 g/L	
	Plastic Foams	50 g/L	
	Porous Material (except wood)	50 g/L	
	Wood	30 g/L	
	Fiberglass	80 g/L	
Adhesives – Specialty	PVC Welding	510 g/L	
	CPVC Welding	490 g/L	
	ABS Welding	325 g/L	
	Plastic Cement Welding	250 g/L	
	Adhesive Primer for Plastic	550 g/L	
	Contact Adhesive	80 g/L	
	Special Purpose Contact Adhesive	250 g/L	
Sealants	Architectural	250 g/L	
	Non-membrane Roof	300 g/L	
	Single Ply Roof Membrane	450 g/L	
<div><div>1.</div><div>VOC content is determined by subtracting water and exempt compounds and expressed as grams per liter, with no exception granted to chlorinated chemical species. VOC limits must be in accordance with the <i>South Coast Air Quality Management District (SCAQMD) Rule 1168</i>.</div></div> <div><div>2.</div><div>VOC emissions results are determined by either of the following test methods: <i>Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers CA/DHS/EHLB/R-174, July 14, 2004 with Addendum 2004-01, October 19, 2004</i> or <i>GREENGUARD Environmental Institute: Standard Method for Measuring and Evaluating Chemical Emissions From Building Materials, Finishes and Furnishings Using Dynamic Environmental Chambers (GGTM.P066.R8, 10/29/2008)</i>.</div></div> <div><div>3.</div><div>Indoor REL developed by the California Office of Environmental Health and Hazard Assessment (OEHHA).</div></div>			

Alternatively, projects can require that certain products have third-party certifications showing compliance to predetermined indoor air quality standards. Programs include the following:

- EcoLogo® (Paints & Adhesives) – Environmental Choice
  - EcoLogo Standard for Adhesives: CCD-046
  - EcoLogo Standard for Paints: Architectural Surface Coatings CCD-047
  - EcoLogo Standard for Recycled Paints: Architectural Surface Coatings – Recycled Water-borne CCD-048
- Green Seal® (Paints & Adhesives)
  - Green Seal Environmental Standard for Paints and Coatings, GS-11
  - Green Seal Environmental Standard for Commercial Adhesives, GS-36
- GREENGUARD Children & Schools – GREENGUARD Environmental Institute
  - Program Manual For GREENGUARD Product Certification Programs, GG.PM.01 2009
  - GREENGUARD Environmental Institute: Standard Method for Measuring and Evaluating Chemical Emissions From Building Materials, Finishes and Furnishings Using Dynamic Environmental Chambers (GGTM.P066.R8, 10/29/2008)
- Indoor Advantage Gold™ – Scientific Certification Systems
  - California Department of Health Services Standard Practice for the Testing Of Volatile Organic Emissions Sources Using Small Scale Environmental Chambers (CA/DHS/EHLB/R-174, JULY 15, 2004 with Addendum 2004-01)
  - SCS - EC10.2 -2007, Environmental Certification Program—Indoor Air Quality Performance, May, 2007

During the Design Review, the Assessor will verify that the above VOC limits or third-party certifications have been incorporated into the project specifications. If available, product submittals should also be reviewed by the Assessor.

### 3.7.2.1.2 Criteria:

Is there a requirement that carpet, carpet pad, and under-carpet adhesives will comply with the Carpet and Rug Institute's (CRI) Green Label Plus program?

#### Answers:

- Yes (2 points)
- No (0 points)
- N/A

#### ToolTip:

Mark "N/A" if there will be no carpeting.

#### References:

- *The Carpet and Rug Institute (CRI), Commercial Green Label / Green Label Plus:*  
<http://www.carpet-rug.org/commercial-customers/green-building-and-the-environment/green-label-plus/>.

#### Assessment Guidance:

During the Design Review, the Assessor will verify that the above VOC limits or third-party certifications have been incorporated into the project specifications. If available, product submittals should also be reviewed by the Assessor.

### 3.7.2.1.3 Criteria:

Is there a requirement that paints will comply with prescribed limits of VOCs and/or be certified?

#### Answers:

- Yes (3 points)
- No (0 points)

#### ToolTip:

"Certified" means compliance with any of the certifications listed in Table 3.7.2.1.3: Paint VOC Limits and the assessment guidance below. For other types of interior coatings containing VOC's, refer to the manufacturer's data and, where possible, cite the same. Refer to Table 6.2.1.3: Paint VOC Limits for the types of paints and the test methods used to determine VOCs in these products. The "prescribed limits" are based on *ASTM D6886-03 Standard Test Method for Speciation of the VOCs in Low VOC Content Waterborne Air-Dry Coatings by Gas Chromatography* for volatile organic compounds. For other types of interior coatings containing VOC's, refer to the manufacturer's data and, where possible, cite the same *ASTM D6886-03* standard.

#### References:

- *ASTM D6886-03 Standard Test Method for Speciation of the VOCs in Low VOC Content Waterborne Air-Dry Coatings by Gas Chromatography*
- *ASTM D523-08: Standard Test Method for Specular Gloss*
- See Assessment Guidance for additional references

#### Assessment Guidance:

Project specifications should include provisions for limiting VOC content in building materials that emit contaminants that deteriorate the indoor air quality. Most green building projects will incorporate a section in the Division 01 specification that addresses all the environmental requirements, including emissions, of all materials to be used on the project. In

order to comply with these criteria, these specifications should include the specific VOC content or emissions criteria for all applicable products. The performance criteria listed in the specification should match the limits in the Table below. In the case of specialty interior coatings, consult manufacturer's product data related to VOC content, and determine level of equivalent compliance with paint products.

In Table 3.7.2.1.3, determining whether the VOC content of paint complies with this criterion can be shown by either the use of MSDS sheets that shows that the VOCs for every paint used on the project meets the criteria OR by using a "VOC budget" approach. This calculation shows the total VOCs of the design and base cases, allowing evaluation and comparison for coating systems specified versus what is allowed under this criterion. The calculation indicates total VOCs in grams and indicates whether the design case total lies within the base case requirement for total VOCs. In order for the calculation to work, the following information must be identified by the user:

- Total square footage of area(s) to be painted.
- VOC content of specified coating systems.
- Coverage rates of coatings specified (from manufacturer's data sheet).
- Number of coats specified (primer and topcoats).
- Sheen of each coating based on *ASTM D523-08: Standard Test Method for Specular Gloss*.

**Table 3.7.2.1.3: Paint VOC Limits**

Product Area	Product Sub-area	VOC Content <sup>1</sup>	VOC Emissions Criteria <sup>2</sup>
Walls	Paints - Interior Latex Coatings flat	50 g/L	To determine acceptability of the emission results, the estimated building concentrations are compared to ½ their corresponding chronic RELs. The two exceptions to this requirement are (1) formaldehyde for which the calculated building concentration shall not exceed ½ of the indoor REL of 33µg/m³ and (2) acetaldehyde in which the full chronic REL of 9µg/m³ shall not be exceeded.
	Paints - Interior Latex Coatings non flat	150 g/L	
	Untreated Masonry or Concrete	Not applicable	
<div>1. VOC content is determined by subtracting water and exempt compounds and expressed as grams per liter, with no exception granted to chlorinated chemical species. For VOC content, a VOC is any organic compound that participates in atmospheric photochemical reactions as defined by the U.S. EPA in 40 CFR §51.100 (s) and has an initial boiling point lower than or equal to 280°C measured at standard conditions of temperature and pressure. The VOC concentration of the product shall not exceed those listed below in grams of VOC per liter of product as determined by <i>ASTM D6886-03: Standard Test Method for Speciation of the Volatile Organic Compounds (VOCs) in Low VOC Content Waterborne Air-Dry Coatings by Gas Chromatography</i>. Source of test method and criteria is Green Seal (GS-11).</div> <div>2. VOC emissions results are determined by either of the following test methods: <i>Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers CA/DHS/EHLB/R-174, July 14, 2004 with Addendum 2004-01, October 19, 2004</i> or <i>GREENGUARD Environmental Institute: Standard Method for Measuring and Evaluating Chemical Emissions From Building Materials, Finishes and Furnishings Using Dynamic Environmental Chambers (GGTM.P066.R8, 10/29/2008)</i>.</div> <div>3. Indoor REL developed by the California Office of Environmental Health and Hazard Assessment (OEHHA).</div>			

Alternatively, projects can require that certain products have third-party certifications showing compliance to predetermined indoor air quality standards. Programs include the following:

- EcoLogo® (Paints & Adhesives) – Environmental Choice
  - *EcoLogo Standard for Adhesives: CCD-046*
  - *EcoLogo Standard for Paints: Architectural Surface Coatings CCD-047*



- *EcoLogo Standard for Recycled Paints: Architectural Surface Coatings – Recycled Water-borne CCD-048*
- Green Seal® (Paints & Adhesives)
  - *Green Seal Environmental Standard for Paints and Coatings, GS-11*
  - *Green Seal Environmental Standard for Commercial Adhesives, GS-36*
- GREENGUARD Children & Schools – GREENGUARD Environmental Institute
  - *Program Manual For GREENGUARD Product Certification Programs, GG.PM.01 2009*
  - *GREENGUARD Environmental Institute: Standard Method for Measuring and Evaluating Chemical Emissions From Building Materials, Finishes and Furnishings Using Dynamic Environmental Chambers (GGTM.P066.R8, 10/29/2008)*
- Indoor Advantage Gold™ – Scientific Certification Systems
  - *California Department of Health Services Standard Practice for the Testing Of Volatile Organic Emissions Sources Using Small Scale Environmental Chambers (CA/DHS/EHLB/R-174, JULY 15, 2004 with Addendum 2004-01)*
  - *SCS - EC10.2 -2007, Environmental Certification Program—Indoor Air Quality Performance, May, 2007*

During the Design Review, the Assessor will verify that the above VOC limits or third-party certifications have been incorporated into the project specifications. If available, product submittals should also be reviewed by the Assessor.

#### 3.7.2.1.4 Criteria:

Is there a requirement that floors, floor coverings, and other interior products will comply with prescribed limits of VOCs and/or be certified?

##### Answers:

- Yes (2.5 points)
- No (0 points)

##### ToolTip:

“Certified” means compliance with any of the certifications listed in Table 3.7.2.1.4: Floor and Other Interior Product VOC Limits. The “prescribed limits” are given in the Indoor Reference Exposure Levels (REL) developed by the California Office of Environmental Health and Hazard Assessment (OEHHA) for volatile organic compounds. “Floor coverings” include carpeting, resilient and other non-carpet flooring. “Interior products” include insulation, acoustical ceilings, and wall coverings. Does not apply to countertops, casework, cabinetry, and shelving. Refer to Table 3.7.2.1.4 (Floors and Other Interior Products) for the types of products, the test methods used to determine VOC emissions from these products, and the VOC emissions criteria.

