Assessment Tool

2009 Edition Criteria

FOR
NEW CONSTRUCTION
MAJOR MODERNIZATIONS

MASSACHUSETTS
COLLABORATIVE FOR
HIGH PERFORMANCE
SCHOOLS

CHPS

Better buildings. Better students.

Overview

Disclaimer

IMPORTANT NOTICE TO THE READER: This publication is designed to provide accurate and authoritative information with regard to the subject matter covered. It is distributed with the understanding that local, state and federal laws, regulations and requirements will vary based on the particular circumstances such as building characteristics, geographic region and similar factors. It is also distributed with the understanding the publisher is not engaged in rendering engineering, architectural, legal, or other professional advice or service. The publisher and its participants, officers, directors, employees, contractors and affiliates cannot be responsible for errors or omissions, or any material set forth or referenced in this publication. If professional advice or other expert assistance is required, the services of a competent advisor familiar with the law, regulation, practices and circumstances of the project should be sought.

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Collaborative for High Performance Schools

The Collaborative for High Performance Schools (CHPS®) began in November 1999, when the California Energy Commission called together Pacific Gas and Electric Company, San Diego Gas and Electric, and Southern California Edison to discuss the best way to improve the performance of California's schools. Out of this partnership, CHPS grew to include a diverse range of government agencies, utility companies, school districts, non-profit organizations and private companies, all with a unifying goal: to improve the quality of educational facilities for California's children. With the successful launch of the Best Practices Manual in 2001, interest in high performance design grew, and CHPS expanded its focus beyond California, developing a national version of the manuals as well as other state-specific versions in Massachusetts, Washington, New York, Maine, Vermont, Connecticut, New Hampshire, Rhode Island, Colorado and Texas. In early 2002, CHPS incorporated as a non-profit organization, and today is a national organization committed to building a new generation of healthy, efficient, environmentally responsive schools for all school children. CHPS offers technical resources and databases, training and education, membership, verification and recognition.

CHPS Technical Resource Oversight

A state adaptation of the CHPS Criteria, including Massachusetts CHPS (known as MA-CHPS), is developed and revised with oversight from four bodies.

- CHPS Board of Directors. The CHPS Board of Directors is responsible for ensuring the state adaptation is a credible and reliable resource that is acceptable to be released for use by the public.
- CHPS National Technical Committee. The CHPS National Technical Committee is responsible for ensuring the technical rigor, cohesion and consistency to the extent possible with other state adaptations
- State Advisory Committee. The State Advisory Committee is responsible for ensuring that the Criteria is representative of the unique needs, climates, policies, codes, requirements, and natural resources in a given sate.
- Public. The public, or all stakeholders in the school design, construction and operation industry, is responsible to participate in public reviews to the extent possible to ensure the Criteria is a comprehensive, usable and valuable resource.

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Acknowledgements

The 2009 version of the MA-CHPS Criteria marks a timely update and improvement to the Criteria and a significant transition for the MA-CHPS high performance school verification system. Beginning January 1, 2010, the MA-CHPS system is administered entirely by CHPS instead of by the Massachusetts Clean Energy Center (MCEC) in collaboration with the Massachusetts School Building Authority (MSBA). CHPS wishes to thank MCEC and MSBA for their immense contributions to the MA-CHPS system and for their continuing support for high performance green schools. CHPS, MCEC and MSBA jointly thank the following staff members and consultants for their countless hours in putting together the update:

- Elisabeth Krautscheid (MCEC)
- Christie Howe (MCEC)
- Sara Jayanthi (MCEC)
- Andrea Ranger (KEMA Services Inc.)
- Bill Orr (CHPS)
- Kristin Parineh (CHPS)
- Ed Wansing (CHPS)
- Karl Brown (MSBA)

A number of individuals contributed significant expertise and insight to the Criteria and/or application template:

- Joseph Buckley (MSBA)
- Mary Pichetti (MSBA)
- David Korn (The Cadmus Group, Inc.)
- M. Magda Lelek (Andelman and Lelek Engineering, Inc.)
- Joel Travis (Andelman and Lelek Engineering, Inc.)
- Martine Dion (Symmes, Maini, and McKee Associates)
- Elizabeth Cordero (Green Building Consulting)
- Carolyn Sarno (Northeast Energy Efficiency Partnerships)
- Isaac Elnecave (formerly of Northeast Energy Efficiency Partnerships)
- Ian Finlayson (Executive Office of Energy & Environmental Affairs)
- Glenn Heinmiller (Lam Partners, Inc.)
- Sandra Brock (Nitsch Engineering Inc.)
- Stephen Benz (Sasaki Sustainable Solutions)
- Chin Lin (HMFH Architects, Inc.)
- Colleen Soden (The Green Roundtable)
- Phoebe Beierle (The Green Roundtable)
- Price Jepsen (STV)

Many thanks to all who participated in the public comment periods or otherwise lent support and guidance:

- David Bearg (Life Energy Associates)
- Richard Blanchet (Massachusetts Department of Environmental Protection)
- Paul Brown (Drummy Rosane Anderson, Inc.)
- Arnel Catalan (Mount Vernon Group Architects)
- Amy Costello (Armstrong World Industries)
- Joseph da Silva, dCS
- Carolyn Highlands (Symmes, Maini, and McKee Associates)

Overview

- Jenna Ide (Massachusetts Division of Capital Asset Management)
- Josh Jacobs (GREENGUARD Environmental Institute)
- Meg Lusardi (Massachusetts Department of Energy Resources)
- Gil Martin (RDK Engineers, Inc.)
- Maria McDonnell (RDK Engineers, Inc.)
- Marc McMillan (Finelite, Inc.)
- Chris Schaffner (The Green Engineer)
- Prisco Tammaro (RDK Engineers, Inc.)

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Overview

MA-CHPS Criteria

The Commonwealth of Massachusetts recognizes the increasing demands on financial and natural resources to support the renovation and construction of its public schools. Therefore, the Commonwealth, with CHPS, has embarked on a program to encourage the design and construction of schools known as "high performance, green schools" to ease the energy, water, materials, and financial burden of building educational facilities for students.

The MA-CHPS Criteria explicitly defines a high performance school. The MA-CHPS Criteria was developed to take advantage of New England climates, school needs, state codes and regulations, and environmental priorities of the region by Massachusetts stakeholders. When first published in 2001, in California, the MA-CHPS Criteria established the nation's first building rating program created to specifically facilitate the design of school learning environments that are healthy, comfortable, energy, resource, and water efficient, safe, secure, adaptable, and easy to operate and maintain. The MA-CHPS Criteria was first published in 2006 and will be updated every three years to take advantage of the latest strategies and tools for high performance schools.

Schools that meet the MA-CHPS Criteria are environmentally sustainable and healthy places of learning that demonstrate that while high performance technologies may be new, they need not be complicated, expensive or unreliable. CHPS schools are saving their school districts money through energy and water utility savings and increasing occupant health and productivity. Quite simply, a CHPS school belongs to the next generation of schools.

A high performance green school is designed to optimize the durability of the facility and to utilize high efficiency, "right sized" heating, ventilating, and air conditioning equipment and lighting systems. Where possible, glare-free daylight is brought into the school to enhance the learning environment. The building shell integrates the most effective combination of insulation, glazing, and thermal mass to ensure energy efficiency, and plumbing fixtures are specified to reduce water consumption. Together, these measures significantly reduce the operational costs of running the school building. It is reasonable to assume a 20%-40% cost savings in utility bills versus a non-green building of the same size and shape.

A high performance green school is thermally, visually, and acoustically comfortable. Thermal comfort means that teachers, students and administrators should neither be hot nor cold as they teach and learn. Visual comfort means that the quality of lighting makes visual tasks, such as reading and following classroom presentations, easier. Acoustic comfort is achieved when students and teachers can hear each other and are not impeded by loud ventilation systems or noise from adjoining spaces.

High quality indoor air is another important feature of a green school. Air intakes are located away from potential sources of contamination and ventilation systems are designed to optimize fresh air. Architects and engineers incorporate best design practices to prevent water intrusion into wall and roof assemblies. This, in turn, prevents the accumulation of moisture in materials that could support mold growth or lead to premature replacement of indoor finishes and even structural elements.

A high performance green school has an environmentally responsive site**.** To the extent possible, the school's site conserves existing natural areas and incorporates them into the curriculum. Stormwater runoff is minimized and/or captured on site for irrigation or flushing water closets. The site is accessible to bicycle and pedestrian traffic and is conveniently located for community activities.

While operational savings, environmental stewardship, and community-building are attractive benefits, it is important to emphasize that, above all, a high performance green school provides an environment that enhances the primary mission of public schools: education of future citizens.

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The Criteria is also useful as a goal-setting and planning tool. Districts can use it to simply and clearly communicate their design goals to project managers, architects, engineers, construction managers and contractors. At the same time, the Criteria's flexibility allows designers to deliver a CHPS school while managing the regional, district, and site-specific constraints of the school design. The Criteria is also intended for use as the basis for incentive funding.

Throughout this document references are made to Massachusetts Climate Zones 5. CHPS is defining the Massachusetts climate zone in accordance with the American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) *Advanced Energy Design Guide for K-12 Schools*. ASHRAE standards are used frequently throughout the CHPS Criteria.

Traditionally adaptations of the CHPS Criteria include prerequisites for construction pollution prevention, environmental site assessments and prohibition of tobacco use on school sites, however since these policies are already enforced at the state level they have been left out of the MA-CHPS Criteria.

MA-CHPS Criteria and Massachusetts School Building Authority

The Massachusetts School Building Authority (MSBA) is authorized to grant an additional reimbursement incentive for a public school construction project that achieves certain high performance school thresholds. MA-CHPS schools may be eligible for reimbursement that utilize the MA-CHPS Verified program. Contact the MSBA to determine if your project is eligible to receive funding.

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Criteria Organization

The Criteria are provided as a benchmark for green school buildings. This document is divided into three categories: Strategy, Design, and Performance, and seven sections: Integration & Innovation (II), Indoor Environmental Quality (EQ), Energy (EE), Water (WE), Site (SS), Materials and Waste Management (MW), and Operations & Maintenance (OM). Each section has both prerequisites and optional credits. Points are assigned to each credit. Prerequisites are required for all CHPS projects before any points may be obtained, except for major renovations and new buildings on existing campuses, in which compliance with prerequisites varies based on the scope of the project.

Table 1, offers an example of how the prerequisites and credits are organized. In Table 1, *Design* is the main category and *Site* is the section. There is a prerequisite, *SS.P1 Joint Use of Facilities and Parks* (prerequisites are all denoted with a "P"), which has one requirement *SS.P1.1*. There is also one credit, *SS.C1: Sustainable Site Selection*, which has four possible requirements for points, SS.C1.1, SS.C1.2, SS.C1.3, SS.C1.4. Compliance with the requirements under SC.1 would achieve a CHPS project one to four points in this example.

Table 1– Volume Organization Example

Category	Section	Credit/Prerequisite	Requirements	Points
Design	Site	SP.1: Joint use of Facilities and Parks	SP.1.1	P
		SC.1: Sustainable Site Selection	SC.1.1	5
			SC.1.2	
			SC.1.3	
			SC.1.4	

Finally, under each prerequisite and credit there is helpful guidance, examples, calculations and documentation procedures for meeting each prerequisite or credit. The applicability section offers guidance on appropriate use of the prerequisite or credit based on the project type. The resources section lists resources, websites, and alternate publications and websites that may offer additional information or support for compliance.

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Recognition as a MA-CHPS Verified School

A district or school may choose to be recognized for compliance with the MA-CHPS Criteria through the CHPS Verified program. CHPS Verified offers projects the ability to be independently, 3rd-party reviewed. CHPS realizes that school districts are constantly faced with multiple challenges with student population growth, demand for improved student performance, and social and financial constraints and tries to address these through its recognition program. MA-CHPS projects can be recognized under the CHPS Verified process.CHPS Verified combines project management, the MA-CHPS Criteria, and a third-party assessment to ensure that the school project is designed and built to the highest performance standards. A school that is recognized as CHPS Verified is healthier, more environmentally efficient and cost-saving, and has been verified by an independent, third-party to be so. Participation in this program will help ensure that the school project has the required high performance features to realize all the benefits associated with high performance schools, including improved student and worker health, increased productivity and student performance, decreased operating costs through energy and resource savings, and reduced environmental impact. CHPS Verified helps design teams manage the design and documentation process with tools for project oversight, plan review and other resources. The Verification Program User Guide is available online and outlines design and construction review requirements and what each registered project will receive. CHPS Verified is ideal for school districts or design teams seeking to verify their project's performance. Participation will give design teams access to project management tools, and will assist in obtaining incentive funding. Accountability will rest not only on the school district and design team but also on CHPS and an assigned independent reviewer. More information on CHPS Verified, how to register, programs, costs, processes and documentation requirements are outlined in the CHPS Verified User Guide available for free download on the CHPS website:. http://www.betterbuildingsbetterstudents.org/dev/Drupal/node/43

Eligibility Levels

There are 127 total points possible for the following project types in Massachusetts:

- New school construction (including new buildings on an existing campus)
- Renovations (with or without additions to existing buildings)

Repair projects (i.e. those that involve only replacement of finishes or equipment) do not qualify for MA-CHPS recognition. It is recommended that the school district use CHPS best practices where appropriate with the intent that over time, through a series of improvements, the school will achieve essentially the same higher performance building as if it had been designed that way. Existing schools can also utilize the CHPS Operational Report Card (ORC). The ORC is a new program that benchmarks the current performance of existing schools, provide a report card of results and make suggestions for improvement.

New School Construction (including new buildings on an existing campus)

There are two levels in which a new school may qualify as a high performance school.

A new school may be recognized as MA-CHPS Verified if it meets all of the prerequisites and earns at least 40 points, with a minimum of 2 points from the Energy (EE) category, and no more than 4 points from the Integration and Innovation (II) category. A project may earn more than 4 points from the Integration and Innovation (II) category once it has reached the 40 point minimum. For example, a project that earns 40 points can only receive 4 of them from Integration and Innovation (II) category, however a project that earns

50 points can earn as many as 14. The more credits a building earns, the better it is, but the MA-CHPS Criteria is a pass/fail system requiring a minimum score of 40.

A new school may be recognized as a MA-CHPS Verified Leader, a higher level of recognition for school projects that perform well beyond minimum eligibility requirements. MA-CHPS Verified Leaders should be MA-CHPS Verified, and have inspirational designs that incorporate their high performance features into architectural expression. The school should be an image of environmental and social responsibility, and must be balanced in providing benefits to the environment, student health and student performance. A MA-CHPS Verified Leader must meet all of the prerequisites and earn at least 50 points. To ensure the school is balanced across high performance priorities the project must at minimum:

- Claim two (2) points in the Integration and Innovation (II) categories,
- Claim five (5) points in each of the Site (SS), Water (WE), Materials and Waste Management (ME) and Indoor Environmental Quality (EQ) categories,
- Claim ten (10) points in the Energy (EE) category, and

New replacement campuses are subject to "New School Construction" requirements. A replacement campus project is defined as the replacement of all buildings on an existing school site, with completely all new buildings.

Renovations (with or without additions to existing buildings)

Renovations are defined by a substantial improvement to a school in at least two of the following: lighting, HVAC, building envelope systems and/or interior surfaces. A substantial improvement is when more than half the system or surfaces are being replaced or upgraded.

There are two levels in which a renovation may qualify as a high performance school.

In order to qualify as a high performance school, a major renovation may be recognized as MA-CHPS Verified if it meets all of the prerequisites based on the scope of the project, and earns at least 35 points, with a minimum of 2 points from the Energy (EE) category, and no more than 4 points from the Integration and Innovation (II) category. A project may earn more than 4 points from the Integration and Innovation (II) category once it has reached the 35 point minimum. For example, a project that earns 35 points can only receive 4 of them from Integration and Innovation (II) category, however a project that earns 45 points can earn as many as 14. The more credits a building earns, the better it is, but the MA-CHPS Criteria is a pass/fail system requiring a minimum score of 35. The prerequisites required for major renovations are outlined in *Table 2. Prerequisite Applicability for Major Renovation Projects*.

A major renovation may be recognized as a MA-CHPS Verified Leader, a higher level of recognition for school projects that perform well beyond minimum eligibility requirements. MA-CHPS Verified Leaders should be MA-CHPS Verified, and have inspirational designs that incorporate their high performance features into architectural expression. The school should be an image of environmental and social responsibility, and must be balanced in providing benefits to the environment, student health and student performance. In order to be a MA-CHPS Verified Leader, a Renovation/Addition project must meet all of the prerequisites and earn at least 45 points. To ensure the school is balanced across high performance priorities the project must at minimum:

- Claim two (1) points in the Integration and Innovation (II) categories,
- Claim five (3) points in each of the Site (SS), Water (WE), Materials and Waste Management (ME) categories and Indoor Environmental Quality (EQ) category,

- Claim ten (7) points in the Energy (EE) category, and

Table 2 – Prerequisite Applicability for Major Renovation Projects

Prerequisite	Systems and Surfaces	Requirements
II.P1 Integrated Design		Always Required
II.P2 Educational Display		Always Required
EQ.P1 HVAC Design – ASHRAE 62.1	HVAC and Interior Surfaces	Required when both are substantially improved.
EQ.P2 Construction IAQ Management		Always Required
EQ.P3 Pollutant and Chemical Source Control		Always Required
EQ.P4 Moisture Management		Always Required
EQ.P5 Minimum Filtration	HVAC	Required only when HVAC is substantially improved.
EQ.P6 Thermal Comfort- ASHRAE 55	HVAC	Required only when HVAC is substantially improved.
EQ.P7 View Windows – 70%	Envelope	Required only when the envelope is substantially improved.
EQ.P8 Eliminate Glare	Envelope	Required only when the envelope is substantially improved.
EQ.P9 Minimum Acoustical Performance	HVAC and/or Interior Surfaces	Required when HVAC is substantially improved. Reverberation time only required when interior surfaces are included.
EQ.P10 Minimum Low-Emitting Materials	Interior Surfaces	Required only when interior surfaces are substantially improved.
EE.P1 Minimum Energy Performance, 20%		Always Required.
EE.P2 Commissioning		Always Required.
EE.P3 Facility Staff & Occupant Training		Always Required.
WE.P1 Irrigation System Performance on Recreational Fields		Required for outdoor water system improvements including plant replacement.
WE.P2 Indoor Water Use Reduction, 30-40%		Required for indoor water system improvements such as fixture or appliance replacement.
SS.P1 Joint-Use of Facilities and Parks		Always Required.
MW.P1 Storage and Collection of Recyclables	Interior Surfaces	Required only when interior surfaces are substantially improved.
MW.P2 Minimum Construction Site Waste Management, 75%		Always Required
OM.P1 Maintenance Plan		Always Required
OM.P2 Anit-Idling Measures		Always Required
OM.P3 Green Cleaning		Always Required

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Criteria Summary

CATGORY	ID	TITLE	TOTAL POSSIBLE POINTS	POINTS TARGETED
STRATEGY	**INTEGRATION & INNOVATION**		**11**	
	II.P1	Integrated Design	P	
	II.P2	Educational Display	P	
	II.C1	Demonstration Areas	1	
	II.C2	Innovation	1-4	
	II.C3	Life Cycle Cost Analysis	3	
	II.C4	School Garden	1	
	II.C5	School Master Plan	1	
DESIGN	**INDOOR ENVIRONMENTAL QUALITY**		**23**	
	EQ.P1	HVAC Design - ASHRAE 62.1	P	
	EQ.P2	Construction IAQ Management	P	
	EQ.P3	Pollutant and Chemical Source Control	P	
	EQ.P4	Moisture Management	P	
	EQ.P5	Minimum Filtration	P	
	EQ.P6	Thermal Comfort - ASHRAE 55	P	
	EQ.P7	View Windows, 70%	P	
	EQ.P8	Eliminate Glare	P	
	EQ.P9	Minimum Acoustical Performance	P	
	EQ.P10	Minimum Low Emitting Materials	P	
	EQ.C1	View Windows, 80 – 90%	1-2	
	EQ.C2	Daylighting in Classrooms	1-6	
	EQ.C3	Advanced Low-Emitting Materials	1-4	
	EQ.C4	Ducted Returns	1	
	EQ.C5	Enhanced Filtration	1	
	EQ.C6	Post-Construction IAQ	1	
	EQ.C7	Enhanced Acoustical Performance	1-4	
	EQ.C8	Controllability of Systems	1-2	
	EQ.C9	Duct Access & Cleaning	1	
	EQ.C10	Electric Lighting	1	

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DESIGN	**ENERGY**		**36**	
	EE.P1	Minimum Energy Performance, 20%	P	
	EE.P2	Commissioning	P	
	EE.P3	Facility Staff & Occupant Training	P	
	EE.C1(A)	Superior Energy Performance (Performance Approach)	2-15	
	EE.C1(B)	Superior Energy Performance (Prescriptive Approach)	2-4	
	EE.C2	Minimize Air Conditioning	1-3	
	EE.C3	Renewable Energy	1-12	
	EE.C4	Plug Load Reduction & ENERGY STAR Equipment	1	
	EE.C5	Energy Management System and Sub Metering	1-3	
	EE.C6	Flex Energy	1-2	
DESIGN	**WATER**		**16**	
	WE.P1	Irrigation System Performance on Recreational Fields	P	
	WE.P2	Indoor Water Use Reduction, 20%	P	
	WE.C1	Indoor Water Use Reduction, 30-50%	1-3	
	WE.C2	Reduce Potable Water Use for Sewage Conveyance	4	
	WE.C3	No Potable Water Use for Non-Recreational Landscaping Areas	3	
	WE.C4	Reduce Potable Water Use for Recreational Landscaping Areas	2	
	WE.C5	Irrigation System Commissioning	1	
	WE.C6	Water Management System	1-3	
DESIGN	**SITE**		**16**	
	SS.P1	Joint Use of Facilities and Parks	P	
	SS.C1	Sustainable Site Selection	1-5	
	SS.C2	Central Location / Smart Growth	1	
	SS/C3	Reduced Building Footprint	1	
	SS.C4	Building Layout & Microclimates	1	
	SS/C5	Public Transportation	1	
	SS.C6	Pedestrian/Bike/Human Powered Transportation	2	
	SS.C7	Parking Minimization	1	
	SS.C8	Post-Construction Stormwater Management	1	
	SS.C9	Reduce Heat Islands – Landscaping	1	
	SS.C10	Reduce Heat Islands – Cool Roofs	1	
	SS.C11	Light Pollution Reduction	1	

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DESIGN	**MATERIALS & WASTE MANAGEMENT**		**14**	
	MW.P1	Storage and Collection of Recyclables	P	
	MW.P2	Minimum Construction Site Waste Management, 75%	P	
	MW.C1	Minimum Construction Site Waste Management, 90%	1	
	MW.C2	Single Attribute - Recycled Content Materials	1-2	
	MW.C3	Single Attribute - Rapidly Renewable Materials	1	
	MW.C4	Single Attribute - Certified Wood	1	
	MW.C5	Single Attribute - Regional Materials	1-2	
	MW.C6	Material Reuse	1	
	MW.C7	Durable and Low Maintenance Flooring	1	
	MW.C8	Building Reuse – Exterior	1-4	
	MW.C9	Building Reuse – Interior	1	
PERFORMANCE	**OPERATIONS & MAINTENANCE**		**9**	
	OM.P1	Maintenance Plan	P	
	OM.P2	Anti-Idling Measures	P	
	OM.P3	Green Cleaning	P	
	OM.C1	Work Order and Maintenance Management System	1	
	OM.C2	Indoor Environmental Management Plan	1-3	
	OM.C3	Green Power	1	
	OM.C4	Climate Change Action: Diesel Bus Retrofit	1	
	OM.C5	Carbon Footprint Reporting	1	
	OM.C6	Energy Benchmarking	3	

TOTAL POINTS POSSIBLE **127**

II.P1: Integrated Design

Intent: Integrate high performance goals into district planning in early programming and in on-going decision-making to maximize system integration, and the associated efficiencies and benefits of high performance schools.

Integrated design is the consideration and design of all building systems and components together. It brings together the various disciplines involved in designing a building to develop and review their recommendations as a whole. It recognizes that each discipline's recommendations have an impact on other aspects of the building. For example, the HVAC system selection and design should take into consideration the building envelope and other building systems such as lighting and daylighting. A lack of teamwork can result in oversized systems or systems that are optimized for non-typical conditions. Integrated design allows professionals working in various disciplines to take advantage of efficiencies that are not apparent when they work in isolation. The earlier the integration is introduced into the design process, the greater the benefit.

Requirement

Prerequisite	II.P1.1	Conduct a minimum of two integrated design team workshops that identify the project's high performance goals, ensure the incorporation of all MA-CHPS prerequisites, and target the appropriate MA-CHPS best practices and credits as an ongoing part of programming and design decision making. The outcome shall be a plan of how each prerequisite and credit will be implemented, the person responsible, and a timeline of key deliverables or implementation procedures. The first meeting must take place at the beginning of the schematic design phase (and preferably in the programming phase), and the second must occur prior to the beginning of construction drawings. Attendees must include all individuals that have influence on a MA-CHPS credit or prerequisite: • Owner Representatives – Required: Owner's Project Manager, District or School Capital Project Staff, Commissioning Agent (if under contract); Recommended: School Facility Manager, School Board Representative and Superintendent or Designee, Strongly Recommended: Utility Representative (to ensure project is enrolled in appropriate incentive programs). • All Design Consultants – Required (if under contract): Architect, Interior Designers, Engineers (Mechanical, Electrical, Plumbing and Civil), Food Service, Acoustic and Energy Consultants, Lighting Designer, and Landscape Architect. • Construction Representatives – Required: General Contractor (if under contract) and Major Subcontractors (if under contract). • School Occupants Representatives – Recommended: Principal, Students, Teacher Representative(s), Parent Representative(s), Operations Staff, and Community Members

Implementation

Submit the agenda, attendee list and meeting minutes, for each integrated design team meeting. The meeting minutes shall include high performance project goals, implementation procedures, topics needing further investigation or research, and team members responsible for each prerequisite and targeted credit.

The CHPS Verified Application Templates and/or Scorecard are efficient tools to record the results. In addition, if time and resources allow, software programs are becoming available that can be used during the meetings to provide immediate feedback on the feasibility of the strategies being considered.

Keep in mind that although a high performance integrated design team meeting is an important first step in achieving the benefits of high performance schools, a collaborative team process should be carried out through continual interdisciplinary dialogue all the way through the completion of construction and into post-occupancy. In addition, although only two integrated design meetings are required, depending on the district's and team's level of high performance schools knowledge and experience, and/or the complexity of the project, more meetings may be required to ensure optimum results.

Applicability

Integrated design can, and should be incorporated into any project planning.

Resources

CHPS Best Practices Manual, Volume II: Integrated Design.

U.S. Department of Energy Office of Renewable Energy and Energy Efficiency. Integrated Building Design: http://www.eere.energy.gov/buildings/info/design/integratedbuilding/

ANSI/MTS 1.0 Whole Systems Integrated Process Guide (WSIP)-2007 for Sustainable Buildings & Communities ©

II.P2: Educational Display

Intent: Increase the school community's knowledge about the basics of high performance design using an educational display to serve as a three-dimensional textbook.

Recognizing that the school itself can serve as a learning tool, students and staff can benefit by having an educational display to illustrate the environmentally sustainable, efficient, healthy design of the school.

Requirement

Prerequisite	II.P2.1	Provide a permanent display on the school site that describes the high performance features that are part of the school's design.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

Provide a labeled site plan showing the location of the display. The permanent educational display must be located in a prominent location at the school. The display shall include a list of all MA-CHPS features with a statement of the intent, and an explanation of each high performance feature. Visual aids or drawings can be used to illustrate features as needed. Include a map of the school and grounds pointing to location(s) where demonstration areas of the sustainable features can be seen. The display may be electronic and interactive, but must be physically present at the school site and dedicated for this purpose. It may not be a virtual display only accessible via computer, unless that computer is permanently located as described above. It is recommended that it is designed so that it can be updated periodically.

Schools are encouraged, but not required, to develop curriculum and dedicate instructional hours for green school education. Schools that do this may consider applying for an innovation credit.

Applicability

This prerequisite applies to all project types.

Resources

The Education and the Environment Initiative:http://www.calepa.ca.gov/education/eei

II.C1: Demonstration Areas

Intent: Provide students, teachers and staff with more in-depth knowledge for each aspect of high performance design on their school site, including sustainable sites, water conservation, energy and material efficiency, and indoor environmental quality.

High performance features offer excellent opportunities to teach students about the specific ideas and technologies incorporated into the school. Demonstrating these features in the architecture of the school provides a hands-on experience for students, teachers and staff.

Requirement

1 point	II.C1.1 Create demonstration areas for three out of the five major high performance categories of the MA-CHPS Criteria: Site, Water, Energy, Materials and Waste Management, and Indoor Environmental Quality. Within these demonstration sites at least one feature of a high performance category must be showcased. Each demonstration area must explain how the high performance features work, its environmental and economic benefits, and how it exemplifies a holistic and integrated approach to sustainable design.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

Provide a labeled site plan showing the location of the demonstration areas. Create demonstration areas for three out of the five major high performance categories in MA-CHPS Criteria. Each demonstration area will showcase a minimum of one feature included in a high performance category. This feature will have been utilized in the design of the new school, new building, or renovation project. The design of the demonstration areas may include, but are not limited to, signage, kiosks, cut-always, meters, graphic illustrations, artistic murals, videos, real-time displays, or other design elements. For example, a demonstration area could be a meter of resource flows/usage, or a visual display of electrical generation provided by the photovoltaics. The display may be electronic and interactive, but must be physically present at the school site and dedicated for this function. It may not be a virtual display only accessible via computer, unless that computer is permanently located as described above.

Schools are encouraged, but not required, to develop curriculum and dedicate instructional hours for green school education. Schools that do this may consider applying for an innovation credit.

Applicability

This credit applies to all project types.

Resources

Real Goods Solar Living Center, Hopland, CA: http://www.solarliving.org/design.cfm

School Diversion and Environmental Education Law (DEEL)

II.C2: Innovation

Intent: Test, understand and implement innovative approaches to improving the health of school occupants and the performance of school facilities.

The purpose of this credit is to allow school project teams to be creative and to take advantage of and/or test new technologies or strategies for improving the health and performance of students, schools and the environment. The innovation may take an existing MA-CHPS credit to a new height, or take a direction not offered by MA-CHPS.

The following may be considered for innovation points under MA-CHPS, however are not guaranteed:

- Performance beyond that awarded in existing MA-CHPS credits or prerequisites such as the minimum ASHRAE standard for ventilation
- Concepts that significantly ease implementation of a credit defined in the MA-CHPS Criteria for Performance and Operation of Existing Schools
- Innovative strategies or technologies such as displacement ventilation
- School programs with high performance benefits
- Master plans which incorporate high performance elements
- Providing Indoor Air Quality (IAQ) testing and benchmarking during school operation

Requirement

1-4 points	II.C2.1	The innovation credit offers an opportunity to earn points that further the spirit of the MA-CHPS requirements. These points can reward highly innovative or creative actions or measures that are not already contained in MA-CHPS. **OR** The innovation credit can reward exceptional performance in an existing credit area through submission of a narrative explaining how the credit was exceeded by a significant amount.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

The point value of the credit will be determined through the MA-CHPS Verified review process. Points will be awarded based on the technology's or strategy's ability to:

- Improve the health and performance of students and staff.
- Improve the performance and efficiency of school facilities, or operation of those facilities.
- Improve the natural environment.

The MA-CHPS Criteria are designed to be a comprehensive guide to high performance green design, but as new technologies and creative designs evolve, there is a need to support and encourage them. These credits are also offered for communities that go beyond what is required by the guidelines and push to achieve superior performance, educational and environmental benefits, and excellent policies.

II.C2: Innovation

As innovation credits are achieved in MA-CHPS projects, they will be made publicly available on the MA-CHPS website.

Ideas for innovation credits are listed below:

- Develop a comprehensive and innovative plan for using the sustainable aspects of the school as teaching tools.
- Implement an Environmental Management System for the school.
- Install sensors and monitor indoor air quality.
- Implement green construction practices, such as limiting dust, noise and exhaust into nearby neighborhoods.
- Purchase building materials or systems that have undergone a Life Cycle Impact Assessment (LCIA).
- Adopt an indoor temperature setting policy that establishes the air temperature for all rooms and is publicized so that occupants know what to expect.
- Establish “walking school buses”.

For each new credit attempted: 1) define the credit and its purpose; 2) describe the proposed criteria for compliance including any applicable standards; 3) identify documentation requirements that verify compliance with the proposed credit; 4) submit a narrative describing how the credit reflects sustainable or environmental health and safety practices, and 5) submit documentation identified in 3).

OR

If the Innovation credit is for exceptional performance in an existing credit area, then submit a narrative of the design approach, including an explanation of how the original credit was exceeded by a significant amount.

Applicability

Innovation credit can be used in any project type.

Resources

None.

II.C3: Life Cycle Cost Analysis

Intent: Optimize environmental performance and economic savings through making decisions based on operational life.

Typically, first cost is the primary economic factor when analyzing whether to proceed with a specific strategy, sustainable or not. However, it is in the long period of operation that the employed strategy will prove economically advantageous or not. According to the Sustainable Building Technical Manual, a publication of the Public Technologies Institute, when viewed over a 30 year period, initial building costs for major building systems account for approximately just 2% of the total, while operations and maintenance costs equal 6%, and personnel costs equal 92%.

Requirement

3 points	II.C3.1	As part of the design process, perform a life cycle cost analysis showing net present value over 30 years of the major building systems considered for the project that are anticipated to consume significant amounts of energy, water, or other natural resource.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

A Life Cycle Cost Analysis (LCCA) will provide a much more accurate context for decision making than a tally of short-term initial costs. Ideally, this analysis compares alternatives that are relevant and viable options of interest to the owner and project participants. Major building systems should include, but are not limited to the following, HVAC, lighting, ventilation, and flooring. At least three options should be studied for each major system.

There are a variety of methods to use to conduct an LCCA, varying in complexity. The National Institute of Building Sciences describes LCCA in its Whole Building Design Guide. The discussion includes a description of "Present Value" Analysis required to earn this credit. This method converts cash flows to present values by discounting them to a common point in time.

The spreadsheet available through the Washington State ELCCA program is available electronically and can be modified to address alternatives other than energy. As an alternative to ELCCA, the Pacific Northwest National Laboratory has developed Facility Energy Decision System – FEDS 5.0 which analyzes energy efficiency in single or multiple buildings. In addition, FEDS can determine the impact of energy efficiency retrofits on emissions of CO, CO2, NOx, SO2, hydrocarbons, and particulates.

Applicability

This credit applies to all project types.

Resources

Energy Life Cycle Cost Analysis Spreadsheet, Washington State General Administration, available at http://www.ga.wa.gov/EAS/elcca/sheets.html

FEDS Software, Pacific Northwest National Laboratory, www.pnl.gov/FEDs

Whole Building Design Guide, National Institute of Building Sciences, http://www.nibs.org/index.php/wbdg

Building Life-Cycle Cost (BLCC) Programs, U.S. Department of Energy, Energy Efficiency and Renewable Energy, Federal Energy Management Program, http://www1.eere.energy.gov/femp/information/download_blcc.html

Energy-10, National Renewable Energy Lab, http://www.nrel.gov/buildings/energy10.html

II.C4: School Garden

Intent: To encourage schools to incorporate teaching gardens into their sites and curriculum.

School gardens can provide a diverse learning environment as well as a beautiful respite from the demands of the rest of the school day. Gardens promote learning about healthy foods, the environment and natural systems. Students who are not engaged by traditional learning methods often find the experience of working and learning in the garden a welcome path to understanding.

Gardens can be integrated into science and social studies curriculum and should promote alternatives to the use of pesticides & herbicides. School Gardens can also be the site of school-wide composting programs.

Requirement

1 point	II.C4.1 Provide a site on campus for one or more school gardens with a minimum of 100 sf for every four (4) classrooms. It shall have a permanent source of water for irrigation that may include access to a tap and hose, an installed irrigation system, or access to a rain barrel. There must also be dedicated storage space for garden maintenance supplies and tools. II.C4.2 Provide signage to designate the area as a school garden and to differentiate it from the surrounding grounds. II.C4.3 Develop a long-term maintenance plan to ensure the garden is implemented and continues to thrive. II.C4.4 For existing school sites (major renovations or new building on existing campus project) the soil must be tested to ensure there are no contaminants.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

To earn this credit, the project shall designate an area(s) appropriate for gardening by the school community. Indicate on the plans the location of the garden and its components. A school garden can come in many different forms. It can be fenced off, or physically separated from buildings, making it easily accessible to the school and to community members, or it can be integrated onto the school site in multiple areas or planters. Unique gardens, such as roof gardens, can also be considered for credit.

It is highly recommended that school community members, including staff and parents, are involved the school garden and its development. When school is closed during summer months, the garden will still need care, and community support is essential for this purpose.

The garden must have:

- A prominent entrance that is easily accessible and/or identified by signage.
- A long-term maintenance plan to ensure the garden is implemented and continues to thrive.
- Soil that has been tested (for existing school sites or redeveloped sites) to ensure there are no contaminants.
- Permanent irrigation.

Submit plans and specifications for the garden that meet the above requirements.

II.C4: School Garden

Submit either a) the long-term maintenance plan or b) a letter of commitment from the school committee or the superintendent indicating that the plan will be developed and by whom.

Applicability

This credit applies to new schools, a new building on an existing campus, additions, and buildings included in a major renovation project. A renovation project can claim this credit if the existing site qualifies.

Resources

The Edible Schoolyard: http://www.edibleschoolyard.org/

EarthWorks Boston is a non-profit that promotes environmental and health education for urban children in the Boston area through the planting and care of school orchards and gardens: http://www.earthworksboston.org.

II.C5 School Master Plan

Intent: Ensure high performance school priorities are carried out throughout the life of the school.

While a school is being renovated or designed it is important to consider the needs the school may have in the future, and how those needs may be met while keeping high performance principles in mind. It is also important to have a master plan in place to ensure that the intent of the design or renovation is carried out when the school is renovated and maintained in its future.

Requirement

1 point	II.C5.1	Develop a School Master Plan for the site and facilities of an individual school in collaboration with school board members and community stakeholders that: • Supports the continued compliance with high performance strategies followed in this Criteria. • Assess and plan for future transportation impacts on the school and flexibility for addition of alternative forms of transportation. • Assess and plan for the possibility of increased and decreased student enrollment. • Assess using the school for emergency preparedness such as a shelter. • Assess and plan for future high performance upgrades and renovations by documenting the life cycle of major materials and systems, and documenting opportunities for high performance replacement such as recycle or reuse.

Implementation

The complete compliance requirements are listed in the CHPS Verified Application Templates. The School Master Plan should cover ten (10) to fifteen (15) years from the school opening or a major renovation being completed. Many school districts in Massachusetts already have a master plan, so a new plan may not be needed. The existing plan can be reviewed for compliance with the above requirements.

Applicability

This credit applies to new schools. For renovations and a new building on an existing campus, this credit may be earned if the master plan is developed for the entire school site, not just the portion being renovated or built.

Resources

None. (As Massachusetts schools comply with this credit, examples will be posted on the MA-CHPS website).

EQ.P1: HVAC Design – ASHRAE 62.1

Intent: Establish a minimum level of indoor air quality to protect student and staff health and improve performance and attendance.

Establishing a minimum level of indoor air quality positively impacts student and teacher performance, can reduce absenteeism, and avoid the potential for long and short-term health problems. All of the prerequisites and credits in this category can be used to achieve excellent indoor air quality which starts during construction with proper drainage of the site, careful siting of air intakes, protecting building materials from moisture, and protecting HVAC systems from dust and debris. Implementing all the prerequisites and credits in this section will provide a foundation for providing clean, breathable air in your school.

Requirement

Prerequisite	EQ.P1.1 *Minimum outside air ventilation requirement*: Design and construct the HVAC system to provide continuous outside air (OA) ventilation to each space during occupied hours including all full- and part-load conditions. The design shall ensure that the ventilation system operates in continuous mode during occupied hours and is not readily defeated. Ventilation rates shall be no less than required by the outdoor ventilation rate calculated according to the out door air ventilation rate procedure in the current ASHRAE 62.1 § 6.2 using the ASHRAE 62.1 Spreadsheet for calculations; the OA rate that is greatest shall be applied to each space. For multiple spaces served by variable air volume (VAV) systems, this means that the minimum supply setting of each VAV box should be no less than the design outdoor ventilation rate calculated for each space. The box must be controlled so that the minimum required airflow is maintained at all times when the space is occupied, even when the fan has modulated to its minimum capacity. Additionally, if the following rooms have significant pollutant sources, art classrooms, darkrooms, kitchens and kitchenettes, locker rooms, copy printing rooms, science lab classrooms, woodwork shops and/or other classrooms, the pollutants shall be exhausted directly to the outside and not re-circulated. Local contaminate exhaust in rooms such as fume hoods may meet this requirement. The exhaust airflow rates shall be no less than current ASHRAE 62.1 § 6.2.8. *Exception*: Naturally ventilated spaces that meet the requirements of the current ASHRAE Standard 62.1, §5.2 or the natural ventilation systems must be engineered to demonstrate sufficient outdoor air ventilation and thermal comfort to assist convective air movement, and to provide back up ventilation when indoor pollutant episodes occur. HVAC systems and equipment shall meet the requirements of ASHRAE Standard 62.1-2007, §5, which addresses among other things the design of condensate pans (§5.11), and the mold resistance of air stream surfaces (§5.5). Project do not need to follow the requirements for location of outside air intakes (§5.6) since it is covered under Massachusetts Code and referenced under EQ.P3 Pollutant and Chemical Source Control.
Prerequisite	EQ.P1.2 To maintain clean ducts and avoid particulate accumulation and/or mold in the ductwork, duct liners must meet the American Society for Testing and Materials (ASTM) standards C 1071 or UL 181 for surface erosion resistance and ASTM standards C 1104 or C 209 (at <0.5% absorption by volume) for water vapor sorption.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

EQ.P1.1

The construction documents (drawings and specifications included in Construction Specifications Institute (CSI) Section 01350 or CSI Format (2004) 01 35 43.16 Environmental Procedures for Toxic Materials, shall include design details and control sequences presented in a manner allowing that compliance with the prerequisite may be verified. In addition to information on the contract documents, calculations used to determine the most stringent outside air ventilation rate shall be signed and submitted by a professional engineer. ASHRAE 62.1 Mechanical Ventilation Calculation Worksheet shall be completed by project engineers and submitted to MA-CHPS for verification that each space meets the minimum outdoor air quantities according to ASHRAE 62.1 calculations, whichever are greatest. The spreadsheet shall show that the outside air quantity in each room served by an HVAC system meets the minimum outside air quantity for the space. For multiple spaces the spreadsheet shall show that the minimum outside air quantities are met in each space including during times when all VAV boxes are turned down to their minimum flow positions. A completed table shall be compiled by project engineers and included in the project drawings and design documentation. The table shall list for each room: the HVAC system ID number and HVAC type, and the minimum outside air flow rate, the rooms air classification and all exhaust fans. These drawings and documents including the table and electronic spreadsheet shall be submitted to MA-CHPS for verification. Minimum outside air quantities in turn down positions for all spaces shall be verified during HVAC system Testing and Balancing and included in minimum Commissioning requirements.

Throughout this credit, ventilation air means the designed outside air flow rate for maximum occupancy.

Controls shall be specified that operate the HVAC fans to provide outside air ventilation continuously during occupied hours, whether or not there is a need for heating or cooling. Thermostats with an “automatic” setting do not meet this requirement, since in this mode, the fans cycle on and off according to demands for heating or cooling.

The HVAC shall be operated continuously during working hours except during scheduled maintenance and emergency repairs or during periods for which the school district can demonstrate that the quantity of outdoor air supplied by non-mechanical means meets the outdoor air supply rate required by ASHRAE Standard 62.1, §5.2 (climate is suitable and an acceptable means for natural ventilation is provided).

