# DHCD Design Guidelines and Standards

**For State Aided Public Housing**

**August 2022**

Massachusetts *Department of Housing and Community Development*

dhcd Massachusetts

# DESIGN AND CONSTRUCTION GUIDELINES AND STANDARDS

## INTRODUCTION

The DHCD Design & Construction Guidelines and Standards are intended to aid designers of DHCD-funded projects in developing durable and forward-thinking solutions for the design challenges of capital projects at local housing authorities (LHA) in the Commonwealth of Massachusetts. They also embed our evolving understanding about life-cycle investment and smart approaches to sustainability, climate resilience, indoor air quality, and environmental protection. The standards do not ultimately constrain the designer's choice of solutions; they are a practical benchmark of best practices at LHAs. The designer who proposes an alternative design solution must explain why the proposed solution will work better than our standard and be more cost-effective, and must back up that explanation with data and examples in the field. Such explanation would be considered part of the basic design fee, not an extra service and must be provided within the normal design contract timeframe.

These standards were launched in 2007 and have been periodically revised over time. These standards will be continually reviewed and revised as we gain more experience with existing products and techniques, and as new products and techniques become available and withstand the test of time.

Your feedback on these standards is most welcome. We would be particularly interested in designers who would like to share with us materials or design details which you have found to be extremely reliable and cost-effective over several years of use and observation. Please email all suggestions or comments to me at the address shown below. Thank you for your interest in DHCD-funded work.

Simone Early
Assistant Director of AESU & House Doctor Administrator
Bureau of Housing Development & Construction
Simone.Early@mass.gov

# Design and Construction Guidelines and Standards

The Design and Construction Guidelines and Standards (the Standards) are DHCD's technical recommendations regarding materials, products, and installation, relevant to the development of construction drawings and specifications for projects at LHAs. The Standards summarize what works and what does not in order to promote high quality, sustainable construction that reduces initial costs without compromising long-term economies. The Standards are also intended to help reduce exposure to key climate change hazards.

## USING THESE STANDARDS

These Standards provide useful information when making detailed, technical decisions about material, design, and installation. Architects and Engineers are the primary audience, although housing authorities and the Regional Capital Assistance Teams (RCATs) will likely use them as a reference for smaller projects that may or may not require engagement of design professionals. The information presented contains technical language that may be unfamiliar to those who are not design or construction professionals.

**This is not an outline specification, but rather a reference source for Designers in the preparation of construction documents. Most of the standards are stated in the form of minimum standards and recommendations.** Recognizing that each project has a unique context, alternative solutions to illustrate how a high level of construction quality can be achieved in different contexts and circumstances may be shown. DHCD expects the construction of state-aided public housing to meet the level of quality described in these Standards. When no specific information is provided, standards of professional practice apply.

## CODES

Architects and Engineers are responsible for identifying and addressing all relevant codes and regulations pertaining to the design and construction of buildings and sites. The Standards do not identify or interpret code requirements; in some cases, they do recommend materials and features that are more stringent than what is required in applicable codes. The

Standards are not intended to contradict state codes and regulations. If recommendations in the Standards conflict with codes or regulations applicable to a particular project, the Designer should bring it to the attention of the DHCD design review architect or engineer. However, the Designer is still responsible for producing a design that complies with all codes, regulations, laws, ordinances, and by-laws.

Filed Sub Bid

M.G.L. c.149 §44F

## FILED SUB BID TRADES

When using the Standards, the following symbol may appear in a section which may require Filed Sub Bids in a construction contract. M.G.L. c.149 §44F requires Awarding Authorities to make certain trades Filed Sub Bid Trades. These trades are identified by the symbol shown on the left. Technical specifications for Filed Sub Bid Trades require more administrative attention than the no-filed sub bid trades specification. For example the specifications must spell out exactly which drawings contain work to be completed by this trade, and the work in related sections needs to be spelled out clearly to avoid conflicts such as a sub bidder claiming work is not required under its section. If there are any questions regarding the requirements of c.149 §44F contact the DHCD assigned design reviewer. Additional information may be found on the DHCD Modernization webpage on Public Housing Bidding Information.

ADA/MAAB

REQUIREMENTS

## ADA - AAB REQUIREMENTS

The symbol on the left indicates those items that may be seriously impacted by the Americans with Disabilities Act (ADA) or the Massachusetts Architectural Access Board (MAAB).

## HOW THE STANDARDS ARE ORGANIZED

These Standards consist of sections that are organized as closely as possible to the Construction Specifications Institute (CSI) index. Each section includes the title of the section, the **general** CSI division to which the section belongs, and the topic areas included within the section. For example, section 07 40 00 Siding is part of CSI's Division 7, Thermal and Moisture Protection and covers within it Vinyl and Polypropylene Siding, Wood Clapboards, Fiber Cement Siding as well as other sidings used on housing. Requirements and recommendations for each of these topic areas is described in terms of materials, design, and execution.

DHCD requires that specification numbers follow the CSI numbers as closely as possible. The actual numbering may differ as long as the specification sections are clearly identifiable.

The Standards include some drawings which describe DHCD's recommendations for the detailing and assembly of building and site components. The drawings are for illustrative purposes only, and should not be taken as standardized details.

# SUSTAINABILITY and LIFE-CYCLE DESIGN CONSIDERATIONS

In Massachusetts, Executive Order 484 of 2007 requires public agencies to "Lead by Example" in promoting energy and water conservation, clean energy practices, waste reduction and recycling, environmentally preferable procurement, toxic use reduction, and resource conservation. Executive Order 484 has been replaced with Executive Order 594 which which also includes fuel oil reduction, zero emission vehicles and EV charging stations. These values are also captured in the Governor's Sustainable Development Principles and the Green Communities Act of 2008, as amended. Specific statewide greenhouse gas reductions targets are now set at net-zero emissions by 2050, per the Governor's Determination Letter in April of 2020.

Since 2007, DHCD's Bureau of Housing Development & Construction added a Sustainability Program, which has focused on seeking technical and financial resources for housing authorities in order to meet DHCD's and the Commonwealth's goals to reduce greenhouse gas emissions, save energy and water, improve indoor air quality, and deploy renewable energy technologies. With this sustainability undertaking, DHCD aims to achieve the Commonwealth's goals of net-zero emissions by 2050, to improve the living environments of public housing, and to ensure that future generations have the same ability to meet their needs as present peoples.

In recent years, experts in the sustainable building community have advanced Leadership in Energy & Environmental Design (LEED) certifications for existing buildings and new construction, ENERGY STAR® building and product certifications, Passive House standards and Life Cycle Assessment (LCA) approaches and tools, and Healthy Product Declarations. In soliciting design work for particular projects, DHCD may require designers to work with Mass Save® energy efficiency programs, use ENERGY STAR® certified products, design a project to be LEED-certifiable, or design to certain sustainability goals defined by DHCD. However, while the end goal is to achieve the directives, these Guidelines & Standards do not explicitly require application for certifications.

Throughout these guidelines, "Eco-Icons" are located adjacent to text to highlight how sustainability objectives might be applicable to design and construction approaches for public housing capital improvement:

- **Energy Performance and Intensity**: Saving energy in public housing decreases operating costs, reduces air pollutants such as those from greenhouse gas emissions, and preserves natural resources from depletion. The embedded energy intensity of building products (energy use in manufacture, distribution to market, installation and use) should be balanced with other attributes such as durability, ease of maintenance, and recyclability at end of life. DHCD is supportive of demonstrating renewable energy technologies such as solar photovoltaic and solar thermal, combined heat and power, and air source heat pump technology, which reduce consumption of fossil fuel and greenhouse gas emissions and help advance Massachusetts' clean energy economy. Where possible, the elimination of products which consume fossil fuels is preferred and every effort should be made to achieve that goal.

- **Recycling/ Green Products**: Recycled content, non-toxicity, recyclability, and packaging waste are relevant to specification of products. Sound recycling practice in construction is also a high priority in Massachusetts given limited landfill capacity.

- **Water Conservation**: Saving water reduces operating costs, extends life of septic systems, and is consistent with resource conservation goals.

- **Health/Indoor Environmental Quality**: Health impacts on residents, housing authority staff, and the construction workforce can be affected by design decisions, product selection, construction period impacts, and operational practices. Indoor, environmental air quality in public housing can be affected by construction best practices relative to:
  - Mold, dust, and moisture management.

- Off-gassing or other exposure to chemical contaminants in construction materials, including but not limited to VOCs (volatile organic carbon compounds), phthalates, etc.
- Pest-related contamination and pest management methods.
- Pollutants inside and outside of the unit

## CHARM

In September 2016, Governor Baker signed ***Executive Order 569:* Establishing an Integrated Climate Change Strategy for the Commonwealth**. Complementing the Global Warming Solutions Act, which is aimed at greenhouse gas emission reductions that cause climate change, EO 569 directs public agencies to provide leadership and protect public safety by reducing emissions from operations, planning and preparing for impending climate change, and enhancing the resilience of government facilities and other assets.

Since then, state agencies and authorities, as well as cities and towns, have begun taking steps to prepare for the impacts of climate change by assessing vulnerability and adopting strategies to increase the adaptive capacity and resiliency of building facilities and other infrastructure.

In 2018, DHCD initiated the Climate Hazard Adaptation and Resilience Masterplan (CHARM) project to:

- assess the state-funded public housing portfolio's risk and vulnerability to climate change impacts,
- provide a detailed climate change resilience opportunity assessment of selected pilot housing developments, and
- develop design guidelines for DHCD facilities to implement capital projects that incorporate climate adaptation and resilience best practices.

CHARM provided a unique opportunity for DHCD to assess climate risk to its building portfolio and to the LHA residents, develop resilience guidelines, and advance a strategic plan for implementation.

# RISK AND VULNERABILITY ASSESSMENT

The Risk and Vulnerability Assessment (RVA) was developed for 1,347 developments based on a the latest climate hazard data to identify which developments are most at risk for climate change impacts from extreme weather events such as drought, precipitation flooding, sea level rise and increased storm surge, and extreme temperatures. For more information on the assessment, see the Appendix at the end of the Introduction.

The developments' site and building components most at risk have been identified and tagged in the DHCD Capital Planning System (CPS), so that the information is readily available to housing authorities as they select and scope the projects in their capital plans.

Therefore, engineers and architects working with these design guidelines should be informed by the housing authority, the planning document and DHCD staff whether the subject property requires particular focus on climate adaptation and resiliency measures. The design team should also take the initiative to bring up issues and questions related to resiliency if they seem pertinent to the scope in the design process.

# CLIMATE CHANGE IMPACTS

DHCD has summarized best available resilient design guidance for these four categories:


**Precipitation Protection:** The risk of flooding is increasing as the impacts of climate change lead to more frequent and intense rainfall events. Flooding often occurs beyond designated flood zones, due to the site design and to the aging or undersized, storm sewer infrastructure which is unable to carry stormwater during extreme rainfall events.


**Sea Level Rise & Storm Surge** exposes some housing authority developments to increased coastal flooding. Impacts will continue to worsen over time. Adapting buildings and sites to sea level rise and storm surge is often similar to adapting for the flooding risk from extreme rainfall, but in some locations may require more expansive interventions to mitigate risk.


**Extreme Heat:** As the climate warms, the number of days with extreme, high temperatures and high heat indexes (the combination of temperature and humidity) is increasing across Massachusetts. Some parts of the state will experience this trend more acutely, and some locations already experiencing the effects of urban heat island will have increased heat impact in both temperature and length of time high temperatures are experienced.

**Emergency Preparedness:** To help ensure staff and resident safety during extreme events, and to shelter in place during power outages and extreme weather when and where possible, these items recommend strategies for preparing housing authority developments. These recommendations will be used in tandem with new operational emergency preparedness planning guidance from DHCD.

## FINIS

DHCD technical and sustainability staff welcome suggestions from designers on innovative approaches to this capital project work, especially those that accomplish climate resilience and sustainability objectives. And while the focus must always be on the scoped project and budget constraints, DHCD and housing authorities may be subject to special awards, and resiliency and sustainability initiatives that may augment the budgets with utility rebates, targeted grants, power purchase agreements, tax credits, or DHCD Sustainability funding.

# APPENDIX:

## RISK AND VULNERABILITY ASSESSMENT

The risk and vulnerability assessment ranked developments based on:

- **Criticality** parameters that include a development's size and density, type of housing occupants per DHCD categories, ability to provide for sheltering in place, environmental impact, interdependencies with other community resources, and if a development had experienced evacuations in the past.
- **Exposure** parameters that indicate the development's susceptibility to selected climate-related events including primary climate hazards (flooding due to sea level rise and storm surge, flooding due to extreme precipitation, and extreme heat) and related climate hazards (severe winter storms, extreme wind, landslide, drought, wildfire). Exposure is based on information from historic climate events as well as projected climate-related impacts as made more extreme by climate change and projected for 2030 and 2070. Developments that score higher in exposure are the ones that reported having experienced climate-related impacts and/or that are at risk to future climate-related impacts by 2030; and
- **Adaptive capacity** parameters that characterize the development's ability to adapt and/or sustain itself and its residents during an extreme event. Developments with significant on-site infrastructure (e.g., generator, wastewater treatment, etc.) have a higher adaptive capacity score. A higher score means that residents may be able to maintain livable conditions in at least a portion of the development during hazardous weather or power outages without evacuating the site.

| SUSTAINABILITY ISSUES MATRIX | | | | |
|---|---|---|---|---|
| **Energy Issues** -- Energy Use, Conservation Features or Embedded Energy in Products; Reduced Transport Energy for Local Sourcing; Use renewable energy materials | E | | | |
| **Recycling/Recyclability -** Recycled Content and Post-Use Recycling Opportunities | R | | | |
| **Water** - Conserve a limited resource; reduce wastewater | W | | | |
| **Health** - Limit exposure of humans (Residents, Maintenance and Construction Workers) to toxic materials, pests and allergens; ensure indoor air quality; protect groundwater and soil | H | | | |
| | | | | |
| | | | | |
| **CATEGORIES by GUIDELINE SECTION** | **ENERGY** | **RECYCLING** | **WATER** | **HEALTH** |
| 01 74 19 -- Waste Management | x | x | | |
| 02 41 00 -- Demolition | | x | | x |
| 02 61 00 -- Contaminated Site Material Removal | | x | | x |
| 02 65 50 -- Underground Storage Tank Removal | | | | x |
| 02 82 00 -- Asbestos Remediation | | | | x |
| 02 83 00 -- Lead Paint Remediation | | | | x |
| 03 30 00 -- Concrete | x | x | | |
| 04 20 00 -- Unit Masonry | x | | | |
| 05 10 00 -- Structural Steel | x | x | | |
| 05 50 00 -- Miscellaneous and Ornamental Iron | | x | | |
| 06 10 00 -- Rough Carpentry | x | x | | x |
| 06 20 00 -- Finish Carpentry | x | | | |
| 06 61 00 -- Plastic Tub and Shower Panels | | x | | |
| 06 65 00 -- Plastic and Composite Trim | | x | | |
| 06 70 00 -- Plastic Structural Plastics and Composites | | x | | |
| 07 07 00 --Solar Photovolatic Systems | x | | | |
| 07 10 00 -- Waterproofing and Dampproofing | | | | |
| 07 20 00 -- Building Insulation & Moisture Protection | x | | | x |
| 07 20 001 --Attic Hatch & Insulation Tent | x | | | |
| 07 20 002 -- Soffit Insulation Dam | x | | | |
| 07 30 00 -- Asphalt Roof Shingles | x | x | | |
| 07 40 00 -- Siding | x | x | | |
| 07 45 00 -- Gutters and Downspouts | x | | | |
| 07 50 00 -- Membrane Roofing | x | | | |

| | | | | |
|---|---|---|---|---|
| 07 62 00 -- Sheet Metal Trim & Flashing | | | | |
| 07 90 00 -- Sealants | x | | | |
| 08 10 00 -- Doors and Frames | x | | | |
| 08 40 00 -- Entrances and Storefronts | x | | | |
| 08 50 00 -- Windows | x | | | |
| 08 70 00 -- Hardware | x | | | |
| 09 20 00 -- Gypsum | | x | | x |
| 09 30 00 -- Tile | | | | x |
| 09 64 00 -- Wood Flooring | x | x | | x |
| 09 65 00 -- Resilient Flooring | | x | | |
| 09 68 00 -- Carpeting | x | x | | x |
| 09 90 00 -- Painting | | x | | x |
| 10 00 00 -- Specialties | x | | | |
| 11 31 00 -- Residential Appliances | x | | | |
| 12 30 00 -- Casework | x | | | |
| 14 20 00 -- Elevators | | | | |
| 21 00 00 -- Fire Suppression --Sprinklers | | | | |
| 22 00 00 -- Plumbing | x | | x | |
| 23 00 00 -- Heating, Ventilating & Air Conditioning | x | | | |
| 23 80 00 -- Air Source Heat Pumps | x | | | x |
| 26 00 00 -- Electrical | x | | | |
| 28 00 00 -- Electronic Safety & Security | | | | |
| 31 00 00 -- Earthwork | | | | x |
| 31 31 00 -- Soil Treatment | | | | x |
| 32 12 00 -- Asphalt Paving | | | x | |
| 32 30 00 -- Site Improvements | x | x | x | |
| 32 80 00 -- Site Irrigation | | | x | |
| 32 90 00 -- Landscaping | x | | x | |
| 33 00 00 -- Site Utilities | | | | |
| 33 36 00 -- Septic Systems | | | x | x |

dhcd Massachusetts

| CLIMATE RESILIENCE ISSUES MATRIX | | | | |
|---|---|---|---|---|
| **Precipitation & Flooding Protection:** Climate change is causing more frequent and intense rainfall events. Flooding is often occurring beyond designated flood zones, because of site conditions or aging or undersized storm sewer infrastructure. | | | | |
| **Sea Level Rise & Storm Surge (SLR&SS):** Coastal flooding impacts will continue to worsen through this century. Adapting to sea level rise and storm surge is often similar to adapting to flood risk from extreme rainfall, but in some locations may require more expansive interventions to mitigate risk. | | | | |
| **Extreme Heat:** The number of days with extreme high temperatures and increased risk from high heat index (the combination of temperature and humidity) will grow drastically as the climate changes. Measures for reducing extreme heat impacts at a site and building are recommended in the relevant sections of this guide. | | | | |
| **Emergency Preparedness:** Resilient capital upgrades plus operational emergency preparedness planning are both needed to help ensure staff and resident safety during extreme events. These items address capacity to shelter in place during power outages and extreme weather. | | | | |
| | | | | |
| **CATEGORIES by GUIDELINE SECTION** | **Precipitation Flooding** | **SLR&SS Flooding** | **Extreme Heat** | **Emergency Preparedness** |
| 01 74 19 -- Waste Management | | | | |
| 02 41 00 -- Demolition | | | | |
| 02 61 00 -- Contaminated Site Material Removal | | | | |
| 02 65 50 -- Underground Storage Tank Removal | | | | |
| 02 82 00 -- Asbestos Remediation | | | | |
| 02 83 00 -- Lead Paint Remediation | | | | |
| 03 30 00 -- Concrete | | | | |
| 04 20 00 -- Unit Masonry | X | X | | |
| 05 10 00 -- Structural Steel | | | | |
| 05 50 00 -- Miscellaneous and Ornamental Iron | | | | |
| 06 10 00 -- Rough Carpentry | X | X | | |
| 06 20 00 -- Finish Carpentry | X | X | | |
| 06 61 00 -- Plastic Tub and Shower Panels | | | | |
| 06 65 00 -- Plastic and Composite Trim | | | | |
| 06 70 00 -- Plastic Structural Plastics and Composites | | | | |
| 07 07 00 --Solar Photovolatic Systems | | | | X |
| 07 10 00 -- Waterproofing and Dampproofing | X | X | | |
| 07 20 00 -- Building Insulation & Moisture Protection | X | X | X | |
| 07 20 001 --Attic Hatch & Insulation Tent | | | | |
| 07 20 002 -- Soffit Insulation Dam | | | | |
| 07 30 00 -- Asphalt Roof Shingles | X | X | X | |
| 07 40 00 -- Siding | X | X | X | |
| 07 45 00 -- Gutters and Downspouts | X | | | |
| 07 50 00 -- Membrane Roofing | X | X | X | |
| 07 62 00 -- Sheet Metal Trim & Flashing | X | X | | |

| | | | | |
|---|---|---|---|---|
| 07 90 00 -- Sealants | X | X | | |
| 08 10 00 -- Doors and Frames | X | X | | |
| 08 40 00 -- Entrances and Storefronts | X | X | | |
| 08 50 00 -- Windows | X | X | X | |
| 08 70 00 -- Hardware | X | X | | |
| 09 20 00 -- Gypsum | X | X | | |
| 09 30 00 -- Tile | X | X | | |
| 09 64 00 -- Wood Flooring | X | X | | |
| 09 65 00 -- Resilient Flooring | X | X | | |
| 09 68 00 -- Carpeting | X | X | | |
| 09 90 00 -- Painting | X | X | | |
| 10 00 00 -- Specialties | | | | |
| 11 31 00 -- Residential Appliances | | | | |
| 12 30 00 -- Casework | | | | |
| 14 20 00 -- Elevators | X | X | | X |
| 21 00 00 -- Fire Suppression --Sprinklers | | | | X |
| 22 00 00 -- Plumbing | X | X | X | |
| 23 00 00 -- Heating, Ventilating & Air Conditioning | | X | X | X |
| 23 80 00 -- Air Source Heat Pumps | X | X | X | X |
| 26 00 00 -- Electrical | | X | X | X |
| 28 00 00 -- Electronic Safety & Security | | | | X |
| 31 00 00 -- Earthwork | | | | |
| 31 31 00 -- Soil Treatment | | | | |
| 32 12 00 -- Asphalt Paving | X | X | | |
| 32 30 00 -- Site Improvements | X | X | X | |
| 32 80 00 -- Site Irrigation | | | | |
| 32 90 00 -- Landscaping | X | | | |
| 33 00 00 -- Site Utilities | X | | | X |
| 33 36 00 -- Septic Systems | X | | | X |

**Bolded Sections Contain Filed Sub Trade Information**

**Bolded Sections Contain Filed Sub Trade Information**

# 01 74 19 • WASTE MANAGEMENT

### SECTION INCLUDES

Construction and Demolition Waste Management and Recycling

### RELATED GUIDELINE SECTIONS

02 41 00 Demolition

### ENVIRONMENTAL ISSUES

Reducing the amount of construction waste sent to landfills is an important environmental protection and sustainable development goal of the Commonwealth of Massachusetts. Construction materials that can be reused rather than disposed contain a lot of embodied energy and natural resources. A Waste Management Plan that is appropriate for the site and conditions should be included in the specification. The introduction of a Waste Management Plan into the specification can help avoid the negative environmental impact of waste materials which are filling up the diminishing amount of landfill space and creating pollutants through incineration.

As additional incentive, many of the recycling agencies are more cost effective than traditional construction waste facilities, making waste management strategies a financially prudent approach.

In addition, paperless projects with construction submittals in pdf format should be considered.

### SPECIFICATIONS FOR THE WASTE MANAGEMENT PLAN

❑ Specification prepared for the bid documents must be comprehensive and specific.

- Based on the survey of existing conditions, include the specific materials and quantities that the contractor will be required to salvage or recycle. Including packing materials.
- List Procedures for recycling: Salvage, on-site reuse, single source recycling, etc.
- List recycling facilities or a contact for assistance in identifying recycling facilities.
- List reporting requirements for waste materials removed from the project.
- List method for receiving authorization for alternative methods of disposal.
- Construction bins must be clearly marked to help avoid mixed waste contamination and in some cases the dumpster may need to be locked after hours of operation.

❑ The contractor and all the subcontractors are to be notified that the Waste Management Plan is mandatory.

## CONSTRUCTION WASTE MANAGEMENT REFERENCES

The following links may be helpful in determining potential recycling markets for building materials:

Massachusetts Department of Environmental Protection (Mass DEP) Managing Construction & Demolition (C & D) Wastes

http://www.mass.gov/eea/agencies/massdep/recycle/reduce/managing-construction-demolition-wastes.html

Whole Building Design Guide (WBDG) Construction Waste Management www.wbdg.org/resources/cwmgmt.php

Construction Waste Management Database www.wbdg.org/tools/cwm.php

Green Goat www.greengoat.org

The Reuse Network www.irnsurplus.com

## EXECUTION

Prepare the comprehensive Waste Management Plan for the project and provide for oversight of implementing the provisions of the approved Waste Management Plan.  Note the Waste Management Plan oversight is recorded like an “As Built” drawing.

Include a communication plan which outlines how recycling will take place, who the responsible contacts are for the general contractor as well as each subcontractor, what forms of submittals are acceptable, the schedule for submittal, what the expected recycled content will be and predicted quantities. The communication plan needs to be discussed at the initial construction meeting and to specify when and how the waste management plan will be tracked.

Submit records in CAP Hub of recycling salvage and dumping after demolition is complete or as an ongoing process depending on the project conditions. The submittal of records should be a shop drawing requirement in the submittal section of the specification. DHCD will be tracking and creating a data base of recycling on our projects as a part of the ongoing effort to create more sustainable and ecologically sound projects. Therefore, the mandatory submittal of records is essential to the project.

Provide text on all specifications reading: work shall comply with rules, laws and regulations of local, state and federal authorities of jurisdiction. See 310 CMR 19.000: Solid Waste Management Mass DEP and 310 CMR 19.017: Massachusetts Disposal Ban Regulation.

# DESIGN AND CONSTRUCTION GUIDELINES AND STANDARDS

DIVISION 2 • EXISTING CONDITIONS

## 02 41 00 • DEMOLITION

### SECTION INCLUDES

Existing Conditions
Building Demolition
Selective Demolition

### RELATED GUIDELINE SECTIONS

| | |
|---|---|
| 01 74 19 | Waste Management |
| 02 61 00 | Contaminated Site Material Removal |
| 02 65 00 | Underground Storage Tank Removal |
| 02 82 00 | Asbestos Remediation |
| 02 83 00 | Lead Paint Remediation |
| 21 00 00 | Fire Suppression-Sprinklers |
| 22 00 00 | Plumbing |
| 23 00 00 | Heat, Ventilation & Air Conditioning |
| 26 00 00 | Electrical |
| 31 00 00 | Earthwork |
| 33 00 00 | Site Utilities |

### RESEARCH AND INVESTIGATION

- ❑ Perform **complete physical and record surveys** and photo-documentation of existing building and site conditions. Date all photos and reports.

- ❑ If warranted, perform **selective** demolition prior to bidding in an effort to expose latent conditions that may result in costly change orders during construction. Latent conditions need to be identified as much as practicable and included within the bid documents.

- ❑ Prepare an **inventory of materials to be removed from the site** and the inventory should indicate material with value as scrap, for resale, or donation, as well as materials that cannot be dumped in landfills. For example, existing metal stairs with lead-based paint can be sold to a scrap metal facility, are not considered hazardous waste, and provide a positive cash flow by eliminating the cost of disposal. Investigate the options to recycle all demolished materials and include specific provisions within the contract documents in Section 01.74.19 Construction and Demolition Waste Management.

- ❑ Prepare an **inventory of materials to be removed and returned to the owner or reinstalled**, as well as items to be protected in Section 01 11 10 Summary of Work.

  In many cases the Housing Authority may have a use for the material to be removed. Building artifacts, such as plaques and ornate building components may be removed, refurbished, and reinstalled.

- ❑ Determine if the building is within a historic byway or historic district.

- ❑ Identify any procedures and permitting requirements of local, state and federal authorities of jurisdiction with oversight for building demolition.

# 02 41 00 • DEMOLITION

- ❑ Determine if the existing building is located in wetlands or in a flood zone.

- ❑ Be aware of local planning and zoning bylaws and other municipal requirements prior to demolition of any structure. Once a building has been removed from a site, local rules governing proposed occupancy, set back requirements, minimum lot size, and a host of other important concerns can all affect the owner's intended use of the property.

- ❑ Carefully investigate below grade conditions.

  Housing Authority properties are typically not well documented by Dig Safe. Check for as built drawings from the housing authority as well as records that the city or town may have.

  When doing work in basements of existing buildings to be rehabilitated, identify conditions with ledge, foundations of previous buildings, heavily reinforced slabs, etc. to determine the cost to incorporate the potential space for use within the building. Identify potential material that can interfere with the installation of waste piping, utility lines, and foundation construction.

- ❑ Locate nearby utility connections and show on drawings.

There may be a delay between the time of the site investigation and construction. Take continuing deterioration of existing buildings over time into account when preparing scopes of work. This is especially important when the scope of work involves reusing substantial portions of an existing building. A second survey of the building may be required just prior to bidding to verify if there has been further deterioration or new issues to consider.

**HAZARDOUS MATERIALS**

Testing, remediation and disposal of hazardous wastes often includes multiple public entities that may, or may not, be the actual Authority of Jurisdiction (AOJ). If the presence of hazardous material is unknown or suspected, care must be taken to fully research the appropriate AOJ, determine the specific requirements of the AOJ, and then plan accordingly.

- ❑ Lack of proper planning for the demolition project can result in the discovery of hazardous materials during demolition. Avoid this scenario at all costs since the entire project will likely halt while immediate health and safety concerns are addressed. Such ill-planned projects can result in personal injury, health claims, fines and penalties, construction delays, claims for unforeseen conditions, exorbitant change order costs, etc.

- ❑ Prior to building demolition, hazardous materials surveys conducted by trained and licensed individuals are recommended. Surveys can provide quantities of hazardous materials, remediation strategies, and cost estimates.

- ❑ It is not uncommon for an existing building structure to have been built over a previously demolished building, or for existing older buildings to contain sump pits or spaces with contaminated soils. Obtaining knowledge of these conditions and careful planning prior to demolition activities, is strongly advised in order to avoid problems and delays during demolition.

- Animals may also contaminate a site. Health concerns can emerge for example due to large amounts of pigeon droppings in attics, cooling towers, or occupied spaces. Proper planning should take into account any requirements of the AOJ regarding cleaning and decontamination.
- Polychlorinated biphenyls (PCBs) may also contaminate a site. PCBs are manufactured materials that were added into building materials during past years. PCBs are regulated by the U.S. Environmental Protection Agency and are no longer allowed to be manufactured or allowed to be present in building materials. The EPA does not require testing to determine the presence PCBs and testing to determine the presence of PCBs is not included in DHCD's standard scope and is not required.

### DRAWING AND SPECIFICATIONS FOR DEMOLITION

- Drawings and specifications prepared for the bid documents must be comprehensive and specific. Any furnishings must be addressed in the documents. Show the limits of demolition work on the site. Identify vegetation to be protected and/or removed.
- Drawings are required even for the complete demolition of an existing building.
- Include photographic documentation in the specifications to record the pre-construction conditions. Cover specific conditions related to the project where existing materials are to remain, proper disposal of waste, etc.
- General statements and sentences such as "as required" are not acceptable. All demolition materials should be qualified in the specifications.
- If shoring is anticipated the requirements must be explicit and included within the drawings and specifications.
- Based on the survey of existing conditions, include the specific materials that the contractor will be required to salvage or recycle.
- Determine if the Plumbing, HVAC, Fire Suppression-Sprinklers or Electrical filed sub-bidder should be responsible for specific demolition scope of work. If not specifically identified, demolition is provided by the general contractor, although the individual trades may be needed to cap off any utility connections to make the site safe for all workers. These specific functions need to be called out in the filed sub-bid sections.

### EXECUTION

Contract documents must include the results of the Designer's or Designer's consultants Waste Management Plan.

Damage to the existing building beyond the demolition specified in the contract documents shall be repaired by the contractor.

Prepare an accurate record of capped utilities, subsurface obstructions, etc.

## 02 61 00 • CONTAMINATED SITE MATERIAL REMOVAL

### SECTION INCLUDES

Contaminated Soil Removal

### RELATED GUIDELINE SECTIONS

| | |
|---|---|
| 02 65 00 | Underground Storage Tank Removal |
| 31 00 00 | Earthwork |
| 33 00 00 | Site Utilities |

### REFERENCES

**310 CMR 40.000 Massachusetts Contingency Plan**
http://www.mass.gov/eea/agencies/massdep/cleanup/regulations/massachusetts-contingency-plan.html

**MassDEP Policy #WSC-00-425 Construction of Buildings in Contaminated Areas**
https://www.mass.gov/doc/wsc-00-425-construction-of-buildings-in-contaminated-areas-0/download

**MassDEP Policy #WSC-16-435 Vapor Intrusion Guidance**
https://www.mass.gov/files/documents/2016/10/nu/vapor-intrusion-guidance-10-14-2016.pdf

**ASTM E1527-13: Phase I Environmental Property Assessment**

### INVESTIGATION

The discovery of Oil and Hazardous Material (OHM) contaminated soils can result in large change orders and be very disruptive to a construction contract.

Researching the historic uses of a property can help anticipate the likelihood of encountering contaminated soils. Properties with historic industrial, manufacturing, dry cleaning, and automotive property uses, or a history of Underground Storage Tanks (USTs) have a greater potential for soil contamination. Research regarding a property's environmental history is most efficiently conducted utilizing MassDEP's online data portal: https://eeaonline.eea.state.ma.us/portal#!/search/wastesite. Research on adjoining properties should be conducted as well, as contamination plumes may cross property lines. An ASTM Phase I Environmental Property Assessment may be commissioned when published information is limited. **Refer to figure 1 – THE CONTAMINATED SOIL DECISION MATRIX at the end of this section.**

If soil contamination is known or suspected, subsurface exploration including the advancement of soil test pits, borings, and groundwater monitoring wells, can be conducted to determine the horizontal and vertical extent. Subsurface exploration field work can be completed alongside geotechnical field work for increased efficiency. This work should be completed under the supervision of a Licensed Site Professional (LSP) or environmental consultant hired by the LHA or

LHA's design consultant. Data gathered during subsurface exploration can be useful for eventual soil disposal qualification, and for calculating anticipated volumes.

If contamination or evidence of a release is found, the LSP and/ or environmental consultant will determine the applicability of MassDEP Reporting Requirements and determine the next steps.

If soil contamination is identified during the installation of underground utilities, cleanup efforts may be eligible for management under a simplified Utility Release Abatement Measure (URAM) pursuant to 310 CMR 40.0460.

Should a project involve the construction of occupied buildings in areas of contaminated soil, the potential for vapor intrusion should be evaluated and mitigated pursuant to MassDEP Policy #WSC-16-435 Vapor Intrusion Guidance. It is advisable to incorporate an active or passive Sub-Slab Depressurization System into foundation designs for buildings in areas with soil contamination. Vapor intrusion considerations continue to apply even after contaminated soils have been excavated and removed from the property, as it is typically impossible to eliminate all traces of contamination.

### DESIGN

For projects where contaminates are found, plans and specifications should be prepared in accordance with all local regulations and pursuant to the most recent edition of 310 CMR 40.0000, the Massachusetts Contingency Plan and MassDEP Policy #WSC-00-425 Construction of Buildings in Contaminated Areas. The plans should require that an LSP be hired by the LHA or the LHA's design consultant and should include a narrative addressing any contamination found during the excavation. If contamination is found during construction, the narrative should be amended and incorporated into applicable reports generated throughout the MassDEP regulatory process.

If there is any question as to whether contamination is present in soil, sampling and analyses should be completed. Indicators of potential soil contamination include dark staining, an oily or greasy sheen, petroleum or solvent odors, and the presence of Urban Fill (*i.e.,* coal ash, wood ash, brick, glass, etc.). In addition, the discovery of previously unknown underground structures, including USTs, dry wells or other leaching structures, and unidentified piping should trigger an investigation into potential soil contamination. Any ensuing regulatory coordination with MassDEP should be directed by an LSP.

Contact Dig Safe and other non-Dig Safe member utilities and obtain a trench permit, if required, prior to commencing any excavation or subsurface investigation. Verify that all parties have obtained clearance and have recorded Dig Safe ticket numbers. The consultant should hire a utility locator service to locate any privately-owned utilities.

## EXECUTION

The Contractor must comply with all federal, state, and local regulations regarding contaminated soils removal. The soil characterization, excavation, transport, and disposal process should be completed under the direction of an LSP.

Prior to the start of work, a soil sampling and analyses plan should be developed and executed. Soil sampling and analysis data will determine the appropriate method of soil reuse, disposal, or recycling, and will determine if material is eligible for receipt at a given facility. Excavation dewatering may be required if groundwater is encountered. The Contractor shall be solely responsible for dewatering and the management of groundwater, including any contaminated groundwater, if encountered. The contractor must evaluate the need for and obtain any required permits, including but not limited to National Pollutant Discharge Elimination System (NPDES) permits and municipal sewer and/ or stormwater discharge permits.

The Contractor shall prepare a site-specific Health and Safety Plan (HASP). The HASP shall outline procedures for the on-site handling and storage of impacted soil, personal protective equipment (PPE) requirements, worksite safety protocols, and equipment and vehicle decontamination procedures. The Plan shall be submitted to the LSP within 7 days of Notice to Proceed. The Contractor shall be responsible for preparing all hazardous material manifests and/or bills of lading with all applicable sampling and analyses data, supporting documents, notifications, and control forms. The Contractor shall submit these to the LSP for review. The LSP will incorporate these results into applicable MassDEP regulatory process documentation.

The LHA will be the designated Waste Generator/Responsible Party and, in conjunction with the LSP, will sign all manifests and/or bills of lading.

## EXCAVATION OF CONTAMINATED MATERIAL

Work and decontamination procedures in areas containing contaminated material shall be performed in accordance with standard engineering practices. The Contractor shall employ methods necessary to isolate contaminated soils from noncontaminated soils. The excavation may include removing additional soils found to contain residual contamination as directed by the LSP.