##### References:

- See Assessment Guidance for references

##### Assessment Guidance:

Project specifications should include provisions for limiting VOC content in building materials that emit contaminants that deteriorate the indoor air quality. Most green building projects will incorporate a section in the Division 01 specification that addresses all the environmental requirements, including emissions, of all materials to be used on the project. In order to comply with these criteria, these specifications should include the specific VOC content or emissions criteria for all applicable products. The performance criteria listed in the specification should match the limits in the Table below.



**Table 3.7.2.1.4: Floor and Other Interior Product VOC Limits**

Product Area		VOC Emissions Criteria <sup>1</sup>
Floors / Floor Coverings (including carpeting, resilient and other non-carpet flooring) and	Other Interior Products (including insulation, acoustical ceilings, and wall covering but excluding countertops, casework, cabinetry, and shelving).	To determine acceptability of the emission results, VOC building concentrations are estimated for the Standard Private Office Scenario in CDPH Standard Method V1.1 Tables 4.4 and 4.5 and are compared to the maximum allowable concentrations in CDPH Standard Method V1.1, Table 4.1. The maximum allowable concentrations shall not be exceeded.
VOC emissions results are determined by California Department of Public Health (CDPH) “Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers,” V 1.1, 2010, Standard Private Office Scenario. Alternatively, VOC emission results are determined by UL 2821 “GREENGUARD Certification Program Method for Measuring and Evaluating Chemical Emissions from Building Materials, Finishes and Furnishings,” March 2013, Table 2 Office Model and Section 34.1 Allowable Limits for GREENGUARD Certification Gold.		

Alternatively, projects can require that certain products have third-party certifications showing compliance to predetermined indoor air quality standards:

- FloorScore® (Resilient Flooring) – Resilient Floor Covering Institute
  - California Department of Public Health (CDPH), "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers," V 1.1, 2010, Standard Private Office Scenario.
  - SCS - EC10.2 -2007, *Environmental Certification Program—Indoor Air Quality Performance*. May, 2007
- GREENGUARD Gold – UL Environment
  - UL 2821, "GREENGUARD Certification Program Method for Measuring and Evaluating Chemical emissions from Building Materials, Finishes and Furnishings," March 2013, Table 2 Office Model and Section 34.1 Allowable Limits for GREENGUARD Certification Gold.
  - UL 2818, "GREENGUARD Certification Program for Chemical Emissions for Building Materials, Finishes and Furnishings," March 2013.
- Indoor Advantage Gold™ – Scientific Certification Systems
  - California Department of Public Health (CDPH), *Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers*, V 1.1, 2010, Standard Private Office Scenario.
  - SCS - EC10.2 -2007, "Environmental Certification Program—Indoor Air Quality Performance", May, 2007.

During the Design Review, the Assessor will verify that the above VOC limits or third-party certifications have been incorporated into the project specifications. If available, product submittals should also be reviewed by the Assessor.

### 3.7.2.2 Moisture and Vapor Control Methods

#### 3.7.2.2.1 Criteria:

Are there the following measures to avoid fungus, mold, and bacteria:

- **3.7.2.2.1.1:** HVAC is able to monitor and control dew point?
  - **Answers:**
    - Yes **(4 points)**
    - No **(0 points)**

- **ToolTip:** “Dewpoint” means the temperature at which moisture in the air at a given humidity will condense. Condensation can be reduced by keeping the air colder than the coldest surfaces in the space, and/or by reducing the humidity in the air.
- **3.7.2.2.1.2:** Materials and finishes are resistant to mold growth in spaces that generate high humidity (e.g. kitchens, toilet rooms, pools, laundry facilities, shower areas, etc.)?
  - **Answers:**
    - Yes **(2 points)**
    - No **(0 points)**
  - **ToolTip:** Examples of resistant materials and finishes include concrete, masonry, glass, and metals.
- **3.7.2.2.1.3:** There are floor drains located in all areas where equipment failures may cause plumbing leaks or where certain operations may cause spills or overflows?
  - **Answers:**
    - Yes **(2 points)**
    - No **(0 points)**

**ToolTip:**

Verify that the construction documents specify materials, finishes, and mechanical systems that effectively minimize the accumulation of moisture, with special attention to thermal bridges, capillary junctions, and areas that generate a significant amount of humidity (such as showers or bathrooms).

**References:**

- *ANSI/ASHRAE Standard 62.1-2010 - The Standards For Ventilation & Indoor Air Quality*
- *ANSI/ASHRAE Standard 160-2009 (plus addenda), Design Criteria for Moisture Design Analysis in Buildings*
- *SMACNA HVAC Duct Construction Standards: Metal and Flexible 3rd Edition 2005*
- *International Building Code®(IBC)*

**Assessment Guidance:**

HVAC designers should be aware that the relative humidity (RH) and dew point of the air are relevant as they affect moisture content of the food source of the fungi. Potential cold surfaces should be identified in the project so the engineer can design the HVAC system to prevent condensation on these surfaces.

Architects should specify materials that are naturally resistant to mold or have been chemically treated to resist mold growth since these may be able to resist higher surface RH and/or be able to resist for longer periods. The Manufacturer’s specification and performance criteria should be checked for these properties. Some materials that would be appropriate include concrete, masonry, glass, metals, greenboard, etc.

*ANSI/ASHRAE Standard 62.1-2010* recommends that the following items be incorporated into the building’s envelope:

- A weather barrier to prevent liquid water penetration into the envelope (see 3.5.10 Envelope – Barriers).
- An appropriately placed vapor retarder to prevent condensation on cold surfaces within the envelope (see 3.5.10.2 Vapor Retarders).
- All exterior joints, seams or penetrations in the envelope should be properly caulked, gasketed, weather-stripped, provided with an air barrier, or sealed.
- For areas with high radon concentration sub-slab depressurization should be considered (see 6.5.1 Control Other Pollutants (PCBs, Asbestos, Radon)).
- Insulating all pipes, ducts, and other surfaces whose surface temperatures are expected to fall below the surrounding dew point temperature. All insulation thermal resistance and characteristics shall be sufficient to prevent condensation from forming on the surface and within the insulating material.

Another factor to consider in a building’s mold/mildew prevention plan is to ensure that areas where equipment failure will cause large amount of water to be spilled onto the floor have appropriate drainage capabilities including a floor drain

and flooring sloped toward the drain. Plumbing engineers should coordinate floor drain locations with large pieces of architectural or mechanical equipment.

The assessor may also request documentation demonstrating compliance with *ANSI/ASHRAE Standard 62.1-2010*, *SMACNA HVAC Duct Construction Standards: Metal and Flexible 3rd Edition 2005*, and *ICC's International Building Code® (IBC)*.

### 3.7.2.3 Access for HVAC Maintenance

#### 3.7.2.3.1 Criteria:

Are there the following measures to facilitate maintenance of HVAC equipment that require routine and periodic maintenance:

- **3.7.2.3.1.1:** Access to equipment complies with the *2009 International Code Council International Mechanical Code (ICC IMC 2009)*, *2009 Uniform Mechanical Code (IAPMO/ANSI UMC 1-2009)*, and the manufacturer published and/or suggested recommendations?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
- **3.7.2.3.1.2:** Distribution systems are installed in accordance with *ANSI/ASHRAE Standard 62.1-2010*, and *SMACNA's HVAC Duct Construction Standards: Metal and Flexible 3<sup>rd</sup> Edition 2005*?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
- **3.7.2.3.1.3:** Architectural features related to access are specified to be installed in accordance with the *International Building Code® (IBC)*?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
- **3.7.2.3.1.4:** Access doors to HVAC are removable or have full degree swing?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**

#### ToolTip:

Verify that there is easy access to, and effective drainage design of AHUs.

#### References:

- *ICC IMC 2009: 2009 International Code Council (ICC) International Mechanical Code(IMC), section 306*
- *IAPMO/ANSI UMC 1-2009: 2009 Uniform Mechanical Code (UMC), section 304*
- *International Building Code® (IBC)*
- *ANSI/ASHRAE Standard 62.1-2010*
- *SMACNA HVAC Duct Construction Standards: Metal and Flexible 3rd Edition 2005*

#### Assessment Guidance:

HVAC equipment should have proper service clearances to allow for sufficient working space for maintenance and inspections. Manufacturers will give their recommended service clearances from all faces of the equipment. These distances will take into account door openings, coil removal, filter replacement, fan belt adjustment, etc. The

*International Mechanical Code (IMC) 2009 Section 306 and The Uniform Mechanical Code (UMC) 2009 Section 304 also have recommended service clearances<sup>19</sup>.*

*IMC 2009 Section 306 lists access requirements including:*

- 30"x30" in front of the control side to a service appliance
- A pathway equal to 30" wide by 80" high to a service appliance
- Central furnaces shall have 3" along the side, top, and back with a total width of enclosing space of at least 12 inches wider than the furnace
- Where equipment is located on a roof or structure over 16 feet, a permanent means of access should be provided
- Sloped roofs shall have level platforms not less than 30" in any dimension and shall be provided with guards

*The UMC 2009 Section 304 stipulates that:*

- Appliances shall be accessible without removing permanent structure
- A platform with not less than 30" in depth, width and height shall be provided to access appliances

Access to HVAC equipment also needs to be considered in the design of other trades who share mechanical room space and plenum/ceiling space with the HVAC system. Mechanical engineers should include all service clearances for all pieces of equipment (including terminal unit boxes, heat pumps, controllers, sensors, etc.) on their plans on an appropriate layer and this information should be shared with the electrical engineer, plumbing engineer, fire protection engineer, and architect to ensure that no other items are placed in these areas. This includes access doors for volume dampers, fire dampers, etc.

The project architect will also need to specify some items to ensure proper access. Where access is needed to equipment or parts of systems above gypsum ceilings, access doors, panels, or other means shall be provided and sized to allow convenient and unobstructed access. Any piece of equipment that requires a platform or railing will need to have these items specified and designed.

### 3.7.2.4 Carbon Monoxide Monitoring

#### 3.7.2.4.1 Criteria:

Are there carbon monoxide monitoring devices and alarms in enclosed areas where there are sources of combustion?

#### Answers:

- Yes **(4 points)**
- No **(0 points)**
- N/A

#### ToolTip:

Examples of enclosed areas with sources of combustion include parking garages and boiler rooms. Mark "N/A" where there are no areas with combustion sources.

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<sup>19</sup> This list is not exhaustive and does not contain all requirements listed in UMC Section 304 and IMC Section 306. Mechanical engineers should consult the code requirements for their specific piece of equipment and location.

### **Assessment Guidance:**

Carbon monoxide monitoring is typically done in an enclosed garage or room with combustion (e.g. boiler room) with a sensor that is interconnected to the exhaust system. The exhaust engages when the pre-established maximum CO ppm has been reached, and disengages when the CO limits have dropped into the acceptable range. However, this system is typically put in place to save energy and is not designed with the indoor air quality aspect in mind. Therefore, in order to ensure that drivers and building staff are protected against harmful levels of CO, either the sensors connected to the HVAC system need to be equipped with alarm capabilities and tie into the BAS, or independent sensors should be installed that have alarm capabilities. OSHA's permissible exposure limits for CO in the workplace are 50 ppm time weighted average, but the requirements can change from state to state so the local OSHA chapter or AHJ should be consulted.