Natural ventilation systems must be engineered to demonstrate sufficient outdoor air ventilation and thermal comfort and shall adhere to natural ventilation guidelines including:

- Maximize wind-induced ventilation by siting the ridge of a building perpendicular to the summer winds.
- Generally, naturally ventilated buildings should be narrow.
- Generally, each room should have two separate supply and exhaust openings. Locate exhaust high above inlet to maximize stack effect. Orient windows across the room and offset from each other to maximize mixing within the room while minimizing the obstructions to airflow within the room.
- Provide ridge vents.
- Consider the use of clerestories or vented skylights.
- Provide attic ventilation.

- Consider the use of fan-assisted cooling strategies.
- Consider open staircases that provide stack effect ventilation, but observe all fire and smoke precautions for enclosed stairways.

For naturally ventilated spaces that have no outside air from mechanical ventilation, provide documentation that the requirements of ASHRAE are met. The requirements include the maximum distance from a window or ventilation opening and the minimum size of ventilation openings. Doors are not acceptable natural ventilation openings.

ASHRAE Standard 62.1 §5 has a number of requirements to improve the effectiveness of outside air ventilation systems. Some of these requirements apply to the design of equipment and manufacturers. The design engineer shall check with manufacturers to verify that the equipment that is specified, complies with the requirements of §5. Some manufacturers identify product lines or equipment as complying with Standard 62.1. Specifications shall specify that the HVAC system provides a slope in condensate pans so that water does not stand, provides access for cleaning coils and other components, and makes sure that air stream surfaces are not porous including the requirement that insulation is not placed on internal air stream surfaces except for sound attenuation insulation that may be placed selectively on the inside of HVAC ducts if it is certified to meet ASTM C 1071 and ASTM C 1104 for surface erosion resistance and water vapor sorption.

EQ.P1.2

Duct insulation should be located on the outside of ductwork, unless it is being installed for the purpose of attenuating sound, and there is no other means of attenuation sound. Duct liners have been known to deteriorate over time and absorb moisture, leading to the release of particles in the ducts that can be blown into classrooms and offices. Ensure that the duct liners used for sound attenuation meet the ASTM standards for surface erosion resistance and water vapor sorption.

Designate the CSI number, section, and page number that highlight the requirements for ASTM standards C 1071 or UL 181 for surface erosion resistance and ASTM standards C 1104 or C 209 (at <0.5% absorption by volume for ASTM C 209) for water vapor sorption.

Applicability

This credit applies to all projects.

Resources

ANSI/ASHRAE Standard 62.1, Ventilation for Acceptable Indoor Air Quality.

ANSI/ASHRAE Standard 62.1 User's Manual.

ANSI/ASHRAE Standard 62.1 Mechanical Ventilation Calculation Worksheet

EQ.P2: Construction IAQ Management

Intent: Achieve good indoor air quality to protect student and staff health and improve performance and attendance.

A high level of indoor air quality starts during design, is implement during construction and maintained during operation.

Requirement

Prerequisite	EQ.P2.1 During construction meet the recommended Design Approaches of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) *IAQ Guideline for Occupied Buildings Under Construction*, 2007, Chapter 3. Include the erosion and sedimentation control measures to minimize site dust during occupied renovations.
Prerequisite	EQ.P2.2 If installing a new duct system, follow the SMACNA guidelines for "Duct Cleanliness for New Construction Guidelines" according to **advanced** levels of cleanliness. Of specific importance are the following: • Specify that ductwork be sealed when transported to the construction site. • Store ductwork in clean, dry conditions and keep sealed while it is stored. • Wipe down internal surfaces of ductwork immediately prior to installation to remove dust. • Seal open ends on completed ductwork and overnight work-in-progress. • During installation, protect ductwork waiting to be installed with surface wrapping, etc. • During construction, seal HVAC supply and return openings to protect them from dust infiltration (e.g., from drywall installation or wood floor sanding).
Prerequisite	EQ.P2.3 Building Flush Out. The design professional shall develop a plan, and include it in the specifications to flush out the building with outside air (no return air) based on the requirements and recommendations in the specifications to remove indoor pollutants prior to occupancy. The information should also be detailed in division 23, in the TAB (23 05 93) and control sequence (23 09 93) specifications. The specifications at minimum must state that the maximum amount of outside air (the design outside air flow rate for maximum occupancy) must be provided during and after installation of VOC emitting materials for the maximum amount of time feasible, but not less than continuously (i.e. 24 hrs) for seven days. It should be noted that the maximum amount of ventilation provided by an HVAC system may be limited not only by the system's capacity but also by the temperature and humidity of the outdoor air. The specifications should be developed utilizing the CHPS Best Practices Manual Volume on Design guidelines for building flush out. After construction ends, prior to occupancy, and with all interior finishes flush-out the building. Do this by supplying the ventilation rates over the specified time period per the plan developed in detail by the design engineer and provided in the specifications.

Prerequisite Cont..	For the case where a potential CHPS project has fallen behind schedule, the school may alternatively conduct the flush-out while the building is occupied provided all of the following measures to protect building occupants are taken prior to their use of the space: All of the rooms in the school must be inspected for health and thermal comfort by a trained technician or a certified Industrial Hygienist before occupancy. And the occupancy evaluation report which has been reviewed and approved by a certified Industrial Hygienists (i.e. certified by the American Council of Government and Industrial Hygienists (ACGIH)) shall be submitted to CHPS showing the following elements have been met at a minimum: • Each classroom has been tested to show that the ventilation rate meets minimum code required ventilation rate and receives continuous ventilation during occupancy, per Title 8, Sec. 5142. • The HVAC filters on all HVAC units are properly in place and meet the MERV rating (minimum MERV 10) as specified for the MA-CHPS school project, the HVAC condensate pans drain correctly and the internal HVAC insulation is undamaged. • Each classroom has been tested to show that the particulate matter, PM 10, has been measured to be 20 micrograms per cubic meter or less than the outdoor levels and the PM 2.5 12 micrograms per cubic meter or less than outdoor levels • Each classroom has been tested to show that the carbon monoxide has been measured and is less than 9 parts per million but not greater than 2 ppm above outdoor levels. Each classroom has been tested to show that the carbon dioxide has been measured and is less than 200 ppm above outdoor CO_2 levels nearby. The room must be unoccupied during testing, and testing should occur during at least one rush-hour period. • Each classroom has been tested to show that the temperature and relative humidity have been measured and are within the criteria in current ASHRAE Standard 55. Each classroom has been inspected and observed to ensure that there are no health or safety concerns from any chemical, moisture and odor sources in or near the classrooms. • Conduct the flush out for 24 hours a day continuous ventilation for a total of days necessary for all supply fans at their maximum rate and position. Thermal comfort is maintained during occupied hours, per the criteria in current ASHRAE Standard 55. Internal temperatures are maintained at the most energy efficient level above 60°F; relative humidity is maintained no higher than 60% during non-occupancy hours. Under conditions where the heating can't be met (60°) at that fan speed, then adjust the fan to meet the 60°. • All air handling unit dampers are at their maximum outdoor air position during the 14 day flush out. Do not "bake out" the building by increasing the temperature of the space. (If continuous ventilation is not possible, flush-out must total the equivalent of 14 days of maximum outdoor air.) *Post-occupancy ventilation*: When the contractor is required to perform touch-up (including furniture after occupancy) work involving products with chemical emissions, provide temporary construction ventilation during application and extend the building flush-out by a minimum of 4 days after touch-up application, with 100% tempered outside air for 24 hours each day.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

EQ.P2.1

For new schools constructed on new school sites there are no requirements.

For new schools constructed next to occupied schools, the construction process (and demolition process if the existing school is later torn down) will create dust, fumes, and exhaust from activities such as site grading, pouring of the foundation, framing, enclosing the walls and roof, landscaping, installation of stormwater and utility systems, and paving. The construction team must have a communications plan in place to alert school occupants to potential exposures. Additionally, there must be an occupant complaint system in place when construction activities are creating nuisance dust, fumes, and exhaust. Furthermore, if warranted, the construction team should consider protecting the occupied school's outdoor air intakes to prevent entrainment of pollutants.

Reference specifications for a communication plan between the construction team and building occupants regarding complaints, concerns, and predicted changes to IAQ. The plan must consider communications from occupants as well as to occupants. And the plan must consider whether protection of outdoor air intakes is necessary for the project Designate the CSI number, section, and page number that highlight compliance with this requirement.

For occupied renovations, provide photographs (at least six), taken at various times during construction, with a narrative for each photo describing compliance with SMACNA guidelines as follows:

- Construction areas that were isolated from adjacent non-construction areas using temporary walls, plastic sheeting, or other vapor retarding barriers.
- Construction areas that were maintained at a negative air pressure compared to surrounding non-construction areas.
- Recirculating air ducts that were temporarily capped and sealed (appropriate filters may be used if nuisance particulates are the only contaminant of concern).
- Supply air systems that were operated with filters in place.

For occupied renovations, applicants must implement containment procedures for dusts, gases, fumes, and other pollutants created as part of any planned construction, addition to, or renovation of a school building. Containment procedures must follow the SMACNA *IAQ Guidelines for Occupied Buildings Under Construction.* All bids received for school construction or renovations must include the cost of planning and execution of containment of construction pollutants consistent with the SMACNA guidelines. The plan must include a plan for communicating information about procedures, protective measures, and construction schedules from the construction team to the building occupants. Additionally, there must be an occupant complaint systems in place when construction activities are creating nuisance dust, fumes, and exhaust.

Reference specifications for an Indoor Air Quality Management Plan that addresses SMACNA control measures for maintaining good indoor air quality on the job site. The specifications should indicate who is responsible for implementing the IAQ management plan, and the plan should address depressurizing work areas, ongoing housekeeping, scheduling of construction activity to lower impacts of IAQ problems on workers and building occupants, and the method of communication between construction team and building occupants regarding complaints, concerns, and predicted changes to IAQ. Designate the CSI number, section, and page number that highlight compliance with this requirement.

EQ.P2.2

This construction practice will improve indoor air quality by minimizing the amount of indoor pollutants that are distributed and retained by the surface materials and ventilation systems during construction.

Read the SMACNA guidelines and reference specification sections for duct protection including specific references to SMACNA Duct Cleanliness Guidelines Advanced Levels. Designate the CSI number, section, and page number showing compliance with this requirement. Provide photographs taken at various times during construction, with a narrative for each photo describing compliance with SMACNA Duct Cleanliness advanced levels.

Applicability

EQ.P2.1 applies to both occupied renovations and new schools that are constructed next to occupied schools. EQ.P2.2 and 2.3 apply to all projects.

Resources

ASHRAE Standard 62.1Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guideline for Occupied Buildings Under Construction, 2008.
http://www.smacna.org/bookstore/index.cfm?fuseaction=search_results&product_id=210

Sheet Metal and Air Conditioning Contractors' National Association, Inc., Duct Cleanliness for New Construction Guidelines; © SMACNA 2000 http://www.smacna.org/technical/index.cfm?fuseaction=papers

EQ.P3: Pollutant & Chemical Source Control

Intent: Achieve good indoor air quality to protect student and staff health and improve performance and attendance.

This prerequisite builds on the first two, to maintain a high level of indoor air quality.

Requirement

Prerequisite	EQ.P3.1 Off-Gassing - Where chemical use occurs, including housekeeping areas, chemical mixing areas, copying/print rooms, photolabs, and vocational spaces, use deck-to-deck partitions with dedicated outside exhaust at a rate of at least 0.50 cubic feet per minute per square foot, no air recirculation, and adequate make up air. These spaces must have vapor barriers and have negative air pressure when the doors are closed, Negative air pressure is defined as an outside exhaust at a rate of at least 0.50 cubic feet per minute per square foot. The spaces must maintain a negative pressure of at least 5 Pa (0.02 inches of water gauge) to a minimum of 1 Pa (0.004 inches of water) compared to their immediate environment and when their doors are closed. In photolabs, specify table vents to draw chemical vapors away from the breathing zone of dark room users. Doors to areas where hazardous materials are stored are used must be secured with self-locking and closing mechanisms.
Prerequisite	EQ.P3.2 Walk Off Mats - Provide a two part walk-off mat system for all high volume entryways to capture dirt, particulates, and moisture before they enter the building. Part one is a mat in the vestibule that scrapes dirt and moisture off of shoes allowing particles to drop below the surface of the mat. Part two is a walk-off mat in the entranceway that finishes drying and cleaning of shoes. The recommended length of part two is 15 feet. Specify periodic maintenance of walk off mat systems.
Prerequisite	EQ.P3.3 Electric Ignitions for Gas-Fired Equipment – Specify electric ignitions for the following gas-fired equipment: water heaters, boilers, air-handling units, and cooking stoves.
Prerequisite	EQ.P3.4 Air intake locations shall follow those specified in ASHRAE Standard 62.1-2007, §5. All intakes must be 6 feet above landscaped grade including soil, lawn, shrubs, or any plant life within 1.5 ft. horizontally of intake. Exception: For projects where, locating an air intake within 25 feet of a contaminant source is unavoidable, such as a renovation project, the intake opening shall be a minimum of 2 feet below the contaminant source and 10 feet horizontally from the nearest edge of the air intake to the nearest edge of the contaminant source.
Prerequisite	EQ.P3.5 No Mobile Fossil-Fuel Powered Equipment Indoors. Do not acquire fossil-fuel-powered machinery that is mobile and whose specific function is for use inside the building. This is to prevent accumulation of exhaust inside the building from equipment such as polishers and burnishers. This prerequisite does not include stationary equipment such as gas stoves, chemistry equipment, and vocational equipment.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

EQ.P3.1

Design to physically isolate activities associated with chemical contaminants from other locations in the building, and provide dedicated exhaust systems to contain and remove chemical pollutants from source emitters at source locations. Eliminate or isolate high hazard areas and design all housekeeping chemical storage and mixing areas (central storage facilities and janitors closets) to allow for secure product storage. Design copier rooms with structural deck-to-deck partitions and dedicated outside exhaust systems.

Provide a letter signed by a professional engineer explaining how the spaces stated in the prerequisite are ventilated to maintain a 1–5 Pa negative pressure, compared to their immediate environment, and are exhausted at a rate of 0.50 cfm/ft^2.

EQ.P3.2

Particles tracked into the school on shoes are one of the chief sources of contamination of floors and carpets. .Research shows that pesticides, heavy metals, and soil are tracked in on students' shoes. The best way to keep the school free of dust, dirt, and contaminants is to prevent these unwanted items from entering the building in the first place. It is especially important to protect young school children since they are more likely to sit and play on classroom floors and be more directly exposed to contaminants.

EQ.P3.3

The purpose of this prerequisite is to prohibit standing pilot lights in gas-fired equipment. Under certain conditions, the accumulation of carbon dioxide from unlit pilot lights can cause dangerous air quality conditions for staff and students. Therefore, electric ignitions are required for the equipment listed in this prerequisite.

Reference specification sections for gas-fired equipment that uses electric ignitions to light gas burners.

EQ.P3.4

Locating air intakes away from sources of potential air pollution will ensure that indoor air quality is not compromised by diesel fumes or exhaust air from ventilation, kitchen, or HVAC systems. Be particularly careful to locate air intakes away from areas where school buses and other vehicles may be idling.

Provide drawings showing all air intake openings. Clearly identify hazardous and noxious contaminant sources on the drawings and bubble each air intake with a 50 ft. diameter circle (25 ft. radius) on the drawings. In some cases, Massachusetts State Building Code equation 2801.2.2.2. will determine that the distance between exhaust air or vent outlets should be greater than 25 feet. In such instances, the greater distance is required. Indicate this variation on the drawings.

Where intake openings front on a street or public way, measure the horizontal distance from the centerline of the street or public way to the air intake. If an air intake is within 25 ft. of vents, chimneys, plumbing vents, exhaust fans, cooling towers, streets, alleys, parking lots and loading docks, then show that it is at least 2 feet below the contaminant source and 10 feet away horizontally from the nearest edge of the air intake to the nearest edge of the contaminant source. Indicate the horizontal and vertical distances from the contaminant source in the drawings.

EQ.P3.5

EQ.P3: Pollutant & Chemical Source Control

Provide a letter signed by the school superintendent stating that no indoor mobile fossil fuel burning equipment will be used in the new or renovated facility and provide cut sheets.

Applicability

This credit applies to all projects.

Resources

None.

EQ.P4: Moisture Management

Intent: Achieve good indoor air quality to protect student and staff health and improve performance and attendance.

Due to health risks associated mold and microbial growth and the damage caused to buildings by water infiltration, all surface grades, drainage systems, and HVAC condensate must be designed to move water away from buildings and their foundations.

Requirement

Prerequisite	EQ.P4.1 Drainage - Design surface grades to slope away from the building and the building foundation to drain away rain water, snow melt, and HVAC condensate and to prevent ponding, pooling or otherwise saturating the building envelope or foundation. Rain leaders, or downspouts, must be directed to infiltration structures, on site storage, rain gardens, or daylight - provided that surface drainage moves water well away from the building and does not result in unintended ponding or pooling. Condensate removal systems that rely on gravity drainage are strongly preferred to systems that use pumps due to the reduced maintenance associated with gravity systems. Note: The project is prohibited from specifying HVAC systems that use evaporation drip pans for condensate removal.
Prerequisite	EQ.P4.2 Lawn irrigation systems shall be designed to prevent spray on building walls.
Prerequisite	EQ.P4.3 Mold Prevention - Building materials, especially gypsum wallboard, wood, porous insulation, paper, and fabric, should be kept dry to prevent the growth of mold and bacteria. Cover these materials to prevent rain damage, and if resting on the ground, use spacers to allow air to circulate between the ground and the materials. Water damaged materials should be dried within 24 hours. Due to the possibility of mold and bacterial growth, materials that are damp or wet for more than 24 hours may need to be discarded. Immediately remove materials showing signs of mold and mildew, including any with moisture stains, from the site and properly dispose of them. Replace moldy materials with new, undamaged materials.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

EQ.P4.1

The following should be submitted to adequately show compliance:

1. Site plan showing grading plan
2. Diagram of condensate system
3. Typical detail of condensate drains showing drain trap and gravity drainage system

EQ.P4.2

Permanent irrigation systems that spray on buildings can cause structural damage and mold growth. Do not install irrigation systems in locations where they may spray directly onto buildings. Note: This requirement only

applies to schools with permanent irrigation systems. Submit a plan of irrigation system showing that sprinkler ranges do not intersect with buildings.

EQ.P4.3

Construction activities can affect indoor air quality long after the building is occupied. Being careful to protect building materials from moisture and removing water-damaged materials are important practices in the prevention of mold growth in new buildings.

Use specification language in Appendix C as sample language for your bid specifications. Reference specification sections for protection of building materials from water damage, and designate the CSI number, section, and page number that highlight compliance with this requirement.

Provide photographs taken at various times during construction, with a narrative for each photo describing techniques for protecting building materials from mold and moisture damage.

Applicability

This credit applies to all projects.

Resources

ANSI/GREENGUARDMold and Moisture Management Standard for New Construction
www.greenguard.org/Default.aspx?tabid=111

EQ.P5: Minimum Filtration

Intent: Provide minimum adequate air filtration to ensure good indoor air quality.

A minimum level of filtration is necessary to reduce the health risks associated air contaminants from outdoors.

Requirement

Prerequisite	EQ.P5.1 Replace all HVAC filtration media immediately prior to occupancy. Filtration media shall have a Minimum Efficiency Reporting Value (MERV) of 10 or higher, excluding unit ventilators, which can have MERV 7. Filters should be installed in outdoor air intakes. Note: If the credit for EQ.C5 – Enhanced Filtration – requiring MERV 13 filters is fulfilled, then this prerequisite is waived.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

Reference specification sections for replacement of filters with MERV 10 or higher. Keep track off all air handling units, roof top units, unit ventilators, etc. and the rating of filters used for each piece of equipment.

Applicability

This credit applies to all projects.

Resources

None.

EQ.P6: Thermal Comfort – ASHRAE 55

Intent: To provide a high level of thermal comfort to support optimum health, productivity, and comfort.

Thermal comfort is controlled by six factors: air temperature, relative humidity, radiant temperature, air movement, occupant activity and clothing. Design the building envelope and mechanical systems to provide optimal comfort and energy efficiency.

Requirement

Prerequisite	EQ.P6.1 Comply with the current ASHRAE *Standard 55* for thermal comfort standards within established ranges for Massachusetts' Climate Zone 5.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

Indoor design temperature and humidity for general comfort applications shall be determined in accordance with the current American National Standards Institute (ANSI)/ASHRAE 55. The standard specifies conditions in which a specified fraction of the occupants will find the environment thermally acceptable. Comfort conditions for naturally ventilated buildings are included in the standard. Provide a summary that identifies each thermally controlled zone and the temperature and humidity control ranges and method of control used for each zone.

The design should also consider other important factors such as minimizing temperature differences between exterior surfaces and interior walls, decreasing the temperature variation between floors and ceilings, and decreasing the velocity of air flow such as drafts.

Supply a letter signed by the project's professional engineer (P.E.) certifying that ASHRAE *Standard 55* guidelines will be achieved and how they will be achieved.

Applicability

This credit applies to all projects.

Resources

Massachusetts Building Code, 780 CMR 1303.3.1

ASHRAE Standard 55

EQ.P7: View Windows, 70%

Intent: To provide a connection between indoor spaces and the outdoor environment through the introduction of sunlight and views into the occupied areas of the building.

View windows are essential to areas where students and staff will be working for extended periods of time. Ample and interesting views have consistently been found to increase student performance. Distant views enable the occupants of the room to relax their eyes, which is especially beneficial to computer users and younger children who are still developing their visual capabilities.

Requirement

Prerequisite	EQ.P7.1 Provide direct line of sight to view glazing from 70% of the combined floor area of classrooms, library and administration areas. To qualify, a space shall have view glazing area equal to or greater than 7% of the floor area. View glazing shall be clear and only include window area above 2.5 ft and below 7.5 ft from the floor. The total width of view glazing shall be greater than 1% of the floor area. Exception: School buildings that share at least two sides with other buildings are exempted from this requirement.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

Determine the total floor area of spaces for which this requirement applies by creating a table listing the classrooms, library reading rooms and administrative areas. Like spaces may be listed just once. A like space is one with the same physical configuration, including windows.

For each space in the list determine how much of the floor area qualifies for the view credit. Two considerations come into play: the view window area and the total width of the view windows. Each of these limit how much of the area qualifies, as explained below:

- To determine the maximum qualifying area based on the view window area, divide the view window area by 7%.
- To determine the maximum qualifying area based on the width of the view windows, divide the total width of view windows by 1%.

For each space the qualifying floor area is the lesser of the total floor area, the maximum floor area based on view window area, or the maximum floor area based on view window width. Sum the qualifying area and compare to the total area. If it is greater than 70%, then the school project qualifies, otherwise it does not.

The MA-CHPS Verified templates have tables that should be used in setting up these calculations.

Example Calculation

Question: A new school has 30 like classrooms each with a floor area of 960 ft². Each classroom has view windows with an total area of 60 ft² and a total width of 9 ft. The school also has six larger 1,040 ft² classrooms with 70 ft² view windows with a total width of 10.5 ft. The 2,600 ft² library reading area has 200 ft² of view windows with a total width of 25 ft. The 2,000 ft² administration area has 150 ft² of view windows with a total

width of 18 ft. Does this school qualify for the view windows credit and how much of the floor area qualifies as having view windows?

Answer: The total floor area of classrooms, administration areas and library reading rooms is 39,640 ft² (see column D in Table 3). To meet the prerequisite, at least 70% of the floor area of these spaces shall have view windows, or a total of 35,676 ft². The qualifying floor area must be determined for each space based on the total view window area and the total width of the view windows. For the smaller classrooms, the maximum qualifying floor area based on view window area is 857 ft² or 60 ft² divided by 7%. The maximum qualifying floor area based on window width is 900 ft or 9 ft divided by 1%/ft. The qualifying area is the smaller of these numbers or 857 ft². For the larger classrooms, the qualifying area is 1,000 ft²; 2,500 ft² for the library reading area; and 1,800 ft² for the administration areas. The total qualifying area is 36,010 ft² or 91%. See Table 3 for details of the calculation.

Table 3 – Example Calculation of View Window Credit

A	B	C	D	E	F	G	H	I	J
				For each space					
Space	Size (ft²)	Number of spaces	Total area (ft²)	View window area (ft²)	Maximum Floor Area based on view window area (ft²)	Total width of view windows (ft)	Maximum floor area based on view window width	Qualifying floor area per space (ft²)	Total qualifying floor area (ft²)
Classroom type 1	960	30	28,800	60	857	9	900	857	25,710
Classroom type 2	1040	6	6,240	70	1,000	10.5	1,050	1000	6,000
Library reading	2600	1	2,600	200	2,857	25	2,500	2500	2,500
Administration	2000	1	2,000	150	2142	18	1,800	1800	1,800
Totals			39,640						36,010
Percent									91%

Applicability

This credit applies to all new classrooms, libraries and administration areas. Renovation projects that involve window replacement can meet this prerequisite by modifying existing window configurations that do not conform to the requirements to configurations that do meet the requirements for this credit. Schools with special needs facilities may request an exemption or variance based on circumstances.

Resources

The Daylighting Collaborative is a clearinghouse of best practices and resources about daylighting: http://www.daylighting.org.

EQ.P8: Eliminate Glare

Intent: Provide high quality daylighting in classrooms to enhance student performance and to improve student productivity through quality daylighting designs that minimize glare and direct sunlight penetration.

Daylighting is fundamentally important to high performance design, and should be the primary source of light in classrooms. Daylighting has a number of advantages, including improved occupant productivity, improved connection to the outdoors, improved health, energy savings, and quality of light.

Requirement

Prerequisite	EQ.P8.1 Design spaces to optimize daylight while preventing glare by controlling direct sunlight ingress with blinds, shades, overhangs, lightshelves, translucent material, or other effective means. Use either of the following three metrics to document achievement of this credit: • No direct sunlight can strike the teaching surfaces or a work plane located 4 ft. or more inside the exterior walls at 9:00AM, 12:00PM and 3:00PM on the winter and summer solstice and the equinox. **OR** • The maximum illuminance to average illuminance ratio cannot exceed 15 at 9:00AM, 12:00PM and 3:00PM on the winter and summer solstice and the equinox. **OR** • The maximum Daylight Autonomy for the daylit spaces must be below 5% for all daylit spaces. Skylights and roof monitors shall meet the requirements of no direct sun penetration as described above, unless they have diffusing devices. Include a control strategy to automatically turn off or dim the electric lights when adequate daylighting is available in a given daylit space. Strategies for daylight responsive electric lighting controls include: open and closed loop photosensor systems, astronomical clock/timer based systems, or proper zoning and manual controls with an educational program to train occupants.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

Direct Sunlight Penetration

Requirement EQ.P8.1 (direct sunlight penetration) shall be verified by one of the following methods:

- A physical model should be placed on a heliodon or otherwise positioned so that the sun angles represent the dates and times specified in EQ.P8.1. Verify by photograph that the 9 conditions do not have any direct sunlight on the workplane or teaching wall.
- A model may be set up in a computer based tool that can calculate sunlight on interior surfaces. Verify be rendering images or task plane illuminance calculations that the 9 conditions do not have any direct sunlight on the workplane or teaching wall.

- Manually calculate the sun profile angles and show that the criteria are satisfied for the dates and times specified in EQ.P8.1 Illustrate the any shading strategies provide complete direct sunlight control for the 9 conditions specified.
- Perform an incremental maximum Daylight Autonomy calculation using 300fc or other recommended target illuminance x 10. The DA_{max} should be 5% or less for no more than 5% of the workplane points.

For any manually controlled shading devices included in the above calculations (ie. Blinds, roller-shades), provide documentation that can be given to users and informing of optimal use of shading devices, namely ensuring they are not left down when there is plentiful daylight.

Daylight Responsive Lighting Controls

Requirement EQ.P8.1 (direct sunlight penetration) shall be verified by one of the following methods:

- For photosensor based systems; documentation showing location of sensors and lighting zones, and setpoint and commissioning information for the system.
- For timer based systems; documentation of astronomical clock schedule and narrative of why a time based system is adequate for the daylit space.
- For occupant education approach; a manual to be provided to the building occupants describing the daylighting intent of the space and function of all daylighting, lighting and shading devices.

Applicability

This credit applies to all projects.

Resources

CHPS Best Practices Manual: Volume II: Daylighting and Fenestration Design Chapter.

LEED™ Reference Guide: Indoor Environmental Quality Credit 8

Advanced Lighting Guidelines: 2003 Edition: www.newbuildings.org/lighting.htm

AGI32 Lighting Design Software: www.agi32.com/

DAYSIM Daylighting Analysis Software: http://irc.nrc-cnrc.gc.ca/ie/lighting/daylight/daysim_e.html

DOE-2 Building Energy Use and Cost Analysis Software: http://doe2.com/

Ecotect: http://ecotect.com/

EnergyPlus Building Energy Simulation Program: http://gundog.lbl.gov/

Equest: www.doe2.com/equest

Lightscape: http://usa.autodesk.com

The Daylighting Collaborative is a clearinghouse of best practices and resources about daylighting: http://www.daylighting.org.

EQ.P9: Minimum Acoustical Performance

Intent: Provide classrooms with adequate acoustical environments.

Student learning suffers in acoustically poor environments. Excess noise and highly reverberant spaces can make it difficult, and sometimes impossible, for students and teachers to communicate. The background noise environment is characterized by a noise level measured in A-weighted decibels (dBA). The reverberation is described by a reverberation time, which is the time (in seconds) it takes for the sound to drop 60 decibels in level after the source of the sound has ceased.

To provide a realistic and representative measurement method for both steady-state HVAC noise and time varying exterior environmental noise, the A-weighted equivalent level (Leq) shall be used. The Leq is the steady sound level that contains the same acoustic energy as the actual time-varying sound level during the measurement period.

Reverberation time can be estimated by the following formula:

$$RT(60) = \frac{0.05 \cdot V}{\sum S \cdot \alpha}$$

Where V is the volume of the space in ft3, S is the surface area of each room surface in ft2 and □□ is the associated sound absorption coefficient at a given frequency. Absorption coefficients of common interior surface materials are provided in the ASA Classroom Acoustics a resource for creating learning environments with desirable listening conditions (ASA 2000) and by most manufacturers of interior finish products. The Noise Reduction Coefficient (NRC) is the arithmetic mean of sound absorption coefficients at the 250, 500, 1000 and 2000 Hz octave band center frequencies which happen to be the bands at which the majority of the energy from human speech is contained.

The reverberation time can be measured in a space by popping a balloon and using a meter designed for that purpose. The reverberation times of interest are taken at octave band center frequencies of 500, 1000, and 2000 Hz.

A “core learning space” as defined by ANSI, and accepted by MA-CHPS is “spaces for educational activities where the primary functions are teaching and learning and where good speech communication is critical to a student’s academic achievement. These spaces include, but are not limited to, classrooms, instructional pods or activity areas, group instruction rooms, gymnasiums, conference rooms, libraries, offices, speech clinics, offices used for educational purposes and music rooms for instruction, practice and performance.”

Requirement

Prerequisite	EQ.P9.1 Unoccupied classrooms must meet the following design requirements: For each classroom and core learning space, document that the reverberation time meets the requirements of ANSI S12.60. Calculations are to assume a fitted out and furnished but unoccupied classroom, and Design all walls, roof-ceiling and floor-ceiling assemblies separating classrooms and other core learning spaces to meet the Sound Transmission Class (STC) requirements as defined in ANSI Standard S12.60-2002, except windows which must meet an STC rating of at least 35, and For enclosed core learning spaces the exterior windows may comprise no more that 25% of the area of the partition. For enclosed core learning spaces interior windows may comprise no more than 10% of the area of the demising partition. Design classrooms and other core learning spaces to meet an Leq 45 dBA for HVAC system noise in an unoccupied classroom during normal hours of classroom operation, and Floor-ceiling assemblies over classrooms must meet Impact Insulation Class (IIC) of 50 or greater where occupied space is over a classroom. There are multiple carpet and non-carpet strategies to achieving this performance level.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

For each classroom and core learning space, document that the combined total area of acoustical wall panels, ceiling finishes, and other sound-absorbent finishes equals or exceeds the total area requirements relative to ceiling heights as called out in Table C.1 of ANSI S12.60. Calculations are to assume a fitted out and furnished but unoccupied classroom.

Provide narrative describing measures taken to limit sound transmission between core learning spaces and the following adjacencies:

- Other core learning spaces
- Bathrooms
- Corridors
- Offices, conference rooms
- Music rooms
- Mechanical equipment rooms
- Cafeterias, gymnasiums, natatoriums

The narrative should address the following:

- Demising wall constructions
- Interior glazing assemblies
- Door constructions
- Operable partition constructions, including STC rating, if available.
- Measures taken to limit noise transmission through sound paths, including:
  - Open plenums above core learning spaces
  - Connecting doors between core learning spaces
  - Ceiling air return grilles into open plenums
  - “Cross-talk” via mechanical ductwork

- Special circumstances or considerations regarding the project

Document compliance in classrooms and other core learning spaces using the methodology listed in the 2003 (or most recent version) HVAC Applications ASHRAE Handbook, Chapter 47 on Sound and Vibration Control. Commercially available programs using the ASHRAE Algorithms are acceptable.

Documentation must include typical classrooms as well as core learning spaces such as art, science and gym and music spaces utilizing alternative materials and constructions.

Cross Category & Other Considerations

Site Selection: When selecting the site for a school, consider the current and future exterior noise pollution surrounding the potential site that will affect indoor acoustics such as busy traffic corridors and, trains, and/or airport activities.

Enhanced Acoustic Systems (teacher microphones and speakers): A classroom that meets the reverberation time and dBA requirements set for in this credit should not require enhanced classroom audio systems. However, there may be circumstances, such as the health of the teacher, that may require sound amplification. If installing sound amplification systems consider the new levels of noise that may be transmitted between classroom walls, ceilings and floors and necessary improvements or upgrades to ensure the noise does not affect neighboring classes. Also consider the maintenance and user training of such systems. Improperly maintained systems can lead to poorer speech communication between teacher and student than without the system.

Applicability

This prerequisite applies to all newly constructed classrooms and can be incorporated into classroom renovation projects depending on the scope of the project. For new construction, the design of the classroom and the materials specified should ensure compliance.

Resources

National Clearinghouse for Educational Facilities: http://www.edfacilities.org/

Acoustical Society of America: http://asa.aip.org/ and http://asa.aip.org/classroom/booklet.html

American National Standards Institute: www.ansi.org/

American Speech-Language-Hearing Association: http://www.asha.org

EQ.P10: Minimum Low-Emitting Materials

Intent: Provide classrooms with acceptably low indoor air concentrations of harmful volatile organic chemicals that derive from building products and building materials used indoors.

Many common building products and building materials used indoors in the construction of educational facilities and other buildings are sources of volatile organic chemicals (VOCs). When emitted to indoor air, these pollutants are inhaled by occupants. Such inhalation exposures can result in adverse health effects. These effects include sensory and upper respiratory irritation, pulmonary irritation, asthma, damage to organ systems and neurological and reproductive systems, and increased risk of cancer. Exposure to airborne VOCs is an especially important issue for schools as children may be more susceptible than adults. In order to reduce the potential for adverse effects due to inhalation exposures to VOCs, it is important to specify and utilize products and materials in the construction of the interiors of classrooms and other educational buildings that have low emissions of VOCs that are known to be harmful.

It is required that paints and coatings, and wood products in the project be low-emitting. Projects can claim further points for other product categories in EQ.C3.

Requirement

Prerequisite	EQ.P10.1 Paints & Coatings All paints and architectural coatings totaling 90% or more of the total volumes of such products applied in the project's interior shall meet the requirements described herein. Products in this category include but are not limited to sealers, stains, clear wood finishes, floor sealers and coatings, waterproofing sealers, primers, flat paints and coatings, non-flat paints and coatings, and rust preventative coatings. All such products shall meet the VOC content requirements in the applicable category of South Coast Air Quality Management District (SCAQMD) Rule 1113, Architectural Coatings (amended July 2007, or current version). Further, all such products shall comply with the requirements of the Safe Drinking Water and Toxic Enforcement Act of 1986 and the most current list of chemicals (Proposition 65, CA Office of Environmental Health and Hazardous Assessment). Products that are labeled or would require labeling under this law are not eligible for this credit. Further all paints and coatings normally applied to walls, ceilings, floors or trim shall be tested and evaluated for emissions of VOCs of concern with respect to chronic inhalation exposures following the specifications of the CDPH Standard Practice. The product shall be applied to the appropriate plate or gypsum board panel and tested individually (i.e., not as part of a multi-coat assembly). Flooring sealers and paints shall be modeled to the school classroom using the manufacturer's specified coverage and the classroom flooring area. Wall applied paints and coatings shall be modeled using the manufacturer's specified coverage and the classroom wall paint and wallcoverings area. Ceiling applied paints and coatings shall be modeled similarly using the ceiling area. Wood stains and finishes and trim applied paint shall be modeled similarly using the area of the classroom door plus the area of the wall base (i.e., 11.6 m^2).

Prerequisite	EQ.P10.2 Composite Wood and Agrifiber Products The purpose of this requirement is to reduce a major indoor source of formaldehyde typically found in conventional construction. At least 90%, by area, of the composite wood and agrifiber products installed onsite in the project's interior shall meet either one or both of the requirements described herein. Composite wood products in this category are defined in the California Air Resources Board (CARB) Airborne Toxic Control Measure (ATCM) to Reduce Formaldehyde Emissions from Composite Wood Products (Sections 93120-93120.12, Title 17, California Code of Regulations). The fibers may be wood, straw, bamboo, or similar cellulosic material (e.g., agrifiber). The affected products include hardwood plywood, plywood with decorative softwood veneer, laminated products with a composite wood core or platform, particleboard, medium density fiberboard (MDF), and finished goods fabricated from these products (e.g., doors, trim or molding, cabinetry, counter tops). All such products shall be manufactured with no-added formaldehyde based resins and shall meet the emission requirements established by the ATCM for such products. Alternately, the products shall employ ultra-low emitting formaldehyde (ULEF) resins as defined by the ATCM and shall meet the emission requirements established by the ATCM for such products. Conformance of no-added formaldehyde and ULEF products under this option shall be demonstrated by formaldehyde emission test results and chain-of-custody documentation as required by the ATCM, or equivalent. Structural plywood, structural panels, oriented strand board, structural lumber, glue laminated timber, prefabricated wood joists, and finger jointed lumber, are excluded from this prerequisite and these requirements.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

CHPS expects the burden of testing and compliance to be on the manufacturer. Design teams are encouraged to specify materials from approved lists as referenced in the resources section, and not to be burdened with understanding the specific testing procedures and VOC limits. CHPS pre-approves products that meet these criteria for ease of use by design professionals on approved lists, however if a design team wishes to use a product that is not listed, the design professional can work with the manufacturer to have the product 3rd party tested and approved.

For the purposes of these requirements, indoor products and materials are defined as materials installed or applied on site inside of a building. Low-VOC impact materials within a selected option shall be used throughout the project including all classroom areas, teaching laboratories, administrative and staff areas, indoor circulation areas, restrooms, and multipurpose areas such as gymnasiums. Shops or other areas requiring specialty finishes may be excluded. Ninety percent (90%) or more of the combined surface area or quantity measure of an entire system (e.g., floor, ceiling, furniture) or the individual components of a system (e.g., wall assembly consisting of three components – insulation, wall panel, and wall covering) shall be comprised of low VOC impact materials in order to receive credit for an option. Unless otherwise specified below, low VOC impact materials shall meet the testing and VOC emission requirements of the California Department of Public Health's (CDPH) *Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Chambers* (2004), including its 2004 Addenda. The school classroom shall be used as the exposure modeling scenario for evaluating the acceptability of VOC emissions as described in the Standard Practice (CDPH, 2004, Table 7.4). For wet applied products, additional content criteria are specified.

EQ.P10: Minimum Low-Emitting Materials

Construction documents shall specify the low emitting products to be used on the project and that these meet the requirements defined herein. Products requiring testing for VOC emissions may be selected from the CHPS Low-Emitting Materials (LEM) Table or acceptable labeling or certification programs acknowledged on the CHPS web site. Additionally, products not currently listed may be tested by an independent laboratory as prescribed by CHPS. Provided the results of the tests are accepted by CHPS, credit may be obtained assuming all other requirements have been met.

Applicability

This prerequisite applies to all projects.

Resources

CHPS Best Practices Manual: Design Volume: Interior Surfaces and Finishes Chapter.

CHPS *Product Database*: http://www.chps.net/dev/Drupal/node/445

South Coast Air Quality Management District (SCAQMD) Rule 1113, Architectural Coatings: http://www.aqmd.gov/rules/reg/reg11/r1113.pdf

State of California DHS, *Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chamber:* http://www.dhs.ca.gov/iaq/VOCS/Practice.htm

Healthy Building Network Alternatives to Formaldehyde in Pressed Wood Products: http://healthybuilding.net/healthcare/Alternative%20Resin%20Binders.pdf

The following are currently available 3rd-party certifiers of low-emitting material products; check the CHPS web site to determine which listed products are acceptable.

- Carpet and Rug Institute: *Green Label Plus* http://www.carpet-rug.org/commercial-customers/green-building-and-the-environment/green-label-plus/index.cfm.
- Greenguard Environmental Institute: *GREENGUARD Product Emission Standard For Children & Schools* http://www.greenguard.org/Default.aspx?tabid=110
- Scientific Certification Systems: FloorScore: http://www.scscertified.com/iaq/floorscore.html and Indoor Advantage Gold http://www.scscertified.com/iaq/indooradvantage.html

EQ.C1: View Windows, 80 - 90%

Intent: Provide a visual connection to the outdoors.

View windows are essential to areas where students and staff will be working for extended periods of time. Ample and interesting views have consistently been found to increase student performance. Distant views enable the occupants of the room to relax their eyes, which is especially beneficial to computer users and younger children who are still developing their visual capabilities.

Requirement

1-2 Points	EQ.C1.1 Provide direct line of sight to view glazing from at least 80% of the combined floor area of classrooms and administration areas. Access to Views, 80% = 1 point Access to Views, 90% = 2 points To qualify, a space shall have view glazing equal to or greater than 7% of the floor area. View glazing shall be clear and only include window area above 2.5 ft and below 7.5 ft from the floor. The total width of view glazing shall be greater than 1% of the floor area.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

The documentation requirements are the same as EQ.P7, with the exception that the threshold for this credit is 80% access to views for 1point and 90% access to views for 2 points. See EQ.P7 for information on preparing the calculations for this credit.

Applicability

This credit applies to all new classrooms, libraries and administration areas. Renovation projects that involve window replacement can earn this credit by modifying existing window configurations that do not conform to the requirements to configurations that do meet the requirements for this credit.

Resources

LEED™ *Reference Guide*: Indoor Environmental Quality Credit 8: Daylighting.

The Daylighting Collaborative is a clearinghouse of best practices and resources about daylighting: http://www.daylighting.org.

EQ.C2: Daylighting in Classrooms

Intent: Provide high quality daylighting in classrooms to enhance student performance.

Daylighting is fundamentally important to high performance design, and should be the primary source of light in classrooms. Daylighting has a number of advantages, including improved occupant productivity, improved connection to the outdoors, improved health, energy savings, and quality of light.