The Contractor shall direct-load contaminated soil into roll-off containers or trucks for transportation and disposal off-site if feasible. Material that requires on-site storage prior to shipment off the property should be stockpiled atop a double layer of heavy-duty High-Density Polyethylene (HDPE) sheeting. The stockpile should be covered with HDPE sheeting at the end of each workday and sufficiently secured or weighed down in such a manner as to prevent wind or precipitation from disturbing or eroding the soil stockpile. The soil stockpile should be positioned so that it may be secured in the same manner as required for open excavations.

## SOIL RECYCLING, REUSE, OR DISPOSAL

The Contractor shall be responsible for obtaining approvals for final disposal of contaminated material. The Contractor shall assist the LHA in obtaining a Resource Conservation and Recovery Act (RCRA) generator ID number for hazardous waste, if required.

The Contractor shall be required to submit a copy of all analytical results to the LSP within 5 days of receipt of the laboratory report. Analytical data shall be kept confidential and distributed to the LSP and LHA only.
The LSP shall review data within 5 days. Sampling and analyses of contaminated soil shall be completed at sufficient and adequately distributed locations so that OHM concentrations are adequately characterized. The sampling and analyses regimen should consider individual receiving facility requirements that dictate sampling frequency (*i.e*. number of samples analyzed per volume of soil) and analytical method requirements. The LSP shall be present to observe sample collection activities.

The receiving facility shall be fully permitted in accordance with all applicable local, state and federal regulations and shall be a hot mix asphalt plant, thermal processing plant, cold mix emulsion plant, approved landfill, or MassDEP permitted Reclamation Project site. The facility shall be eligible to accept petroleum contaminated soil without direct MassDEP approval provided that levels of contaminants in the soil comply with the specific levels established in the facility's permit. An out-of-state recycling facility shall be approved or permitted by the state in which it is located to accept petroleum contaminated soil with contaminant concentration ranges specified in its permit.

The Contractor shall submit to the LSP initial approvals or letters of intent and facility information for the disposal or recycling facility selected.

The facility information shall include the following:

1. General Information
   a. Facility Name
   b. Facility Address
   c. Name of Contact Person
   d. Title of Contact Person
   e. Telephone Number of Contact Person.
   f. Permit Number.
2. Written confirmation that the facility is permitted to accept and will accept the classified soil of the general quality and quantity expected at the site.
3. A listing of all current and valid facility permits, licenses, letters of approval, and other authorizations to operate, pertaining to the receipt and management of the soils or materials specified in the Contract.

   The Contractor shall submit a complete list of the disposal facility's permitted allowable contaminant levels and physical characteristic requirements for contaminated material, and list any required regulatory approvals for individual waste streams.

## WASTE PROFILES AND MANIFESTS

The Contractor shall be responsible for preparing all waste profile applications and questionnaires and submitting them to the LSP for review, for coordinating with disposal facilities, and for coordinating with all Federal and State environmental agencies.

The Contractor shall be responsible for preparing all hazardous material manifests and/or bills of lading with all required supporting documentation, notification, and control forms. The Contractor shall submit these to the LSP for review at least 5 business days before transport. The LHA will sign bills of lading in conjunction with the LSP.

The Contractor shall be required to provide a written log using the appropriate prescribed forms, if applicable, for the transport of each load from the site. At a minimum, the forms should include load volume, tractor/trailer registrations and fleet numbers, time of departure, time of arrival at the receiving facility, and signature of vehicle operator.

The Contractor shall also provide certified tare and gross weight slips for each load received at the designated disposal facility. These shall be attached to each returned manifest and/or bill of lading.

The LHA will be designated as generator and will sign all manifests and waste profile application or questionnaires in conjunction with the LSP.

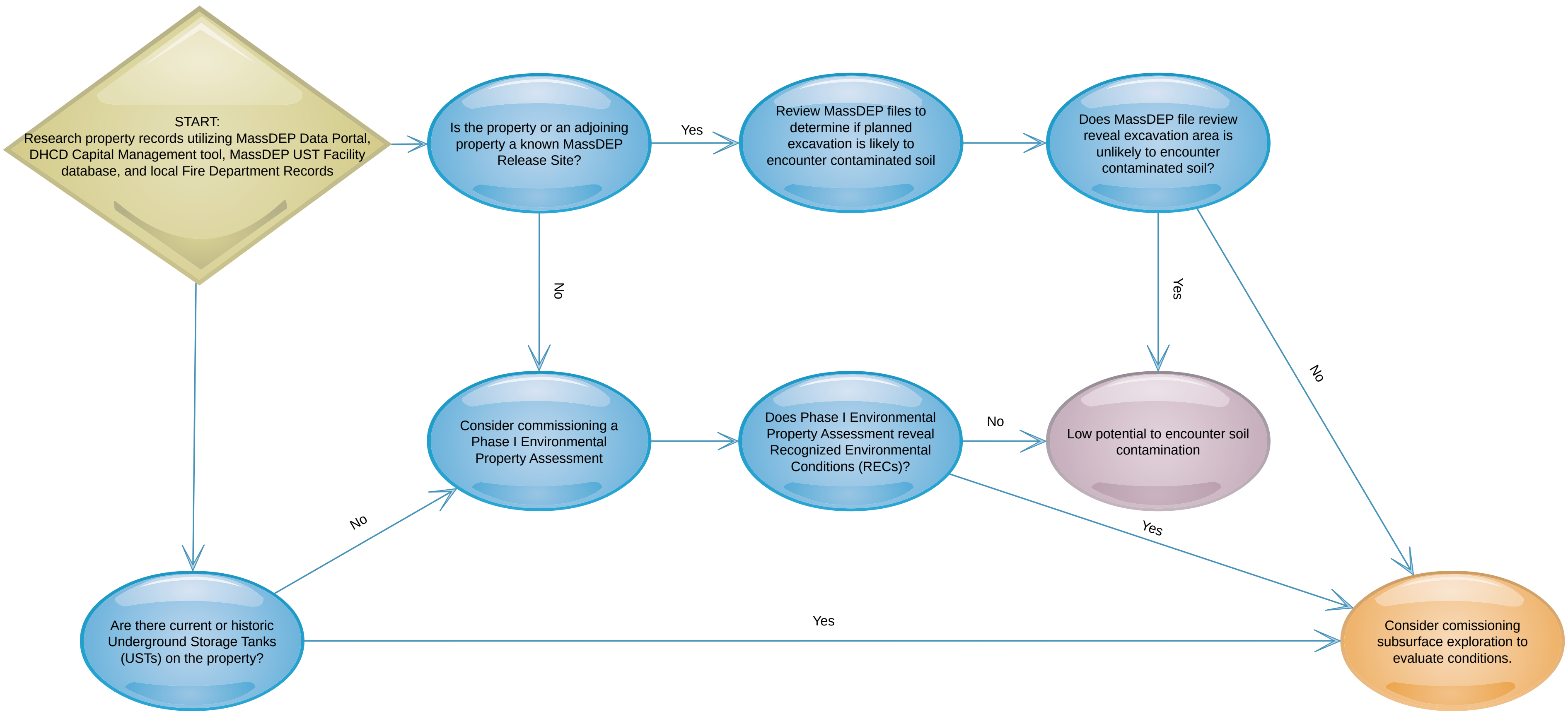
The Contractor shall furnish all generator copies of the hazardous material manifest to the Engineer for submittal to the appropriate State environmental agencies, if required, and for the LHA's records.

The Contractor shall submit to the LSP, no later than 10 business days and prior to receiving progress payment, all original documentation certifying that all materials were transported to, accepted, and disposed of, at the selected disposal facility.

The documentation shall include the following, at a minimum:

1. Documentation shall be provided for each load from the site to the disposal facility, including all manifests and any other transfer documentation as applicable.
2. All documentation for each load shall be tracked by the original manifest.
3. If material is transported under a Massachusetts Bureau of Waste Site Cleanup transmittal form (BWSC Form 113, parts A, B, and C), all original forms must be returned with original signatures, including the final signature of the receiving facility verifying receipt, no later than 10 business days from completion of transporting soil.

Figure 1 – Research Decision Matrix



# 02 65 00 • UNDERGROUND STORAGE TANK REMOVAL

## SECTION INCLUDES

Underground Storage Tank Removal

## RELATED GUIDELINE SECTIONS

02 61 00 Contaminated Site Material Removal
31 00 00 Earthwork

## REFERENCES

**310 CMR 40.000 Massachusetts Contingency Plan**
http://www.mass.gov/eea/agencies/massdep/cleanup/regulations/massachusetts-contingency-plan.html

**310 CMR 80.00 Underground Storage Tank (UST) Systems**
https://www.mass.gov/regulations/310-CMR-80-underground-storage-tank-ust-systems

**MassDEP Policy #WSC-402-96: Commonwealth Of Massachusetts Underground Storage Tank Closure Manual**
https://www.mass.gov/files/documents/2017/11/07/96-402%20UST%20Closure%20manual.pdf

## INVESTIGATION

The discovery of latent or abandoned Underground Storage Tanks (USTs) and associated contaminated soils can result in large change orders and be very disruptive to a construction contract.

Researching the historic uses of a property can help anticipate the likelihood of encountering USTs and/ or associated contaminated soils. Research regarding a property's environmental history is most efficiently conducted utilizing MassDEP's online data portal: https://eeaonline.eea.state.ma.us/portal#!/search/wastesite. Research regarding the potential presence or history of USTs on a property is best conducted using DHCD's Capital Planning System, at the local Fire Department's Office of Fire Prevention, records division; and utilizing the MassDEP online UST Facility Search tool: https://ma-ust.windsorcloud.com/ust/facility/search/list?0=

Should USTs be suspected at the property, a Ground Penetrating Radar (GPR) or magnetometer survey can be commissioned to investigate potential USTs. Test pits, soil borings, and groundwater monitoring wells can be advanced to assess potential contaminated soil and/ or groundwater associated with USTs. This work should be completed under the direction of an environmental consultant or certified Department of Environmental Protection Licensed Site Professional (LSP) hired by the LHA or the LHA's design consultant.

If contamination or evidence of a release is found, the LSP overseeing the project should determine the next appropriate steps.

Contact Dig Safe and other non-Dig Safe member utilities and obtain a trench permit, if required, prior to commencing any excavation or subsurface investigation. Verify that all parties have obtained clearance and have recorded Dig Safe ticket numbers. The consultant should hire a utility locator service to locate any privately-owned utilities.

## DESIGN

UST investigation and Closure plans and specifications should be prepared in accordance with all local regulations, and pursuant to the most recent editions of 310 CMR 40.0000, the Massachusetts Contingency Plan, and 310 CMR 80.00, Underground Storage Tank (UST) Systems. The plans should require that a licensed UST closure contractor and LSP be hired by the LHA or the LHA's design consultant, and should include a narrative addressing any contamination found during the investigation and the final disposition of the removed UST. If contamination is found during construction, the narrative should be amended and incorporated into applicable reports generated throughout the MassDEP regulatory process.

Costly delay claims may also occur when the extent of contaminated soil is not clearly reflected in the plans and specifications. It is understood that underground conditions, at times, may be difficult to document. Subsurface exploration, including the advancement of soil test pits, borings, and groundwater monitoring wells, can be conducted to determine the horizontal and vertical extent of contamination. Data gathered during subsurface exploration can be useful for coordinating soil disposal with a receiving facility.

If a UST is situated such that its removal could compromise the integrity of nearby structures, it may be eligible for Closure In-Place. A report from a licensed structural engineer will be required to determine whether UST excavation could impact other structures. This report should be submitted as part of the application package to the local Fire Department, who will have final authority to either permit or deny the Closure In-Place. Closures In-Place tend to be more costly than traditional closures, and approvals are rarely granted in some jurisdictions. Therefore, they should only be sought when absolutely necessary.

## EXECUTION

UST closure work must be conducted in accordance with 310 Code of Massachusetts Regulation 80.00. The UST closure contractor must obtain an approved FP-292 Permit from the local Fire Department and coordinate a physical inspection of the closure by the Fire Department's appointee.

A UST Closure Assessment, including confirmatory soil sampling and testing, should be completed pursuant to MassDEP Policy #WSC-402-

96: Commonwealth Of Massachusetts Underground Storage Tank Closure Manual following any UST closure, even if no evidence of a Release is identified. This includes USTs closed in-place. The UST closure contractor or LSP should provide the UST Closure Assessment Report to the LHA for their records. The report should include a project narrative, soil sampling, screening, and analytical results, and copies of any disposal documentation, permits, and tank scrap yard receipts.

Should evidence of a release of oil and hazardous materials associated with a UST be identified, the LSP and/ or environmental consultant will determine the applicability of MassDEP Reporting Requirements and determine the next steps, including but not limited to contaminated soil removal. The project will not be considered complete until all applicable close-out documentation has been received and approved by authorities having jurisdiction, including the local Fire Department and MassDEP. The local Fire Department should receive a copy of the UST Closure Assessment report. UST Closure notifications sent to MassDEP, when required, receive presumptive approval.

# DESIGN AND CONSTRUCTION GUIDELINES AND STANDARDS

DIVISION 2 • EXISTING CONDITIONS

## 02 82 00 • ASBESTOS REMEDIATION

### SECTION INCLUDES

Asbestos Remediation

### RELATED GUIDELINE SECTIONS

| | |
|---|---|
| 02 41 00 | Demolition |
| 02 61 00 | Contaminated Site Material Removal |
| 07 20 00 | Building Insulation & Moisture Protection |
| 07 30 00 | Asphalt Roof Shingles |
| 07 40 00 | Siding |
| 07 90 00 | Sealants |
| 08 50 00 | Windows |
| 09 65 00 | Resilient Flooring |
| 23 00 00 | Heating, Ventilating & Air Conditioning |

### REFERENCE

29 CFR Part 1910, US Department of Labor, OSHA Act of 1970
40 CFR Part 61 & Part 763, US Environmental Protection Agency
49 CFR Parts 172 and 173, US Department of Transportation Regulations
310 CMR 7.15 MassDEP Asbestos Regulation, July 2019
453 CMR 6.0 “The Removal, Containment or Encapsulation of Asbestos”
MassDEP Asbestos Information & Resource Guide

### TECHNICAL STANDARDS

#### PROJECT GOALS

All tested materials that contain one percent (1.0%) asbestos fibers or more, using Polarized Light Microscopy method, are considered friable and are hazardous. The disturbance or dislocation of such Asbestos Containing Materials (ACM) may cause asbestos fibers to be released into the environment, thereby creating a potential health hazard to workers and building occupants.

The general project goal is to identify cost effective means of dealing with ACM that comply with all applicable regulations and rules and minimize health and environmental risks during the asbestos abatement, removal or disturbance activities. DHCD strongly recommends that the LHAs consultants hire a licensed Asbestos Consultant to perform the asbestos testing during the design phase of the project.

All asbestos abatement work shall take place in accordance with the provisions outlined in the current local, state and federal regulations. Specifically, work must adhere to Massachusetts Department of Environmental Protection (MADEP) 310 CMR 7.15 and Department of Labor Standards (MADLS) 454 CMR 6.00 Regulations regarding asbestos removal and disposal.

### INVESTIGATION AND RESEARCH

MADEP Regulations as well as federal Environmental Protection Agency (EPA) regulations require a survey to be performed to identify ACM prior to any renovation and/or demolition work that disturbs asbestos. Confirmed ACM that will be disturbed will then need to be removed by a Massachusetts Licensed Asbestos Abatement Contractor as part of the project. Designers will need to identify the scope of abatement in the Contract Documents for construction. For example: on a heating job, the pipe insulation should be tested, as well as flooring or walls that may be penetrated by heating pipes. Similarly, on an electrical job, areas of conduit penetration should be tested.

Note: Materials installed prior to 1980 are classified as Presumed Asbestos Containing Materials (PACM). This presumption can be rebutted by testing using Polarized Light Microscopy method.

### DESIGN

Once the locations of the asbestos containing materials (ACM) have been determined, the design goal is the selection of the appropriate cost-effective abatement methods. In general, the options are removal, encapsulation, or management in place.

ACM can be placed into the following categories:

**Friable Material** is defined as any ACM that, when dry, can be crumbled, shattered, pulverized or reduced to powder by hand pressure or any non-friable ACM that has been subjected to sanding, grinding, cutting, or abrading or has been crumbled, shattered, or pulverized by mechanical means such as, but not limited to, the use of excavators, bulldozers, heavy equipment, or power and/or hand tools.

**Non-Friable Material** is defined as any ACM that, when dry cannot be crumbled, shattered, pulverized, or reduced to powder by hand pressure and that has not been crumbled, shattered, or pulverized by mechanical means such as, but not limited to, the use of excavators, bulldozers, heavy equipment, or power and/or hand tools.

Removal of these materials depends on the locations and/or conditions of the materials. In general, abatement or interior ACM's requires full containment and a three-stage decontamination unit under negative pressure. For exterior work, abatement is usually performed under a Regulated Area which restricts access to the work area to only authorized abatement personnel.

A final visual inspection and/or clearance air sampling at the end of the asbestos removal action is mandatory by a third party (Asbestos Consultant) and not by the Asbestos Abatement Contractor.

In some instances, the work can involve disturbance of minor amounts of material such as less than 3 square feet (SF) or 3 linear feet (LF) of ACM. In this situation, 16-hour abatement trained personnel can be used to perform the abatement in lieu of fully trained and licensed asbestos workers. However, this decision should be made by the Designer as to the applicability to the regulations and if it is the most cost-effective option. Typical Types of ACM encountered:

- Pipe insulation
- Contaminated soil
- Resilient floor tile
- Spray on fire proofing
- Roofing felts & Shingles
- Siding Shingles
- Caulking
- High temperature gaskets
- Glazing materials
- Joint compound
- Wall board
- Transite panels
- Mastics
- Fire doors
- Kitchen sink under-coating insulation
- Popcorn ceiling coatings
- Transite Masonry Sills

Typical Situations:

- Old basement piping that is covered with deteriorated asbestos pipe insulation needs to be removed, disposed of properly and replaced with new insulation per code.

- Insulation in an area not accessible to tenants that is essentially intact can be repaired and encapsulated depending on quantity and location.

- Although vinyl-asbestos floor tile (VAT) can be partially abated to accommodate new floor penetrations (e.g. for heating and electrical systems upgrade projects) DHCD's preferred method on flooring projects with concrete underlayment is to completely remove the VAT.

- If ACM insulation particles are visually detected in the crawl spaces with dirt floors, all visible debris should be carefully cleaned, properly packed and legally disposed of as defined in both MADEP and MADLS Regulations.

Alternative approaches exist for dealing with various ACM; the designer's task is to identify the method that best balances the budget, environmental risk, and longevity. The time required for residents to be out of their unit should be taken into consideration when determining the appropriate method of ACM removal. Every effort should be made to minimize the relocation time required.

Requirements for procedures during abatement are defined by the applicable regulations, however it is important to note that asbestos removal under full containment is not the *only* procedure allowed by regulations.

Contract documents must clearly identify the type and provide quantities of asbestos containing materials to be abated and method of abatement. They should also identify existing conditions that will affect the work of the abatement contractor such as location of electric panels and water lines which will be used for temporary services, proposed locations of HEPA exhaust systems and decontamination facilities, etc. Coordination shall exist between the abatement under this Section and the work of other trades.

It is important that the contract documents be written to allow the Contractor to decide how to complete the work using the most cost effective, compliant work practice. A phasing plan for the containment method and relocation coordination may need to be specified in the contract documents.

Asbestos containing waste shall be containerized, transported and disposed in compliance with all local and state regulations. An approved Waste Shipment Record (WSR) is required to be used for disposal of all asbestos waste leaving the site. A representative from the LHA is required to sign-off as “generator” for each WSR and a copy shall be given to the LHA. Final disposal documents acknowledging acceptance of the waste at the landfill is required to be received by the LHA within 35 days of the date the waste leaves the site.

### EXECUTION

Full time abatement monitoring is not required for asbestos abatement projects. Normal construction administration services, with the parallel services of the Asbestos Abatement Consultant, including conducting the initial submittal reviews (e.g. medical records, licenses, etc.), final visual inspections and air clearance tests (whichever is required by the class of abatement) are usually adequate project oversight. At the conclusion of the abatement process the Asbestos Consultant shall submit a detailed report to the LHA, which includes a summary of abatement operations, results of air sampling, and documentation relative to the proper disposal of asbestos waste. A PDF version shall be supplied to the LHA and uploaded into CAP Hub.

## 02 83 00 • LEAD PAINT REMEDIATION

### SECTION INCLUDES

Lead Paint Remediation
Lead Contaminated Waste Disposal

### RELATED GUIDELINE SECTIONS

01 74 19 Waste Management
02 41 00 Demolition
04 20 00 Unit Masonry
05 10 00 Structural Steel
05 55 00 Miscellaneous and Ornamental Iron
07 40 00 Siding
08 10 00 Doors and Frames
08 50 00 Windows
09 90 00 Painting
32 30 00 Site Improvements
32 90 00 Landscaping

### TECHNICAL STANDARDS PROJECT GOALS

DHCD in the mid 1990's initiated a lead-based paint abatement program to delead all the family housing units built before 1978. At this time, over 90% of the 15,000 family housing units have received letters of compliance in accordance with Massachusetts Department of Public Health (DPH) which are on file at the housing authority's' offices or on CLIPP.

Massachusetts DPH regulations apply to buildings built before 1978 that have children under the age of 6 living in the units. Additionally, federal Environmental Protection Agency (EPA) under 40 CFR 745 Renovation Repair and Painting (RRP) regulations also specify specific requirements to be adhered to when performing construction work in pre-1978 homes or child occupied facilities. Therefore, lead paint abatement and RRP compliance is only a concern when working on family housing units built before 1978 that contain lead-based paint. In some instances, seniors who care for their grandchildren may also have deleading concerns.

The RRP regulations also apply to elderly housing units if all of the following criteria are met:

* Visited regularly by the same child, under 6 years of age:
* Visits are on at least 2 different days within any week (Sunday through Saturday), provided that each day's visit last 3 hours; and
* Combined weekly visits last at least 6 hours, and the combined annual visits last at least 60 hours

If the majority of the project work is deleading to achieve compliance with Massachusetts DPH Regulations, then the project should be bid with General Bidders being DCAMM certified in Deleading. This eliminates the need for Deleading subcontractor and thus makes construction administration easier.

If the project is just construction work and the intent is to not perform deleading to achieve compliance with DPH standards, then all work must be done in accordance with the provisions outlined under EPA's RRP Regulations as well as Massachusetts Department of Labor Standards (DLS) 454 CMR 22.11 "Work Practices and Other Requirements for Renovation Work".

**PROJECT GOALS**:

Lead paint hazards are a concern to the designer for a variety of reasons, including:

Childhood Lead Poisoning Prevention Program (CLPPP)

- 105 CMR 460.000 Lead Poisoning Prevention and Control. Web Site [www.mass.gov/orgs/childhood-lead-poisoning-prevention-program](www.mass.gov/orgs/childhood-lead-poisoning-prevention-program)

Board of Health regulations

United States Occupational Health and Safety Administration (OSHA)

29 CFR 1926.62-Lead in Construction Regulations
Massachusetts Department of Labor Standards (DLS)

- 454 CMR 22.00 Deleading and Lead Safe Regulations

Environmental Protection Agency (EPA)

- 40 CFR 745 Renovation, Repair and Painting Regulations.

A typical project goal for DHCD projects is obtaining:

**Letters of Deleading Compliance** for all residential units within the project scope.

Units tested that have no lead violations may receive **Letters of Initial Lead Inspection Compliance**.

A **Letter of Deleading Compliance** can only be issued if all violations at the interior of the unit, common areas and building exterior are deleaded.

**A Letter of Re-occupancy** can be issued for the unit if only the interior and common areas were deleaded. Additionally, a **Letter of Interim Control** may also be issued if the unit meets all requirements outlined under 105 CMR 460.105 – Lead Hazards: Lead Management and Interim Control.

Changing regulations are a fact of life with regulated construction activities such as lead paint. Finding cost effective solutions that comply with the regulations and minimize health and environmental risks is a general project goal when lead paint is involved. Our preferred methodology is removal and disposal of lead painted components instead of encapsulation, whether interior, common area or exterior components.

After **Letters of Full Deleading Compliance** have been received, items that have been made intact or covered need to be maintained in good condition to maintain compliance. **Post Compliance Assessment Determinations** (PCADs} may be required to obtain a **Letter of Maintained Compliance** or a **Letter of Restored Compliance** after the initial letter of compliance has been issued for a unit. PCADs are performed by a certified and Massachusetts licensed Lead Paint Inspector.

If a PCAD is performed on the unit, any violations noted need to be corrected. If done within 30 days of the PCAD, that work can be done by maintenance personnel or an outside Contractor who has received appropriate training and license as required under EPA's Renovation, Repair and Painting (RRP) 40 CMR 745 Regulations. Additionally, all provisions of the RRP regulations as well as Massachusetts DLS 454 CMR 22.11 Regulations must be followed. If the work is completed after 30 days of the PCAD, a licensed Lead Abatement Contractor will be required.

### INVESTIGATION

Typically, the Designer retains the services of a licensed Lead Paint Inspector to test all units within the project scope for the presence of hazardous levels of lead paint. An initial test of 5 units where the work will be performed is usually recommended to get a sample of the lead paint abatement issues at the site. It is a good idea to have the same Lead Paint Inspector perform the initial testing of the units and perform the re-occupancy inspections after the construction is complete. Note that all units need to have a comprehensive lead paint inspection performed on the interior, common areas and building exterior in order to identify all lead based paint hazards. Additionally, a reinspection is required upon completion of the deleading work including collection and analysis of lead dust wipes in order to confirm the work is complete and the unit can be reoccupied. A Letter of Deleading Compliance can be issued if all violations identified on the initial inspection report for the interior, common areas and building exterior have been deleaded.

The Designer's job is to transform this raw information into a construction scope. The first step toward this goal is to establish an unambiguous understanding of the test reports and summary information in order to determine the location and quantity of components needing lead paint abatement. The use of uniform building component terminology is a crucial part of this process. For example, when a lead tester uses the term "door frame", there is a strong chance that the referenced component is actually the *casing*. Be clear. Communication with the initial tester is important to identify any uncertainty concerning the intent of the inspection reports.

## 02 83 00 • LEAD PAINT REMEDIATION

### DESIGN

Once the location of the lead hazards has been determined, the design goal is the selection of appropriate abatement methods.

In general, the options are *removal*, *covering* or *restoration*. For example;

- Old, beat-up basement windows that are covered with lead paint are better removed, discarded and replaced with a new window.
- Lead paint on building trim or siding can be covered by new materials but can create problems with components falling out of compliance if future construction work is done in these areas. Therefore, this method is not recommended.
- An ornate entranceway can be abated through the removal of the paint, and repainting, essentially restoring the component.

Alternative approaches exist for each component; the Designer's task is to identify the approach that best balances budget, environmental risk, longevity and appearance. Some items such as door removal, exterior shutter removal and interior cabinet door removal may be considered low risk as defined by the Department of Public Health's Regulations which can be found at: [www.mass.gov/orgs/childhood-lead-poisoning-prevention-program](www.mass.gov/orgs/childhood-lead-poisoning-prevention-program) . The Designer should review the lead paint consultant's summary reports and quantify the items to be abated with their scope of work and construction budget.

An important step in the design of abatement projects is working with the regulatory agencies that have a say in the process which include CLPPP, DLS and the local Board of Health.

**WAIVERS**

Waivers no longer apply to tenant re-entry at the end of the work day or for non-deleading contractors doing the installation of building components after the components have been removed.

### EXECUTION

Full time abatement monitoring is <u>not</u> required for lead paint abatement projects. Normal construction administration services, with the parallel services of the inspection company conducting the post abatement compliance inspections is usually adequate project oversight. The contractor and the lead consultant should coordinate the re-inspections to allow residents to reoccupy their units as quickly as possible.

**WASTE DISPOSAL**

Residential lead abatement waste is exempt from Massachusetts Department of Environmental Protection (MADEP) and federal Resource Conservation and Recovery Act (RCRA) hazardous waste regulations. The material can be disposed of in a regular municipal landfill.

The construction process often continues after the abatement work is done, with other trades becoming involved with the installation of the final architectural product. These sections of the specifications should be alerted to the project intent and the presence of lead based paint, with the appropriate precautions identified. The contract documents should clearly make the contractor responsible for compliant work practices. For example, if a painter is scheduled to coat a previously leaded surface, it should be noted that no “dust generating” procedures are allowed. Also, cladding and siding must be installed in a manner consistent with all current abatement regulations, even though the work is not being done by licensed abatement contractors.

# 03 30 00 • CONCRETE

## SECTION INCLUDES

Cast-In-Place Concrete
Vapor Barrier under Slabs
Architectural Precast Concrete
Concrete Repair

## RELATED GUIDELINE SECTIONS

| | |
|---|---|
| 05 10 00 | Structural Steel |
| 05 50 00 | Miscellaneous and Ornamental Iron |
| 06 10 00 | Rough Carpentry |
| 07 10 00 | Waterproofing and Dampproofing |
| 07 20 00 | Building Insulation & Moisture Protection |
| 07 90 00 | Sealants |
| 31 00 00 | Earthwork |
| 32 12 00 | Asphalt Paving |
| 32 30 00 | Site Improvements |
| 33 00 00 | Site Utilities |

## CAST-IN-PLACE CONCRETE

### MATERIALS

Provide structural concrete as per code and engineering requirements. The following classes of concrete are recommended:

| | |
|---|---|
| Foundations, basements walls, slabs not exposed to weather | 3,000 psi |
| Foundations, basements walls, slabs exposed to weather | 3,500 psi |
| Driveways, slabs, sidewalks, porches, patios, and steps exposed to weather | 4,000 psi |

Mixing Types:

- ❑ Type I, IA Residential work
- ❑ Type II, IIA Soils or ground water contains sulfates
- ❑ Type IIIA Cold weather use when freezing is a risk

Air entrainment for all exterior concrete exposed to weather such as flatwook, steps, walkways, and patios should be 5% to 7%. Air entrianed concrete resists harmful effects from rock salt and performs better in freeze thaw cylces. Admixtures shall be employed only when necessary for use in a particular concrete, and they shall be in accordance with manufacturer's instructions.

Admixture Types:

Admixtures shall comply with ASTM C 494 and are classified as follows:

| | |
|---|---|
| Type A | Water-reducing |
| Type B | Retarding |
| Type C | Accelerating |
| Type D | Water-reducing and retarding |
| Type E | Water-reducing and accelerating |
| Type F | High range water-reducing |
| Type G | High range water-reducing and retarding |

The use of chloride-containing admixtures is prohibited because it can cause detrimental effects on embedded metals and degradation of concrete structures.

Where removable formwork is used, specify a biodegradable form release agent.

Specify standard ready-mix concrete for which historical performance data is available.

The Designer and DHCD Construction Advisor will determine the extent of testing. If testing is necessary it shall be ordered by the designer per the requirements of the State Building Code, and paid for by the LHA.

**Sustainable Products:**

Concrete as a building material is very durable, provides some thermal benefits and pest deterrence. Concrete also has the highest embedded energy (and therefore greenhouse gas emissions) of building materials in its manufacture and the lowest value when it comes to recycling at the end of its life. However, most concrete is produced locally or regionally; using concrete with some recycled content helps reduce its CO2 emissions.

In addition to recycled content, other sustainability issues to consider in using concrete include:
Use reusable concrete formwork with vegetable based form release.
Use termite shields in lieu of chemical treatment.
Low VOC concrete hardening compounds may be considered.
Use plastic rebar supports in lieu of steel and consider glass fiber reinforced polymer rebar near the shore.

### DESIGN

Standards:

All cast-in-place concrete shall comply with the following standards:

- ❑ ACI 302, “Recommended Practice for Concrete Floor and Slab Construction”
- ❑ ACI 304, “Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete”
- ❑ ACI 305, “Recommended Practice for Hot Weather Concreting”
- ❑ ACI 306, “Recommended Practice for Cold Weather Concreting”
- ❑ ACI 308, "Standard Practice for Curing Concrete"
- ❑ ACI 309, “Consolidation of Concrete”
- ❑ ACI 315, “Recommended Practice for Detailing Reinforced Concrete Systems”
- ❑ ACI 614, “Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete”
- ❑ CRSI, “Reinforced Concrete - A Manual of Standard Practice”

Mix designs shall be submitted to the Designer for approval prior to placing concrete.

Concrete Finishes:

- Floated finish: shall be provided where concrete flatwork is to receive waterproofing membranes or setting beds for finished materials.
- Floated finish: shall be provided for top surfaces of walls, slabs and beams
- Smooth troweled finish: shall be provided where interior concrete flatwork is to be exposed work or is to receive resilient flooring materials.
- Broom Finish, transverse direction (with smooth edging): shall be provided at exterior concrete walks, pavements and steps.
- HC Ramps: broom finish, parallel to pitch to facilitate water run-off.

The minimum interior slab thickness is 4” per industry standard, with 6” for garages. Allowed tolerances for slab levelness are a 1/4 inch over 10 feet typical and an 1/8 inch over 10 feet for concrete slab to receive new wood flooring. Provide a concrete sealer to the exposed edges of slab-on-grade. Exterior Concrete Slab Thickness:

- 4” walkway slab
- 6” concrete slab for vehicular travel
- 8” utility slab for heavy equipment
- 8” dumpster pad

For exterior post footing, tubular column formwork should be used.

Coordinate the design and the documentation of the foundation drainage systems.

For New Slabs at Existing Basement Floors:

- New fully bonded slab over existing concrete: use overlay toppings 1”-2” thick (Self-Leveling Concrete ),
  or conventional concrete (low slump, high sand, small aggregate)

  Do not use gypsum-based products.

- New unbonded concrete floor slab over the existing floor slab: provide a polyethelene bondbreaker.

For Crawl Space Floors:

- Provide a “rat slab” (3” average depth over polyethelene vapor barrier)

### EXECUTION

The contractor is to turn over a copy of all concrete delivery slips to the project representative.

If concrete piles are required, the work must be done under the observation of the Owner's approved testing lab.

Power troweling is a recommended finishing technique where ever possible.

Consider requiring a washout disposal system to capture concrete materials from equipment washing operations

Designer shall provide control joint and expansion joint layout in the plans.

For larger cast-in-place paving project, have the contractor provide a sample panel for approval.

## INTERIOR VAPOR BARRIER & INSULATION

### MATERIALS

Install minimum10-mil or high performance vapor barriers for under slab applications. A selected vapor barrier shall meet or exceed ASTM E-1745, "Standard Specification for Water Vapor Retarder Used in Contact with Soil or Granular Fill under Concrete Slabs," with low permeance value (0.03 perms or less) and great resistance to punctures and tears.

Whenever possible, all slabs on grade shall be completely insulated horizontally underneath with a minimum of 2" rigid insulation; or extend the rigid insulation 2' down the foundation wall per IRC "Insulation and Fenestration Requirement by Component."

In below grade wet locations, an under slab waterproofing system -"floating slab" or drain protection system shall be designed in conjunction with positive side waterproofing on below grade foundation walls.  .

A fluid-applied or sheet-membrane system of water proofing or damp proofing shall be applied on all below grade exterior side of concrete foundation walls.

### EXECUTION

All seams of under slab vapor barrier shall be overlapped 6 to 8 inches and taped appropriately.

Rigid insulation should be tongue and groove with end joints butted tightly.

## ARCHITECTURAL PRECAST CONCRETE

### DESIGN

Precast concrete is a good choice for sills, copings, and other architectural elements that are part of new masonry wall construction.  In existing, older buildings which use stone for these elements, consider the use of cast-stone products where precast units cannot match the existing construction.

Precast elements should be thoroughly designed, sized, and scheduled to facilitate construction coordination and improve overall quality.

Precast stair assemblies are generally not recommended.

Provide positive slopes away from the building envelope on all horizontal surfaces exposed to weather.

Standards:

- ACI 318, Building Code Requirements for Reinforced Concrete
- CRSI Manual of Standard Practice

- PCI MNL 117, Manual of Quality Control for Plants and Production of Architectural Precast Concrete Products Manual
- Design Mix: 5000 psi, 28-day compressive strength, 4 to 6 percent air content.

#### EXECUTION

Require contractors to submit samples for approval, and include precast elements as part of masonry sample panels or mock-ups.

The concrete batch plant and the installer fabricator should be PCI certified.

### PATCHING CONCRETE, CONCRETE REPAIR

#### DESIGN

Prior to any repair work, conduct a comprehensive condition evaluation to identify the cause(s) and degree of deterioration or damage, and design a durable repair accordingly. Repair should not be undertaken until cause of cracking has been determined. Structural repair or new drainage systems may be required.

For cracks in walls and slabs:

Wall crack options:

- Conventional grouting systems:
  - Portland cement with or without acrylic admixtures for bond.
  - proprietary "dry-pack" mixtures.
  - hydraulic cements : will prevent water penetration.
  - fiber reinforced cements : "surface bonding" cements.
- Epoxy injections are an advanced technique to restore structural soundness. This is a preferred option.
- Urethane grout injections are good when there is substantial seepage through the wall. These are costly, state of the art products used in critical situations where there is sturctural movement and water penetration.

General concrete repair options:

- Spall repair by low-pressure spraying. Depending on the mortar mixture selected, low-pressure spray is used for surface repairs, structural repairs, or cosmetic renovation. Bond with the prepared substrate is achieved through a combination of proper surface preparation, low-velocity impact, and the material properties of the prepackacged mortar. Low-pressure spray is typically used for vertical and overhead repairs. See ACI RAP Bulletin 3 – Spall Repair by Low-Pressure Spraying.
- Surface repair using form and pour techniques. The primary purpose of this type of repair is to restore the structure integrity, and/or concretet cover requirement for the damaged element. A trial installation is highly recommended for each project, to verify the preparation, material, and placement technique using quality-control procedures outlined in the ACI RAP Bulletin 4 – Surface Rpair Using Form-and Pour Techniques.