## **3.7.2.5 Wet Cooling Towers**

### **3.7.2.5.1 Criteria:**

Do wet cooling towers have drift eliminators and inlet air louvers?

or

Are there no wet cooling towers?

### **Answers:**

- There are no wet cooling towers **(2 points)**
- Cooling towers have drift eliminators and inlet air louvers **(1 point)**
- No **(0 points)**

### **ToolTip:**

Refer to *ASHRAE Guideline 12-2000: Minimizing the Risk of Legionellosis Associated with Building Water Systems*.

### **References:**

- *ASHRAE Guideline 12-2000: Minimizing the Risk of Legionellosis Associated with Building Water Systems*

### **Assessment Guidance:**

Legionnaires' disease can be caused when individuals, whose immune system is usually compromised or weak, inhale water particles that contain the Legionellae bacteria. Cooling towers and other evaporative HVAC equipment, have been known to cause outbreaks of Legionnaire's disease. Legionella control methods for cooling towers include keeping the condenser water system clean, having a biocidal treatment program, and installing drift eliminators and inlet air louvers.

A qualified water treatment specialist should be retained to oversee the cooling tower treatment. The maintenance of the tower should also include regular inspection of drift eliminators, cleaning of cold water basin, and start-up and shut-down procedures that comply with *ASHRAE Guideline 12-2000*.

High efficiency drift eliminators can significantly reduce tower drift. In addition to tower drift, legionella dissemination can occur through tower windage. In open basin designs, when the fan is idle, water droplets can exit the tower at the basin air intake opening, become entrained in the air. To combat this, inlet air louvers should be installed in open basin cooling towers.

Assessors will be looking at design documents and specifications to ensure that any outdoor, evaporative cooling devices include methods for legionella control, including high efficiency drift eliminators and inlet air louvers for open basin units.



### 3.7.2.6 Domestic Hot Water Systems

#### 3.7.2.6.1 Criteria:

Is the domestic hot water system designed to maintain hot water storage at or above 131° F (55° C)?

or

Is there a tankless system?

#### Answers:

- Hot water storage at or above 131° F **(2 points)**
- Tankless system **(2 points)**
- No **(0 points)**

#### ToolTip:

Specifications, design drawings, and construction documentation should show how the water system will comply with the requirements of *ASHRAE Guideline 12-2000: Minimizing the Risk of Legionellosis Associated with Building Water Systems*.

#### References:

- *ASHRAE Guideline 12-2000: Minimizing the Risk of Legionellosis Associated with Building Water Systems*

#### Assessment Guidance:

Although cooling towers have been considered the main source of Legionella bacteria growth and dispersal, current research find that domestic hot water system are also a common source of Legionella colonization. According to ASHRAE, Legionellae can amplify in domestic water pipes with temperatures between 77-108°F and areas of infrequent use, where water becomes stagnant. In order to minimize the domestic water system's growth of Legionella bacteria, domestic hot systems should be designed to eliminate any stagnant piping areas such as dead legs, attached hoses, hot water tanks, and reservoirs. Domestic water heating systems should be designed to store hot water at 140°F and have a hot water return system with a minimum return temperature of 124°F. It is important to note, that the guideline does allow for cooler water temperatures, down to 120°F, "where practical in other situations."<sup>20</sup>

In order to comply with Green Globes the domestic hot water storage tank temperature should not be below 131°F or a tankless system should be used to eliminate any Legionella growth due to stagnant water.

Other design items can be included to prevent Legionella growth, even though they are not specifically called out by these criteria:

- Water heaters and storage tanks should have a drain at the lowest point and the heating elements should be located as close as possible to the bottom of the vessel to provide better water mixing and less temperature stratification.
- Pipe runs should be kept as short as possible.
- Hot water systems should be kept at temperature by either an insulated return system or heat tracing.
- Showers should be specified such that the warm water section of pipe between the control valve and shower head should be self-draining.
- The facility might also request that Legionella control be provided through the use of a treatment system applied directly to the domestic water system. Common disinfection techniques include thermal heat/flush, sodium hypochlorite generation, chlorine dioxide, shock/hyper chlorination, and copper-silver ionization. Copper-silver

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<sup>20</sup> ASHRAE Guideline 12- 2000, page 4, Section 4.1.6



ionization is the newest form of disinfection and is a good choice for recirculation systems. It involves a permanent installation of a metallic ion unit that dissolves and distributes small amount of copper and silver ions throughout the domestic water system to eliminate bacteria. This method does not pose a threat of corrosion of domestic system components, unlike the others, but it is important to note that the efficacy of copper-silver ions, like chlorine, is adversely affected by elevated pH. Designers should investigate which system is right for a facility by looking at the overall water quality, treatment effectiveness, application cost, and potential for domestic system corrosion.

### 3.7.2.7 Humidification and Dehumidification Systems

#### 3.7.2.7.1 Criteria:

Are drain pans for dehumidifying cooling coils designed to properly capture and drain the condensate in the air handler in terms of the following:

- Drain pans have a 1/8 inch slope per foot (10 mm slope per meter) in two directions toward the drain outlet?
- The drain opening is located at the lowest point of the drain pan?
- The drain pan is sufficiently wide to span the cooling coils and is sized to prevent overflow under peak dew point conditions?
- A P-trap or other seal prevents ingestion of air while allowing complete drainage?

#### Answers:

- Yes **(3 points)**
- No **(0 points)**
- N/A

#### ToolTip:

Condensate that is not being adequately captured and drained can wet nearby ductwork, causing rust and mold. Refer to *ANSI/ASHRAE Standard 62.1-2007 Section 5.11 Drain Pans*. Mark "N/A" if there is no humidification or dehumidification system.

#### References:

- *ANSI/ASHRAE Standard 62.1-2007: Section 5.11*
- *ANSI/ASHRAE Standard 160-2009: Criteria for Moisture Control Design Analysis in Buildings*

#### Assessment Guidance:

There are two typical humidification systems that are known to prevent the growth of micro-organisms: steam or ultrasonic. Both systems have one micron droplets, or smaller, that allow for immediate evaporation and thus there is less risk for equipment and ductwork to collect water. All drain pans for dehumidifying cooling coils should have a 1/8th inch slope per foot in 2 directions. The drain should have a P-trap and sufficient width to span the cooling coils.

A direct injection steam type system acts as a cleaning agent and the high temperatures create a virtually sterile environment. The water for steam humidification should be clean or potable water when practical. The designer must take care to locate any objects (fans, filters, dampers, etc.) well downstream of the steam absorption zone, and must estimate the length of that zone based on the lowest expected air temperature upstream of the humidifier.

An ultrasonic humidification system vibrates a piezoelectric transducer at a high frequency to create tiny water droplets. Typically, specialized nozzles are used to discharge a mist of atomized water and compressed air. Like steam systems, the water used in ultrasonic systems should be clean, potable and preferably demineralized water. Ultrasonic humidifiers, when installed in a duct, may need an effective moisture eliminator to prevent mist from being carried too far downstream.

### 3.7.2.8 Pest and Contamination Control

#### 3.7.2.8.1 Criteria:

Are the following integrated pest management strategies used:

- **3.7.2.8.1.1:** Outdoor air inlets have insect screens of 18x14 mesh for plenum systems feeding multiple air handlers?
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
- **3.7.2.8.1.2:** Structural and mechanical openings are fitted with permanent protection (e.g. screens, sealants, etc.)?
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
- **3.7.2.8.1.3:** Advertising signs and other assemblies affixed to the building façade are designed and constructed in a way that reduces bird habitation, and penetrations in the façade are sealed to prevent entry?
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
- **3.7.2.8.1.4:** Mullions and ledges are less than 1 in (2.5 cm) deep to discourage bird roosting?
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**

#### Assessment Guidance:

The University of California, Davis, describes Integrated Pest Management (IPM) as follows:

*"An ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural practices, and use of resistant varieties. Pesticides are used only after monitoring indicates they are needed according to established guidelines, and treatments are made with the goal of removing only the target organism. Pest control materials are selected and applied in a manner that minimizes risks to human health, beneficial and nontarget organisms, and the environment."<sup>21</sup>*

A comprehensive IPM plan would include:

- Identification of type of likely or identified pests, and the potential damage, health risks, or other hazards they pose.
- Rationale for mitigation of pests (addressing the problems pests are likely to cause).
- Description of pest management mitigation and control methods for each anticipated type of pest (insecticides and alternatives, and others).
- Addressing the environmental impacts (toxicity for example) introduced by proposed pest management methods.

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<sup>21</sup> "Definition of Integrated Pest Management", UC IPM Online, last modified July 10, 2014, <http://www.ipm.ucdavis.edu/GENERAL/ipmdefinition.html>

- Requirements for purchases, storage, application of pest management materials, such as pesticides, fungicides, traps, and other containment/elimination methods.
- Description of the roles and responsibilities of those assigned to manage and carry out the Integrated Pest Management plan.
- Process for review and update of the plan.
- Documentation requirements for reporting/recording pest infestation incidents and the outcomes of pest management interventions.

The IPM plan should also include strategies for the following:

- Building and maintaining healthy soils
- Site-appropriate plants
- Efficient watering practices
- Integrated pest management
- Natural lawn-care management
- Building design features that minimize potential pest entry
- Specifications for pest control products that can be used on the project site, preferably non-toxic
- Building notification for when toxic pesticides are applied on site
- Contracting of a Green Shield Certified pest control vendor ([www.greenshieldcertified.org](http://www.greenshieldcertified.org))

#### **3.7.2.8.2 Criteria:**

Is there a sealed storage area for food/kitchen solid waste and recycling?

##### **Answers:**

- Yes **(1 point)**
- No **(0 points)**

##### **Assessment Guidance:**

This criterion will be checked during the Assessor's Onsite Assessment.

#### **3.7.2.9 Other Indoor Pollutants (Tobacco, Radon)**

##### **3.7.2.9.1 Criteria:**

Is there a construction management policy to prohibit smoking in the building and a provision to require that smoking be a minimum of 25 feet from the building with posted signage?

##### **Answers:**

- Yes **(1 point)**
- No **(0 points)**

##### **ToolTip:**

Smoking should be prohibited within 25 feet of all building entrances, operable windows, and building ventilation intakes.

##### **Assessment Guidance:**

The Tobacco Smoke Control policy should be included in the Design Review documentation. This policy can be included as a subsection of the IAQ Management policy (See 3.1.2.1 Environmental Management System (EMS) and/or 3.1.2.4 IAQ During Construction). Signage should be posted to ensure that smoke is kept at least 25 feet away from building

entrances, operable windows and outdoor air intakes for the building's HVAC system. For the Design Review, provide the assessor with approximate location of signage in relation to doors, windows, and intake louvers.