Requirement

1-4 points

For all **classroom** spaces, choose one of the following two options:

EQ.C2.1 Multiple Point in Time Approach

1 Point	Achieve >20fc average illuminance for >50% of classroom area
2 Points	Achieve >30fc average illuminance for >50% of classroom area
3 Points	Achieve >40fc average illuminance for >50% of classroom area
4 Points	Achieve >40fc average illuminance for >75% of classroom area

OR

EQ.C2.2 Daylight Autonomy Approach

1 Point	Achieve >40% DA for >50% of occupied area
2 Points	Achieve >60% DA for >50% of occupied area
3 Points	Achieve >80% DA for >50% occupied area
4 Points	Achieve >80% DA for >75% occupied area

**Computer rooms and other spaces where daylight would have an adverse impact on the use of the space are excluded.*

1-2 points	For **support** spaces, choose one of the following two options:		
	EQ.C2.3	Multiple Point in Time Approach	
		1 Point	Achieve >30fc average Illuminance for >50% of administration office area
		1 Point	Achieve >40fc average Illuminance for >50% of library, cafeteria, auditorium and multi-purpose/commons area
		OR	
	EQ.C2.4	Daylight Autonomy Approach	
		1 Point	Achieve >60% DA for >50% of administration office area
		1 Point	Achieve >60% DA for >50% of library, cafeteria, auditorium and multi-purpose/commons area
	**Any spaces where daylight would have an adverse impact on the use of the space are excluded. Provide documentation illustrating impact*		

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

EQ.C2.1 and EQ.C2.3 Multiple Point in Time Approach

Option calculations for the requirements may be made with a qualified computer simulation tool.

- Computer Simulation Tool: Any daylighting simulation tool that can perform accurate daylight illuminance calculations for a grid of points under standard CIE skies for the times specified. Commercially available simulation tools include AGI32, Radiance, SPOT, 3DS Max Design, DAYSIM, DIALux
- A minimum analysis grid of 4 ft by 4 ft shall be used. The grid shall be positioned so that no analysis points are located closer than 3 ft to a wall.
- The annual average illumination should be determined by first calculating the workplane average illuminance for 10 design sky conditions: 9AM, 12PM, and 3PM for winter and summer solstice and equinox under a CIE clear sky and 12PM on the equinox under a cloudy sky condition The annual average illuminance is calculated with this formula:

$$E_{avg} = W9 + W12 \times 2 + W3 + (E9 + E12 \times 2 + E3) \times 2 + (S9 + S12 \times 2 + S3) \times 0.5) \times Sunny\ \% + EC12 \times Cloudy\ \%$$

Where:

E_{avg} = estimated annual average illuminance

WX = Sunny winter solstice condition at 9AM, 12PM, and 3PM

EX = Sunny equinox condition at 9AM, 12PM and 3PM

SX = Sunny summer condition at 9AM, 12PM, and 3PM

EX12 = Cloudy equinox condition at 12PM

EQ.C2.2 and EQ.C2.4 Daylight Autonomy Approach

Option calculations for the requirements must be made with a computer simulation tool.

- Computer Simulation Tool: Any daylighting simulation tool that can perform accurate daylight illuminance calculations for a grid of points under standard CIE skies for the times specified. Commercially available simulation tools include AGI32, Radiance, SPOT, 3DS Max Design, DAYSIM, DIALux.
- A minimum analysis grid of 4 ft by 4 ft shall be used. The grid shall be positioned so that no analysis points are located closer than 3 ft to a wall.
- A design illuminance of 30fc should be used unless a drastically different illuminance target is recommended – for example 15fc for a computer room or 50fc for a gymnasium.
- A max illuminance of 10x design illuminance should be used.
- "Continuous" calculation method to be used for DA calculations. This method allows for hours that receive partial daylight contribution. For example, when 20fc of daylight is provided and the design illuminance is 30fc this counts for 20/30 or 66% for that time.
- "Incremental" calculation method to be used for DA_{max} calculations. This method only counts hours that completely meet or exceed the design illuminance with daylight.
- The school occupancy schedule and a representative weather file should be used for the annual DA and DA_{max} calculations.

Applicability

This credit applies to all projects. To earn this credit for major renovations, it may be necessary to add skylights or modify the size and location of windows.

Resources

CHPS Best Practices Manual: Volume II: Daylighting and Fenestration Design Chapter.

LEED™-NC 2.2 Reference Guide: Indoor Environmental Quality Credit 8: Daylighting.

Advanced Lighting Guidelines: 2003 Edition: www.newbuildings.org/lighting.htm.

3DS Max Design: usa.autodesk.com

AGI32 Lighting Design Software: www.agi32.com/

DAYSIM Daylighting Analysis Software: http://www.nrc-cnrc.gc.ca/eng/projects/irc/daysim.html

DIALux: www.dial.de

DOE-2 Building Energy Use and Cost Analysis Software: doe2.com/

Ecotect: usa.autodesk.com

EnergyPlus Building Energy Simulation Program: gundog.lbl.gov/EP/ep_main.html

Equest: www.doe2.com/equest/

Radiance: radsite.lbl.gov/radiance/

SPOT: www.archenergy.com/SPOT

SkyCalc: www.energydesignresources.com/resource/129

The Daylighting Collaborative is a clearinghouse of best practices and resources about daylighting: http://www.daylighting.org.

EQ.C3: Advanced Low-Emitting Materials

Intent: Provide classrooms with acceptably low indoor air concentrations of harmful volatile organic chemicals that derive from building products and building materials used indoors.

Many common building products and building materials used indoors in the construction of educational facilities and other buildings are sources of volatile organic chemicals (VOCs). When emitted to indoor air, these pollutants are inhaled by occupants. Such inhalation exposures can result in adverse health effects. These effects include sensory and upper respiratory irritation, pulmonary irritation, asthma, damage to organ systems and neurological and reproductive systems, and increased risk of cancer. Exposure to airborne VOCs is an especially important issue for schools as children may be more susceptible than adults. In order to reduce the potential for adverse effects due to inhalation exposures to VOCs, it is important to specify and utilize products and materials in the construction of the interiors of classrooms and other educational buildings that have low emissions of VOCs that are known to be harmful.

This credit offers points for certain product types that are low emitting, whereas EQ.P10 is a prerequisite that requires paints and coatings, and wood products in the project be low-emitting.

Requirement

1 point	EQ.C3.1 Adhesives & Sealants All adhesives and sealants used on the project in quantities of 2.5 gal (10 liters) or more and totaling 90% or more of the total volumes of such products applied in the project's interior shall meet the requirements described herein. Products in this category include but are not limited to carpet, resilient and wood flooring adhesives; base cove adhesives; ceramic tile adhesives; drywall and panel adhesives; aerosol adhesives; adhesive primers; acoustical sealants; fire-stop sealants; HVAC duct sealants, sealant primers; and caulks. Note that structural adhesives are excluded, and sealers including concrete floor sealers and other waterproofing sealers are treated under Option 2. All included products shall meet the VOC content requirements in the applicable category of South Coast Air Quality Management District (SCAQMD) Rule 1168, *Adhesive and Sealant Applications* (amended January 2005, or current version). Further, all flooring, wall covering and wall base adhesives and sealants shall be tested and evaluated for emissions of VOCs of concern with respect to chronic inhalation exposures following the specifications of the CDPH California Department of Public Health's (CDPH) *Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Chambers* (2004),. The product shall be applied to the appropriate plate or gypsum board panel and tested with the product surface exposed directly to chamber air (i.e., not as part of an assembly). Flooring adhesives and sealants shall be modeled to the school classroom using the manufacturer's specified coverage and the classroom flooring area. Wall applied adhesives and sealants shall be modeled using the manufacturer's specified coverage and the classroom wall paint and wallcoverings area. Wall base adhesives shall be modeled similarly using the wall base area.

1 point	EQ.C3.2 Flooring Systems All flooring systems installed in the project's interior totaling 90% or more of the total floor area of the project shall meet the requirements described herein. Flooring systems include but are not limited to carpet with its integral adhesive system and integral or separate cushion, if used; resilient flooring; wood flooring; ceramic tile flooring; other mineral-based flooring (either natural or manmade) without any organic component, and concrete flooring. For the purposes of this option, it is assumed that ceramic tile, organic-free mineral-based flooring, and concrete flooring are negligible sources of VOCs and are available for credit without any testing requirements. Flooring systems shall be tested and evaluated for emissions of VOCs of concern with respect to chronic inhalation exposures following the specifications of the CDPH Standard Practice. Each individual flooring system shall be modeled to the Standard Practice school classroom using the classroom flooring area. For systems consisting of more than one distinct layer (e.g., carpet with separate cushion), all layers shall individually meet the requirements of the Standard Practice.

1 point	EQ.C3.3 Ceiling & Wall Systems All ceiling and wall systems installed in the project's interior totaling 90% or more of the total areas of such systems shall meet these requirements. Ceiling and wall systems include but are not limited to ceiling insulation installed within the structural envelop, wall insulation, acoustical ceiling panels, gypsum board wall panels, tackable wall panels, and wallcoverings. Ceramic tile and other organic-free metal- or mineral-based wallcoverings are available for credit without any testing requirements. Site applied adhesives and sealants and site applied paints and coatings associated with ceiling and wall systems are treated under the prerequisite. Ceiling and wall systems shall be tested and evaluated for emissions of VOCs of concern with respect to chronic inhalation exposures following the specifications of the CDPH Standard Practice. The separate components or distinct layers of these systems shall be modeled to the Standard Practice school classroom using the classroom ceiling area and/or wall area as appropriate. For systems consisting of more than one distinct layer (e.g., walls comprised of insulation, wall panel and wallcovering), all layers shall individually meet the requirements of the Standard Practice.

1 point

EQ.C3.4 Furniture & Furnishings

The purpose of this option is to ensure that new furniture used in classrooms and administrative areas of the project meets the best available emissions standards for furniture. This option is only available if 75% or more of the total number of individual stations (defined as a chair and associated work surface, either desk or chair) are new and/or newly remanufactured/refurbished. All such furniture totaling 90% or more of new individual stations (i.e., combined classroom and administrative stations) shall meet this requirement.

All furniture, both classroom and administrative, shall be tested for VOC emissions following the procedures in ANSI/BIFMA M7.1-2007. Workstations and seating, both classroom and administrative, shall be tested individually. Administrative area and teacher workstations and seating shall be evaluated for VOC emissions using the parameters for an open plan workstation defined in M7.1-2007. Pupil classroom workstations and seating shall be evaluated for emissions using parameters developed for the classroom defined in the CDPH Standard Practice. The furniture parameters are listed in Table 5, below.

Table 5. Modeling parameters and VOC emission guideline requirements for administrative area and teacher workstations and seating and classroom pupil workstations and seating.

	Admin Area & Teacher		**Classroom Pupil**	
Modeling Parameters	**Workstn**	**Seating**	**Workstn**	**Seating**
Number of units	1	1	27[a]	27[a]
Air Flow rate, m^3/h	15.01[b]	24.84[b]	187[c]	187[c]
Total workstation area, m^2	21.75[d]	n/a[e]	n/a[e]	n/a[e]
VOC Emission Guidelines				
Must meet ANSI/BIFMA X7.1	Yes	Yes	Yes	Yes
Must meet CDPH Std Practice guidelines	Yes	Yes, ¼ CREL[f]	Yes	Yes

a. CDPH Standard Practice specifies 27 occupants per classroom.
b. Air flow rates specified in ANSI/BIFMA M7.1-2007 for open plan workstations and seating.
c. Classroom air flow rate from CDPH Standard Practice.
d. Calculate emission factors for components (worksurface, storage, and panel) as described in M7.1 and perform modeling using area for entire workstation. If workstation does not include a component (e.g., panel), the acceptable guideline is reduced by the fraction of that component's defined standard area to the defined total workstation area.
e. Modeling to be performed on a per unit basis, not area
f. Seating in this category is allowed only one half of the guidelines defined in CDPH Standard Practice.

The IAQ acceptance criteria for furniture specified in California Department of General Services, Procurement Division RFP DGS-5675 for Open Office Panel Systems (March 3, 2008) shall be used to determine compliance. As described in Sections 5.7.2.1 and 5.7.2.2 of the RFP, compliance with both the limits specified in ANSI/BIFMA X7.1-2007 and the individual VOC (iVOC) limits listed in Table 5.7.2.2.1 of the RFP is required. Note that these iVOC limits are consistent with the limits defined in the CDPH Standard Practice. Administrative area and teacher seating shall be allowed only one-half of the defined limits (e.g., one-quarter of the Standard Practice guidelines). The guideline requirements are summarized in Table 5.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

CHPS expects the burden of testing and compliance to be on the manufacturer. Design teams are encouraged to specify materials from approved lists as referenced in the resources section, and not to be burdened with understanding the specific testing procedures and VOC limits. CHPS pre-approves products that meet these criteria for ease of use by design professionals on approved lists, however if a design team wishes to use a product that is not listed, the design professional can work with the manufacturer to have the product 3rd party tested and approved.

For the purposes of these requirements, indoor products and materials are defined as materials installed or applied on site inside of a building. Low-VOC impact materials within a selected option shall be used throughout the project including all classroom areas, teaching laboratories, administrative and staff areas, indoor circulation areas, restrooms, and multipurpose areas such as gymnasiums. Shops or other areas requiring specialty finishes may be excluded. Ninety percent (90%) or more of the combined surface area or quantity measure of an entire system (e.g., floor, ceiling, furniture) or the individual components of a system (e.g., wall assembly consisting of three components – insulation, wall panel, and wall covering) shall be comprised of low VOC impact materials in order to receive credit for an option. Unless otherwise specified below, low VOC impact materials shall meet the testing and VOC emission requirements of the California Department of Public Health's (CDPH) *Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Chambers* (2004), including its 2004 Addenda. The school classroom shall be used as the exposure modeling scenario for evaluating the acceptability of VOC emissions as described in the Standard Practice (CDPH, 2004, Table 7.4). For wet applied products, additional content criteria are specified.

Construction documents shall specify the low emitting products to be used on the project and that these meet the requirements defined herein. Products requiring testing for VOC emissions may be selected from the CHPS Low-Emitting Materials (LEM) Table or acceptable labeling or certification programs acknowledged on the CHPS web site. Additionally, products not currently listed may be tested by an independent laboratory as prescribed by CHPS. Provided the results of the tests are accepted by CHPS, credit may be obtained assuming all other requirements have been met.

Applicability

This credit applies to all projects.

Resources

CHPS Best Practices Manual: Design Volume: Interior Surfaces and Finishes Chapter.

CHPS *Product Database*: http://www.chps.net/dev/Drupal/node/445

Health Considerations When Choosing School Flooring, Asthma Regional Council of New England: www.asthmaregionalcouncil.org/indoor-and-ambient-air-quality

South Coast Air Quality Management District (SCAQMD) Rule 1168, Adhesive and Sealant Applications: http://www.aqmd.gov/rules/reg/reg11/r1168.pdf

State of California DHS, *Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chamber:* http://www.dhs.ca.gov/iaq/VOCS/Practice.htm

The following are currently available 3rd-party certifiers of low-emitting material products; check the CHPS web site to determine which listed products are acceptable.

- Carpet and Rug Institute: *Green Label Plus* http://www.carpet-rug.org/commercial-customers/green-building-and-the-environment/green-label-plus/index.cfm
- Greenguard Environmental Institute: *GREENGUARD Product Emission Standard For Children & Schools* http://www.greenguard.org/Default.aspx?tabid=110
- Scientific Certification Systems: *FloorScore:* http://www.scscertified.com/iaq/floorscore.html and *Indoor Advantage Gold* http://www.scscertified.com/iaq/indooradvantage.html

EQ.C4: Ducted Returns

Intent: Prevent dust and microbial growth issues associated with plenum returns.

Plenum returns are easily contaminated with dust, dirt and microbial and fungi growth. Ducted returns, though more expensive upfront, will help prevent such after installation problems and reduce maintenance and repairs.

Requirement

1 point	EQ.C4.1 Install ducted HVAC returns throughout the school in occupied spaces to avoid dust and microbial growth issues.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

Ceiling plenum returns are easily contaminated with dust and microbial growth. Ducted returns help prevent such problems and reduce maintenance and repairs.

Provide a letter signed by engineer verifying ducted HVAC returns will be installed.

Examples of non-regularly occupied spaces include storage, mechanical or laundry rooms with low occupancy.

Applicability

This credit applies to all new construction and can be incorporated into renovation projects.

Resources

None.

EQ.C5: Enhanced Filtration

Intent: Provide adequate air filtration to ensure good indoor air quality.

Enhanced air filtration improves indoor air quality especially for schools located near outdoor particulate sources such as highways. Filtration also protects the HVAC equipment. Filters remove airborne particulate material based on their size, shape and density. Filters are rated by different standards (e.g. arrestance and dust spot, MERV) that measure different aspects of performance. ASHRAE standards use the MERV or Minimum Efficiency Reporting Value (MERV) ratings. The higher rating indicates higher particle capture efficiency and capture of smaller particles. As a filter becomes loaded with captured particles, static pressure will increase across the filter bank, which requires more fan power. It is important to select a filter that is specifically designed for the specific application and to make sure that the HVAC filter enclosures designed to perform with the filter in place without leakage around filter.

Requirement

1 point	EQ.C5.1 Design the HVAC system with particle arrestance filtration rated at Minimum Efficiency Reporting Value (MERV) of 13 in all mechanical ventilation systems. Install new filters immediately prior to occupancy.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

Filters rated at MERV 13 will ensure very good quality ventilation air by blocking minute particles and allergens. Note: MERV 13 filters do not fit into unit ventilators. Therefore, schools with unit ventilator systems will not qualify for this point. The pressure drop may be greater with MERV 13 filters versus filters with lower MERV ratings, and therefore, more energy may be required to draw air through these filters. There is often a trade off between incremental indoor air quality improvements and energy efficiency that design teams should bear in mind. This credit may be especially desirable in environments where outdoor air quality is a serious concern, for example near schools in close proximity to heavy traffic.

Reference specification sections for MERV 13 filters in all HVAC air handling systems. Designate the CSI number, section, and page number that highlight compliance with this requirement.

Applicability

This credit applies to all new construction and can be incorporated into renovation projects. For new construction or renovations that replace HVAC equipment, specify systems that accept the required filter efficiency without a loss of operating efficiency.

Resources

None.

EQ.C6: Post Construction IAQ

Intent: Improve indoor air quality by minimizing the amount of indoor pollutants that are distributed and retained by the surface materials and ventilation systems during construction.

Requirement

1 point	EQ.C6.1 Vacuum carpeted and soft surfaces with a certified vacuum or high-efficiency particulate air (HEPA) filter vacuum that meets or exceeds the CRI Seal of Approval/Green Label Vacuum Cleaner Program after construction is complete and prior to occupancy. For phased, occupied renovations, HEPA vacuum the carpet daily in occupied areas. EQ.C6.2 Prior to flushout, filters must be replaced with at least Minimum Efficiency Reporting Value (MERV) 10 filters or higher and replaced again after flushout with a minimum of MERV 10 filters or higher. For unit ventilator systems, a minimum of MERV 7 filters must be installed and then replaced with MERV 7 filters after flushout.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

EQ.C6.1

Reference specifications for vacuuming of carpeted floors prior to full building occupancy. For phased, occupied renovations, submit a signed letter from the Superintendent stating that carpeting in occupied areas of the school will be vacuumed on a daily basis.

EQ.C6.2

Reference specifications calling for installation of MERV 10 filtration or higher media prior to building flushout and post flushout. MERV 7 filters are required for unit ventilators systems both prior and following building flushout. Designate the CSI number, section, and page number that highlight compliance with this requirement.

Applicability

This credit applies to all projects. For new construction or renovations that replace HVAC equipment, specify systems that accept the required filter efficiency without a loss of operating efficiency.

Resources

The Carpet and Rug Institute (CRI) Green Label Vacuum Program: http://www.carpet-rug.org/commercial-customers/cleaning-and-maintenance/seal-of-approval-products/vacuums.cfm

EQ.C7: Enhanced Acoustical Performance

Intent: To design HVAC systems and classrooms to provide acoustic levels that do not interfere with student and teacher communication.

Student learning suffers in acoustically poor environments. Excess noise from exterior sources, loud HVAC systems, or nearby rooms can make it difficult, and sometimes impossible, for students and teachers to communicate.

Poor acoustics affect more children than just those with permanent hearing impairments. Children with learning disabilities, language impairments, or children who are English language learners are also adversely affected by poor acoustics. In addition, children in general do not have fully developed language and auditory skills making quality acoustics very important for learning.

School officials and designers are strongly encouraged to move beyond the prerequisite to achieve background noise levels of NC30 (Noise Criteria) for all classrooms (approximately equivalent to 35 dBA) and sound isolation standards recommended by ANSI (American National Standards Institute).

It may not be possible to reach NC30 with unit ventilator systems, so consider HVAC system options other than unit ventilators. If you do opt for unit ventilators, however, it is important to select quieter models that can operate at low speeds.

Important aspects of classroom acoustical design include isolation from exterior noise (wind loads, traffic, and loud outdoor activities), elimination of interior noise (from HVAC systems, foot traffic, and other classrooms), and the use of appropriate wall assembly, window systems, and interior surface materials to minimize sound propagation and reduce reverberation times in the classrooms. The most common sources of interior mechanical noise are the air conditioning and air-handling systems, including ducts, fans, compressors, condensers, and dampers. The selection, location, and isolation of this equipment should be reviewed to minimize its impact on sound-sensitive spaces within school facilities.

Note: The acoustic measures listed in this section are not suitable for the learning environment needed for hearing-impaired children, which requires even further enhancements of the acoustical environment. Refer to the American Speech-Language-Hearing Association for further guidance.

Requirement

	To claim points below, the project must comply with the prerequisite EQ.P9.
1 point	EQ.C7.1 Classrooms and core learning spaces with volumes greater than 20,000 cubic feet must have a 1.5 second reverberation time maximum.
2 points	EQ.C7.2 Unoccupied classrooms must have a maximum background noise level of no more than 35 dBA Leq. Classroom testing must be performed to ensure noise level and reverberation times have been met.
1 point	EQ.C7.3 Add to school commissioning requirements (in EE.P2) that background HVAC noise (sound and reverberation) is tested to the requirements set forth in EQ.P9 and EQ.C7.2. Use the ASHRAE Recommended Procedure for Measuring the HVAC System – Induced Noise in a Room.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

ANSI Standard S12.60-2002 recommends 35 dBA as the maximum allowable background levels for unoccupied school classrooms. Strategies for improving the background noise levels include using HVAC systems that are remotely located and acoustically isolating mechanical equipment from classrooms. In areas with high ambient noise levels from traffic, trains, airports or industry, special construction must be used in the design of the building envelope to provide acceptable sound isolation. To provide a realistic and representative measurement method for both steady-state HVAC noise and time-varying exterior environmental noise, the Noise Equivalent Level (Leq), is measured over a minimum ½-hour period during class session hours, in unoccupied classrooms. The Leq is the equivalent steady-state A-weighted sound level that, in a stated period of time, would contain the same acoustic energy as the time-varying sound level during the same time period.

A “core learning space” as defined by ANSI, and accepted by MA-CHPS is “spaces for educational activities where the primary functions are teaching and learning and where good speech communication is critical to a student's academic achievement. These spaces include, but are not limited to, classrooms, (enclosed or open plan), instructional pods or activity areas, group instruction rooms, gymnasiums, conference rooms, libraries, offices, speech clinics, offices used for educational purposes and music rooms for instruction, practice and performance.”

The standard anticipates two primary noise sources, steady HVAC equipment noise and the usually unsteady exterior environmental noise. In classrooms with no significant exterior noise contributions the HVAC noise can be measured with a short term (15 second) reading in lieu of a formal integrated Leq. If HVAC equipment noise (produced while operating in its maximum condition), is at least 5 dBA above the other ambient noises due to other sources, a longer term Leq measurement is not required. Short-term measurements shall be taken in each classroom.

Where the measured ambient noises due to other sources is within 5 dB of the measured overall noise (HVAC and exterior intrusive noise, a measurement of at least ½ hour duration shall be made in at least two classrooms in each building in the worst case (noisiest) locations on the school site during normal school days and hours. The standard anticipates two primary sources, HVAC equipment and the exterior environmental noise. In order to verify compliance for exterior noise combined with HVAC noise a measurement of at least ½ hour duration shall be made in at least two classrooms in each building in the worst case (noisiest) locations on the school site during normal school days and hours.

In classrooms with no significant exterior noise contributions the HVAC noise can be measured with a short term (15 second) reading. The HVAC equipment must be operating in its maximum condition and its level must be at least 5 dBA above the ambient due to other sources. Short-term measurements shall be taken in each classroom.

The reverberation times can be measured in three octave bands with center frequencies of 500, 1000, and 2000 Hz. The arithmetic average value shall be compared to the standard.

Important aspects of classroom acoustical design include isolation from exterior noise (wind loads, traffic, and other loud outdoor activities), elimination of interior noise (from HVAC systems, foot traffic, and other classrooms), and the use of appropriate wall assembly and interior surface materials to minimize sound propagation and reduce reverberation times in the classrooms. The most common sources of interior mechanical noise are the air conditioning and air-handling systems, including ducts, fans, condensers, and dampers. Architects and engineers must design to these levels. Verification should be integrated with building commissioning.

Conduct tests to ensure acoustic requirements are met. As opposed to testing every classroom, sample classrooms with common types (i.e. finishes, windows, site location, and size) - and classrooms with a shared walls with an abnormally load spaces (i.e. music) must also be tested to document compliance with the requirements as follows:

- Reverberation time measured in accordance with (ANSI Standard S12.60-2002). The measurements shall follow procedures in conformance with, or equivalent to, those specified for field tests. The recommended sound signal is random noise with a bandwidth extending at least from 315 Hz to 3150 Hz. Reverberation times shall be measured at least at the key location noted in E336 of ANSI s12.60 Annex E for each learning space where reverberation times are to be measured.
- Sound Insulation measured in accordance with ASTM E336 and E413.
- Background HVAC noise measured in accordance with ASHRAE Recommended Procedure for Measuring the HVAC System - Induced Noise in a Room.
- Impact Insulation Class measure in accordance with Field Impact Insulation Class (FIIC) rating of a floor/ceiling assembly, prescribed in ASTM E 1007.

Applicability

This credit applies to all projects.

Resources

National Clearinghouse for Educational Facilities: www.edfacilities.org/.

Acoustical Society of America: http://asa.aip.org/ and http://asa.aip.org/classroom/booklet.html

American National Standards Institute: www.ansi.org/

EQ.C8: Controllability of Systems

Intent: Enable teachers to have reasonable control of the thermal environment within their classrooms.

Operable windows are important for both personal comfort and emergency operation, and have been shown to improve student performance.

Temperature and Ventilation Controls: A high performance school is a comfortable place to learn. Temperature and humidity are important factors in maintaining occupant comfort. A comfortable and healthy indoor environment increases productivity and learning and reduces absenteeism. Increased humidity can induce mold growth, which leads to indoor air quality concerns.

Requirement

1 point	EQ.C8.1 Ninety percent (90%) of all classrooms shall have a minimum of one operable window per classroom that is reasonably accessible to the occupants, i.e., precludes use of ladders to adjust the window opening.
1 point	EQ.C8.2 Provide separate temperature and ventilation controls for each classroom or provide each classroom with an independent temperature sensor to automatically adjust to the conditions in the individually classroom, but that is not necessarily controlled by the teacher. And provide lighting controls for each classroom.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

Operable windows are important for personal comfort, and have been shown to improve student performance. Provide at least one operable window in each classroom. Train teachers how to properly use the HVAC controls in their rooms and how opening doors and windows affects the HVAC system.

Individual classrooms will vary in temperature depending on their orientation, glazing apertures, occupancy, and the effectiveness of the heating or cooling systems. Provide individual systems to allow teachers to regulate the lighting and temperature of their classrooms.

Operable Windows

Reference specifications for operable windows. Designate the CSI number, section, and page number that highlight compliance with this requirement. For the purposes of this part of the credit, classrooms are:

- General classrooms
- Art rooms
- Music rooms
- Science rooms
- Computer rooms
- Special needs, remedial, and collaborative space

Submit floor plans with operable windows in each classroom highlighted and provide a brief narrative stating how many windows meet this requirement.

Temperature/Lighting Controls

Submit specifications showing adjustable thermostats in the classroom types listed above. Provide a narrative description of how occupants may control light levels in each classroom. Classrooms are defined as in the bulleted list above.

Cross-Category and Other Considerations

This credit is related to EE.P1 & C1, Energy Performance; EE.P3, Occupant Training; and II.C2, Innovation. Temperature control systems should not give teachers free range to adjust the temperature to whatever they desire. It is possible to install systems that allow teachers to adjust the temperature in a room to within 1-2 degrees of the standard setting for the season (e.g. 70° in winter) that will improve their comfort while not having a significant adverse impact on the building's energy efficiency. Establishing a standard temperature setting for the entire building is an important corollary action.

Applicability

This credit applies to all projects.

Resources

CHPS Best Practices Manual, Design Volume: HVAC Chapter

EQ.C9: Duct Access and Cleaning

Intent: Protect air quality after construction.

Because school construction typically occurs over a number of seasons in New England, it is not uncommon for the construction team and sub-contractors to run the heating and cooling systems as interior work on the school is completed. However, this practice can entrain dust and debris into the ductwork especially in areas that use return air to help temper the air for certain spaces. This credit encourages the project to clean ducts by building in access doors where appropriate and to hire a duct cleaning vendor to complete the work.

Requirement

1 point	EQ.C9.1 Provide access doors for cleaning all supply and return ductwork and execute a plan for cleaning ductwork prior to occupancy by students and staff.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

Filters meant for occupancy of the building should be put in place after duct cleaning work is complete.

Supply a letter signed by the project's professional engineer certifying that the supply and return ductwork has been designed with access doors to allow for cleaning OR provide mechanical drawings with access doors highlighted for all ductwork in the building. Provide a copy of a purchase order from the town or city for the duct cleaning work or an invoice from the duct cleaning company.

Applicability

This credit applies to all projects.

Resources

None.

EQ.C10: Electric Lighting

Intent: Provide high quality and flexible classroom lighting.

Progressive learning institutions are rapidly moving to better prepare students for today's high-tech, postindustrial world. Many new forms of learning have gained acceptance, as emerging technologies enhance the quality and efficiency of information delivery. These varied media including video, large-screen interactive presentations, and networked computer access to images and data, place new demands on the physical space. K-12 classrooms must be adaptable to support widely varying media and learning activities.

Requirement

1 point	EQ.C10.1	Provide multi-scene indirect/direct lighting systems for all classrooms, with the exception for specialty classrooms where direct lighting only is required for educational purposes.
	EQ.C10.2	The lighting system shall operate in two modes: general illumination and A/V. When general illumination is required, daylighting harvesting should take precedent, if daylight controls are installed.
	EQ.C10.3	In general illumination mode, achieve an average illumination at the desk level of 35 to 50 footcandles with a minimum of 25 footcandles at any point more than 3 ft from any wall.
	EQ.C10.4	In A/V mode, not including contribution from the teaching wall light, achieve an average illumination at the desk level of between 10 and 20 footcandles for any point in the room greater than 3 ft from the side walls, 10 ft from the front wall and 6 ft from the back wall, while limiting vertical illumination on the projection screen to no more than 7 footcandles at any point on the screen.
	EQ.C10.5	In indirect mode, controls shall provide at least two levels of uniform lighting both at night and when daylight is available.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

A lighting computer program shall be used to determine the performance characteristics of the electric lighting system in typical classrooms. Minimum required calculations shall include point-by-point analysis of horizontal illumination levels at desk height in both modes, vertical illumination levels of the teaching wall in general lighting mode, and vertical ambient illumination on the projection screen in A/V mode. Calculations must be carefully set up to analyze only the specific tasks or zones as defined in the requirement. Use of a lighting analysis program employing radiosity and/or ray tracing is necessary. Some acceptable software packages include Lumen Micro 2000, Lumen Designer, AGI32, Radiance, Desktop Radiance, LightPro, Luxicon and Visual. CHPS may pre-approve typical lighting solutions as meeting the requirements.

Applicability

This credit applies to all new classrooms and can also be earned in renovation projects when classroom lighting is included in the scope of work. Many renovation projects include the installation of new lighting systems, providing an excellent opportunity to install energy efficient, high quality electric lighting that is integrated with the available daylight.

Resources

CHPS Best Practices Manual Design Guidelines EL2 and EL3

Advanced Lighting Guidelines: 2003 Edition: www.newbuildings.org/lighting.htm.

EE.P1: Minimum Energy Performance

Intent: Reduce environmental impacts and operational costs associated with consuming energy.

Energy-efficient schools save money while conserving non-renewable energy resources and reducing atmospheric emissions of pollutants and greenhouse gases. MSBA regulations and other state legislation, such as The Green Communities Act of 2008, support the construction of energy efficient schools throughout the Commonwealth whether facilities are additions/renovations or new construction. The minimum requirements of the Massachusetts Building Energy Code, while effective, can be met and exceeded using numerous cost-effective, practical, and straightforward measures.

Energy modeling is an effective tool for achieving energy savings and is a critical part of an integrated design approach. Various combinations of building systems can be modeled using specialized software to show payback calculations for different energy saving measures. The most effective energy modeling is an iterative process whereby different combinations of measures, such as daylighting, HVAC systems controls, lighting systems and controls, and energy recovery equipment, are modeled to determine the best payback and to minimize operational costs.

Another effective approach is to follow the prescriptions developed by others through modeling. The prescriptive approach is much less costly upfront than modeling. The goal of both approaches is to integrate the design of all significant building systems including HVAC, lighting, and building envelope to reduce source energy of the proposed design below what is required by 780 CMR Chapter 13.

Requirement

Prerequisite	EE.P1.1 Follow the current MA Stretch Energy Code (780 CMR Appendix 120 AA, Chapter 5) to achieve energy savings either through the Performance based approach (20% better than the current ASHRAE 90.1 on an energy cost basis) OR the Prescriptive based approach as defined below.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

The Stretch Energy Code is the International Energy Conservation Code (IECC) 2009 with amendments. A copy of the Stretch Code is contained in Appendix A. The Stretch Code offers a Performance path, which as of 2009 is based on ASHRAE 90.1 2007, and a Prescriptive path that is an amended version of Chapter 5 of IECC 2009. Schools that are greater than 100,000 square feet must use the Performance path contained in Section 506. Schools that are 100,000 square feet or less may choose between the Performance approach and the Prescriptive approach contained in Sections 502-505 and 507 of the Stretch Code, with MA-CHPS modifications defined below. The two approaches may not be combined.

Performance Approach

Follow Section 506 of the Stretch Code, modeling the school to show that it will achieve 20% lower energy costs than one built to the energy requirements of the version of ASHRAE/IESNA Standard 90.1 specified in the Stretch Code. Calculations should be made according to ASHRAE 90.1, Informative Appendix G Simulation General Requirements for the Performance Rating Method. Savings should be based on ***total energy loads***, and contribution from on-site generation can be counted towards energy savings. Among other things, Appendix G requires a computer based simulation program for analysis of building energy consumption.

A list of acceptable energy modeling software programs can be found at http://www1.eere.energy.gov/buildings/qualified_software.html, and include but are not limited to DOE-2, BLAST, or Energy Plus.

Identify and quantify all potential "plug loads" (also known as process energy) that will be incorporated in the school. Note that points may be earned under EE.C4 for installing ENERGY STAR equipment and developing a plug load reduction plan. Plug loads are defined here as office and general miscellaneous equipment, shop equipment, vending machines, computers, kitchen cooking equipment and refrigeration, appliances, and laundry washing/drying.

Plug loads shall be identical for both the baseline and proposed building performance rating. However, project teams may follow the Exceptional Calculation Method (ASHRAE 90.1-2007 G2.5) to document measures that reduce process loads. Documentation of process load energy savings shall include a list of the assumptions made for both the base and proposed design, and theoretical or empirical information supporting these assumptions.

Prescriptive Approach

Applicants may demonstrate compliance with this energy prerequisite by following the prescriptive package of energy conservation measures listed below. The list contains a mix of sections from the 2009 Stretch Code and modifications established by MA-CHPS. If a more recent version of the Stretch Code exists, then it should be followed as applicable.

The following sections of the Stretch Code must be implemented in addition to the appropriate retained sections of IECC 2009, e.g. subsection 503.2.5 and Section 504:

- 502 (Building Envelope Requirements)
- 503 (Building Mechanical Systems –specifically subsection 503.2.1, using equipment meeting efficiency requirements in 507, see below)
- 505 (Electrical Power and Lighting Systems – except Table 505.5.2)
- 507 (Alternative Prescriptive Compliance Packages - Alternative a. 507.2.1 Efficient Mechanical Equipment)

The following modifications must be followed:

Lighting Power Density (LPD): Average Installed lighting equipment power density shall not exceed 1.0 Watts/ft^2 for the entire school. This modification replaces Tables 505.5.2 and 507.2.2 of the Stretch Code.

Automatic Light Reduction: Subsection 505.2.2.1.1 Occupancy Sensors is modified as follows: The last sentence is replaced with: Automatic control devices shall be installed to automatically turn off lights within 15 minutes of all occupants leaving the space. The following spaces are included:

- General classrooms including art, music, science, and computer rooms
- Special needs, remedial, and collaborative spaces
- Conference/meeting rooms
- Library
- Private offices
- Administrative Spaces

- Restrooms
- Break rooms
- Storage rooms and janitorial closets
- Any other space of 300 s.f. or less enclosed by ceiling height partitions

Exceptions:

- Emergency lighting
- Night security lighting
- Task Lighting
- Spaces with only one luminaire
- HID luminaires shall reduce the connected lighting load in a reasonably uniform illumination pattern by at least 40 percent.

Dimming/Switching/Bi-Level Control for Lighting. Light switches shall be installed such that more than one level of artificial illumination is possible.

Each perimeter and non-perimeter regularly occupied space enclosed by ceiling-height partitions shall have a manual control to allow the occupant to uniformly reduce the connected lighting load by at least 50%.

This requirement applies to the following spaces:

- General classrooms
- Art rooms
- Music rooms
- Science rooms
- Computer rooms
- Library
- Physical education
- Special needs, remedial, and collaborative space
- Cafeteria
- Administration spaces

Exception: HID luminaires shall reduce the connected lighting load in a reasonably uniform illumination pattern by at least 40%.

Daylight Responsive Lighting Control: Follow 505.2.2.1.3 of the Stretch Code with the exception of the following: Theatrical lighting, specialty lighting, and task lighting.

Fenestration Performance: Follow 502.3.2 of the Stretch Code.

Premium Efficiency Motors: For all motors greater than or equal to 1 horsepower, install premium efficiency motors as defined by the National Electrical Manufacturers Association (NEMA). Link: www.nema.org/stds/complimentary-docs/upload/MG1premium.pdf

Mechanical System Design – Follow subsections 503.2.1 and 507.2.1

Boilers/Burners Selection and Sizing: When the school design includes a boiler plant, the size of any single boiler shall not exceed 50% of the calculated design building heating load. For power burners larger than 400,000 BTU/h, fully modulating burners shall be used.

Boilers are typically sized to meet the building heat loss and ventilation air heating loads at winter design temperature conditions without taking credit for internal heat sources such as lights, equipment, and people. This results in the boilers that are oversized for most of their operating conditions. Oversized boilers are inefficient due to fixed losses, such as radiative heat losses. These fixed losses are inversely proportional to the boiler load. Therefore, radiative heat losses, which can be as little as 1% at full load, can become 5% to 20% at partial load.

On top of fixed losses, inefficiencies also result when boilers "short cycle"; which occurs when an oversized boiler quickly satisfies the heating load, cycles off for a brief period, and then cycles on again. Larger boilers with power burners that have pre- and post- purge cycles are particularly inefficient when they undergo short cycling, since with each cycle, air used to flush the boiler during purging is heated and vented to the chimney. Short cycling also adversely affects the boiler life because the boiler is rapidly heated then cooled, and burner motors are cycled on and off, reducing the longevity of the boiler heat exchanging surfaces and burner motors.

To avoid these problems, size the boiler plant to efficiently meet both the peak and part load heating requirements of the building. Provide multiple boilers, each sized at some fraction less than 50% of the design building heating load, and use modulating burners on larger boilers so that they can operate over a wide load range without short cycling.

Exception: Boiler plants that utilize condensing boilers or plants where each boiler capacity is smaller than 300,000 BTU/h.

Boiler Efficiency: Follow Table 507.2.1(5) with the following addition:

Equipment Type	Size Category	Minimum Efficiency
Gas Hot Water	≥ 2.5 mBtu/h	89% *Et*

Efficient Cooling Equipment: Follow tables in Section 507

CO_2-Based Demand Controlled Ventilation: Follow subsection 503.2.5.

Variable Speed Control: Individual pumps serving variable flow systems and VAV fans having a motor horsepower of 7.5 hp or larger shall have controls and/or devices (such as variable speed control) that will result in pump or fan motor demand of no more than 30% of design wattage at 50% of design flow.

Note 1: If an HVAC unit has a 7.5 hp or larger supply fan, but the return fan is smaller than 7.5 hp, the requirement for variable speed control still applies. This assumption is made since the control method used on the supply fan is almost always the same as that used on the return fan.

Note 2: In some types of boiler plant configurations (especially where larger, non-condensing boilers are used in conjunction with primary-only variable flow hot water loops), it is possible that a net energy cost penalty may occur if the hot water pump is optimized through this measure (i.e. variable frequency drives (VFD's) are installed for hot water pump capacity control). Although VFD's reduce electricity consumption for pumping, they simultaneously reduce heat energy from the pump. As a result, more thermal energy is required from the boiler plant. Depending on one's utility rate structure, the efficiency of the boiler plant at part loads, and other

factors, VFD's for the hot water loop may result in a net energy cost increase for the building. In such circumstances, the VFD requirement for the hot water pump may be waived. Quality engineering analysis shall be applied to assess whether such exception may be relevant to a particular project.

Design Documentation

Lighting Power Density—U.S. Department of Energy's ComCheck output clearly indicating lighting power densities for the entire building. ComCheck is the software developed by the U.S. DOE to help commercial projects demonstrate compliance with all commercial energy code requirements for envelope, lighting, and mechanical systems. For more information, see: http://www.energycodes.gov/comcheck/

Automatic Light Reduction—Supply a letter signed by the project's professional engineer certifying that the automatic lighting reductions will be achieved according to the criteria listed above. Include a brief narrative of the approach used; reference appropriate specification sections for lighting controls and drawing numbers of lighting control schedules and drawings showing the control devices as designed. For computer scheduled lighting reductions, provide a narrative describing how your system works including relevant software and hardware.

Dimming/Switching/Bi-Level Control for Lighting—Supply a letter signed by the project's professional engineer certifying that the above criteria for controlling lighting levels will be achieved. Include in the letter references to appropriate specification sections for dimming, switching or bi-level controls; reference drawing numbers of dimming, switching, or bi-level control schedules; and reference drawings showing the devices as designed.

Daylight Responsive Lighting Control—Supply a letter signed by the project's electrical professional engineer showing the total lighting wattage of the school building and the total lighting wattage controlled by daylight responsive lighting controls. The ratio of daylight responsive wattage to the total installed lighting wattage should be 15% or greater.

Fenestration Performance—Reference fenestration specifications. Please designate the CSI numbers, sections, and page numbers that highlight the U-Factor for each type of fenestration.

Premium Efficiency Motors—Reference specification sections. Designate the CSI numbers, sections, and page numbers that highlight compliance with this requirement.

Mechanical System Design—Provide documentation that shows the methodology for calculating peak load and partial load conditions.

Boilers/Burners Selection and Sizing —Supply a letter signed by the project's mechanical professional engineer certifying that the above criterion is met. The letter should include the assumptions and calculations that guided the sizing of burners and boilers. Include with the letter, outputs from HVAC system design software (e.g. Trane/Trace or Carrier software, or other equivalent software) showing peak load design parameters.

Boiler Efficiency—Reference specification sections for boiler efficiency. Designate the CSI number, section, and page number or drawing numbers that highlight compliance with this requirement.

Efficient Cooling Equipment—Reference specification sections for efficient cooling equipment. Designate the CSI number, section, and page number or drawing numbers that highlight compliance with this requirement.