- Repair spalling at concrete deck. Spalling at concrete decks can be repaired with a cementitious repair mortar. Stainless steel pins may be required for large area of repair. Provide coatings over the repaired surface. Be sure to remove previous coatings prior to re-coating. Do not use an impermeable coating at the underside of the deck which will trap moisture. Provide drip edges at the underside of the deck cut into the deck edge.

- Refer to additional ACI RAP Bulletions for more applications of concrete repair.

Stair repair options:

- Resurface the concrete stair to repair damage from flaking and scaling. Apply a thin cement overlay system which includes a preliminary application of patching compound to fill holes and followed by a thin coat as a resurfacer

- Repair or Replace Steps:
  - For serious stair repairs the designer should perform a cost analysis of repair verses replacement.
  - Preparation is a keycomponent of the repair process. Prep and clean damaged area before apply a bonding agent.
  - For cracks, use a concrete patching compound or expansive mortar.
  - Use hydraulic concrete if there are signs of water seepage.
  - For damaged nosings, use form boards to cast new concrete.
  - For stair corners and difficult areas, use latex based ready-mix or a sand-cement-epoxy-mix.

Standards:

- ICRI guidelines NO 03732 Selecting and Specifying Materials for the Repair of Concrete Surfaces.

- ICRI guidelines NO 03732 Selecting and Specifying concrete Surface preparation for Sealers Coatings and Overlays.

### EXECUTION

Require sample areas of repair for approval to establish quality standard.

Preconstruction meetings are essential to review repair techniques.

Third party inspectors or clerks of the works are advisable for final inspections.

# DESIGN AND CONSTRUCTION GUIDELINES AND STANDARDS

DIVISION 4 • MASONRY

## 04 20 00 • UNIT MASONRY

### SECTION INCLUDES

Brick Veneer
Brick Masonry
Concrete Masonry Units
Masonry Flashing

**Filed Sub Bid**

**M.G.L. c.149 §44F**

*Masonry is a stipulated filed sub-bid category under M.G.L. Chapter 149, §44F. If the cumulative estimated value of the work in this section exceeds $25,000 and the projects total cost is over $150,000, it triggers the filed sub-bid requirement.*

### RELATED GUIDELINE SECTIONS

05 10 00 Structural Steel
06 6100 Rough Carpentry
07 10 00 Waterproofing & Dampproofing
07 20 00 Building Insulation & Moisture Protection
07 90 00 Sealants
08 10 00 Doors and Frames
08 50 00 Windows

## BRICK VENEER, BRICK MASONRY, AND CMU CAVITY WALLS

### MATERIALS

Face brick: ASTM C216; Grade SW
Concrete Masonry Unit ASTM C-90

### DESIGN

Refer to the Brick Industry Association (BIA) Technical Notes for design recommendations.
http://www.gobrick.com/read-research/technical-notes

### CLIMATE RESILIENCE DESIGN CONSIDERATIONS

Many of the existing brick and masonry buildings in the public housing portfolio have limited cavity space for supplemental insulation. Repairing or improving the thermal performance of masonry at all properties should always be done with attention to managing moisture and permeability as well as thermal performance.

Properties exposed to flooding and increased wind-driven rain associated with climate change should particularly review the guidance throughout this section related to moisture protection. The consultant should consider the most durable and cost-effective method for addressing water infiltration and thermal performance in a masonry veneer building envelope, as well as the structural soundness of properties subject to the hydrostatic pressure of floodwater

COST-EFFECTIVE OPTIONS

Panel bricks (8x8 or 12x12 inches) are generally not acceptable because they are difficult to install and tend to leak.

CMU veneers may be considered as cost-effective alternatives to brick veneer. Avoid design composite masonry assemblies with veneers bonded to the CMU backing. Specify smooth-face CMU instead of CMU with textured or split face for greater water resistance in exterior applications.

MORTAR

Avoid using mortar that is too stiff or stronger than needed. This is particularly true for older buildings where softer brick is often being re-pointed. Type O mortar is often used for repointing older brick. Type N may be suitable for repointing newer brick work. For new construction, the following selections are typically recommended:

ASTM C270, Type N for low-rise Masonry Veneer, Type S for load bearing walls and partitions, and Type S or M for below grade masonry work. Site mixed, proprietary masonry cements are not acceptable. Component materials must meet the following standards:

- ❑ Portland cement: ASTM C-150
- ❑ Hydrated Lime: ASTM C-207, Type S
- ❑ Sand: ASTM C-144
- ❑ Grout: ASTM C-476

Refer to the BIA Technical Note 8 and 8B for detailed recommendations,

http://www.gobrick.com/docs/default-source/read-research-documents/technicalnotes/8-mortars-for-brickwork.pdf?sfvrsn=0

http://www.gobrick.com/docs/default-source/read-research-documents/technicalnotes/8b-mortars-for-brickwork---selection-and-quality-assurance.pdf?sfvrsn=0

**MORTARS & ADMIXES**

Typically no mortar additives other than color or water repellents are acceptable. Re-pointing mortar should be pre-hydrated and of low cement content. Testing of existing mortar may be required to determine the strength and ingredient for color.

FLASHING

Through-wall flashing should be copper or copper fabric; PVC through-wall flashing is not acceptable. Zinc-coated copper is recommended for buildings in close proximity to the ocean.

Step flashing for chimneys, cap flashing, and similar locations shall be copper or zinc coated copper.

DRAINAGE & WEEPHOLES

Use polymer mesh products, such as Mortar Net, in cavities of masonry replacement to prevent mortar droppings from blocking weep holes. In new construction, it is recommended to use polymer mesh for the full height of the cavity.

Preferred weeps are open head joints with maximum spacing of 24” on center. Avoid using tube weeps, if used, a maximum of 16” on center is recommended.

Do not use cotton weeps which may disintegrate prematurely and clog. Polymer mesh weeps are typically more effective in providing a larger area of weeping with better drainage.

### ANCHORS & TIES

Coordinate specification of structural anchors, waterproofing, and insulation requirements.

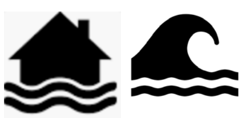
Wire ties and screws must be hot dip galvanized steel or stainless steel.

Corrugated brick strap ties are not acceptable; use two-piece anchors that permit directional movement and resist corrosion.

Provide relieving angles per structural engineer's recommendations. Joints below relieving angles must be detailed with soft joint to allow movement; angles must be hot-dip galvanized. Install plastic bearing strips under the lintel at each jamb to allow the lintel to slip and the control joints to function properly.

Acceptable sheathing materials for cavity wall with veneer masonry include exterior grade gypsum sheathing, cement board, oriented strand board and exterior grade plywood per structure engineer's design. Follow the requirement of the technical note of the BIA. Products that contain formaldehyde should not be used.

### MOISTURE RESISTANCE



Brick veneer construction incorporates an air space in the wall assembly. It allows wind-driven rain that penetrates the veneer wythe to drain down the back side of the brick. The BIA recommends 2" minimum clear air space. The outside face of the sheathing or the outside face of the insulation (depending on the thermal design) provides another location of the air, moisture and water barrier. The complete design of the masonry wall assembly should incorporate considerations of moisture resistance and thermal performance. Refer to the BIA Technical Notes 7 Series and 7 Series under this guideline for more recommendations.

Depending on the scope and the size of the project, the Architect should consider specifying a mock-up. A mock-up should include all components of the exterior wall showing pertinent details such as masonry ties, flashing, mortar net, typical window opening, insulation, and back-up wall assembly. The mockup should provide a useful reference for acceptable details and workmanship. It is also used to test cleaning agents for final cleaning of cavity clearance and weep testing depending on the projects. The mock-up should not be installed as part of the finished building.

### EXPANSION JOINTS

Provide expansion joints to accommodate thermal expansion vertically and horizontally in the masonry wall. Locate expansion joints and select appropriate sealant material and backer rod per the BIA's recommendations. Care should also be taken to locate joints with consideration of the building context and design.

Generally, painting over masonry is not recommended. If circumstance requires painting over the masonry, do not paint veneer masonry with oil-based paint or any paint that would not allow the masonry wall to breath. Painting over masonry could introduce a high-maintenance component to what is otherwise a low-maintenance material. If circumstances demand the use of coating, a penetrating, “breathable” system containing silane or siloxanes are recommended. Consult an architect, if in doubt, about the most durable cost-effective method for addressing water infiltration in a masonry veneer building envelope.

### EXECUTION

Workmanship must follow recommendations of the BIA, including cold weather requirements and on-site mortar batching.

Protect walls and openings during and after completion of masonry work. Do not leave the top of uncompleted cavity walls open to weather during inclement weather.

Unit masonry when installed and exposed to temperatures below 40 degrees during the initial 24 hours of mortar set shall be removed and replaced. Brick installed in temperatures below 40 degrees during the first three days of mortar set shall be tested for minimum mortar compressive strength once the mortar is fully cured.

Masonry materials shall be stored off the ground to avoid contamination with soluble salts commonly found in high concentrations in rain-water. Brick and CMU which is stored on the ground should not be used for exterior veneer.

Extend sill flashing beyond window and door jambs and turn up to form a pan. At lintels and relieving angles, extend flashing 1/2” beyond angle leg to form a proper drip edge.

The bottom of the cavity must be kept clean of mortar droppings. Be sure there is a process in place to oversee work to keep the cavity clean. Cleaning can be done using a rope, board or other processes but be sure devices used not left behind in the cavity. When in doubt schedule investigative testing to verify.

Mortar joints should be concave or recessed straight edge, metal tooled, and a maximum of 3/8 inch height. Flush joints and rough finished joints that tend to absorb excessive water are not acceptable.

### MASONRY CLEANING

Brick or stone masonry shall be cleaned with water and brushes with nonmetal bristles. Diluted detergents may be used. Repeated gentle washings with gentle cleaners are preferred to fewer washings with more abrasive or chemical laden cleaners. Do not use hydrochloric acid (muriatic acid) except in limited applications where other alternatives have been tried and are not successful.

Avoid masonry or grout cleaners which contain phosphates, except where other alternatives are not successful.

Provide adequate site protection to avoid contamination of sites and groundwater.

When power-washing brick and CMU veneers use only low pressure (less than 1000 psi).

### MASONRY RESTORATION

Repointing: In existing masonry buildings of historic or civil significance, hand-cut mortar joints during removal to avoid damage to brick. Typically remove-loose mortar to solid, no more than ¾". Care must be taken to specify compatible replacement mortar. Match new mortar to existing for re-pointing and repair, and be cautious about the lime content of the existing mortar. Perform testing of the existing brick and mortar to determine the ingredients and strength.

A helpful link to reference: Repointing Mortar Joints in Historic Masonry Buildings under Technical Preservation Services of U.S. Department of the Interior

https://www.nps.gov/tps/how-to-preserve/briefs/2-repoint-mortar-joints.htm

## CLIMATE RESILIENCE RESOURCES

Project teams can learn more about strategies to manage masonry where there are thermal and/or moisture concerns from these resources among others:

- EPA's guide "Moisture Control Guidance for Building Design, Construction and Maintenance" details considerations for installing and preparing masonry surfaces for coating applications, which may be important where moisture is a concern: https://www.epa.gov/sites/production/files/2014-08/documents/moisture-control.pdf

- FEMA's "Engineering Principals and Practices for Retrofitting Flood-Prone Residential Structures" contains guidance and graphics related to dry floodproofing masonry walls in section 5D. It is available here: https://www.fema.gov/media-library-data/20130726-1506-20490-2593/fema259_complete_rev.pdf

# 05 10 00 • STRUCTURAL STEEL

## SECTION INCLUDES

Structural Steel
Cold Formed Metal Framing
Metal Decking

## RELATED GUIDELINE SECTIONS

03 30 00 Concrete
04 20 00 Unit Masonry
05 50 00 Miscellaneous and Ornamental Iron (Metal Fabrications)
09 20 00 Gypsum
09 90 00 Painting

Structural Steel and Cold Formed Framing are NOT filed sub-bid categories

## REFERENCES

Structural steel work is defined in the American Institute of Steel Construction (AISC) "Code of Standard Practice."

Structural steel shall comply with the following, but not limited to:

- ❒ ANSI/AISC 303-16 "Code of Standard Practice for Steel Buildings and Bridges"
- ❒ ANSI/AISC "Specification for Structural Steel Buildings" including "Commentary"
- ❒ AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts" approved by the Research Council on Structural Connections
- ❒ American Welding Society (AWS) D1.1 "Structural Welding Code - Steel"
- ❒ ASTM A6/A6M, "Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling"
- ❒ ASTM A36/A36M-19, "Standard Specification for Carbon Structural Steel"
- ❒ ASTM A500/A500M-18, "Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes"
- ❒ ASTM A501/A501M-14, "Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing"
- ❒ ASTM A307, "Standard Specification For Carbon Steel Anchor Bolts And Studs, 60,000 PSI Tensile Strength"
- ❒ ASTM A153/A153M-16a, " Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware"
- ❒ ASTM C150/C150M-19a, "Standard Specification For Portland Cement"
- ❒ ASTM A123/A123M-17, "Standard Specification for Zinc (Hot-Dip Galvanized) Coatings"
- ❒ ASTM A525, "Standard Specification For General Requirements For Steel Sheet, Zinc-Coated (Galvanized) By the Hot-Dip Progress"

# 05 10 00 • STRUCTURAL STEEL

## MATERIALS

Exterior steel should be hot-dip galvanized to conform to ASTM A123. Galvanizing should be done after shop fabrication.

Factory applied color finish is preferred to painted finish over hot-dip galvanized steel.

All metal decking must be hot-dip galvanized per ASTM A653. Use G60 as standard coating designation, G90 for areas with more moisture.

Interior steel in low moisture areas should be shop primed per standards by the Steel Structures Painting Council.

For cold-formed metal framing: use galvanized-steel sheet per ASTM A653, Coating Designation G 90, Grade C, 40,000 psi minimum yield strength, 16 % elongation.

## DESIGN

Structural Design must be carried out by Massachusetts licensed Structural Engineer, and comply with all applicable Code.

Structural design is required prior to specification of materials, with particular attention given to deflection design criteria.

Structural support for veneer masonry must be adequately designed to avoid differential settlement and cracking.

Provide loading information for any specially fabricated components, such as structural trusses.

Structural Engineer shall specify fireproofing and primer per Building Code construction type requirement. Contractor shall coordinate.

Coordinate the type of fireproofing to be used with structural steel primers. Some fireproofing materials cannot be easily or economically applied to painted surfaces and some Underwriter's Laboratories, Inc. (UL) fireproofing designs do not permit primed steel.

For cold-formed metal framing: the fabricator must assume full responsibility including engineering provided by a Massachusetts registered engineer to prepare design calculations, shop drawings, and other structural data.

Early coordination with plumbing and HVAC work is essential to identify conflicts and possible alterations and penetrations requiring structural design solutions.

Contract Documents must clearly separate the Structural Steel scope from Metal Fabrications (05 50 00) which may be a filed sub-trade.

### Sustainable Products

Making steel products is an energy intensive process, so structural steel is a building material with one of the highest levels of embedded energy. Recycled steel takes nearly 75 percent less energy to produce than

# 05 10 00 • STRUCTURAL STEEL

virgin steel. Use recycled steel whenever possible. For energy conservation, detail structural connections to minimize thermal bridging.

## EXECUTION

Thorough review of shop drawings by the architect and the structural engineer is essential for proper execution of design intent.

Contractor should check with the local fire department for welding requirements.

Tolerances: Individual structural steel members shall be plumb, level, and aligned in accordance with the requirements of the AISC “Code of Standard Practice for Steel buildings and Bridges.”

For cold-formed metal framing, allow variations from plumb, level and true to within 1/8” inch in 10 feet, and likewise variation for framing members’ plan location to be within 1/8” out of square

# DESIGN AND CONSTRUCTION GUIDELINES AND STANDARDS

DIVISION 5 • METALS

## 05 50 00 • MISCELLANEOUS & ORNAMENTAL IRON

### SECTION INCLUDES

Handrails & Railings
Miscellaneous & Ornamental Iron
Metal Stairs

### RELATED GUIDELINE SECTIONS

| | |
|---|---|
| 03 30 00 | Concrete |
| 04 20 00 | Unit Masonry |
| 05 10 00 | Structural Steel |
| 09 90 00 | Painting |
| 32 30 00 | Site Improvements |

**Filed Sub Bid**

**M.G.L. c.149 §44F**

*Miscellaneous and ornamental iron is a stipulated filed sub-bid category under MGL Chapter 149, s. 44F. If the cumulative estimated value of the work in this section exceeds $25,000 and the project total cost is $150,000 or greater, it triggers the filed sub-bid requirement.*

*Miscellaneous and ornamental iron is not a stipulated filed sub-bid category under site work MGL Chapter 30, s.39M.*

*Structural steel and cold formed metal framing and aluminum railings are NOT considered filed sub-bid categories.*

### STEEL STAIRS AND RAILINGS

#### MATERIALS

Refer to ASTM A-123 specifications for hot-dip galvanizing on both fabricated and none-fabricated steel products. Specify hot-dip galvanizing after fabrication of exterior steel work whenever possible.

Refer to ASTM A153 specifications for zinc coatings (Hot Dip) on iron and steel hardware.

Require certificates of compliance with ASTM requirements for zinc coating from the galvanizer.

Shop paint metal work, except members or portions of members to be embedded in concrete or masonry to be field welded.

Any items to be field painted shall be shop primed by galvanizer.

Where a complete factory applied coating system is desired, provide hot dip galvanizing and high performance ultra durable coating. Supply galvanizer’s twenty (20) year warranty against rust and 10 year warranty on finish coat gloss level, adhesion, and color retention.

### DESIGN

Use standard professional practice, follow applicable ASTM specifications and AISC Structural Steel Detailing, Steel Construction Manual, and comply with code requirements.

When existing stairs are being replaced and they are covered with lead-based paint specify that the stairs shall be sent to a recycling facility per applicable code regulations.

Bases of exterior pipe railings and columns should have a weep just above finish grade or slab, or tops must have welded covers. Water collection can freeze and crack steel pipe columns. Even with weep holes, water can collect below the weep and rot out the bottom of the railing.

### EXECUTION

Request contractors to submit detailed shop drawings for review and approval. Engineering design may be required for shop drawings.

## ALUMINUM RAILINGS

Aluminum railings are not required as part of a filed subbid. They should be listed in a separate specification section to avoid being overlooked as part of a contract.

Aluminum railings create possible anchoring and expansion and contraction challenges, especially when there are long lengths of railing, both vertically and horizontally.

## OTHER SHOP-FABRICATED METALS

### MATERIALS

Loose lintels, bollards and other items that may be furnished by the subcontractor and installed by others should be included in this filed sub -bid. Lintels which are welded or mechanically fastened should be furnished and installed by the sub-contractor, or clearly identified for installation responsibility.

Ship-ladders, metal brackets, aluminum ramps and railings etc. should be included in this section.

Many off-the-shelf or shop-fabricated items, such as louvers, joists hangers, manhole covers, etc., are not required filed sub-bid items and should be in other specification sections--the same is true for structural steel--all of which should be specified in other sections to avoid an unnecessary filed sub-bid.

Coordination of contract documents is imperative to avoid having items not covered by the contract or covered in two sections.

# 05 50 00 • MISCELLANEOUS & ORNAMENTAL IRON

## DESIGN

Design exterior items with concealed connections and avoid field welding whenever possible. Review shop drawings carefully to prevent unsightly field welding.

## EXECUTION

When galvanized items must be field welded, cut or are otherwise damaged, specify required touch up with zinc rich paint in conformance with ASTM A780

Loose lintels are typically supplied by the miscellaneous iron subcontractor and installed by the masonry subcontractor.

# 06 10 00 • ROUGH CARPENTRY

### SECTION INCLUDES

Dimensional Wood Framing
Sheathing
Prefabricated Trusses
Wood Blocking
Engineered Wood Framing
Termite Shield

### RELATED GUIDELINE SECTIONS

| | |
|---|---|
| 03 30 00 | Concrete |
| 06 20 00 | Finish Carpentry |
| 06 70 00 | Structural Plastics & Composites |
| 06 65 00 | Plastic and Composite Trim |
| 07 62 00 | Sheet Metal Trim & Flashing |

### ABBREVIATIONS-TESTING, CERTIFYING AND GRADING AGENCIES

**AITC-** American Institute of Timber Construction www.aitc-glulam.org
**ALSC-** American Lumber Standards Committee www.alsc.org
**ANSI-** American National Standards Institute www.ansi.org
**APA-** The Engineered Wood Association, (formerly American Plywood Association) www.apawood.org
**AWPA-** American Wood Protection Association www.awpa.com
**CSA-** Canadian Standards Association www.csa.ca
**FSC**- Forest Stewardship Council www.fscus.org
**NIST-** National Institute for Standards and Technology www.nist.gov
**SFI-** Sustainable Forest Initiative www.sfiprogram.org
**TPI-** Truss Plate Institute www.tpint.org

## LOAD CALCULATIONS

### DESIGN

Calculate loads and specify the fiber stress for lumber.

Avoid over-designing that will result in unnecessarily high material costs. Spruce, Pine or Fir should be adequate for most conditions, and Southern Yellow Pine for pressure treated use only. And<u>provide a rationale for any other species.</u>

## ENVIRONMENTAL ISSUES

### PRODUCTS

Use of wood from well-managed forests is preferred. Specify one or more of the following standards: Forest Stewardship Council (FSC); Sustainable Forest Initiative (SFI); or Canadian Standards Association (CSA). Using certified wood encourages a well-managed forest industry.

Look for engineered wood products with certified wood content, recycled or recovered wood, and/or products that are produced within 500 miles of the project site. The use of engineered wood should be evaluated on a case-by-case basis as it has many different impacts on a project and on resource usage.

Use products with low VOC content and no added urea formaldehyde whenever possible. Avoid excessive use of chemicals such as wood preservatives and be attentive to handling requirements for all chemicals.

### ENERGY PERFORMANCE

For new construction as well as for renovations, building framing can have a large impact on a building's energy performance. The Energy Star program includes specific requirements in their "Thermal Enclosure System Rater Checklist".
The checklist promote reduced thermal bridging, fully-aligned air barriers, and air sealing. These design principles should be integrated into work wherever possible regardless of whether project is aiming for Energy Star rating.

Incorporate reduced thermal bridging strategies which impact rough framing design, including continuous rigid insulation, structural insulated panels (SIPs), insulated concrete forms (ICFs), double wall framing, and "Advanced Framing."
Designers should refer to the Energy Star website for more information.

### CLIMATE RESILIENCE DESIGN CONSIDERATIONS

Flood damage-resistant materials should be used for walls, floors, framing and other parts of the building that are subject to flooding by fresh or sea water. Wood building materials are considered flood damage resistant if they can withstand direct contact with water for at least 72 hours without being significantly damaged.

Pressure-treated and/or decay-resistant lumber, pressure-treated and marine grade plywood should meet these requirements for flood damage resistance, and should not absorb contaminants or promote mold and mildew.

Hardware fastened to these water resistant building materials should be stainless or galvanized steel.

For flood prone properties, if wood is not required to match the existing materials that will adjoin the repaired structure, or as part of the architectural expression of the building, the wood-composite structural plastic products described in 06 50 00 Structural Plastics and Composites may be more appropriate than flood damage resistant lumber. These products are more resistant to moisture absorption and rot than treated lumber.

Flood damage resistant materials should be continuous from the lowest point in the building up to the Design Flood Elevation (DFE).

The design of the entire assembly should take into consideration flood hazards and mitigate mold and mildew growth.

### ACOUSTIC (SOUND) SEPARATIONS

The designer must provide wall and floor/ceiling assemblies that provide appropriate sound attenuation insulation between units. Provide a minimum of STC 50 rated assemblies between units.

## DIMENSIONAL FRAMING

### MATERIALS

The following standards apply to the grading, characteristics and design of framing lumber:

- ❑ Lumber materials must comply with the most current American Softwood Lumber Standard PS 20, published by NIST; grade and trademarks are required on each piece of lumber stock (or bundle in bundled stock).
- ❑ Moisture content must not exceed 19% for standard lumber; 15% for treated plywood, and 12% for standard plywood.
- ❑ Species need not be specified unless there is a particular structural requirement.

<u>Finger-jointed wood lumber</u> is acceptable for most interior framing except for floor framing and bathroom wall framing. Specify labelled products, certified by an independent ALSC certified lab. By grade:

- ❑ Vertical Use Only- No. 1 or No. 2 grade for interior stud use only, where no tension loads exist.
- ❑ Interior Horizontal Structural Members No. 1 grade for <u>interior</u> load bearing headers, lintels & beams.

The Contractor should submit lumber schedule to the Architect for approval.

## TREATED LUMBER

### BACKGROUND

The treated wood industry has been undergoing rapid change. Designers are advised to check the latest research reports through [www.buildinggreen.com](http://www.buildinggreen.com) and other industry sources.

Chemical treatment of wood has long raised environmental concerns. By extending the life of wood exposed to weather or moisture, it conserves our wood resources. It does this at the risk of introducing toxic chemicals into the environment, including through direct user contact and through leaching into ground water supplies or into the air when incinerated.

Disposal of CCA (chromated copper arsenate) should be addressed in the Waste Management Plan as a hazardous material. MassDEP requires disposal of PT wood in an approved solid waste facility.

For existing CCA treated wood products remaining in service, the EPA suggests applying penetrating coatings such as oil-based, semi-transparent stains once a year to reduce migration of wood preservative chemicals. Projects involving work associated with existing treated decks or other treated construction should include a requirement to apply preservative coatings in this manner.

Alternatives to using treated lumber include naturally decay and insect resistant wood, and plastic or composite products such as composite decking.

Naturally decay resistant material or treated wood are typically used in the following locations:

- ❑ Interior and exterior sills on foundations and slabs
- ❑ Exterior exposed framing and covered decking
- ❑ Wood in contact with concrete and other masonry
- ❑ Ledger boards in exterior masonry walls

### MATERIALS

All treated wood products must carry labels identifying preservative treatment type and intended use. See preservative chart below. ACQ and CAB types are recommended by DHCD for most applications.

Noncopper-based Preservatives

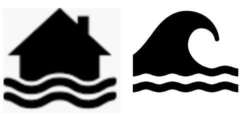
Sodium silicate has emerged as a promising noncopper-based wood preservative. But due to its relative short time on the market, DHCD does not recommend using it until the results of further reasearch have become available.

Copper Based Preservatives

The following chemical preservatives are listed with the American Wood Protection Association (click Here), shown here with retention levels required for various uses.  Information was excerpted from the AWPA website (partial listing):

| | | Retention Factor lb / ft$^3$ | | | |
|---|---|---|---|---|---|
| **Code** | **Preservative Name** | **UC2** | **UC3B** | **UC4A** | **UC4B** |
| ACC | Acid Copper Chromate | 0.25 | 0.25 | 0.50 | --- |
| ACQ | Alkaline Copper Quaternary (Type B or C) | 0.25 | 0.25 | 0.40 | 0.60 |
| ACQ | Alkaline Copper Quaternary (Type A or D) | 0.15 | 0.15 | 0.40 | 0.60 |
| ACZA | Ammoniacal Copper Zinc Arsenate | 0.25 | 0.25 | 0.40 | 0.60 |
| CA-B | Copper Azole, Type B | 0.10 | 0.10 | 0.21 | 0.31 |
| CA-C | Copper Azole, Type C | 0.060 | 0.060 | 0.15 | 0.31 |

| Code | Preservative Name | Retention Factor lb/ft³ UC2 | UC3B | UC4A | UC4B |
|---|---|---|---|---|---|
| CuN-W | Waterborne Copper Naphthenate | 0.070 | 0.070 | 0.11 | --- |
| CX-A | Copper HDO | 0.206 | 0.206 | --- | --- |
| SBX | Inorganic Boron (Formosan termites) | 0.28 | --- | --- | --- |

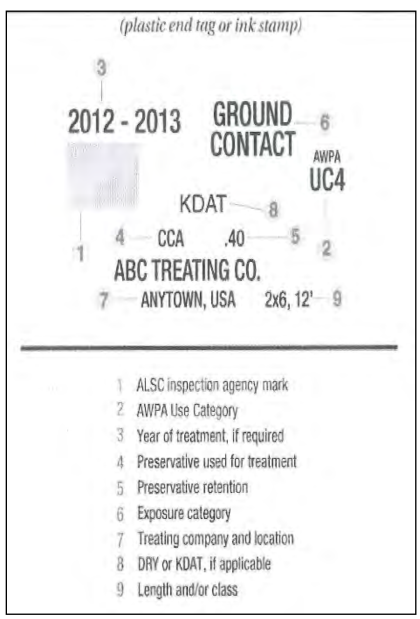


| Category | Locations to Use Each Type |
|---|---|
| UC2 | Interior Damp Locations |
| UC3B | Exterior Above Ground, Uncoated or Poor Water Runoff |
| UC4A | Ground Contact, General Use |
| UC4B | Ground Contact, Heavy Duty |

## Preservative Treatment Grading

### Grade

Any pressure treated lumber used in an outdoor project must be grademarked by an agency accredited by the American Lumber Standard Committee (ALSC).




GRADE STAMP COURTESY OF
SOUTHERN FOREST PRODUCTS ASSOCIATION

The grademark indicates that the lumber meets the structural and appearance specifications established for the grade and has been properly seasoned prior to treatment. In addition, the lumber should have a quality mark indicating it has been treated in accordance with the standards set by the American Wood Preservation Association (AWPA). Often the AWPA seal is found on a label located at one end of the board.

Typical grades used in deck construction include Select Structural (the best), No. 1 and No. 2. Most decks are built with either No. 1 or No. 2 grade lumber.

### SAFETY PRECAUTIONS

When specifying preservative-treated lumber, also specify the following worker precautions:

- ❑ Wash hands after contact;
- ❑ Do not allow food to come in contact with the lumber;
- ❑ Do not cut the lumber in enclosed spaces;
- ❑ Wear gloves and safety goggles while working with the lumber; and
- ❑ Never burn treated lumber as it emits toxic gases when burned.

**Visual inspection is not an acceptable substitute for a label.**

Preservative treatment must comply with AWPA C2 (lumber) and AWPA C9 (plywood). Incising is required for treatment of thin-sapwood species such as douglas-fir, spruce, and hemlock.

Arsenic-containing wood preservatives (CCA) are not acceptable.

Wood preservatives in general fall under the category of pesticides and must be EPA-registered.

Alkaline Copper Quaternary (ACQ) and Copper Azole (CA) are recommended for all uses where wood will be exposed to high moisture or wet conditions (typically all exterior building applications). Variants of these products, such as Micronized Copper Quaternary (MCQ) are also used. These products may not be listed with AWPA, although they have been tested and approved for meeting building code requirements by the International Code Council (ICC).

Acid Copper Chromate (ACC) and Copper HDO (CX-A) should not be used for ground contact, wet, or below ground uses.

Dipped or heavy brush-coated wood preservative is not acceptable where pressure treatment is required, but AWPA recommends all drilled holes and cut ends to be treated with a preservative. Click link Here.
Do not install aluminum flashings in contact with CA or ACQ pressure treated wood. All metal brackets used with these products must be rated for such use.

Boron (SBX) treated lumber is only acceptable for limited applications such as for framing lumber where insect infestation may be a concern. Borate pressure-treated wood products shall be minimum .28 pcf retention, (equivalent to a 42 DOT retention), and shall carry a minimum 20 year manufacturer's warranty against termites, carpenter ants and fungal decay.

Fasteners For Pressure-Treated Wood

Use either stainless steel or hot-dip galvanized fasteners,(meeting ASTM 153) and hot-dipd galvanized connectors, (meeting ASTM- A653), for ACQ and CA pressure-treated wood. Electro-galavanized fasteners are not acceptable as they will be corroded by the chemicals.
Consider galvanic action and compatibility of fasteners with the chemicals used to treat the wood.

Where fasteners connecting structural members are exposed to high moisture, or are in contact with ground or concrete, stainless steel fasteners (Type 304) shall be used.

## DEMISING WALLS AND INTERIOR PARTITIONS

### DESIGN

For common walls between dwelling units, design assemblies which are tested per ASTM E90 for air borne sound.In additon, for common floor/ceiling and wall assemblies between dwelling units and public corridors and stairs, use tested assemblies per ASTM E492 for structure borne sound. Provide STC ratings for all wall and floor/ceiling assemblies, and design details for sound attenuation at all penetrations.

Staggered stud and double stud walls must be fire-blocked as required by code, including a minimum of every ten feet horizontally. Fire blocking may be wood, gypsum board, mineral wool batts, or other approved material. Filling the cavity with dense pack cellulose may be an acceptable alternative. Mineral wool batts or cellulose are preferred to rigid materials which will transmit structure-borne sound and create thermal bridging.

-Electrical outlets and other penetrations shall be offset in party walls to avoid sound transmission.

### EXECUTION

Include specification requirement that the General Contractor is responsible for maintaining the integrity (including shoring) of the structure where cutting and reframing is necessary.

## SHEATHING

### MATERIALS

Plywood must be grade stamped (APA), by the Engineered Wood Association, Teco or Pittsburgh Labs and shall meet the requirements of the latest edition of Voluntary Product Standards PS-1 or PS-2.

Exterior sheathing plywood must be Exposure 1 performance-rated.

Specify sheathing to the span rating and install sheathing with the long dimension (strength axis) of panels across supports- two or more spans. These requirements must also be specified for patching and repairs.

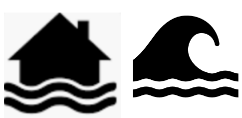
Moisture content of treated plywood sheathing must not exceed 15% before being covered with insualtion or finishes.

Provide plywood and oriented strand board (OSB) according to the following applications.

- ❑ Roofs: 5/8 inch min., 5 ply, Douglas Fir plywood or APA sheathing, Exposure 1.

**The following floor sheathing types should typically be used:**

- ❑ Floors to receive resilient flooring and carpet: 3/4" inch min., 5 ply; Douglas Fir APA Rated Sheathing, Exposure 1, with 3/8 inch APA Sturd-I-Floor rated underlayment is preferred, installed with ring-shank nails; no staples.
- ❑ Floors to receive porcelain or ceramic floor tile: ¾"minimum tongue-and-groove (T&G), 7-ply; Exterior grade plywood is recommended. Follow assemblies listed in latest edition of Tile Council of America Standards. At a minimum, all plywood floors where tile is to be installed shall be t&g, glued and screwed at 8" o.c. using hot-dip galvanized screws and stainless steel screws for all bathroom floors.
- ❑ Floors to receive Hardwood Flooring: 3/4" minimum plywood, glued and screwed with bridging at floor joists.
- ❑ Exterior Walls: plywood, OSB exposure 1 and insulated sheathing are acceptable sheathing materials. Engineering may be required for structural analysis..



- ❑ Cut edges of OSB must be field-treated with waterproof sealant to prevent swelling.
- ❑ Exterior rated plywood is required for subfloors and underlayments at bathrooms.

### EXECUTION

Install subfloors with construction adhesives conforming to APA Specification AFG-01 or ASTM D3498. Use adhesives that have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24). In addition, mechanically fasten all subfloors and underlayments according to APA recommendations. Provide diagonal joist bridging for added floor stiffness to prevent squeaking. Use screws wherever I-joists or 2x4 truss floor framing is used, and at larger spans.

Provide ply clips or continuous lumber blocking for fastening panel edges of roof sheathing.

Inspect attic roof framing during roof replacement projects and provide hurricane ties as required.

Specify staggered panel end joints and offset joints between subfloor and underlayment. Do not align finish floor joints with intermediate underlayment joints.

## BLOCKING

### DESIGN

Include blocking in details, and note all necessary blocking for wall-hung hardware, plumbing fixtures, cabinets, grab bars, etc.  Be sure to include blocking for the following:

- ❑ Drapery tracks to allow drapes to stack clear of the window opening;
- ❑ Kitchen cabinets;
- ❑ Grab bars and other bathroom accessories;
- ❑ At the base of wheel-in showers;
- ❑ Electrical fixtures, outlets, hose bibs (on exterior walls), etc.; and
- ❑ Between jamb stud and next stud at lockset on all doors.

For bathrooms in adaptable and fully accessible units, detail blocking for grab bars that may be added after occupancy (refer to MAAB/ADA regulations to determine the extent of blocking required).

Nailing ¾” plywood over the full wall of studs may be the preferred method of blocking because it allows installation of grab bars anywhere there is plywood, although it reduces overall room dimensions.

Detail corner framing to allow insulation to be installedand to minimize thermal bridging to the extent possible.  Consider pre-installing pre-cut foam insulation during framing in areas which will be difficult to insulate after framing is complete.

Use hot-dipped galvanized steel nails and end nailing for all blocking in =wet walls and exterior walls; do not toe-nail or nail within ½” of the edge of blocking or the supporting structural member. Do not use staples to secure blocking.

## PREFABRICATED TRUSSES

### MATERIALS

The fabricator's shop drawings must be stamped by a structural engineer registered in Massachusetts.

Follow structural spanning, spacing, and bracing requirements in accordance with the Building Code and Truss Institute standards.

Finger-jointed lumber must be Machine Stress Rated, MSR-grade-stress tested, and include finger-jointed wood for truss framing.

### DESIGN

Detail trusses to allow for shrinkage and thermal movement and truss uplift and to prevent gypsum board separation and cracking at the ceiling and wall. Use L-shaped truss clips attached to the top of interior walls

which will allow the truss to move up and down independently of the wall. Do not nail the trusses directly to any interior walls.
Trusses must be designed to be structurally stable to avoid damage during installation.