### 3.7.2.9.2 Criteria:

Is there a requirement to post "No Smoking" signage in the building and near all building entrances and air intakes?

#### Answers:

- Yes (1 point)
- No (0 points)

#### Assessment Guidance:

This criterion will be checked during the Assessor's Onsite Assessment.

### 3.7.2.9.3 Criteria:

Have the following measures been met in order to address radon:

- A site-specific assessment of radon potential has been conducted?
- Radon mitigation measures are specified?

#### Answers:

- Yes (5 points)
- No (0 points)
- N/A

#### ToolTip:

This applies to both new construction and major renovation that involves the addition of a new structure. "Radon mitigation measures" include installation of passive or active radon mitigation systems. Major renovation projects must indicate how testing for radon was conducted. Consult EPA for radon maps, and to determine whether the site is in a high, moderate or low radon zone. Mark "N/A" where the site is in a low risk zone.

#### References:

- U. S. Environmental Protection Agency (EPA)- Map of Radon Zones:  
<http://www.epa.gov/radon/zonemap.html>

#### Assessment Guidance:

The first step that projects should take for this criterion is to check the EPA's map of radon zones:

<http://www.epa.gov/radon/zonemap.html>. If the county for the project location is in Zones 1 or 2, then the project is applicable for this criterion.

Radon can enter structures through the slab, basement, or crawl spaces via cracks, small holes, plumbing penetrations, and/or sumps. This is especially true when an air pressure difference exists between the building's underground structure and the surrounding soil.

Radon mitigation can be achieved through a number of active and passive measures. The most common passive measure is ensuring that all slabs on grade or underground structures have appropriate air/vapor barriers. Other strategies include:

- Reducing stack effect to ensure radon is not drawn in by the building's negative pressure
- All mechanical equipment and ductwork located in basements and crawl spaces should be properly sealed at seams and joints

- Add passive sub-slab depressurization systems such as a radon vent pipe installed through warm spaces and terminated above the roof
- Proper sealing and caulking of all openings in the slab and below-grade walls
- Add an active radon vent pipe with in-line fan exhausting to the roof/ outdoors

#### **3.7.2.9.4 Criteria:**

Is there a requirement that the removal or abatement of asbestos and asbestos-containing materials meet all applicable state and local regulations?

##### **Answers:**

- Yes **(1 point)**
- No **(0 points)**
- N/A

##### **ToolTip:**

Only applies to retro-fit projects. Mark “N/A” for new construction and major renovation projects where there is no asbestos or asbestos-containing materials?

### **3.7.2.10 Ventilation and Physical Isolation for Specialized Activities**

**3.7.2.10.1:** Mark N/A for Green Globes Multifamily for New Construction

**3.7.2.10.2:** Mark N/A for Green Globes Multifamily for New Construction

## **3.7.3. Lighting Design and Systems**

### **3.7.3.1 Daylighting**

#### **3.7.3.1.1 Criteria:**

What percent of floor area occupied for critical visual tasks achieves a minimum daylight factor (DF) of 2 (excluding all direct sunlight penetration)?

##### **Answers:**

- ≥ 75% **(7 points)**
- 50 - 74% **(5 points)**
- 25 - 49% **(3 points)**
- < 25% **(0 points)**

##### **ToolTip:**

“Daylight factor” means the ratio of internal light level to external light level. Levels between 2 and 5 indicate adequate daylighting and possibly the need for artificial lighting for part of the time. Levels greater than 5 indicate a well daylit area, but glare and solar gain may cause problems. Consult the *Whole Building Design Guide (WBDG)* for recommended DF for various types of spaces.

Daylight Factor Calculation:

$$DF = (E_i / E_o) \times \%$$

where,  $E_i$  = illuminance due to daylight at a point on the indoors working plane; and  
 $E_o$  = simultaneous outdoor illuminance on a horizontal plane from an unobstructed hemisphere of overcast sky.

In order to calculate  $E_i$ , one must establish the amount of light received from the outside to the inside of a building.

A simple rule of thumb to estimate the daylight factor for a daylit space that has vertical windows is:

**DF = 0.1 x PG**, where:

DF = daylight factor

PG = percentage of glass to floor area (area of the windows/floor area)

#### References:

- International Commission on Illumination
- RADIANCE software (for evaluation)
- *Whole Building Design Guide (WBDG) : Daylighting*  
[http://www.wbdg.org/resources/daylighting.php?r=dd\\_lightingdsgn](http://www.wbdg.org/resources/daylighting.php?r=dd_lightingdsgn)
- *CIBSE Lighting Guide (LG10-1999)*

#### Assessment Guidance:

The assessor may also request percentages and calculations for occupied areas with daylight illumination levels as well as lighting plans.

#### 3.7.3.1.2 Criteria:

What percentage of task areas were designed to have views to the exterior or atria within 25 ft. (7.6 m) from a window?

##### Answers:

- $\geq 60\%$  of occupied space **(5 points)**
- 31 - 59% **(3 points)**
- 10 - 30% **(1 point)**
- $< 10\%$  **(0 points)**

##### ToolTip:

The percentage is based on the number of task areas that have a view to the building exterior over the total number of task areas in the building.

#### Assessment Guidance:

Providing exterior views to occupants enhances their wellbeing and work place comfort. Projects should utilize glazing on interior partitions to allow for the maximum number of regularly occupied spaces to have a direct line of sight to the outdoors or an atrium. Architects should consider exterior wall layout, window to wall ratios, interior partition layout, furniture layout for interior spaces, and height of any partial walls along the perimeter of the space. In order to accomplish the highest percentage of occupants with views, a common strategy for an office building is locate open office areas along the perimeter and private office along the interior with fully glazed or partially glazed partitions between. Green Globes further specifies that the maximum distance from the occupant to the view shall be 25 feet. If this criterion is to be pursued by the project, the architect should take this maximum distance into account at the conceptual design stage to ensure that the building footprint allows for this type of space layout.

The assessor may also request percentages and calculations for view to building exterior or atria.

#### 3.7.3.1.3 Criteria:



Are there shading devices on southern, western, and eastern exposures?

**Answers:**

- Yes **(1 points)**
- Partially **(0.5 points)**
- No **(0 points)**

**3.7.3.1.4 Criteria:**

Are there shading devices to eliminate direct sunlight from reaching task areas?

**Answers:**

- Yes **(1 point)**
- No **(0 points)**

**Assessment Guidance:**

The assessor may also request percentages and calculations for primary occupied spaces with IESNA recommended task lighting levels; specifications for solar shading devices and luminaries; and lighting plans.

**3.7.3.1.5 Criteria:**

What percentage of daylit areas are there photo-sensors to maintain consistent lighting levels throughout the day using both daylighting and artificial lighting?

**Answers:**

- > 75% of spaces **(3 points)**
- 50 - 75% of spaces **(2 points)**
- 25 - 49% of spaces **(1 point)**
- < 25% of spaces **(0 points)**

**ToolTip:**

This applies to areas with a Daylight Factor of at least 2.

**Assessment Guidance:**

Shading and solar control devices can be incorporated into many aspects of the building such as:

- Vertical fins or overhangs for exterior glazing. This is generally for southern facing windows.
- Interior light shelves will reflect daylighting from higher windows into the space and will provide a shade for lower windows.
- Exterior glazing that has low transmittance (5-10%).
- Interior glare control devices like vertical or horizontal blinds or curtains (manual or automatically operated). Horizontal shading should be used for southern exposures and vertical for east and west.
- Exterior landscaping features such as adult trees are good for controlling East and West exposure glazing that is harder to shade with overhangs or fins.

Motorized interior shades are a great way to control glare from the sun, daylighting, and solar heat gain. Systems now can be provided that accomplish all this by adjusting the levels of the shades with reference to the measured daylighting level in specific areas of the building, time of day, and aesthetics (the level of adjacent shades to maintain a continuous appearance from the exterior). These systems can also be tied into the electric lighting system to ensure that the electric

lighting ramps up on especially cloudy days and dims down or turns off when there is adequate daylight. The architect and electrical engineer should coordinate all aspects of the electric lighting system and its controls.

### 3.7.3.2 Lighting Design

#### 3.7.3.2.1 Criteria:

Do primary occupied spaces have the prescribed lighting levels for the types of tasks anticipated in the various building spaces?

#### Answers:

- Yes (7 points)
- No (0 points)

#### ToolTip:

“Prescribed lighting levels” are found in the most recent *Illuminating Engineering Society (IES): The Lighting Handbook* and in Tables 3.7.3.2.1-A: IESNA Illuminance Categories and 3.7.3.2.1-B: IESNA Location/Task Categories. Lighting levels should take into account special needs and circumstances.

#### References:

- *Illuminating Engineering Society (IES): The Lighting Handbook*

#### Assessment Guidance:

The lighting design for the project should take into account a number of factors including:

- IESNA recommended light levels
- Owner’s Project Requirements for light levels (see 3.1.3.1 Pre-Commissioning)
- Applicable energy code’s maximum lighting power density

The tables below list some of IESNA’s illuminance recommendations (lux) typical facilities. This is the height off of the floor at which the average measured illuminance should be at least as high as the IESNA recommended value. This is an average illuminance value, so multiple measurements in a space should be averaged at this height to ensure compliance with the recommended levels. The information below is listed as an example; designers should consult the IESNA lighting design guide for detailed information about how to properly utilize their recommendations.

**Table 3.7.3.2.1–A: IESNA Illuminance Categories**

Illuminance Category	Description	Recommended Illuminance (lux/footcandles)
<b>A</b>	Public Spaces	30 / 3
<b>B</b>	Simple orientation for short visits	50 / 5
<b>C</b>	Working spaces where simple visual tasks are performed	100 / 10
<b>D</b>	Performance of visual tasks of high contrast and large size	300 / 30
<b>E</b>	Performance of visual tasks of high contrast and small size or visual tasks of low contrast and large size	500 / 50
<b>F</b>	Performance of visual tasks of low contrast and small size	1,000 / 100
<b>G</b>	Performance of visual tasks near threshold	3,000-10,000 / 300-1,000

**Table 3.7.3.2.1–B: IESNA Location/Task Categories**

Interior Location/Task	Horizontal Category	Vertical Category
Auditoriums – Assembly	C	-
CAD drafting stations	C	A
Conference Rooms – Meeting	D	B
Conference Rooms – Video Conference	E	D
Hospital patient rooms – general	B	A
Hospital nursing stations – general	D	B
Hospital lobby	B	A
Hospital anesthetizing locations	E	C
Hospital general critical care	B	A
Hotel guest rooms – general	C	-
Hotel lobby general lighting	C	-
Library reading stacks	D	-
Museum exhibit cases	D	B
Open Office – Intensive VDT	D	B
Open Office – Intermittent VDT	E	B
Office lobby	C	A
Office copy room	C	A
Stairways and corridors	B	-
Toiles and washrooms	B	A

Lighting designers and electrical engineers should also keep in mind that the lighting design also needs to meet energy code lighting power density watts per square foot values. With the advances within the lighting industry, designing a lighting system that meets both the energy codes and recommended illuminance values can be achieved.