CO_2 -Based Demand Controlled Ventilation—Reference appropriate specification sections indicating the implementation of CO_2 sensors and their placement away from outdoor sources of CO_2 exhaust OR reference specifications calling for heat recovery systems with a minimum effectiveness of 50% or total energy recovery of 65% sensible heat.

Variable Speed Control—Supply a letter by the project's mechanical professional engineer certifying that the criteria for Variable Speed Control systems are met; include references to appropriate specification sections and drawings.

In the project commissioning report, the summary of functional testing reports will be reviewed for lighting controls (daylight, occupancy, light switching), HVAC systems (such as hot water systems, chilled water systems, central air systems, ventilation systems), domestic hot water systems, and energy management system. The commissioning report should verify that the requirements for performance testing and actual performance have been met.

Applicability

This prerequisite applies to all projects. For major additions/renovation a variance may be granted depending on the scope of the project.

Resources

Commonwealth of Massachusetts State Building Code, 780 CMR Chapter 13 and *Stretch Code,* 780 CMR Appendix 120 AA. See Appendix A of this document for Section 5 of the Stretch Code.
http://www.mass.gov/Eeops/docs/dps/inf/780_CMR_Chapter_13_energy.pdf

2009 IECC and ANSI/ASHRAE/IES Standard 90.1-2007 Energy Standard for Buildings Except Low-Rise Residential Buildings, published jointly by ICC and ASHRAE.
http://www.iccsafe.org/Store/Pages/Product.aspx?category=7130&cat=ICCSafe&id=7802S09

ENERGY STAR—www.energystar.gov/—ENERGY STAR is a federal government-sponsored program helping businesses and individuals protect the environment through superior energy efficiency.

Rebuild America—www.rebuild.org/sectors/ess/index.asp—Rebuild America manages the Energy Smart Schools program.

The Consortium for Energy Efficiency (CEE) provides information on high performance equipment: www.cee1.org

EE.P2: Commissioning

Intent: Verify that fundamental building elements and systems are designed, installed, and calibrated to operate as intended, and provide for the ongoing accountability and optimization of building energy performance over time.

Commissioning, maintenance, and training are vitally important to the performance of the school and are key to maintaining energy efficiency. Commissioning involves a rigorous quality assurance program that ensures the building and its systems are built and operated as designed and that the school district receives the proper training and documentation needed to operate and maintain the building. No building can perform optimally without adequate maintenance. Training is critically important for maintenance staff to thoroughly understand how to maintain and operate the building systems. When staff turnover occurs, appropriate documentation must be on hand in order to train new team members.

Do not underestimate the value of commissioning. Buildings, even simple structures, are complex systems of electrical, mechanical, and structural components. High performance buildings are healthy, efficient, environmentally sensitive structures whose performance can be significantly affected if the building has not been designed following the owner's project requirements or constructed according to the designers' specifications. Commissioning is a rigorous quality assurance program administered by a knowledgeable third party that ensures the building performs as expected.

This prerequisite requires a commissioning process to be in place early in the design process and carries through to the post-occupancy 10-month warranty review and subsequent completion of a commissioning report.

Requirement

Prerequisite	EE.P2.1 Implement ALL of the fundamental best practice commissioning procedures, as described below and contained in the Massachusetts School Building Authority's *Standard Scope of Commissioning Services*. Public schools will meet this prerequisite automatically because MSBA contracts directly for commissioning. Non- MSBA-funded schools must implement the following: Engage an independent, third-party commissioning agent. The commissioning agent will be responsible for commissioning the following critical building systems: *Electrical Systems*: • Lighting controls (daylight, occupancy, timing switches, etc.); • On-site renewable solar electric or wind systems • Voice and data systems • Electrical distribution systems • Life and safety systems *Mechanical Systems:* ▪ HVAC systems (such as hot water systems, chilled water systems, central air systems, ventilation systems); ▪ Domestic hot water systems; ▪ Energy management system ▪ Renewable energy heating systems *Plumbing Systems:* • Flow control devices • Pumping systems • Special hazardous waste treatment systems (e.g. for lab wastes) • Domestic hot water systems • Graywater systems (if applicable) *Building Envelope and Roofing Systems* Review design intent and basis of design documentation. Conduct a focused review of the design prior to the construction documents phase. Conduct a focused review of the construction documents when close to completion. Include commissioning requirements in the construction documents. Develop and utilize a commissioning plan. Conduct a selective review of contractor submittals of commissioned equipment. Review the Operations & Maintenance manual. Verify installation, functional performance testing (including off-season testing), training, and operations and maintenance documentation. A minimum 15% sampling strategy for testing terminal units and repetitive units is permissible. All major systems must be tested. Participate in training of facility staff in accordance with the training plan. Complete a commissioning report. Conduct a 10-month warranty, post-occupancy review.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

The following list describes each of the commissioning steps listed above in greater detail.

- *Engage a commissioning agent*. The commissioning agent (CA) directs the commissioning process and should be hired in time for the design development phase. The commissioning services must be performed by an independent third party, i.e. not part of the design or construction management of the project. For non MSBA-funded school projects, the CA may be hired by the owner, the owner's project manager, or the design firm as long as the CA is not an employee of the design firm and reports to both the school district and the design firm. The CA should satisfy the qualifications of, and perform in accordance with, the Building Commissioning Associations' (BCA) 1999 version of the Essential Attributes of Building Commissioning. The CA must have experience commissioning similar projects in accordance with this standard.
- *Review design intent and basis of design documentation.* The architect and the design engineer are the most appropriate people to create this document, which should list the owner's project requirements and design intent for each of the systems or features to be commissioned. The CA will review this document, and a copy of the review shall be provided to the owner.
- *Conduct a focused review of the design prior to the construction documents phase*. This review early in the design process should be focused on an assessment of how well the design meets the owner's design intent. Assessment should be made as to how the design meets the functionality, utility performance, maintainability, sustainability, cost, and indoor environmental quality requirements outlined in the design intent. Evidence of the review is to be documented in the commissioning report.
- *Conduct a focused review of the construction documents when close to completion.* This review should be conducted prior to issuing the construction documents for bid and captured in the commissioning report. The review should answer these questions:
    - Does the design meet the owner's design intent?
    - Does the design allow for proper maintenance access?
    - Do the construction documents clearly detail the construction requirements?
    - Do the construction documents clearly define the commissioning requirements?
- *Include commissioning requirements* in the construction documents. All commissioning requirements must be integrated into the construction documents to clearly specify the responsibilities and tasks to be performed. Of particular importance are the delineation of the contractors' responsibilities regarding documentation, functional performance testing, occupant and operator training, and the creation of the operations and maintenance manuals.
- *Develop commissioning plan.* The commissioning plan includes a list of all equipment and systems to be commissioned, delineation of roles for each of the primary commissioning participants, and details on the scope, timeline, and deliverables throughout the commissioning process.
- *Conduct a selective review of contractor submittals of commissioned equipment*. Contractor submittals for the systems and equipment included in the commissioning scope shall be reviewed by the CA in conjunction with the designer's review. The review shall focus on the ability of the submitted product to

meet the owner's requirements and review comments shall be provided to the owner and the design team.

- *Review Operations & Maintenance manual.* This manual is intended to help future operating staff to understand and optimally operate and maintain the commissioned systems. The general contractor compiles the O&M manual and the commissioning agent reviews it for completeness and readability. The O&M manual must contain the following items:
  - As-built sequences of operations for all equipment as provided by the design professionals and contractors, including time-of-day schedules and schedule frequency, and detailed point listings with ranges and initial setpoints.
  - Ongoing operating instructions for all energy- and water-saving features and strategies.
  - Seasonal operational guidelines.
  - Recommendations for recalibration frequency of sensors and actuators by type and use.
  - Guidelines for continuous maintenance of the owner's project requirements (operational requirements) and basis of design (basis of operation).
- *Verify installation, functional performance testing, training, and operations and maintenance documentation for each commissioned system and feature.* The CA must complete off-season functional performance testing. This is the heart of the commissioning process.
- *Participate in training of facility staff in accordance with the training plan.* Included in MSBA's standard scope for commissioning, the CA may be charged with reviewing the training plan, developed by the Construction Manager/General Contractor, for adequacy. The CA may additionally be charged with participating in the training itself. This task is related to Energy Prerequisite 3, below.
- *Complete a commissioning report.* The report must show that the building's systems have met the design intent and specifications, have been properly installed, are performing as expected, and that proper O&M documentation and training have been provided. The report should include a compilation of all commissioning documentation described in this credit, including complete functional testing results and forms and should note any items that have not been resolved at the time the report is issued.
- *Ten month warranty, post-occupancy review*. The commissioning contract shall contain provisions for a 10-month warranty and post-occupancy review. The review is intended to bring the design, construction, commissioning, and facility staff together to solicit the facility staff's comments, suggestions, and areas of concern regarding the systems in their first year of operation. Warranties on any commissioned systems should be reviewed and deficient equipment should be identified and a plan for resolution developed.

Testing Sampling Criteria

The contractors shall submit to the CA documentation that they have performed installation and functional performance verification in accordance with the commissioning plan for all equipment components and systems. The functional performance test may be demonstrated to the CA for a sample of systems that comply with all of the following criteria:

- There are many of the equipment or systems with similar components and configurations. For component testing, sampling may apply where there are many identical component types with similar applications.
- The systems or equipment have identical sequences of operation which are implemented using identical control software programming or firmware settings.
- The components and systems to be included in the demonstrated samples shall be chosen by the commissioning authority at the time of demonstration.
- Building Automation System mapping of component to the operators graphic shall be demonstrated for all components.
- The trend logging portions of all functional performance test shall be completed for 100% of the systems or components

Failure Testing

The Commissioning Plan must also identify retesting protocols for components and systems that fail initial testing.

Applicability

This prerequisite applies to all school projects.

Resources

Massachusetts School Building Authority, www.massschoolbuildings.org

CHPS *Best Practices Manual*, Volume V: Commissioning

ASHRAE Guideline 1-1996: The HVAC Commissioning Process

ASHRAE Guideline 4-1993: Preparation of Operations & Maintenance Documentation for Building Systems

The Building Commissioning Association, Essential Attributes of Building Commissioning, 1999 Edition: http://www.bcxa.org/membership/attributes1999.htm

ASHRAE Guideline 0 – 2005 The Commissioning Process: http://webstore.ansi.org/RecordDetail.aspx?sku=ASHRAE+Guideline+0-2005

The National Clearinghouse for Educational Facilities includes a bibliography on commissioning: http://www.edfacilities.org/rl/commissioning.cfm

EE.P3: Facility Staff & Occupant Training

Intent: Training is the foundation of effective maintenance programs and is an essential tool to protect indoor air quality and maintain superior energy performance.

The design and construction of the school may incorporate all the latest high performance features, yet problems can occur simply because important information is not transferred from the design and construction teams to the school facilities and maintenance staff, or to the building occupants. Training the facilities and maintenance staff is essential to the performance of the building, but is often not performed or is hastily completed. Training the teachers and administration staff in how they can control their room environments provides them with an understanding that will help the facilities staff keep the building performing optimally.

Requirement

Prerequisite	EE.P3.1 Training is the foundation of effective maintenance programs and is an essential tool to protect indoor air quality and maintain superior energy performance. Facility Staff Training: Facility staff must receive training and operation and maintenance documentation on all building systems included in the commissioning scope of work under the EE.P2 Commissioning prerequisite.
Prerequisite	EE.P3.2. Teacher/Administrative Staff Training: Teachers, administrators, and support staff must be offered training on operations of lighting, heating, and cooling systems in classrooms, offices, gyms, auditoriums etc. A User's Guide, explaining basic systems operations, should be developed and posted in each room of the school.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

EE.P3.1

The owner's project manager shall verify that the following required actions are planned for and executed.
Provide Operations & Maintenance training for facilities and maintenance staff on all major building systems from the bulleted list above. It is typical to specify training requirements in the construction contract and subsequently, the general contractor arranges for equipment vendors, controls contractors etc. to teach building operators how to use and maintain their new equipment. The training is overseen by the commissioning agent to ensure that the facilities staff receives the materials and hours of training stipulated in the construction contract. It is vital that facility and maintenance staff attend these training sessions.

Compile an Operations & Maintenance Manual: The manual should provide detailed operations and maintenance information for all equipment and products installed; it should be specifically written for maintenance and facility staff. The construction contractor typically furnishes the O&M manuals and the commissioning agent reviews the manual for completeness and clarity.

EE.P3.2

Create a brief and concise classroom "User's Guide" for teachers and administrative staff explaining how to operate their room lighting and HVAC systems. A User's Guide should be posted in every room of the school. A sample User's Guide is included in Appendix B.

EE.P3: Facility Staff & Occupant Training

Conduct Operations & Maintenance training for staff. Provide a short introduction for all school staff explaining how classroom systems work such as lighting and temperature controls, particularly if classrooms have operable windows and air conditioning systems.

It is strongly recommended that the training include a discussion of the school's indoor temperature settings and related policy, if any. Staff should be informed of what to expect in terms of temperature settings so that they do not ask the school operators to exceed the standard setting (recommended at no more than 70º during winter). Individual room controls typically allow for a "drift" of 1-2 degrees +/- the standard setting, which should be sufficient to allow an occupant to find a comfortable temperature without drastically altering the building's efficiency.

Cross-Category and Other Considerations

This prerequisite relates to all prerequisites and credits that involve operable building systems, including HVAC, windows, and room controls. Good training is critical for good operations, and good operations are critical for good building performance. The prerequisite also relates to the required Maintenance Plan in OM.P1. The operations & maintenance manual described here will be part of the plan, along with the inventory and schedule of maintenance.

Applicability

This prerequisite applies to all school projects.

Resources

ASHRAE Guideline 16: The HVAC Commissioning Process

ASHRAE Guideline 4: Preparation of Operations & Maintenance Documentation for Building Systems

LEED™ *Reference Guide*: Energy and Atmosphere Prerequisite 1 and Credit 3: Fundamental Building Systems Commissioning and Additional Commissioning

EE.C1(A): Superior Energy Performance (Performance Approach)

Intent: Exceed the minimum energy performance beyond the prerequisite.

There are significant opportunities to reduce energy use beyond the EE.P1 Minimum Energy prerequisite. Providing a more energy efficient building saves money for the school district, reduces environmental impacts and has a number of other long-term benefits.

Requirement

See points available below	EE.C1(A).1 Utilize the Performance Approach from Energy Prerequisite EE.P1 for quantifying energy cost savings. Points are awarded according the percentage saved over a baseline building.
2 points	22.5% reduction in total energy cost compared to 780 CMR Chapter 13
3 points	25% reduction in total energy cost compared to 780 CMR Chapter 13
4 points	27.5% reduction in total energy cost compared to 780 CMR Chapter 13
6 points	30% reduction in total energy cost compared to 780 CMR Chapter 13
7 points	32.5% reduction in total energy cost compared to 780 CMR Chapter 13
9 points	35% reduction in total energy cost compared to 780 CMR Chapter 13
10 points	37.5% reduction in total energy cost compared to 780 CMR Chapter 13
12 points	40% reduction in total energy cost compared to 780 CMR Chapter 13
13 points	42.5% reduction in total energy cost compared to 780 CMR Chapter 13
15 points	45% reduction in total energy cost compared to 780 CMR Chapter 13

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

To obtain credit, the school must achieve at least **22.5%** less energy cost than an ASHRAE 90.1-2007 (or current) minimum building, based on total energy loads. Modeling for the credit must be the same as for the prerequisite. Points are awarded for higher percentages of savings as indicated in the table above. No partial points are allowed.

Applicability

This credit applies to any project using the Performance approach.

Resources

See resources under EE.P1.

EE.C1(B): Superior Energy Performance (Prescriptive Approach)

Intent: Exceed the minimum energy performance beyond the prerequisite.

There are significant opportunities to reduce energy use beyond the EE.P1 Minimum Energy prerequisite. Providing a more energy efficient building saves money for the school district, reduces environmental impacts and has a number of other long-term benefits.

Requirement

2 - 4 points	EE.C1.1(B) Meet the requirements of EQ.C2, Daylighting in Classrooms AND ensure that 40% of the installed electrical lighting wattage throughout the school is dimmed or turned off when sufficient natural light is present. (2 points) EE.C1.2(B) Install an energy recovery ventilation (ERV) system to recover waste heat into the incoming fresh air stream. The ERV should include latent heat recovery with an effectiveness of 70% or higher unless precluded by local or internal humidity conditions. In that case, install an air-to-air sensible heat recovery system with an effectiveness of at least 50%. All units should be on the approved list of the Air Conditioning and Refrigeration Institute (ARI). For more information, see the *Core Performance Guide* from New Buildings Institute. (2 points)

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

Applicability

This credit applies to any project using the Prescriptive approach.

Resources

Advanced Buildings Core Performance Guide, New Buildings Institute: http://www.newbuildings.org. See Section 3.7, Heat Recovery.

Also see resources under EE.P1

EE.C2: Minimize Air Conditioning

Intent: Encourage schools to not install air conditioning.

Schools that are designed for the Massachusetts climate should not need to rely on air conditioning.

Requirement

1 - 3 points	EE.C2.1 Earn one point by designing and installing a dehumidification system, which tempers air but does not act as a full air conditioning system. Spaces such as computer classrooms and server rooms are exempt. For two points, design 80% of permanent classrooms without air conditioning. For three points, design 90% of permanent classrooms without air conditioning.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

This credit is intended to reward the avoidance of air conditioning, and its associated energy consumption, in classrooms where it is not needed due to limited summer use. However, there is growing recognition that tempered air, that is, air that is dehumidified but not cooled to the same degree as “air conditioned” air is a comfortable and affordable alternative. Dehumidification systems wring out a portion of the humidity from the air, delivering drier, more comfortable air. By contrast, air conditioning systems cool air to ~44ºF to thoroughly dry out supply air, and then reheat the air just before it is delivered to classroom or other spaces. While dehumidified systems do not provide precise cooling temperatures, they can be very comfortable because they do not overcool the air to reach the 44 degree temperature. As a result, they use roughly half of the energy of full air conditioning systems.

The decision to include dehumidification or not include air conditioning must be carefully weighed by the school building committee. The purpose of this credit would be defeated if window air conditioning units were later installed in classrooms. Therefore, the school district must be confident that the schedule of use and expected comfort levels will be obtained by whichever approach is selected.

For this credit, classrooms are defined as:

- General classrooms
- Art rooms
- Music rooms
- Science rooms
- Computer rooms
- Special needs, remedial, and collaborative space

For the minimal AC options, calculate the total number of classrooms without air conditioning versus the total number of classrooms. The credit is achieved if 80-90% of the classrooms are designed without air conditioning.

Note: ASHRAE Standard 55 thermal comfort standards are not expected to be met in non-air conditioned classrooms.

EE.C2: Minimize Air Conditioning

Applicability

This credit applies to all school projects.

Resources

CHPS Best Practices Manual: Design Volume II: Guideline TC3 on thermal displacement ventilation.

EE.C3: Renewable Energy

Intent: Encourage on-site or net-metered energy usage from renewable sources.

Renewable energy sources use the sun, air, and earth instead of non-renewable, polluting sources, such as coal, oil or natural gas. They include solar electric systems (photovoltaics), solar thermal systems (domestic water and space heating, sun chillers), non-polluting biomass, wind turbines, and geothermal sources (geothermal hot water, geoexchange water loops).

Requirement

1-5 points	EE.C3.1 Use renewable energy sources for electricity production that are on-site or allocated to the school facility through net metering. The table below shows the point levels corresponding to the percentage of energy cost savings supplied by renewable energy sources as compared to the total energy cost of the as-designed school, total loads. Note: The full points for EE.C3.1 are only available to projects that also earn 1 or more points for EE.C2, Minimize Air Conditioning. If a project does not earn any EE.C2 points, it is eligible for a maximum of 3 points, based on the size of the system, for this credit.	
	Electricity-Producing Renewables	Percentage Renewable Energy of As-Designed Energy Costs
	1 point	0.5%
	2 points	1.0%
	3 points	3.0%
	4 points	6.0%
	5 points	7.0%
1-7 points	EE.C3.2 Use on-site renewable energy sources for heating/cooling. The table below shows the point levels corresponding to the percentage of energy cost savings supplied by renewable energy sources as compared to the total energy cost of the as-designed school, total loads.	
	Thermal Energy-Producing Renewables	Percentage Renewable Energy of As-Designed Energy Costs
	1 points – Solar thermal	0.5%
	2 points—Solar thermal	1.0%
	3 points—Solar thermal	2.0%
	5 points—*Biomass/Biodiesel heating/cooling	10.0%
	7 points—*Biomass/Biodiesel heating/cooling	20.0%
	**See Glossary for definitions of biomass, bio-gas, biodiesel, and bio-oil.*	

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

On-site renewable energy has many benefits. Renewable energy sources such as photovoltaics and wind turbines use the sun and wind instead of non-renewable, polluting sources, such as coal, oil or natural gas. Producing energy on-site also eliminates the environmental impacts of transmission losses associated with remote sources and transportation emissions associated with fuel delivery. On-site sources can be very effective components of school curricula, educating students on a wide variety of energy and science issues. And on-site renewable energy production has the added advantage of increasing fuel diversity. Utilizing indigenous resources such as woody biomass, biogas, wind, and solar energy is increasingly important as New England is rapidly becoming dependent upon natural gas.

As reported by the U.S. Department of Energy, the average school in the "cool and humid" climate zone, which includes Massachusetts, uses energy for heating (23%), cooling (30%), hot water (10%) and lighting (30%). (7% Miscellaneous / Plug Loads)

When considering the contributions of renewable energy technologies on the school's energy loads, it is helpful to know what the greatest loads are and why. Clearly, a building with partial air-conditioning would narrow the slice of the energy pie for the consumption of electricity for air-conditioning. It is typical for schools to consume one-third of their energy on heating and hot water and almost two-thirds on electricity.

A note about photovoltaic electricity: While solar electric systems are a source of clean energy and reduce our dependence on fossil fuels, they are also subject to efficiency losses through the conversion of the Direct Current (DC) produced by the system and the Alternating Current (AC) used in buildings. Buildings that install low voltage direct distribution systems including power limited systems (class 2) would not be subject to this efficiency loss because there would be no need to convert DC to AC. Low voltage systems are becoming more readily available: Solid State Lighting, HVAC controls, fire alarms, data centers, security systems and many other systems are being designed to be low voltage.

Electricity Generating Renewables

For purposes of this credit, electricity-generating renewables are defined as follows:

- Photovoltaics
- Wind
- On site hydropower
- Landfill gas
- Low emission, advanced biomass power conversion technologies, such as woodchip-based biomass, biodiesel, bio-oil, and bio-gas.

Great Falls Middle School/Turners Falls High School—Montague. A 34 kW solar PV array was installed on the roof of the school's swimming pool building. The array supplies 2.3% of the school's as-designed energy needs. Photo credit: Symmes, Maini & McKee Associates (SMMA).

Biomass—Biomass is any biological material that can be used as fuel. Biomass fuel is burned or converted in systems that produce heat, electricity, or both heat and power. In this document, biomass-fired systems refer to systems that are fueled by clean wood chips from forestry or saw mill operations.

Biodiesel—Biodiesel is a domestic, renewable fuel for diesel engines derived from natural oils like soybean oil, and which meets the specifications of American Society for Testing and Materials D 6751. Biodiesel is not the same thing as raw vegetable oil. It is produced by a chemical process which removes the glycerin from the oil.

Bio-gas—Gas, rich in methane, which is produced by the fermentation of animal dung, human sewage or crop residues in an air-tight container. It is used as a fuel to heat stoves, lamps, run small machines and to generate electricity. The residues of biogas production can be used as a low-grade organic fertilizer.

Bio-oil—A liquid known as bio-oil can be created from biomass found in forestry and agricultural residues. The biomass is thermochemically converted to bio-oil by using processes called direct liquefaction or fast pyrolysis. The high water and oxygen content of bio-oils reduces their heating value to less than half the value of petroleum. However, bio-oils are low in viscosity and have been successfully burned in boilers, kilns, turbines and diesel engines.

Michael E. Capuano Early Childhood Center—Somerville. A small 400 Watt wind turbine was installed on the roof of the school's garden shed for demonstration and instructional purposes. Photo credit: HMFH Architects, Inc.

Note: Projects proposing to use electricity-generating biomass technology for MA-CHPS credits are advised to seek eligibility for the Massachusetts Renewable Portfolio Standards from the Massachusetts Division of Energy Resources (Pursuant to 225 CMR 14.00; section 14.06(5), available at www.mass.gov/doer/rps/index.htm).

Financial Benefits Beyond CHPS: Net-Metering

In Massachusetts, electricity consumers that install an on-site generating system with a rated capacity of 2 MW or less can qualify for net metering. Under net metering, the output of such a system is either consumed immediately by the loads active within the building or sent to grid, spinning the electric meter backwards and effectively avoiding purchases of electricity from the utility at its retail rates. This is particularly helpful for wind and solar systems, which are intermittent in nature. Larger systems (above 2 MW) may benefit at retail rates in the event the output displaces utility-provided power on a simultaneous basis. Surplus output during any billing period (for net metered systems) or instantaneously (for other systems) will be bought by the utility at rates established by Department of Public Utilities regulations, 220 CMR 18.00.

Renewable Energy Certificates

The environmental attributes for each megawatt hour of electricity generated by certain on-site, electricity-generating renewables (including all electricity-generating technologies that are eligible for this credit) may be captured by Renewable Energy Certificates (RECs). These RECs may have monetary value and can be traded on the open market. Schools that claim points under this credit may only sell RECs associated with the electrical energy generated in excess of that needed to claim EE.C3 Renewable Energy points.

Schools have the opportunity to utilize renewable energy generated off-site under OM.C3 Green Power.

Thermal Energy-Producing Renewables

For purposes of this credit, thermal energy-generating renewables are defined as follows:

- Solar thermal
- Biomass heating/cooling

Schools can use solar thermal collectors to provide hot water for lavatories, showers, kitchens, and pools. Although solar thermal systems will be most productive in the summer months, collector technologies are advanced to work effectively in cold climates. Nonetheless, those schools with significant summer hot water demands will benefit most from solar water heating.

Woody biomass heating systems are commercially available for school heating and are widely used in Vermont. Projects in Massachusetts include the Athol-Royalston School and Mt. Wachusett Community College. These biomass heating systems serve as the primary heating system for the schools with smaller conventionally-fuel boilers as backup and for shoulder seasons. Systems are fully automated.

Biodiesel is a renewable bio-based fuel that can be blended with conventional heating oil and used in a heating boiler or furnace. Typically, biodiesel is blended at a 10% or 20% rate. The use of biodiesel requires no modifications to the boiler and improves system performance and maintenance, and reduces emissions. Biodiesel suppliers are available in Massachusetts.

If the biomass system is designed to co-fire with a non-renewable fuel (i.e., accommodate less than 100% biofuel), the points claimed must be pro-rated accordingly. For example, if plans call for use of 20% bio-oil and 80% conventional fuel, only 20% of energy generated by the system can be counted as renewable for purposes of calculating points.

This woodchip conveyor belt delivers woodchips to the biomass gasifier and boiler heating system.

Photo Credit: Biomass Energy Resource Center, Montpelier, VT.

Special Consideration

The most effective way to reduce energy use impact on the environment is to first reduce energy consumption in the building(s), and then the energy used to covert renewable energy into useable building energy. 10-20% savings can be found with a low voltage direct current (DC) system instead of alternative current (AC).

More information can be found at: http://hightech.lbl.gov/dcpowering/ and http://www.lbl.gov/Science-Articles/Archive/EETD-DC-power.html

Applicability

This credit applies to all projects.

Resources

CHPS *Best Practices Manual*, Volume II: Guideline OS1: Photovoltaics.

LEED™ *Reference Guide*: Energy and Atmosphere Credit 2: Renewable Energy.

For more information on the Massachusetts Renewable Energy Portfolio Standard, see

www.mass.gov/doer (Click on: Renewable Energy → Renewable Portfolio Standard)

See http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=MA01R&re=1&ee=1 for the regulations governing net metering.

For information on grants for renewable electric energy systems, contact the Renewable Energy Trust at the Massachusetts Clean Energy Center or visit www.masscec.com

EE.C4: Plug Load Reduction and ENERGY STAR® Equipment

Intent: Reduce the electric load from plugged-in equipment where efficiencies are available and controls can be utilized.

Plug loads can contribute to a significant amount of the total school energy load. Choosing equipment and appliances carefully to ensure they are energy efficient, and understanding what the future plug loads of the school will be once opened, are important steps during school design, planning and construction to reduce these energy loads.

Requirement

1 point	EE.C4.1 The school committee must pass a resolution to require ENERGY STAR equipment and appliances, where available, for all new purchases for the school and to prohibit the purchase of low efficiency products, including halogen torchieres and portable electrical resistance heaters. Develop a plug load reduction plan that identifies all potential plug loads in the school and devices to turn off or "sleep" when not in use. Plug loads identified in the plan should be incorporated into the energy model used in Energy Prerequisite EE.P1 Minimum Energy Performance, if the performance option is followed.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

The ENERGY STAR program maintains a database of compliant manufacturers and products. To earn this credit, the school committee must pass a resolution requiring that all new equipment or appliances purchased for the school must be ENERGY STAR-compliant. Products not currently covered under the ENERGY STAR program are excluded from the scope of this credit. A partial list of equipment covered by ENERGY STAR includes computers, monitors, copy machines, water coolers, printers, scanners, refrigerators, and washing machines.

The resolution must also state that the district cannot purchase halogen torchieres and portable electrical resistance heaters.

Plug loads are defined here as the above list plus vending machines, kitchen cooking equipment, shop/vocational equipment, and general miscellaneous equipment that is not hard-wired to the building. Examples of plug load reduction techniques include putting to sleep computers and other such equipment at night or when not in use, installing energy misers on vending machines, and limiting or prohibiting the use of individual refrigerators in classrooms.

Provide a copy of the signed resolution passed by the School Committee, which meets the criteria above. In addition, a copy of the plug load reduction plan, including the inventory of equipment and identification of the responsible party for implementation of the plan. Provide an inventory list and submittals for all equipment and appliances indicating that they are Energy Star approved products.

Applicability

This credit applies to all projects.

EE.C4: Plug Load Reduction and ENERGY STAR® Equipment

Resources

ENERGY STAR: www.energystar.gov/.

ENERGY STAR Low Carbon IT Campaign. This program can help reduce power used by computers and other office equipment. http://www.energystar.gov/index.cfm?c=power_mgt.pr_power_mgt_low_carbon

EE.C5: Energy Management Systems and Submetering

Intent: Provide ongoing accountability and optimization of the building energy performance over time.

Energy Management Systems (EMS) are an important tool to monitor and control energy use in schools. However, care must be taken to specify and install an appropriate system for the district and maintenance staff. An appropriate EMS is the simplest direct digital control (DDC) system that still addresses the school's needs. Increased complexity does not always mean increased value for the district. EMS systems can potentially save significant energy, but only if the staff understands how to operate it. Proper training of district staff is critical, and high turnover rates continue to challenge school districts to provide retraining programs and on-site manuals. It is recommended that the EMS be installed for the entire site.

Requirement

1 Point	EE.C5.1 Install an energy management system (EMS) to monitor and trend the energy consumed by the following systems throughout the school. • Lighting (interior and exterior) systems using light sweep control, or controlled by theatrical dimming systems, motion sensors, daylight sensors, or automatic control devices such as programmable time switches or relay panels with programmable time functions. • HVAC (terminal units, packaged units, centralized hydronic heating and cooling systems, fans including fume hoods, but excluding fractional horsepower single room exhaust fans). • Domestic hot water systems. Meter all energy sources (electric, natural gas, steam, chilled water, domestic/potable water, etc.) provided by utility sources and trend the data against outside air temperature. Ensure that the system has the following attributes: Sensors (as defined below), points matrix, trend capabilities, system architecture (as defined below), data storage, and operator interface (as defined below). Provide a plan addressing trendlogging, operator training, and data analysis as detailed in the documentation requirements for this credit. The plan should explain how the collected data will be used to improve building operation as related to energy efficiency.

Requirement Continued

2 points	EE.C5.2 During design, circuit the electric loads to designated lighting and general power panels so that a true energy measurement of these systems can be achieved. Mechanical and other non-related systems must be fed from separate panelboards. Regarding installation of submeters, it is *strongly preferred* that all submeters are able to interface with the EMS and its software. All data should be trended. Take either approach for two points. Submeter: **Major Electrical Equipment Loads:** • Chiller System • Cafeteria Systems (Food-Related Equipment and Refrigeration) • Lighting and plug loads (separate out the metering for interior and exterior lighting) • HVAC system (group metering is acceptable unless a load exceed 100A, and then individual meters are needed) **OR** **Boiler System:** Install a recording gas or oil meter capable of logging hourly consumption. The purpose is to compare gas input and BTU output (from EMS logs) to determine whether the boiler system is operating at optimum efficiency. The boiler system can be tracked by season as well as on a year-to-year basis. For any type of submeter installation, provide a plan explaining how submetered data will be used to improve energy system management. The plan may be included as part of the documentation required for Credit EE.C5.1 (EMS) above.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

While energy management systems (EMS) are typically installed with new HVAC and heating systems, care must be taken to specify and install an appropriate system for the district and its maintenance staff. The best EMS for a district is the simplest system that still addresses the school's energy management needs. Increased complexity does not always mean increased value for the district.

Energy management systems can potentially save significant energy, but only if the staff understands how to operate them. With EMS installation, proper training of district staff is absolutely critical. The district must be prepared to budget for staff training and for training new staff when those knowledgeable about the EMS leave employment.

Monitoring capabilities of the EMS should allow for comparison between various types of building loads throughout all spaces of the school. This information is valuable and can be used to manage and optimize energy use. By trending and monitoring the building operation, any deviation from the design operation can be identified and corrected before an impact on occupant comfort and energy performance of the building is created. Building performance can also be optimized by longer-term trending, observation of performance characteristics, and benchmarking performance against expected operation.

The EMS should comprise the following:

- Sensors should be provided as follows:
- Sensors to trend outdoor air temperature.
- Sensors to monitor and trend equipment status for all equipment with motors greater than ½ hp.
- Indication and trending of damper and valve commanded position.
- Sensors to monitor building electrical, natural gas, and heating oil demand and consumption.
- Sensors to monitor indoor and outdoor CO_2.

Sensors to monitor and *trend* (create trend logs) controlled variables at the operator interface. Control variables may include air and/or water flow, temperature, pressure, CO_2, and pump or fan speed. Relevant multiplexed data from microprocessors located in chillers, boilers, humidifiers, VAV box controllers, variable speed drives, and other HVAC equipment with multiplexing capabilities may be used in lieu of specifying separate sensors.

Wells and other ports shall be specified for the installation of calibration devices to facilitate calibration of sensors.

Exceptions:

Unit heaters, cabinet heaters, radiation and convectors located in vestibules, storage rooms, janitor closets, and other unoccupied areas.

Natural gas and heating oil demand sensors are not required on buildings less than 50,000 ft2.

Points Matrix: A points matrix including all hardwired input and output devices connected to the automation system, all set points, upper and lower control limits.

Trend Capabilities: Trend requirements including a trend point list and preprogrammed sample of point (performed by controls contractor), sample rate, storage interval, upload interval, custom trend abilities, alarms, and automated trend data review and notification (automated diagnostics).

System Architecture: A system architecture capable of allowing sampling of these points to facilitate building commissioning and diagnostics without significantly affecting system performance.

Data Storage: A data storage system with adequate capacity to record trend data for use by building operators. Data export requirements must facilitate user-friendly data access and manipulation.

Operator Interface: An operator interface designed for remote/web access, monitoring requirements, trend-log reporting and diagnosing building problems through a user-friendly interface. This includes providing a visual (non-text based) operations and reporting interface to facilitate rapid system assessment that utilizes color coding, diagrams of floor plans and graphing capabilities.

Source: Advanced Buildings Benchmark Version 1.1, by the New Buildings Institute, Inc. pp. 38-39.

Applicability

This credit applies to new schools. For a new building on an existing campus, additions, and major renovations, the EMS must be installed for the entire school site, not just for the new building or the building(s) being modernized. For new buildings, it is acceptable to extend an existing EMS to serve the new building.

Resources

New Buildings Institute, Advanced Buildings, E-Benchmark October 2003, Version 1.0

CHPS *Best Practices Manual*, Volume II: Guideline TC23: Adjustable Thermostats; Guideline TC24: EMS/DDC; Guideline EL4: Lighting Controls for Classrooms.

School Facilities Manual, Washington State Office of the Superintendent of Public Instruction, 4th Edition, March 2000, available online at: http://www.eric.ed.gov/ERICWebPortal/custom/portlets/recordDetails/detailmini.jsp?_nfpb=true&_&ERICExtSearch_SearchValue_0=ED447673&ERICExtSearch_SearchType_0=no&accno=ED447673

EE.C6: Flex Energy

Intent: To design the school to be cost-effectively adaptable to the future use of renewable or alternative energy systems. The intent is that installation can be readily accomplished with minimal cost and that alternative technologies are not inadvertently designed-out.

This credit is for developing a plan to address certain future energy scenarios.

Requirement

1-2 points	EE.C6.1 Design the school so that the following technologies can be easily incorporated: • Photovoltaic electricity systems • Solar thermal systems • Electric vehicles For one point, identify the locations where one or more of these technologies can be incorporated and what steps must be taken to make them possible. For two points, identify the locations that will be constructed to be ready for one or more of these technologies.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

To address the changing economics of energy supply, schools should think early about how to be adaptable and what features can be incorporated in the beginning in order to be ready for a new technology. The following are suggestions:

- To be PV ready, design a flat roof with minimal perforations and mechanical equipment such that a free area large enough to hold a PV system is available. Design in space for all associated electrical equipment and wiring, including meter and inverter.
- To be solar thermal ready, design the roof to contain a sufficient system, and identify the location of the storage system that will be sufficient to contain 8 hours of peak heating or cooling, whichever is larger.
- To be electric vehicle ready, locate electric vehicle charging station(s) to handle a load equivalent to 50% of the total expected vehicles.

Applicability

All MA-CHPS projects are eligible to earn this credit. If energy is purchased on a district wide basis then 50% of the required energy for the school claiming this credit must be supplied by green power.

Resources

FLEX Energy Workbook: http://www.chps.net

WE.P1: Irrigation System Performance on Recreational Fields

Intent: Intent: Reduce and optimize potable water use for irrigating recreational areas.

New technologies to measure the amount of moisture in soil can be used to alert grounds staff to provide only the quantity of water, and only at the time it is necessary to sustain species life on recreational fields. The U.S. Environmental Protection Agency claims that water savings of 10-20% can be achieved through such technologies.

Requirement

Prerequisite	WE.P1.1	Any in-ground irrigation systems used for recreational fields must have soil moisture meters, weather stations, or equivalent technology (ET Controllers) to control and shut off operation of irrigation systems when adequate ambient moisture is available to the turf.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

Recreational areas include athletic fields, playing fields, practice fields, etc.

Reference specifications for high efficiency irrigation technologies including devices that save water such as soil moisture meters.

Provide submittals for high efficiency irrigation technologies such as soil moisture meters.

Applicability

This prerequisite applies to only those projects that are installing irrigation systems on recreational fields.

Resources

LEED™ Reference Manual: Water Credit 1: Water Efficient Landscaping.

Local water utility staff, water efficient landscape consultants, Certified Irrigation Designers (www.irrigation.org/), and Master Gardeners are also good resources for helping achieve this credit.

WE.P2: Indoor Water Use Reduction, 20%

Intent: Maximize water efficiency within buildings to reduce the burden on municipal water supply, aquifers, and wastewater treatment systems.

The growing value of potable water in Massachusetts underscores the importance of lowering demand. Efficient water consumption naturally reduces the amount of water pumped from the ground or transported from reservoirs to cities and towns. In addition, water efficiency reduces the cost and amount of sewage needing treatment after use. Because water-efficient devices can vary in quality and performance, specify only durable, high performance fixtures.

A maximum of 7 points can be earned with the Indoor Systems credits. Well designed, water efficient systems may earn one point by reducing the overall amount of potable water used in the schools (Water Credit WE.C1) and by reducing the amount of potable water used for sewage conveyance (Water Credit WE.C2).

Requirement

Prerequisite	WE.P2.1	Employ strategies that, in aggregate, reduce potable water use by 20% beyond the baseline calculated for the building (not including irrigation) after meeting the Energy Policy Act of 1992's fixture performance requirements.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

This prerequisite requires reductions in total indoor water use; therefore all significant water uses are included in the calculations.

Use the MA-CHPS Verified Application Templates to calculate the total water use (excluding landscaping) for the baseline design and for the proposed efficient design. Create a spreadsheet that lists each fixture type, the flow rate, estimated duration of use, and any automatic controls. For the baseline design calculations assume the flow rates outlined by the EPAct of 1992's fixture performance requirements (Table 6). Food service appliances and fixtures should be considered to the extent that there is an existing baseline for those items such as clothes washers, dishwashers, and ice machines. Fixtures and appliances that are used for consumption, such as a soda machines or coffee makers, should not be included. Baseline recommendations for food service appliances and fixtures should not compromise school health regulations or codes. Then estimate the number of occupants that will use each fixture type and the number of uses per day. Use this data to calculate the water use for each fixture type and the total daily and annual water use of the school. Create a similar spreadsheet for the efficient design case using actual flow rates of the specified fixtures and equipment. The estimated number of occupants and daily uses remains the same for both cases.

Table 6 – Federal Energy Policy Act (EPAct) Performance Requirements as subsequently ruled and implemented by the U.S. Department of Energy

Fixture	1992 EPAct and Subsequent Plumbing Code Requirements (Maximums)
Toilets	1.6 gal/flush
Urinals	1.0 gal/flush
Showerheads	2.5 gal/min
Kitchen Faucets	2.2 gal/min
Lavatory Faucets	0.5 gallons/minute or 0.25 gallons/cycle - Massachusetts State Plumbing Code*
Replacement Aerators	0.5 gal/min
Metering Faucets	0.25 gal/cycle

** For lavatory faucets in public buildings, Massachusetts code supersedes EPAct fixture performance requirements.*

Note: Table 6 is not a comprehensive list. Among other fixtures found in schools, there are food service fixtures and appliances that consume a considerable amount of water and should be included in the baseline as outlined in the implementation section above where appropriate and established limits have been set.

Example Calculation

Question: How is the total potable water consumption savings calculated beyond the baseline established by the EPAct for the school in this example?

Example: Calculate the water use of the efficient design using high-efficiency fixtures where possible and the baseline design using Energy Policy Act guidelines. Divide the efficient design annual use by the baseline design annual use and subtract this from 1. The total savings in the following example is 34.1% which meets this prerequisite. If reclaimed or recycled water, or greywater are used for irrigation in place of potable water, that volume of water is further subtracted from the efficient design. See Table 7 & 8 for the detailed calculations.

Table 7 – Baseline Design Case Total Water Consumption

Fixture Type	Flow-rate	Duration	Automatic Controls	Occupants	Daily uses	Water use
Conventional Toilet (male)	1.6 gal/flush *	1 flush	-	500	1	800
Conventional Urinal (male)	1.0 gal/flush *	1 flush	-	500	2	1000
Conventional Toilet (female)	1.6 gal/flush *	1 flush	-	500	3	2400
Bathroom Lavatory Sink	0.5 gal/min	.25 min	-	1000	3	375
Conventional Shower	2.5 gal/min *	5 min	-	100	1	1250
Kitchen Sink	2.2 gal/min *	45 min	-	2	2	198
Clothes Washer	40 gal/load	1 load	-	-	2	80
					Total Daily Volume	6,123
					Number of School Days	180
					Baseline Total Annual Volume	102,140

* Federal Energy Policy Act Requirements

WE.P2: Indoor Water Use Reduction, 20%

Table 8 – Efficient Design Case Total Indoor Water Consumption

Fixture Type	Flow-rate	Duration	Automatic Controls	Occupants	Daily uses	Water use
High- Efficiency Toilet (male)	1.28 gal/flush	1 flush	-	500	1	640
High-Efficiency Urinal (male)	0.13 gal/flush	1 flush	-	500	2	130
High- Efficiency Toilet (female)	1.28 gal/flush	1 flush	-	500	3	1920
Bathroom Lavatory Sink	0.5 gal/min	.25 min	20% saved	1000	3	375
Low-flow Shower**	1.5 gal/min	5 min	-	100	1	750
Low-flow Kitchen Sink	1.5 gal/min	45 min	-	2	2	180
Efficient Clothes Washer	20 gal/load	1 load	-	-	2	40
					Total Daily Volume	4,035
					Number of School Days	180
					Design Total Annual Volume	726,300
					Percent Saved	34.1%

** Low Flow Showers at flow rates below 2.5gpm should not be installed without Automatic Compensating Valve certified at the same flow rate as the showerhead.