Minimum six inch truss bottom chords are preferred to ensure rigid ceilings.

Consider using raised heel roof trusses or design the pitch of the roof to accommodate the full depth of insulation and adequate ventilation.

## ENGINEERED WOOD FRAMING

### DESIGN

The Designer should carefully evaluate which engineered wood products are appropriate based on cost-effectiveness, availability, durability and acceptance by local code officials.  If any of these factors are identified as potential problems during design, the Designer should specify conventional framing.  Where appropriate, consider listing engineered wood framing as an alternate to base bid.

For non-uniform loading conditions the Contractor shall provide an engineering analysis signed and stamped by a Massachusetts registered structural engineer.

## STRUCTURAL GLUED-LAMINATED TIMBER (GLULAMS)

Glulams shall be APA - Engineered Wood Association grade-stamped, in conformance with AITC/ANSI A190.1, American National Standard for Glued Laminated Timber.

The Contractor shall submit manufacturer's certificate of compliance.

Glulams shall be specified for the following characteristics:

- ❑ Appearance: graded as
  - "architectural" for all exposed applications;
  - "industrial" for all concealed appications.
- ❑ Additional appearance characteristics shall be per Engineered Wood Systems Technical Note EWS Y110;
- ❑ Required design stress (with or without camber);
- ❑ Maximum allowable wane;
- ❑ Adhesives-based on wet or dry use;
- ❑ Fire resistance (where applicable); and
- ❑ Preservative treatments (when applicable)  per American Wood Preservers' Association (AWPA)  Standard C28.

## I-JOISTS

I-Joists shall be grade labeled per allowable spans for uniformly loaded residential construction at various I-Joist spacings.  They should also be APA Performance Rated (PRI), maximum deflection of L/480, conforming with Performance Standard for APA EWS I-Joists, PRI-400.  Rim Boards shall be manufactured and stamped in accordance with APA Rim Boards, PRI-401.

All accessory products such as blocking panels, rim boards, squash blocks, web stiffeners, etc. shall be provided and installed in accordance with APA Performance-Rated I-Joists, Form Z725. When desinging with I-Joists do not mix and match details of conventional framing with I-Joist framing.

### LAMINATED VENEER LUMBER (LVL)

Laminated veneer lumber shall be grade marked per the LVL manufacturer's published structural design values using methods established in ASTM Standard Specification D5465 for Structural Composite Lumber.

Proprietary engineered products should be carefully evaluated and specified only after availibility and cost-effectiveness have been confirmed. LVL is considered a resource efficient material. The manufacturing of LVL does not require the harvest of old growth trees.

### EXECUTION

Maintain protective covering and or sealants on glulams and I-Joists during shipment, storage and handling. Protect glulams and I-Joists from rain and sunlight.Where glulams are "architectural" grade, maintain protective coverings until after installation.

### ENGIEERED WOOD FRAMING MISC.

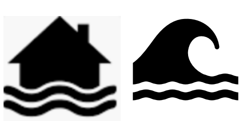
Seal cut ends of glulams with waterproof sealant immediately after trimming.

Store, stack and handle I-Joists vertically.

Do not allow workers to walk on or load I-Joists until entire sheathing and bracings are installed.

All damaged I-Joists should be removed and replaced with new. DO NOT REPAIR DAMAGED I-JOISTS. I-Joists which show evidence of excessive moisture (swelling of webs), greying due to sunlight exposure, cracking, checking or splitting, shall not be installed.

### FASTENERS



In general, wood fasteners should be chosen for their ability to transfer structural loads between the members joined, to resist corrosion and deterioration or avoid staining of adjacent materials, and to limit the amount of deflection, particularly in floors. See building code for requirements on fastener type and spacing for different components.

In low-rise construction, the rough carpenters may be expected to install building wrap or other forms of air and/or water barrier. It is particularly important in such instances that the rough carpenters are familiar with the spec sections on air, water, moisture and thermal barriers.

### CLIMATE RESILIENCE RESOURCES

Project teams can learn more about best practices for choosing wood materials where water is a concern from these resources among others:

- FEMA's Homebuilder's Guide to Coastal Construction includes a set of accessible fact sheets which include graphics and resilience strategies for choosing materials and resilient fasteners: https://www.fema.gov/media-library-data/20130726-1538-20490-2983/fema499web_2.pdf
- EPA's guide "Moisture Control Guidance for Building Design, Construction and Maintenance" includes some guidance on choosing appropriate wood materials for areas where moisture is a concern. It also includes photos to help diagnose moisture related problems. It is available here: https://www.epa.gov/sites/production/files/2014-08/documents/moisture-control.pdf
- For guidance on cleaning wood assemblies after a flood the guide Creating A Healthy Home, A Field Guide for Clean-Up of Flooded Homes may be useful. It is available here: https://www.huduser.gov/portal/Publications/pdf/FloodCleanupGuide_NCHH.pdf

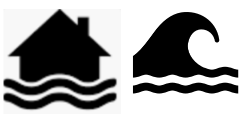
### SECTION INCLUDES

Exterior Finish Carpentry
Interior Finish Carpentry

### RELATED GUIDELINE SECTIONS

| | |
|---|---|
| 06 10 00 | Rough Carpentry |
| 06 70 00 | Structural Plastics and Composites |
| 06 65 00 | Plastic and Composite Trim |
| 07 40 00 | Siding |
| 08 10 00 | Doors & Frames |
| 08 50 00 | Windows |
| 09 90 00 | Painting |

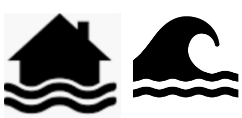
### CLIMATE RESILIENCE DESIGN CONSIDERATIONS



Flood damage-resistant materials should be used for walls, floors, framing and other parts of the building that are subject to flooding by fresh or sea water. Wood building materials are considered flood damage resistant if they can withstand direct contact with water for at least 72 hours without being significantly damaged.

Pressure-treated and/or decay-resistant lumber, pressure-treated and marine grade plywood should meet these requirements for flood damage resistance, and should not absorb contaminants or promote mold and mildew.

Hardware fastened to these water resistant building materials should be stainless or galvanized steel.



For flood prone properties, if wood is not required to match the existing materials that will adjoin the repaired structure, or as part of the architectural expression of the building, the wood-composite structural plastic products described in 06 50 00 Structural Plastics and Composites may be more appropriate than flood damage resistant lumber. These products are more resistant to moisture absorption and rot than treated lumber.

Flood damage resistant materials should be continuous from the lowest point in the building up to the Design Flood Elevation (DFE).

The design of the entire assembly should take into consideration flood hazards and mitigate mold and mildew growth.

### WOOD STAIRS

#### DESIGN

Design stairs and railings to comply with building code requirement.

For interior stairs, consider prefabricated units.

Field finish stairs with resilient treads/risers and resilient tiles for landings at public areas.

Consider pre-fabricated laminated oak treads with polyurethane finish for interior stairs at family-duplexes. Avoid carpeting on stairs.

Provide skirt boards of durable, easily cleaned materials.

Straight runs with intermediate landings are preferred where space and layout allows.

## INTERIOR TRIM & SHELVING

### DESIGN

Material choices should be based on durability, cost, long-term maintenance and availability.

Specify standard in-stock profiles; no custom profiles. Simple flat casings or readily available profiles are preferred.

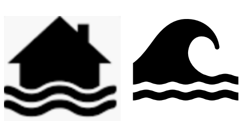
5/8” thickness flat-stock with eased edges is preferred; ½” or less thickness is not acceptable.

- ❑ Interior trim: Paint-grade finger-jointed pine (pre-primed).
- PVC trim (unpainted) is recommended for bathrooms where the labor savings of not requiring painting can offset the higher cost of trim. Plastic trim is not typically cost-effective for interior trim. Specify paint-grade wood for most interior applications. Stained wood trim is used to match existing
- Do not use expanded polyurethane foam or MDF trims.

❑ Shelving:

- Solid hardwood or hardwood plywood with solid wood edge band is preferred over plastic laminate and particleboard.
- Vinyl-clad wire shelving installed with proper blocking, is preferred at bedroom closets.
- See Section 12 35 00 Cabinets for DHCD standards on kitchen and bath shelving.

## EXTERIOR TRIM & PORCH COLUMNS



❑ Exterior trim:

- Specify No. 1 pre-primed solid pine; finger-jointed trim is not acceptable.
- Cedar trim is not used frequently. When specifying clear cedar trim and fascia, apply back prime and seal both cut ends. (Cedar appearance grade: Grade A to D. Clear Cedar refers to A & Better and is free of almost all knots, but not 100% free of knots.)

- Fiber Cement Products which are pre-primed and painted are acceptable but are generally not as durable as solid PVC trim.

- High-density solid PVC Trim is preferred. Painting is optional, specify concealed fasteners if painting is not specified. Do not use caulking or sealant to seal countersunk trim fasteners. See Siding Section 07 46 00.

- Polyurethane foam trim is not acceptable.

- Specify fasteners for the desired finish appearance.

Use 5/4 thickness solid wood trim of decay resistant hardwood or red cedar where natural finish or unstained cedar siding is used. Specify PVC trim where painted or stained wood shingle or clapboard siding is used.

Complex trim molding profiles are not acceptable unless used to match historic profiles in designated historic buildings or for selective replacement of existing trim.

❑ Columns and Column Covers:

- Wood columns: Staved construction is not allowed, except where historic building columns require replacement.

- Structural fiberglass columns are preferred for new construction.

- High-density dimensional PVC column covers are acceptable for cladding existing metal columns where wood cladding and trim are being replaced.

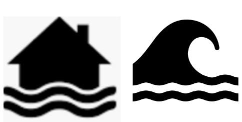
- Thin-wall and tubular PVC are not acceptable for columns, post covers or railing posts.

- See Section 06 10 00 for pressure-treated wood posts.

- Designer should choose solutions which match the architectural style of existing buildings, use similar proportions and detailing, for replacement columns and column-cladding.

- Designer should specify one-piece assemblies, and those which minimize field labor, where possible.

**INSTALLATION**

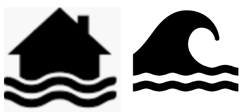


Detail exterior wood with adequate flashing and separation between wood trim and concrete, grade, and surfaces where excessive water and snow-build-up is likely to occur, such as roof rakes at cheek walls, skirt boards at slab-on-grade construction, storage sheds, etc.

Spot-prime all cut ends on wood and fiber-cement trim prior to installation; install products strictly following manufacture's' instructions to preserve warranty protection. Architects should specify the requirement in the installation section of the spec.

Install blind mitered joints on all continuous lengths of trim.
Countersink fasteners in all wood trim and fill with color-matched wood filler or trim manufacturer's proprietary plugs. Do not use sealants or caulk as fillers.

## Exterior Wood Decking and Railings



### Materials

Where natural, un-stained cedar, redwood, Ipe or other naturally, decay-resistant wood is used as part of the architectural expression, consider using no. 1 or 2 grades (knotty) decking where a rustic appearance is acceptable.

Exterior stair treads: three pressure treated 2x4s or 5/4x4s are a very cost-effective option. Specify non-corrosive compatible hardware and fasteners. This will maximize both the durability and the cost-effectiveness of this option.

Consider other options where a more finished low maintenance appearance is required.

A variety of decay-resistant hardwood species have become more readily available in recent years. Many of these products are equally or more durable than pressure treated and plastic decking. Spanish Cedar is available for milled profiles such as railings and a variety of decking alternatives such as Ipe, Cumaru (Brazlion Teak) and Garapa (Brazilion Ash) are available from New England lumber yards, depending on the lumber sizes and profiles required.

Research availability and costs in design phase and specify at least three equivalent products. Specify FSC certified products.

Consider listing local sources to facilitate contractor pricing and ordering when a particular specie is specified due to its unique attributes.

Research lead times for products specified to minimize last minute substitutions with inferior products during construction.
See Section 06 10 00 Rough Carpentry for requirements on wood preservatives.

See Section 06 65 00 Plastic Composite Trim & Decking for design standards on synthetic decorative trim and accessories.

Where pressure-treated posts and framing are intended to be left exposed, specify the appropriate lumber grade to eliminate excessive warping, splitting and checking.

Do not install lumber which is saturated beyond 19% moisture content or which is not kiln-dried after treatment (KDAT).

Provide aluminum stand-offs for columns.

Requirements for proper protection and storage of materials on site should be specified and enforced by testing wet lumber with moisture meters if necessary.

### DESIGN

Specify KDAT, pressure treated wood rails with sloped top for drainage. Max. moisture content – 19%.

Note that sloped 2x4 top rails are not ADA code compliant and do not provide an effective gripping surface for elderly tenants. Supplement wood railings with tubular handrails at stairs and ramps to comply with accessibility requirements.

Design tapered framing or shim to allow exterior decking to be installed with a slope for water drainage to prevent ponding.

Specify staining of KDAT lumber promptly after installation in Section 09 90 00 Painting.

Consider decay-resistant hardwoods from FSC managed forests for sustainable, durable and cost-effective alternatives to plastic decking. Research the availability and cost of any material which is not readily available at local lumberyards during design and ensure specified products to match current market conditions

Sustainable materials which are more durable and cost-effective can often be ordered and delivered within a short period of time. Research and specify accordingly.

Note: some decay-resistant hardwood species require finishing to maintain their durability, while finishing is optional and more of aesthetic consideration for others. If equals are specified, make sure you specify finishing for those require it. When contractors choose to substitute with an equal, the required finishing must also be provided.

Do not paint exterior decking; this is highly maintenance intensive. Choose products such as decay-resistant hardwoods or pressure-treated decking meeting DHCD design standards.

### CLIMATE RESILIENCE RESOURCES

Project teams can learn more about best practices for choosing wood materials where water is a concern from these resources among others:

- FEMA's Homebuilder's Guide to Coastal Construction includes a set of accessible fact sheets which include graphics and resilience strategies for choosing materials and resilient fasteners: https://www.fema.gov/media-library-data/20130726-1538-20490-2983/fema499web_2.pdf
- EPA's guide "Moisture Control Guidance for Building Design, Construction and Maintenance" includes some guidance on choosing appropriate wood materials for areas where moisture is a concern. It

also includes photos to help diagnose moisture related problems. It is available here: https://www.epa.gov/sites/production/files/2014-08/documents/moisture-control.pdf

- For guidance on cleaning wood assemblies after a flood the guide Creating A Healthy Home, A Field Guide for Clean-Up of Flooded Homes may be useful. It is available here: https://www.huduser.gov/portal/Publications/pdf/FloodCleanupGuide_NCHH.pdf

## 06 61 00 • PLASTIC TUB & SHOWER PANELS

### SECTION INCLUDES

Solid Surface Tub & Shower Surrounds
Glass-Fiber-Reinforced Plastic Tub & Shower Surrounds
Shower Pans
(Composite countertops are in section 12 35 00 Casework)

### RELATED GUIDELINE SECTIONS

| | |
|---|---|
| 06 10 00 | Rough Carpentry |
| 06 20 00 | Finish Carpentry |
| 07 20 00 | Building Insulation and Moisture Protection |
| 09 30 00 | Tile |
| 09 90 00 | Painting |
| 12 35 00 | Casework |
| 22 00 00 | Plumbing |

## SOLID-SURFACE TUB & SHOWER SURROUNDS

### TECHNICAL STANDARDS

ASTM E-84 – Surface Burning Characteristics

ANSI Z-124.2- Plastic Shower Receptors and Stalls

IAMPO/ANSI Z124.1.2(2005)-Plastic Bathtubs and Shower Units

ANSI A-117.1- Standard for Accessible and Usable Buildings and Facilities

### DESIGN

Specify solid surface ¼" thick products with a minimum 10 year manufacturer's warranty.

Specify a matte finish for solid surface. Minimize joints.

PVC tub and shower surrounds are not acceptable alternatives to solid surface acrylic products.

PVC tub liners should not be specified; consider refinishing cast iron tubs if budget does not permit replacement. Cast-iron is the preferred tub.

For tile surrounds, see 09 30 00 Tile.

### DESIGN

When specifying solid surface-surrounds, include specific requirements for preparation of backer-board, such as priming and/or sealing based on the specific adhesive requirements of the panel manufacturer.

Do not install solid surface panels on loose or damaged tile, glossy tile, green board, drywall, or textured surfaces. Follow manufacturers' recommendation for substrate and preparation.
Check the condition of the walls where panels are proposed. Verify that they are square and plumb and that any insulation or vapor barriers at exterior walls are in good condition. Add insulation behind surround where missing or deteriorated.

Provide details for shimming backer board, if necessary. Tape all backer board joints with compatible materials – not joint compound. Use moisture-resistant backing materials such as cement board.
Corner trim and sealant joints should not be used to cover variations out of square or plumb, greater than ¼" along any direction.

Design panels to extend a minimum of 72" above the tub lip or 84"minimum above the shower floor if a curb-less shower is proposed. Panels should extend to the ceiling whenever possible.

Provide a membrane flashing over the floor water-proofing membrane at the base detail of all showers and tubs.

Provide a 4" high wall cove or base tile at shower floors; do not design solid surface panels extending down to floor.

### MATERIALS

Acceptable manufacturers include but are not limited to:
Swanstone, Corian, Sterling Vikrell by Kohler, American Standard Ciencia.A number of these products are GreenGuard approved as having low chemical emissions or are considered greener products because the polymer is bonded to natural materials like quartz.

### INSTALLATION

Note that some solid surface panels require installation by manufacturer-certified installers and most require installation using the manufacturer's proprietary adhesives to maintain warranty coverage.

Avoid using unsealed grout, as it traps moisture and can lead to mold growth.

Provide adequate ventilation for curing of adhesives to prevent harmful build-up of toxic air.

## FIBERGLASS-REINFORCED PLASTIC (FRP) TUB & SHOWERSURROUNDS

We do not recommend using fiberglass reinforced plastic tub, shower surround and shower pan due to concerns of the products' durability and high maintenance.

## PRE-FABRICATED SHOWER PANS

### STANDARDS

ASTM D635 Flammability and E165.75 Fire Retardancy

ADA Federal Guidelines Section 608 Inhalation Toxicity Test

### MATERIALS

Acceptable materials include:

- Copper Shower Pans (with tile)
- Polyurethane Pans (with tile)

- Solid Surface/Marble Resin
- Composite Concrete Pan-- Composed of a 1 ½” Concrete base covered by a Waterproof Membrane and topped by a1 ½” Concrete topping.
- Latex Mastic Flooring and Wall Base System

### DESIGN

Specify a non-skid finish, and verify that the product chosen has a minimum .6 coefficient of friction, (both wet and dry).

If the floor is a fire-rated assembly, verify that the pan meets fire-resistance, smoke-development and flame-spread requirements.

Waterproofing membrane should be used with all pans. Flash membrane into the floor drain. Durable wall membrane should always be used around showers. 4-6 mil loose polyethylene is not acceptable as substitute for a durable adhered waterproofing membrane.

Verify compatibility of panel adhesives with the membrane chosen.

### INSTALLATION

Pans should be mud-set where possible.
At a minimum floor should be leveled with grout or self-leveling compound to permit full contact and structural support of pan.

# 06 65 00 • PLASTIC & COMPOSITE TRIM

## SECTION INCLUDES

Plastic Trim & Panels
Wood-Plastic Composite Trim and Decking

### RELATED GUIDELINE SECTIONS

| | |
|---|---|
| 06 20 00 | Finish Carpentry |
| 06 70 00 | Structural Plastics and Composites |
| 07 40 00 | Siding |
| 07 90 00 | Sealants |
| 08 10 00 | Doors & Frames |
| 08 50 00 | Windows |
| 09 90 00 | Painting |

### TECHNICAL STANDARDS

| | |
|---|---|
| ASTM D570 | Water Absorption in Plastics |
| ASTM D638 | Tensile Properties in Plastics |
| ASTM D198 | Compressive Strength |
| ASTM D696 | Coefficient of Thermal Expansion |
| ASTM D1037 | Water Absorption by Weight |
| ASTM D2394 | Static Coefficient of Friction |
| ASTM D1761 | Screw Withdrawal |
| ASTM E84 | Flame Spread Index |

### GENERAL DESIGN CONSIDERATIONS

Plastic and composite lumber and trim have become common replacement materials for exterior wood trim and decking applications. Painted wood trim, metal cladded trim and treated wood lumber and decking has long been a source of maintenance issues. Composite and plastic materials provide the advantage of lower maintenance due to the material's resistance to rot and decay. When specifying products for specific applications, care must be taken to consider:

- The intended use of the material
- Fire resistance requirement
- Material manufacturing process
- Material Composition (recycled material content)
- Life cycle cost

## PLASTIC TRIM

### MATERIALS

Rigid PVC foam materials are typically produced in two ways: the Celuka process that produces larger cells with a higher density shell or the free foam extrusion process that produces a uniform cell density and a cloudy surface. The free foam product is more desirable for building materials because of its denser composition and ability to accept a painted finish.

PVC lumber products are made from virgin PVC or varying amounts additives, polyethylene (HDPE and LDPE), or polystyrene (PS). Polyethylene possesses lesser chemical hazards and associated environmental health impacts, making it environmentally preferable to PVC or PS. We also favor single-polyethylene-resin products as they are more environmentally preferable over plastic composites or lumber made from commingled plastics.Specify products with UV stabilizers, single source recycled content and a minimum 25 year warranty

Specify the use of plastic materials as an acceptable alternate to wood when:

- Application requires a product that is resistant to moisture, corrosive substances, and insects
- Application requires a product that will not rot, splinter or crack
- Application requires no waterproofing, staining or similar maintenance
- Application requires resistance to graffiti.

### WOOD PLASTIC COMPOSITE TRIM

#### MATERIALS

We do not recommend the use of wood-plastic composite trim because of concerns about mixing biological and synthetic materials, including limited end-of-life recyclability. However, some environmental conscious wood plastic decking products are acceptable due to their robust moisture resistance and low maintenance features.

We would like to limit the use of wood-plastic composites because of concerns about mixing biological and synthetic materials, including limited end-of-life recyclability.

#### DESIGN

Do not use paint or stain as a finish.

#### INSTALLATION

Install all trim materials in strict accordance with manufacturer's specifications.

### PLASTIC ACCESSORIES

#### MATERIALS

Specify pre-formed plastic products for exterior building trim components such as, gable vents, hose-bib mounting blocks, exterior light fixture mounting blocks, column covers, and corner trim to provide a clean, finished appearance for exterior accessories.

# DESIGN AND CONSTRUCTION GUIDELINES AND STANDARDS

DIVISION 6 ● WOODS & PLASTICS

## 06 70 00 • STRUCTURAL PLASTICS & COMPOSITES

**SECTION INCLUDES**

Plastic & Composite Railings
Plastic & Composite Decking

**RELATED GUIDELINE SECTIONS**

| | |
|---|---|
| 06 10 00 | Rough Carpentry |
| 06 20 00 | Finish Carpentry |
| 06 65 00 | Plastic and Composite Trim |
| 08 10 00 | Doors & Frames |
| 09 90 00 | Painting |

### Technical Standards

ASTM D 570 Water Absorption in Plastics
ASTM D 638 Tensile Properties in Plastics
ASTM D 198 Compressive Strength
ASTM D 696 Coefficient of Thermal Expansion
ASTM D 1037 Water Absorption by Weight
ASTM D 2394 Wet Static Coefficient of Friction
ASTM D 1761 Screw Withdrawal
ASTM E 84 Flame Spread Index

### General Material Considerations

The manufacturing process of Structural Plastics is similar to that of non-structural plastics. The difference in materials is the introduction of fiberglass strands, selected additives, and rebar rods for added structural strength. The material is resistant to insect infestation, moisture absorption and corrosive substances. The material will not rot, splinter or crack.

## PLASTIC & COMPOSITE RAILINGS

**DESIGN**

Carefully evaluate costs for structural plastic and composite railings. Avoid specifying proprietary products or products without 5-year minimum field-tested installation track record.

Specify a 25-year warranty.

Avoid railing "systems" which rely on excessive, labor-intensive disassembly or large-scale replacement of parts to accomplish minor repairs.

Do not specify painted systems whose long-term warranty is contingent upon a painted finish.

Avoid specifying products which possess inherent obstacles to future, cost-effective recycling. (Proprietary mixes of organic and inorganic compounds which are difficult to separate or binders with known toxicity).

## WOOD-PLASTIC COMPOSITE DECKING

### DESIGN

Material choices should be based on durability, cost and availability.

Specify decking materials with a static coefficient of friction greater than 0.60. Some products are coated in a mildew resistant coating which is extremely slippery when wet. These products should be avoided.

Design framing to effectively utilize the spanning capabilities of the decking.

Specify light, high reflectance colors to mitigate heat build-up, thermal movement and fading from ultraviolet light.

Do not specify products containing a high percentage of recycled wood (greater than 50%). These products are inherently prone to water and UV damage because the wood fillers do not bind completely to the plastics and require painting and ongoing maintenance.

### MATERIALS

Avoid specifying products which possess inherent obstacles to future, cost-effective recycling. (Proprietary mixes of organic and inorganic compounds which are difficult to separate or binders with known toxicity).

Do not specify decking whose long-term warranty is contingent upon a painted finish.

Consider using high-density, polyethylene products in lieu of wood products where in direct contact with the ground.

### INSTALLATION

Allow for water drainage. Rainwater should runoff naturally without causing standing water.

Installation of decking using a concealed screw system per manufacturer's recommendation is preferred.

A minimum of 25 years of limited manufacturer's warranty is recommended.

# DESIGN AND CONSTRUCTION GUIDELINES AND STANDARDS

DIVISION 7 • THERMAL & MOISTURE PROTECTION

# 07 07 00 • SOLAR PHOTOVOLTAIC SYSTEMS

## SECTION INCLUDES

Solar PV Sustainability Grants
Third Party Solar PV Installations
Technical Criteria for Selecting Solar Mounted PV Sites
Preparing for Potential Future PV Installation
Building Integrated Photovoltaic Systems
Ground Mounted Solar PV Systems

## RELATED GUIDELINES SECTIONS

| | |
|---|---|
| 07 30 00 | Asphalt Roof Shingles |
| 07 50 00 | Membrane Roofing |
| 22 00 00 | Plumbing |
| 26 00 00 | Electrical |

## REFERENCES

The following links may be helpful in designing a Solar PV System:

Massachusetts Clean Energy Center- www.masscec.com
National Training & Education Resource- www.nterlearning.org
Solar-Massachusetts.org- www.solar-massachusetts.org

## INTRODUCTION

Installation of solar photovoltaic systems on existing and new construction buildings should be considered a building enhancement after attention has been given to making the buildings more energy efficient with wall and roof insulation, new energy efficient windows and mechanical systems. In a retrofit situation, it may be more effective to replace the windows and add additional insulation before adding a PV system to the roof of the building. Planning for new PV arrays should include replacing any older roofs, to make the roofs solar ready and investigation to the roofs orientation and shading from surrounding trees and other buildings. Before installing a new solar photovoltaic system on an existing roof, review the existing insurance policy for this building regarding new PV systems. Funding for solar photovoltaic systems can come from sustainability grants or third party solar PV installations as outlined below. Solar renewable energy certificates (SRECS) also generate a stream of income once the panels are installed,only one of many financial options available.

## SOLAR PV SUSTAINABILTY GRANTS

DHCD's Sustainability Initiative works with housing authorities interested in installing solar photovoltaic or solar thermal/hot water systems with supplemental funding from federal, state or utility grants or rebates. Since these resources are not always available in the timeframe that roof replacement projects are being bid, DHCD expects designers to provide conceptual or schematic design details about how solar panels could later be retrofitted to the roof. In addition to the roof-related construction involved with solar panel installation, the designers should indicate where the associated electrical equipment and inverters could be located for PV systems, and where piping, heat exchangers and storage equipment could be located for solar thermal systems.

### THIRD PARTY SOLAR PV INSTALLATIONS

In some cases, housing authorities may pursue the development of solar PV systems through a third party roof lease and power purchase agreement (PPA). This “Third Party” is usually a private solar development company that installs and maintains the solar panels over a 15-20 year timeframe, and the authority commits to purchase at below-market rates the kilowatts generated on the roof. Below–market rates are possible since the vendor is able to take advantage of federal and state tax credits and solar renewable energy certificates (S-RECS). Even when the development is to be third party, the LHA should take advantage of using DHCD’s technical assistance in planning and reviewing their project.

### CLIMATE RESILIENCE DESIGN CONSIDERATIONS

Solar photovoltaic (PV) systems with battery backup have the potential to provide residents with much needed resiliency in the face of natural disasters and associated power outages. By providing power when the electric grid goes down, these systems can allow residents the option to shelter in place and reduce or eliminate the need for emergency generators fueled by diesel or other fossil fuels. While batteries for this purpose may increase the cost to install a solar photovoltaic system, the cost of batteries is declining and is expected to continue to decline, just as solar technology has done in recent decades. Space for future battery installation should be considered in the system design.

To accommodate future battery storage, locate any central solar photovoltaic inverters in a location with additional room for a battery system (at least 10’ x 10’ or near an exterior wall for a battery to be located outside). Specify an islandable inverter. An islandable inverter will also allow a solar photovoltaic system to operate during a power outage, provided there is adequate sunshine. An islandable inverter should be equipped with one or more 120v electrical receptacles to allow device charging or refrigeration during the day. Ensure that all solar photovoltaic equipment, conduit, inverters, panels, subpanels, meters, and switches are located above the design flood elevation (DFE).

When choosing locations for solar PV systems, consider solar PV canopy installations above unshaded parking lots or paved areas. These installations can lower surface temperatures of paved area and add to the solar PV output at a development.

# 07 07 00 • SOLAR PHOTOVOLTAIC SYSTEMS

## RESEARCH AND INVESTIGATION

Technical Criteria for Selecting Solar Roof Mounted Photovoltaic (PV) Sites:

- ❑ Orientation of the Existing Roof.
  The basic parameter for roof orientation is idealy between Southeast to South to Southwest.

  Roofs with orientations between Southeast to South to Southwest will produce close to optimum energy production. Flat roofs are typically rectangular in nature and have an associated orientation when using a mounting system that holds modules at a set non zero pitch. A zero pitch mounting system is acceptable but not desireable.

  .

  Although mounting flat to the roof is considered acceptable, it is less desireable because there is less output than tipped system per installed watt, longer retention of snow, and potential for less effective cleaning of dirt by rain water.

  Roof orientation can be determined in a number of ways. Maps including aerial photo maps by Google Maps, MapQuest, etc. show true North as the top of the page.

  Shadows at solar noon will point toward true North. Solar noon is roughly 12 noon during standard time and roughly 1 PM during daylight savings time. Actual solar noon factors in a small offset due to the earth's non circular orbit around the sun. A compass will show magnetic North, which in Massachusetts is approximately 15 degrees West of North.

- ❑ Condition of the Existing Building Roof.
  The existing roof should have greater than 20 years of rated life left. Re-roofing offers an opportunity to select long life roofing prior to installation of roof mounted photovoltaic arrays.

  For sloped roofing replacement it is advisable to use 40 or 50 year (lifetime) architectural asphalt roofing shingles. If a roof has been recently replaced, the LHA should check the existing roofing warranty to determine the remaining useful life to the roof.

  Flat roofs with rubber or other membrane roofing using the top-of-the-line products such as modified bitumen or PVC roofing rather than EPDM using a sleeper system over the roof should be in good condition and it should be a requirement of the roofing contractor to add an additional layer of membrane roofing on the area of the roof where a PV array will be installed. Mounting PV system arrays on EPDM or single membrane flat roofs is not acceptable since the warranties for these roofs is limited to 15 years. Roofing warranty is not the criteria but the quality of the roof that is installed.

- ❑ Strength of the Existing Roof.
  Roof strength must be adequate to support the additional weight load from the solar PV arrays. In addition the roof must be capable

of meeting wind uplift loads for attached systems during hurricane force winds.

DHCD requires a professional structural engineer to verify that a roof can take the additional load of a PV system. A typical PV system mounted on a sloped roof adds about 3 lbs. per square foot which is approximately equal to an additional layer of shingles in the area where the PV is mounted. Lag screws attached to roof rafters must be selected for a potential wind upload during hurricane force winds. Alternate attachment methods must meet the same engineering requirements such as shroads or heavier mounting frames etc. Every roof should be investigated for its own unique characteristics.

Ballasted PV on a flat roof relies on the weight and interconnections between sections of the mounting system to keep the array from blowing off the roof may range in weight from near 3 lbs. per square foot to as much as 10 lbs. per square foot. Mechanically attached PV system arrays should be avoided if possible since additional roof penetrations are required and provide additional locations for water to enter the building envelope.

- ❑ Roof Pitch with Orientation of Roof.
Both flat roofs and sloped roofs are acceptable for PV systems installations. A South facing sloped roof will naturally tilt modules towards the sun for good energy production and good snow shedding. A 30 to 40 degree pitch on a South facing roof is optimum for energy production.

A steep roof has low energy production when it is oriented East or West off of South. A Southern orientation of a sloped roof is ideal. No PV systems should be mounted on sloped roofs with orientations that have any Northern component.

A roof with a low pitch (below 15 degrees) will tend to retain snow. A roof with a steep pitch will loose snow quickly. Consider potential hazardous sheets of icy snow coming off a steeply pitched PV array. Leaving exposed shingle roof below an array can reduce the chances of snow falling quickly off the roof.

Mounting PV system arrays on EPDM or single membrane flat roofs is not acceptable since the warranties for these roofs is limited to 15 years. Mounting on flat roofs is most often done with mounting systems that do not penetrate the roof membrane or only penetrate the roof membrane at a limited number of locations. A ballasted system does not require roof penetrations and relies on the weight of the system to keep the system from blowing off the roof. A second method is to attach the system to the roof. In either case, the system must meet building code for worst case wind conditions. Systems on sloped roofs are typically more cost effective and producing more energy than systems on flat roofs.

- Shading of Existing Trees or other Buildings.
  Shading is equally important as roof orientation. Roofs must be clear of shading between 9 AM and 3 PM standard time for most of the year.

  Energy production is maximized when shading is minimized. At our latitude, the winter sun at the December Solstice reaches a maximum angle of 25 degrees above the horizon. Ideally tree tops will be below this angle. A variety of charting tools allow one to determine the effect of shading on annual energy production. The best known tool is called Solar Pathfinder. http://www.solarpathfder.com/ .

  When considering the removal of trees to improve photovoltaic system output, one must consider the intrinsic value of the trees as well as beneficial shading that keeps buildings, grounds and people cooler.

  Shading can come from other homes and buildings nearlby. A house in a valley can be shaded by a house on a hill.Tall buildings will cast long shadows in winter months.

  Located on the same roof or building, vent pipes, chimneys, and roof features can cause shading of photovoltaic arrays. A module may be caused to be electrically bypassed if only one or two cells of that module are shaded. If several modules are shaded this way at the same time, the output of the entire array may be reduced to a small fraction of its potential output. Using small micro inverters behind each module allows the panels to produce AC power directly at the source making the system more efficient in generating electric and with an AC system most of the system's equipment is included within the panels.

- Electrical Installation Requirements.
  Electrical code specifies required space for inverter and metering equipment. Inverters and support equipment are typically outside of living area, removed from heat sources (e.g. attics are not suitable), and secure. Electrical code must be followed with particular attention to amperage ratings of electrical panels and circuit breakers.

  The inverter is typically mounted next to the main electrical distribution panel of a building or unit. An inverter and disconnects may be mounted on the outside of a building or in a shed. It may not be appropriate to have an inverter mounted where there is a strong possiblility that it may be tampered with. An exterior North wall will help the inverter run cool by providing shade.

  Solar photovoltaic plus battery storage technology is a valuable climate resilience strategy that may effect be cost-effective within the life of the system. Space should be designated for locating batteries in the future, and inverters should be islandable. See the Climate Resilience Design Consideration section above for details.

- ❑ Additional Considerations.

**Finding an Installer** - There are 3 resources that are available in Massachusetts to find installers who might bid on your solar project:

SEBANE- Solar Electric Business Association of New England
http://www.sebane.org

NESEA- Northeast Sustainable Energy Association
http://www.nesea.org/sgp/ (Sustainable Green Pages)

NABCEP- North American Board of Certified Energy Practioners
https://www.nabcep.org/

**Meet Interconnect Standards**- the local investor owned electric utilities such as National Grid, Northeast Utilities/ Eversouce Energy have interconnection procedures with documentation that must be followed. If your community is served by a municipal electric compny, investigate the interconnection procedures during the design phase.

**Meet Electrical Code.** NEC 2020 Article 690 – Solar Photovoltaic Systems. Article 690 points to other sections of the electrical code.

**Meet good practice** – Recommendations:

1. Avoid creating habitat for birds and squirrels- accessible spaces under a PV array that have a horizontal rail close to the roof allow animals to create nests that are supported by the rail.
2. Keep wires off the roof using wire ties, etc..
3. Use lightning arrestors on the roof.
4. Confirm that module string sizing for an invertor is within the voltage range, perferable not at the bottom of the voltage range.
5. For large PV systems in new construction, it is advisable to properly size electrical service to meet the electrical code. This may require a larger service to be installed.

Preparing for Potential Future PV Installation:

- ❑ There are several minor measures that can be adopted during new construction or significant rehabilitation work that can greatly reduce the cost of adding solar PV generation or solar hot water at a later date. Consultants with PV expertise should evaluate the following components:

1. Install metal conduit for DC power from attic or roof to basement or electrical room. Determine conduit sizing with the intended scale of PV system array.
2. Reserve space next to targeted electric service panel for inverter, meters, disconnect and other electrical equipment.