Illuminance level verification can be sent in the Design Review via calculations and/or lighting plans showing illuminance values or during the Onsite Assessment handheld measurements can be recorded and presented to the Assessor for verification. If any areas have special circumstances, a narrative should be provided during the Design Review.

The assessor may also request percentages and calculations for primary occupied spaces with IESNA recommended task lighting levels (IES HB-10) as well as lighting plans.

**3.7.3.2.2:** Mark N/A for Green Globes Multifamily for New Construction

**3.7.3.2.3:** Mark N/A for Green Globes Multifamily for New Construction

## 3.7.4 Thermal Comfort

### 3.7.4.1 Thermal Comfort Strategies

**3.7.4.1.1:** Mark N/A for Green Globes Multifamily for New Construction

**3.7.4.1.2:** Mark N/A for Green Globes Multifamily for New Construction

**3.7.4.1.3:** Mark N/A for Green Globes Multifamily for New Construction

#### 3.7.4.1.4 Criteria:

Do smaller functional areas such as offices, meeting rooms, and hospital/hotel rooms have thermal control zones that are 1,200 ft<sup>2</sup> (111 m<sup>2</sup>) or less?

##### Answers:

- 750 ft<sup>2</sup> (70 m<sup>2</sup>) or less **(3 points)**
- 1,200 ft<sup>2</sup> (111 m<sup>2</sup>) or less **(2 points)**
- More than 1,200 ft<sup>2</sup> (111 m<sup>2</sup>) **(0 points)**
- N/A

##### ToolTip:

“Thermal zone” means a segment of a building with similar thermal requirements serviced by the same mechanical equipment and controls.

##### Assessment Guidance:

Thermal control zones, for this criterion’s purpose, can be defined as a space or group of spaces with similar desired thermal conditions (temperature, humidity, etc.) that are maintained using a dedicated sensor (thermostat, humidistat, etc.). Mechanical designers typically call these simply HVAC zones and will usually develop a zone plan early in the design stage showing which rooms/areas will fall into each zone. This zone plan should be updated throughout the design and final zone plan should be issued to the owner’s building staff for their records and use. Thermal control zones should be laid out based on following parameters:

- Client requests for individual control in special areas (President’s office, etc.)
- Heating and cooling load profiles for rooms and spaces
- Thermal design conditions for rooms and spaces
- Occupancy/usage schedules for rooms and spaces

In order for the Assessor to easily verify the above criterion sought, projects should submit the zone plan, including space names and square footages, during the Design Review or Onsite Assessment.

### 3.7.4.2 Thermal Comfort Design

#### 3.7.4.2.1 Criteria:

Has an Engineer signed off on the design that shows the building conforms to *ANSI/ASHRAE Standard 55-2010* or *ANSI/ASHRAE Standard 55-2004*?

##### Answers:

- Yes (55-2010) **(6 points)**
- Yes (55-2004) **(4 points)**
- No **(0 points)**

##### References:

- *ANSI/ASHRAE Standard 55-2010*
- *ANSI/ASHRAE Standard 55-2004*

##### Assessment Guidance:

Most mechanical designers will cite an *ANSI/ASHRAE Standard 55* in their project specifications or their design standards but that does not necessarily mean the actual HVAC design complies with the specific requirements of the standard. In order to comply with *ANSI/ASHRAE Standard 55*, calculations need to be performed to determine the predicted percentage of dissatisfied (PPD) occupants. These calculations will include factor such as metabolic rate, clothing, supply air temperature, radiant temperature, supply air speed, and humidity level in the space. These calculations can be

performed by hand but the typical program used to determine the PPD for the project's design parameters is ASHRAE's Thermal Comfort Tool. For general comfort conditions, ASHRAE recommends a PPD level less than 10. The 2010 version of this standard has taken into account the fact that higher air speeds can be used to increase the upper temperature limits of the air while maintaining an acceptable comfort range for occupants. Projects claiming to meet *ANSI/ASHRAE Standard 55* need to list the standard in the Basis of Design document and/or specifications. Also calculations showing a PPD less than 10 for the heating and cooling design operating conditions should be provided.

## 3.7.5 Acoustic Comfort

### 3.7.5.1 Acoustic Comfort Design

#### 3.7.5.1.1 Criteria:

Does the building design include the following acoustic design strategies:

- **3.7.5.1.1.1:** Mark N/A for Green Globes Multifamily for New Construction
- **3.7.5.1.1.2:** Leave blank for Green Globes Multifamily for New Construction
- **3.7.5.1.1.3:** Entry doors to rooms opposite each other on the same corridor are staggered?
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
- **3.7.5.1.1.4:** Through-wall penetrations comply with Annex B of *ANSI/ASA S12.60-2010/Part 1*?
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
- **3.7.5.1.1.5:** Walls separating acoustically separated areas from other areas are constructed full height to underside of the next floor above or the roof deck?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
- **3.7.5.1.1.6:** Walls separating quiet areas from other areas have all joints and penetrations sealed with acoustical sealant?
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**

**3.7.5.1.1.7:** Leave blank for Green Globes Multifamily for New Construction

#### ToolTip:

Acoustic design strategies should be implemented in order to achieve specific interior sound control performance targets. "Acoustically separated area" means an enclosed space that to function properly, requires separation from other adjacent spaces by wall, floor, and ceiling assemblies that have an STC rating adequate to allow clear, intelligible communication between sender and receiver within the space (e.g. meeting rooms, auditoria, lecture halls, libraries, classrooms, conference rooms, private offices, private rooms in health care facilities, sleeping rooms etc.).

#### References:

- *ANSI/ASA S12.60-2010/Part 1*

### **Assessment Guidance:**

Most of the design decisions and construction procedures for these criteria will be detailed on the architectural drawings. The Architect should be made aware if a project is pursuing these criteria early in the design, when space planning is being coordinated. In general, architectural acoustic design attempts to optimize isolation (keeping noise within or preventing it from entering a space) and/or sound quality (judicious use of surfaces, shaping, and finishes to achieve a desired effect). Although these goals often go together, there are many examples where one is targeted with little concern for the other. For example, a mechanical equipment room may be designed with heavy walls, high-quality doors, and structural breaks to keep noise and vibration from being transmitted to occupied spaces; however, the quality of the noise within the mechanical equipment room is perceived as irrelevant and no thought is given to the room finishes or layout with regard to room acoustic response. Similarly, a large space used for a marching band to practice indoors in the event of inclement or uncomfortable weather may incorporate specific architectural features and finishes to provide a good listening environment for the users but there may be little concern about noise leaking out of the building due to its location or the expectations of adjacent users. Designers should remember that not every area that is 'acoustically separated' requires both good isolation and good quality – the requirements depend on whether the room houses sources or receivers, as well as the function of the rooms.

For sub-criteria 3.7.5.1.1.2, mechanical rooms refers to both mechanical and electrical equipment rooms since electrical equipment can also have high, tonal noise levels.

Entry doors to acoustically sensitive areas are often the weak point in the design of the enclosure. Exterior doors should be vestibules/double-doors or should incorporate bubble/brush gaskets and/or drop seals. Interior doors should be staggered for rooms opposite each other on the same corridor.

### **3.7.5.1.2: Mark N/A for Green Globes Multifamily for New Construction**

#### **3.7.5.1.3 Criteria:**

Has an Acoustical Consultant or Acoustician signed off on a design that complies with minimum Sound Transmission Class (STC) ratings of floor/ceiling assemblies, walls and doors between acoustically separated areas (e.g. learning spaces), and adjacent spaces as follows and as applicable:

- **3.7.5.1.3.1:** STC-45 where the adjacent space is a corridor, stair, office, or conference room?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
- **3.7.5.1.3.2:** Leave blank for Green Globes Multifamily for New Construction
- **3.7.5.1.3.3:** Mark N/A for Green Globes Multifamily for New Construction
- **3.7.5.1.3.4:** Mark N/A for Green Globes Multifamily for New Construction
- **3.7.5.1.3.5:** STC-35 for exterior windows?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**

### **ToolTip:**

Verify that construction documents include measures to mitigate sound transmission through the building envelope from external sources such as traffic, air traffic, car alarms etc., and that ambient sound levels in enclosed, occupied spaces fall within specified STC ratings. Review the acoustical analysis prepared by an Acoustical Consultant or Acoustician and the design and construction drawings showing the details required for optimum acoustic performance.

### **Assessment Guidance:**

The STC rating indicates the maximum noise reduction performance of an architectural element based on its performance relative to an ideal defined curve but allows for significant deviations within narrow frequency bands. Projects pursuing this criterion should provide acoustical consultant report/diagrams or architectural drawings that detail and describe the



STC ratings of walls, floors, ceiling, doors, and windows. STC ratings that meet or exceed the above criteria will count for points.

#### 3.7.5.1.4 Criteria:

Does the Impact Insulation Class (IIC) design of all floor-ceiling assemblies have a minimum rating of IIC-50?

##### Answers:

- Yes (2 points)
- No (0 points)

#### 3.7.5.1.4.1 Sub-Criteria:

Indicate the Impact Insulation Class (IIC) value.

##### Answers:

- [Numerical text field] (0 points)

##### ToolTip:

Verify that sound transmission from the outside and between rooms and floors will be attenuated, and that primary spaces will be effectively insulated from undesirable impact noise (stairways, mechanical transportation, etc.) when adjacent spaces are fully occupied and being used normally. Check that the appropriate Impact Insulation Class (IIC) values have been specified. Check that engineering design calculations and drawings by an Acoustical Consultant or Acoustician are included.

##### References:

- ASTM E989-06

##### Assessment Guidance:

Since not every state has a separate designation for acoustical engineers and, since few Acoustics Consultants or Acousticians are registered engineers, IIC calculations and drawings should, at minimum, be prepared by a firm that specializes in or has a department that specializes in acoustics.

#### 3.7.5.1.5 Mark N/A for Green Globes Multifamily for New Construction

### 3.7.5.2 Mechanical, Plumbing, and Electrical

#### 3.7.5.2.1 Criteria:

Has an Acoustical Consultant or Acoustician signed off on a design that complies with minimum background sound levels associated with mechanical systems as follows:

- **3.7.5.2.1.1:** Airborne sound power levels from HVAC unit do not exceed the Room Criteria detailed in *ASHRAE Systems Application Handbook 2007, Chapter 47, Table 42* for listed spaces when HVAC units are in operation?
  - **Answers:**
    - Yes (1.5 points)
    - No (0 points)
    - N/A
  - **ToolTip:** Mark "N/A" for MURBs.
- **3.7.5.2.1.2:** Spaces are designed such that room background noise using the Room Criteria (RC) ratings complies with *ASHRAE Systems Application Handbook-2007, Chapter 47, Table 42*.