Comparing the two spreadsheets, the water-efficient fixtures reduced potable water use by:

% Savings = 100 – [(Efficient Design Total Annual Volume / Baseline Design Total Annual Volume) x 100]

% Savings = 100 – [(800,100/1,156,140) x 100] = 100 – (.692 x 100) = 30.8%

If a rainwater collection system part of the project, then provide justification for the volume of collected, useable rainwater over the school year. If seeking Site Credit SS.C8 Post-Construction Stormwater Management, documentation used to justify rainwater storage sizing may be used for this credit. Helpful documentation would include: a building rainwater reuse plan and a water balance analysis that includes integrated analysis of source, storage, and demand. A source analysis should take into consideration the contributing watershed, daily and/or weekly rainfall data, the variations in rainfall during the year, and rainfall abstraction.

Applicability

This prerequisite applies to all projects

Resources

LEED™ *Reference Guide*: Water Credit 2: Innovative Waste Water Technologies; Water Credit 3: Water Use Reduction.

WE.C1: Indoor Water Use Reduction, 30-50%

Intent: Reduce the use of indoor potable water.

By increasing the efficiency of existing water consuming fixtures and equipment, the demand on water from reservoirs, ground water, lakes and streams is reduced. The federal Energy Policy Act (EPAct) of 1992 established water conservation standards for shower heads, faucets and other fixtures.

Requirement

	WE.C1.1 Exceed the potable water use reduction beyond the calculated baseline determined in Water Prerequisite WE.P2.
1 point	30%
Or 2 points	40%
Or 3 points	50%

Implementation

To earn a credit, specify fixtures that further reduce water consumption by 30-50% beyond the baseline established in Water Prerequisite WE.P2. Documentation for this credit is the same as for WE.P2.

Applicability

This credit applies to all projects.

Resources

CHPS Best Practices Manual, Volume II: Guideline OS6: Efficient Terminal Devices; OS7: Waterless Urinals.

LEED™-NC 2.2 Reference Guide: Water Credit 2: Innovative Waste Water Technologies; Water Credit 3: Water Use Reduction.

Utilize the U.S. Environmental Protection Agencies Water Sense[SM] program to assist in identify efficient fixtures at: http://www.epa.gov/watersense/

WE.C2: Reduce Potable Water Use for Sewage Conveyance

Intent: Reduce wastewater generated and/or the amount of potable water used for sewage conveyance.

Water efficiency naturally reduces the overall amount of water needing to be pumped from it's source or distributed around the city or state, thus resulting in lower energy needs. In addition, water efficiency reduces the cost and amount of sewage needing treatment after use. Because water-efficient devices can vary in quality and performance, specify only durable, high performance fixtures.

Use water-efficient fixtures and reclaimed water (where available) to reduce the amount of potable water used for sewage conveyance. Only those sources that produce black water, such as toilets and urinals, are included in this credit. Reclaimed water (tertiary treated wastewater) and/or recycled water from municipal sources (greywater, or harvested rainwater) or greywater generated and treated on-site are suitable for flushing toilets and urinals, which typically produce the largest amounts of wastewater in a school.

A new generation of High Efficiency Toilets (HETs) and Urinals (HEUs) that use a maximum volume of 1.28 and 0.5 gallons per flush, respectively, are now readily available. Third-party testing to determine the Maximum Performance (MAP) for different toilet fixtures has been available since 2003. Although testing has occurred for primarily tank-style toilets, more and more flushometer style toilets (toilets using flush valves) are now being tested and their performance quantified. For more information, see the following website: http://www.cuwcc.org/MAPTesting.lasso.

Requirement

4 points	WE.C2.1 Reduce the use of potable water for building sewage conveyance by a minimum of 50% through the utilization of water-efficient fixtures, use of rainwater catchment systems, or both.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

Use water-efficient fixtures and/or site-collected water to reduce the amount of potable water used for sewage conveyance. Only those sources that produce blackwater, such as toilets and urinals, are included in this calculation. Rainwater is suitable for flushing toilets and urinals, which typically produce the largest amounts of wastewater in a school. A growing number of schools are collecting rainwater for use in sewage conveyance—the Dedham Middle School, Whitman-Hanson Regional High School, and Woburn High School are three examples. At the Whitman-Hanson school, the water generated from HVAC condensate is also collected in the rainwater collection tank and used for toilet flushing.

To quantify water use reductions, use the MA-CHPS water use spreadsheet in the Application Template to determine baseline and design water consumption. List each fixture that produces blackwater, the amount of daily uses, number of occupants, and total water use. A water-efficient design for a 1,000-student school is shown in Table 9. The example assumes the use of low-flow toilets and waterless urinals, with all fixtures either using no water or using non-potable water.

Rainwater Collection and Water Storage – "Keep Water Local"

The mantra of watershed protection organizations across the world is this: "Keep water local." In other words, harvest, use, treat, and re-infiltrate water close to the source of its use. Every step of extracting water, treating

it, transporting it, and eventually reintegrating it into the water cycle uses energy. Transporting water, in particular, uses enormous electrical and infrastructure resources.

For some schools, installation of a rainwater catchment systems with underground storage tanks is an economic option to provide water for flushing water closets and supplemental irrigation. Catchment systems can decrease some irrigation water demand depending on the size of the fields being irrigated. However, they are unlikely to contribute much to schools with many playing fields and large irrigation demands.

A rainwater catchment system should be designed with a water storage capacity for sewage conveyance and/or irrigation in typical years under average conditions. Oversizing water storage to meet drought conditions will be costly and undersizing storage may simply result in a system that is too small to significantly offset potable water consumption. In addition, rainwater collection and storage systems should be designed to avoid stagnation that could lead to mold growth and accumulation of bacteria. It will be important to check with your plumbing inspector early in the process if you pursue a catchment system.

The underground storage tanks and cisterns could at times run dry during drought conditions. Therefore, it is acceptable for tanks and cisterns to connect to wells or municipal water supplies.

Table 9—Design Sewage Conveyance Calculation

Fixture Type	Flow-rate	Duration	Occupants	Daily Uses	Water Use (gal)
Toilets (male)	1.6 gal/flush	1 flush	500	1	800
Waterless Urinals (male)	0.0 gal/flush	1 flush	500	2	0
Toilets (female)	1.6 gal/flush	1 flush	500	3	2400
Total Daily Volume					3200
				Number of School Days	180
				Design Total Annual Volume	576,000
				Minus Collected Rainwater	(396,000)
				Total Potable Water Used for Sewage Conveyance	180,000

Calculate Daily Water Use per fixture using the following equation:
Daily Water Use = (Flow-rate) (Duration)(Occupants)(Daily Uses)

- Sum Daily Water Volumes for each fixture to find Total Daily Volume.
- Multiply the Total Daily Volume by the number of school days for Total Annual Volume.
- Subtract the amount of reclaimed water used to find Total Potable Water Used for Sewage Conveyance.

For baseline indoor water consumption calculations, use a similar spreadsheet in the Application Template, but change only the type of fixture and its associated design details. For baseline calculations, assume flow rates outlined by the Energy Policy Act of 1992's fixture performance requirements:

Table 10—Baseline Sewage Conveyance Calculation

Fixture Type	Flow-rate	Duration	Occupants	Daily uses	Water use (gal)
Conventional Toilet (male)	1.6 gal/flush	1 flush	500	1	800
Conventional Urinal (male)	1.0 gal/flush	1 flush	500	2	1000
Conventional Toilet (female)	1.6 gal/flush	1 flush	500	3	2400
				Total Daily Volume	4200
				Number of School Days	180
				Baseline Total Annual Volume	756,000

Comparing the two spreadsheets, the water-efficient fixtures reduced potable water use for sewage conveyance by:

% Savings = 1 – (Design Total Annual Volume / Baseline Total Annual Volume) = 1 – (180,000/756,000) = 0.76 = 76%

Therefore, this design would earn one point because potable water used for sewage conveyance has been reduced by 76% through using reclaimed water in the toilets and urinals. Note that the low-flow fixtures by themselves were not enough to earn this credit.

If a rainwater collection system is part of the project, then provide justification for the volume of collected, useable rainwater over the school year. If seeking Site Credit SS.C8 – Post-Construction Stormwater Management, documentation used to justify rainwater storage sizing may be used for this credit. Helpful documentation would include: a building rainwater reuse plan and a water balance analysis that includes integrated analysis of source, storage, and demand. A source analysis should take into consideration the contributing watershed, daily and/or weekly rainfall data, the variations in rainfall during the year, and rainfall abstraction.

Applicability

This credit applies to new schools and major renovations. A new building on an existing campus, and additions may be eligible for this credit if enough toilets and urinals are provided within the building to meet the occupant load. In cases where compliance with the toilet to occupant load ratio is determined on a campus wide basis the calculations for this credit should be performed for the entire school site.

Resources

CHPS Best Practices Manual, Volume II: Guideline OS6: Efficient Terminal Devices; OS7: Waterless Urinals.

LEED™-NC 2.2 Reference Guide: Water Credit 2: Innovative Waste Water Technologies; Water Credit 3: Water Use Reduction.

Utilize the U.S. Environmental Protection Agencies Water Sense[SM] program to assist in identify efficient fixtures and sensors at: http://www.epa.gov/watersense/.

Low flow standards for fixtures are available through the American National Standards Institute (ANSI) as published by the International Association of Plumbing and Mechanical Officials (IAPMO): http://www.webstore.ansi.org.

WE.C3: No Potable Water Use for Non-Recreational Landscaping Areas

Intent: Reduce or eliminate potable water use for landscape irrigation.

Significant amounts of potable water are currently used to irrigate landscaping and playing fields. Although the New England region receives an average of several inches of rainfall per month, expanding development is increasing the demand for potable water. As more water is withdrawn to meet demand, aquifers and rivers can be stressed to the point of creating water shortages and ecological changes to rivers and streams. Summer dry spells cause the most stress to underground and surface waters as water is withdrawn for irrigation and other outdoor activities but is not replaced by rainfall.

Use of potable water for irrigation can be minimized by specifying water conservative plants and grasses, collecting and using rainwater for irrigation and/or using highly water-efficient irrigation systems where irrigation is absolutely necessary (e.g., playing fields). When specifying drought-resistant plants, determine soil composition and ensure that existing soils will support the plants to be specified. Consider all operating and maintenance costs of any irrigation equipment specified. If irrigation is necessary, make arrangements to irrigate during early morning hours to maximize irrigation efficiency and minimize evaporation.

Requirement

3 points	WE.C3.1 Do not install permanent irrigation systems for watering non-playing field landscaped areas (excluding designated school gardens) AND specify drought resistant plants or grasses in these areas so that irrigation is not needed beyond plant establishment.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

Provide a letter signed by landscape architect certifying that permanent irrigation systems have not been specified for non-playing field areas AND that only drought resistant plants and grasses have been specified for these areas. Letter must clearly state that no irrigation, manual or otherwise, will be needed in these areas after plants are established. Letter must also indicate the species of drought resistant plants and grasses that have been specified.

Applicability

This credit applies to new schools. For a new building on an existing campus, additions, and major renovations, the calculations must be made for the entire school site, not just the area around the new building or the buildings being modernized.

Resources

Local water utility staff, water efficient landscape consultants, Certified Irrigation Designers (www.irrigation.org), and Master Gardeners are also good resources for helping achieve this credit.

CHPS Best Practices Manual, Volume II: Guideline SP6: Drought Tolerant and Pest-Resistant Plants, Guideline SP10: Water-Efficient Irrigation Systems; Guideline SP12: Reclaimed Water for Irrigation.

WE.C4: Reduce Potable Water for Recreational Landscaping Areas

Intent: Reduce or eliminate potable water use for irrigating recreational areas.

Significant amounts of water are used to irrigate recreational fields. A typical natural turf recreation field needs up to 5,000 gallons of water/acre/day during the peak of the irrigation season and in many locations exceeds 7,000 to 8,000 gallons/acre/day.

Requirement

2 points	WE.C4.1 Reduce the irrigation needs of athletic fields by specifying appropriate soils and drought tolerant grasses for all sports fields. Specify organic content of athletic field soils to be between 3% and 7% or more, of total soil content. Specify athletic field grasses for new fields to be a mixture of 80% Kentucky bluegrass cultivars and 20% perennial rye grass cultivars, spread at a rate of 3 to 4 lbs/1000 ft^2.

Recreational areas include athletic fields, playing fields, practice fields, etc.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

Soil Types

The best types of soil for playing fields are 3% to 7% organic content and fall into the U.S. Department of Agriculture soil categories:

Table 11 - Watering Requirements by Soil Type

Soil Type	Watering Requirements
Loamy sand	1 in. per week
Sandy loam	1 in. per week
Loam	1 in. per week

Artificial Turf

Artificial sports turf can be considered as a substitute for soil-based athletic fields. While no credits for artificial turf are available under the Water section, if the turf contains recycled material, it may qualify for points under the Materials section of this document. Check with manufacturers to ascertain whether recycled materials are incorporated into their turf products.

Applicability

This credit applies to new schools. For a new building on an existing campus, additions, and major renovations, the calculations must be made for the entire school site, not just the area around the new building or the buildings being modernized.

WE.C4: No Potable Water Use for Recreational Landscaping Areas

Resources

MA-CHPS Best Practices Manual, Volume II: Guideline SP6: Drought Tolerant and Pest-Resistant Plants, Guideline SP10: Water-Efficient Irrigation Systems; Guideline SP12: Reclaimed Water for Irrigation.

LEED™-NC 2.2 Reference Manual: Water Credit 1: Water Efficient Landscaping.

Local water utility staff, water efficient landscape consultants, Certified Irrigation Designers (www.irrigation.org/), and Master Gardeners are also good resources for helping achieve this credit.

WE.C5: Irrigation System Commissioning

Intent: Verify that the site's irrigation systems and controls are operating as intended and that effective training has been provided.

Irrigation system testing and training is a rigorous quality assurance program administered by a knowledgeable party that ensures the irrigation systems perform as expected. Irrigation system testing can help to ensure that water efficiency measures are working properly and design water savings are achieved.

Requirement

1 point	WE.C5.1 Create an irrigation commissioning plan and complete installation review during construction, performance testing after installation, and documentation for ongoing operations and maintenance.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

Reference specifications for an irrigation commissioning plan. Designate the CSI number, section, and page number. State that irrigation commissioning plan must include:

Identify which entity will prepare the irrigation commissioning plan and who will perform the commissioning tasks.

Review of irrigation system installation during construction, with record of deficiencies found and corrected.

Performance testing and documentation of results (as compared to specified performance) at least once during the first year of installation, and

Site-specific documentation detailing maintenance requirements and frequency and operation procedures including a recommended irrigation schedule to apply 1 inch of water per week to athletic fields.

Acceptance testing shall be included in the specifications and performed on the following, if applicable:

- Irrigation pipes and fittings. Under static conditions the system pressure loss shall not exceed 3 psi over a one hour time period.
- Irrigation heads and coverage. The system shall have a measured distribution uniformity (lower quarter) of no less than 65%.
- Back-flow devices.
- Automatic sensors, timers and other controls.

For equipment not listed, the design team shall provide acceptable test results, and the contractor shall certify that the tests were performed and the equipment performs as specified.

Supply a letter signed by commissioning agent verifying requirements for performance testing of irrigation equipment and actual performance have been met.

WE.C5: Irrigation System Commissioning

Applicability

This credit applies to projects that include irrigation systems. This credit can not be claimed if there are no irrigation systems or controls for the project.

Resources

LEED™ Reference Manual: Water Credit 1: Water Efficient Landscaping.

Local water utility staff, water efficient landscape consultants, Certified Irrigation Designers (www.irrigation.org/), and Master Gardeners are also good resources for helping achieve this credit.

WE.C6: Water Management System

Intent: Provide ongoing accountability and optimization of the building and site water performance over time.

A water management system must monitor both indoor and outdoor water usage to detect leaks and improve efficiency. The U.S. Environmental Protection Agency ranks water monitoring as one of the Top 10 ways to save water. Water leaks can result in significant water losses and costs, and have the potential to cause structural damage and promote mold growth. Information obtained from water meters can be valuable in managing and optimizing water usage. When selecting a water management system take into consideration district and maintenance staff needs, training considerations, and how the system could be integrated with a energy management system. A water management system can potentially save significant water, but only if staff understands its reports and how to operate it. Proper training of district staff is critical, and high turnover rates continue to challenge school districts to provide retraining programs and on-site manuals.

Requirement

1 point	WE.C6.1 Install a Water Management System to monitor water for any equipment or system that exceeds 20% of the total amount of water used on the school site. At minimum, separate water meters (also called sub-meters) should monitor and report on water usage for the following: • Domestic water • Exterior irrigation
Or 3 points	WE.C6.2 Install a Water Management System to monitor water use of all indoor and outdoor water uses. Water meters should have a pulsed output for automatic meter readings (AMR). Separate water meters (also called sub-meters) should monitor and report on water usage for the following: • All indoor water usage except gyms with showers • Gyms with showers • Landscaping if irrigated • Recreational fields if irrigated • Swimming pool • Cooling towers, if equipped.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

The plans and specifications should include a list of all sensors (measurements to be taken through the building and exterior) and actuators (devices to be controlled). It should also specify the protocol communication between the sensor, actuators, and the computer (controller).

The construction documents should also specify the requirements for the graphic user interface (GUI). The designers should work with the school district maintenance and operation staff to determine the desired features. School districts should consider standardizing on one type of system in order to reduce the need to learn and maintain different operating systems.

WE.C6: Water Management System

Monitoring capabilities should allow for comparison between indoor water usage, landscaping if irrigated and recreational fields if irrigated. This information is valuable and can be used to manage and optimize water use.

Applicability

This credit applies to new schools. For a new building on an existing campus, the water management system may only monitor the building's indoor water uses. For major renovation projects the water management system may monitor both indoor water uses and outdoor water uses depending on the scope of the project.

Resources

Utilize the U.S. Environmental Protection Agencies Water Sense[SM] program to assist in identify efficient fixtures at: http://www.epa.gov/watersense/

SS.P1: Joint-Use of Facilities and Parks

Intent: Allow for more community and neighborhood integration within the school facility and grounds.

Joint-use of school facilities is a growing trend across the country and state. Many schools make their facilities available to community groups during and/or after schools hours providing benefits to both the school and the community. The design of the building must designate an area for joint-use and address access and security measure considerations to facilitate use during and/or after school hours.

Parks, playgrounds and athletic fields are community resources which should be made available after school hours. By sharing these assets with local parks, the cost of maintenance can also be shared. Joint-use can have a variety of benefits, including increased campus security, improved community integration, and reduced site acquisition and construction costs.

Requirement

Prerequisite	SS.P1.1 Design, with community involvement, one or more spaces (2,500ft^2 minimum) for use by community or other appropriate organizations. The plans shall designate this area as the "Joint-Use Area." Provide an entrance for spaces identified for joint-use so that after school hours access can not be granted into the non-public parts of the school buildings. The "Joint-Use Area" must be accessed and secured independently of the non-joint-use portions of the facility. The "Joint-Use Area" must contain bathroom facilities that can be accessed without compromising the security of the non-joint-use portions of the facility.
Prerequisite	SS.P1.2 Share park or recreation space with the community.

Implementation

SS.P1.1

The most successful schools have a high level of parent and community involvement. This involvement can be enhanced if a school is designed so that neighborhood meetings, recreation activities, and other community functions can take place at the school in a safe and secure fashion.

Building or renovating a school provides an opportunity for the community to incorporate municipal programs and services into the building program. During the planning stages, school districts should give careful thought to the types of programs, services, and facilities they may wish to offer via the future school building (e.g., library services, recreation services, meeting space, space for special events, etc.).

Other strategies that contribute to shared use of the school building include designing separate entrances for spaces likely to be shared, adjusting building orientation and layout to separate classroom and administration areas from shared spaces during events, and designing special features into the school that the community can use.

It is important to remember that the relatively low cost strategies mentioned above satisfy this prerequisite. Additional features, such as the walking track pictured here, are encouraged only if the community has the resources to pay for and maintain these facilities.

SS.P1: Joint-Use of Facilities and Parks

Letter signed by project architect and school superintendent indicating features of the school that enhance its shared use with the community.

To earn this credit the physical design must incorporate measures to facilitate joint-use while providing security for the school. Provide doors or security gates to close off portions of the school that are not being used during off-hour events. Provide a separate entry to spaces intended for joint-use such as gymnasiums, auditoriums, libraries and multipurpose rooms.

Whitman-Hanson Regional High School. An elevated walking track surrounds the gymnasium. Local residents will be able to use it any time throughout the

SS.P1.2

Joint use of recreational space is a growing trend across the country. This prerequisite is intended to encourage schools to share their recreational space with the community at large or vice versa –to encourage municipalities to allow schools to use local parks in lieu of having the school construct playing fields. Either arrangement allows the community to optimize resources dedicated to community and school recreation.

A copy of the formal agreement between the school district and municipality on joint use of parks and recreational space OR provide copies of applicable insurance policies governing use of the parks or recreational space by the municipality or by the school if the spaces are municipally owned.

Urban schools with a lack of adequate outdoor space may consider use of off-site public park space to comply.

Applicability

These prerequisites apply to all projects. A new building on an existing campus can claim this credit only if the building is designated as a “Joint-Use Area”, and the above requirements are satisfied for the whole campus. A renovation project can claim this credit if new measures are taken or if the existing campus already satisfies the requirements. Schools with special needs facilities may request an exemption or variance based on circumstances.

Resources

New Schools Better Neighborhoods offers information on the benefits of joint-use facilities, examples of join-use projects, joint-use analysis, recommendations, and policies at: www.nsbn.org/case/jointuse/.

SS.C1: Sustainable Site Selection

Intent: Avoid development on environmentally sensitive sites to reduce impact of the building footprint. Protect open space and channel development to previously developed sites in order to protect habitat and natural resources.

Protect environmentally sensitive site features, such as wetlands and tree stands, and encourage landscaping and architecture that responds to and includes the school's immediate environment. A district faces many issues during site selection. Cost, student demographics, and environmental concerns all influence when sites are acquired and how the school district uses them. The site is a crucial element in determining the overall sustainability of the school. Sites are sometimes purchased years in advance, and some of these credits may be out of the control of the districts and/or designers at the time the school is being built. However, districts that are considering multiple sites can substantially lower the environmental impact of the school by choosing centrally located sites, sharing parks or facilities with community organizations, preserving open space, and protecting environmentally sensitive areas.

Urban redevelopment reduces environmental impacts by utilizing established infrastructure and preserving the open space of undeveloped lands. If the site already contains a building, additional credits may be possibly earned with Materials Credits MW.C8 and MW.C9 on Building Reuse.

Requirement

1 point	SS.C1.1 Do not temporarily or permanently modify land, which prior to acquisition for the project was public parkland, conservation land, or land acquired for water supply protection.
1 point	SS.C1.2 Do not develop buildings on land whose elevation is lower than 5 feet above the elevation of the 100-year flood as defined by FEMA and as shown on the FEMA Flood Insurance Rate Map (FIRM) for the site.
1 point	SS.C1.3 Do not develop school sites that are within wetland resource areas as defined by Massachusetts Wetlands Protection Act, M.G.L. Chapter 131 Section 40 or within 50 feet of banks, vegetated wetlands, or vernal pools. Site development includes the school facilities, playing fields and parking lots and construction operations that are not related to wetlands improvement. *Exception:* Drainage outfall structures may be located within the 50 ft. buffer zone provided they meet setback criteria specified in Volume 2 of the Massachusetts Department of Environmental Protection's Stormwater Handbook.
1 -2 points	SS.C1.4 Do not build on greenfields. For the purposes of this credit, greenfields are defined as undeveloped lands or lands that are used for agriculture, forestry, or park purposes. Undeveloped lands are defined as lands that have not been in use for a period of 50 years or more and cannot be identified, by visual inspection, as having been developed. • New School Projects – 1 point • Addition /Renovation and Renovation Projects –2 points

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

SS.C1: Sustainable Site Selection

SS.C1.1

A district faces many issues during site selection. Cost, student demographics, and environmental concerns all influence site acquisition. The site is a crucial element in determining the overall sustainability of the school design. Some sites are purchased years in advance, which leaves little room for input from the districts and designers. However, districts that are considering multiple sites can substantially lower the environmental impact of the school by choosing centrally located sites, sharing parks or facilities with community organizations, preserving open space, and protecting environmentally sensitive areas.

Provide a current existing site survey with the school site property boundaries marked in bold.

SS.C1.2

Do not construct permanent buildings, or structures to support buildings within the 100-year flood plain. Both federal and state agencies have worked together over the last several decades to prevent construction of buildings in 100-year floodplains to achieve two important results: 1) a significant decrease in building damage and liability and 2) a restoration of functional floodplains to absorb flood waters and minimize impacts to downstream communities.

"Above the floodplain" means that the building footprint must be above the 100-year flood plain, but the requirement does not apply to non-building areas of the site. In Massachusetts, floodplains are defined as Wetland Resource Areas; therefore, if the school project develops athletic fields, parking lots and other structures in the 100-year floodplain, then the project is prohibited from receiving Wetlands Site Credit 1.3, as these areas would constitute wetlands under the law.

To locate the 100-year floodplain elevations in Massachusetts, FEMA Flood Insurance Studies (containing Flood and Coastal Profiles) and flood maps are available on the web at www.msc.fema.gov/. For locations not mapped by FEMA, consult the Massachusetts Wetland regulations, available on the web at: http://www.mass.gov/dep/water/laws/regulati.htm#wl specifically 310 CMR 10.57 which describes the process to follow in determining the floodplain elevation in the absence of FEMA information. It is also recommended that you consult with your municipal conservation commission, which regulates construction in floodplains pursuant to the Wetlands Protection Act. The conservation commission may be able to provide useful information regarding flood prone locations in the municipality as well as may have copies of the FEMA Flood Insurance Studies and Maps on file.

In Massachusetts, construction within the 100-year floodplain is subject to regulation pursuant to the Massachusetts wetlands protection regulations, 310 CMR 10.02, and State Building Code, 780 CMR 3107. The Massachusetts Department of Conservation and Recreation (DCR) Office of Water Resources, Flood Hazard Management Program can provide assistance to municipalities regarding floodplain regulations. The contact telephone number is 617-626-1406, or visit the web at www.mass.gov/dem/programs/mitigate.

SSC1.3

Do not build on sites, which are within 50 ft. of a wetland as defined below. Site development includes the school facilities, playing fields and parking lots and construction operations that are not related to wetlands improvement. Drainage outfall structures may be located within the 50 ft. buffer zone provided they meet setback criteria specified in Volume 2 of the Massachusetts Department of Environmental Protection's Stormwater Handbook.

The Massachusetts Wetlands Protection Act, MGL Chapter 131 Section 40 lists each specific wetland type subject to protection, including, but not limited to, swamps, marshes, bogs, salt marshes, lakes, ponds, rivers, riverfront areas, and land subject to flooding. Alterations to coastal and inland wetland resource areas, including any associated buffer zones, are regulated pursuant to the Massachusetts Wetlands Protection Act

(WPA) and Water Quality Certification regulations. Local conservation commissions administer WPA regulations.

The Wetlands Protection Act and 401 Water Quality Certification regulations for discharge of dredged or fill material may be found on the web at the following address: http://www.mass.gov/legis/laws/mgl/131-40.htm.

SS.C1.4

During the site selection process, use previously developed sites instead of greenfields. Redevelopment reduces environmental impacts by utilizing established infrastructure and preserving the open space of undeveloped lands.

To determine whether there have been significant developments on a site prior to its designation as a school construction site, submit a summary of a Phase I Initial Site Investigation report prepared according to Massachusetts Contingency Plan regulations (310 CMR 40.00). The Massachusetts Contingency Plan regulations were created for the prevention and control of activities leading to the release of oil and/or hazardous material, and they include provisions for researching historical site activities. The summary should describe any previous uses of the school site as far back as a reasonable search of local fire department records, records of incorporation, Registry of Deeds etc. can be achieved. Provide a copy of the Massachusetts Environmental Policy Act (MEPA) Office's Environmental Notification Form (ENF) showing that the site is not in use for agricultural or forestry purposes and is not in use as a park.

Applicability

This credit applies to all new schools. A new building on an existing campus or additions to existing buildings can earn this credit if the site for the new building or addition is not on environmentally sensitive land. For major renovations, this credit may be earned if it can be verified that the site is not environmentally sensitive land as defined by SS.C1.

Resources

Massachusetts Stormwater Handbook, Massachusetts Department of Environmental Protection, February 2008: http://www.mass.gov/dep/water/laws/policies.htm#storm

For wetlands definitions, see: http://www.mass.gov/dep/water/laws/ilsf.htm for wetland definitions

Lists of Prime and Statewide Important Farmland Soils are maintained for each soil survey area and may be obtained from the Field Office Technical Guide (FOTG) located in each NRCS field office. County and state offices of the NRCS keep maps showing the status of lands within their jurisdiction. County offices can be located at: http://offices.sc.egov.usda.gov/locator/app

FEMA Region XI information can be found at: www.fema.gov/regions/xi/. To find a map showing the 100-year flood elevations, contact your community representative on the Region XI Community Status List at: www.fema.gov/regions/xi/, or call 877-336-2627 to talk to a map specialist. Unofficial maps by ESRI are available online at: www.geographynetwork.com.

Federal Wetlands information (40 CFR, Parts 230-233) can be found at the US EPA website: www.epa.gov/owow/wetlands/regs/

SS.C2: Central Location

Intent: To make the school more accessible to its occupants, and to promote smart growth through centrally locating new schools close to dense, mixed-use areas to encourage alternatives to automobile use.

Over the lifetime of the building, schools and parents invest significant amounts of time, energy, and money transporting students to and from school. Cars driven by parents, guardians, or the students themselves are one of the largest resource users and sources of pollution. Centrally located sites allow more students to walk or bike to school, while reducing the distance cars must travel. Additional transportation-related credits are covered in Site credits SS.C5, SS.C6, and SS.C7.

Furthermore, locating new schools in areas of density and/or mixed use allows more students to walk or bike to school, while reducing the distance cars must travel. Schools located near public and private services such as libraries and community centers not only allow students to access these services after school, they put parents en route to these services if they pick their children up after school (though use of public transportation is strongly encouraged). Planning around centers of public and private activity is embodied in the concept of Smart Growth, which promotes dense development in order to preserve public parks and natural features such as open space and wildlife habitat.

Requirement

1 point	SS.C2.1	Construct or renovate a school according one of the following criteria: Site the school within ½ mile of at least 8 of the basic services listed: 1) Supermarket; 2) Commercial Office Building; 3) Convenience Grocery; 4) Day Care; 5) Cleaners; 6) Fitness center; 7) Hair Care; 8) Hardware; 9) Laundry 10) Library; 11) Medical/Dental Services; 12) Senior Care Facility 13) Public Park; 14) Pharmacy; 15) Post Office; 16) Bank; 17) Community Center (e.g., recreation center, after-school program building, or art center); 18) Community Park; 19) Theater or Museum. **OR** Verify that your municipality has a current Commonwealth Capital score or Commonwealth Capital Application submitted by the time of your MA-MA-CHPS design submission. For regional school districts, verify that at least half of the municipalities in the regional school district have current scores or submitted applications.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

Siting schools in areas of density and/or mixed use allows more students to walk or bike to school, while reducing the distance cars must travel. Schools located near public and private services such as libraries and community centers not only allow students to access these services after school, they put parents en route to these services if they pick their children up after school (though use of public transportation is strongly encouraged). Planning around centers of public and private activity is embodied in the concept of Smart Growth, which promotes dense development in order to preserve public parks and natural features such as open space and wildlife habitat.

SS.C2: Central Location

Provide a map showing the ½ mile perimeter around the school and indicating the names and location of eight of the basic services listed in the credit text box. The ½ mile radius may be drawn from EITHER the front entrance of the school, where the school driveway meets the public way, or from the front door of the school. The front door of the basic service identified on the map must fall within the ½ mile radius. Online tools such as MapQuest™ may also be submitted as documentation of the ½ mile radius.

Each year, many municipalities apply to the Massachusetts' Executive Office of Energy and Environmental Affairs Commonwealth Capital program. Communities receive points on their applications for zoning, planning, natural resources protection etc. that weave together initiatives that embody the concept of "smart growth". To learn more information about the program, visit the Executive Office of Energy and Environmental Affairs' website at www.mass.gov/envir

Provide a copy of your municipality's Commonwealth Capital current score as furnished by the Executive Office of Energy and Environmental Affairs.

Applicability

This credit applies to all projects.

Resources

Executive Office of Energy and Environmental Affairs Smart Growth Toolkit: http://www.mass.gov/envir/smart_growth_toolkit/

Massachusetts Smart Growth Alliance: www.ma-smartgrowth.org

EPA's Smart Growth site: www.epa.gov/smartgrowth

Commonwealth Capital site: www.mass.gov (Click on: Key Priorities → Jobs & Economy → Clean Energy & Smart Growth-Smart Energy → Commonwealth Capital)

SS.C3: Reduced Building Footprint

Intent: Reduce the extent of land used for development.

This credit is intended to mitigate negative impacts on existing ecosystems. Reducing a building footprint can reduce site disturbance to these systems. Multi-story schools decrease the amount of land used in construction and help preserve existing open space.

Requirement

1 point	SS.C3.1 Increase the Floor Area Ratio (FAR) of the school to be at least 1.4 to reduce the development footprint and preserve open space. In this document, the FAR is defined as building's gross square footage divided by the square footage of the building footprint.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

Demonstrate that the design meets this requirement through the following equation:

$$\frac{\text{Total Floor Area of Building (ft}^2\text{)}}{\text{Total Floor Area of the Building Footprint (ft}^2\text{)}} \geq 1.4$$

Building multi-story schools reduces the amount of land used in construction. Said another way, achieving a floor area ratio (FAR) of 1.4 requires at least 40% of the total building square footage needs to be above the first floor. The building footprint is defined as the ground surface occupied by the structure and excludes awnings, overhangs and projections from the building. For new schools, include the total floor area for all of the building(s) footprints and the total floor area of all of the building(s).

Calculate the Floor Area Ratio (FAR) by dividing the school facility's footprint by the facility's entire square footage including all stories. See Application Template to input your project's data.

Applicability

This credit applies to all projects. A major renovation project can claim this credit if the building already satisfies the requirement or if an addition is planned above the ground level.

Resources

None.

SS.C4: Building Layout and Microclimates

Intent: Affect energy efficiency and environmental impacts by decisions made early in the planning process.

Requirement

1 point	SS.C4.1 Sustainable Site and Building Layout. Implement four of the following best practice site strategies: 1. Orient the building(s) to take advantage of maximum natural daylighting OR plot shadow patterns from surrounding buildings and place buildings to optimize access to daylight (for urban-infill sites). 2. Consider prevailing winds when determining the site and building layout. For example, consider how the shape of the building itself can create wind-sheltered spaces and consider prevailing winds when designing parking lots and driveways to help blow exhaust fumes away from the school. 3. Take advantage of existing land formations and vegetation to provide shelter from extreme weather or to deflect unwanted noise. 4. Plant or protect existing deciduous trees to block summer sun and allow winter solar gain. Plant or protect existing coniferous trees to block winter wind. Planting should be done an adequate distance from the building to prevent the accumulation of water along the building envelope. 5. Minimize importation of non-native soils and exportation of native soils. Optimize Cut & Fill (ideally in 1:1 proportions) during clearing and excavation. 6. Create physical connections to bike paths, natural features, or adjacent buildings. 7. Site the building to maximize opportunities for on-site renewable energy generation. For example, preserve or ensure availability of space for wood chip storage facilities for biomass heating, wind turbines, or other renewable energy sources.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

Performing a thorough site analysis at the pre-design phase is critical to understanding all the opportunities and complexities of a building site. A good site analysis allows the designer to make informed decisions to take full advantage of solar orientation, prevailing wind direction, topography, and tree species and locations. Adjacent streets & traffic patterns should be considered, functional synergies with surrounding buildings created, and special environmental elements featured.

Item #1 highlights the importance of building orientation. Energy efficiency and environmental impacts are affected by decisions made early in the planning process. For example, when the building is oriented along the east-west axis, the designer can take advantage of natural daylighting, which reduces the need for electrical lighting and resultant energy consumption. Note: Urban infill projects do not usually have the

opportunity to orient the building to the sun, due to tight site constraints. However, project designers are encouraged to think about maximum solar exposure within the limits of the surrounding buildings.

Item #2 encourages designers to consider prevailing winds in their design. Proper orientation can help move vehicle exhaust away from the school. In addition, winter winds and snow accumulation should be considered to predict and prevent snowdrifts in driveways and in front of air intakes.

Earth berms, forests, and other natural features can help inform layout of the school building during early design. Likewise, manmade structures, such as storage structures for biomass fuel, can be sited carefully to provide protection to the site. Plantings of deciduous trees provide shade to the school during warmer months and access to sunlight at the end of autumn when the trees' leaves have fallen. These suggestions refer to items #3 and #4 above.

Importation or exportation of soil can be costly in terms of both dollars and environmental impact. Item #5 encourages the conservation of the environment by minimizing excavation and importation of non-native soils. By optimizing Cut & Fill (ideally 1:1) during clearing and excavation, use of native soils is maximized, reducing the adverse impacts on the site.

In item #6, creating physical connections means considering features on adjacent properties and designing the site layout such that it promotes their use.

Item #7 encourages early consideration of opportunities for on-site renewable energy generation. Biomass heating, for example, can be an effective option for many school projects, but the building and site layout must take into consideration the need for wood chip storage. Wind electricity generation may also make sense for many schools, but wind resources should be investigated early and designers should investigate the best location for turbines on the school site. Likewise, electricity generated by the sun through photovoltaic (PV) panels may be an option, but PV panels must be installed such that they will not be shaded and should be oriented toward the south.

Applicability

This credit applies to all projects. A renovation project can claim this credit if the building already satisfies the requirement.

Resources

None.

SS.C5: Public Transportation

Intent: Encourage the use of public transportation.

Public transportation is a more efficient method of transportation than the private automobile. Some school districts offer reduced or subsidized fares for students and staff who use public transportation. If sufficient capacity exists, schools can use public transportation to replace district provided bus service. Schools located near high traffic areas must ensure safe student access. In addition, all transportation-related pollution must be considered when investigating site air quality and the potential for natural ventilation.

Requirement

1 point	SS.C5.1 Public Transportation. Locate building within 1/2 mile of a commuter rail, light rail or subway station, or within ¼ mile of one or more bus lines.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

The energy use and pollution associated with transportation often dwarfs the total lifetime energy used by the school itself. Locating the site close to public transportation, encouraging use of public transportation and carpooling by minimizing parking, and creating bike facilities and safe walking/biking access all reduce the automobile-related pollution. Some school districts offer reduced or subsidized fares for students and staff using public transportation. If sufficient capacity exists, schools can use public transportation to replace district provided bus service.

Provide an area map locating transportation lines within the distance to school as noted. Measure from the main entrance of the school building (i.e. front door), and mark bus stops or stations for commuter rail, light rail, or subway lines.

Applicability

This credit applies to new schools. A renovation project, a new building on an existing campus, and an addition can claim this credit if the existing campus already satisfies the requirement.

Resources

None.

SS.C6: Pedestrian / Bike Access / Human Powered Transportation

Intent: Encourage alternative transportation methods to and from school that increase physical activity, improve health, and reduce dependence on fossil fuels.

Bicycles, scooters and skateboards, are a popular and pollution-free form of transportation. When encouraging the use of bicycles it is important to ensure the safety of pedestrians and bicyclists through providing bike lanes and sidewalks.

Requirement

1 point	SS.C6.1 Provide sidewalks or walkways and bike lanes that extend at least to the school entrance at the public way; AND provide bike lanes or sidewalks that connect to residential areas at least ¼ mile from the school entrance at the public way; AND provide suitable means for securing bicycles, scooter and/or skateboards for 5% or more of building occupants. For elementary schools, count only students in the 4th grade and above as building occupants. Staff should be included in all calculations regardless of the age of the school's students.
1 point	SS.C6.2 Collaborate with local organizations and the municipality to provide safe bike lanes that extend appropriately from the school site at least two miles into neighboring communities or access ways. Please note that the addition of bike lanes or sidewalks from the school to surrounding neighborhoods may not be an expense that is reimbursed by the Massachusetts School Building Authority.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

To earn this credit, safe bicycle lanes must extend at least to the end of the school zone (1/4 mile from school property) to protect and encourage cyclists. Work with the local authorities to extend the bike lanes beyond the project limits and across busy roads. Bike lanes should be designed to accommodate significant traffic (lane width established by the local jurisdiction) and be separated from pedestrian sidewalks and parking.

The purpose of this credit is to provide safe access to the school by students and staff who choose to walk or ride their bicycles to school.

Applicability

This credit applies to all projects.

Resources

CHPS Best Practices Manual, Volume II: Guideline SP3: Safe and Energy Efficient Transportation.

LEED™-NC 2.2 Reference Guide: Site Credit 4: Alternative Transportation.

Safe Routes to Schools http://www.saferoutesinfo.org/guide/index.cfm

SS.C7: Parking Minimization

Intent: Discourage the use of automobiles for transportation to and from school.

Excess parking spaces encourage increased automobile use, contribute to urban heat island effects, and can increase pollution from stormwater runoff. Design parking so as not to exceed listed amounts and include clearly marked, preferred parking areas for carpools.

Requirement

1 point	SS.C7.1 Minimize Parking **New Construction**: Size parking capacity: 1. to meet, but not exceed, minimum local zoning requirements, OR 2. to not exceed: • High schools: 2.25 spaces per classroom plus parking for 20% of students. • Elementary and Middle: Three parking spaces per classroom. AND provide preferred parking spaces and signage for 5% of total parking spaces for carpools, vanpools, and low-emitting, fuel-efficient vehicles (e.g. hybrids and vehicles using bio-diesel, CNG or other low-emitting fuel or technology), **Major Renovations:** Add no new parking compared to existing conditions, AND provide preferred parking spaces and signage totaling 5% of total parking spaces for carpools or vanpools and for low-emitting, fuel-efficient vehicles (e.g. hybrids, vehicles using bio-diesel, CNG or other low-emitting fuel or technology).

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

Excess parking spaces encourage increased automobile use, contribute to urban heat island effects, and can increase pollution from stormwater runoff. Design parking so as not to exceed listed amounts, and include clearly marked, preferred parking areas for carpools, vanpools and low-emitting, fuel-efficient vehicles. For the purposes of making calculations for this credit, classrooms include:

- General classrooms
- Art rooms
- Music classrooms
- Computer labs
- Science labs
- Special needs collaborative, and remedial classroom space

SS.C7: Parking Minimization

For new construction, provide a site plan showing parking layout (indicate total number of parking spaces). Highlight preferred parking spaces. Signage schedule highlighting Preferred Parking signage. Indicate number of classrooms (as defined for this credit) and total number of students.

For major renovation, provide an existing site plan showing existing parking conditions (indicate total number of parking spaces). Site plan of new parking layout (indicate total number of parking spaces). Highlight preferred parking spaces. Signage schedule highlighting Preferred Parking signage.

Applicability

This credit applies to all projects.