3. In new construction or renovation, consult with PV integrator to determine if electrical service should be larger to accommodate potential PV system.
4. In new construction, design roof to be strong enough to accommodate the additional weight of PV system.
5. In new construction, keep roof areas designated for PV clear of vent pipes and other obstructions in the design phase and during the construction process.
6. Additional signal wire/or conduit may be installed for sensing physical parameters such as sunlight, temperature, wind speed, etc..

- ❑ Estimating potential PV array size for a roof:
  1. For a rectangular roof with no features in it and no shading, should have a minimum of 60% of the roof area covered by a PV array. This would allow for some open roof from the top of the array to the peak of the roof, open roof from the bottom of the array to the eave of the roof, and some area of exposed roof on either end of the array. Conservatively every 100 square feet of roof space will accommodate 1 kW DC of PV array. The same 100 square feet of roof space will accommodate 1.5 kW DC of PV array using the most efficient PV modules.
  2. Flat Roof- vent pipes, elevator shafts, HVAC equipment, skylights, etc, may significantly reduce the potential usable area for mounting a PV array. When installing new roof vent pipes consider the distance requirements between vent pipes and future PV arrays. If possible, place roof walkways on North side of roofs. Roughly a PV array should be 3 times the distance away from a roof obstruction as it is tall to avoid shading. Ballasted PV systems should typically be a least 6 feet from the edge of a roof with 10 feet from the edge of a roof being a more conservative approach. It is advisable that a PV integrator be involved in this decision. PV systems may be installed flat to the roof or tilted. Tilted mounting take more space but produces more energy per installed watt than flat mounted systems. A PV mounting systems that tilts the modules 5 to 10 degrees will use approximately 50% more roof space than a flat mounted system per kW.

- ❑ Designing for PV on new construction building roofs:
  1. Orient sloped roofs to near South if possible.
  2. Plant trees types that do not grow tall enough to shade roofs.
  3. Cut trees to accommodate solar access for PV or abandon PV if the trees are highly valued.
  4. Design buildings so that they do not self shade. One wing of a building might shade a South facing roof of another part of a building for a significant part of the day.
  5. Reduce interruptions in South facing roofs, such a dormers, vent pipes, skylights, etc. within reason or abandon PV if other features are of higher value and leave little South facing roof space.
  6. Study PV mounting systems to determine best ways to perpare for PV. Accurately recording the framing layout is often useful.

7. Allocate space for inverter and electrical gear near electrical distribution panel.
8. Run metal conduit for DC power from attic to basement (typical installation) before closing in walls.
9. Properly size the electrical distribution system to accommodate the size PV system to be installed. This step must happen early in the construction process.

## GROUND MOUNTED SOLAR PV SYSTEMS

A ground mount system that can rotate single or double during the day might be appropriate near a housing development if the housing authority owns land that could not foreseeably be needed in the future for residential use.

Instead of depending on the pitch and orientation of the roof, a ground mount system can be installed to capture as much sunlight as possible and maximize electrical output. Ground mount solar systems allow for more air circulation around the solar panels, which actually perform best in cooler temperatures. They are also easier to clean if a good rainfall doesn't do the job.

## CLIMATE RESILIENCE RESOURCES

Project teams can learn more about best practices for solar photovoltaic systems from this resources and others:

- The Clean Energy Group provides technical and design guidance for solar photovoltaic and battery storage systems, as well as technical assistance funding for feasibility studies to affordable and low-income housing partners: https://www.cleanegroup.org/ceg-projects/solar-storage-optimization/
- The National Renewable Energy Laboratory's REopt Lite tool is a user-friendly, web-based, free solar photovoltaic and battery storage system feasibility assessment tool: https://reopt.nrel.gov/tool
- The National Renewable Energy Laboratory's PVWatts is a web-based, free preliminary solar feasibility assessment tool: https://pvwatts.nrel.gov

# DESIGN AND CONSTRUCTION GUIDELINES AND STANDARDS

DIVISION 07 • THERMAL & MOISTURE PROTECTION

# 07 10 00 • WATERPROOFING & DAMPPROOFING

## SECTION INCLUDES

Dampproofing
Bituminous Waterproofing
Air/Vapor Barriers
Water Repellants

## RELATED GUIDELINE SECTIONS

| | |
|---|---|
| 03 30 00 | Concrete |
| 04 20 00 | Unit Masonry |
| 07 90 00 | Sealants |
| 31 00 00 | Earthwork |

## REFERENCES

**IBC Section 406 and Mass amendment 406.2 Residential Code**
**IBC Section 1805 Building Code Mass Amendments 1805.1.1.2, 1805.4.2 & 1805.5**

**Filed Sub Bid**

**M.G.L. c.149 §44F**

*Waterproofing, damp-proofing and caulking is a stipulated filed sub-bid category under M.G.L. Chapter 149, §44F. While these types of work are typically specified in different sections if the cumulative estimated value of the work in this section exceeds $25,000 and the projects total cost is over $150,000.it triggers the filed sub-bid requirement. If this is the case, specify it all in a single section to avoid confusion*

**Note that a wide range of waterproofing products and assemblies would be considered part of this file sub-bid. Only materials typically used for public housing are discussed herein. Care should be taken when an atypical waterproofing product, such as traffic coatings, and deck and plaza waterproofing systems are included as part of the filed sub bid.**

## CLIMATE RESILIENCE DESIGN CONSIDERATIONS

Waterproofing is a climate resilience best practice for protecting the building structure and equipment from flooding associated with extreme precipitation, sea level rise and extreme tidal conditions. It is particularly critical for elevator systems and to keep electrical, heating, cooling, and domestic hot water systems from flooding. It can have the added benefit of reducing pest infestation, such as from termites that is likely to become worse over time as the climate zone in Massachusetts becomes warmer and more humid.

# 07 10 00 • WATERPROOFING & DAMPPROOFING

Waterproofing may only be of value for a limited time in buildings that already experience frequent and severe flooding. Few of the original plans for housing authority buildings have information about the elevation of each building in a development that could be compared to the future flood elevation projections that are or will soon be available for most Massachusetts communities (2030, 2050, and 2070). For some buildings, relocating electrical and mechanical equipment from basements to upper floors, diverting coastal or stormwater flood waters away from a building with piped stormwater infrastructure or external permanent, or temporary barriers, or pumping water out of below-grade spaces with sump pumps should be compared to the efficacy of a major waterproofing project.

Waterproofing should be continuous from the lowest point in the building up to the Design Flood Elevation (DFE).

## TECHNICAL STANDARDS

### FOUNDATION & WALL DAMPPROOFING & WATERPROOFING

#### MATERIALS

There is a distinct difference between dampproofing and waterproofing. Dampproofing is intended to keep out soil moisture, while waterproofing is intended to keep out both moisture and water. Waterproofing is intended to create a barrier that large quantities of water, under pressure (such as standing water), cannot penetrate. Dampproofing is intended to prevent the penetration of small quantities of water not under pressure. As waterproofing is a more rigorous and usually a more expensive treatment than dampproofing, waterproofing should only be used when damp-proofing will not provide sufficient protection. In general, the designer should avoid construction below the water table.

### DAMPPROOFING

The intent is to protect interior surfaces from water vapor diffusion, and moisture wicked in by capillary action.

Products available include:

- Crystallization products or cementitious coatings are often used in elevator or sump pits on the “Negative” or interior side only.
- Cementitious coatings to exterior of foundation wall, “Parging” used for CMU walls conforming to ASTM C887.
- Asphaltic or Bituminous Coatings applied to exterior of foundation wall. Spray on or trowel-on applications. General Installation: Apply dampproofing to exterior below grade concrete walls in contact with earth or other backfill, and where the space is enclosed on the opposite side. Apply to back side of concrete or masonry retaining walls to prevent the percolating of water through the wall. Requires the installation of a protection board.

# 07 10 00 • WATERPROOFING & DAMPPROOFING

## WATERPROOFING

Applied to exterior (positive) side. Products should meet ASTM C-836

- Asphaltic based products applied to exterior of foundation wall. Built up with 2 or 3 coats combined with membranes. Most economical

- Rubberized asphalt coating applied to exterior of foundation wall or slab surface. High performance and more flexible. Spray applied or sheet membranes. Requires a protection layer.

- Clay based waterproofing system applied to exterior of foundation wall. This is a traditional and effective solution for difficult waterproofing situations, but it is costly and requires careful application.

- Thermoplastic Sheet Waterproofing: Typically a multi-layered PVC membrane system combined with drainage blanket and reinforcing fabrics. An effective system typically used for below grade habitable spaces.

In wet areas, a rigid insulation board drain system with channels is used in conjunction with a perimeter drain in order to direct water away from the foundation.
All of the above the systems rely on a properly designed drainage system. Civil engineering services should be used.

### Design

Dampproof basement, foundation walls and provide waterproofing as dictated by site conditions. A full range of test pits or borings should be utilized to identify subsurface soil and water table issues.

Testing of waterproofing (ponding, spray tests) assemblies is recommended prior to covering.

## AIR/VAPOR BARRIERS

### Materials

For midrise residential buildings, the Massachusetts Energy Code requires a continuous air barrier assembly at opaque exterior walls or soffits, including joints and junctions to abutting constructions to control air movement through the wall. The air barrier also serves as a liquid-water drainage plane flashed to discharge water or condensation to the exterior.

Modified Bituminous Sheet is the recommended product: Consider using a 40-mil thick, peel and stick membranes. Care must be taken in selecting compatible accessory transition strips to adjacent spray applied materials. Compatibility of material issues may require the use of a primer prior to attachment.

## UNIT MASONRY & VENEER BRICK WATER REPELLENTS

**Materials**

Protective Coatings: The resolution of water infiltration problems at above ground masonry should be accomplished by other means than masonry sealants or coatings. If circumstances demand the use of these products, a penetrating "breathable" system containing silane or siloxanes should be used rather than a film coating.

Protective masonry coatings are acceptable as long as they allow moisture to escape. Coatings should have a 10 year minimum guarantee.

**Design**

Specify water repellants in accordance with manufacturer's recommendations.

**CLIMATE RESILIENCE RESOURCES**
Project teams can learn more about best practices for moisture control from this resources and others:

- EPA's guide "Moisture Control Guidance for Building Design, Construction and Maintenance" has strategies for using appropriate paint types and photos of example challenging conditions: https://www.epa.gov/sites/production/files/2014-08/documents/moisture-control.pdf
- FEMA's publication "Reducing Flood Risk to Residential Buildings That Cannot Be Elevated" (FEMA P-1037) has strategies and graphics explaining how to reduce water intrusion as well as some of the details to consider when doing so. https://www.fema.gov/media-library-data/1443014398612-a4dfc0f86711bc72434b82c4b100a677/revFEMA_HMA_Grants_4pg_2015_508.pdf
- FEMA's "Flood Damage-Resistant Materials Requirements" (FEMA Technical Bulletin 2) should be used for materials selection in waterproofed spaces: https://www.fema.gov/media-library-data/20130726-1502-20490-4764/fema_tb_2_rev1.pdf

# DESIGN AND CONSTRUCTION GUIDELINES AND STANDARDS

DIVISION 7 • THERMAL & MOISTURE PROTECTION

## 07 20 00 • BUILDING INSULATION & MOISTURE PROTECTION

### SECTION INCLUDES

Batt Insulation
Insulating Sheathing
Rigid Insulation
Blown-In Loose Fill Insulation
Blown-In Foam Insulation
Water Barrier
Vapor Retarder
Air Barrier Systems

### RELATED GUIDELINE SECTIONS

| | |
|---|---|
| 03 30 00 | Concrete |
| 04 20 00 | Unit Masonry |
| 06 10 00 | Rough Carpentry |
| 07 10 00 | Waterproofing and Dampproofing |
| 07 40 00 | Siding |
| 07 50 00 | Membrane Roofing |
| 07 90 00 | Sealants |

### INTRODUCTION

The standards for effectiveness of building insulation have increased substantially as effects of greenhouse gases has become known, and as the cost of energy has increased.

In recognition of the fact that energy use has impacts well beyond the individual building owner and occupants, the Massachusetts State Building Code (780 CMR), sections of 2015 IEBC and 2015 IBC now contain requirements for building insulation and moisture control.The use of energy certification programs such as ResChec is now required in most cities and towns which may apply to scattered site single family buildings

The use of improved insulation and moisture control in new construction and the retro-fitting of insulation in existing structures has created unforeseen problems, especially with moisture and mold growth. Building scientists continue to study the dynamics of the building envelope and have focused attention on the need for air barriers, moisture retarders, and interior ventilation, as well as the traditional weather (bulk water) barrier and insulation. For a comfortable, durable, cost-effective, healthful building, all these factors must be considered together.

Additions and partial renovations of existing structures present special issues for building envelope systems due to the fact that the entire envelope is not being addressed.

## CLIMATE RESILIENCE DESIGN CONSIDERATIONS

Well insulated, airtight buildings with appropriate vapor control keep heat inside in winter and can be cooled more efficiently in summer. This section on insulation and moisture protection is  applicable to both “normal” weather variability as well as the more extreme thermal conditions, extreme precipitaion, and flooding that may be exacerbated by climate change,

The need for moisture protection associated with upgrading building insulation is an issue that requires attention both to internally trapped moisture from vapor drive and condensation.

## SELECTING INSULATION SYSTEMS

### GOAL

The designer’s goal should be to design an effective, low-cost, durable, non-toxic building envelope which contributes minimal greenhouse gas to the environment and contributes to climate resilience. The insulation and moisture control materials should be selected to work effectively with the other components of the envelope.

### REQUIREMENTS

Refer to the latest codes, as the requirements for insulation, water, moisture and air barriers get more stringent with each edition. DHCD favors exceeding code requirements. There are utility funded weatherization programs available in many communities served by an investor-owned utility company.

The building envelope must include an air barrier, a moisture retarder and a water barrier, as well as the thermal insulation. Insulation can perform multiple functions, depending on the type of insulation, where it is located, and the overall design of the assembly.

### OTHER FACTORS TO CONSIDER

Type of insulation: Insulation can be in the form of batts or rigid boards, or it may be blown-in or sprayed in. There is a unique set of pros and cons for each insulation product as noted in the insulation products section below.

Effectiveness: Note the aged insulation values when designing and calculating the insulation’s thermal value in assemblies and to meet MA Energy Code requirements. Foam insulations may degrade over time, while loose fill insulations may settle.

Cost and Availability: Be aware of what’s actually available and cost-effective.  Prices may fluctuate widely from year to year and the industry is constantly evolving to produce new, safer and more cost-effective products.

Life Cyle Cost: Analyse the cost benefit of adding longer lasting more expensive insulating material options.

Constructability: Make certain to design a system that can be built. Consider construction sequences and divisions of labor and sub-contracts.

Durability: Insulation assemblies should remain intact and effective for very long periods of time, generally for the life of the building, which could be 50 to 100 years, or longer.

Toxicity: Consider what is included in the insulation product, such as flame retardants, insecticides, formaldehyde, or other potentially toxic materials. Reduce the potential for toxic chemicals in the environment wherever feasible.

Global Warming Potential (GWP): One reason for using insulation is to reduce the emissions of greenhouse cases into the environment. The designer should consider the GWP of the insulation manufacture and transportation, as well as the nature of the blowing agents in foam. Blowing agents may leak out of the foam over time and may have a GWP that is 1,000 or more times that of $CO_2$.

Ozone Depleting Potential (ODP): Although foam blowing agents in the past sometimes had high ODP, these agents have generally been phased out.

### WATER BARRIER

Bulk water barriers are required for all new construction, additions, and siding replacements. The most effective wall assemblies have a primary water barrier (the exterior cladding: brick, clapboards, shingles, etc.) and a secondary, vapor-open, bulk water barrier (house wrap with all joints taped, peel-and-stick membrane, liquid-applied air and water barrier or other product). Some sort of spacer or vented rainscreen should be applied exterior to the secondary water barrier to facilitate drainage of any water that penetrates past the exterior cladding.

Water barriers placed to the exterior of the insulation should be vapor open so that moisture is not trapped in the assembly. Water barriers may also perform as air barriers if properly detailed.

### THERMAL INSULATION

The designer should consider providing additional insulation to further reduce energy requirements and its attendant GWP.

Insulation is most effective when it is continuous rather than being interrupted by studs and other elements. Studs act as thermal bridges, significantly reducing the effectiveness of the insulation and creating cold spots in the envelope. Metal studs are much worse than wood studs. Even fasteners can act as thermal bridges

### VAPOR RETARDER

Vapor retarders are often included in wall and roof assemblies to inhibit moisture diffusion into envelope cavities where it may condense and damage the assembly. Moisture tends to diffuse from areas of higher humidity (typically the interior, heated space) to areas of lower humidity (typically cold outside air). The wall or roof assembly needs to be designed to avoid moisture getting into the cavities, cooling down below its dew point, and condensing in the cavity. Placing materials with low perm ratings on the heated side of the assembly is an effective way to block moisture diffusion, if there is no insulation exterior of the sheathing. if there is no insulation exterior of the sheathing. With exterior continuous insulation of at least R-7.5, no vapor retarder should be placed on the interior, heated side of the assembly.

High permeability materials should be used on the cold side of the envelope assembly to permit moisture that does get into the assembly to diffuse to the exterior, allowing the assembly to dry out. Assemblies should be analyzed to ensure that the materials used will not trap water. The Building Science Corporation website lists permeability of many common building materials. (http://www.buildingscience.com/documents/information-sheets/building-materials-property-table/ )

Penetrations or gaps in the moisture barrier are a serious matter, especiallyif the moisture barrier is also the air barrier, care must be taken to seal all openings, electric boxes, seams, tears, etc.

### AIR BARRIER

Air barriers are required for all new construction, additions, and siding replacements. Air barriers may be formed of rigid materials or flexible membranes that are securely fastened and sealed to resist air infiltration. All seams and penetrations must be sealed and all transitions from wall planes to foundations, floors, ceilings or roof planes, as well as doors and windows, must be fully detailed for a continuous barrier covering the entire building.

An air barrier may be placed anywhere within the wall or roof assembly. It can be a taped “house wrap” or “peel-and-stick” membrane placed outside the sheathing, air-tight sheathing with taped joints, air-tight drywall construction, spray foam insulation, or some combination of these products. Continuity is important as a small opening can allow a large volume of air to move through it. The air may carry moisture which will condense within the wall or roof assembly, causing mold or rot to form, or it may just leak unconditioned air into the building or conditioned air out of the building. Special attention should be paid to transitions from walls to roofs and at other building elements which may tend to interrupt the barrier.

The air barrier may also function as a water barrier or moisture retarder. It is important that the membrane's physical properties and position in the assembly are consistent with the functions (intentional or not) that it will perform. A well installed building wrap can function both as a water barrier and an air barrier, thus serving two of the four building envelope functions. Building wraps are often placed outside the insulation where they perform as a secondary water barrier behind the siding. They are designed to be vapor permeable to allow moisture to migrate from the wall assembly to the outside.

In high-rise construction, the vapor, water, and air barrier are often one product. These products are designed to be vapor retarders. In the Massachusetts climate they should only be used where insulation is applied exterior to the membrane. The membrane also acts as a secondary water barrier. The insulation to the exterior is generally a foam that will perform when wet from water leaking past the siding. It may also have to be dense enough to provide support for the siding.

Refer to Energy Star "Thermal Enclosure System Rater Checklist" (http://www.energystar.gov/ia/partners/bldrs_lenders_raters/downloads/Energy_Star_v3_TERC_Guidebook.pdf) for specific requirements for fully-aligned air barriers. See also the Energy Star "Water Management System Builder Checklist" in the same document for required drainage plane (water barrier) behind exterior cladding.

### Fire Protection

In general, insulation should not be left exposed in living spaces or basements. Batt facings, and foam insulation require ½" gyp board finished.

## Insulation Products

### Batt Insulation

Batt insulation, whether fiberglass, mineral wool, or some other material is relatively inexpensive and is easily installed in stud wall framing, as well as other locations. The effectiveness of batt insulation may be significantly reduced by internal air circulation as well as by gaps allowing air to move around the insulation, by compression of the insulation, and by conduction through framing (thermal bridging). It can be difficult to install properly at electric boxes, wires, and pipes, where it should be cut to avoid being compressed.

Mineral and glass fibers are skin and respiratory irritants and should be isolated from occupied spaces. Protective gear should be required for installers.
Mineral and glass fibers typically have 20-30% recycled content and a very low global warming potential (GWP).

Avoid using fiberglass batt which contains formaldehyde.

Batts may get wet during flooding and are easily replaced. Any cavity insulation that becomes wet during flooding should be tested both for mold and for moisture content before re-installing or sealing the cavity.

#### RIGID INSULATION

While foam insulation boards may be more expensive than batts, they allow for a more effective thermal layer when placed across the exterior of the sheathing or interior of the framing to prevent thermal bridgingSome board products can also be used for the moisture barrier, air barrier, and/or secondary water barrier, when joints are properly sealed and taped.

Foams are made from petrochemicals, which are a limited resource. They are inherently flammable and so are generally manufactured with flame retardants. Some also have termiticides to fend off termites who would otherwise consider the foam an excellent place to colonize. Bromated flame retardants, as used with polystyrene, present a greater health concern than the nonbromated retardants used in other foams. As noted above under Fire Protection, foam boards generally should not be left exposed.

Polyisocyanurate (polyiso) insulation board has the highest R-value of the common insulation boards. It also has a fairly low GWP based on the use of Pentane for the blowing agent. Polyiso is often provided with aluminum facings, which can make it an effective air and moisture barrier. All seams have to be taped and other joints need to be sealed for a complete air barrier. Polyiso may contain TCPP flame retardants, although this fact may not show up in the MSDS sheet. TCPP is regarded as environmentally preferable to HBCD used in polystyrene.

Polystyrene can be either extruded (XPS) or expanded (EPS). These products are significantly different from each other. XPS has often been preferred for building insulation in the past as it had a higher R value and was more durable. However, the XPS blowing agent has been changed to avoid ozone depleting chemicals and this has lowered its R value to be comparable to EPS.

Foam boards may get wet during flooding and then dried out after opening up the cavity and ensuring adequate dehumidification. Any cavities that become wet during flooding should be tested both for mold and for moisture content before re-installing insulation or sealing the cavity.

### BLOWN –IN LOOSE FILL INSULATION

Cellulose, Rock Wool, Fiberglass or Slag-Wool are all acceptable choices for blown in insulation. Products should be selected which don't require a binder to be added. The Designer should specify the most cost effective choice based on local availability.

If wet-blown cellulose is specified be sure the specifications require ample drying time; minimum 3 days in the construction schedule and additional time if climatic conditions require or higher amounts of water than 1.5 lbs. per bag, are used in the installation.

Cellulose:
If cellulose is used, specify baffles or some method for holding down insulation in areas of potential high velocity air movement, such as adjacent to gable vents and also provide rigid insulation hatch covers for all moveable portions of attic floor, such as stairs and access hatches. If cellulose is specified which contains ammonium sulfate fire-retardant require the insulation to be isolated from metals and pipes, particularly in wet-spray applications, due to corrosive effects of chemicals in insulation with metal.

Loose fill, especially cellulose, can not be allowed to get wet during flooding Any cavities with loose fill that become wet during flooding should be cleared of all insulation and tested both for mold and for moisture content before installing new insulation and sealing the cavity.

### BLOWN –IN FOAM INSULATION

Because of concerns of toxicity, spray polyurethane foam should only be used when no other options are available.

Urethane/Icynene Foams are among the most durable insulation materials, have excellent bonding characeristics and ability to fill cracks and crevices, and may be cost-effective where these particular attributes are required or for hard to access cavities and crevices.

Evaluate product availability and cost prior to specifying, choose ASTM C1303-rated products with low thermal drift and which do not employ HCFC blowing agents.  Some of these product may not be cost effective on moderniation applications because of the high cost of  mobilization.

Typical products are closed cell polyurethane, open cell polyurethane and cementitious foam insulation. They should be used as the scenario dictates.

Spray foam may get wet during flooding and then dried out after opening up the cavity and ensuring adequate dehumidification. Any cavities that become wet during flooding should be tested both for mold and for moisture content before re-sealing the cavity.

### INSULATING SHEATHING

Other products, such as insulated sheathing may be used if approriate.

## RELATED BUILDING ENVELOPE PRODUCTS

### PRODUCTS

An air barrier is not a product; it is a system including sheets or membranes, tapes, and sealants, forming a barrier which is continuous over the entire building envelope. Products comprising this system may include the following:

Building wraps may be manufactured from polyethylene or polyolefin.

- ❑ Building Wrap: ASTM E 1677, Type I air retarder; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E 84; UV stabilized; and acceptable to authorities having jurisdiction.
  - Water-Vapor Permeance: Not less than 10 perms using
  - ASTM E 96, Desiccant Method (Procedure A).
  - Allowable UV Exposure Time: Not less than three months.
- ❑ Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.
- ❑ Building-Wrap Fasteners: Fasteners as recommended by the manufacturer to resist pull-through due to air pressure from the interior of the building.

### OPENINGS & PENETRATIONS

Foamed in place low-expansion polyurethane (1.5-1.75 pcf), acoustic sealant, or gasketing is required around windows, doors, ducts, and all other building envelope penetrations including pipes, wiring, tops of chase walls, flues, access panels, elevator shafts, etc. At flanged windows the sealant should be behind the flange at the side flanges. Lap the building wrap in the direction of water flow.

Installation of low-expansion foam should be sufficient to fill void with out causing window or door operation problems by overfilling.

### INSTALLATION

Install wraps following manufacturers instructions. Seal all seams, edges, fasteners, and penetrations with tape. Extend into jambs of openings and seal corners with tape. Wrap must be installed with manufacturer-approved fasteners or furring strips in order to resist billowing and fasterner pull-outs due to air pressure from either inside or outside. It is imperative that the wrap be protected from abuse during construction.

Seal wrap where new construction abuts existing and at all adjacent construction including roofs, foundations, windows and doors. Designer must provide details for all such conditions.

Some self adhered membranes may require that a primer is installed on the substrate in order for the membrane to stick.

## SPECIFIC APPLICATIONS

### FOUNDATIONS

Rim Joists: Specify and detail insulation at rim joists and chases at exterior walls. Fully insulate at rim joists.

Crawl spaces: For slab-on-grade and crawl space foundations, perimeter insulation should extend down at least 4 feet from grade unless ventilated. For unvented crawl spaces, mechanical ventialion is required

Basement foundations: perimeter insulation should extend all the way down to the top of the footing to help keep it in place during backfill. Insulation can be anchored higher up on the wall with a construction adhesive specifically formulated for adhering extruded polystyrene.

Use 2" rigid insulation, min. 25 psi under the entire slab in basements which are occupied or for slab-on-grade multi-family residential construction. Consider ship-lapped or tongue and groove insulation during design, if it is available and cost-effective at the time of construction.

Interior foundation insulation is prefered. Where exterior foundation insulation must be used, cover exterior exposed portions of the foundation insulation with a reinforced cement board or rigid fiberglass reinforced plastic protection board. For very large exposed areas of foundation insulation, consider providing strapping and covering with siding.

Waterproofing rigid insulation board with grooves cut into it that channel water toward drain lines may be used at basements in lieu of, or in addition to, drainage fill.

Sill sealer: Provide a non-water absorbing sealant between the foundation and sill. Seal rim joist penetrations prior to insulating.

### FLOORS

Batt insulation having facings with flame-spread ratings above 25 and smoke-developed indexes above 450 should not be left exposed in open joists above basements and crawlspaces. This applies to most batt insulation products with facings. See fire resistant construction applicable requirements of the Residential Building Code and thermal and sound insulation materials in the Base Building Code for finish materials over the batt insulation.

Unfaced batts, properly secured, may be installed above crawl spaces, but should not be left exposed above basements as the glass fibers will get into the air and irritate the skin of occupants and as batts may contain small quantities of phenol-formaldehyde binder, which is a carcinogen.

### EXTERIOR WALLS

The prefered location for the air barrier is outside of the framing in stud wall construction. In that location it will be less impacted by wiring, electric boxes, interior partitions, and so forth.

Insulating sheathing should be installed continuous without penetrations by blocking, furring strips or framing members. For best thermal performance, it is preferred that insulation extend up to the rough opening of windows and that low expansion foam be used to seal at the perimeter of windows.

Expanded polystyrene foam (EPS) is not as durable as extruded products but is sometimes recommended for its permeability and/or reduced environmental impact. EPS quality varies; look for breaking through beads, not between them.

Use tongue & groove foam board in order to prevent gaps and air infiltration. Ensure that all components of the building envelope run continuously behind tubs and shower units. These are often installed before interior insulation and wallboards, which can result in a lack of insulation or other components in that area. In bath retrofit situations apply insulation to exterior walls. Partition walls may interrupt interior components of the envelope assembly.
Pay close attention to detailing, especially if the air barrier will be impacted. Chases, stairways and other items on the perimeter can present special difficulties.

### OPENINGS & PENETRATIONS

Do not use fiberglass to seal around window openings, outlets or exterior wall penetrations; use low expansion foam instead.

Install only sealants rated for high-temperatures around furnace flues or chimney penetrations in attics. Do not use spray foam.

Consider building flashing shrouds around metal furnace and water heater flues which will provide a minimum of 1” separation between inner flue and outer flue, while sealing air penetrations and allowing insulation to be placed around the outer flue.

### ROOFS/ATTICS

When there are existing water pipes running through attics, use batts to provide an insulation tent whereby pipes are fully covered with insulation and exposed to ceiling drywall below which will allow conditioned air to reach the pipes.

Insulate interior access hatches to attics with layers of rigid insulation in conjunction with weatherstripping to create a well sealed and insulated opening. Follow Energy Star guidelines, available at www.energystar.gov.

Under roofing, specify only rigid insulation that is approved by the roofing membrane manufacturer. Tapered insulation is required on flat roofs where framing does not provide positive drainage pitch. Insulation used with built-up roofing must have a layer of fiberboard or other material that will absorb water vapor, otherwise blistering will occur. When using two layers of insulation, stagger the joints to avoid a through seam.

At the perimeter of attics, the full depth of blown-in insulation should cover the top plate but should not extend out beyond into the unheated eave space;  about 12 inches clear is needed to allow for full insulation. This requires use of raised heel trusses unless the roof pitch is about 8 in 12. Blown in insulation is susceptible  to being blown around in the attic space - leaving areas uninsulated, in some instances pipes can be left unprotected if special provisions are not taken to prevent such insulation drifting. Provide blocking to keep ventilation air from infiltrating the insulation. To ensure adequate attic ventilation, provide a baffle or other means for a channel for air flow from the soffit vent to the ridge vent.

Combine fiberglass batts with blown-in insulation to provide an insulation tent for water pipes that are run through attics  Do not install insulation between the pipes and the ceiling below. Air seal floor of attic before insulation is added. Use flags (witness stakes) to determine the depth of cellulose as it is blown in.

### REFERENCES

Air Barrier Association:
http://www.airbarrier.org/views/design_e.php

Environmental Building News 19:6 “Avoiding the Global Warming Impact of Insulation”. 2010.
http://www.buildinggreen.com/auth/article.cfm/2010/6/1/Avoiding-the-Global-Warming-Impact-of-Insulation/

Energy Star "Thermal Enclosure System Rater Checklist"
http://www.energystar.gov/ia/partners/bldrs_lenders_raters/downloads/Energy_Star_v3_TERC_Guidebook.pdf

The Building Science Corporation website lists permeability of many common building materials.
http://www.buildingscience.com/documents/information-sheets/building-materials-property-table/

BuildingGreen.com. "The Global Warming Potential of Insulation Materials – New Calculator". March 21, 2011
http://www.buildinggreen.com/live/index.cfm/2011/3/21/Global-Warming-Potential-Insulation-Calculator-polystyrene-eps-xps-gwp

BuildingGreen.com. "Insulation: Thermal Performance is Just the Beginning". 14:1 2005.
http://www.buildinggreen.com/auth/article.cfm/2005/1/1/Insulation-Thermal-Performance-is-Just-the-Beginning/

Insulation- The BuildingGreen Guide to Insulation Products and Practices Alex Wilson. BuildingGreen, Inc. 2012
http://www.buildinggreen.com/auth/article.cfm/2011/10/20/Guide-to-Insulation-Products-and-Practices-Released/

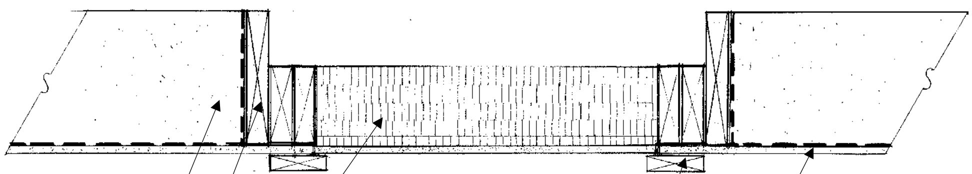
**CLIMATE RESILIENCE RESOURCES**

Project teams can learn more about best practices for moisture control from this resources and others:

- FEMA's "Flood Damage-Resistant Materials Requirements" (FEMA Technical Bulletin 2) should be used for materials selection in waterproofed spaces: https://www.fema.gov/media-library-data/20130726-1502-20490-4764/fema_tb_2_rev1.pdf

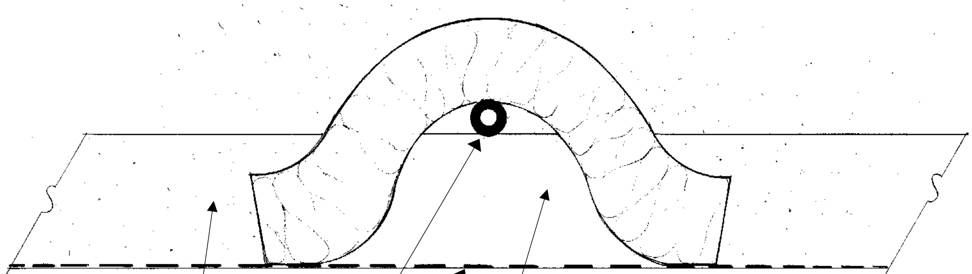
# 07 20 001 • ATTIC HATCH & INSULATION TENT

## INSULATED ATTIC HATCH



Batt or loose-fill
Insulation
2" × Rough Framing"
4" rigid insul.
Self-adhering foam
Weather stripping
Vapor barrier
NOTE:
Provide locks to compress hatch onto weather stripping

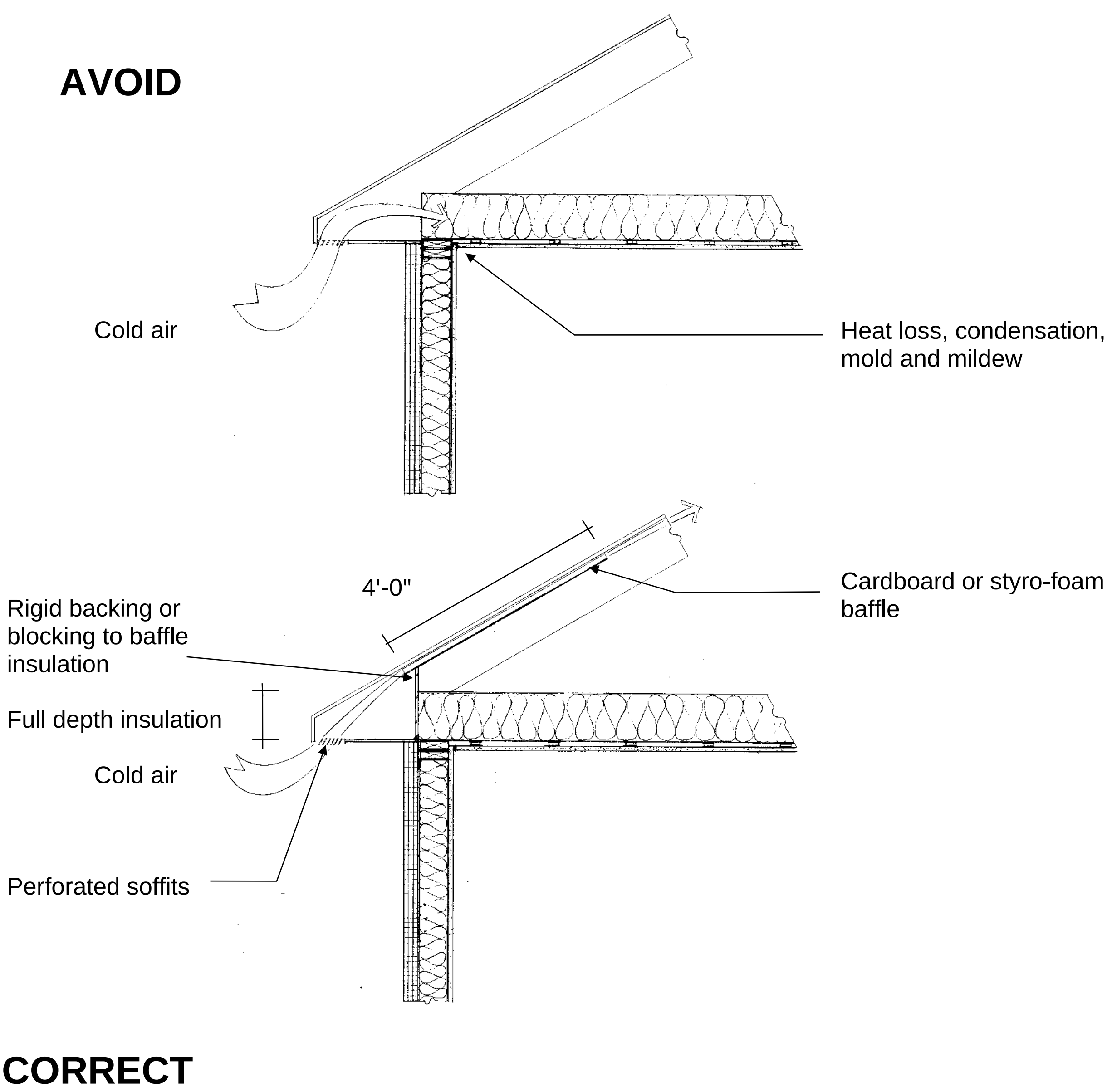
## ATTIC INSULATED TENT OVER PIPES



Cellulose
Insulated pipe
Vapor barrier
Open

**07 20 001 • INSULATION** | **ATTIC HATCH & INSULATION TENT**

# 07 20 002 • SOFFIT INSULATION DAM




**07 20 002 • INSULATION** | **SOFFIT INSULATION DAM**

# DESIGN AND CONSTRUCTION GUIDELINES AND STANDARDS

DIVISION 7 • THERMAL & MOISTURE PROTECTION

# 07 30 00 • ASPHALT ROOF SHINGLES

## SECTION INCLUDES

Roof Shingles
Underlayment
Rubberized Membrane
Fasteners
Flashing
Attic Ventilation

## RELATED GUIDELINE SECTIONS

| | |
|---|---|
| 01 74 19 | Waste Management |
| 02 41 00 | Demolition |
| 02 82 00 | Asbestos Remediation |
| 06 10 00 | Rough Carpentry |
| 07 07 00 | Solar Photovoltaic Systems |
| 07 20 00 | Building Insulation and Moisture Protection |
| 07 45 00 | Gutters and Downspouts |
| 07 62 00 | Sheet Metal Trim and Flashing |

For Contracts estimated over $100,000 that are predominately Roofing Work, the DCAMM category for the General Contractor should be Roofing.
An alternative is to have the DCAMM category as General Building Construction but will require filed sub-bids for the roofing. This requirement needs to be clearly spelled out in the Advertisement.