- **Answers:**
  - Yes **(1 point)**
  - No **(0 points)**
  - N/A
- **ToolTip:** Mark “N/A” for MURBs.

**ToolTip:**

Noise attenuating measures include: ducts positioned appropriately and enclosed in sound isolation materials; mechanical rooms sound-proofed; acoustic zoning separates quiet areas from noisy machinery; and systems selected for their sound qualities.

**References:**

- *ASHRAE Systems Application Handbook- 2007, Chapter 47, Table 42*
- *ASA/ INCE/ NCAC Interim Sound and Vibration Design Guidelines for Hospital and Healthcare Facilities*
- *CHPS –Collaborative for High Performance Schools*
- *HUD Guide to Airborne, Impact and Structure Borne Noise*
- *WBDG: Federal Green Construction Guide for Specifiers: 01 57 19.12 (01353) Noise and Acoustic Management*
- *WBDG: DG 1110-3-122 Design Guide for Interiors, 1997*
- *ASTM E989-06*
- *A Practical Guide to Noise and Vibration Control for HVAC Systems, Second Edition, by Mark E. Schaffer, ASHRAE Publications.*
- *Application of Manufacturers' Sound Data, by Charles Ebbing and Warren Blazier, ASHRAE Publications.*

**Assessment Guidance:**

Room Criteria are representations of sound pressure levels, measured with a standard microphone. Sound power levels for all HVAC large equipment (chillers, supply fans, pumps, etc.) should be specified in the project design drawings tables or in the specifications. Assessors will review these items to ensure compliance with Green Globes RC values. Many data for equipment is only available in sound pressure level format at a given distance from the equipment. Specifying sound pressure levels at a distance is a valid approach when sound power levels are not available.

The ASHRAE recommended RC values for different spaces should be verified with field measurements taken with a sound level meter and a real-time frequency analyzer. At the time of measurement, all other non-HVAC systems should be shut-down. In order to ensure compliance, the measurement/testing procedure should be included in the project specifications and should include the following six points (as recommended by ASHRAE):

- Identify sound metrics measured (specify levels in each octave frequency band)
- Specify where and how the sound levels are to be measured (time durations, locations, etc.)
- Dictate what type of instruments are to be used to make the measurements (specify ANSI or IEC Type 1 or 2 sound level meters with octave band filters, etc.) and how they are to be calibrated
- Procedures for how sound level measurements are to be adjusted for the presence of other sound sources
- Procedures for how results of the measurements are to be interpreted (specify whether octave band sound levels, NC, RC, dBA or other values are to be reported).

Table ASHRAE Design Guidelines<sup>22</sup>

Room Types	RC (N)	Room Types	RC (N)
<b>Residence, Apartments, Condominiums</b>	25 to 35	<b>Performing Art Spaces</b>	
<b>Hotels/Motels</b>		Drama theaters, concert and recital halls	25
<b>Individual rooms or suites</b>	25 to 35	Music teaching studios	25
<b>Meeting/banquet rooms</b>	25 to 35	Music practice rooms	30 to 35
<b>Corridors/lobbies</b>	35 to 45	<b>Laboratories (with fume hoods)</b>	
<b>Service/support areas</b>	35 to 45	Testing/research, minimal speech communication	45 to 55
<b>Office Buildings</b>		Research, extensive telephone use, speech communication	40 to 50
<b>Executive and private offices</b>	25 to 35	Group teaching	35 to 45
<b>Conference Rooms</b>	25 to 35	<b>Church, mosque, Synagogue</b>	
<b>Teleconference rooms</b>	≤ 25	General assembly with critical music programs	25 to 35
<b>Open plan offices</b>	≤ 40	<b>Schools</b>	
<b>Open plan w/ sound masking</b>	≤ 35	Classrooms	25 to 30
<b>Corridors and lobbies</b>	40 to 45	Large lecture rooms	25 to 30
<b>Hospital and Clinics</b>		Large lecture rooms with speech amplification	≤ 25
<b>Private rooms</b>	25 to 35	<b>Libraries</b>	30 to 40
<b>Wards</b>	30 to 40	<b>Indoor Stadiums, Gymnasiums</b>	
<b>Operating rooms</b>	25 to 35	Gymnasiums and natatoriums	40 to 50
<b>Corridors and public areas</b>	30 to 40	Large seating-capacity spaces with speech amplification	45 to 55
<b>Courtrooms</b>			
<b>Unamplified speech</b>	25 to 35		
<b>Amplified speech</b>	30 to 40		

Projects pursuing sub-criteria 3.7.5.2.1.1 should engage an Acoustical Consultant or Acoustician or other applicable party to compose and perform the HVAC sound level testing and measurement procedures. A final report should be administered and given to the Assessor showing compliance.

<sup>22</sup> Designers should also be sure to consult the additional guidance of the footnotes for this table listed in the *ASHRAE Applications Handbook, 2007 version, Chapter 47, Table 42*.

Although this section only provides points for addressing and designing around noise from air handling units and the air distribution systems, many other design approaches and considerations are good to integrate into all designs, such as:

- Vibration isolation at all rotating, vibrating, and reciprocating equipment, including resilient supports/mounts/hangers for a certain distance (typically 50' from the equipment or the MER wall, whichever comes first) and flexible connections (duct, pipe, conduit)
- Design of piping systems to keep fluid velocities below levels which cause turbulence-induced noise
- Use of mufflers/attenuators/lagging on equipment with high airborne noise levels (cooling towers, generators, exhaust fans, condensing units, steam pressure reducing stations, compressors)
- Locating VAV boxes and other equipment/sources of noise above non-sensitive spaces such as corridors

Additional resources that designers can utilize include:

- *A Practical Guide to Noise and Vibration Control for HVAC Systems, Second Edition*, by Mark E. Schaffer, ASHRAE Publications.
- *Application of Manufacturers' Sound Data*, by Charles Ebbing and Warren Blazier, ASHRAE Publications.

The assessor may also request sound level measurements taken at the property line; description of acoustic design strategies and all design targets; FIIC value for flooring assemblies; and acoustic mitigation measures for mechanical equipment and plumbing systems.

### 3.7.5.2.2 Criteria:

Has an Acoustical Consultant or Acoustician signed off on the design such that there are the following measures to minimize airborne noise from the HVAC system:

- **3.7.5.2.2.1:** Duct transitions are spread out and graduated to minimize generation of turbulence and air flow separations?
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
- **3.7.5.2.2.2:** Secondary attenuators are located immediately downstream of duct fittings that would otherwise generate noise?
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
- **3.7.5.2.2.3:** Air flow velocities in low pressure ductwork did not exceed the following values?
  - For main duct trunk lines: 900 f/m (4.5 m/s).
  - For branch ducts: 700 f/m (3.5 m/s).
  - For final run outs: 400 f/m (2.0 m/s).
  - For main vertical ducts in shafts: 1200 f/m (6 m/s).
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
- **3.7.5.2.2.4:** Where significant cross talk paths exist between two habitable spaces, there are sound attenuators and/or silencers, or ducts are designed in a "Z" configuration?
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**
- **3.7.5.2.2.5:** HVAC grilles and diffusers were selected that comply with *ANSI/ASA S12.60-2010/Part 1*?
  - **Answers:**
    - Yes **(0.5 points)**
    - No **(0 points)**

### References:

- *ASTM E1332-90 (2003)*

- *ASTM E90-04*
- *ASTM E1686-03*
- *ASTM E413-04*
- *ASTM E966-04*
- *ASTM E1374-06*
- *ASTM E336-07*
- *ANSI S12.60-2010/Part 1*
- *ASHRAE Systems Application Handbook-2007, Chapter 47*
- *ASA/ INCE/ NCAC Interim Sound and Vibration Design Guidelines for Hospital and Healthcare Facilities*

### **Assessment Guidance:**

Mechanical engineers for the project should design the HVAC system in accordance with *ASHRAE Systems Application Handbook-2007, Chapter 47*. It is important to note that the *ANSI S12.60* allowable NC values for learning spaces do not necessarily agree with the values supplied in the ASHRAE Handbook. The Mechanical engineer should always adhere to the stricter of the two values. The main source for HVAC system noise is from the fan, which travels through the ductwork and into the space. A portion of the fan's sound energy is converted to vibrations of duct walls. The sound energy that is retained in the ductwork can be mitigated through the use of fiberglass lining, duct bends, junctions and duct cross-sectional changes.

Increasing the turbulence of the HVAC system airflow will increase the noise level of the system. In order to reduce turbulence, smooth transitions should be used. For example long radius elbows should be used in lieu of 90° square elbows. If square elbows and right angle branch take-offs must be used, then they should be provided with turning vanes to reduce turbulence. Transitions should not be located close together, and designers should gradually change duct sizes downstream in lieu of one large, dramatic change. Another important factor that can contribute to turbulence is the velocity of the airflow through the ductwork. Ductwork should be sized to maintain the maximum airflow velocities listed in the sub-criteria 7.5.2.2.3 above. Since air velocity and pressure are interdependent in an HVAC system, low pressure ductwork is synonymous with low velocity.

Diffusers, registers and grilles also need to be specified and sized with a lower NC value to mitigate acoustical noise through the HVAC system. *ANSI S12.60–2002, Annex B* lists the design guidelines for noise control for HVAC diffusers, registers and grilles. ANSI recommends selecting air devices that have a listed NC value of 18 or less, providing the NC catalog rating is based on a correction of 10 dB for room sound absorption.

Secondary attenuators, also called duct silencers or mufflers, have a cross-section equal or greater to the ductwork in which they are installed. It works by dividing the airflow into two or more fiberglass-lined openings. They are typically available in prefabricated sizes and lengths. Mechanical engineers should place these secondary attenuators downstream of duct fittings that will create large amounts of noise or when cross-talk between spaces might be an issue. Another way to mitigate cross-talk or cross-transmission between spaces served by common ductwork is by designing the ductwork in a "Z" configuration to place at least two elbows in the duct-path. This will increase the sound path and thus mitigate the cross transmission.

For the Design Review, the Assessor will examine the mechanical design drawings to ensure that projects pursuing 7.5.2.2 criteria have noise mitigation strategies included in the plans and details.

The assessor may also request description of acoustic design strategies and all design targets; acoustic mitigation measures for mechanical equipment and plumbing systems; specification which includes Annex E of *ANSI S12.60–2010/Part 1*; and Test Report indicating compliance with *ANSI S12.60–2010/Part 1*.

### **3.7.5.2.3 Criteria:**

Has an Acoustical Consultant or Acoustician signed off on the design such that it adheres to the following best practices to minimize structure-borne noise from the HVAC system:

- **3.7.5.2.3.1:** Fans and other powered HVAC equipment are acoustically separated from the structure using vibration isolators?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
- **3.7.5.2.3.2:** Ducts are supported on resilient mounts to isolate them from the structural system, and ducts are isolated using resilient material where they pass through walls?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**

#### **Assessment Guidance:**

Mechanical design drawings and specifications should indicate all the sub-criteria listed above, if pursuing. To better separate HVAC equipment, flexible connectors should generally be employed as well as vibration isolators. Since the incompressibility of most fluids used in HVAC systems and the high speed of sound in steel and copper makes piping very effective conveyors of noise and vibration, isolation from the structural systems should be desired for the piping as well as ductwork in HVAC systems. Both should be supported on resilient mounts to ensure ample mechanical isolation.