Resources

CHPS Best Practices Manual, Volume II: Guideline SP3: Safe and Energy Efficient Transportation.

LEED™-NC 2.2 Reference Guide: Site Credit 2: Alternative Transportation & Site Credit 4.

SS.C8: Post Construction Stormwater Management

Intent: Manage stormwater after construction to control erosion and runoff, recharge local aquifers, and maintain the quality of receiving waters. Encourage the use of Low Impact Development and other innovative techniques.

Requirement

1 point	SS.C8.1 Exceed the Massachusetts Stormwater Standards by implementing a stormwater management plan that results in a 25% decrease in stormwater runoff volume from existing conditions through one of the options listed in below.

Implementation

For the purpose of verifying compliance, the peak stormwater discharge rate is assumed to be directly proportional to the imperviousness of the site. For example, a 25% reduction in imperviousness is assumed to equate to a 25% reduction in the peak stormwater runoff discharge rate.

Stormwater runoff is precipitation that flows over surfaces on the site and enters either the sewage system or receiving waters (local bodies of water). Stormwater carries sediment and pollutants from the site into the sewage system or local lakes and ponds and is the single biggest cause of degradation to water. Because runoff is directed to these features rather than allowed to infiltrate the soil and into groundwater, the result is reduced water tables, impaired quality of lakes and streams, erosion of natural features, and a high cost to the municipality to manage the effects. For example, the cumulative runoff throughout the local area requires significant investments in municipal infrastructure to handle peak runoff loads.

Reducing the amount of runoff is the most effective way to minimize its negative impacts. Many strategies exist to limit stormwater runoff, including the following:

- Significantly reduce impervious surfaces, maximize on-site stormwater infiltration, and retain pervious and vegetated areas.
- Capture rainwater from impervious areas of the building for groundwater recharge or reuse within the building.
- Use green/vegetated roofs.

All applicants must meet the applicable minimum Stormwater Standards and requirements of the Massachusetts Department of Environmental Protection, including:

- Preparation of a Stormwater Pollution Prevention Plan (SWPPP).
- Complying with the Stormwater Standard for Water Quality (Standard 4) pertaining to Total Suspended Solids.

OPTION 1: Reduce imperviousness by 25% compared to existing conditions. Volumetric coefficients of different types of land cover can be used to determine the cumulative reduction. A combination of techniques can be utilized, such as minimizing impervious surfaces (e.g. pavement) and Low Impact Development. See the LEED 2.1 Reference Guide for information on Schueler's methodology for using volumetric coefficients.

OPTION 2: Install a green roof that is equal to 25% of the proposed impervious area. The area covered by the green roof does not need to be contiguous.

OPTION 3: Provide a rainwater reuse system that results in an average 25% net decrease in runoff on an annual basis. Seasonal or continuous systems will be accepted as long as the average annual decrease meets the 25% threshold. The captured water may be used indoors or outdoors.

OPTION 4: Implement a stormwater management plan that results in a 25% decrease in the peak runoff rate for the 2-year, 24-hour storm from existing to developed conditions, AND design a stormwater system that results in a 25% decrease in runoff volume for the 2-year, 24-hour storm from existing to developed conditions.

Applicability

This credit applies to new construction projects on previously developed land and renovation projects. The credit does not apply to new construction schools on greenfield sites (open land).

Resources

Massachusetts Stormwater Handbook, MA Department of Environmental Protection, February 2008: http://www.mass.gov/dep/water/laws/policies.htm#storm

U.S. EPA Storm Water Management for Construction Activities, EPA Document No. EPA-833-R-92-001.

U.S. EPA Best Management Practice Design Guide, EPA Document No. EPA-600/R-04/121A.

U.S. EPA NPDES Construction General Permit: cfpub2.epa.gov/npdes/stormwater/cgp.cfm.

CHPS Best Practices Manual, Volume II: Guideline SP9: Stormwater Management, Groundwater Management, and Drainage Materials.

CHPS Best Practices Manual, Design Volume: Guideline GC4: Site Protection During Construction.

CHPS Best Practices Manual, Design Volume: Guideline SP11: Stormwater Management and Drainage Materials.

LEED™-NC 2.2 Reference Guide: Site Credit 6: Stormwater Management.

LEED™-NC 2.2 Reference Guide: Site Prerequisite 1: Erosion and Sedimentation Control.

SS.C9: Reduce Heat Islands – Landscaping

Intent: Reduce heat islands to minimize impact on microclimate and human and wildlife habitat.

Heat islands raise temperatures and can impact school communities by increasing peak energy demand, air pollution levels, air conditioning costs, and heat-related illness. Employ design strategies, materials, and landscaping designs that reduce heat absorption of exterior materials.

Requirement

1 point	SS.C9.1 Provide shade (within five years) on at least 20% of non-roof, impervious surfaces on the site, including parking lots, walkways, plazas, etc. OR use light-colored/ high-albedo materials (a Solar Reflectance Index* (SRI) of at least 0. 29) for 20% of the site's non-roof, impervious surfaces OR use a combination of shading and high-albedo materials for 20% of the site's non-roof surfaces. **SRI or Solar Reflectance Index is calculated according to ASTM E 1980. Reflectance is calculated according to ASTM E 903, ASTM E 1918 or ASTM C 1549. Emittance is calculated according to ASTME E 408 or ASTM C 1372.*

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

Note that the "heat island effect" is largely an urban phenomenon. Dark surfaces, such as pavement, cladding, and roofing absorb heat and radiate it back to surrounding areas. In a city, where there are many dark, heat absorbing surfaces, infrared radiation can easily boost temperatures by 10˚F or more. The heat island effect increases the need for air conditioning (and therefore electricity consumption) and is detrimental to site plantings, local wildlife, and maintaining comfortable temperatures.

Employ design strategies, materials, and landscaping designs that reduce heat absorption of exterior materials. Note Solar Reflectance Index (SRI) requirements in the drawings and specifications. Provide shade using native or climate-tolerant trees and large shrubs, vegetated trellises, or other exterior structures supporting vegetation. Substitute vegetated surfaces for hard surfaces. Explore elimination of blacktop and the use of new coatings and integral colorants for asphalt to achieve light colored surfaces.

A site plan or landscaping plan should show trees that contribute to shade and/or highlight light-colored, non-roof impervious surfaces.

Calculations for shading and/or high-albedo materials:

- Shading
- Identify all non-roof impervious surfaces on the project site and sum the total area.
- Identify all trees that contribute shade to non-roof impervious surfaces. Highlight these trees on the plan you submit.
- Calculate the shade coverage provided by these trees after five years of growth on the non-roof impervious surfaces on June 21 at solar noon to determine the maximum shading effect.

- Determine the total area of shade provided for non-roof impervious surfaces. Divide by total—result must be 20%.

For use of light-colored/ high-albedo materials:

- Identify all non-roof impervious surfaces on the project site and sum the total area.
- Calculate the total area of non-roof impervious surfaces designed with light-colored/high-albedo materials. Divide by total—result must be 20%.
- If light-colored/ high-albedo materials are used to achieve this credit, provide specifications showing an SRI of 29 or better.

Note: Applicants may achieve 20% coverage by adding together areas of shading and areas of light-colored/high-albedo materials to total 20%.

Applicability

This credit applies to new schools. For a new building on an existing campus, additions, and major renovations, the requirement applies to the entire school site, not just the area around the new building or the buildings being modernized. A major renovation project, a new building on an existing campus, and an addition can also claim this credit if the existing campus already satisfies the requirement.

Resources

CHPS Best Practices Manual, Volume II: Guideline SP2: Landscaping to Provide Shade to Buildings and paved Areas, SP5: Impervious Surfaces.

LEED™-NC 2.2 Reference Guide: Site Credit 7: Landscape and Exterior design to Reduce Heat islands.

US EPA Heat Island resources and strategies can be found at: www.epa.gov/heatisland/.

Sustainable Development with Concrete– www.concretethinker.com

SS.C10: Reduce Heat Islands – Cool Roofs/Green Roofs

Intent: Employ cool or green roofs to reduce the heat island effect.

Cool roofs can significantly reduce school cooling loads and urban heat island effects by reflecting the sun's energy, instead of absorbing, retaining, and radiating it into the occupied spaces below. This credit is most beneficial for schools with significant cooling loads.

Requirement

1 point	SS.C10.1 Cool Roofs. Use roofing materials that have a Solar Reflectance Index* (SRI) as listed below for roof type for a minimum of 75% of the roof surface. Roof Type — Slope — SRI Low-Sloped Roof — <=2:12 — 78 Steep-Sloped Roof — >2:12 — 29 **OR** For 75% of roofing materials, use one of the strategies listed above and/or install a "green" (vegetated) roof. The vegetated roof must equal at least 25% of the roof surface. Develop a guide and maintenance plan for the vegetated roof.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

Cool roofs can significantly reduce school cooling loads and urban heat island effects by reflecting the sun's energy, instead of absorbing, retaining, and radiating it into the occupied spaces below. Both the reflectivity and emissivity are important characteristics of cool roofs. A solar reflectance of 0.0 means that all the solar energy hitting the surface is absorbed and none is reflected. Emissivity is the ability of a material to shed infrared radiation.

Schools that do not have significant cooling loads (i.e. schools that do not have significant summer use) or are not located in urban areas may not wish to pursue this credit. In these cases, a cool roof can actually result in more energy use in the heating season than it will offset in cooling loads during the summer. Energy modeling can help predict which facilities would be likely to experience an energy benefit by installing a cool roof. To find qualifying roof products, see the Cool Roof Rating Council website at www.coolroofs.org.

Green roofs have been found to significantly reduce both the heating and cooling loads of buildings on which they are implemented. While they may significantly reduce the urban heat island effect by not using traditional building materials, they also provide increased insulation and help reduce heating costs in the winter months, unlike cool roofs, which can possibly increase a building's energy use during the winter. In addition to improving the insulation of a roof, green roofs have also been found to considerably lengthen the lifespan of a roof and reduce stormwater runoff. In some cases implementing a green roof has been found to more than double the lifespan of a roof.

Green roofs may be difficult to implement on existing structures due to limitations on the weight load of the existing roof. Retrofitting roofs with certain types of green roofs may not be possible because the substrate and vegetation placed on the roof will exceed permitted static loading. In addition to issues concerning weight

load, waterproofing the existing roof structure can potentially be an obstacle because of the amount of water retained on the roof and the potential for roots to penetrate the waterproof membrane. For an informational database containing more information on the implementation and different kinds of green roofs that exist, see http://www.greenroofs.com/.

Applicability

This credit applies to all projects.

Resources

CHPS Best Practices Manual, Volume II: Guideline IN3: Cool Roofs.

LEED™-NC 2.2 Reference Guide: Site Credit 7: Landscape and Exterior design to Reduce Heat Islands.

Cool Roof Rating Council (CRRC): www.coolroofs.org/

Greenroofs.com provides an informational database for green roofs at: www.greenroofs.com/

US EPA Energy Star ® program reflected roof products can be found at: www.energystar.gov/index.cfm?c=roof_prods.pr_roof_products

US EPA Heat Island resources and strategies can be found at: www.epa.gov/heatisland/

Lawrence Berkeley Laboratory, Heat Island Group resources can be found at: www.epa.gov/heatisland/.

Solar Reflectance Calculator (SRI) available at: http://coolcolors.lbl.gov/assets/docs/SRI%20Calculator/SRI-calc10.xls.

SS.C11: Light Pollution Reduction

Intent: Reduce development impacts on the nocturnal environment.

Good outdoor lighting supports the comfort and safety of the school community. Low glare, appropriate light levels, optical guidance, and good color rendition are attributes of good outdoor lighting. Good lighting also prevents light pollution that impacts the night sky or trespasses onto neighboring properties.

Design site lighting and select lighting styles and technologies to have minimal impact off-site and minimal contribution to sky glow. Minimize outdoor lighting of architectural and landscape features and design interior lighting to minimize trespass outside from the interior.

Requirement

1 point

SS.C11.1 Uplight, light trespass, and glare shall be limited for all exterior lighting equipment as described in Sections SS.C11.2 and SS.C11.3. **Exceptions to SS.C11.2 and SS.C11.3:** Lighting used for the following exterior applications is exempt when equipped with a control device independent of non-exempt lighting.

- In Exterior Lighting Zones 3 and 4, lighting for building facades, as long as fixtures incorporate shielding devices such as hoods, louvers, and source shields.
- Roadway lighting required by governmental authorities.
- School identification signage or directional signage; (see 5.3)
- Flag lighting (see 5.3)
- Lighting for public monuments (see 5.3)
- Lighting for athletic playing areas (see 5.4)

SS.C11.2 Uplight. All exterior lighting fixtures shall comply with the requirements of either Table 1 **or** Table 2. Exterior Lighting Zones (LZ) are defined in Table 5.

Table 1
Uplight Ratings

	LZ 1	LZ 2	LZ 3	LZ 4
Maximum Luminaire Uplight Rating as defined by IES TM-15-07 Addendum A	U1	U2	U3	U4

Note: Uplight ratings shall be determined by the actual photometric geometry in the specified mounting orientation.

Table 2
Maximum Site Uplight

	LZ 1	LZ 2	LZ 3	LZ 4
Maximum percentage of total exterior fixture lumens allowed to be emitted above horizontal	0%	1%	2%	5%

Requirement Continued

SS.C11.3 Light Trespass and Glare:

All building mounted luminaires located two mounting heights or less from the *lighting boundary* shall not exceed the applicable glare ratings in Table 3. All other exterior luminaries shall not exceed the applicable Backlight and Glare ratings in Table 4.

Definition of *Lighting Boundary*: Where the property line abuts a public walkway, bikeway, plaza, or parking lot, the lighting boundary shall be 5 feet beyond the property line. Where the property line abuts a public roadway or public transit corridor, the lighting boundary shall be the centerline of the public roadway or public transit corridor. In all other circumstances, the lighting boundary shall be at the property line.

Table 3. Maximum Glare Ratings for Building Mounted Luminaires Located Two Mounting Heights or Less from Lighting Boundary

	LZ1	LZ2	LZ3	LZ4
Maximum luminaire glare rating as defined by IES TM-15-07 Addendum A.	G0	G1	G1	G2

Note: The rating shall be determined by the actual photometric geometry in the specified mounting orientation.

Table 4. Maximum allowable Backlight and Glare Ratings

	LZ 1	LZ 2	LZ3	LZ 4
Luminaire located more than two mounting heights from *lighting boundary*	B4 G1	B3 G2	B2 G3	B0 G4
Luminaire located one to two mounting heights from *lighting boundary*	B4 G1	B3 G2	B2 G3	B0 G4
Luminaire located one-half to one mounting heights from *lighting boundary*	B4 G1	B3 G2	B3 G3	B1 G4
Luminaire located less than one-half mounting height from *lighting boundary*	B4 G1	B4 G2	B3 G3	B2 G4

Notes for Table 4:

1. Backlight and Glare (BUG) ratings are defined by IES TM-15-07 Addendum A.
2. Luminaires located two mounting heights or less from the *lighting boundary* shall be installed with Backlight towards the *lighting boundary*, unless they are lighting a roadway, bikeway, or walkway which intersects a public roadway.
3. The rating shall be determined by the actual photometric geometry in the specified mounting orientation.

Requirement Continued

SS.C11.4 Signs, Flags, and Public Monuments

Lighting for school identification and directional signs, for flags, and for public monuments is limited to 50-watts per fixture. Fixtures must incorporate shielding devices such as hoods, louvers, and source shields. Fixtures must direct the light substantially to the sign surface, flag, or monument. Signs should be lighted from the top down if feasible. Internally illuminated signs with luminous backgrounds are discouraged. Flags should be lowered each night, but if that is not feasible, then protocol dictates that flag of the United States be lighted. Two fixtures maximum, with narrow beam distribution should be used to light the flag.

SS.C11.5 Sports field lighting

Sports Field lighting design must follow IES RP-6. Fixtures must incorporate extensive shielding to minimize and redirect stray light. Controls must be provided that encourage the shutting off of the lights when the sports field is not in use.

Table 5. Definitions of Exterior Lighting Zones

Lighting Zone	Description
1	Developed areas of national parks, state parks, forest land, and rural areas
2	Areas predominantly consisting of residential zoning, neighborhood business districts, light industrial with limited nighttime use and residential mixed use areas
3	All other areas
4	High activity commercial districts in major metropolitan areas as designated by the local jurisdiction

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

Provide the following:

- A site lighting plan showing the location of all exterior lighting fixtures, including those mounted on buildings. Plan should show the *Lighting Boundary* and indicate any fixtures that are believed to be exempt per Exceptions to SS.C11.2 and SS.C11.3.
- A lighting fixture schedule with complete specifications for each fixture type.
- Mounting heights for all fixtures shown either on the plan or the fixture schedule.
- Cut sheets for all exterior lighting fixtures.
- BUG ratings for all non-exempt fixtures (may be shown on fixture schedule).
- If using section 5.1 Uplight, Table 2 option, submit a spreadsheet showing each non-exempt fixture type and its lumen output and zonal lumens above horizontal each multiplied by the quantity of the fixture, and the ratio of total lumens above horizontal to total fixture lumens, expressed as a percentage.

- A declaration of the Lighting Zone that project is in.
- A signed letter from the project's site lighting designer confirming that to the best of their knowledge the requirements of this credit have been met.

Applicability

This credit applies to all projects.

Resources

CHPS Best Practices Manual, Volume II: Guideline EL11: Outdoor Lighting.

LEED™-NC 2.2 Reference Guide: Site Credit 8: Landscape Light Pollution Reduction.

The Illuminating Engineering Society (IES): www.iesna.org/

The International Dark Sky Association: http://www.darksky.org/

The International Dark Sky Association Lighting Handbook is available on line at: www.darksky.org/ordsregs/lchintro.html

Illuminating Engineering Society; www.ies.org

Illuminating Engineering Society, Luminaire Classification System for Outdoor Luminaires, TM-15-07 with Addendum A

Illuminating Engineering Society, Lighting for Exterior Environments, RP-33-99

Illuminating Engineering Society, Lighting for Parking Facilities, RP-20-98

Illuminating Engineering Society, Sports and Recreational Area Lighting, RP-6-01

MW.P1: Storage and Collection of Recyclables

Intent: Facilitate the separation and collection of materials for recycling

Providing easily accessible recycling to the students, teachers and staff ensures a significant portion of solid waste can be diverted from landfills and transformation facilities. Recycling of paper, cardboard, metals, plastics and organics diminishes the need to extract virgin materials.

Prerequisite	MW.P1.1 The school building shall meet any local ordinances for recycling space, if such exist, and provide both an easily accessible area that is dedicated to the separation, collection, and storage of materials for recycling, including—at a minimum—paper (white ledger and mixed), cardboard, glass, plastics, aluminum cans, and metals and also a plan for the removal of these recyclables.

Implementation

The Commonwealth of Massachusetts has banned the following materials from the solid waste stream: aluminum cans, white paper, corrugated cardboard, single polymer plastics, glass bottles, televisions and computer monitors. Therefore, designers should designate areas in the school where these materials can be handled and sorted. For sizing guidelines on spaces for storage and handling of recyclable material, see the California Integrated Waste Management Board's *Recycling Space Allocation Guide* —go to: www.ciwmb.ca.gov/publications/localasst/31000012.doc.

Early in the design phase, be sure to reserve space for recycling functions and show areas dedicated to the collection of recycled materials on floor plans. Consider the question of how recyclable materials will be collected and removed from classrooms, teachers' prep rooms, and offices. When recycling bins are used, they should be able to accommodate a 75% diversion rate (from normal waste basket contents) and be easily accessible to students and staff as well as custodial staff. Consider bin designs that allow for easy cleaning to avoid health issues.

For more advanced recycling programs that may include recycling of organic waste (food and soiled paper), and dry waste, consider the extra storage space needed and where to locate materials to prevent nuisances such as odors and fruit flies. (Note: The Williamstown Elementary School in Williamstown, MA has instituted a composting program. Children separate their lunch food waste and it is composted off-site.)

Applicability

This prerequisite applies to all projects.

Resources

For more information about recycling in Massachusetts, see the Department of Environmental Protection's Web site: http://www.mass.gov/dep/recycle/recycle.htm

California Integrated Waste Management Board Recycling Space Allocation Guide at: http://www.ciwmb.ca.gov/publications/localasst/31000012.doc

MW.P2: Construction Site Waste Management, 75%

Intent: Divert construction and demolition waste from landfills.

This prerequisite, and its corresponding points under MW.C1, are very feasible in all parts of Massachusetts. Even if there are limited recycling facilities or waste management recycling companies in the project area, construction waste management can still take place through sub-contractor sorting the waste into multiple dumpsters. The cost is then associated with the dumpster costs and hauling charges. Construction and demolition waste account for approximately 22% of the waste disposed. Recycling construction and demolition (C&D) materials reduces demand for virgin resources and diminishes the need for landfill space. Meet local ordinance requirements concerning C&D materials at construction sites, if applicable; and develop and implement a C&D waste management plan, quantifying material diversion by weight.

Requirement

Prerequisite	MW.P2.1 Recycle, reuse, and/or salvage at least 75% (by weight) of non-hazardous construction and demolition waste, not including land clearing and associated debris.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

The Massachusetts Department of Environmental Protection's (DEP) instituted a ban on asphalt paving, brick, concrete, metal and wood wastes from Massachusetts's landfills and incinerators. Prerequisite 2 encourages a reasonable percentage of 75% diversion of non-hazardous construction and demolition wastes from new construction and renovation projects. For an additional point, Credit 1 sets a slightly more ambitious but achievable diversion rate of 90%. To view the latest version of the DEP waste ban see: http://www.mass.gov/dep/recycle/laws/policies.htm#wastebans

Waste Management Plans

Successful salvage, recycling, and diversion of construction and demolition materials is usually the result of a well thought out waste management plan and on-site training for contractors and subcontractors.

See the *Recycling Construction and Demolition Wastes, a Guide for Architects and Contractors*, www.architects.org/emplibrary/CD_Recycling_Guide.pdf, sponsored by the Boston Society of Architects, Associated General Contractors of Massachusetts, and MA Dept of Environmental Protection (DEP). The DEP provides sample waste management plans at this link: www.mass.gov/dep/recycle/files/wastplan.doc. The Vermont Waste Management Division also provides tips for handling C&D wastes: www.anr.state.vt.us/dec/wastediv/recycling/planning.htm.

In addition, there are successful C&D waste diversion pilot projects that can be reviewed on the DEP web site. See links below:

- Cambridge City Hall Annex, Cambridge, MA: www.mass.gov/dep/recycle/files/cdcmbrdg.doc
- Douglas School, Douglas, MA: www.mass.gov/dep/recycle/files/cddougls.doc
- MIT Media Lab, Cambridge, MA: www.mass.gov/dep/recycle/files/cdmit.doc

Compliance calculations for this credit must be based on weight. Many recycling and landfill facilities weigh incoming materials. Shipments that cannot be weighed can be estimated based on their volume and density.

Recycle Rate (%) = [Recycled Waste [Tons] / (Recycled Waste [Tons] + Garbage [Tons])] x 100

Note: DO NOT include materials classified as hazardous wastes in these calculations.

The Construction Waste Management Plan should detail the following components:

- The diversion percentage goals for C&D wastes, e.g., 75% or 90%. A 95% recycling rate will receive an Innovation credit.
- Recycling/reuse strategies and processes for onsite recycling, deconstruction and salvage, e.g., scheduling of different stages of deconstruction to best remove recyclable or salvageable materials intact.
- On-site communication: the general contractor will detail communication strategies for construction workers and subcontractors about the recycling program and goals.
- Waste management documentation: The construction waste management plan will specify documents needed to show waste diversion—e.g., weight tickets for all wastes removed from the site including recycled and salvaged materials.
- Recycling summary: Recycling and waste data will be collected into a summary document for construction documentation.

Applicability

All new construction work and major renovations are eligible for this credit.

Resources

CHPS Best Practices Manual, Volume II: Guideline GC2: Construction and Demolition Waste Management.

CHPS High Performance Schools Best Practices Manual Electronic Appendix A: Job Site Specification: www.chps.net

LEED™-NC 2.2 Reference Guide: Materials Credit 2: Construction Waste Management.

Recycling Construction and Demolition Wastes: A Guide for Architects and Contractors www.architects.org/emplibrary/CD_Recycling_Guide.pdf

Massachusetts Department of Environmental Protection, Bureau of Waste Prevention, C&D Waste Prevention—. http://mass.gov/dep/recycle/reduce/managing.htm

Recycling Construction and Demolition Wastes: A Guide for Architects and Contractors http://www.architects.org/emplibrary/Recycling_Guide_11-19-04.pdf

U.S. EPA C&D: http://www.epa.gov/epaoswer/non-hw/debris-new/index.htm

CIWMB Construction/Demolition and Inert Debris Tools and Resources: www.ciwmb.ca.gov/leatraining/resources/cdi/tools/calculations.htm

MW.C1: Construction Site Waste Management, 90%

Intent: Divert construction and demolition waste from landfills.

This credit builds on the prerequisite MW.P2 for increased construction debris diversion.

Requirement

1 Point	MW.C1.1	Recycle, reuse, and/or salvage an additional 15% for a total of at least 90% (by weight) of non-hazardous construction and demolition waste, not including land clearing and associated debris.

Implementation

Follow the implementation guidelines under prerequisite MW.P2.

Applicability

All new construction work and major renovations are eligible for this credit.

Resources

See resources under prerequisite MW.P2.

MW.C2: Single Attribute - Recycled Content

Intent: Specify and install recycled content products in order to reduce the environmental impacts associated with extraction and processing of virgin materials.

The number and variety of products using recycled-content materials expands every year. Using these materials closes the recycling loop by creating markets for materials collected through recycling programs across the country. It also reduces the use of virgin materials and landfill waste. Recycled-content alternatives exist for all major building materials and surfaces. Recycled content is either a postconsumer (collected from end users) or secondary material. Secondary material (also known as post-industrial or pre-consumer) is collected from manufacturers and industry. Both of these materials combined make up the total recycled-content of a product.

Requirement

1-2 points	MW.C2.1 *Prescriptive Approach*: Specify and install at least four major materials from Table 15 for 1 point, or eight major materials from Table 15 for 2 points. ***OR*** *Performance Approach*: The weighted average recycled-content value is at least 10% (postconsumer + ½ secondary), or at least 20% for 2 points.

Fly ash generated from municipal solid waste incinerators is not an acceptable recycled content material under this credit, nor is fly ash generated as a coal combustion by-product where the coal plant is fired with hazardous waste, medical waste or tire-derived fuel.

For Massachusetts school projects mercury concentration should not be more than 5.5 ppb (0.0055 mg/L) as determined by a Toxic Characteristic Leaching Procedure (TCLP) following EPA 7470A. Most U.S. fly ash has mercury content of 2 ppb or less. This is a level that is deemed acceptable for drinking water in the U.S. and is safe for use in construction. Furthermore, when this mercury is bound in the matrix of construction materials, the scientific literature indicates that it does not leach out, even when subjected to more aggressive conditions than anticipated in real life. Certain combinations of coal types and power plant combustion may produce fly ash with higher mercury content, though this appears to be rare.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

The number and variety of products using recycled-content materials expands every year. Using these materials closes the recycling loop by creating markets for materials collected through recycling programs across the country. It also reduces the use of virgin materials and landfill waste. Recycled-content alternatives exist for all major building materials and surfaces. Recycled content is either a post-consumer (collected from end users) or secondary material. Secondary material (also known as post-industrial or pre-consumer) is collected from manufacturers and industry. The objective of this credit is to maximize post-consumer recycled content; therefore industrial secondary recycled content is discounted 50% for the calculations.

Recycle content claims must be in accordance with the International Organization of Standards document ISO 14021-1999 – Environmental labels and declarations.

Prescriptive Approach:

At least four major materials shall be specified and installed in the project that meet the minimum total recycled content levels as listed in Table 15, Minimum Recycled Content Levels in the appendix. A total of two points shall be achieved when at least eight major materials are specified and installed that meet the recycled content levels as listed in Table 15. A "major" material is defined as those materials covering more than 50% of a major building surface (such as parking areas, floor, roof, partitions, walls), or serving a structural function throughout the majority of the building. For example, credit would not be issued if tackable wall panels were used in only one classroom. Recycled content products with minimum recycled content levels must be used throughout the project.

Table 15 – Minimum Recycled Content Levels[1] (*MW.C2: Recycled Content, Prescriptive Approach****)***

Total Recycled Content = Post-consumer Recycled Content + ½ Secondary Recycled Content

Note: If tire derived products are used indoors, it must also meet EQ.C3 standards for low-emitting materials.

Category	*Product*	*Total Recycled Content*	*Post Consumer Recycled Content*
Building Insulation	Fiberglass Insulation	30%*	30 %
	Cellulose Insulation (Including Cotton and Denom)	75%*	75 %
Flooring	Nylon Carpet (Total) Weight	10%*	10 %
	Polyester Carpet Fiber Face	25%*	25 %
	Plastic	40%	0 %
	Tire-derived Rubber	50%*	50 %
	Glass	50%*	50 %
	Ceramic	45%	0 %
Acoustical Ceiling Tiles and Wall Panels	Glass	30%	0 %
	Recycled Newspaper, Slag Wool, Aluminum	30%	0 %
Countertops	Paper	30%*	30 %
	Glass	50%*	50 %
	Ceramic Tile	45%	0 %
Cabinetry	Medium Density Fiberboard	80%	0 %
Wall Coverings	Tackable Wall Panels	100%*	100 %
	Paint	50%*	50 %
Aggregate Base and Subbase	Recycled Aggregate	50%	0 %
Structural Concrete	Fly Ash, Rice Hull Ash, or other Pozzolanic Materials (See credit restrictions on claiming credit for fly ash.)	25%[2]	0 %
Structural Steel	Basic Oxygen Furnace (BOF) Produced Steel	16%*	16 %
	Electric Arc Furnace (EAF) Produced Steel	67%*	67 %
Shower/Restroom Partitions	Plastic	20%	0 %
	Steel	25%	0 %
Windows	Fiberglass Frame	15%	0 %
Roofing Materials	Steel	25%	0 %
	Aluminum	20%	0 %
	Fiber (Felt) or Fiber Composite	50%*	0 %
	Tire-derived Products	50%*	50 %

[1] Table A2 is adapted from the US EPA Comprehensive Procurement Guidelines. www.epa.gov/cpg/

* Note: Asterisked products must meet their minimum total recycled content level entirely with post-consumer (collected from end-users) content. For all other products, secondary recycled content (also known as post-industrial or pre-consumer) may count as half credit toward the minimum total recycled content required. For example, the 30% total recycled content requirement for acoustical ceiling tiles could be met by a product with 60% secondary content or one with 10% post-consumer content and 40% secondary recycled content.

[2] Recycled content levels must not exceed recommended CA Division of the State Architect (DSA) guidelines.

	Plastic or Plastic/ Rubber Composite	100%*	100 %
Playground Equipment	Plastic	90%	90 %
	BOF Steel, EAF Steel	16%, 67%	16 %, 67 %
	Aluminum	25%*	25 %
Playground Surfaces	Plastic	10%*	10 %
Landscaping Products	Compost, Co-compost, and Mulch	80%*	80 %
Plastic Lumber and Timbers	Plastic	10%*	10 %
Parking Stops	Plastic	10%*	10 %
	Tire-derived Products	100%*	100 %
New product categories may be considered provided the value exceeds 5% of the total project material cost. See ME 4.1.2 which states that a default value of 35 % of the Total Construction Cost can be used for Total Project Material Cost. i.e. for a $5 major modernization project take 35 % of that cost then 5 % of that cost and a new product category would need to be worth at least $87,500 to be considered		20%	10%
All Other Product Categories (Maximum of 2 points from this category are eligible for credit under ME4.1. To receive credit, products must also complete a Life Cycle Effects Screening (LCES) to ensure there are no environmental or health tradeoffs).		25%	0 %

Performance Approach:

Another method to verify compliance with this credit is to use the performance approach. The weighted average of recycled-content value is calculated using the following equations:

- Recycled Content Value (RCV): Calculate the Recycled Content Value of each product by multiplying the cost of the product by the percent of postconsumer recycled content and then adding ½ of the cost of the product multiplied by the percent of secondary recycled content. Material Cost is the construction cost of each individual material excluding all labor costs, project overhead, and fees.

RCV = (% postconsumer recycled content x material cost) + 0.5 x (% secondary recycled content x material cost)

- Total Recycled Content Value: Total Recycled-content Value is the sum of the postconsumer and secondary recycled-content value of all recycled-content products.

$$\sum RCV = RCV\ Product\ A + RCV\ Product\ B + RCV\ Product\ C, etc.$$

- Verify RCV of Each Recycled Product DOES NOT Exceed 25% of ∑RCV: If RCV of Product A is greater than 25% of ∑RCV, then 25% (∑RCV) must be substituted for the value of Product A in the Total Recycled Content Value equation. This step must be repeated for each product to verify that no one material accounts for more than 25% of the ∑RCV.

$$RCV\ Product\ A \leq (25\%)\ (\sum RCV)$$

(If RCV of Product A is greater than 25% of ∑RCV, then 25% (∑RCV) must be substituted for the value of Product A in the Total Recycled Content Value equation. Repeat equation for each product.)

Weighted Average Recycled Content Value (%): The Weighted Average Recycled Content Value is calculated by dividing the Total Recycled-Content Value (∑RCV) by the Total Project Material Cost. The Total Project Material Cost is the construction cost of all materials excluding all labor costs, project overhead, and fees. A default value of 35% of the total construction costs can be used for the Total Project Material Cost.

Weighted Average Recycled Content Value [%] **=** Total Material Cost [$]/Total Recycled Content Value [$] x 100

Applicability

This credit applies to all projects.

Resources

CHPS Best Practices Manual, Volume II: Interior Surfaces and Finishes Chapter.

CHPS Product Database: http://www.chps.net/dev/Drupal/node/445

LEED™-NC 2.2 Reference Guide: Materials Credit 4: Recycled Content.

State Agency Buy Recycled Campaign (SABRC) at http://www.ciwmb.ca.gov/BuyRecycled/StateAgency/

California Integrated Waste Management Board (CIWMB) Recycled-content Products Database: www.ciwmb.ca.gov/rcp

US EPA's Comprehensive Procurement Guideline (CPG) Program: www.epa.gov/cpg

CA Department of Toxic Substance Control TCLP and WET:

http://ccelearn.csus.edu/wasteclass/mod6/mod6_05.html

CA Department of Toxic Substance Control WET Procedures:

http://www.dtsc.ca.gov/LawsRegsPolicies/Title22/upload/OEARA_REG_Title22_Ch11_AppII.pdf

MW.C3: Single Attribute - Rapidly Renewable Materials

Intent: Specify and install materials that replenish themselves faster than traditional extraction demand and are organically grown.

Rapidly renewable raw materials are those materials that substantially replenish themselves faster than traditional extraction demand (e.g. planted and harvested in less than a 10 year cycle); and that are sustainably managed. Products in this category include, but are not limited to, bamboo products, wheat grass cabinetry, linoleum and bioplastics. Ensure that the products protect indoor air quality and are durable.

Requirement

1 point	MW.C3.1 Use rapidly renewable materials, excluding wood fiber, for 2.5% of the total value of all products used in the project. ***OR*** Prescriptive Approach: Specify rapidly renewable materials, for 50% of one of the following major interior finish or structural materials: • Flooring (ft^2) • Casework (ft^3) • Acoustical Ceiling Tile (ft^2) • Wall Covering (ft^2) • Tile (ft^2) • Exterior Walls (ft^2) • Roof (ft^2) A product must contain 25% rapidly renewable raw materials based on weight.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

Rapidly renewable raw materials are those materials that substantially replenish themselves faster than traditional extraction demand (e.g. planted and harvested in less than a 10 year cycle); and that are sustainably managed. Products in this category include, but are not limited to, bamboo products, wheat grass cabinetry,

To confirm compliance with this credit determine the total costs of all qualifying materials and the total cost of all renewable materials. Materials considered as qualifying are listed on Table 16- Materials to be Included and Excluded from Calculations.

Table 16 – Materials to be Included and Excluded from Calculations

Division	*Name*	*Included in the cost calculation*	*Not included in the cost calculation*	*Notes on DHS Materials Testing*
1	General Conditions	Not Applicable	Not Applicable	Not applicable
2	Site Work	Site furnishings, bike racks, site paving systems (including asphalt, concrete for sidewalks and driveways as well as other paving systems), gravel, fences and gates, parking lot accessories, play ground surfaces, and play ground equipment.	Plant materials, earth, sand and outdoor lighting fixtures (see Division 16).	No testing required.
3	Concrete	All products. Include all concrete used in the construction of the building: slabs, structural concrete, basement walls and concrete toppings on steel or wood decks. Concrete used in site work is also included, but in Division 2.	Formwork and temporary scaffolding.	No testing required.
4	Masonry	All products. Include all masonry used in the construction of the building, both structural and otherwise. Masonry used in site work is also included, but in Division 2.	Nothing	No testing required.
5	Metals	Light gauge metal framing for walls, roofs or floors, wood structural connectors, metal roofing, decorative metal, guard rails and hand rails. Aluminum or steel used in the manufacturing of windows and doors is included in Division 8.	Structural steel including steel reinforcing bars or meshes used in concrete.	No testing required.
6	Wood and Plastic	All products used in the permanent construction of the building.	Formwork, temporary fences, construction barriers, scaffolding, bracing, and other elements that are not part of the finished building.	Only applies for materials that are exposed to the interior space. If people can see from inside it you have to test it. Most structural wood products would not need to be tested: framing lumber, OSB, and plywood.
7	Thermal and Moisture Protection	All products. All insulation used in walls, roofs, floors and slabs as well as insulation used for pipes and ducts. All air barriers and vapor barriers.	Nothing	Testing required.
8	Doors and Windows	All products `	Nothing	No testing required.
9	Finishes	All products	Nothing	Everything has to be tested.
10	Specialties	All products	Nothing	Testing only required for surface mounted whiteboards and tack boards.
11	Equipment	Nothing is included.	All products	No testing required.
12	Furnishings	Fixed casework and other built-items	Moveable desks, tables, chairs, cabinets and bookcases that are not in the construction contract. Generally everything that is not bolted down is excluded.	Testing required.
13	Special Construction	Excluded	All Products	No testing required.

Division	*Name*	*Included in the cost calculation*	*Not included in the cost calculation*	*Notes on DHS Materials Testing*
14	Conveying Systems	Excluded	All products	No testing required.
15	Mechanical	Excluded	All products	No testing required.
16	Electrical	Excluded	All products	No testing required.

Material cost is the construction cost of a material excluding all labor costs, project overhead, and fees. Divide the cost of all renewable materials by the total qualifying material cost and multiply by 100 to determine the percentage of renewable materials in the construction.

Renewable Raw Materials [%] = Renewable material cost[$]/Total material cost[$] x100Be sure to use the total qualifying materials cost for the project in the denominator of the calculation equation.

The prescriptive approach requires that 50% of all material from one of the listed groups meet the criteria. For example, a minimum of 50% of all floor coverings used in the school must contain 25% rapidly renewable raw materials based on weight. This calculation may use the formula above for the dollar value of the materials or may be calculated on the base unit:

Renewable Raw Materials [%] = Renewable Material Unit/ Total Material Unit x100

Applicability

This prerequisite applies to all projects.

Resources

CHPS Best Practices Manual: Volume II: Interior Surfaces and Finishes Chapter.

CHPS Product Database: http://www.chps.net/dev/Drupal/node/445

LEED™-NC 2.2 Reference Guide: Materials Credit 6: Renewable Materials.

LEED™-NC 2.2 Reference Guide: Materials Credit 7: Renewable Materials - Certified Environmentally Responsible Management.

CHPS Best Practices Manual: Volume II: Interior Surfaces and Finishes Chapter.

ISEAL Member certifying organizations: www.isealalliance.org/membership

MW.C4: Single Attribute - Certified Wood

Intent: Specify and install sustainably harvested wood.

Wood grown and harvested in an ecological manner is a truly sustainable material that is renewable, biodegradable, energy efficient and recyclable. The Forest Stewardship Council (FSC) guidelines help to ensure wood is grown and harvested with responsible forest management practices.

Requirement

1 point	MW.C4.1	Specify that a minimum of 50% of the wood-based materials used for construction are certified in accordance with the Forest Stewardship Council (FSC) guidelines for wood building components. This includes all wooden framing, flooring, casework, furniture, and finishes.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

The Forest Stewardship Council (FSC) has developed guidelines for the sustainable harvest of wood. FSC works with landowners and lumber companies to ensure that sustainable forestry is practiced, and they accredit independent organizations to certify that these practices are met. The independent organizations also verify that suppliers of FSC wood have chain of custody certification to ensure that the wood they sell can be tracked back to an FSC certified forest.

Wood products bearing the FSC label come from forests that are managed in environmentally responsible, socially beneficial, and economically viable ways. For more information about certified wood and where it can be purchased, see: www.fscus.org.

To perform the calculation for this credit, determine the cost of total new wood based products and the cost of FSC-certified wood based products. Exclude all labor costs, project overhead and fees. Divide the total cost of FSC certified wood products by the total cost of all new wood products that are incorporated into the permanent construction. Multiply this result by 100 to determine the percentage of wood products that are FSC certified. Be sure to use the total wood products cost for the project in the denominator of the calculation equation.

Certified Wood Material Portion [%] = Certified Wood Products Cost [$]/Total New Wood Based Products Cost [$] x 100

Applicability

This credit applies to all projects.

MW.C4: Single Attribute – Certified Wood

Resources

CHPS Best Practices Manual: Volume II: Interior Surfaces and Finishes Chapter.

CHPS Product Database: http://www.chps.net/dev/Drupal/node/445

Old to New: Design Guide, Salvaged Building Materials in New Construction, 3rd Edition (2002)
http://www.lifecyclebuilding.org/files/Old%20to%20New%20Design%20Guide.pdf

LEED™ *Reference Guide*: Materials Credit 3: Resource Reuse.

Forest Stewardship Council Web site at: www.fscus.org

LEED™ *Reference Guide*: Materials Credit 7: Certified Wood.

MW.C5: Single Attribute – Regional Materials

Intent: Increase demand for building materials and products that are extracted and manufactured within the region, thereby supporting the use of indigenous resources and reducing the environmental impacts resulting from transportation.

Establish a project goal for locally sourced materials, and identify materials and material suppliers that can achieve this goal. During construction, ensure that the specified local materials are installed and quantify the total percentage of local materials installed.

Requirement

1-2 points	MW.C5.1 Specify a minimum of 10% of building materials (based on cost) that are extracted, and manufactured regionally within a radius of 500 miles for 1 point and 20% of building materials for 2 points.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value. Mechanical, electrical and plumbing components and specialty items such as elevators and equipment shall not be included in this calculation. Only include materials permanently installed in the project. Furniture may be included.

Applicability

This credit applies to projects that obtain salvaged material from off-site. For a new building, the calculation should be performed using the total salvaged material costs and the material costs for the new building. The costs of new materials purchased for renovations should be used in the denominator of the equation for calculations in this instance.

Resources

LEED-NC V2.2 Credit MR5.1 and MR5.2: www.usgbv.org

CHPS Product Database: http://www.chps.net/dev/Drupal/node/445

MW.C6: Materials Reuse

Intent: Specify and install re-used (salvaged) materials to limit waste and the use of raw materials.

Salvaged materials or products are reused from a previous use or application and then used in a new use or application with only superficial modification, finishing, or repair. Commonly salvaged building materials include wood flooring/paneling/cabinets, doors and frames, mantels, ironwork and decorative lighting fixtures, brick, masonry and heavy timbers.