**Filed Sub Bid**

**M.G.L. c.149 §44F**

*When replacing shingle roofs are part of a larger General Contract, Roofing is a stipulated filed sub-bid category under M.G.L. Chapter 149, §44F. While different types of roofing are typically specified in different specification sections, if the project's total cost is over $150,000 and the cumulative estimated value of all roofing work exceeds $25,000.it triggers the filed sub-bid requirement. It is then better to specify all roofing work in a single section to avoid confusion.*

## CLIMATE RESILIENCE DESIGN CONSIDERATIONS

Massachusetts will experience increased amounts of precipitation and more extreme heat and storms in the coming years as a result of climate change. This increases the demand for effective roof drainage, as excessive amounts of precipitation, both rain and snow, can cause significant damage to a building if water is allowed to enter through a roof or wall assembly.

Insufficient roof drainage and insulation can lead to ice dams during the winter, which cause water leakage, rot, and mold growth. Making improvements to roof drainage will help buildings address the threat of water penetration and structural failures by effectively shedding the increased amounts of rain and snow. Improving roof insulation and performing air sealing at the eaves of sloped roofs will reduce the freeze-thaw cycling of ice and snow on the roof that leads to ice dams.

## 07 30 00 • ASPHALT ROOF SHINGLES

Consider adding a secondary water barrier when a roof is being rebuilt. NRCA and the International Code Council recommend the use of a secondary water barrier for all low slope roof systems. (Mass code requires two layers of underlayment on roof pitch between 2/12 and 4/12) A self-adhering polymer-modified bitumen underlayment provides a weatherproofing layer beneath primary roof coverings, and asphalt-saturated felts are water-shedding.

With asphalt-saturated felt alone, standing water can work its way under the felt in severe weather or in vulnerable areas of the roof and water can seep through fastener holes or other defects. Self-adhering underlayment contains a compound that seals around fasteners.

A roof replacement offers an ideal time to evaluate the orientation of the roof for future installation of solar photovoltaic (PV) or solar thermal domestic hot water heating systems. A solar PV system can be an importance climate resilience measure during power outages when coupled with a battery system and/or an islandable inverter. Even if a solar and battery installation is not cost effective at present, the roof replacement project should be designed for “solar readiness” at a future date. Making a roof replacement “Solar ready” can be done by making intentional design choices so that solar could be installed without having to change the roof structure, without having to open walls for conduit or electric cable, or without having to create an additional location for electric components, batteries, storage tanks, or other necessary components of the system. To make an asphalt roof “solar ready”, the work scope should address:

1) Identifying the roof surfaces that have the best solar exposure;
2) Ensuring that these surfaces are structurally designed to accommodate the weight, wind, and snow loads that the solar system might impose;
3) Relocating or consolidating rooftop equipment or plumbing vents from the roof surfaces with best exposure;
4) Identifying space within the building that is readily available for the installation of controls and ancillary components, such as electric invertors and hot water storage tanks; and
5) Installing an internal chase or other means for connecting the future rooftop solar system to the building’s mechanical or electrical systems and spaces identified for auxiliary solar equipment per 4) above.

### INVESTIGATION AND RESEARCH

Check for rotted and delaminated sheathing when examining attic spaces. This may be especially apparent in areas where leaks and water stains are visible, as well as around chimneys and other roof penetrations. It will be necessary to verify the actual thickness of the existing sheathing. The size specified on the original plans may not be a guarantee of the actual size and thickness.

# 07 30 00 • ASPHALT ROOF SHINGLES

Field verify the condition and existence of existing step flashing. In many instances it may be missing, or it might be the original deteriorated step flashing, even if the original roof may have been replaced.

Document the type and condition of the existing shingles. Check condition of the fascia and roof drainage system as this may be included in the roof replacement project. Test shingles and mastic for asbestos. Complete stripping and recycling of existing shingles is required. Check every building for the number of existing layers of shingles.

Examine the existing soffit, ridge and mechanical venting equipment. Be sure the existing insulation is not blocking the soffit venting system. Verify attic ventilation conforms to current new construction codes and upgrade wherever possible. Check with the Authority to determine if bath and kitchen exhaust is to be re-routed and ducted through the roof.

Verify that the existing roofs have adequate attic insulation to meet the current new building energy code and augment as required Funding may be available from the local utility companies and other sources to mitigate the cost to upgrade insulation.

Prior to visiting the site verify design wind speed for the development as this will determine if additional structural wall to rafter connections are required. See IEBC 706.3.2. In addition, nailing requirements for asphalt shingles must be verified and specified.

Design wall to roof/attic detail to coordinate and connect thermal, moisture, air and water barrier to provide a continuous weather barrier at the building envelope.

Evaluate the roof to determine if solar thermal or photovoltaic installations are feasible. Technical criteria for selecting potential PV sites should include condition of the roof, structural strength of roof for additional weight, orientation of roof, roof pitch, shading and electrical installation requirements. See Section 07 07 00 Photovoltaic Systems & Solar Thermal for more information. Discuss with DHCD and the Authority as to the feasibility of adding solar panels to the roof.

## TECHNICAL STANDARDS

### SHINGLES

### MATERIALS

Class "A" label fiberglass shingles that meet ASTM 3462 are preferred.

Shingles must carry a lifetime warranty and be algae resistant.

Architectural Shingles are preferred because installation is usually less labor intensive.

Consider using high solar reflectance index (SRI) ENERGY STAR light colored shingles to reduce the heat island effect outside the building and heat transmission into the building to reduce the impact of extreme heat and chronic temperature increases. Avoid dark brown and black shingles because they tend to build up and retain heat, and also have a shorter lifespan.

## 07 30 00 • ASPHALT ROOF SHINGLES

### DESIGN

Carefully detail flashing and connections where the roof pitch changes slope, especially from a steeper to a shallower pitch, or where a roof meets a wall.
Closed cut valleys should always be used – run a full 36" width of rubberized membrane up the entire length of all valleys.
Open valleys are not acceptable.
Develop details, or refer to the manufacturer's details, for each type of penetration including skylights, hatches, and exhaust and plumbing vents.

### EXECUTION

Always strip existing shingles and re-nail sheathing before re-shingling. Remove existing underlayment (including rubberized membranes) before installation of new underlayment. Specify magnetic device to aid in daily nail clean up.

Specify weather conditions that are NOT acceptable for shingle installation, ie temperatures below 40 degrees, high winds
and rain. Follow manufacturer's recommendations to ensure proper installation and to avoid compromising the warranty. Additional guidance is available at www.asphaltroofing.org (Asphalt Roofing Manufacturing Association)

## SHINGLE UNDERLAYMENT

### MATERIALS

Follow the recommendations of the shingle manufacturer for asphalt impregnated 15lb felt underlayment. Use double layer of roofing felt on roofs with a pitch of 3 in 12 or lower.
Use rubberized membrane 36" wide at valleys rake and at eaves to three feet inside of the heated wall perimeter line of the building. Membrane must be minimum 40 mil complying with ASTM D 1970 (Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials)

Most manufacturers make a variety of similar products; select the appropriate product for the project.

Run underlayment beneath the drip edge along the rake.

### EXECUTION

Install only as much of the felt underlayment that will be covered by shingles on the same day. Prolonged exposure to the weather creates wrinkles in the felt underlayment and leads to poor installation. When temperatures are below freezing, the contractor must wait to install shingles until roofs are dry and free of frost and moisture.

## FASTENERS

### MATERIALS

Use hot-dipped barbed shank galvanized roofing nails to fasten shingles because of their strong holding power.

Staples are not acceptable because they tend to punch through shingles.

# 07 30 00 • ASPHALT ROOF SHINGLES

### EXECUTION

Use of nail guns needs to be monitored closely. Some of the common problems include having the nail heads punch through the shingles, leaving the heads up too high, having the nail heads pop off, or having the nail driven in at an angle leaving a sharp edge that cuts through the top shingle.

Determine if there is a need for additional nailing or adhesive in addition to nailing for high wind applications such as properties near the ocean. See shingle manufacturer's installation guidelines for high wind applications.

## FLASHING

### MATERIALS

Flashing materials must be compatible with the specifications of the roofing system's manufacturer. See Section 07 62 00 Sheet Metal Trim and Flashing. For masonry chimneys, use lead coated copper flashing only. For step flashing at side walls use aluminum or lead coated copper; avoid galvanized steel. Always use an aluminum drip edge with a minimum 8" upturn leg. Aluminum drip edge must be a minimum of .024 gauge. Aluminum drip edge is recommended along the rakes, eaves and other special conditions.

### EXECUTION

Refer to the Sheet Metal and Air Conditioning Contractors National Association design manual for details and installation standards. www.smacna.org

## ATTIC VENTILATION

### DESIGN

Always calculate the existing ventilation to determine if additional ventilation may be necessary (see comments above). Lack of proper attic ventilation can lead to a host of moisture related problems in the building.

Ridge vents with soffit vents is the preferred approach to venting attics.

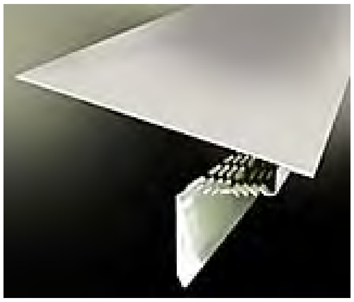
If there are existing gable vents do not add ridge vents.

### MATERIALS

Use heavy PVC ridge vents. Always specify a ridge vent with baffles. Roll type ventilation tends to get crushed and may not create the correct dynamic for good ventilation. Use perforated vinyl soffits, or fabricated continuous aluminum soffit vents, 1 to 2 inches wide with insect screens or fine holes.

In retrofit situations where there is no overhang and soffit ventilation does not exist consider extending the overhang to provide adequate soffit venting.

# 07 30 00 • ASPHALT ROOF SHINGLES



Coordinate location of ventilation with location of piping and other items in ventilated spaces.  These items may be susceptible to cold and freezing temperatures which may be intensified by the ventilation.

Install insulation baffles between the rafters to insure adequate air flow from the soffit venting system. See 07 20 002 Soffit Insulation Dam Detail. Also check the building insulation to ensure that adding soffit venting does not create a heating leak at the wall/roof intersection which will create ice damming issues as well as increase the costs of heating the dwelling units.

**CLIMATE RESILIENCE RESOURCES**
Project teams can learn more about best practices for protecting roofsby consulting these and other resources:

- The report “Climate Resilience Strategies for Buildings in New York State” includes information on materials to use when retrofitting asphalt roofs. It also includes guidance on reducing heat absorption and preparing roofs for significant rain. It is available here: here:https://ap.buffalo.edu/content/dam/ap/PDFs/NYSERDA/Climate-Resilience-Strategies-for-Buildings.pdf
- High solar reflectance index ENERGY STAR roofing products can be found here: https://www.energystar.gov/productfinder/product/certified-roof-products/

# 07 40 00 • SIDING

## SECTION INCLUDES

Wood Shingles and Shakes
Wood Clapboard Siding
Plastic Siding
Fiber Cement Siding Molded Wood/Resin Board & Hardboard Siding

## RELATED GUIDELINE SECTIONS

02 83 01 Lead Paint Remediation
06 65 00 Plastic & Composite Trim
07 45 00 Gutters and Downspouts
07 62 00 Sheet Metal Trim & Flashing
07 90 00 Sealants
08 10 00 Doors and Frames
08 50 00 Windows
09 90 00 Painting
31 31 00 Soil Treatment (termite protection)

## REFERENCES

ASTM D6864 Spec for Color and Appearance Retention of Solid Colored Plastic Siding Products
ASTM D3679-Vinyl Siding certification
ASTM D7251 Spec. for Color Retention
ASTM7254-Spec. for Polypropylene Siding
Vinyl Siding Institute www.vinylsiding.org
Cedar Shingle and Shake Bureau www.cedarbureau.org
Forest Stewardship Council www.fsc.org

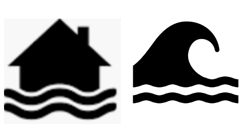
## GENERAL DESIGN CONSIDERATIONS

There are many types of siding used in public-housing which are proven good choices when the variables are considered. The Designer should evaluate the following before choosing a siding type:

- Durability;
- Ease of repair and maintenance;
- Neighborhood character and regional aesthetic features.
- Cost-effectiveness;
- Appearance; and
- Sustainability.

A preference is for siding that is regionally sourced, i.e. within 500 miles.

## CLIMATE RESILIENCE DESIGN CONSIDERATIONS



Moisture-resistive materials are useful where flooding is a concern. For coastal or areas where flooding is a concern, recommended materials include: Vinyl siding, fiber cement siding, brick or masonry, or heartwood of naturally durable species *FEMA 499, 1.7*

Resilient buildings in areas that experience frequent wind driven rain should include a pressure neutral rain-screen when installing fiber cement board, brick, masonry, or wood siding. Maintain an air gap between the siding and wall by installing suitable clips or vertical furring strips between the insulation, air and vapor retarder and siding material. The cavity facilitates drainage of water from the space between the vapor retarder and backside of the siding and it facilitates drying of the siding and vapor retarder.

Typical vinyl siding products inherently provide air cavities behind the siding that facilitate drainage, so vertical furring strips are not needed.

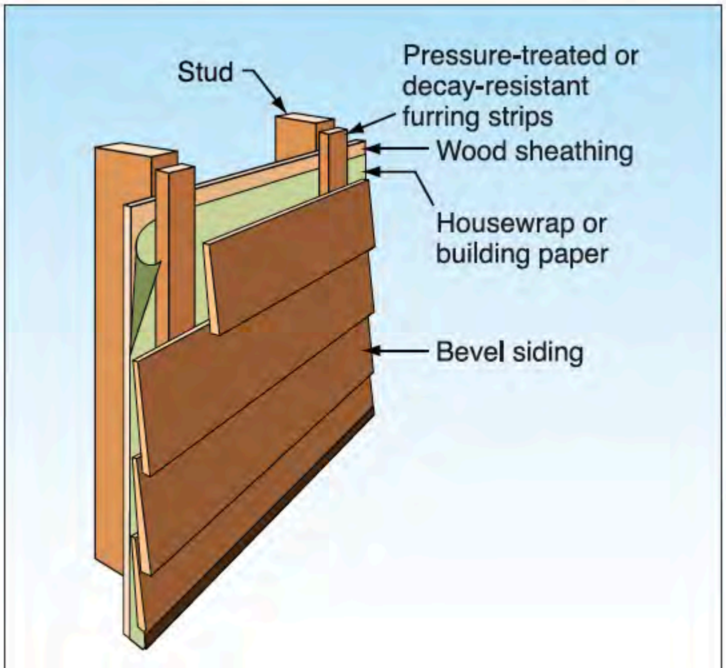



*Figure 9. Pressure-equalized rain screen system.*

U of Buffalo, *Climate Resilience Strategies for Buildings, p. 120 and FEMA 499 5.3 p.5 of 8*

Flood damage resistant materials should be continuous from the lowest point in the building up to the Design Flood Elevation (DFE), if known.

**SIDING OPTIONS BY DEVELOPMENT TYPE**

Family Developments: often require more impact resistant siding due to the wear and tear which the siding undergoes, fiber cement siding is generally the most **durable.** Vinyl siding or un-stained wood are **cost-effective** in other instances where durability is not as much of a concern.

Elderly Developments: vinyl or un-stained cedar shingles are **low-maintenance, cost-effective** options preferred where durability is not a major concern.

Special Needs Housing: wood, cement board or vinyl siding can be used depending on durability required and neighborhood character.

### INVESTIGATION AND RESEARCH

- Confirm whether the development and building are subject to extreme precipitation and flooding.
- Verify how level the existing building sills are to receive the new siding material.
- Verify the type of sheathing that is on the building. Some buildings may have gypsum board sheathing and rigid insulation which makes the attachment of new siding more difficult. For buildings with no sheathing, horizontal 1x2 wood strapping matching at intervals matching shingle exposure may be used to provide required fastener holding power for wood or fiber cement siding.
- Verify the condition of the existing exterior sheathing and determine if selective or complete replacement is required.
- If the building has fiberboard sheathing, it should be replaced with new plywood or OSB sheathing.
- Check to see if there are more than one layer of siding. Verify if existing exposed or covered wood siding contains lead based paint which may require special precautions in removal and disposal. The housing authority may have a certification of lead compliance
- Verify whether the existing siding is asbestos-containing and remove it.
- As part of their building code analysis, the Designer should document that the new siding and exterior wall construction will meet the R value required by the International Energy Code and the Massachusetts Building Code. Exterior rigid insulation should be installed with new vinyl siding. Take test cuts if necessary.
- Where termite protection is needed, provide a termite shield detail at sill.
- Install flashing and water proofing around windows and doors and use metal flashing for trim pieces. Cap flashing is recommended for any horizontal trim.
- Check the condition of the existing electrical service banks.
- Check locations of wall mounted light fixtures
- Verify the location of the existing cable TV and telephone service and talk to these companies early to remove and reinstall these connections during the installation of the new siding materials.
- Verify the location of existing building numbers and mailboxes which will need to be removed and reinstalled or replaced after the new siding is installed.

- Check for mold and mildew on the exterior siding of the building; check the condition of gutters, downspouts, splash guards; and check the closeness of vegetation to building.

Rain-screen type installation of wood and cement siding is recommended by certain manufacturers to prevent moisture from penetrating into the exterior sheathing and wall cavity due to air pressure and capillary action.

### MATERIALS

**WOOD SHINGLES & SHAKE SIDING**

Red cedar is preferred to white cedar because it is more resistant to curling, ages better, and it is more thermally stable.

Unstained cedar shingles are a cost effective choice where a rustic appearance is preferred or required.

Painted or stained wood shingle siding is not recommended as these finishes are not cost effective.

Selective replacement of wood shingles can be done in many instances to extend the useful life of the majority of the siding and is a cost effective alternative to complete siding replacement

Use clear heart grade and A-clear cedar trim board, where required.

Only White cedar (pre-finished) is acceptable.  Use only number 1 blue label white cedar shingles as designated by the Cedar Shake and Shingle Bureau or use “VG Heart and A-Clear grades”.

Shingles must be sealed on all sides, including field cut ends. Specify manufacturers when using factory-prefinished shingles.

Specify kiln-dried products wood shingles, wood clapboard siding can be selectively replaced.

As with wood shingles, wood clapboard siding can be selectively replaced extending the useful life of the existing siding.

A sealant coat followed by two coats of semi-transparent stain is the preferred finish where a finish is specified. Do not specify paint or solid color stains.

### DESIGN

The maximum exposure for white cedar shingles is 5 inches to the weather and is 6 inches for red cedar shingles.

Use PVC corner boards for a more durable installation.

Nail shingles directly to plywood or to wood furring strips if rigid insulation is installed over sheathing. Do not nail shingles directly onto rigid insulation.

### EXECUTION

Space sawn red cedar shingles 1/8”- ¼” inch apart.

**PANEL SHINGLES**
**PANEL SIDING**
**CLAPBOSRD SIDING**

Panelized shingles are not recommended because of premature failure. If existing panelized shingles are being repaired, check proper fastening to studs, as these are typically used in lieu of exterior wood sheathing and are not uniformly fastened to studs.

Painted wood panel siding such as T-111 is not recommended unless it is to be used to match existing siding materials. Pine or other softwoods are generally not acceptable. Even when factory finished, pine siding tends to warp and deteriorate quickly when the finish is damaged or water infiltrates envelope.

Prefinished wood clapboard siding with 15 year finish warranties are available in both red and white cedar shingle and clapboard siding. Specify three equals if using these products.

Select kiln dried, grade A, wood clapboard siding.

**DESIGN**

The maximum exposure is 4 inches to the weather. A minimum 1 inch overlap on plain bevel siding is recommended.

Do not nail wood siding over rigid foam board. To install wood clapboards with foam board, install furring strips or drainage plane mats to provide a drainage plane behind the siding.

Detail to maintain at least 2” clearance between siding and roof surfaces and 6” minimum at grade and concrete stair landings to prevent water damage to siding.

Review grading and detail to minimize future damage from contacting siding. Provide durable waterproof coatings or cladding to exposed concrete slabs on grade to avoid wicking moisture from concrete slab edges into wood sills, siding and interior finishes.

**EXECUTION**

To minimize dimensional change after shrinkage, install siding properly acclimated to current temperature and humidity conditions The material should be stored on site.

Back-prime all sides, edges, and ends. Specify field touch up of all cut edges.

Use ring shank double- hot-dipped galvanized or stainless steel, 6d siding nails. Always use Type 316 stainless steel fasteners in coastal ocean environments to avoid fastener bleed.

**MAINTENANCE**

Renewing cedar shingle or clapboard siding which is moldy or discolored can be done with a stiff,(non-metal) bristle brush and water. For more drastic cases, a mild detergent and water scrubbing, followed by a clean water rinse is usually adequate.

Existing wood clapboards that are to remain can also be power washed prior to re-staining to remove dirt, mold and loose paint/stain. Specify the water pressure or prior to cleaning, require contractor to pressure wash a small area to determine appropriate pressure so as not to damage existing wood siding.

Staining within 90 days of installation will prolong the life of the clapboard siding. Discuss the maintenance plan with the Housing Authority to ensure their success in maintaining the siding in order to maximize the useful life and cost-effectiveness. Stains applied to shingles which are weathered will not last as long as stain applied during initial installation, therefore the decision to stain should be made as part of design.

**VINYL SIDING**

Choose premium quality solid vinyl, minimum .042” thickness, with flat low-gloss finish. Non-embossed patterns are easier to keep clean.

Consider specifying vinyl siding in whites or greys which are readily available from most manufacturers.

In selective applications when the appearance of wood shingles is desired, polypropylene siding may be used.

Smooth finish, prefabricated, vinyl covered aluminum or enameled aluminum are both acceptable for rakes, fascia, and window trim.

Composite PVC trim corner boards are a low-maintenance option.

Prefinished, aluminum coil stock corner boards are not an acceptable alternative to solid PVC corner boards. Install solid PVC trim with a concealed fastener system.

Wood trim is not recommended as trim material with vinyl siding as it requires periodic painting or staining.

Do not install vinyl siding and insulation on gypsum wallboard sheathing.

Use bead-board pattern vinyl for porch ceilings- 6” wide panels are less likely to sag.

Use vinyl J-channel “block-outs” for penetrations such as light fixtures, hose bibs, dryer vents, etc.

**DESIGN**

3½-4 inch exposure (triple three) is preferred for both structural stability and an appearance that closely resembles wood clapboards.

Avoid vinyl siding with molded imprints, such as wood grain in light colors. Imprints trap dirt and provide an environment for mildew.

Use vinyl accessories to provide structural stability, to help the installation stand up to wear, and to provide visual interest.

Minimize horizontal pattern changes, since the J-bead connections between them are particularly subject to wind stress.

Details must be carefully designed and shown in contract documents; provide details that minimize the use of caulking,

Do not leave details up to the installer in the field.

Corner beads, rakes, fasciae, vented soffits, as well as door and window trim clad in aluminum and/or vinyl help to reduce maintenance costs.

Open-Celled foamed PVC trim is not recommended.

When combining vinyl siding with vinyl window installations consider using vinyl trim kits that are available from the window manufacturer.

Where possible provide solid PVC mounting panels to organize exterior components such as cable, telephone and electrical panels in a unified design. Design flashing and air sealing details to prevent air and water infiltration at all penetrations and around panel. Do not leave these details for the contractor to design.

**EXECUTION**

Follow the installation requirements set forth by the siding manufacturer and the Vinyl Siding Institute, including:

Separate vertical joints in siding by at least two siding courses;

Avoid vertical joints above and below windows;

Never use length of siding under 2 feet, except where necessary such as at tightly spaced windows or under shutters at the location of the shutter fastener;

Never fasten things to the vinyl, always fasten to something solid behind the siding. This typically includes items such as hose bibs, wall mounted dryer vents, safety sirens and strobes and exterior conduit;

Allow for expansion and contraction; and

Install PVC trim with concealed fasteners.

## FIBER CEMENT CLAPBOARD AND PANEL SIDING

**MATERIALS**

There are several manufacturers of fiber cement shingles and clapboard. Third party pre-finishing with solid stain is available along with a 15 year warranty from the paint applicator.

This product is best suited for areas requiring impact resistance, durability and climate resilience. The clapboard siding product may not be a cost-effective choice where these characteristics are not the primary concerns. Consider alternatives such as the panelized fiber cement products or alternative clapboard siding materials.

Fiber cement is a durable alternative to vinyl siding that typically has more recycled content and less of a life cycle impact in terms of the use of energy and toxic materials in manufacturing.

Design for a drainage plane behind this siding type regardless of whether rigid insulation is installed behind it

Pre-finished fiber-cement trim products are available, but DHCD recommends PVC trim when fiber cement clapboard siding is used, due to the brittle nature of fiber cement trim and the damage which results in material transport and handling during construction.

### DESIGN

Specify a 4 3/4" maximum exposure for clapboard siding where maximum durability is important. 6 ¼" exposure is available but the cost savings are minimal. Also consider the scale of the building when choosing the exposure and texture of the siding.

Synthetic stone siding is also available in a variety of textures and modular formats.

Panelized products are cost-effective options for siding and are typically available in ¼" and 3/8" thicknesses and 4x8 and 4x10 panel sizes. The cost of these products can be significantly less than fiber cement clapboard siding and comparable in cost to medium-grade vinyl siding. Consider architectural style and appearance, as large panels may lend a stark appearance to traditional style architecture. They are typically used in contemporary-style buildings.

If panelized products are used, design details and modular patterns to minimize the use of sealant joints and job-site waste.

### EXECUTION

Follow installation requirements set forth by the manufacturer.

Prefinished fiber cement siding must be stored properly to prevent boards from getting wet and freezing to each other which can remove the finish.

Specifying an additional finish coat in the field will produce more favorable results but may be cost prohibitive.

## MOLDED WOOD/RESIN BOARD & HARDBOARD SIDING

DHCD has had a number of disappointing experiences with hardboard and molded wood/resin siding. Therefore, we do not recommend its use and recommend its replacement if budget allows

However, if it must be used to match existing siding, and if the material is still available, give extra special consideration to:

- ❑ Expansion and contraction,
- ❑ Corners, window and door details,
- ❑ Color selection, some colors fade more dramatically and matching color years later becomes extremely difficult.

# 07 40 00 • SIDING

## CLIMATE RESILIENCE RESOURCES

Project teams can learn more about best practices for protecting buildings from water intrusion using siding by consulting these and other resources:

- The report "Climate Resilience Strategies for Buildings in New York State" addresses strategies for adapting buildings in order to make them more resilient and is available here:https://ap.buffalo.edu/content/dam/ap/PDFs/NYSERDA/Climate-Resilience-Strategies-for-Buildings.pdf
- FEMA's Guide to Coastal Construction has a number of strategies and graphics that may be useful in planning siding updates. It is available here:https://www.fema.gov/media-library-data/20130726-1538-20490-2983/fema499web_2.pdf

# DESIGN AND CONSTRUCTION GUDELINES AND STANDARDS

DIVISION 7 • THERMAL & MOISTURE PROTECTION

## 07 45 00 • GUTTERS AND DOWNSPOUTS

### SECTION INCLUDES

Gutters and Downspouts

### RELATED GUIDELINE SECTIONS

| | |
|---|---|
| 06 10 00 | Rough Carpentry |
| 07 20 00 | Building Insulation and Moisture Protection |
| 07 30 00 | Asphalt Roof Shingles |
| 07 62 00 | Sheet Metal Trim and Flashing |
| 33 00 00 | Site Utilities |

### CLIMATE RESILIENCE DESIGN CONSIDERATIONS

Extreme precipitation will be increasingly common throughout Massachusetts as a result of climate change.

When designing new 1-2 story buildings, architects should design ample roof overhangs, durable perimeter foundation and siding materials to minimize the need for gutters. Gutters have traditionally been a high maintenance item, even with gutter guards.

For existing buildings, where gutters are not installed, do not install gutters unless they will be maintained. In certain instances, gutters can be useful to mitigate basement flooding, however options such as site grading should be considered first. Gutters can also contribute to basement flooding and building siding damage if they are not properly designed and maintained.

For buildings designed with gutters: seamless aluminum gutters should be sized to adequately manage the rainwater collected by the roof and to properly fit the scale of the building. See Sheet Metal and Air Conditioning Contractors National Association (www.smacna.org) for gutter and downspout sizing software.

Where appropriate, **60-gal rain barrels** or an alternative may be included to retain some stormwater and reduce flooding. These may be of interest to residents who keep area gardens.

Roof and gutter **maintenance are critical** to protecting buildings of all sizes from the negative effects of poor roof drainage.

Onsite infiltration systems need to be considered and designed. See on site utilities. In some localities the permitting authority may require an engineering study and design of the collection and mitigation of the onsite discharge of rainwater. When replacing roof shingles in one-story buildings with adequate roof overhangs, consider alternatives to gutters such as shrubs planted around building, a 4’“layer of crushed stone at the perimeter of the building and durable siding materials to withstand roof run-off. Verify subsurface soil conditions to confirm the appropriate apron materials. Eliminating the gutters, except where necessary, can reduce maintenance.

Gutterguards range in price, durability and required maintenance. Consider designing larger gutters and downspouts first, rather than installing gutter guards. If gutter guards are installed, expanded metal type are preferred.

Pay special attention to details to avoid water getting behind the gutters. Typically, the front edge of the gutter should be at least ½" below the plane of the roof.

Locate downspouts so that water runs away from the buildings. Install downspout strap hangers using a minimum .032" thickness straps, screwed, (not nailed) into building sheathing at 24" on center for the lowest 8' of downspout and at 48" on center for the upper portions. If vandalism is an issue that cannot be solved with additional downspout straps, consider using either galvanized steel or PVC schedule 40 or even schedule 80 PVC pipe as downspouts.

Do not use cast aluminum spike type downspout hangers.

Where roof drainage is not directed to a subsurface drainage system include precast concrete splash blocks on every gutter installation. Identify vandal-prone areas and specify heavier splash blocks to make it more difficult for them to be moved. Place splash blocks to direct water down grade and away from the building. Routine inspection and repair or re-placing of splash blocks should be part of planned gutter maintenance.

Consider lawn and landscape maintenance and locate downspouts and splash blocks in locations least likely to impede the path of lawn mowers

At buildings which have experienced basement flooding, downspouts with longer extensions and splash blocks should be carefully placed, such as within a border of shrubs. Avoid trip hazards and exposure to damage from activities occurring around the building.

Where possible, downspouts from upper roofs should not be placed to discharge directly onto lower roofs, but rather should carry water in downspouts all the way down to grade.

When re-using existing underground storm water drainage systems with new replacement gutters, verify that the underground system is functional before installing new downspouts into hubs. Cleanouts may be required where system is not functioning properly, install downspouts with splash blocks in lieu of the underground system

### MATERIALS

Seamless aluminum gutters are available in a variety of profiles with 5" and 6" ogee profiles being most common. Clearly specify the necessary size and profile. Consider designing the replacement system to exceed code rainfall minimums as storms will become more intense.

Size downspouts to match gutter size and to manage rainwater design load.

Specify .027" thick aluminum drip edges at all eaves and rakes.

## 07 45 00 • GUTTERS AND DOWNSPOUTS

Provide aluminum gutters in .032” thickness and aluminum downspouts in .040” thickness.

Specify pre-cast concrete splash blocks (large and heavy enough to prevent being accidently displaced or stolen) at the base of downspouts unless there is an underground storm drain system. Place splash blocks to direct water down grade and away from the building.

Do not use wood gutters. If refurbishing wood gutters which are structurally sound and in a historic renovation, consider lining them with copper.

Do not use plastic gutters.

If steel gutters and downspouts are used, seamless gutters are not readily available. 20’ lengths with seamed and sealed joints should be specified.

### EXECUTION

Follow manufacturer’s recommendations and standard professional practice.

When installing gutters into underground storm drainage systems, include adequate cleanouts at the locations where the downspouts tie into the underground systems and at drywells. These locations should be designed to facilitate future maintenance and to eliminating obstructions at the connections where they are most likely to occur.

### CLIMATE RESILIENCE RESOURCES

Project teams can learn more about best practices for managing and maintaining gutters and downspouts (including the use of rain barrels) using these sources and others:

- The roof drainage and green infrastructure sections of the publication “Climate Resilience Strategies for Buildings in New York State” address stormwater management and gutter considerations as well as green infrastructure. This document also has links to other resources. https://ap.buffalo.edu/content/dam/ap/PDFs/NYSERDA/Climate-Resilience-Strategies-for-Buildings.pdf

# DESIGN AND CONSTRUCTION GUIDELINES AND STANDARDS

DIVISION 7 • THERMAL & MOISTURE PROTECTION

## 07 50 00 • MEMBRANE ROOFING

### SECTION INCLUDES

Built-up Roofing
Modified Bitumen Roofing
Rolled Roofing
PVC Roofing
EPDM Rubber Roofing
TPO Roofing
Access Walkways
Roof Coatings

### RELATED GUIDELINE SECTION

**02 41 00 Demolition**
06 10 00 Rough Carpentry
07 10 00 Waterproofing and Dampproofing
07 20 00 Building Insulation and Moisture Protection
07 30 00 Asphalt Roof Shingles
07 45 00 Gutters and Downspouts
07 62 00 Sheet Metal Trim and Flashing
07 90 00 Sealants
22 00 00 Plumbing

For Contracts estimated over $100,000 that are predominately Roofing Work the DCAMM category for the General Contractor should be **Roofing**.

An alternative is to have the DCAMM category as General Building Construction but require filed sub-bids for the roofing. This requirement needs to be clearly spelled out in the Advertisement.

**Filed Sub Bid**

**M.G.L. c.149 §44F**

*When replacing membrane roofing is part of a larger General Contract, Roofing and Flashing is a stipulated filed sub-bid category under M.G.L. Chapter 149, §44F. While different types of roofing are typically specified in different specification sections, if the project's total cost is over $150,000 and the cumulative estimated value of all roofing work exceeds $25,000 it triggers the filed sub-bid requirement. It is then better to specify all roofing work in a single section to avoid confusion.*

### CLIMATE RESILIENCE DESIGN CONSIDERATIONS

Massachusetts is expected to experience more days of extreme heat state-wide in the coming decades. Standard built up asphalt, rubber, black EPDM, or other dark roofs can reach temperatures of 150°F or more in the summer sun. A light-colored "cool roof" under the same conditions could stay more than 50°F cooler.

A cool roof can benefit a building and its occupants by:
- Reducing energy bills by decreasing air conditioning needs

- Improving indoor comfort for spaces that are not air conditioned, such as garages or covered patios
- Decreasing roof temperature, which may extend roof service life. Beyond the building itself, cool roofs can also benefit the environment, especially when many buildings in a community have them. Cool roofs can:
    - Reduce local air temperatures (sometimes referred to as the urban heat island effect);
    - Lower peak electricity demand, which can help prevent power outages; and
    - Reduce power plant emissions, including carbon dioxide, sulfur dioxide, nitrous oxides, and mercury, by reducing cooling energy use in buildings.

A roof replacement offers an ideal time to evaluate the orientation of the roof for future installation of solar photovoltaic (PV) or solar thermal domestic hot water heating systems. A solar PV system can be an importance climate resilience measure during power outages when coupled with a battery system and/or an islandable inverter. Even if a solar and battery installation is not cost effective at present, the roof replacement project should be designed for "solar readiness" at a future date.

Making a roof replacement "Solar ready" can be done by making intentional design choices so that solar could be installed without having to change the roof structure, without having to open walls for conduit or electric cable, or without having to create an additional location for electric components, batteries, storage tanks, or other necessary components of the system. To make an asphalt roof "solar ready", the work scope should address:

1) Identifying the roof surfaces that have the best solar exposure;
2) Ensuring that these surfaces are structurally designed to accommodate the weight, wind, and snow loads that the solar system might impose;
3) Relocating or consolidating rooftop equipment or plumbing vents from the roof surfaces with best exposure;
4) Identifying space within the building that is readily available for the installation of controls and ancillary components, such as electric invertors and hot water storage tanks; and
5) Installing an internal chase or other means for connecting the future rooftop solar system to the building's mechanical or electrical systems and spaces identified for auxiliary solar equipment per 4) above.