The Assessor will check these items during the Design Review and spot check installation during the Onsite Assessment . The assessor may also request sound level measurements taken at the property line; description of acoustic design strategies and all design targets; and acoustic mitigation measures for mechanical equipment and plumbing systems.

#### **3.7.5.2.4 Criteria:**

Has an Acoustical Consultant or Acoustician signed off on the design such that it adheres to the following best practices to mitigate noise from the plumbing system:

- **3.7.5.2.4.1:** Piping was not run above quiet areas and learning spaces with the exception of sprinklers and radiant heating systems?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
- **3.7.5.2.4.2:** Waste water piping noise is mitigated using cast iron pipe or with acoustic insulation above quiet areas and learning spaces, and a water hammer arrester was used?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**

#### **References:**

- *ANSI A112.26.1*
- *PDI WH-201*

#### **Assessment Guidance:**

Plumbing design drawings should indicate all the sub-criteria listed above, if pursuing. Water hammer arrestors should meet *ANSI A112.26.1*, be sized in accordance with *PDI WH-201*, and be installed on the top of all water risers and branch lines supplying fixtures served by flush valves and at equipment connections where quick closing or solenoid valves are used, such as washing machine, water closets, etc. The Assessor will check these items during the Design Review.

Additional strategies to mitigate the noise from the plumbing system include:

- Many plumbing systems in large/tall buildings have sump pumps, sewage ejector pumps, booster pumps, hot water recirculating pumps, and elevator pit pumps. Designers should take care to locate/install these in a manner to avoid transmitting noise/vibration to sensitive spaces.



- Plumbing designers should avoid judicious routing of storm lines to prevent having large volumes of water flowing through sensitive spaces at intermittent times.
- Ensure that electric water coolers use split chillers or that the chiller is not mounted in walls or above ceilings that could affect sensitive spaces.

The assessor may also request sound level measurements taken at the property line; description of acoustic design strategies and all design targets; and acoustic mitigation measures for mechanical equipment and plumbing systems.

### 3.7.5.2.5 Criteria:

Has an Acoustical Consultant or Acoustician signed off on the design such that it complies with the following best practices to minimize noise from the electrical system:

- **3.7.5.2.5.1:** Low-noise ballasts are installed in quiet areas and all other areas where speech intelligibility is important?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**
- **3.7.5.2.5.2:** Noise from light fixtures and other electrical fixtures does not exceed values indicated in *ANSI/ASA S12.60-2010/Part 1*?
  - **Answers:**
    - Yes **(1 point)**
    - No **(0 points)**

### References:

- *ANSI/ASA S12.60-2010/Part 1*
- *ANSI/ASA S1.13-2005*

### Assessment Guidance:

Ballast noise from electromagnetic and electronic ballasts used in fluorescent lighting systems is typically characterized by a “humming” sound. Ballast manufacturers assign a sound rating to their ballasts from “A” through “F”, with “A” being the quietest. Because electronic ballasts have smaller components, they tend to have the lowest sound rating. However, there is no standard for this rating; it is left entirely up to the manufacturers to rate their ballasts. This sound rating can be found listed under the ballast’s specifications. In situations where the required light output necessitates using ballasts with a higher sound rating, the ballasts should be remotely located.

*ANSI S12.60-2010/Part 1* covers the acoustical performance criteria, design requirements, and guidelines for permanent schools, though this standard is used for other learning or sound critical spaces as well. Noise from light fixtures or other electrical equipment is not dictated in the standard by ratings or sound levels of the equipment. In order to comply with the standard, the interior-source background noise cannot exceed the limits specified in the table below. Although the table separates sound level limits by HVAC type, the limits include all building services, including lighting. Section 5.2.2.1 of the standard indicates: “The one-hour average A- or C- weighted sound levels of any other building sounds (e.g. lighting) for which sound power data are available, shall be combined on time-means-square basis with calculated one-hour average A- or C- weighted sound level of the HVAC noise before determining conformance. Where sound power data are not available, estimated one-hour average A- or C- weighted sound levels shall be used.” Table 3.7.5.2.5: *ANSI/ASA S12.60-2010 Noise Limits*, are on one-hour average A- and C-weighted sound levels—designated by X/Y in the table below—from sources associated with the building services and utilities.

Table ANSI/ASA S12.60-2010 Noise Limits

Room Type	HVAC Operating Condition	Building Services <sup>a)</sup> sound level limits (dB) <sup>c) d)</sup>	
		Single mode HVAC Type 1	Multiple mode HVAC Type 2
Core learning space	Design or maximum capacity heating or cooling	35 / 55	37 / 57
	Reduced or low capacity heating or cooling or ventilation <sup>b)</sup>	N/A	34 / 54
Ancillary space	Design or maximum capacity heating or cooling	40 / 60	42 / 62
	Reduced or low capacity heating or cooling or ventilation <sup>b)</sup>	N/A	39 / 59
<p><b>Type 1</b> – represents systems that have a single operational mode of performance  <b>Type 2</b> – represents systems that have multiple stages of cooling or heating, multiple or variable fan speeds, or ventilation-only models</p> <p>a) The level for HVAC sound shall be combined with the level of the sound from other building systems such as lights, plumbing, etc., if applicable. If present, the contribution of an outdoor condenser or chiller to the classroom sound level shall be combined with the sound from the other building services.</p> <p>b) The operating condition is one that occurs frequently and represents airflow less than design or reduced refrigeration capacity of both.</p> <p>c) The HVAC design location shall be at the loudest position that is at a height of 1 m above the floor and no closer than 1 m from a wall or fixed object such as HVAC supply or return opening.</p> <p>d) An HVAC unit designed to provide climate control and ventilation for individual classrooms that conforms to the 35 dB hourly equivalent level requirements of <i>ANSI/ASA S12.60 Part 2</i> shall be considered to conform to the requirements of <i>ANSI/ASA S12.60 Part 1</i>.</p>			

Beyond the above requirements, *ANSI S12.60* also has requirements from the tonal sounds generated from building utilities (e.g. ballast noise). Any tonal sounds from lighting ballasts need to be quantified using the methods in *ANSI/ASA S1.13-2005* ensuring no “prominent discrete tones.” A prominent discrete tone can be defined as a sound (often perceived as a whine or hum) that can be heard distinctly as a single pitch or a set of pitches. Technically, a prominent discrete tone exists if the one-third octave band sound pressure level in the band with the tone exceeds the arithmetic average of the sound pressure levels of the 2 contiguous one-third octave bands by:

- 5 dB for center frequencies of 500 Hz and above
- 8 dB for center frequencies between 160 and 400 Hz
- 15 dB for center frequencies less than or equal to 125 Hz

For compliance with sub-criteria 3.7.5.2.5.1, cut sheets should be provided during the Design Review for all ballasts specified on the project showing the manufacturer’s sound rating. A narrative should be provided, justifying areas with ballasts rated lower than “A.”

For compliance with sub-criteria 3.7.5.2.5.2, calculations should be performed by an Acoustical Consultant or Acoustician for all relevant building systems (HVAC, lighting, etc.) sources and paths or testing shall be required for each learning space (or other acoustically sensitive) to ensure that the requirements of Table 3.7.5.2.5: *ANSI/ASA S12.60-2010 Noise Limits* above are met. The testing shall also include provisions for measuring tonal sounds emitted by electrical equipment and lighting fixtures. Annex A of *ANSI S12.60-2010* outlines how to verify the conformance to the standard by field measurements and so should be referenced in the project’s specifications. These test results should be submitted to the Assessor prior to the Onsite Assessment for review.

Additional strategies to mitigate the noise from the electrical system include:

- Transformers often emit strong tonal noise and vibration characteristics. Identify location of transformers and hang with isolation hangers or mount resiliently. Ensure the feeder enters at the top or side to avoid transmitting vibration to structure.
- If dimmers are to be employed, use sine-wave dimmers or specify dimmers with high 'rise-times' to avoid having the filaments and fixtures 'sing' when partly loaded.
- Conduit penetrations at equipment rooms and other noisy spaces should be sealed to the same standard of care and detail as piping and ductwork.

The assessor may also request sound level measurements taken at the property line; description of acoustic design strategies and all design targets; FIIC value for flooring assemblies; acoustic mitigation measures for mechanical equipment and plumbing systems; specification which includes Annex E of *ANSI S12.60-2010/Part 1*; and Test Report indicating compliance with *ANSI S12.60-2010/Part 1*.

## Appendix A: LIST OF REFERENCES

The following is an alphabetical list of References recommended within this Technical Reference Manual. Click on the criteria number to link back to the corresponding subsection heading within the manual (references with website links listed at end of Appendix A).

- **AAMA 508-07:**
  - [Criteria 3.5.9.2.2](#)
- **AAMA/WDMA/CSA 101/I.S.2/A440-08:**
  - [Criteria 3.5.7.3.1](#)
- **ACI 302.1R:**
  - [Criteria 3.5.8.1.1](#)
- **ACI 302.2R-06:**
  - [Criteria 3.5.8.1.1](#)
- **ACI 360R:**
  - [Criteria 3.5.8.1.1](#)
- **American Concrete Institute 302.2R-06:**
  - [Criteria 3.5.8.1.1](#)
- **American Tree Farm System® (ATFS): 2010-2015:**
  - [Section 3.5.1.2 \(Path B: Prescriptive Path for Building Core and Shell\)](#)
  - [Section 3.5.2.2 \(Path B: Prescriptive Path for Interior Fit-outs\)](#)
- **ANSI A112.26.1:**
  - [Criteria 3.7.5.2.4](#)
- **ANSI A138.1:**
  - [Section 3.5.2.2 \(Path B: Prescriptive Path for Interior Fit-outs\)](#)
- **ANSI/ASA S12.60-2010/Part 1:**
  - [Criteria 3.7.5.1.1](#)
  - [Criteria 3.7.5.1.5](#)
  - [Criteria 3.7.5.2.2](#)
  - [Criteria 3.7.5.2.5](#)
- **ANSI/ASHRAE Standard 15-2010:**
  - [Criteria 3.6.2.4.2](#)
  - [Criteria 3.6.2.4.3](#)
- **ANSI/ASHRAE Standard 55-2004**
  - [Criteria 3.7.4.2.1](#)
- **ANSI/ASHRAE Standard 55-2010**
  - [Criteria 3.1.1.2.1](#)
  - [Criteria 3.7.4.2.1](#)
- **ANSI/ASHRAE Standard 62.1-2007:**
  - [Criteria 3.7.1.1.1](#)
  - [Criteria 3.7.1.1.2](#)
  - [Criteria 3.7.2.3.1](#)
  - [Criteria 3.7.2.7.1](#)
- **ANSI/ASHRAE Standard 62.1-2010:**
  - [Criteria 3.1.3.4.1](#)
  - [Criteria 3.7.1.1.1](#)