Requirement

1 point	MW.C6.1 *Performance Approach:* Specify re-used, salvaged or refurbished materials obtained off-site for 5% of building materials. To receive credit for salvaged materials, the materials may not be considered hazardous, those containing lead based paint, asbestos, mercury, arsenic, or other harmful PCB's. **OR** *Prescriptive Approach*: Specify re-used, salvaged or refurbished materials for 25% of one of the following major finish materials: • Flooring (ft^2) • Casework (ft^3) • Acoustical Ceiling Tile (ft^2) • Wall Finishes (ft^2) • Tile (ft^2) • Roofing Materials (ft^2)

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

Re-used materials are defined as material taken from another site and used for the same purpose at the new site, e.g. removing wood flooring from another site to use as flooring in the new school. Salvaged material may also come from the same building site but must be used for a different purpose, otherwise it is considered recycled material. For example, many schools build on the same site and demolish the old school building when the new one is completed. If the project demolished concrete structures from the old school and ground the concrete as fill for the new school, the concrete fill would be considered salvaged material. Commonly salvaged building materials include wood flooring/paneling/cabinets, doors and frames, mantels, ironwork and decorative lighting fixtures, brick, masonry, and heavy timbers.

To verify compliance with this credit first determine the total cost of all salvaged materials if purchased new, and the total cost of all qualifying materials. Materials considered as qualifying are listed on Table 16 – Materials to be Included and Excluded from Calculations under MW.C4.

Material cost is the construction cost of a material excluding all labor costs, project overhead, and fees. If the cost of the salvaged or refurbished material is below market valued, use the replacement cost to estimate the material value; otherwise use the actual cost to the project. The next step is to divide the total cost of salvaged materials by the total cost of all qualifying materials and then multiply by 100 to determine the salvage rate as a percentage of all qualifying materials.

$$\text{Re-Used Rate [\%]} = \underline{\text{Salvaged Material Cost [\$]}}/\text{Qualifying Material Cost [\$]} \times 100$$

Hazardous re-used or salvaged materials should be avoided that contain lead based paint, asbestos, mercury, arsenic or other harmful PCB's.

The prescriptive approach requires that 25% of all material from one of the listed groups be salvaged or refurbished for 1 point or 25% of all material from two of the listed groups be salvaged or refurbished for two points. 50% of the material from one group will also earn two points. For example, using salvaged ceiling tile for 55% of all ceilings in the school will earn one points. This calculation may use the formula above for the dollar value of the materials or may be calculated on the base unit:

Re-Used / Salvage Rate [%] = Salvaged Material [Unit]/ Qualifying Material [Unit] x 100

Exclude all labor costs, all mechanical and electrical material costs, and project overhead and fees. If the cost of the salvaged or refurbished material is below market value, use replacement cost to estimate the material value; otherwise use actual cost to the project. Provide the specifications for the salvaged material. Designate the CSI number, section, and page number that highlight compliance with this requirement.

Applicability

This credit applies to new schools, a new building on an existing campus, additions and major renovation projects that obtain salvaged material from off-site. For a new building, the calculation should be performed using the total salvaged material costs and the material costs for the new building. The costs of new materials purchased for renovations should be used in the denominator of the equation for calculations in this instance.

Resources

CHPS Best Practices Manual, Volume II: Materials Selection and Research Section; Interior Surfaces and Furnishings Chapter.

CHPS Product Database: http://www.chps.net/dev/Drupal/node/445

LEED-NC 2.2 Reference Guide: Materials Credit 1: Building Reuse.

LEED-NC 2.2 Reference Guide: Materials Credit 3: Resource Reuse.

MW.C7: Durable and Low Maintenance Flooring

Intent: Choose flooring finishes that reduce maintenance needs and perform well in the long run.

Interior school traffic can cause certain flooring surfaces to wear faster than other building uses. Flooring materials should be chosen wisely to ensure ease of maintenance and a long life span.

Requirement

1 point	MW.C7.1 Chose flooring products for 50% of the interior surface floor that have the following low maintenance and durability features: • Impermeable to moisture and air • 15 year non-prorated life time warranty • Provide documentation showing that the life cycle (15 year) initial costs and maintenance needs of all flooring in the project have been assessed.

Implementation

Identify flooring finishes that meet the above requirements as being durable and having low maintenance needs.

Applicability

This credit applies to new schools, a new building on an existing campus, additions and major renovation projects.

Resources

CHPS Best Practices Manual: Volume II: Interior Surfaces and Furnishings Chapter.

For information on choosing durable, healthy flooring specific for schools, visit the Asthma Regional Council of New England's site: www.asthmaregionalcouncil.org/indoor-and-ambient-air-quality

MW.C8: Building Reuse - Exterior

Intent: Increase the reuse of existing building structure and shell.

Reusing parts of the building can save significant money and resources, while greatly reducing the amount of construction waste. When materials are re-used, the environmental benefits start with resource savings and extend down through the entire life-cycle of the material: less energy is spent extracting, processing, and shipping the materials to the site. Depending on the amount of building re-used, school districts can significantly reduce their construction and material costs. However, the building envelope will significantly affect many important high performance areas, such as space programming, energy performance, opportunities for daylighting, and indoor air quality. In addition, care must be taken to ensure that any environmental hazards such as toxins, lead, and asbestos have been identified and addressed. Develop a list of benefits and tradeoffs, and make the decision based upon the overall, integrated design tradeoffs.

Requirement

1-4 points	MW.C8.1 Reuse large portions of existing structures during renovation or redevelopment projects. Maintain at least 50% of existing building structure and shell (exterior skin and framing, excluding window assemblies). Hazardous materials that are remediated as part of the project scope AND elements requiring replacement due to unsound material condition shall be excluded from the calculation of the percent maintained. Points are allocated as follows: • Maintain 50% of existing structure and shell – 1 point • Maintain 65% of existing structure and shell – 2 points • Maintain 80% of existing structure and shell – 3 points • Maintain 95% of existing structure and shell – 4 points

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

Reusing parts of the building can save significant money and resources, while greatly reducing the amount of construction waste. When materials are re-used, the environmental benefits start with resource savings and extend down through the entire lifecycle of the material: less energy is spent extracting, processing, and shipping the materials to the site. Depending on the amount of building reused, school districts can reduce their construction and material costs. However, the building envelope will significantly affect many important high performance areas, such as space programming, energy performance, opportunities for daylighting, and indoor air quality. In addition, care must be taken to ensure that any environmental hazards such as toxins, lead, and asbestos have been identified and their removal addressed.

Percentage of reused structural materials (foundation, slab on grade, beams, floor and roof decks, etc.) and shell materials (roof and exterior walls) should be estimated in square feet. Average together the structural and shell reuse percentages. The average will be used to determine the overall reuse percentage for the building.

Building Reuse (%) = 100 x [Reused (floor+ roof area + ground floor/slab) + Reused (exterior wall area excluding window assemblies)] ÷ [[Total (floor+ roof area + ground floor/slab) + Total (exterior wall area excluding window assemblies)].

Note: This credit will be subject to review if design changes are made affecting the amount of existing structure and shell that are retained.

Applicability

This credit applies to all renovation projects or conversion of non-school buildings into schools.

For new schools to obtain this credit, the new school must be in an existing (previously non-school) facility.

For new buildings on an existing campus, this credit would apply in the instance of an existing building, for instance a maintenance shed, being converted into conditioned space for classrooms, administration, or other school functions. In addition, this credit pertains to a case where a building next to an existing school is purchased by the school district and converted into classroom or other school space.

For major renovations this credit would apply in reuse of the existing structure and shell of the building(s) being modernized.

Resources

CHPS Best Practices Manual, Volume II: Material Selection and Research Section; Interior Surfaces and Furnishings Chapter.

LEED™-NC 2.2 Reference Guide: Materials Credit 1: Building Reuse.

LEED™-NC 2.2 Reference Guide: Materials Credit 3: Resource Reuse.

MW.C9: Building Reuse - Interior

Intent: Increase the reuse of interior non-shell elements.

There are many materials that may be reused from within a building beyond the existing shell and structural system. Interior partitions, finishes, doors and ceilings systems are among the items that can be salvaged and reused in the refurbished building. Reuses of these materials not only reduces the amount of waste sent to landfills, but can also significantly reduce material and construction costs.

Requirement

1 point	MW.C9.1 Maintain 50% non-structural elements (walls, floor coverings, and ceiling systems).

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

Percentage of reused, non-shell building portions will be calculated as the total area (ft^2) of reused walls, floor covering, and ceiling systems, divided by the existing total area (ft^2) of walls, floor covering, and ceiling systems.

Internal Building Reuse (%) =

Reused Non -structural Elements [ft^2]/ Total Non-structural Elements [ft^2] x 100

Applicability

Refer to the applicability section of credit MW.C8, Building Reuse of Exterior. See also credit MW.C6, Salvaged Materials.

Resources

CHPS Best Practices Manual, Volume II: Material Selection and Research Section; Interior Surfaces and Furnishings Chapter.

LEED™-NC 2.2 Reference Guide: Materials Credit 1: Building Reuse.

LEED™-NC 2.2 Reference Guide: Materials Credit 3: Resource Reuse.

OM.P1: Maintenance Plan

Intent: Provide useful tools and ensure that the school continues to perform as designed, to protect student and staff health during occupancy.

Maintenance plans should specify energy efficient equipment to minimize energy loads and operational costs. Reduce emissions of district buses and other idling vehicles on school site. Recognize design teams and project owners for adopting innovative high performance features, greatly exceeding existing credits, or adopting significant policies that truly represent best practices in sustainability and/or environmental health and safety.

Requirement

Prerequisite	OM.P1.1 The district must create a school maintenance plan that includes an inventory of all equipment in the new or renovated school and its preventive and routine maintenance needs. The inventory should cover the following systems: *Electrical Systems*: • Lighting controls (daylight, occupancy, timing switches, etc.); • On-site renewable solar electric or wind systems • Cable access television • Telecommunication Systems • Electrical distribution systems • Life and safety systems *Mechanical Systems*: • HVAC systems (such as hot water systems, chilled water systems, central air systems, ventilation systems); • Domestic hot water systems; • Energy Management System; • Renewable energy heating systems *Plumbing Systems:* • Flow control devices • Pumping systems • Special hazardous waste treatment systems (e.g. for lab wastes) • Domestic hot water systems • Graywater systems (if applicable) *AND* *Building Envelope and Roofing systems* The plan must address the preventive and routine maintenance needed and include staff time and materials costs for each maintenance task and clearly define who is responsible for performing the task, as well as the overall management of maintenance activities.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

Operations and Maintenance

OM.P1: Maintenance Plan

Like conventional schools, all high performance schools and their systems require preventive and routine—not deferred—maintenance. This prerequisite encourages districts to plan for preventive and routine maintenance tasks and invest adequate funds in the maintenance of their school facilities.

The maintenance plan should include all regularly scheduled preventative and routine maintenance tasks and their frequency over the lifetime of the building system or equipment. These tasks include cleanings, calibrations, component replacements, and general inspections. Operations and maintenance manuals and commissioning reports developed during the commissioning process should be used as references for developing the maintenance plan. The plan must include staff time and materials costs for each maintenance task and clearly define who is responsible for performing the task, its frequency, as well as the overall management of maintenance activities.

Cross-Category and Other Considerations

The O&M Plan is one of the most important features of a green school because it establishes the practices that will continue to ensure the school is operated according to its high-performance intent. The O&M Plan is a key part of Commissioning, see Energy Prerequisite 2 (page X), and Training, see Energy Prerequisite 3 (page D), and has a strong connection to other energy efficiency performance items such as Energy Benchmarking (page C). It also relates directly to other requirements and credits in this section, including Green Cleaning (page Y), Work Order & Maintenance Management System (page Z), Indoor Environmental Management Plan (page A), and Carbon Footprint Reporting (page B).

For more on what should be contained in an O&M Plan, schools can refer to the MSBA Standard Scope of Services for Commissioning.

Applicability

This prerequisite applies to new schools. For major renovations and a new building on an existing campus this prerequisite is required based on the scope of the project. However, if required, the annual water budget must be calculated for the entire school site, not just for the area around the new building or building(s) being modernized.

Resources

CHPS Best Practices Manual Volume IV – Maintenance & Operations (2006 Ed.): www.chps.net

NE Best Practices Manual (Volume TBD) - Maintenance & Operations (to be published in 2010): http://www.neep.org

Massachusetts School Building Authority: http://www.massschoolbuildings.org

Massachusetts Facilities Administrators Association: http://www.massfacilities.org

OM.P2: Anti-Idling Measures

Intent: Prevent idling that pollutes the air, wastes fuel, and causes excess engine wear.

According to the U.S. Environmental Protection Agency (U.S. EPA), exposure to diesel exhaust, even at low levels, is a serious health hazard and can cause respiratory problems such as asthma and bronchitis. Diesel emissions are well-documented asthma triggers and may increase the severity of asthma attacks. Asthma is currently the leading cause of missed school days for American children, and asthma affects more than 1 in 9 children in New England. (Source: Asthma Regional Council): www.asthmaregionalcouncil.org/about/documents/SchoolBusNoIdlingPolicy7.29.04.doc).

Requirement

1 point	OM.P2.1 Adopt a no idling policy that applies to all school buses operating in the school district and all vehicles operating in the school zone. The policy must include the following provisions: • School bus drivers will shut off bus engines upon reaching destination, and buses will not idle for more than five minutes while waiting for passengers. This rule applies to all bus use including daily route travel, field trips, and transportation to and from athletic events. School buses should not be restarted until they are ready to depart and there is a clear path to exit the pick-up area. • Post signage expressly prohibiting the idling of all vehicles for more than five minutes in the school zone. • Transportation operations staff will evaluate and shorten bus routes whenever possible, particularly for older buses with the least effective emissions control. • All school district bus drivers will complete a “no idling” training session at least once. All bus drivers will receive a copy of the school district’s No Idling Policy at the beginning of every school year.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

Massachusetts’s law prohibits vehicle idling for longer than five minutes with certain restrictions.

See M.G.L. Chapter 90, Section 16B, Stopped Motor Vehicles as written below:

> Section 16B. (a) For the purposes of this section, the term “school grounds” shall mean in, on or within 100 feet of the real property comprising a public or private accredited preschool, accredited Head Start facility, elementary, vocational or secondary school whether or not in session, and shall include any athletic field or facility and any playground used for school purposes or functions which are owned by a municipality or school district, regardless of proximity to a school building, as well as any parking lot appurtenant to such school, athletic field, facility or playground.
>
> (b) No person shall cause, suffer, allow or permit the prolonged idling of a motor vehicle engine on school property in violation of registry of motor vehicles regulations relative thereto, adopted pursuant to subsection (c). An operator or owner of a motor vehicle who violates this section shall be subject to a civil assessment of $100 for the first violation and

$500 for a second or subsequent violation. This subsection shall be enforced by law enforcement agencies.

(c) The registrar of motor vehicles, in consultation with the department of education, the department of environmental protection, the executive office of public safety and the executive office of health and human services, shall adopt regulations to implement this section. Such regulations shall include, but not be limited to, establishing the length of time an operator on school grounds may idle an engine before such idling becomes prolonged, and the limited circumstances under which the prolonged idling of an engine shall be permitted, including periods necessary to operate defrosting, heating or cooling equipment to ensure the health or safety of a driver or passengers or to operate auxiliary equipment and to undergo inspection or during maintenance.

Such regulations shall prohibit an operator of a school bus from idling a school bus engine while waiting for children to board or exit a bus on school grounds and from starting a school bus engine for any unnecessary period of time in advance of leaving the school grounds, unless the registrar determines that a school bus engine must be fully engaged in order to operate safety devices or that such idling prohibition would otherwise compromise the safety of children boarding or exiting a bus. Such regulations shall further prescribe templates for “no idling” signage to be posted by schools.

Applicability

This credit applies to all projects.

Resources

The Asthma Regional Council offers a number of tools for the school district to use for its anti-idling program, including a model policy: www.asthmaregionalcouncil.org/indoor-and-ambient-air-quality

The Massachusetts Department of Environmental Protection offers training to help school bus drivers and municipal employees eliminate unnecessary idling. See the following link for more information: http://www.mass.gov/dep/air/community/schbusir.htm DEP also has a variety of tools for school districts, including fact sheets, sample language for signage, sample newsletters, policy statements, and information on bus routing software

OM.P3: Green Cleaning

Intent: Protect student and staff health, and the environment through cleaning products.

The use of green cleaning products and practices supports the goal of maintaining a healthy, safe, and clean environment for students, faculty, and staff.

Requirement

Prerequisite	OM.P3.1 The school committee must pass a resolution adopting a comprehensive green cleaning policy that ensures only environmentally preferable cleaning products and practices are used.

Implementation

Green cleaners are those that are:

- Evaluated and certified by Green Seal and the Massachusetts Environmentally Preferable Products Program (EPP)
- Non-irritating
- Environmentally friendly
- No strong fumes or perfumes
- Safe to dispose

The green cleaning policy must include a) a statement of purpose, b) a requirement to use only non-toxic cleaning products that are verified by Green Seal and EPP, c) best practices for cleaning and management, and d) a requirement for staff training.

Applicability

This credit applies to all projects.

Resources

The Healthy Schools Initiative of the Massachusetts Coalition for Occupational Safety & Health (MassCOSH): www.masscosh.org

The policy from Boston Public Schools: www.masscosh.org/files/BPS_Cleaner_Policy.pdf

Green Seal: www.greenseal.org

Massachusetts Operational Services Division, Environmentally Preferable Products Procurement Program: www.mass.gov/eoaf > Budget, Taxes & Procurement > Procurement Information & Resources > Procurement Programs and Services > Environmentally Preferable Products (EPP) Procurement Program

OM.C1: Work Order and Maintenance Management System

Intent: Maintenance management systems can be used to optimize staff resources, detect impending problems, optimize equipment performance and control equipment inventory.

Requirement

1 point	OM.C1.1 The school district shall develop or purchase and use a work order and maintenance management system (MMS) in the new or renovated school.

Implementation

A Best Management Practice for preventive maintenance is a maintenance management system (MMS). Options exist for developing an MMS or implementing a computerized MMS with stand-alone software or web-based services. MMS systems may be integrated with other software programs used to maintain the school, such as the Energy Management System.

Applicability

This credit applies to all projects.

Resources

None.

OM.C2: Indoor Environmental Management Plan

Intent: Verify that the sites irrigation systems and controls are operating as intended and that effective training has been provided.

Irrigation system testing and training is a rigorous quality assurance program administered by a knowledgeable party that ensures the irrigation systems perform as expected. Irrigation system testing can help to ensure that water efficiency measures are working properly and design water savings are achieved.

Requirement

1-3 points	OM.C2.1 To ensure a healthy indoor environment in a new school or renovation, the points are awarded for the following initiatives. • Option 1 - Existing implementation of U.S. EPA's Tools for Schools Program or an equivalent indoor health & safety program at the school district level. Documentation must show that there is a point person for the program and significant action within the last two years, such as staff training, policy implementation, development of personnel infrastructure for problem solving and reporting issues, or IAQ assessment activities such as school walk throughs, data collection, mapping, and/or action plans. (3 points). **OR** • Option 2 - Custodial/Facility Staff Training: The Massachusetts Facility Administrators Association offers training modules on maintaining IAQ, integrated pest management (IPM), radon, clean drinking water, and "Cleaning for Health" (2 points). **OR** • Option 3 - Prior to completion of new school or renovation, the school district must arrange for a presentation on Tools for Schools or the Massachusetts Healthy Schools Checklist to the school committee, allowing at least 45 minutes for the presentation (1 point).

Implementation

According to the U.S. EPA, the indoor environment may contain levels of air pollutants that are 2-5 times higher, and occasionally 100 times higher, than outdoor levels. Poor indoor air quality (IAQ) can cause headaches, fatigue, asthma attacks, and ultimately absenteeism. In fact, asthma is the leading cause of school absenteeism due to chronic illness (U.S. EPA).

This credit is designed to raise awareness of and focus attention on prevention of indoor environmental problems in schools. In an ideal scenario, a school district will have already adopted the U.S. EPA's Tools for Schools, which is a well known prevention and comprehensive planning program for indoor air problems.

If the Tools for Schools program or an equivalent set of comprehensive policies and programs has not been implemented, then the school district may choose to invest in custodial and facility staff training through the Massachusetts Facility Administrators Association. The MFAA has developed a series of modules addressing IAQ, integrated pest management (IPM), radon, clean drinking water, and "Cleaning for Health". Up to 3 points are available, 1 point for each module. Contact the MFAA through its website at: http://www.massfacilities.org for more information.

The third option is to arrange training for the district's school committee on either the Tools for Schools program or the Massachusetts Healthy Schools Checklist. The checklist may be found at this website: http://www.mass.gov/Eeohhs2/docs/dph/environmental/iaq/schools_checklist.doc. Presenters may be located through the Massachusetts Coalition for Occupational Safety and Health at www.masscosh.org and through the Region 1 U.S. Environmental Protection Agency New England office in Boston, Massachusetts—ph: (888) 372-7341 and at: www.epa.gov/iaq/schools/tools4s2.html.

Applicability

This credit applies to all projects.

Resources

Region 1 U.S. Environmental Protection Agency New England office in Boston, Massachusetts—ph: (888) 372-7341 and at: www.epa.gov/iaq/schools/tools4s2.html

Massachusetts Facility Administrators Association www.massfacilities.org

Massachusetts Coalition for Occupational Safety and Health www.masscosh.org

Massachusetts Healthy Schools Checklist: http://www.mass.gov/Eeohhs2/docs/dph/environmental/iaq/schools_checklist.doc, located on the MA Executive Office of Health and Human Services.

Massachusetts Public Health Association provides information for school administrators, teachers, and others: http://www.mphaweb.org/HealthySchools.htm

The Asthma Regional Council of New England provides information on a variety of indoor air quality topics: www.asthmaregionalcouncil.org/indoor-and-ambient-air-quality

OM.C3: Green Power

Intent: Reduce the use of fossil-fuel energy sources.

School districts and municipalities have the opportunity to purchase green power in the form of Renewable Energy Certificates (RECs) or through Power Purchase Agreements (PPAs). These two mechanisms allow schools to use green power in cases where they would otherwise not be using on-site renewable power of their own.

Requirement

1 point	OM.C3.1 Commit to purchasing Renewable Energy Certificates (RECs) or renewable power purchased through a PPA equivalent to at least 15% of the school's projected annual regulated electricity needs.

Implementation

RECs

In Massachusetts, a renewable energy certificate can be classified as ***old*** or ***new***. ***New*** RECs, which qualify under the Massachusetts Renewable Portfolio Standard (RPS), come from renewable energy generation facilities built after 1997. ***Old*** RECs come from renewable energy sources built before 1997.

For each megawatt-hour of power generated and supplied to the electric grid through renewable electricity generation (solar, wind, ocean thermal, wave, tidal, landfill gas and "low emission" bio-energy sources), a REC is issued for trade on the open market. Both ***new*** and ***old*** RECs can be purchased by retail electricity suppliers or renewable electricity suppliers for resale to customers. Consumers can purchase RECs through programs or companies across the country. When a consumer purchases RECs, the RECs are effectively retired and taken out of circulation, which contributes to the increased demand for generation and sale of additional renewable electricity.

An interesting characteristic of renewable energy certificates is that they can be purchased from any location in the country. However, purchasing RECs from local generation sources means that the environmental benefits are experienced locally.

PPAs

Power Purchase Agreements are a contractual means for a site-owner and a renewable energy installer to work together to provide green power on-site when the site-owner does not wish to outright own the system. In a PPA, the system is owned and maintained by the installer (ownership may also be by a 3rd party investor), and the site-owner purchases the power generated by the system for the contracted price. Typically, PPAs are structured so that the site-owner eventually has the right to own the system. The benefits of a PPA to a site-owner are that the upfront capital costs of installation and the ongoing maintenance costs are borne by the installer. Theoretically, a PPA allows the installer to build a larger system at the site than might otherwise be possible (site conditions are still the primary determinants of system size), therefore offsetting a larger portion of the site's fossil fuel use.

To achieve this credit, purchase a block of megawatt-hours (MWh) of renewable electricity from a REC supplier or wholesaler. The RECs must be Massachusetts Renewable Portfolio Standard eligible. The block of megawatt-hours purchased should equal 15% of the anticipated total electricity load of the school for one year

of occupancy. The documentation section of this credit will explain methodology for calculating the building's ideal electricity load.

Purchasing clean energy can be documented as indicated below.

If the project developed an energy model for Energy Prerequisite 1, then cite the electricity load (in kWh) from the energy modeling report. Otherwise, an energy model must be developed to determine the school's total electricity loads.

Purchase enough blocks of RECs to offset at least 15% of the school's annual total electricity load. The RECs must be Massachusetts Renewable Portfolio Standards eligible. Supply a receipt or copy of a renewable energy certificate to document proof of purchase.

Applicability

This credit applies to all projects.

Resources

For more information on the Massachusetts Renewable Energy Portfolio Standard, see www.mass.gov/doer (Click on: Renewable Energy → Renewable Portfolio Standard)

Community Energy: www.newwindenergy.com

Sterling Planet: www.sterlingplanet.com

Massachusetts Energy Consumers Alliance: www.massenergy.com/

U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, see: www.eere.energy.gov/greenpower/buying/buying_power.shtml?state=MA

For more information on PPAs, contact the Renewable Energy Trust at the Massachusetts Clean Energy Center: www.masscec.com

OM.C4: Climate Change Action - Diesel Bus Retrofit

Intent: Reduce harmful fumes from diesel-powered school buses.

Buses play a vital role in high performance schools by transporting students safely to and from school. Many of the buses on the roads today are diesel-powered, which emit harmful fumes affecting our local air and our global climate. By retrofitting tailpipes to keep engine fumes away from children and reduce exhaust emissions, districts create cleaner rides for kids and healthier air for everyone.

Requirement

1 point	OM.C4.1 Retrofit buses by participating in the Department of Environmental Protection's MassCleanDiesel Initiative.

Implementation

Taking the bus to school is by far the safest choice for hundreds of thousands of Massachusetts children every year. However, school buses, like all diesel-powered vehicles, pollute the air with harmful gases and particles. Installing diesel retrofits on buses can decrease the amount of harmful pollution generated, helping to reduce asthma attacks, respiratory problems, and other diseases associated with diesel exhaust for everyone, especially children.

In 2008, Massachusetts began to offer a fully funded statewide initiative to reduce air pollution from Type B, C, or D school buses with diesel engines built before 2007. MassCleanDiesel provides free retrofits to bus owners who enroll in the program. A diesel retrofit is essentially an enhanced exhaust filtering system that reduces pollution from tailpipes of school buses and other diesel-powered vehicles. Three types of technologies are offered for the owner's choice:

1. Diesel oxidation catalyst, verified to remove at least 25% of particulates.
2. Flow-through filter that removes 50% of particulate matter.
3. Diesel particulate filter that removes upwards of 80% of particulates.

The program is only offered through 2010, however, because the program requires that retrofitted buses stay in service in the district for at least 3 years, projects seeking MA-CHPS verification beyond 2010 may still be able to claim this credit. School districts must have participated in the program between 2008 and 2010 or commit to participating before the end of 2010 to be eligible. Districts that contract for bus services should require in the contract that the vendor participate in the program before the end of 2010.

Applicability

This credit applies to all projects.

Resources

http://www.mass.gov/dep/air/diesel/masscleandiesel.htm

OM.C5: Carbon Footprint Reporting

Intent: Encourage the use of measures that reduce school contributions to greenhouse gas emissions.

The CHPS community believes that all schools should be making steps to reducing emissions of greenhouse (GHG) gases (CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6) that contribute to global warming. Understanding and monitoring emissions can be a powerful tool to reducing waste and inefficiency. A school's contribution to climate change begins with the impact of materials and resources used in the construction, or renovation of the school. It continues through the operation of building systems, and transportation choices to and from school. In 2007 the largest building element contributors to GHG emissions are indoor and outdoor electric lighting, followed by heating and cooling. The largest non-building element is transportation to and from the school site. Lastly schools contribute to GHG emissions at the end of their life cycle, when schools are re-used or deconstructed.

Requirement

1 point	OM.C5.1 Join The Climate Action Registry to commit to calculate, report, and verify annual GHG emissions using The Climate Action Registry Online Reporting Tool (CRIS) software.

Implementation

The complete compliance requirements are listed in the MA-CHPS Verified Application Templates.

A copy of the completed Statement of Intent signed by the District must be submitted to CHPS along with proof of registration.

Applicability

This credit applies to all project types.

Resources

The Climate Action Registry: http://www.theclimateregistry.org/

OM.C6: Energy Benchmarking

Intent: Track energy use over time to help maximize savings.

Benchmarking school energy use can be one of the most straightforward and simple methods available to help keep a school operating efficiently. Energy benchmarking typically shows how a school is operating compared to its peers or to itself — with multiple years of utility data — and shows how well a school operates from year to year. Good benchmarking systems account for yearly changes in weather and track energy use per square foot per year.

Requirement

2 points	OM.C6.1 The school must adopt a policy of benchmarking its energy use over time to track the building's performance.
1 point	OM.C6.2 Commit to conduct a post-occupancy analysis of the building's performance after 1-2 years or do recommissioning after 2-5 years.

Implementation

OM.C6.1

There are 2 options for benchmarking:

- Use the school's own energy model created at design of the building. If a model was done according to the guidelines contained in Energy Prerequisite 1 and contains accurate information on plug load and operating hours, it will provide the most suitable benchmark for the school. Utility data, including kWh, therms, and costs, must be tracked annually by the school, normalized using heating degree days, and organized in a way that allows them to be analyzed against the model, i.e. total costs over time must be calculated.
- Use EPA's Portfolio Manager. Portfolio Manager generates a score from 0-100 using data on energy usage, space attributes, and operating hours. A school must achieve at least a 75 to reach the ENERGY STAR level. Schools using Portfolio Manager will need to go to the website, create an account, and follow the instructions for inputting data and generating reports.

Portfolio Manager was used in the *Massachusetts Green Schools Post-Occupancy Study of Energy Efficiency*. One year of utility data was used to benchmark 29 schools. The results indicate that benchmarking to a national system is useful for tracking performance very broadly, and it has the benefit of being free to use, however it cannot be customized to track performance precisely. Schools wishing to track their energy performance more accurately should choose to benchmark to an energy model.

Schools benchmarking to their own energy model must submit a letter of commitment to do so, signed by the chair of the school committee or the superintendent, that contains a description of the tool that will be used to organize data (e.g. Excel) and identifying the person who will be responsible.

Schools using Portfolio Manager should submit a copy of the initial facility report, showing the score.

OM.C6.2

Committing to perform a post-occupancy analysis or to recommission the school years after it is completed to MA-CHPS standards helps to ensure the high performance features of the school continue to provide benefits over the life of the school.

Recommissioning (also sometimes called retro-commissioning) involves having a commissioning agent re-check the systems after a couple years of operation. Recommissioning can be done by the original

commissioning agent or by a different one but should be performed by someone meeting the same qualifications described in EE.P.2. The scope of recommissioning should follow the original commissioning scope for testing and balancing and any other aspects that might be appropriate.

A post-occupancy analysis of resource use essentially combines recommissioning and benchmarking to evaluate the building's performance. Systems are typically checked to see how they're working, and utility bills are recorded and evaluated against a baseline. The post-occupancy analysis must include, at a minimum, an evaluation of energy and water use, and may include occupant or end-user surveys regarding thermal comfort, air quality, and acoustical comfort. The post-occupancy study should cover at least 1 full heating and 1 full cooling season.

Applicability

This credit applies to al projects.

Resources

The US Environmental Protection Agency (EPA's) portfolio manager is available at
http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager

Post-Occupancy Study of Energy Efficiency, Massachusetts Renewable Energy Trust:
http://www.masstech.org/greenschools

Appendix

Appendix A – 780 Code of Massachusetts Regulations
Appendix 120 AA Stretch Energy Code

780 CMR Appendix 120 AA
Stretch Energy Code

The Stretch Energy Code is the *International Energy Conservation Code (IECC) 2009* with amendments contained herein.

CHAPTER 1 - ADMINISTRATION

SECTION 101 - SCOPE AND GENERAL REQUIREMENTS

Remove sections 101.1, 101.2, and 101.3 and replace with:

101.1 Title. This code shall be known as the Massachusetts Stretch Energy Code and shall be cited as such. It is referred to herein as "this code."

101.2 Scope. This code applies to residential and commercial buildings. Buildings not included in this scope shall comply with 780 CMR 13, 34, 61, or 93, as applicable.

101.3 Purpose and Intent.

The purpose of 780 CMR 120.AA is to provide a more energy efficient alternative to the base energy code applicable to the relevant sections of the building code for both new construction and existing buildings. A municipality seeking to ensure that construction within its boundaries is designed and built above the energy efficiency requirements of 780 CMR may mandate adherence to this appendix.

This appendix may be adopted by any municipality in the commonwealth, by decision of its governing body. In a city having a Plan D or Plan E charter the governing body shall be the city manager and the city council, and in any other city the mayor and city council. In towns the governing body shall be the board of selectmen. In order to be adopted, the appendix must be considered at an appropriate municipal public hearing, subject to the municipality's existing public notice provisions. If adopted by a municipality this appendix rather than 780 CMR 13, 34, 61, or 93, as applicable, shall govern.

This appendix shall regulate the design and construction of buildings for the effective use of energy. This appendix is intended to provide flexibility to permit the use of innovative approaches and techniques to achieve the effective use of energy. This appendix is not intended to abridge safety, health or environmental requirements contained in other applicable codes or ordinances.

Remove section 101.4.3 Exceptions and replace with:

Exceptions

1. Storm windows installed over existing fenestration.
2. Repairs to an existing sash and frame.
3. Existing ceiling, wall or floor cavities, of the building envelope, exposed or accessible during construction provided that any empty cavities are filled with insulation that meets or exceeds an *R* value of R - 3.5/inch.
4. Reroofing or residing over uninsulated roofs or walls where the sheathing is not exposed.
5. Replacement of existing doors that separate conditioned space from the exterior shall not require the installation of a vestibule or revolving door, provided, however, that an existing vestibule that separates a conditioned space from the exterior shall not be removed,
6. Alterations that replace less than 50 percent of the luminaires in a space, provided that such alterations do not increase the installed interior lighting power.
7. Alterations that replace only the bulb and ballast within the existing luminaires in a space provided that the alteration does not increase the installed interior lighting power.

Remove section 104.1 and replace with:
104.1 General. Construction or work for which a permit is required shall be subject to inspection by the code official or approved inspection agencies.

Remove section 104.5 and replace with:
104.5 Approved inspection agencies. The code official is authorized to require or accept reports of approved inspection agencies, provided such agencies satisfy the requirements as to qualifications and reliability.

Delete sections 107, 108 and 109

CHAPTER 2 – DEFINITIONS

Insert in section 202:
FENESTRATION PRODUCT, FIELD-FABRICATED is a fenestration product including an exterior glass door whose frame is made at the construction site of standard dimensional lumber or other materials that were not previously cut, or otherwise formed with the specific intention of being used to fabricate a fenestration product or exterior door. Field fabricated does not include site-built fenestration with a label certificate or products required to have temporary or permanent labels.
FENESTRATION PRODUCT, SITE-BUILT is fenestration designed to be field-glazed or field assembled units using specific factory cut or otherwise factory formed framing and glazing units. Examples of site-built fenestration include storefront systems, curtain walls, and atrium roof systems.
FURNACE ELECTRICITY RATIO. The ratio of furnace electricity use to total furnace energy computed as ratio = (3.412*EAE)/(1000*EF + 3.412*EAE), where EAE (average annual auxiliary electrical consumption) and EF (average annual fuel energy consumption) are defined in Appendix N to subpart B of part 430 of title 10 of the Code of Federal Regulations and EF is expressed in millions of Btu's per year.
ON-SITE RENEWABLE ENERGY. Includes solar photovoltaic; active solar thermal that employs collection panels, heat transfer mechanical components and a defined heat storage system; wind; small hydro; tidal; wave energy; geothermal (core earth); biomass energy systems; landfill gas and bio-fuel based electrical production. Onsite energy shall be generated on or adjacent to the project site and shall not be delivered to the project through the utility service.

CHAPTER 3 – CLIMATE ZONES

Delete section 301 and replace with:
Climate Zone 5 and moisture regime A (Moist) shall be used in determining the applicable requirements from Chapters 4 and 5 for locations in Massachusetts.

Delete Chapter 4 and replace with:
CHAPTER 4 – ADVANCED RESIDENTIAL ENERGY EFFICIENCY
401.1 Scope. This chapter applies to residential buildings.
401.2 New construction. New low-rise (three stories or less) residential buildings including townhouses shall require a HERS (Home Energy Rating System) index rating as verified by a RESNET (Residential Energy Services Network) certified HERS rater.

- For units equal to or greater than 3,000 sq ft in conditioned floor space, a HERS rating of 65 or less is required.
- For units less than 3,000 sq ft, a HERS rating of 70 or less is required.
- In addition, all new construction shall demonstrate compliance with the Energy Star Qualified Homes Thermal Bypass Inspection Checklist[1].

401.3 Prescriptive option for residential additions. Additions to an existing building, building system or portion thereof shall conform to the most recent Energy Star for Homes Prescriptive Builders Option Package (BOP), except for heating and cooling equipment and appliances, and shall demonstrate compliance with:

- The Energy Star Qualified Homes Thermal Bypass Inspection Checklist.
- Envelope insulation requirements that meet or exceed IECC 2009 requirements (Chapter 4, Section 402) for climate zone 5.

401.4 Performance option for residential additions. The performance approach and HERS ratings of 401.2 may be followed in lieu of the prescriptive requirements of 401.3

401.5 Prescriptive option for alterations, renovations or repairs. Alterations, renovations or repairs that involve accessing the building envelope shall require the affected portion of the envelope to comply with 401.3. Envelope insulation shall meet or exceed IECC 2009 requirements (Chapter 4, Section 402) for climate zone 5, or fully fill existing cavities with insulating material which meets or exceeds an R value of R 3.5/inch.

401.6 Performance option for alternations, renovations or repairs. In all cases of alternations, renovations or repairs the performance approach of 401.2 may be followed in lieu of the prescriptive requirements of 401.5 with the following HERS rating requirements:

- For units equal to or greater than 2,000 sq ft in conditioned floor space, a HERS rating of 80 or less is required.
- For units less than 2,000 sq ft, a HERS rating of 85 or less is required.
- Compliance with the Energy Star Qualified Homes Thermal Bypass Inspection Checklist.

Change Chapter 5 title to:

CHAPTER 5 – ADVANCED COMMERCIAL ENERGY EFFICIENCY

Remove section 501.1 and 501.2 and replace with:

501.1 Scope. The requirements contained in this chapter are applicable to new construction of commercial buildings, or portions of commercial buildings.

Exceptions:

1. Commercial buildings less than 5,000 sq. ft.
2. Commercial buildings from 5,000 to 40,000 sq. ft. in area with these uses:
    - Supermarkets
    - Warehouses
    - Laboratories

[1] http://www.energystar.gov/ia/partners/bldrs_lenders_raters/downloads/Thermal_Bypass_Inspection_Checklist.pdf

- A building of specialized use by variance to this appendix through appeal to the BBRS.

501.1.1 Buildings greater that 100,000 sq. ft. Buildings greater than 100,000 sq. ft., and additions to such buildings greater than or equal to 30% of the existing conditioned floor area, shall be designed to achieve energy use per square foot equal to at least 20% below the energy requirements of *ASHRAE/IESNA Standard 90.1-2007, Energy Standard for Buildings Except for Low-Rise Residential Buildings*, Appendix G, measured by industry-accepted energy modeling.

501.1.2 Special energy use buildings. Buildings greater than 40,000 sq. ft. in area, and additions to such buildings greater than or equal to 30% of the existing conditioned floor area with these uses:

- Supermarkets
- Warehouses
- Laboratories

shall be designed to comply with the performance requirements of 501.1.1.

501.1.3 Performance option for buildings from 5,000 to 100,000 sq. ft. Buildings between 5,000 sq. ft. and 100,000 sq. ft. shall comply with the performance requirements of 501.1.1, or the prescriptive option 501.1.4.

501.1.4 Prescriptive option for Buildings from 5,000 to 100,000 sq. ft. The requirements contained in section 501.1.4.1 and beyond of this chapter are applicable to buildings from 5,000 to 100,000 sq. ft. and additions to such buildings greater than or equal to 30% of the existing conditioned floor area where the addition has its own heating system.

501.1.4.1 Application. The *commercial building* project shall comply with the requirements in Sections 502 (Building envelope requirements), 503 (Building mechanical systems), 504 (Service water heating), 505 (Electrical power and lighting systems), and 507 (Advanced Prescriptive Options) in its entirety.
Compliance with section 507 requires complying with any ONE of the following prescriptive options:

a. 507.2.1 Efficient Mechanical Equipment
b. 507.2.2 Reduced Lighting Power Density
c. 507.2.3 On-Site Supply of Renewable Energy

Compliance with section 507 does not remove the requirement to comply with any other mandatory requirements in this code.

SECTION 502 - BUILDING ENVELOPE REQUIREMENTS

Delete from section 502.1.1, the last sentence:
Buildings with a vertical fenestration area or skylight area that exceeds that allowed in Table 502.3 shall comply with the building envelope provisions of ASHRAE/IESNA90.1.

Remove Table 502.1.2, Table 502.2(1) and Table 502.2(2) and replace with:

TABLE 502.1.2 - BUILDING ENVELOPE REQUIREMENTS OPAQUE ELEMENT, MAXIMUM U-FACTORS

Roofs	All Other	Group R
Insulation entirely above deck	U - 0.039	U - 0.039

Metal buildings (with R-5 thermal blocks)	U - 0.049	U - 0.049
Attic and other	U - 0.027	U - 0.027
Walls, Above Grade		
Mass, exterior insulation	U- 0.080	U- 0.071
Mass, interior insulation	U- 0.085	U- 0.085
Metal building	U- 0.061	U- 0.061
Metal framed	U- 0.064	U- 0.057
Wood framed and other	U- 0.051	U- 0.051
Walls, Below Grade[a]		
Mass, exterior insulation	C- 0.119	C- 0.119
Mass, interior insulation	C- 0.063	C- 0.063
Floors		
Mass	U- 0.074	U- 0.064
Metal Joist	U- 0.033	U- 0.033
Wood Joist/Framing	U- 0.033	U- 0.033
Slab-on-Grade Floors		
Unheated slabs	F- 0.540	F- 0.520
Heated slabs	F- 0.580	F- 0.580
Opaque Doors		
Swinging	U- 0.37	U- 0.37
Roll-up or sliding	U- 0.50	U- 0.50

For SI: 1 inch = 25.4 mm.
ci – Continuous Insulation
a. When heated slabs are placed below grade, below grade walls must meet the F-factor requirements for perimeter insulation according to the heated slab-on-grade construction.

TABLE 502.2
BUILDING ENVELOPE REQUIREMENTS - OPAQUE ASSEMBLIES

Roofs	**All Other**	**Group R**	**Note: IECC 2009 equivalent**
Insulation entirely above deck	R-25 ci	R-25 ci	Zone 7
Metal buildings (with R-5 thermal blocks [a,b])	R-13 + R-19	R-19 + R-10	Zone 7
Attic and other	R-38	R-38	Zone 2-7
Walls, Above Grade			
Mass, exterior insulation	R-11.4 ci	R-13.3 ci	Zone 5
Mass, interior insulation	R-13	R-13	N/A
Metal building [c]	R-13 + R-5.6 ci	R-13 + R-5.6 ci	Zone 5-6
Metal framed	R-13 + R-7.5 ci	R-13 + R-7.5 ci	Zone 5-6
Wood framed and other	R-13 + R-7.5	R-13 + R-7.5	Zone 6
Walls, Below Grade[d]			
Mass, exterior insulation	R-7.5 ci	R-7.5 ci	Zone 5-6
Mass, interior insulation	R-19	R-19	N/A
Floors			
Mass	R-10 ci	R-12.5 ci	Zone 5
Metal Joist	R-30	R-30	Zone 4-8
Wood Joist/Framing	R-30	R-30	Zone 4-8
Slab-on-Grade Floors			

Unheated slabs	R-10 for 24 in. below	R-15 for 24 in. below	Zone 6
Heated slabs	R-15 for 36 in. + R-5 ci below	R-15 for 36 in. + R-5 ci below	NBI Core Performance Values
Opaque Doors			
Swinging	U – 0.37	U – 0.37	
Roll-up or sliding	R – 4.75	R – 4.75	

For SI: 1 inch = 25.4 mm.
ci – Continuous Insulation
NR – No Requirement

a. Thermal blocks are a minimum R-5 of rigid insulation, which extends 1-inch beyond the width of the purlin on each side, perpendicular to the purlin.
b. The first R-value is for faced fiberglass insulation batts draped over purlins. The second R-value is for unfaced fiberglass insulation batts installed parallel to the purlins. A minimum R-3.5 thermal spacer block is placed above the purlin/batt, and the roof deck is secured to the purlins. Reference: ASHRAE/IESNA 90.1 Table A2.3 including Addendum "G"
c. The first R-value is for faced fiberglass insulation batts installed perpendicular and compressed between the metal wall panels and the steel framing. the second *rated R-value of insulation* is for insulation installed from the inside, covering the girts. Reference: ASHRAE/IESNA 90.1 Table A3.2 Appendix "G"
d. When heated slabs are placed below grade, below grade walls must meet the exterior insulation requirements for perimeter insulation according to the heated slab-on-grade construction.