Roofing products should either be specified with an SRI at or above 65, or additional coatings should be added to other roofing materials to increase roof SRI to 65 or higher and provide a "cool roof".

# 07 50 00 • MEMBRANE ROOFING

## INVESTIGATION AND RESEARCH

The choice of roofing type and materials varies depending on many factors for every roof contract:

- Existing Conditions/Materials/Details (Reroofing contracts);
- LHA's capacity for maintaining a specific product;
- Location & height of building and the difficulty of getting materials to the roof;
- Wind Exposure - developments near the ocean or in other high wind areas require special design considerations and precautions during construction;
- Design roof assemblies per the wind load requirements found in the building code, with adjustments for higher wind zones based on the building site and massing. Interview the LHA staff to better understand the specific conditions at the site;
- Type of Occupancy - some tenants have problems with strong odors;
- Walkway pads– review mechanical equipment and whether residents have access to roof. Address the issue of roof traffic in conjunction with selecting material. Single-ply roofing products require more protection if foot traffic is anticipated;
- Environmental considerations- discuss with LHA maintenance staff any unique circumstances, such as seagulls or other wildlife which may potentially damage roof and design protective measures where appropriate; and
- Future solar panel installations- review roofs for future solar potential and consider providing reinforcing, blocking or other improvements to facilitate future panel installation without adversely affecting new roof assembly.

Employ cost effective strategies-determine if the roof should be repaired or replaced. Although single-ply roofs require more maintenance over their lifetime, their lifetime can be extended by 50% or more using repairs

Inspect existing drains and specify cleaning drain lines, replacing flanges, and similar repairs as part of roof replacement contracts. Roof drainage capacity and discharge must conforms to current code. Roof drain work, below the roof deck, is plumbing work and should be coordinated with the plumbing section of the specifications. Replacement of roof drain covers and inserts into existing drain lines is usually done by the roofing contractor.

## DESIGN

Combine roof penetrations through the roof membrane as much as possible and avoid using pitch pockets. Where pitch pockets are used, confirm that all manufacturers specified will warranty roof with pitch pockets. Liquid applied waterproofing, such as used with PVC roofs is not as durable as pitch pockets and details should be designed for redundancy if these details are employed.

Evaluate rooftop mechanical equipment and assess whether replacement is a cost effective option. Flashing details are more difficult to achieve when cutting an existing roof than when installed as part of a new roof assembly.

Do not mount equipment on top of roof insulation; use pre-fab equipment manufacturer's curbs or steel equipment racks or design wood blocking to be tied directly to the structural roof deck. Integrate the flashing into the roof assembly.

### TECHNICAL STANDARDS

National Roofing Contractors Association www.nrca.net

EPDM Roofing Assoc. www.epdmroofs.org

Single Ply Roofing Industry www.spri.org

Asphalt Roofers Manufacturers Association www.asphaltroofing.org

Sheet Metal & Air Conditioners Contractors Association www.smacna.org

### MATERIALS

Refer to the manufacturer for all components and specify work so that all products are provided by one source to prevent suppliers from backing out of their warranty.
The composition of the built up roof system shall meet or exceed the specific requirements of the project taking into account existing environmental and building conditions, budget and warranty requirements. Cold process B.U.R. or modified bitumen is acceptable and preferred on sites where odor is a concern. Hot applied is not recommended. SBS modified FR cap sheet with granules is also acceptable as surfacing. Specify polyisocyanurate insulation for its higher fire resistance and insulating qualities. Roof insulation thickness shall meet the energy requirements of the current building code, including any Stretch Code provisions

All materials and details should meet the requirements of NRCA, SMACNA and UL as applicable.

### DESIGN

Built-up roofs must have a minimum of 3 plies and minimum pitch of 1/4 inch per foot to drain. Built-up and modified bitumen roofing are available with manufacturer's 25 year warranty which is longer than most membrane roofing warranties. Specify the warranty period required for the project. Built-up roofing is preferred in family development where tenants may have access to the roof or where there is a significant amount of rooftop equipment which will require servicing.

Minimum flashing height requirements are 8" for all mechanical, skylights, wall flashings or any other item that extends above the roof line. This is a minimum flashing height; windows or other such items should be well above 8” above the roof line.

All mechanical equipment is required to be set on curbs which are placed on roof deck or on vibration insulators. No equipment should sit on insulation.

All aluminum (coping, counter flashings and edge metal) associated with roof system should be a minimum of 24 gauge (.032 inch) and color clad. Copper, zinc and zinc-coated copper can be used in certain applications.

### EXECUTION

Do not install hot applied built-up roofs during winter months and avoid overheating hot asphalt during application which affects material performance.

Install cold applied built-up roofing according to manufacturer’s installation requirements for warranty specified.

Contractor shall furnish roofing manufacturers shop submittals for Architect review and approval. In addition, any changes to those details should be reviewed by both the Architect and the roofing manufacturer’s field representative. Schedule a pre--installation conference with the manufacturer’s representative.

Do not close out the project until the roofing manufacturer has inspected the roof and confirmed acceptance for issuance of warranty.

Pros: Proven history, Low maintenance, Easy to repair
Cons: Costs more to install, slower to install, hazardous vapors, and need experienced installers.

## MODIFIED BITUMEN ROOFING

### MATERIALS

Modified bitumen products are acceptable in appropriate circumstances over traditional built-up roofing. Modified bitumen roofing comes in APP (Atactic Polypropylene, hot applied only) , SBS (Styrene Butadiene Styrene, hot or cold applied) membrane rolls or SEBS (Styrene Ethylene Butylene Styrene) The SEBS system, similar to the BUR systems is expensive to install and not commonly used. The systems generally come in two and three ply layers.

Cold applied roofing or SBS is a cost effective alternative to using hot asphalt for built-up roofing or torch applied modified bitumen roofing systems. The cold applied can be solvent-based or water based.

Roofing products should either be specified with an SRI at or above 65, or additional coatings should be added to other roofing materials to increase roof SRI to 65 or higher and provide a “cool roof”.

### DESIGN

Determine if hot applied, torch applied or cold applied modified bitumen is appropriate for the project due to the location of the roof, access, occupancy etc. Modified bitumen roofing can have a 10, 15 and 20 year warranty which should be clearly specified in the specifications.

Cold applied roofing eliminates the odors associated with hot asphalt built-up roofing. In areas that have difficult access for hot asphalt equipment such as high-rise buildings it is also a plus. Cold applied roofing can be applied during colder weather, however specialized equipment to maintain materials above 40 degrees is often required. The likelihood of achieving the best workmanship, durability and longevity is increased if roofing is applied in temperatures over 40 degrees.

Do not install roofing, except temporary roofing in emergency situations, when daily temperatures are below freezing.

Cold applied modified bitumen roofing can also be used in “green roof” installations under soil and plant materials to provide a waterproof membrane. Garland’s GreenShield System is an Energy Star approved commercial roofing system.

Pros: Easily repaired, Available with “cool coatings”, Shorter install time than BUR

Cons: Torch down installation can present a safety issue.

### EXECUTION

APP modified bitumen roofing is applied using a torch.

SBS modified bitumen roofing can be installed by heat welding, hot asphalt, cold applied adhesive, mechanical attachment or as part of a self-adhered system.

Before work proceeds, a pre-installation meeting must be held with representatives from the manufacturer, architect, roofing contractor, general contractor, LHA, and DHCD.

Install modified bitumen roofing according to manufacturer’s installation requirements for warranty specified.

## GREEN ROOFS

Green roof assemblies typically require several additional components of roofing materials, including root protection mats, water retention mats, soil and plants. The existing roof structure should be reviewed by a licensed structural engineer prior to the conversion of a traditional low-slope roof to a green roof to confirm the structure’s ability to withstand additional loads.

It should also be noted that these roofs require significant additional maintenance; therefore their use is not generally recommended. Although well designed and maintained planted roofs can extend the life of the roof membrane below, their additional life cycle costs do not justify their use for most DHCD projects. There are many other more cost effective alternatives to provide 40-50 year roof lifespans.

### EXECUTION

APP modified bitumen roofing is applied using a torch.

SBS modified bitumen roofing can be installed by heat welding, hot asphalt, cold applied adhesive, mechanical attachment or as part of a self-adhered system.

Before work proceeds, a pre-installation meeting must be held with representatives from the manufacturer, architect, roofing contractor, general contractor, LHA, and DHCD.

Install modified bitumen roofing according to manufacturer's installation requirements for warranty specified.

Note that approved details for items such as roof drains, flashing and penetrations vary among manufacturers. Prefabricated metal flashings are preferred over field liquid-applied flashings and manufacturer approvals should be obtained when using non-conventional more durable flashing details. Pitch pockets are preferred over liquid-applied details for items such as conduit penetrations and roof-mounted guard railing assemblies.

## SINGLE PLY ROOFING SYSTEMS

## TPO

### MATERIALS

The primary single ply membrane types are PVC, TPO, and EPDM.

TPO (Thermoplastic Polyolefin) roofing or white EPDM are single-membrane roofing systems and are much preferred over either PVC or black EPDM.
Pros: Quick installation, Ease of repair, Availability of "cool coatings"
Cons: Thinner sheets may puncture, Seams may dislodge

Use TPO or white EPDM membrane in minimum 60 mils thickness, complying with ASTM 4434, Type 1. Thicker TPO or white EPDM membranes are available (70 and 80 mils) and can be used in certain circumstances.

### DESIGN

Unlike black EPDM rubber roofing, TPO or white EPDM roofing comes in white or light colors and can reduce energy consumption, abate urban heat and help to slow the reaction of smog forming pollutants. The light color provides a high level of solar reflectance for urban settings and reduces the amount of energy required to maintain comfort in an air-conditioned building by reducing heat flow through the building envelope.

TPO or white EPDM membranes carry an Energy Star listings in certain applications with reflectivity ratings in the high 80 percent range where Energy Star specifications require 65 percent minimum. A benefit of using TPO roofing is that it is available in sheets up to 12 feet wide.

Use TPO or white EPDM membrane in minimum 60 mils thickness, complying with ASTM 4434, Type 1. Thicker TPO or white EPDM membranes are available (70 and 80 mils) and can be used in certain circumstances.

Specify white or light colored products with one or two side welded seams and minimum 30 year warranty. Note: products made by GAF come with a 35-year warranty.
Installation may be done in either of two ways:

1) Mechanically fastened: Each product comes with its own specified fastening patterns, which must be adhered to in order to not void the warranty.
2) Fully adhered: This application is required in high wind areas, such as near the ocean. It may be used at the contractor's preference if installation is faster than mechanically fastened. Any adhesive used must meet low-VOC requirements, which typically means they are water-based.

   Combine roof penetrations through the roof membrane as much as possible.

### EXECUTION

Before work proceeds, a pre-installation meeting must be held with representatives from the manufacturer, architect, roofing contractor, general contractor, LHA, and DHCD.

## TPO ROOFING

### DESIGN

Typically a bituminous membrane roof with a light colored granular surface provides a more-durable cost effective choice, even though its reflectivity is not as high as some PVC and TPO membranes. Note however that PVC Roofing is not recommend for use at housing Authorities.

### EXECUTION

Before work proceeds, a pre-installation meeting must be held with representatives from the manufacturer, architect, roofing contractor, general contractor, LHA, and DHCD.

Install TPO roofing according to manufacturer's installation requirements for warranty specified.

## EPDM RUBBER ROOFING

### MATERIALS

Specify complete EPDM (Ethylene Propylene Diene Monomer) rubber roofing systems (including all roof components) to ensure that the installation does not void the manufacturer's warranty.

# 07 50 00 • MEMBRANE ROOFING

Consider the comprehensiveness of the manufacturer's warranty when selecting a roofing system. Warranties vary with the manufacturer and installer. The minimum standard warranty should be 15 years.

Use EPDM in either 45 or 60 mils thickness complying with ASTM D 4637, Type 1. 90 mils thickness is also available by EPDM roofing manufacturers.

Use uncured neoprene flashing at penetrations for membrane roofs.

### DESIGN

Flat roofs with single-ply membranes must have a minimum pitch of 1/8 inch per foot for positive drainage. Single-ply membranes should not be installed on roofs with a pitch of over 2 in 12. Use parapets if possible and run roofing up wall in lieu of gravel stops.

White EPDM roofing can be installed fully-adhered, mechanically-fastened or loose laid. Fully-adhered white EPDM using water or solvent based adhesives to adhere the rubber to the substrate is preferred. Mechanically-fastened EPDM roofing should be avoided. A ballast of light-colored round river rock or concrete pavers is used to hold the materials in place and in roof locations susceptible to high winds. For re-roofing projects ballast can be washed and reused.

Specify products with welded seams.

### EXECUTION

Install sheets as large as possible to minimize the number of seams.

Specify that the Contractor should provide a seaming diagram before installation. The seams are sealed using either an adhesive or a splice tape.

Before work proceeds, a pre-installation meeting must be held with representatives from the manufacturer, architect, roofing contractor, general contractor, LHA, and DHCD.

Do not rely solely on field inspections by the manufacturer's representative to ensure the quality of the installation. Use a clerk when possible or provide the architect more field supervision time in the contract.

Install EPDM rubber roofing according to manufacturer’s installation requirements for warranty specified.

## ROLLED ROOFING

### MATERIALS

Rolled roofing comes in rolls composed of roofing felt saturated and coated on both sides with asphalt which contains fine mineral stabilizer. Asphalt rolled roofing is available smooth-surfaced or mineral surfaced. Smooth surfaced roll roofing is not as durable as mineral-surfaced roll roofing and is not recommended. Mineral-surfaced rolled roofing is available in 36 feet long rolls with the entire surface covered with granules, with a 2- or 4-inch bare lapping edge and with a 19-inch bare lapping edge.

# 07 50 00 • MEMBRANE ROOFING

### DESIGN

Use rolled roofing on low slope roofs with a pitch of 1 inch to 6 inches per foot.

### EXECUTION

Coated roll roofing should only be applied in warm weather when the material is flexible. Avoid exposed nails wherever possible. A blind nailed 4 inch lap cemented with plastic asphalt gum is preferred to a 2 inch lap with exposed nails.

## ACCESS WALKWAYS

### MATERIALS

Ensure that access walkways are compatible with the specified roofing system. The benefit of a ballasted roof is that pavers are not required.

Pre-cast solid pavers are an acceptable material. Avoid organic materials such as wood or felt. Use walkway protection boards that are compatible with the roofing membrane that is being used on the project.

### DESIGN

Walkway protection requirement may be needed where tenants have emergency egress on roof between stair penthouses. Railings should also be designed and installed to direct traffic over roof and pavers or stone ballast installed.

## ROOF COATINGS

### MATERIALS

The application of white acrylic liquid roof coatings on existing membrane roofs helps to prolong the life to the roof and reflects the sun's UV rays and infrared radiation. Manufacturers include Snow Seal by Ames, CLP and Liquid Roof by US Coatings Solutions.

### EXECUTION

Apply roof coatings according to manufacturer's installation requirements for warranty specified.

### TECHNICAL STANDARDS

Roof coating Manufacturers Association www.roofcoating.org

Cool Roof Rating Council https://coolroofs.org/resources/home-building-owners

**CLIMATE RESILIENCE RESOURCES**
Project teams can learn more about best practices for protecting roofs by consulting these and other resources:

High solar reflectance index ENERGY STAR roofing products can be found here: https://www.energystar.gov/productfinder/product/certified-roof-products/

# DESIGN AND CONSTRUCTION GUDELINES AND STANDARDS

DIVISION 7 • THERMAL & MOISTURE PROTECTION

## 07 62 00 • SHEET METAL TRIM & FLASHING

### SECTION INCLUDES

Sheet Metal Trim and Flashing

Note: See Section 23 00 00 Heating, Ventilating & Air Conditioning for sheet metal for ductwork.

### RELATED GUIDELINE SECTIONS

04 20 00 Unit Masonry
06 10 00 Rough Carpentry
06 50 00 Structural Plastics & Composites
07 20 00 Building Insulation and Moisture Protection
07 30 00 Asphalt Roof Shingles
07 40 00 Siding
07 45 00 Gutters and Downspouts
07 50 00 Membrane Roofs
08 50 00 Windows

**Filed Sub Bid**

**M.G.L. c.149 §44F**

*Sheet Metal Trim & Flashing is part of the Roofing & Flashing which is a stipulated filed sub-bid category under MGL Chapter 149, s. 44F. If the cumulative estimated value of the work in this section exceeds $25,000 and the project total cost is $150,000 or greater, it triggers the filed sub-bid requirement.*

Sheet Metal & Air Conditioning Contractors Association: www.smacna.com for typical details and technical guidelines on metal design & fabrication.

### CLIMATE RESILIENCE DESIGN CONSIDERATIONS

Enhanced flashing techniques are recommended in areas that frequently experience high winds and driving rain. Water penetration at deck ledgers, eaves, or building intersections can cause wood dry rot and corrosion of connectors leading to deck collapse, water intrusion, or other structure failure.

In coastal areas it is important to lap flashing and moisture barriers correctly, and to use sealed tapes and products. At roof to wall intersections, use flashing with longer vertical edges. Tape the top step of flashing with a 4-inch or wider self-adhering roof tape, and lap the house wrap or building paper over the flashing and tape that as well.

### DESIGN

Design adequate expansion joints or design profiles to minimize buckling. Metal with a face width over 6" should have an expansion break to prevent oil canning. To limit the effects of thermal gutter expansion due to temperature change, 50 feet is the practical length before an expansion joint is required for seamless aluminum gutters. Expansion joints can be pre-made with a rubber expansion joint or have the two runs connected by end caps.

When designing cladding over existing roof fascia, rake trim or other exterior siding components, clarify with details how rainwater is to be prevented from entering behind cladding at joints.

Provide details for overlapping successive or adjacent courses of cladding and for providing drip edges to avoid capillary action.

Specify 10' lengths of cladding (typical) and 4' minimum length; maximizing lengths wherever possible to avoid excessive joints and increased potential for leakage.

Rotted wood trim and siding can result from improperly installed metal cladding. Show the details for seaming and joining cladding and provide drip-edges to clarify the intended method of installation to contractors.

Specify hidden fasteners where possible and prefinished fasteners where fasteners are exposed.

See section 06 10 00 Rough Carpentry for termite shield guidelines.

### MATERIALS

A minimum .024-inch thickness material is suitable for most applications as profiles can be bent in the field and do not require shop fabrication. Where greater durability is required, consider thicknesses of .032" or .040" thickness, both of which can be shop fabricated with conventional brake presses or cold-rolled.

When designing custom bent metal profiles, research standard components which are readily available from metal distributors and use standard shapes if possible. If a custom shape is required, simplify the profile to allow the entire piece to be fabricated as one.

If there are multiple pieces required due to the limitations of the brake press, clarify the joints in architectural details and clearly show details for fastening, flashing and providing for thermal expansion.

### EXECUTION

Specify field mock-ups for architect review and approval for any cladding, window, cornice, or termite shield corner details which deviates from the architect's details as well as any atypical details not shown on architectural drawings.

Locate laps and seams to shed water and prevent water from penetrating the system and causing damage to the substructure.

# 07 62 00 • SHEET METAL TRIM & FLASHING

Overlap seams a minimum of 2 inches.

Blind riveting and concealed cleats which allow for thermal expansion are the preferred installation method for cladding such as roof fascia. Use slotted nail holes when fastening to prevent oil canning and buckling. Use prefinished nails where fasteners are exposed

Install lengths to be as long as possible to eliminate joints. This may result in a higher waste factor. Specify lengths so bidders are aware of expectations. Slip joints are the typical accepted detail for long lengths of cladding.

Do not install aluminum over pressure treated (PT) lumber, regardless of whether aluminum is pre-finished. Consider using solid fir blocking instead of pressure-treated wood where blocking will be protected from weather and aluminum flashing, or cladding is proposed. Where wood is exposed to weather, consider alternative decay resistant hardwoods or flashing materials such as solid or perforated vinyl soffit materials. Verify the compatibility of all metals when used together to eliminate galvanic corrosion. Use stainless steel fasteners with pressure treated lumber.

**CLIMATE RESILIENCE RESOURCES**

Project teams can learn more about protecting structures from moisture using flashing in this resource and others:

- FEMA's Homebuilder's Guide to Coastal Construction includes discussion on flashing: https://www.fema.gov/media-library-data/20130726-1538-20490-2983/fema499web_2.pdf
- EPA's Moisture Control for Building Design, Construction, and Maintenance contains several useful flashing details: https://www.epa.gov/sites/production/files/2014-08/documents/moisture-control.pdf

# 07 90 00 • SEALANTS

## SECTION INCLUDES

Elastomeric Sealants
Joint Fillers
Backer Rod

## RELATED GUIDELINE SECTIONS

| | |
|---|---|
| 02 82 00 | Asbestos Remediation |
| 03 30 00 | Concrete |
| 04 20 00 | Unit Masonry |
| 06 20 00 | Finish Carpentry |
| 06 64 00 | Plastic Tub & Shower Panels |
| 07 10 00 | Waterproofing & Dampproofing |
| 07 50 00 | Membrane Roofing |
| 07 62 00 | Sheet Metal Trim & Flashing |
| 08 10 00 | Doors and Frames |
| 08 40 00 | Entrances and Storefronts |
| 08 50 00 | Windows |
| 09 65 00 | Resilient Flooring |
| 09 90 00 | Painting |

**Filed Sub Bid**

**M.G.L. c.149 §44F**

*Waterproofing, Dampproofing, and Caulking is a stipulated filed sub-bid category under M.G.L. Chapter 149, §44F. While these types of work are typically specified in different sections, if the cumulative estimated value of the work in this section exceeds $25,000 and the projects total cost is over $150,000.it triggers the filed sub-bid requirement, then specify it all in a single section to avoid confusion.*

When specified as a separate filed sub-bid section, all the specified sealant work will be performed by the sub-bidder. If the Designer’s intent is for the window installer or another trade to install sealants, then the necessary sealants, installation, and relevant materials should only be specified in the specification sections for that particular trade.

The Designer should also consider the sequencing of work when deciding whether sealants work shall be included as separate filed sub-bid.

## CLIMATE RESILIENCE DESIGN CONSIDERATIONS

The decision to use sealants to waterproof a wall should include a **consideration of the structural soundness** of the building, including the walls and floor slab, and the building’s ability to resist flood and flood-related loads. The structural systems should be evaluated when any type of dry floodproofing is under consideration. When the determination has been made that the building and foundation system can withstand the expected flood-related forces, selecting a sealant system is relatively straightforward.

# 07 90 00 • SEALANTS

## TECHNICAL STANDARDS

### SEALANTS

### MATERIALS

**Sealant:** Typically refers to elastomeric products to prevent air and water infiltration, both in building envelope assembly and in interior wet areas such as bathrooms. The standard used is ASTM C 920 *Standard Specifications for Elastomeric Joint Compounds*.

**Caulking:** A type of joint filler most often used for interior applications where movement is insignificant and often refers to latex filler compounds. The standard used is ASTM C 834 *Standard Specification for Latex Sealing Compounds.*

**Adhesives:** Used to bond seams between two or more materials. Select adhesives with low or no VOC levels, as certified by GreenGuard (GreenGuard.org) or Scientific Certification Systems Indoor Advantage (https://www.scsglobalservices.com/services/indoor-air-quality-certificationher relevant standards include:

ASTM C1193- Standard Guide for the Use of Joint Sealants
ASTM C679- Standard Test Method for Tack Free Time of Elastomeric Sealants
ASTM D624- Standard Test Method for Tear Strength of Conventional Vulcanized Rubber & Thermoplastic Elastomers
ASTM D2202- Standard Test Method for Slump of Sealants
Food and Drug Administration (FDA):Reg. No. 21 CFR 177.2600

For most interior applications, not subject to excessive movement, latex or acrylic-emulsion sealants are typically acceptable. Exceptions are joints in wet areas such as plastic tub surrounds and along lip of bathtubs where one-part mildew resistant 100% silicone sealants should be used.

For most exterior applications, silicone sealants should be used, rather than urethanes, because of their excellent performance characteristics and resistance to UV degradation.

Review temperature constraints and curing times for the sealants which are specified and include those in part 3 of the sealant specifications.

For horizontal surfaces in concrete not subject to thermal movement, use a multi-part, pourable, flexible epoxy joint filler for exterior applications.

A pourable two-part urethane filler is typically acceptable for most interior horizontal joints and exterior joints subjected to movement. Install rigid, pre-formed cap over the joint if the joint will be subjected to abrasives or heavy traffic.

Oil-based caulking is not acceptable. Caulking should meet the Greenguard Gold Standard.

# 07 90 00 • SEALANTS

Refer to sealant manufacturer for recommendations for specific materials and products.

Backer rods should be used whenever the depth of joint exceeds the depth to width sealant ratio.  Close cell backer rods should be specified.

## DESIGN

Proper joint design:

- The Designer should check the relative expansion/contraction of abutting materials in order to properly size sealant joints.
- Sealant type, grade and class should be specified for each type of joint.
- Details showing sealant profile, joint depth-to-width and backer rod, (if required) should be included in drawings.  Do not leave the design of sealant joints up to the contractor.
- Fillet sealant joints typically involve the least amount of joint preparation, however, they are often not durable enough to withstand building movement.  Design joints for maximum durability.
- All sealants require surface preparation. Primers may be required per the manufacturer for certain surfaces.  In the selection of sealants, care should be taken that they are compatibility with adjacent materials.
- Sealants should adhere to only two surfaces; Use backer rods and bond breakers to facilitate this.
  Depth to width ratio should typically not exceed 1 to 2.
- Width of joint should not exceed that recommended by the sealant manuafacturer

Care should be taken to account for all necessary sealants in the contract documents.  The following locations, which often require the use of sealant, are frequently neglected and should be clearly documented in contract document.

Sealant Locations typically include:

- The top of a wall base at irregular walls and rough substrates like masonry.
- The perimeter of an interior door, sidelight, and transom frames.
- At the joint between acoustical ceiling wall angles and irregular walls.
- At countertops where backsplash meets wall base.
- At joints between dissimilar exterior cladding materials.
- At all window and door openings.
- Air sealing of  framing and other building envelope components per MA Energy Code.

Care should also be be taken to account for rain screen wall assembly drainage and weepholes. Drawings should clearly indicate intent for maintaining weepholes and other drainable components of rain-screen wall assemblies to prevent sealants from covering drainage components. It is not uncommon to see sealants incorrectly installed covering window drainage weepholes or brick weepholes.

**Dry Floodproofing**

Dry floodproofing can be a **relatively inexpensive** mitigation measure. Waterproof membranes and sealants may be useful for preventing water from entering the structure through walls. Masonry and masonry veneer walls can be made watertight using sealants. For dry floodproofing, electrometric “urethane” sealant and bentonite grout may be used.

**Applying Sealants to Above-Ground and Below-Ground Walls**

Creating a waterproof barrier in a section of wall to make it impermeable may require the use of sealants which are applied directly to the exterior surface of the building to seal exterior walls and floors. Sealants typically fall into two categories:

■ Positive-side sealant. Applied to the wall exterior where the sealant acts as a barrier between floodwaters and the wall.

■ Negative-side sealant. Applied to the interior of a wall or floor where the water pushes against the sealant after it has passed through the wall or slab

Above-ground walls can be sealed using either category of sealant while below-ground walls and floor slabs almost always require negative-side sealants.

- Positive-side sealants also include wrap-style adhered membranes and spray-applied sealants, both of which can be applied to the exterior wall or foundation at or below the ground.

- Products such as elastomeric waterproofing material and self-adhering membrane sheets have been successfully used to prevent water intrusion for more than 24 hours.

- Temporary positive-side sealants called “flood wraps” can be attached to the wall above-grade during flooding. Negative-side sealants that are applied to a concrete slab or wall must be bonded directly to the slab or wall to prevent the sealant from pulling away from the surface.

Negative-side sealants on slabs must be formulated and installed to withstand floor-related wear and must be applied across expansion joints common in concrete floor systems.

## 07 90 00 • SEALANTS

### INSTALLATION

The use of preconstruction field tests or mock ups to verify sealant adhesion to joint substrates is advisable, and should be called out in the specifications.

It is the responsibility of the Designer and, if applicable, the clerk of the works, to review the sealants work performed by the Contractor to determine whether sealants are installed within the thermal and temperature constraints recommended by sealants manufacturer. Sealants which are installed improperly shall be removed and reinstalled.

Post-installation testing of sealants such as pull tests, paid for by the contractor, are recommended if the Designer observes that sealants are improperly installed or cured. Specify such tests to be performed at the discretion of the Designer so they are included in the scope of contractor's work.

Expandable foam products should not be used as an alternate to flashing and waterproofing sealants.

### CLIMATE RESILIENCE RESOURCES

Project teams can learn more about best practices for protecting buildings from water intrusion using sealants by consulting these and other resources:

- The City of Boston Coastal Flood Resilience Guidelines includes graphics and images of sealants used to mitigate water intrusion and is available here: http://www.bostonplans.org/getattachment/d1114318-1b95-487c-bc36-682f8594e8b2
- The Southeast Region Research Initiative has tested various dry-floodproofed wall assemblies and their report, while technical and extensive, is available here: https://static1.squarespace.com/static/54500d67e4b0fe2b86e37264/t/549343a1e4b0d5186e34f6e6/1418937249160/SERRI+Report+80024-01_Floodproof+Construction+%28Sept+2011%29.pdf
- FEMA P-936 includes a discussion of sealant types and application images. This document is primarily focused on non-residential buildings and is available here: https://www.fema.gov/media-library-data/1541615774329-170190ea05ddbbb6fdc5f1170a018d41/P-936_11-06-18_508r.pdf

# DESIGN AND CONSTRUCTION GUIDELINES AND STANDARDS

DIVISION 8 • OPENINGS

## 08 10 00 • DOORS AND FRAMES

### SECTION INCLUDES

Exterior Doors & Frames
Interior Doors & Frames
Screen & Storm Doors
Patio Doors
Unit Entry Doors & Frames
Corridor Doors
Access Doors
Closet Doors

### RELATED GUIDELINE SECTIONS

| | |
|---|---|
| 03 30 00 | Concrete |
| 06 10 00 | Rough Carpentry |
| 06 20 00 | Finish Carpentry |
| 08 40 00 | Entrances and Storefront |
| 08 70 00 | Hardware |
| 09 90 00 | Painting |

### INVESTIGATION AND RESEARCH

If the contract is just for door replacement without frame replacement, require on field measurement of <u>every</u> door before fabrication. Investigate code and fire requirements in connection with the replacement of existing doors.

### REFERENCE STANDARDS

| | |
|---|---|
| American National Standards Institute | www.ansi.org |
| Window & Door Manufacturers Association | www.wdma.com |
| National Fenestration Rating Council | www.nfrc.org |

**AWI** Architectural Woodwork Institute "Quality Certification"
www.awinet.org
Section 1300 (flush)
Section 1400 (style and rail) and
Section 1500 (factory finishing),

**NEMA** National Electrical Manufacturers Association www.nema.org

**NFPA** National Fire Protection Association www.nfpa.org
**UL** **Underwriters Laboratories** www.ul.org

**ADA REQUIREMENTS**

Accessible Entrances: Comply with: Massachusetts Architectural Access Board and the U.S. Department of Justice "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."

### CLIMATE RESILIENCE DESIGN CONSIDERATIONS

Doors provide daily and emergency ingress and egress, air circulation, and visual access to the outdoors and street life for building residents. Shading devices and screens can be integrated into the design of doors to help reduce temperature related climate impacts, including overheating during heat waves. Electrically controlled door openers need an automatic manual override during power outages.

Wood doors and frames should be avoided in locations subject to flooding and wind-driven rain. In these guidelines, fiberglass, vinyl and metal doors and frames are preferred for reasons of overall cost-effectiveness and durability, and the consideration of resilience reinforces this preference. All doors filled with foam or wood cores should be evaluated after exposure to salt or fresh water flooding, to determine whether the interior materials were saturated and could provide an environment for mildew and mold growth.

If flooding is a concern, exterior doors can be fitted with removable shields, or replaced with flood doors to protect from low-level flooding. Integrated waterproof flood doors or flood gates may be installed at entryways and if paired with sump pumps connected to a backup power source, may prevent interior flooding, pending that the rest of the structure is flood tight. Consult an engineer to see if this is a viable strategy.

Frequent inspection of temporary barriers is often necessary, and yearly training and practice is recommended so that staff can practice installation and make any repairs necessary.

## EXTERIOR ENTRIES & FRAMES

### MATERIALS

Pre-hung fiberglass doors with vinyl composite frames are preferred, although insulated steel is acceptable if custom sizes are required or if there are security concerns. Use metal frames (welded, galvanized, prefinished) if heavy use is anticipated. In specifying steel or fiberglass doors, identify locations for reinforcing to accept hardware, including door closers. . Also specify Energy Star certified products.

Specify the thresholds, if the door will be used as an accessible entry.

Steel doors are made in various gauges of metal and with various insulating values. Steel doors should be a minimum of 16 gauge over a closed cell slab. Include these requirements in the specifications, as well as requirements for reinforcing to accept hardware.

Do not specify applied plastic trim and mail slots.

Wood doors are not recommended for exterior use. If wood doors must be used, specify factory finish.

Egress Doors: Not more than 30 lb./ft. required to set door in motion and not more than 15 lb./ft. required to open door to minimum required width. Operating force requirements shall conform with requirements of all applicable codes.

## SCREEN & STORM DOORS

### MATERIALS

For exterior unit entries, provide highly durable extruded, heavy gauge aluminum framed storm doors with:

- ❑ solid bottom panels
- ❑ factory-welded or brazed frame joints
- ❑ aluminum wire or fiberglass fabric screens
- ❑ concealed screen
- ❑ solid core

Avoid Slab Doors

With insulated exterior doors, storm doors are not necessary, and may void metal door warranties. Provide screen doors (without glass insert) for ventilation.

Combination storm doors/screen doors do not hold up over time for some uses, such as at special needs or congregate residences. In these buildings provide screen doors (without glass insert) with solid bottom panel.

## PATIO DOORS

### MATERIALS

Patio doors should be swinging, insulated steel, vinyl, fiberglass or clad wood, with insulated tempered glass, and include the manufacturer's sliding screen door.

Due to operating force requirement for elderly tenants and the fact that sliders fail over time, DHCD suggests avoiding sliders unless there are no other choices.

## UNIT ENTRY DOORS & FRAMES

### MATERIALS

Interior unit entries: solid core, 1-3/4 inch doors with 16 ga. metal frames (welded if required for fire rating) set up for hardware at the factory fire rated per code. Knock-down, field assembled door frames have been problematic.

Provide a UL certification label on all rated doors.

## CORRIDOR DOORS & DOORS OFF PUBLIC AREAS

Interior doors, within units, should be solid core doors: 1-3/8 inch; pre-hung in wood frames; (metal frames for solid core doors are typically only used with metal studs); 6-panel, pre-finished hardboard or field finished 6-panel wood veneer are both acceptable. Prefinished all interior veneered wood doors.

## INTERIOR DOORS

Avoid interior hollow core doors.

### MATERIALS

Select products with low/no VOC and formaldehyde emissions or content. Select FSC certified wood or reclaimed wood or composite doors with the following features when possible, outside of flood areas or areas with wind-driven rain:

- Rapidly renewable materials,
- Agri-fiber residue,
- No added urea formaldehyde,
- FSC certified veneer stiles and rails, and
- Recycled content.

### Execution

Install frames, if doors are not pre-hung, using the door as a template to assure perfect alignment of the door and frame. Provide a fastener at each clip.

## CLOSET DOORS & VENTILATING CLOSETS

### MATERIALS

Louvers may be required in some interior doors, such as for closet doors in elderly housing and 689 developments. Although wood louvers are costly, they are used in order to maintain air circulation in the closet and reduce the possibility of mold accumulation.

Louvers should not be used in family housing because they are susceptible to damage and undercutting the doors is preferred.

Bifold and sliding doors should be avoided except in accessible units.

## FIRE DOORS

Fire door assemblies must meet positive pressure testing requirement of UL 10c. Specify fire rated doors includes specifying gasketing to maintain positive pressure.

## ACCESS DOORS

The location and specific requirements of access panels and doors should be considered ~ exterior requires insulation, interior requires security, etc.

Heavy duty steel access panels and doors may exceed the requirements for the certain locations. The specifications should be developed to meet the application.

## DOOR & FRAME SCHEDULE

Provide a door and frame schedule in the plans.

# DESIGN AND CONSTRUCTION GUIDELINES AND STANDARDS

DIVISION 8 • OPENINGS

## 08 40 00 • ENTRANCES AND STOREFRONT

### SECTION INCLUDES

Storefront
Insulated Panels
Glass and Glazing

### RELATED GUIDELINE SECTIONS

| | |
|---|---|
| 06 10 00 | Rough Carpentry |
| 06 20 00 | Finish Carpentry |
| 07 90 00 | Sealants |
| 08 10 00 | Doors and Frames |
| 08 70 00 | Hardware |
| 26 00 00 | Electrical |

**Filed Sub Bid**

**M.G.L. c.149 §44F**

*When furnished and installed separately from the storefront frame, glass and glazing is a stipulated filed sub-bid category under M.G.L. Chapter 149, §44F. If the cumulative estimated value of the work in this section **exceeds $25000** and the projects total cost is over $1500,000, it triggers the filed sub-bid requirement and must be specified in a separate filed sub-bid section of the Specifications.*

### TECHNICAL STANDARDS

**AAMA – American Architectural Manufacturers Association**
www.aamanet.org **-** source of performance standards, product certification and educational programs for the window, door and skylight industry.