- [Criteria 3.7.1.1.2](#)
- [Section 3.7.1.2.1 \(Path A: Mechanical Ventilation Only\)](#)
- [Section 3.7.1.2.2 \(Path B: Natural Ventilation Only\)](#)
- [Section 3.7.1.2.3. 1 \(Path C: Combination of Mechanical & Natural Ventilation\)](#)
- [Criteria 3.7.1.2.3.2 \(Path C: Combination of Mechanical & Natural Ventilation\)](#)
- [Criteria 3.7.1.3.1](#)
- [Criteria 3.7.2.2.1](#)
- **ANSI/ASHRAE Standard 160-2009:**
  - [Criteria 3.7.2.2.1](#)
  - [Criteria 3.7.2.7.1](#)
- **ANSI/ASHRAE/ASHE Standard 170-2008:**
  - [Criteria 3.7.1.1.2](#)
- **ANSI/ASHRAE/IES Standard 90.1-2007:**
  - [Criteria 3.3.6.2.2](#)
  - [Criteria 3.3.6.4.1](#)
  - [Criteria 3.3.6.5.1](#)
  - [Criteria 3.3.6.8.1](#)
- **ANSI/ASHRAE/IES Standard 90.1-2010:**
  - [Section 3.3.1.1.1 \(Path A: ENERGY STAR® Target Finder\)](#)
  - [Section 3.3.1.1.2 \(Path B: ANSI/ASHRAE/IES STANDARD 90.1-2010, Appendix\)](#)
  - [Section 3.3.1.1.3 \(Path C: ANSI/GBI 01-2010 Energy Performance Building Carbon Dioxide Equivalent Emissions\)](#)
  - [Criteria 3.3.2.1.1](#)
  - [Criteria 3.3.4.1.1](#)
  - [Criteria 3.3.5.1.1](#)
  - [Criteria 3.3.5.4.2](#)
  - [Criteria 3.3.6.2.1](#)
  - [Criteria 3.3.6.2.2](#)
  - [Criteria 3.3.6.4.1](#)
  - [Criteria 3.3.6.5.1](#)
  - [Criteria 3.3.6.8.1](#)
- **ANSI/ASHRAE/USGBC/IES Standard 189.1-2009**
  - [Criteria 3.5.5.1](#)
- **ANSI/ASHRAE/USGBC/IES Standard 189.1-2011**
  - [Criteria 3.1.1.1.1](#)
  - [Criteria 3.1.1.2.1](#)
  - [Criteria 3.1.1.3.1](#)
- **ANSI/ASHRAE/IES/USGBC Standard 189.1-2014**
  - [Criteria 3.1.1.1.1](#)
  - [Criteria 3.1.1.2.1](#)
  - [Criteria 3.1.1.3.1](#)
- **ANSI/BIFMA e3-2014e:**
  - [Section 3.5.2.2 \(Path B: Prescriptive Path for Interior Fit-outs\)](#)
- **ANSI/GBI 01-2010:**
  - [Section 3.3.1.1.3 \(Path C: ANSI/GBI 01-2010 Energy Performance Building Carbon Dioxide Equivalent Emissions\)](#)
  - [Criteria 3.3.2.2.1](#)
- **ANSI/NSC 373:**
  - [Section 3.5.2.2 \(Path B: Prescriptive Path for Interior Fit-outs\)](#)
- **ASA/ INCE/ NCAC:**

- [Criteria 3.7.5.2.1](#)
  - [Criteria 3.7.5.2.2](#)
- **ASHRAE Fundamentals Handbook:**
  - [Criteria 3.3.2.1.1](#)
  - [Criteria 3.5.9.1.2](#)
  - [Criteria 3.5.9.1.3](#)
- **ASHRAE Guideline 4:**
  - [Criteria 3.3.2.1.4](#)
- **ASHRAE Guideline 0-2005:**
  - [Criteria 3.1.3.1.1](#)
  - [Criteria 3.1.3.1.2](#)
  - [Criteria 3.1.3.1.3](#)
  - [Criteria 3.1.3.2.1](#)
  - [Criteria 3.1.3.2.3](#)
  - [Criteria 3.1.3.3.1](#)
  - [Criteria 3.5.7.2.1](#)
  - [Criteria 3.5.7.3.1](#)
  - [Criteria 3.5.8.1.1](#)
  - [Criteria 3.5.8.2.1](#)
  - [Criteria 3.5.9.1.2](#)
  - [Criteria 3.5.9.1.3](#)
- **ASHRAE Guideline 12-2000:**
  - [Criteria 3.5.7.2.1](#)
  - [Criteria 3.7.2.6.1](#)
- **ASHRAE Standard 129-1997 (RA 2002):** :
  - [Section 3.7.1.2.1 \(Path A: Mechanical Ventilation Only\)](#)
  - [Section 3.7.1.2.3 \(Path C: Combination of Mechanical & Natural Ventilation\)](#)
- **ASHRAE Standard 202-2013:**
  - [Criteria 3.1.3.1.1](#)
  - [Criteria 3.1.3.1.2](#)
  - [Criteria 3.1.3.1.3](#)
  - [Criteria 3.1.3.2.1](#)
  - [Criteria 3.1.3.2.3](#)
  - [Criteria 3.1.3.3.1](#)
  - [Criteria 3.5.7.2.1](#)
  - [Criteria 3.5.7.3.1](#)
  - [Criteria 3.5.8.1.1](#)
  - [Criteria 3.5.8.2.1](#)
  - [Criteria 3.5.9.1.2](#)
  - [Criteria 3.5.9.1.3](#)
- **ASHRAE Systems Application Handbook:**
  - [Criteria 3.5.7.2.1](#)
  - [Criteria 3.7.5.2.2](#)
- **ASME A17.1-2007:**
  - [Criteria 3.3.8.1.2](#)
- **ASTM D523-08:**
  - [Criteria 3.7.2.1.3](#)
- **ASTM D6886-03:**



- [Criteria 3.7.2.1.3](#)
- ASTM D5957 – 98 (05):
  - [Criteria 3.5.8.2.1](#)
- ASTM E283-04(2012):
  - [Criteria 3.5.9.2.2](#)
- ASTM E283-84 :
  - [Criteria 3.5.7.3.1](#)
- ASTM E90-2004:
  - [Criteria 3.7.5.2.2](#)
- ASTM E1686-03:
  - [Criteria 3.7.5.2.2](#)
- ASTM E330/E330M-14:
  - [Criteria 3.5.9.2.2](#)
- ASTM E331-00(2009):
  - [Criteria 3.5.9.2.2](#)
- ASTM E336-07:
  - [Criteria 3.1.3.3.1](#)
  - [Criteria 3.7.5.2.2](#)
- ASTM E413-04:
  - [Criteria 3.1.3.3.1](#)
  - [Criteria 3.7.5.2.2](#)
- ASTM E779-03:
  - [Criteria 3.5.10.1.2](#)
- ASTM E989-06:
  - [Criteria 3.7.5.1.4](#)
  - [Criteria 3.7.5.2.1](#)
- ASTM E966-04 :
  - [Criteria 3.7.5.2.2](#)
- ASTM E1105-2000:
  - [Criteria 3.5.7.3.1](#)
- ASTM E1332-90 (2003):
  - [Criteria 3.7.5.2.2](#)
- ASTM E1374-06:
  - [Criteria 3.7.5.1.2](#)
  - [Criteria 3.7.5.2.2](#)
- ASTM E1677-11:
  - [Criteria 3.5.10.1.2](#)
- ASTM E1692-95a (2012):
  - [Criteria 3.5.6.3.1](#)
- ASTM E1745-11:
  - [Criteria 3.5.8.1.1](#)
- ASTM E1980-11:
  - [Criteria 3.2.2.4.4](#)
- ASTM E2112-07:
  - [Criteria 3.5.7.3.1](#)

- ASTM E2178-11:
  - [Criteria 3.5.10.1.2](#)
- ASTM E2357-11:
  - [Criteria 3.5.10.1.2](#)
- ASTM E2400-06:
  - [Criteria 3.2.2.4.1](#)
- ASTM F2323-03:
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## Appendix B: ABBREVIATIONS AND ACRONYMS

The following is a list of abbreviations and acronyms found throughout this Technical Manual along with their entire word, phrase, or name.

**25-year, 24-hour storm event:** means the maximum 24-hour precipitation event with a probable recurrence interval of once in 25 years, as defined by the National Weather Service.

**AAMA:** American Architectural Manufacturers Association.

**ACI:** American Concrete Institute.

**AGC:** Associated General Contractors of America.

**ARMA:** Asphalt Roofing Manufacturers Association.

**ASHRAE:** American Society of Heating, Refrigerating and Air-Conditioning Engineers.

**ASTM:** ASTM International.

**ATFS:** American Tree Farm System.

**BUG:** Backlight-Uplight-Glare rating system.

**CAS:** Chemical Abstracts Service.

**CBECs:** Commercial Building Energy Consumption Survey. Developed by the United States Department of Energy's Energy Information Administration (EIA).

**CO2e:** *Carbon Dioxide Equivalent* Emissions Rate.

**EMS:** Environmental Management System.

**EPA:** Environmental Protection Agency.

**EVO:** Efficiency Valuation Organization.

**FYN:** Florida Yards and Neighborhoods Program/University of Florida –IFAS Extension.

**GDDC:** Green Design and Delivery Coordination.

**HVAC&R:** heating, ventilating, air-conditioning, and refrigerating.

**IAPMO:** International Association of Plumbing and Mechanical Officials.

**ICC:** International Code Council®.

**IDA:** International Dark-Sky Association.

**IES:** Illuminating Engineering Society.

**IESNA:** Illuminating Engineering Society of North America.

**ISO:** International Organization for Standardization.

**LCA:** life cycle assessment.

**MERV:** Minimum Efficiency Reporting Value.

**MLO:** Model Lighting Ordinance.

**NEMA:** National Electrical Manufacturers Association.

**NIBS:** National Institute of Building Sciences.

**NIST:** National Institute of Standards and Technology.

**NOX:** nitrogen oxide, produced by the burning of fossil fuels.

**NREL:** National Renewable Energy Laboratory.

**PCI:** Pre-Cast/Prestressed Concrete Institute.

**PEFC:** Programme for Endorsement of Forest Certification.

**SCAQMD:** South Coast Air Quality Management District.

**SMACNA:** Sheet Metal and Air Conditioning Contractors' National Association.

**SPRI:** Single Ply Roofing Institute.

**TPZ:** Tree Protection Zone.

**ULSD:** Ultra Low Sulfur Diesel.

**USDA:** United States Department of Agriculture.

**VOC:** Volatile Organic Compounds.

**WBDG:** Whole Building Design Guide.

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