Remove section 502.3.2 (including Table 502.3) and replace with:

502.3.2 Maximum *U*-factor and SHGC. For vertical fenestration, the maximum *U*-factor and solar heat gain coefficient (SHGC) shall be as specified in Table 502.3, which is uniformly set at 0.40. For skylights, the limit is set at 3% of roof area, but can be expanded to 5% of roof area in conjunction with automatic daylighting controls. In all cases, the maximum *U*-factor and solar heat gain coefficient (SHGC) shall be as specified in Table 502.3.

TABLE 502.3
BUILDING ENVELOPE REQUIREMENTS: FENESTRATION

	All
Framing materials other than metal with or without metal reinforcement or cladding	
U-Factor	0.35
Metal framing with or without thermal break	
Curtain Wall/Storefront *U*-Factor	0.42
Entrance Door *U*-Factor	0.80
All Other *U*-Factor [a]	0.45
SHGC-All Frame Types	
SHGC	0.40

Skylights (3% maximum, or 5% maximum with automatic daylighting controls [b])	
U-Factor	0.45
SHGC	0.40

a. All other includes operable windows, fixed windows and doors other than entrance doors.
b. Automatic daylighting controls shall meet the requirements of Section 505.2.2.1.3

502.4 Air leakage (Mandatory).

Remove section 502.4.1 and 502.4.2 and replace with:

502.4.0 Air Barriers. The building envelope shall be designed and constructed with a continuous air barrier to control air leakage into, or out of the conditioned space. An air barrier system shall also be provided for interior separations between conditioned space and space designed to maintain temperature or humidity levels which differ from those in the conditioned space by more than 50% of the difference between the conditioned space and design ambient conditions.

The air barrier shall have the following characteristics:
1. It must be continuous, with all joints made airtight.
2. Materials used for the air barrier system shall have an air permeability not to exceed 0.004 cfm/ft^2 under a pressure differential of 0.3 in. water (1.57psf) (75 Pa) when tested in accordance with ASTM E 2178. Air barrier materials shall be taped or sealed in accordance with the manufacturer's instructions.
3. It shall be capable of withstanding positive and negative combined design wind, fan and stack pressures on the envelope without damage or displacement, and shall transfer the load to the structure. It shall not displace adjacent materials under full load.
4. Air barrier materials shall be maintainable, or, if inaccessible, shall meet the durability requirements for the service life of the envelope assembly.
5. The air barrier material of an envelope assembly shall be joined and sealed in a flexible manner to the air barrier material of adjacent assemblies, allowing for the relative movement of assemblies due to thermal and moisture variations and creep. Connections shall be made between:

a. joints around *fenestration* and *door* frames
b. junctions between *walls* and foundations, between *walls* at building corners, between *walls* and structural *floors* or *roofs*, and between *walls* and *roof* or *wall* panels
c. openings at penetrations of utility services through *roofs, walls*, and *floors*
d. site-built *fenestration* and *doors*
e. building assemblies used as ducts or plenums
f. joints, seams, and penetrations of vapor retarders
g. all other openings in the *building envelope*

502.4.0.1 Air Barrier Penetrations. All penetrations of the air barrier and paths of air infiltration/exfiltration shall be made air tight.

502.4.1 Window and door assemblies. The air leakage of window, skylight and door assemblies that are part of the building envelope shall be determined in accordance with AAMA/WDMA/CSA 101/I.S.2/A440, or NFRC 400 by an accredited, independent laboratory, and *labeled* and certified by the manufacturer. Window and skylight air leakage shall not exceed 0.2 cfm/ft^2 at 1.57 pounds per square foot (psf) (75Pa), or 0.3 cfm/ft^2 at 6.24 psf (300 Pa). Door assembly air leakage shall not exceed 0.3 cfm/ft^2 for all other products at 1.57 psf (75Pa).

Exceptions:
a. Site-constructed windows and doors that are sealed in accordance with Section 502.4.8.
b. Commercial entrance doors covered by section 502.4
c. Garage doors shall be permitted to use air leakage determined by test at standard test conditions in accordance with ANSI/DASMA 105.
d. Doors and Access Openings to Shafts, Chutes, Stairwells, and Elevator Lobbies. These doors and access openings shall either meet the requirements of 502.4.3 or shall be equipped with weather seals, except weatherseals on elevator lobby doors are not required when a smoke control system is installed.

502.4.2 Curtain wall, storefront glazing and commercial entrance doors. Curtain wall, *storefront* glazing and commercial-glazed swinging entrance doors and revolving doors shall be tested for air leakage at a pressure of at least 1.57 pounds per square foot (psf) (75 Pa) in accordance with ASTM E 283. For curtain walls and *storefront* glazing, the maximum air leakage rate shall be 0.06 cubic foot per minute per square foot (cfm/ft^2) (1.1 m^3/h × m^2) of fenestration area. For commercial glazed swinging entrance doors and revolving doors, the maximum air leakage rate shall be 1.00 cfm/ft^2 (18.3 m^3/h × m^2) of door area when tested in accordance with ASTM E 283.

Remove section 502.4.5 and replace with:
502.4.5 Outdoor air intakes and exhaust openings. Stair and elevator shaft vents and other outdoor air intakes and exhaust openings integral to the building envelope shall be equipped with not less than a Class I motorized, leakage-rated damper with a maximum leakage rate of 4 cfm per square foot (6.8 L/s · C m^2) at 1.0 inch water gauge (w.g.) (1250 Pa) when tested in accordance with AMCA 500D. These air tight, operable dampers shall be installed when the air barrier is penetrated by:
1. Fixed open louvers such as in elevator shafts and machine rooms.
2. Mechanical system components which allow infiltration or exfiltration of air when the systems are inactive, such as atrium smoke exhaust systems, elevator shaft smoke relief openings, and other similar elements.

Such dampers shall be set in the closed position and automatically open upon:
1. the activation of any fire alarm initiating device of the building's fire alarm system;
2. the interruption of power to the damper.

Exception: Gravity (nonmotorized) dampers are permitted to be used in buildings less than three stories in height above grade.

Remove section 502.4.7 and replace with:

502.4.7 Vestibules. Building entrances that separate *conditioned space* from the exterior shall be protected with an enclosed vestibule, with all *doors* opening into and out of the vestibule equipped with self-closing devices. Vestibules shall be designed so that in passing through the vestibule it is not necessary for the interior and exterior *doors* to open at the same time. Interior and exterior *doors* shall have a minimum distance between them of not less than 7 ft when in the closed position. The exterior envelope of conditioned vestibules shall comply with the requirements for a conditioned space. The interior and exterior envelope of unconditioned vestibules shall comply with the requirements for a semi-heated space.

Exceptions:

a. *Building entrances* with revolving *doors*.
b. *Doors* not intended to be used as a *building entrance*.
c. *Doors* opening directly from a *dwelling unit*.
d. *Doors* that open directly from a *space* that is less than 3000 ft^2 in area and is separate from the *building entrance*.
e. *Doors* used primarily to facilitate vehicular movement or material handling and adjacent personnel doors.

Add section 502.5 Vapor retarders.

502.5 Vapor retarders. Class I or II vapor retarders are required on the interior side of walls.

Exceptions:

1. Basement walls.
2. Below grade portion of any wall.
3. Construction where moisture or its freezing will not damage the materials.

502.5.1 Class III Vapor retarders. Class III vapor retarders shall be permitted where any one of the conditions in Table 502.5.1 are met.

TABLE 502.5.1 - CLASS III VAPOR RETARDERS

Climate Zone	Class III vapor retarders permitted for:
5	Vented cladding over OSB Vented cladding over Plywood Vented cladding over Fiberboard Vented cladding over Gypsum Insulated sheathing with R-value >= R5 over 2x4 wall Insulated sheathing with R-value >= R7.5 over 2x6 wall

502.5.2 Material vapor retarder class. The vapor retarder class shall be based on the manufacturer's certified testing or a tested assembly. The following shall be deemed to meet the class specified:

Class I: Sheet polyethylene, non-perforated aluminum foil
Class II: Kraft faced fiberglass batts or low perm paint

(paint with 0.1 < perm <= 1.0)
Class III: Latex or enamel paint

SECTION 503 - BUILDING MECHANICAL SYSTEMS

Insert at end of section 503.1:

NOTE: Compliance path a. (Efficient Mechanical Equipment) in section 507 is not available for equipment installed according to the minimum performance values outlined in section 503.2.3. In this case, compliance can be met with one of the following paths:

b. 507.2.2 Reduced Lighting Power Density
c. 507.2.3 On-Site Supply of Renewable Energy

Replace section 503.2.1 with:

503.2.1 Calculation of heating and cooling loads. Design loads shall be determined in accordance with the procedures described in the ASHRAE/ACCA Standard 183. The design loads shall include an accurate representation of the building envelope, lighting, ventilation and occupancy loads based on the specific design characteristics of the project. Heating and cooling loads shall be adjusted to account for load reductions that are achieved when energy recovery systems are utilized in the HVAC system in accordance with the ASHRAE *HVAC Systems and Equipment Handbook*. Alternatively, design loads shall be determined by an *approved* equivalent computation procedure, using the design parameters specified in IECC 2009 Chapter 3.

Insert at end of section 503.2.5.1, Exceptions:

5. Building spaces where CO_2 Sensors are inappropriate measures for ventilation needs because of ventilation needs other than occupant requirements.
6. Building spaces where the primary ventilation needs are for process loads.

Replace sections 503.2.9 – 503.2.9.3 with:

503.2.9 Mechanical systems commissioning and completion requirements.

503.2.9.1 System commissioning. Commissioning is a process that verifies and documents that the selected building systems have been designed, installed, and function according to the owner's project requirements and construction documents. Drawing notes shall require commissioning and completion requirements in accordance with this section. Drawing notes may refer to specifications for further requirements. Copies of all documentation shall be given to the owner. The building official may request commissioning documentation for review purposes. At the time of plan submittal, the building jurisdiction shall be provided, by the submittal authority, a letter of intent to commission the building in accordance with this code.

503.2.9.1.1 Commissioning plan. A commissioning plan shall include as a minimum the following items:

1. A detailed explanation of the original owner's project requirements,

2. A narrative describing the activities that will be accomplished during each phase of commissioning, including guidance on who accomplishes the activities and how they are completed,
3. Equipment and systems to be tested, including the extent of tests,
4. Functions to be tested (for example calibration, economizer control, etc.),
5. Conditions under which the test shall be performed (for example winter and summer design conditions, full outside air, etc.), and
6. Measurable criteria for acceptable performance.

503.2.9.1.2 Systems adjusting and balancing. All HVAC systems shall be balanced in accordance with generally accepted engineering standards. Air and water flow rates shall be measured and adjusted to deliver final flow rates within 10% of design rates. Test and balance activities shall include as a minimum the following items:

1. **Air systems balancing.** Each supply air outlet and zone terminal device shall be equipped with means for air balancing in accordance with the requirements of Chapter 6 of the International Mechanical Code. Discharge dampers are prohibited on constant volume fans and variable volume fans with motors 10 hp (18.6 kW) and larger. Air systems shall be balanced in a manner to first minimize throttling losses then, for fans with system power of greater than 1 hp, fan speed shall be adjusted to meet design flow conditions.

Exception: Fans with fan motors of 1 hp or less.

2. **Hydronic systems balancing:** Individual hydronic heating and cooling coils shall be equipped with means for balancing and pressure test connections. Hydronic systems shall be proportionately balanced in a manner to first minimize throttling losses, then the pump impeller shall be trimmed or pump speed shall be adjusted to meet design flow conditions. Each hydronic system shall have either the ability to measure pressure across the pump, or test ports at each side of each pump.

Exceptions:
1. Pumps with pump motors of 5 hp or less.
2. When throttling results in no greater than 5% of the nameplate horsepower draw above that required if the impeller were trimmed.

503.2.9.1.3 Functional performance testing

503.2.9.1.3.1 Equipment functional performance testing. Equipment functional performance testing shall demonstrate the correct installation and operation of components, systems, and system-to-system interfacing relationships in accordance with approved plans and specifications. This demonstration is to prove the operation, function, and maintenance serviceability for each of the Commissioned systems. Testing shall include all modes of operation, including:
1. All modes as described in the Sequence of Operation,
2. Redundant or automatic back-up mode,

3. Performance of alarms, and
4. Mode of operation upon a loss of power and restored power.

Exception: Unitary or packaged HVAC equipment listed in Tables 503.2.3 (1) through (3) that do not require supply air economizers.

503.2.9.1.3.2 Controls functional performance testing. HVAC control systems shall be tested to document that control devices, components, equipment, and systems are calibrated, adjusted and operate in accordance with approved plans and specifications. Sequences of operation shall be functionally tested to document they operate in accordance with approved plans and specifications.

503.2.9.1.4 Preliminary commissioning report. A preliminary report of commissioning test procedures and results shall be completed and provided to the Owner. The report shall be identified as "Preliminary Commissioning Report" and shall identify:

1. Itemization of deficiencies found during testing required by this section which have not been corrected at the time of report preparation and the anticipated date of correction.
2. Deferred tests which cannot be performed at the time of report preparation due to climatic conditions.
3. Climatic conditions required for performance of the deferred tests, and the anticipated date of each deferred test.

503.2.9.2 Acceptance. Buildings, or portions thereof, required by this code to comply with this section shall not be issued a certificate of occupancy until such time that the building official has received a letter of transmittal from the building owner that states they have received the Preliminary Commissioning Report as required by Section 503.2.9.1.4. At the request of the building official, a copy of the Preliminary Commissioning Report shall be made available for review.

503.2.9.3 Completion requirements. The construction documents shall require that within 90 days after the date of certificate of occupancy, the documents described in this section be provided to the building owner.

503.2.9.3.1 Drawings. Construction documents shall include as a minimum the location and performance data on each piece of equipment.

503.2.9.3.2 Manuals. An operating manual and a maintenance manual shall be in accordance with industry-accepted standards and shall include, at a minimum, the following:

1. Submittal data stating equipment size and selected options for each piece of equipment requiring maintenance.
2. Manufacturer's operation manuals and maintenance manuals for each piece of equipment requiring maintenance, except equipment not furnished as part of the project. Required routine maintenance actions shall be clearly identified.
3. Names and addresses of at least one service agency.

4. HVAC controls system maintenance and calibration information, including wiring diagrams, schematics, and control sequence descriptions. Desired or field-determined setpoints shall be permanently recorded on control drawings at control devices or, for digital control systems, in programming comments.
5. A complete narrative of how each system is intended to operate, including suggested setpoints.

503.2.9.3.3 System balancing report. A written report describing the activities and measurements completed in accordance with Section 503.2.9.1.2

503.2.9.3.4 Final Commissioning Report. A complete report of test procedures and results identified as "Final Commissioning Report" shall include:

1. Results of all Functional Performance Tests.
2. Disposition of all deficiencies found during testing, including details of corrective measures used or proposed.
3. All Functional Performance Test procedures used during the commissioning process including measurable criteria for test acceptance, provided herein for repeatability.

Exception: Deferred tests which cannot be performed at the time of report preparation due to climatic conditions.

SECTION 505 - ELECTRICAL POWER AND LIGHTING SYSTEMS (Mandatory)

Replace sections 505.2.2.1 and 505.2.2.2 with:

505.2.2.1 Automatic lighting controls. All commercial buildings shall be equipped with automatic control devices to shut off lighting in compliance with one of the following automatic control technologies:

1. Section 505.2.2.1.1 Occupancy Sensors
2. Section 505.2.2.1.2 Time Clock Controls
3. Section 505.2.2.1.3 Automatic Daylighting Controls

505.2.2.1.1 Occupancy sensors Occupancy sensors must be installed in all classrooms, conference/meeting rooms, employee lunch and break rooms, private offices, restrooms, storage rooms and janitorial closets, and other spaces 300 sf. or less enclosed by ceiling height partitions. These automatic control devices shall be installed to automatically turn off lights within 30 minutes of all occupants leaving the space, except spaces with multi-scene control.

505.2.2.1.2 Time Clock Controls In areas not controlled by occupancy sensors, automatic time switch control devices shall be used. It shall incorporate an override switching device that:

1. Is readily accessible.
2. Is located so that a person using the device can see the lights or the area controlled by that switch, or so that the area being lit is annunciated.
3. Is manually operated.

4. Allows the lighting to remain on for no more than 4 hours when an override is initiated.
5. Controls an area not exceeding 5,000 square feet (465 m^2).

Exceptions:
1. In malls and arcades, auditoriums, single-tenant retail spaces, industrial facilities and arenas, where captive-key override is utilized, override time may exceed 2 hours.
2. In malls and arcades, auditoriums, single-tenant retail spaces, industrial facilities and arenas, the area controlled may not exceed 20,000 square feet (1860 m^2).

505.2.2.1.3 Automatic daylighting controls. Automatic controls installed in day lit zones must control lights in the day lit areas separately from the non-day lit areas. Controls for calibration adjustments to the lighting control device shall be readily accessible to authorized personnel. Each daylight control zone shall not exceed 2,500 square feet. Automatic daylighting controls must incorporate an automatic shut-off ability based on time or occupancy in addition to lighting power reduction controls.

Controls will automatically reduce lighting power in response to available daylight by either one of the following methods:

1. Continuous dimming using dimming ballasts and daylight-sensing automatic controls that are capable of reducing the power of general lighting in the day lit zone continuously to less than 35% of rated power at maximum light output.

2. Stepped Dimming using multi-level switching and daylight-sensing controls that are capable of reducing lighting power automatically. The system should provide at least two control channels per zone and be installed in a manner such that at least one control step shall reduce power of general lighting in the daylit zone by 30% to 50% of rated power and another control step that reduces lighting power by 65% to 100%. Stepped dimming control is not appropriate in continuously occupied areas with ceiling heights of 14 feet or lower

Exception: Daylight spaces enclosed by walls or ceiling height partitions and containing 2 or fewer luminaire are not required to have a separate switch for general area lighting.

Retain section ***505.2.2.3 Daylight zone control.***

Replace section 505.2.3 with:

505.2.3 Additional Controls for specific uses

a. Display/Accent Lighting—display or accent lighting shall have a separate control device.
b. Case Lighting—lighting in cases used for display purposes shall have a separate control device.

c. Hotel and Motel Guest Room Lighting—hotel and motel guest rooms and guest suites shall have a master control device at the main room entry that controls all permanently installed luminaires and switched receptacles.
d. Task Lighting—supplemental task lighting, including permanently installed undershelf or undercabinet lighting, shall have a control device integral to the luminaires or be controlled by a wall-mounted control device provided the control device is readily accessible and located so that the occupant can see the controlled lighting.
e. Nonvisual Lighting—lighting for nonvisual applications, such as plant growth and food warming, shall have a separate control device.
f. Demonstration Lighting—lighting equipment that is for sale or for demonstrations in lighting education shall have a separate control device.

Exceptions: a., b. and d. Where LED lighting is used no additional control is required.

Insert at end of section 505.5.2:
NOTE: Compliance path b. (Reduced Lighting Power Density) in section 507 is not available for lighting installed according to the values in table 505.5.2. In this case, compliance can be met with one of the following paths:
a. 507.2.1 Efficient Mechanical Equipment
c. 507.2.3 On-Site Supply of Renewable Energy

Replace, but retain notes and exception, Table 505.5.2 with:
TABLE 505.5.2 - INTERIOR LIGHTING POWER ALLOWANCES

LIGHTING POWER DENSITY		
	Whole Building	**Space by Space**
Building Area Type[a]	**(W/ft²)**	
Active Storage		0.8
Atrium – First Three Floors		0.6
Atrium – Each Additional Floor		0.2
Classroom/lecture/training		1.3
Conference/Meeting/Multipurpose		1.3
Corridor/Transition		0.5
Dressing/Locker/Fitting Room		0.6
Electrical/Mechanical		1.5
Food Preparation		1.2
Inactive Storage		0.3
Laboratory		1.4
Lobby		1.1
Restroom		0.8
Stairway		0.6
Automotive Facility	0.9	
Automotive – Service Repair		0.7
Convention Center	1.2	
Exhibit Space		1.3
Audience/Seating Area		0.9

Courthouse	1.2	
Audience/Seating Area		0.9
Courtroom		1.9
Confinement Cells		0.9
Judges Chambers		1.3
Dining: Bar Lounge/Leisure	1.3	
Lounge/Leisure Dining		1.4
Dining: Cafeteria/Fast Food	1.4	
Dining: Family	1.6	
Dining		1.4
Kitchen		1.2
Dormitory	1.0	
Living Quarters		1.1
Bedroom		0.5
Study Hall		1.4
Exercise Center	1.0	
Dressing/Locker/Fitting Room		0.6
Audience/Seating Area		0.3
Exercise Area		0.9
Exercise Area/Gymnasium		1.4
Gymnasium	1.1	
Dressing/Locker/Fitting Room		0.6
Audience/Seating Area		0.4
Playing Area		1.4
Exercise Area		0.9
Healthcare Clinic	1.0	
Corridors w/patient waiting, exam		1.0
Exam/Treatment		1.5
Emergency		2.7
Public & Staff Lounge		0.8
Hospital/Medical supplies		1.4
Hospital - Nursery		0.6
Nurse station		1.0
Physical therapy		0.9
Patient Room		0.7
Pharmacy		1.2
Hospital/Radiology		0.4
Operating Room		2.2
Recovery		0.8
Active storage		0.9
Laundry-Washing		0.6
Hospital	1.2	
Hotel	1.0	
Dining Area		1.3
Guest quarters		1.1
Reception/Waiting		2.5
Lobby		1.1
Library	1.3	
Library-Audio Visual		0.7

Stacks		1.7
Card File & Cataloguing		1.1
Reading Area		1.2
Manufacturing Facility	1.3	
Low bay (< 25 ft Floor to Ceiling Height)		1.2
High bay (>25 ft Floor to Ceiling Height)		1.7
Detailed Manufacturing		2.1
Equipment Room		1.2
Control Room		0.5
Motel	1.0	
Dining Area		1.2
Guest quarters		1.1
Reception/Waiting		2.1
Motion Picture Theater	1.2	
Audience/Seating Area		1.2
Lobby		1.0
Multi-Family	0.7	
Museum	1.1	
Active Storage		0.8
General exhibition		1.0
Restoration		1.7
Bank/Office – banking activity area		1.5
Office	0.9	
Enclosed		1.0
Open Plan		1.0
Parking Garage	0.3	
Penitentiary	1.0	
Performing Arts Theater	1.6	
Audience/Seating Area		2.6
Lobby		3.3
Dressing/Locker/Fitting Room		1.1
Police Stations	1.0	
Fire Stations	0.8	
Fire Station Engine Room		0.8
Sleeping Quarters		0.3
Audience/Seating Area		0.8
Police Station Laboratory		1.4
Post Office	1.1	
Sorting Area		1.2
Lobby		1.0
Religious Buildings	1.3	
Lobby		1.7
Worship/Pulpit/Choir		2.4
Retail[b]	1.3	
Department Store Sales Area		1.3
Specialty Store Sales Area		1.8
Fine Merchandise Sales Area		2.9
Supermarket Sales Area		1.3
Personal Services Sales Area		1.3

Mass Merchandising Sales Area		1.3
Mall Concourse		1.7
School/University	1.2	
Classroom		1.3
Audience		0.7
Dining		1.1
Office		1.1
Corridor		0.5
Storage		0.5
Laboratory		1.1
Sports Arena	1.1	
Ring Sports Arena		2.7
Court Sports Arena		2.3
Indoor Playing Field Arena		1.4
Town Hall	1.1	
Transportation	1.0	
Dining Area		2.1
Baggage Area		1.0
Airport - Concourse		0.6
Terminal - Ticket Counter		1.5
Reception/Waiting		0.5
Warehouse	0.8	
Fine Material		1.4
Medium/Bulky Material		0.9
Workshop	1.4	

Replace section 506 with:

SECTION 506 – TOTAL BUILDING PERFORMANCE

As referenced in section 501.1, buildings establishing compliance with this appendix through total building performance shall be designed to achieve energy use per square foot equal to at least 20% below the energy requirements of *ASHRAE/IESNA Standard 90.1-2007, Energy Standard for Buildings Except for Low-Rise Residential Buildings*, Appendix G, measured by industry-accepted energy modeling.

Add Section 507:

SECTION 507 - ALTERNATIVE PRESCRIPTIVE COMPLIANCE PACKAGES

507.1 Requirements. Buildings complying with the prescriptive option of section 501.4.1 shall meet the requirements of any one of the following sections:

a. 507.2.1 Efficient Mechanical Equipment
b. 507.2.2 Reduced Lighting Power Density
c. 507.2.3 On-Site Supply of Renewable Energy

507.2.1 Efficient Mechanical Equipment

This mechanical alternative compliance option is intended to allow the builder to meet the requirements of section 507 by choosing to install efficient mechanical equipment.

This section does not replace the requirements in section 503, but is one of several optional compliance packages.

Mechanical equipment choices that fulfill requirements for section 507.2.1 shall comply with the following:

a. Package unitary equipment shall meet the minimum efficiency requirements in Tables 507.2.1(1) and 507.2.1(2)

b. Package Terminal Air Conditioners and Heat Pumps shall meet the minimum efficiency requirements in Table 507.2.1(3)

c. Warm air furnaces and combination warm air furnaces / air conditioning units shall meet the minimum efficiency requirements in Table 507.2.1(4)

d. Boilers shall meet the minimum efficiency requirements in Table 507.2.1(5)

e. Electric chillers shall meet the energy efficiency requirements in Table 507.2.1(6)

f. Absorption chillers shall meet the minimum efficiency requirements in Table 507.2.1(7)

TABLE 507.2.1(1)
UNITARY AIR CONDITIONERS AND CONDENSING UNITS, ELECTRICALLY OPERATED, EFFICIENCY REQUIREMENTS

Equipment Type	Size Category	Subcategory Or Rating Condition	Minimum Efficiency[a]
Air conditioners, Air cooled	< 65,000 Btu/h	Split system	15.0 SEER 12.5 EER
		Single package	15.0 SEER 12.0 EER
	≥ 65,000 Btu/h and < 135,000 Btu/h	Split system and single package	11.5 EER[b] 11.9 IPLV[b]
	≥ 135,000 Btu/h and < 240,000 Btu/h	Split system and single package	11.5 EER[b] 11.9 IPLV[b]
	≥ 240,000 Btu/h and < 760,000 Btu/h	Split system and single package	10.5 EER[b] 10.9 IPLV[b]
	≥ 760,000 Btu/h		9.7 EER[b] 11.0 IPLV[b]
Air conditioners, Water and evaporatively cooled		Split system and single package	14.0 EER

For SI: 1 British thermal unit per hour = 0.2931 W.

a. IPLVs are only applicable to equipment with capacity modulation.

b. Deduct 0.2 from the required EERs and IPLVs for units with a heating section other than electric resistance heat.

TABLE 507.2.1(2)
UNITARY AND APPLIED HEAT PUMPS, ELECTRICALLY OPERATED, EFFICIENCY REQUIREMENTS

Equipment Type	Size Category	Subcategory Or Rating Condition	Minimum Efficiency[a]
Air cooled (Cooling mode)	< 65,000 Btu/h	Split system	15.0 SEER 12.5 EER
		Single package	15.0 SEER 12.0 EER
	≥ 65,000 Btu/h and < 135,000 Btu/h	Split system and single package	11.5 EER[b] 11.9 IPLV[b]
	≥135,000 Btu/h and < 240,000 Btu/h	Split system and single package	11.5 EER[b] 11.9 IPLV[b]
	≥ 240,000 Btu/h	Split system and single package	10.5 EER[b] 10.9 IPLV[b]
Water source (Cooling mode)	< 135,000 Btu/h	85°F entering water	14.0 EER
Air cooled (Heating mode)	< 65,000 Btu/h (Cooling capacity)	Split system	8.5 HSPF
		Single package	8.0 HSPF
	≥ 65,000 Btu/h and < 135,000 Btu/h (Cooling capacity)	47°F db/43°F wb outdoor air	3.4 COP
		77°F db/15°F wb outdoor air	2.4 COP
	≥ 135,000 Btu/h (Cooling capacity)	47°F db/43°F wb outdoor air	3.1 COP
		77°F db/15°F wb outdoor air	2.1 COP
Water source (Heating mode)	< 135,000 Btu/h (Cooling capacity)	70°F entering water	4.6 COP

For SI: °C = [(°F) - 32] / 1.8, 1 British thermal unit per hour = 0.2931 W.
db = dry-bulb temperature, °F; wb = wet-bulb temperature, °F
a. IPLVs and Part load rating conditions are only applicable to equipment with capacity modulation.
b. Deduct 0.2 from the required EERs and IPLVs for units with a heating section other than electric resistance heat.

TABLE 507.2.1(3)
PACKAGED TERMINAL AIR CONDITIONERS AND PACKAGED TERMINALHEAT PUMPS

Equipment Type	Size Category	Minimum Efficiency
Air conditioners	< 7,000 Btu / h	11.9 EER
& Heat Pumps (Cooling Mode)	7,000 Btu / h and < 10,000 Btu / h	11.3 EER
	10,000 Btu / h and < 13,000 Btu / h	10.7 EER
	≥ 13,000 Btu / h	9.5 EER

a. Replacement units must be factory labeled as follows: "MANUFACTURED FOR REPLACEMENT APPLICATIONS ONLY: NOT TO BE INSTALLED IN NEW CONSTRUCTION PROJECTS." Replacement efficiencies apply only to units with existing sleeves less than 16 inches (406 mm) high and less than 42 inches (1067 mm) wide.

TABLE 507.2.1(4)
WARM AIR FURNACES AND COMBINATION WARM AIR FURNACES/AIR-CONDITIONING UNITS, WARM AIR DUCT FURNACES AND UNIT HEATERS, EFFICIENCY REQUIREMENTS

Equipment Type	Size Category (Input)	Subcategory Or Rating Condition	Minimum Efficiency	Test Procedure
Warm air furnaces, gas fired	< 225,000 Btu/h	-	90% AFUE or 90% *Et*	DOE 10 CFR Part 430 or ANSI Z21.47
	≥ 225,000 Btu/h	Maximum capacity	90% *Ec,* note 1.	ANSI Z21.47
Warm air furnaces, oil fired	< 225,000 Btu/h	-	85% AFUE or 85% *Et*	DOE 10 CFR Part 430 or UL727
	≥ 225,000 Btu/h	Maximum capacity	85 % *Et*, note 1.	UL 727
Warm air duct furnaces, gas fired	All capacities	Maximum capacity	90% *Ec*	ANSI Z83.8
Warm air unit heaters, gas fired	All capacities	Maximum capacity	90% *Ec*	ANSI Z83.8
Warm air unit heaters, oil fired	All capacities	Maximum capacity	90% *Ec*	UL 731

For SI: 1 British thermal unit per hour = 0.2931 W.
1. Units must also include an IID (intermittent ignition device), have jackets not exceeding 0.75 percent of the input rating, and have either power venting or a flue damper. A vent damper is an acceptable alternative to a flue damper for those furnaces where combustion air is drawn from the conditioned space. Where there are two ratings, units not covered by the National Appliance Energy Conservation Act of 1987 (NAECA) (3-phase power or cooling capacity greater than or equal to 65,000 Btu/h [19 kW] shall comply with either rating.
Et = Thermal efficiency
Ec = Combustion efficiency (100% less flue losses)
Efficient furnace fan: All fossil fuel furnaces in zones 3 to 8 shall have a furnace electricity ratio not greater than 2% and shall include a manufacturer's designation of the furnace electricity ratio.

TABLE 507.2.1(5)
BOILER, EFFICIENCY REQUIREMENTS

Equipment Type	Size Category	Minimum Efficiency
Gas Hot Water	< 300,000 Btu/h	90% *Et*
	> 300,000 Btu/h and < 2.5 mBtu/h	89% *Et*
Gas Steam	< 300,000 Btu/h	89% *Et*
	≥ 300,000 Btu/h	89% *Et*
Oil	< 300,000 Btu/h	90% *Et*
	≥ 300,000 Btu/h	89% *Et*
***Et* = thermal efficiency**		

TABLE 507.2.1(5)
CHILLERS - EFFICIENCY REQUIREMENTS

		Required Efficiency-Chillers		Optional Compliance Path - Required Efficiency - Chillers With VSD	
Equipment Type	**Size Category**	Full Load (KW/ Ton)	IPLV (KW/ Ton)	Full Load (KW/Ton)	IPLV (KW/ Ton)
Air Cooled w/ Condenser	All	1.2	1.0	N/A	N/A
Air Cooled w/o Condenser	All	1.08	1.08	N/A	N/A
Water Cooled, Reciprocating	All	0.840	0.630	N/A	N/A
Water Cooled, Rotary Screw and Scroll	< 90 tons	0.780	0.600	N/A	N/A
	90 tons and < 150 tons	0.730	0.550	N/A	N/A
	150 tons and < 300 tons	0.610	0.510	N/A	N/A
	≥ 300 tons	0.600	0.490	N/A	N/A
Water Cooled, Centrifugal	< 150 tons	0.610	0.620	0.630	0.400
	150 tons and < 300 tons	0.590	0.560	0.600	0.400
	300 tons and < 600 tons	0.570	0.510	0.580	0.400
	≥ 600 tons	0.550	0.510	0.550	0.400

a. Compliance with full load efficiency numbers and IPLV numbers are both required.
b. Only Chillers with Variable Speed Drives(VSD) may use the optional compliance path here for chiller efficiency.

TABLE 507.2.1(6)
ABSORPTION CHILLERS - EFFICIENCY REQUIREMENTS

Equipment Type	**Required Efficiency Full Load COP (IPLV)**
Air Cooled, Single Effect	0.60, but only allowed in heat recovery applications
Water Cooled, Single Effect	0.70, but only allowed in heat recovery applications
Double Effect - Direct Fired	1.0 (1.05)
Double Effect - Indirect Fired	1.20

507.2.2 Reduced Lighting Power Density.
Whole Building Lighting Power Density (Watts/ft^2) must be reduced by at least 10% from the values in table 505.5.2, or as shown in table 507.2.2.

507.2.2.1 Automatic Daylighting Controls.
Automatic daylighting controls shall be installed in the daylight zone and shall meet the requirements of 505.2.2.1.3.

TABLE 507.2.2
REDUCED INTERIOR LIGHTING POWER ALLOWANCES

LIGHTING POWER DENSITY	
Building Area Type[a]	**Reduced whole building (W/ft²)**
Automotive Facility	0.8
Convention Center	1.1
Court House	1.1
Dining: Bar Lounge/Leisure	1.2
Dining: Cafeteria/Fast Food	1.3
Dining: Family	1.4
Dormitory	0.9
Exercise Center	0.9
Fire Station	0.7
Gymnasium	1.0
Healthcare-Clinic	0.9
Hospital	1.1
Hotel	0.9
Library	1.2
Manufacturing Facility	1.2
Motel	0.9
Motion Picture Theater	1.1
Multi-Family	0.6
Museum	1.0
Office	0.8
Parking Garage	0.3
Penitentiary	0.9
Performing Arts Theater	1.4
Police	0.9
Post Office	1.0
Religious Building	1.2
Retail[b]	1.2
School/University	1.1
Sports Arena	1.0
Town Hall	1.0
Transportation	0.9
Warehouse	0.7
Workshop	1.3

See IECC 2009 Table 505.2 for notes and exception.

507.2.3 On-site Supply of Renewable Energy
The building or surrounding property shall incorporate an on-site renewable energy system that supplies 3% or more of total building electrical loads. On-site power generation using nonrenewable resources does not meet this requirement.

The jurisdiction shall be provided with an energy analysis that documents the renewable energy contribution to the building or a calculation demonstrating that the on-site supply of renewable energy:

a) Is capable of providing at least 3 percent of the total energy load of the building, or
b) Has an installed maximum generating capacity equal to or greater than 0.50 watts per square foot of usable floor space.

Insert IECC 2009 Chapter 6 – Referenced Standards

Appendix B – Sample User's Guide

This template was created to help school designers and facility maintenance personnel to determine the recommended content of a User's Guide for classrooms. A similar approach can be used for other regularly occupied spaces such as private offices and administrative areas.

Divide the template by the types of systems that should be covered, namely lighting controls, temperature controls (including a rudimentary description of how heating and cooling systems work), ventilation, and any measures teachers or room occupants should know to operate the room as efficiently and effectively as possible.

The User's Guides should be posted in every regularly occupied space in the school including; classrooms, administrative space, media centers, cafeterias, gymnasiums, auditoriums, and collaborative spaces. It is up to the school building committee and the school administration to determine the form of the signage – from informal laminated pieces of paper to more formal signs. The guides should be posted and easily visible.

SAMPLE CLASSROOM TEMPLATE:

HOW DO I CONTROL THE LIGHTS IN THIS CLASSROOM?

- Explain how the wall switches control the level of light in the classroom.
- If occupancy sensors are present, describe how the sensors detect occupants (e.g. movement or body heat) and how the occupancy sensors work. Describe how to override the occupancy sensors, if needed.
- State the amount of time the lights will stay on once no presence is detected by the occupancy sensors.
- If the classroom is equipped with daylight sensors, describe how they work.
- Be sure to state how to get the maximum efficiency from daylight sensing devices (i.e. keeping the blinds open- otherwise their energy savings will be defeated).
- Include photos of the technologies used in the classrooms, as shown below.

Occupancy Sensor (Ceiling Mounted)

Daylight Sensor (Ceiling Mounted)

Appendix

HOW CAN I SAVE LIGHTING ENERGY?

- Explain that lights can be switched off when the room is going to be left empty, an approach more effective than an occupancy sensor.

VENTILATION AIR IN THE CLASSROOMS

- Describe how ventilation air is fed to the classroom
- Describe how air is exhausted from the room
- Include photos

Air Diffuser

HOW DO I CONTROL THE TEMPERATURE IN MY ROOM?

- If there is a thermostat located in the room, describe how to increase and decrease the temperature. Let users know that the heating and cooling systems are programmed to go back to setback temperature in the evenings and return to normal temperatures before the start of the school day.

HOW DOES THE HEAT WORK IN MY CLASSROOM?

- Provide a description of the heating system or systems.

HOW DOES THE AIR-CONDITIONING WORK IN MY CLASSROOM?

- If the room has air conditioning, state how it works. If air is tempered with a dehumidification system, then explain its function. Indicate whether there is no air conditioning.

WHAT WILL HAPPEN IF THE AIR CONDTIONING OR HEAT IS ON AND I OPEN THE WINDOW?

- Let the room occupants know the effects on energy savings when windows are open during the heating or cooling seasons. It is appropriate to open window during the shoulder seasons.

SAMPLE CAFETERIA TEMPLATE

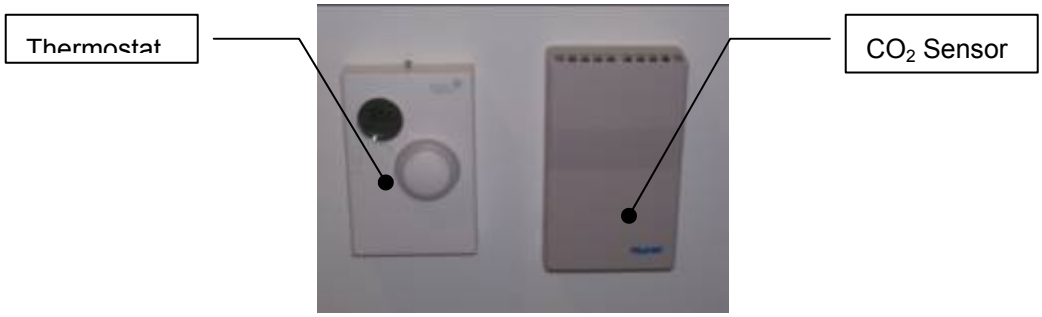
Lighting Control System

- Explain how the lights are controlled in the cafeteria space. A separate template should be created for the food prep and kitchen areas.
- If occupancy sensors are present, describe how the sensors detect occupants (e.g. movement or body heat) and how the occupancy sensors work. Describe how to override the occupancy sensors, if needed.
- State the amount of time the lights will stay on once no presence is detected by the occupancy sensors.
- If the cafeteria is equipped with daylight sensors, describe how they work.

Heating, Cooling & Ventilation System

- Explain how the heating, cooling and ventilation for this space are handled. For example, these functions may be controlled by a single air handling unit (AHU) on the roof or inside the building.
- Additionally, if demand controlled ventilation is present, describe how it works. Sample language may read as follows:

  The fresh air ventilation of the space is controlled via a local CO_2 sensor (see figure below). As people gather in the cafeteria, the CO_2 in the air increases and is detected by CO_2 sensor. The sensor sends a signal the air handler to supply more fresh air to the cafeteria until the CO_2 level decreases to a minimum setpoint. Conversely, as the people filter out of the cafeteria, the sensors detect less and less CO_2 in the air. The sensor then signals the air handling unit to supply less fresh air into the space.



Thermostat and CO_2 Sensor

Appendix C - Protection of Building Materials from Water Damage

Sample Specifications For IEQ

Note: Coordinate this specification language with specification provisions elsewhere regarding protection of the Work and protection of materials from weather damage.

A. General: The General Contractor shall be responsible for protecting the Work from moisture, in order to prevent growth of fungus, bacteria and other biological contaminants.

B. Existing and New Building Construction:

1. Install weatherproof enclosures to protect the Work from exterior sources of moisture, in accordance with Division I specifications for materials and installation of weatherproof enclosures.

2. Remove and replace construction which has been wet for 24 hours or more, or which shows evidence of biological growth due to the presence of moisture.

C. Stored Construction Materials:

1. Store construction materials in clean, dry area to prevent porous materials such as gypsum board, insulation, ceiling tile, wood and similar products from becoming wet.

2. Discard construction material which becomes wet, or which shows evidence of biological growth due to the presence of moisture.

D. Procedures for drying out construction materials that have become wet:

In the case that an unanticipated event permits the entry of water into new or existing construction, the Contractor shall perform procedures to dry out construction within 24 hours. Restoration drying techniques shall be employed to achieve and maintain conditions that will not support biological growth. Consider the use of desiccant drying, which is a very effective way to prevent mold growth and accelerate drying of wet materials, including concrete.

Identify wet materials and remediate in accordance with the following publication: United States Environmental Protection Agency, 2001, “Mold Remediation in Schools and Commercial Buildings”. See: www.epa.gov/mold/mold_remediation.html or www.epa.gov/mold/images/moldremediation.pdf

Construction that is not adequately dried out, or which shows evidence of biological growth, shall be removed immediately from the construction area and disposed of legally.

Where construction has been in contact with contaminated water, subsequent cleaning and decontamination shall be supervised by a qualified company as approved by the Owner.