**AWS – American Welding Society** www.aws.org D 1.2 "Structural Welding Code-Aluminum" This code contains the requirements for fabricating and erecting welded aluminum structures.

**NAAMM – National Association of Architectural Metal Manufacturers**
www.naamm.org **-** "Metal Finishes Manual for Architectural and Metal Products" Storefront.

**NABS – National Association of Building Sciences** www.nibs.org publishes the "Building Envelope Design Guide" offering design tips for exterior entrances (www.wbdg.org/design/env_fenestration_doors.php).

### CLIMATE RESILIENCE DESIGN CONSIDERATIONS

Entrances and storefronts provide daily and emergency ingress and egress, air circulation, and visual access to the outdoors and street life for building residents. Shading devices, operable windows and screens can be integrated into the design of entrances and storefronts to help reduce temperature-related climate impacts, including overheating during heat waves. Designers should consider frits or other solar gain mitigation techniques for South, West, and East facing storefront and entrance glazing to minimize overheating. Electrically controlled door openers need an automatic manual override during power outages or include emergency power backup

Should existing or planned storefront windows extend below the Design Flood Elevation (DFE), flood damage resistant materials should be used below the DFE in place of storefront windows.

### MATERIALS

Storefront entrance doors should have a thermal brake, blast mitigation, hurricane resistance, and for moderate to high traffic application. . Narrow style doors are not acceptable.

For heavily used doors consider balanced doors and concealed hinges for easier operation.

Doors should have a minimum 14 inch high bottom rail to serve as a kickplate.

Include insulated panels in this section of the specifications.

If the glass is installed in the door by the door manufacturer and arrives as one unit to the site, glass and glazing should be specified in the door section of the specifications.

Glazing shall be high performance with low-E coating. Consult building code for locations where tempered glass and/or high impact glass may be required.

All extrusions shall be factory fabricated, and frames factory assembled where possible. Recycled content in fabrication of extrusions have experience appearance with anodized finishes.

### DESIGN

Single leaf doors are sufficient to accommodate foot traffic in most applications; double doors are not as energy efficient.

Include vestibules and awnings where possible to protect the entrance against wind and rain. Otherwise, recess the door assembly as much as possible from building face, provide projecting head flashings or drips, and utilize projecting eaves to shield doors from the weather.

Consider warm air curtain ventilation with thermostatic controls coordinated with the building thermostat to reduce heat loss at locations without vestibules.

Verify exit width of units required by the building occupancy.

Meet ADA requirements for door width, operating force, threshold design, and space requirements for door location, etc.

At flush thresholds, utilize threshold trench drains, sill and pan flashing, waterproofing membranes, water resistant vestibule floor finishes and other design devices to mitigate the entry of water.

Temporary flood barriers may be installed at entrances and deployed in advance of an anticipated flood events. Some types of temporary flood barriers may be integrated into the structure. Temporary barriers can be quickly deployed, generally in less than 24 hours depending on operational availability and size of deployment. However, a flood must be anticipated with sufficient warning time and buildings must be evacuated prior to installing barriers which prevent egress. Consult an engineer to see if this is a viable strategy as flood barriers may put stresses on the building structure and may be in conflict with the building code

Integrated, waterproof, flood doors or flood gates may be installed at entryways and if paired with sump pumps connected to backup power sources, may prevent interior flooding, providing that the rest of the structure is flood tight. Consult an engineer to see if this is a viable strategy. For further information consult FEMA P-259 Chapter 5D. Note however the cost might be prohibitive.

Frequent inspection of temporary barriers is often necessary, and yearly training and practice is recommended so that staff can practice installation and make any repairs necessary.

Evaluate the performance of the complete door/glass assembly as well as individual components of the system when considering product substitutions.

**STOREFRONT**

Require shop drawings for aluminum-framed systems that include plans, elevations, sections, details, and attachments to other work, as well as ~ .

- ❑ structural analysis data signed and sealed by a qualified professional engineer registered in the Commonwealth of Massachusetts responsible for their preparation.
- ❑ structural analysis of story drift and deflection from anticipated live loads, and determination whether head receptors are required.
- ❑ details of provisions for system expansion and contraction and for draining moisture occurring within the system to the exterior.
- ❑ comparative heat loss calculations where insulated panels are being considered as substitutions for glazing in building retrofits.
- ❑ for entrances, include hardware schedule and indicate operating force, operating hardware types, functions, quantities, and locations.

- storefront and entrance systems should be constructed with thermal breaks and weatherstripping to reduce heat loss and condensation.

If steel reinforcement is required specify galvanizing or corrosion-resistant primer to protect against galvanic action.

**METAL PANELS**

Specify insulated metal panels to be glazed into the storefront units by the storefront contractor. Include the R or U value of the metal panel units.

**FINISHES**

Specify painted or anodized finish for frames. Factory applied fluoropolymer thermoset coatings offer good resistance where exposed to coastal environments or deicing salts.

**GLASS AND GLAZING**

**Filed Sub Bid**

**M.G.L. c.149 §44F**

Require shop drawings for each type of glass and glazing material including proof that units as glazed for this Project meet or exceed Code requirements for the following:~ U-value, Solar heat-gain coefficient, wind impact.

*On a project costing more than $150,000, calculate the value for site* ***installed glass and glazing*** *to determine if the value* ***exceeds the $25,000*** *threshold for a filed sub-bid. Doors are generally provided to the site pre-glazed and are not part of the filed sub-bid calculation.*

Operable windows may be provided to the site pre-glazed or site-glazed. Pre-glazed windows are not considered in the cost calculation mentioned above

## CLIMATE RESILIENCE RESOURCES

Project teams can learn more about best practices for protecting entrances and storefronts using this resource and others:

- Engineering Principles and Practices for Retrofitting Flood-Prone Residential Structures; https://www.fema.gov/media-library-data/20130726-1506-20490-2593/fema259_complete_rev.pdf

# 08 50 00 • WINDOWS

## SECTION INCLUDES

Metal Windows
Vinyl/Aluminum Clad Wood Windows
Solid Fiberglass and Vinyl Windows
Wood Windows (Historic Preservation only)

## RELATED GUIDELINE SECTIONS

| | |
|---|---|
| 02 83 00 | Lead Paint Remediation |
| 06 10 00 | Rough Carpentry |
| 06 20 00 | Finish Carpentry |
| 07 20 00 | Building Insulation and Moisture Protection |
| 07 40 00 | Siding |
| 07 62 00 | Sheet Metal Trim and Flashing |
| 07 90 00 | Sealants |
| 09 90 00 | Painting |

**Filed Sub Bid**
**M.G.L. c.149 §44F**

***Metal Windows*** *is a stipulated filed sub-bid category under M.G.L. Chapter 149, §44F. If the project total cost is $150,000.00 or greater and the cumulative estimated value of the work in this section exceeds $25,000, it triggers the filed sub-bid requirement. The one exception would be if windows are the predominant work, in this case the DCAMM category can be doors and windows and a filed sub-bid for metal windows is not necessary.*

*Wood, Fiberglass and Vinyl windows are not required filed sub-bid categories*.

## CODES AND STANDARDS

REFER TO AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION FOR LATEST VERSION OF THE NORTH AMERICAN FENESTRATION STANDARD.

WWW.AAMANET.ORG

Window performance grade ratings must be in accordance with North American Fenestration Standard NAFS 2017 as follows:

- ❑ Residential for one to three stories R 40
- ❑ Low Rise Multi-family LC50
  Low Rise / Mid Rise CW 60
- ❑ High- rise AW60

Consider higher ratings for coastal sites

Consider pan flashing for all windows above three stories

Windows should meet all Massachusetts Building Code (latest edition and/or stretch code) requirements including labeling by the **NATIONAL FENESTRATION RATING COUNCIL NFRC** WWW.NFRC.ORG

Windows should also:

- ❑ Meet forced entry level 10 (ASTM F 588-17)
- ❑ Meet Insulated glass construction Class CBA rating (ASTM E 2188)
- ❑ Meet Energy Star requirements www.energystar.gov

## CLIMATE RESILIENCE DESIGN CONSIDERATIONS

Windows play an important role in minimizing the negative effects of climate hazards like extreme heat by providing daylighting, improved thermal performance, enabling emergency egress, and providing building occupant comfort. Increased reliance on daylighting reduces dependence on electrical systems that can fail during heat waves and other climate hazard events. Shading devices can be integrated into window design to help reduce temperature-related climate impacts, including overheating during heat waves.

Windows have traditionally been specified with the same style and performance profile for an entire development. However, it is also possible and may be cost effective for the designer to customize the performance of the windows depending on which way the face of the building is oriented to the sun and wind, and what neighboring structures are adjacent. North facing windows should allow for more solar gain and lower thermal transfer outwards, to take advantage of sunshine for heating and to keep heat in in the winter. South and West facing windows should prevent solar gain and lower thermal transfer inwards to reduce the need for cooling in the summer. Existing windows can be retrofitted by adding a window coating to reduce solar gain and thermal loss. When replacing or retrofitting existing windows, consult a window expert to help select the appropriate windows or retrofit strategies.

Taking advantage of natural ventilation can reduce energy consumption. Windows can play an important role in cooling a building, especially during power outages. Ensure that all windows are operable. Consider installing additional windows in walls perpendicular to the prevailing wind direction for additional cooling. In units without A/C, windows can be opened at night to flush hot air from the building.

**Shading** windows reduces the amount of solar heat gain in the interior of the building, thereby **reducing cooling loads** during the summer months and leading to lower indoor temperatures during power outages when the cooling system is not operational. Consider adding overhangs to south-facing windows or awnings to east- or west-facing windows or add interior window shading treatments, although these will be less effective compared with outdoor shading.

## DESIGN

Double-hung windows are strongly preferred for new construction. When replacing windows, sliding and casement windows should be replaced with double hung units if possible. Operating force <u>measured after</u> the application of all trim and insulation should be:

| | |
|---|---|
| ❑ Families | 35lb in either direction |
| ❑ Elderly or barrier-free | 15lb in either direction with a minimum breakaway force of 15 lb. |

Accessible window units shall comply with MAAB and ANSI 117-1 requirements. (Window reach and access)

Install window guards conforming to IBC R312 or 1015.8. See ASTM F 2090

Install Window Control Devices in accordance with IEBC 702.4 (Level 1)

Install Replacement Windows in accordance with IEBC 702.5 (Level 1)

Installed windows requiring greater force for operating must be field adjusted to comply with operating force limits as directed by the Designer.

Windows will also be subject to field testing of breakaway force as directed by the Designer.

Avoid sliding windows. They have typically been energy inefficient and difficult to operate. Also, avoid casement windows, especially for families. Both sliding and casement windows are high maintenance items.

To ensure easy operation in elderly and barrier-free units, the window stool for double-hung windows should be no deeper than 6 inches wherever possible.

Half screens are preferred, but in some rare instances, full screens will be more convenient.

Heavy duty security screens may be required at selective urban developments.

Air conditioner wall sleeves should be avoided. However, they might be considered for a window replacement project where the number of existing windows does not allow for at least one window to open if the a/c unit is installed in the window opening.

Storm windows are not necessary unless single pane windows are retained as part of a historic rehabilitation project or needed for noise abatement.

Integral lift rails are preferred.

Provide performance specifications defining optimum thermal characteristics (U value & SHGC), air infiltration and moisture resistance for the specific application.

Window assembly must have a minimum 10 year warranty.

### INVESTIGATION AND RESEARCH

When replacing windows, check for weight pockets. Insulate voids and weight pockets around windows with fiberglass or foam insulation, backer rods, and caulk, or with backer rods and acoustic caulk. This requirement must be clearly spelled out in the specifications. Foam insulation has a better seal, however the correct foam insulation must be utilized or it can have a detrimental effect. See the guidelines on building insulation for more specifics.

Check for prior water infiltration or insect damage around windows and include work to repair any possible hidden structural damage under other specification sections. Conduct destructive testing if required.

Refer to the latest edition of the building code for code compliance of replacement windows. Review applicable codes for egress requirements.

## CLAD WOOD WINDOWS

### MATERIALS

Acceptable windows include vinyl clad Andersen Corporation, Perma-Shield Double-Hung, Pella aluminum clad windows and Marvin Clad windows.

Factory pre-finishing of the interior of sash is preferred. Pre-finishing is a special order that must be included in the specifications. Coordinate with the painting specifications.

Specify aluminum framed insect screens (for durability). Charcoal colored aluminum mesh is generally the most aesthetically pleasing.

**Vinyl Replacement Sash** - Andersen Window Corporation has replacement sash kits available for projects with their Andersen Narrowline windows that were manufactured before 1970. These sash replacement kits can be provided in pre-finished units and have accessories such as finger pulls available for ease of window operation. These replacement units can be ordered as part of a total project replacement or in quantities that can be installed by LHA maintenance staff.

## METAL WINDOWS

### DESIGN

Limit the use of metal windows to situations where oversized or structural concerns are a major factor or for storefront applications.

Aside from storefront applications, double-hung windows are preferred; sliding windows should be avoided.

Design a metal flashing pan and head and jamb flashing system to minimize the possibility of water infiltration. This is especially necessary in applications near the ocean or other buildings subject to higher winds, such as buildings over 3 stories. Thoroughly review manufacturer's details including but not limited to receptors, frame components, flashing details and installation details.

Specify adequate thermal breaks and require that air and water infiltration standards to be met.

### MATERIALS

When specifying metal windows, give serious consideration to AW60 or better rated window.

Use the manufacturer's recommended weatherstripping.

If painted, specify a durable paint finish. (Kynar or equal)

### EXECUTION

Insulate around windows with fiberglass or foam insulation, backer rod, and caulk, or with backer rod and acoustic caulk. This requirement must be clearly spelled out in the specifications.

Refer to Sections 07 90 00 Sealants and 07 20 00 Building Insulation.

**FIBERGLASS AND VINYL WINDOWS**

## MATERIALS

### GENERAL ISSUES

Windows meeting AAMA performance standards are required.
All extrusions shall be fiberglass or 100% virgin PVC.
Nailing fin installation is preferred in new construction and where applicable on replacement windows.

❑ **FRAME:**

Overall depth 3 ¼" minimum
Minimum vinyl extrusion thickness of .065"
Welded frame
Sloped sill preferred - pocket sill discouraged unless required for Grade 60 rating.
Provide shim blocks to support A/C units to avoid window frame damage.

❑ **SASH:**

4 point welded sash preferred. Welded corners are required
Minimum vinyl extrusion thickness of .065"
Metal reinforcing at meeting rails
Adjustable cam locks (Minimum of 2 per sash if sash is over 36" wide)
Interlocking Sash
Double weatherstripping is preferred at meeting rail and base.
Tilt-in sash with two spring loaded sash releases, latches on each sash

❑ **BALANCES:**

Block and tackle or ¾" constant force balances preferred - Spiral balances are not acceptable.

❑ **GLAZING**

IGMA certified construction class CBA [www.IGMAonline.org](www.IGMAonline.org)

Minimum 7/8" thickness
Warm edge technology preferred
Window grids should be between the glass.

❑ **SCREEN**

Aluminum framed half screen
Charcoal finish aluminum
When using locking clips, aluminum is required. Avoid plastic clips.

## FLASHING

All windows in new construction and in retrofits, where feasible, should be flashed with a flashing tape type product similar to Dupont FlexWrap and

StraightFlash, Carlisle Window & Door Flashing, or W.R. Grace Vycor or Vycor Plus. Install per manufacturer's recommendations.

Windows installed in masonry buildings should always have a pan flashing system installed prior to installing the new window.

Typical Flashing Detail for installation of flanged windows in wood framed construction can be found on the next page.

## Wood Windows

### General Issues

Wood windows are typically used when replacing windows to match historic details. If possible windows should meet as much of the criteria listed in this document while maintaining the character and details of the existing windows.

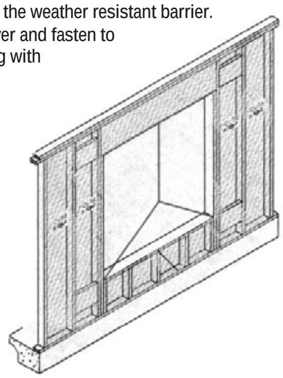
**CLIMATE RESILIENCE RESOURCES**

Project teams can learn more about best practices for using windows to mitigate heat loss and to limit solar heat gain using these resources among others:

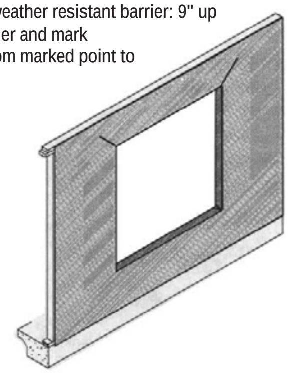
- Enterprise's "Strategies for Multifamily Building Resilience" in chapter eleven provides a number of accessible strategies and example images of how window shades, both external and internal, can be used to limit solar heat gain during the summer season: https://www.enterprisecommunity.org/download?fid=2154&nid=4325
- The Boston Planning and Development agency also offers strategies and graphics for managing and upgrading windows. These are based on local building types and the graphics are easy to understand. This resource is available here: http://www.bostonplans.org/getattachment/d1114318-1b95-487c-bc36-682f8594e8b2

## TYPICAL FLASHING DETAIL IN WOOD FRAMING

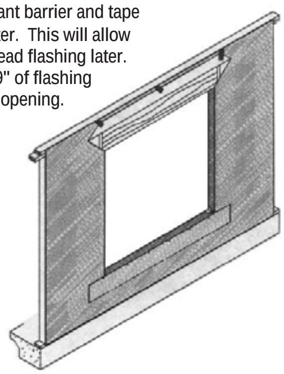
1. Make a modified "I-cut" in the weather resistant barrier. Fold bottom and side flaps over and fasten to interior side of rough opening with staples set 12" to 18" apart.



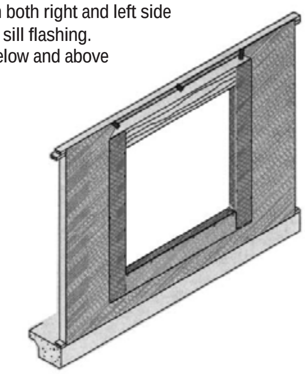
2. Measure for diagonal cuts in weather resistant barrier: 9" up from corner and 9" over from corner and mark (45° diagonal). Cut on diagonal from marked point to rough opening corner



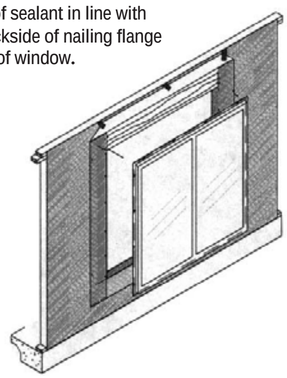
3. Gently raise weather resistant barrier and tape temporarily at corners and center. This will allow for the installation of window head flashing later. Apply flashing at sill allowing 9" of flashing material on eitherside of rough opening.



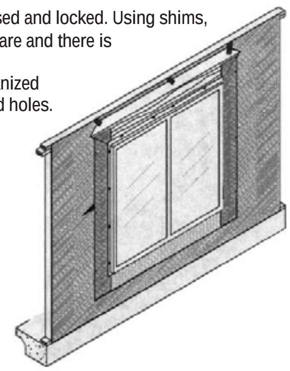
4. Next, apply jamb flashing on both right and left side over- lapping previously applied sill flashing. Flashing should extend 8-1/2" below and above rough opening.



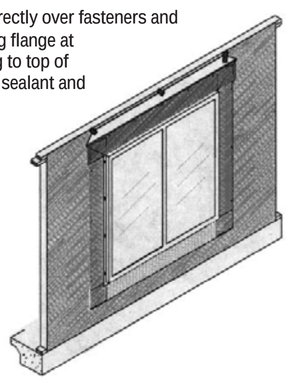
5. Apply 3/8" nominal bead of sealant in line with pre-punched nail slots on backside of nailing flange around the entire perimeter of window.



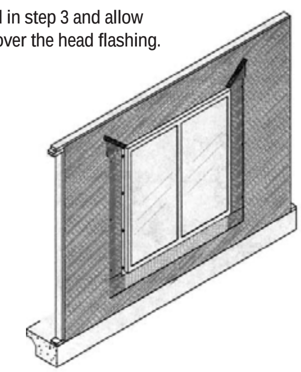
6. Be sure window sash are closed and locked. Using shims, be sure window is plumb and square and there is an equal reveal around the unit. Secure window using 1-3/4" galvanized roofing nails through pre-punched holes. Nail every hole.



7. Apply a bead of sealant directly over fasteners and pre-punched holes in mounting flange at top of window. Apply flashing to top of window pressing flashing into sealant and letting flashing extend 10" on left and right side of rough opening.



8. Remove temporary tape applied in step 3 and allow weather resistant barrier to lie flat over the head flashing. Apply new sheathing tape over the entire diagonal cut made in the weather resistant barrier as shown



# DESIGN AND CONSTRUCTION GUIDELINES AND STANDARDS

DIVISION 8 • OPENINGS

## 08 70 00 • HARDWARE

### SECTION INCLUDES

Exterior Door Hardware Items
Electric Assist Door Operator
Interior Door Hardware

### RELATED GUIDELINE SECTIONS

| | |
|---|---|
| 06 10 00 | Rough Carpentry |
| 08 10 00 | Doors and Frames |
| 08 40 00 | Entrances and Storefronts |
| 26 00 00 | Electrical |
| 28 00 00 | Electronic Safety and Security |

### INVESTIGATION AND RESEARCH

Review keying needs with LHA prior to preparing the specifications and again prior to bidding. New hardware must be compatible with the hardware serving existing facilities. A proprietary specification may be necessary to ensure compatibility. A Board vote is required for proprietary specification of components.

Identify the level of use anticipated and specify accordingly. The hardware sets for most elderly unit doors are not subject to the same use as doors into family units. For example, lever handles are more suitable for elderly units and special needs facilities, but not necessarily in family units where they are subjected to overuse and should be used selectively.

Verify that the door thickness is adequate to install the hardware. In general, mortise locks are not preferred. However, where mortise locks are used, typically in interior unit entry doors, note that the latch bolt of a heavy duty mortise lockset will damage the trim unless the strike plate has an extended lip.

### REFERENCE STANDARDS

**ADA/MAAB REQUIREMENTS**

**521 CMR Regulations -** designed to make public buildings and facilities accessible to, functional for, and safe for use by persons with disabilities.

**ANSI/BHMA** standards - **BHMA Builders Hardware Manufacturers Association** **http://www.buildershardware.com/** is the trade association for North American manufacturers of commercial builders hardware, founded in 1925.

**Door and Hardware Institute** **http://www.dhi.org/** is a professional organization that serves as a resource for information on doors, hardware, security and specialty products for the architectural openings industry.

**American Association of Automatic Door Manufacturers (AAADM)** http://www.aaadm.com/ is a trade association of power-operated automatic door manufacturers established in 1994 to raise public awareness about automatic doors and administer a program to certify automatic door inspectors.

**National Fire Protection Association (NFPA)** http://www.nfpa.org/ develops, publishes and disseminates consensus codes relating to fire, electrical and building safety.

## CLIMATE RESILIENCE DESIGN CONSIDERATIONS

Ocean salts and humidity common in many coastal areas and areas subject to flooding further accelerates the corrosion rate of untreated steel and other metals commonly used in connectors, fasteners, hardware, and other building materials. Consider alternative hardware if corrosion is likely at a development.

Near the coast, sheltered or covered areas do not benefit from occasional rinsing from rain and therefore accumulate more salt, resulting in higher corrosion rates.

To avoid corrosion of hardware, use stainless-steel hardware. Stainless steel hardware is acceptable in virtually all locations A hot-dipped galvanized alternative may not be appropriate in every location.

## EXTERIOR BUILDING AND EXTERIOR UNIT ENTRY DOORS

### KEYS AND LOCKSETS

Building entry doors require heavy duty commercial locksets. Specify commercial grade from manufacturers of proven quality or manufacturer preferred by the Authority.
Specify lever handles for exterior entry doors. Levers with end returns are preferred to straight levers.

The Authority may prefer knob handles for family units. Knob handles may be used for utility and maintenance doors.

The preferred cylindrical locksets should be specified with removable core. Provide master key and 4 change keys for dwelling unit locks;

Provide large bow keys for building and dwelling unit entrances in elderly and barrier-free units for easier opening.

### ELECTRIC STRIKE AND LOCKS

A card reader or buzzer system requires low voltage electricity. Coordinate with electrical specifications as well as door and doors frames. When retrofitting existing doors, investigate to determine if wiring can be configured through door frames.  Frame replacement may be necessary to facilitate wiring. Avoid surface wiring.

### CARD READERS

Card access is appropriate for mid and high rise buildings with many units. Consider use of a proximity card reader system for locks to simplify and improve security. Lost keys can be electronically deleted from use. New keys are easily activated, similar to a hotel key system.

### ELECTRIC ASSIST DOOR OPENERS

Power assist mechanisms reduce the opening resistance of a door upon activation of a switch or a continued force applied to the door itself.

Typical automatic door operator installations include the unit at the top of the door which operates the door closer, the interior and exterior door operators, and a remote power source.

**ADA/MAAB REQUIREMENTS**

The design of the system should allow for manual or automatic operation.

The door may be equipped with card key locks, remote pocket fob opening controls, or with standard keys. The operation may need to be tied into a buzzer system as well. Coordinate with LHA to determine any special operating and locking requirements.

Operating controls may be wall or jamb-mounted. Avoid bollard-mounted controls where possible.

Power assist mechanisms should be adjusted to permit doors to latch securely. Ensure that automatic door operators are compatible with the type and weight of door.

Investigate the need for supplemental interior climate controls at exterior doors where vestibules or airlocks are not present and access requires prolonged opening times. Heated air curtain systems or other localized conditioning devices may be considered. Make sure these are coordinated with building thermostats to ensure proper seasonal operation.

DHCD recommends specifying the electrical requirements for door openers in only one of the following sections: doors, door hardware, or electrical.

Coordinate technical and filed sub-bid requirements with the appropriate electrical and mechanical sub-trades.

### DOOR CLOSERS

In general, avoid closers except where required by code and at multi-unit buildings. Avoid using closers on steel entry doors when possible because they stress the hinges and can damage the door itself. When closers are absolutely necessary consider heavier ball bearing hinges.

Specify surface mounted door closers that have pressure adjustments and delayed closing action.

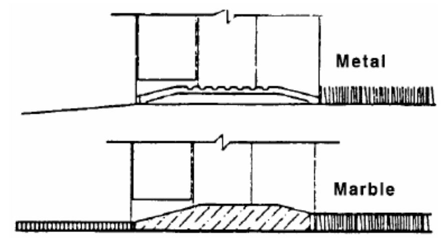
Meet ADA and MAAB requirements for operating pressure.

Closers should not require seasonal adjustments for temperatures between 120 degrees F to -30 degrees F. Hydraulic fluid shall be fireproof.

Only in certain low use applications, such as screen doors, use spring hinges or pneumatic closers provided by the door manufacturer.

**THRESHOLDS**

Where required meet ADA and MAAB requirements for thresholds: not more than 1/2 inch high; bevel raised thresholds with a slope of not more than 1:2.



Thresholds
Figure 26h

**PANIC BARS**

Coordinate with size of structural members in the door. Select manufacturer of proven quality or preferred by the Authority.

**KICK PLATES**

To minimize wear and tear from wheelchair footrests in barrier free units, install kick plates on the push side of doors.

Mount a 10 inch high kick plate so that the top is 14 inches (16 inches in DMR units) above finished floor.

The door design should accommodate the installation of the kick plate. Kick plates look better when mounted on flush face rather than panel doors.

Do not install kick plates on exterior side of metal doors.

Kick plates must be constructed of metal

**DOOR STOPS**

Wall or floor-mounted door stops are preferred.

Provide blocking and use recessed stops if the wall-mounted type will be used with push button locks.

Coordinate with Rough Carpentry section to include blocking.

Never use hinge-mounted pin stops because they can force the hinge and damage the door.

Locate floor-mounted stops close to baseboards, out of the path of travel.

**WEATHER STRIPPING**

Compressive weather stripping is preferred over magnetic.  Specify extra heavy duty exterior door sweeps for all exterior doors.

**MAIL SLOTS**

Do not use mail slots in exterior doors due to energy loss and to security concerns. Utilize alternate mail delivery methods acceptable to LHA.

**PEEPHOLES**

Provide two peepholes in exterior doors at 60 inches and 42 inches above floor height in all accessible units to comply with 521 CMR. Peepholes may be provided for entry doors to non-accessible units at the direction of the LHA.

**HINGES**

Doors under 7'-6" in height require 3 hinges, 1 ½ pairs. Doors over 7'-6" in height require 4 hinges, 2 pairs. Geared continuous hinges may be used where required for doors in high traffic and/or high security situations.

All exterior outswing doors to have hinges with non-removable pins.

**PENTHOUSE DOORS**

Equip penthouse doors with heavy duty commercial locksets as required by the Authority.

## INTERIOR UNIT ENTRY DOORS & INTERIOR COMMON DOORS

**LOCK AND LATCH SETS**

Equip interior unit entry doors with high quality light commercial locksets: use a standard 2-3/4 inch backset on all entry doors.

Specify lever handles for all unit entry doors. Levers with end returns are preferred to straight levers.

The preferred cylindrical locksets should be specified with removable core.

Provide master key and 4 change keys for dwelling unit locks.

Where mortise locks are used, typically in interior unit entry doors, note that the latch bolt of a heavy duty mortise lockset will damage the trim unless the strike plate has an extended lip.

Provide large bow keys for building and dwelling unit entrances in elderly and barrier-free units for easier opening.

**PEEPHOLES**

Provide two peepholes in exterior doors at 60 inches and 42 inches above floor height in all accessible units to comply with 521 CMR. Peepholes may be provided for entry doors to non-accessible units at the direction of the LHA.

**KICK PLATES**

To minimize wear and tear from wheelchair footrests in barrier free units, install kick plates on the push side of doors.

Mount a 10 inch high kick plate so that the top is 14 inches (16 inches in DMR units) above finished floor.

The door design should accommodate the installation of the kick plate. Kick plates look better when mounted on flush face rather than panel doors.

Do not install kick plates on exterior side of metal doors.

Kick plates must be constructed of metal

**DOOR STOPS**

Wall or floor-mounted door stops are preferred. Provide blocking and use recessed stops if the wall-mounted type will be used with push button locks. Coordinate with Rough Carpentry section to include blocking. Never use hinge-mounted pin stops because they can force the hinge and damage the door. Locate floor-mounted stops close to baseboards, out of the path of travel.

**Fire Rated Door Hardware**

Specifying fire rated doors includes specifying the related fire rated door hardware. Among these hardware components are: gasketing to maintain positive pressure, electronic hold open devices, etc.
Refer to NFPA 80 and NFPA 101 for specific hardware requirements for fire rated doors and life safety standards.

**Magnetic Door Holders**

Magnetic door holders require low voltage electricity. Coordinate with electrical and fire alarm specifications and filed sub-bid requirements. Specify the electrical requirements in only one section - doors, door hardware, electrical or fire alarm.

## UNIT INTERIOR DOORS

Equip interior unit doors with high quality residential locksets by manufacturers of proven quality. Provide privacy latch sets for all bathroom doors. Provide passage latch sets for all other interior residential doors

**Kick Plates**

In barrier free units install kick plates on the push side of doors.

Mount a 10 inch high kick plate so that the top is 14 inches (16 inches in DMR units) above finished floor.

The door design should accommodate the installation of the kick plate. Kick plates look better when mounted on flush face rather than panel doors.

Kick plates must be constructed of metal

**Silencers**

Provide 3 silencers for each single door frame, 2 for each pair frame.

**Door Stops**

Wall or floor-mounted door stops are preferred. Provide blocking and use recessed stops if the wall-mounted type will be used with push button locks. Coordinate with Rough Carpentry section to include blocking. Never use hinge-mounted pin stops because they can force the hinge and damage the door. Locate floor-mounted stops close to baseboards, out of the path of travel.

## COMMUNITY ROOM DOORS

Provide cylindrical or keypad lock sets for all Community Room and Office entry doors and interior doors that require them. Discuss requirements with LHA.
Provide Rest Rooms with privacy locksets as required by the Authority. Review any special security requirements with the Authority that may impact the Hardware Schedule.

## GENERAL INFORMATION

**Finishes**

Use BHMA/ANSI finish designations.

Consider exposure to the weather and climactic conditions when selecting hardware finishes. Avoid bright and mirror finishes. Make all finishes consistent throughout the project

**PACKAGING**

Each lockset and hardware item should be packaged separately and delivered complete with all necessary fasteners, key instructions and required templates.

Containers should be marked with corresponding item number from the hardware schedule, identifying contents and location in the finished work.

## DRAWINGS AND SPECIFICATIONS

Before preparing specifications for hardware, discuss the needs with the LHA management and maintenance staff.

Contract Documents shall include a full hardware schedule and specifications for:

- Keys and key control
- Locksets and latch sets
- Hinges (butts)
- Finishes
- Silencers
- Specialized hardware (bumpers, closers, etc.)

The specification of door hardware, particularly door hardware that requires electricity, is a specialized area of construction specification writing. Obtain the services of a hardware consultant to provide detailed information to the design team. Coordinate the hardware specifications with the electrical specifications and filed sub-bid requirements to make sure any required work is covered completely but only covered in one section.

Particular attention should be made to supplying the proper voltage to the specified electric openers, closers, or buzzers.

Most exterior doors are pre-hung, metal insulated or fiberglass insulated doors that come with weather stripping, hinges, and thresholds. The hardware specifications do not need to say anything about these items. Cross reference specification sections to avoid having redundant or conflicting requirements.

Locksets for metal insulated doors need to be carefully specified and coordinated with the door specification so that reinforcing can be located and holes can be cut in the factory. For example, a mortise lockset requires a longer block than a cylindrical lockset.

Coordinate installation of electric strikes with electrical work. Specify electric strikes are to be installed by an experienced locksmith. Coordinate with the door and frame size.

Door closers are typically field installed but the designer needs to specify blocking to be installed in the door by the manufacturer.

Carefully coordinate the location of glazing, the door stile width, kickplates and the mounting height of the lockset and panic bar hardware.

Verify that the door is adequate thickness for the hardware set to be installed. Avoid the need for stainless steel wraps or metal jackets to reinforce the door.

Determine the need for extra dwelling unit entrance locksets and key sets with extra cylinders. As a rule of thumb, specify 2 extra lock/key sets for up to 25 units, 3 for up to 50 units, and 1 or 2 extra cylinders for building entrance locksets.

Specify locksets with interchangeable, removable cores.

Specify the finish of each hardware component in the project. The supplier cannot be expected to coordinate the colors and finishes of the finished project

**ADA/MAAB REQUIREMENTS**

Where necessary, specify the specific MAAB and ADA Requirements for door operating pressure. Note that MAAB requires power assist mechanisms on doors with an operating force greater than the maximum stipulated opening force. Automatic closers, power assist mechanisms or other door hardware must not project beyond the clear width limits of the door opening and must comply with maneuvering space requirements.

Specify specific models of hardware components, and coordinate where necessary to ensure compatibility with other components.

**PRODUCTS (Example)**

| **Item** | **Preferred Manufacturer** | **Acceptable Manufacturers** |
|---|---|---|
| Hinges | Ives (IVE) | McKinney, Hager |
| Continuous Hinges | Markar (MAR) | Stanley |
| Locksets & Deadlocks | Schlage (SCH) | Sargent, Best |
| Keypad Locks | Schlage (SCH) | User Standard |
| Cylinders & Keying | Schlage (SCH) | User Standard |
| Exit Devices & Mullions | Von Duprin (VON) | Precision, Sargent |
| Door Closers & Auto Operators | LCN (LCN) | Norton |
| Push & Pull Plates & Bars | Ives (IVE) | Rockwood, Burns |
| Flush Bolts & Coordinators | Ives (IVE) | Rockwood, Burns |
| Protection Plates | Ives (IVE) | Rockwood, Burns |
| Stops & Holders | Ives (IVE) | Rockwood, Burns |
| Overhead Stops | Glynn-Johnson (GLY) | Sargent, Rixson |
| Silencers | Ives (IVE) | Rockwood, Burns |
| Thresholds & Weatherstrip | National Guard (NGP) | Pemko, Reese |

**CLIMATE RESILIENCE RESOURCES**

Project teams can learn more about selecting resilient hardware using this resource and others:

- FEMA's Homebuilder's Guide to Coastal Construction section 1.7 includes discussion and guidance on hardware selection: https://www.fema.gov/media-library-data/20130726-1538-20490-2983/fema499web_2.pdf

# DESIGN AND CONSTRUCTION GUIDELINES AND STANDARDS

DIVISION 9 • FINISHES

## 09 20 00 • GYPSUM

**SECTION INCLUDES**

Gypsum Board
Non-Structural Metal Framing
Exterior Gypsum Sheathing
Backerboard
Veneer Plaster (Filed Sub-Bid)
Trim Accessories
Acoustical Sealant
Auxiliary Materials

**RELATED GUIDELINE SECTIONS**

| | |
|---|---|
| 06 10 00 | Rough Carpentry |
| 07 10 00 | Waterproofing and Dampproofing |
| 07 20 00 | Building Insulation and Moisture Protection |
| 07 90 00 | Sealants |
| 09 30 00 | Tile |
| 09 90 00 | Painting |

**TECHNICAL STANDARDS AND INFORMATION**

Gypsum Association Representing manufacturers of gypsum board in the US and Canada www.gypsum.org
Drywall Information Trust Fund drywallinformation.org
Drywall Recycling www.gypsumrecycling.us/, and www.drywallrecycling.org,
USG Installation and Application Guides www.usg.com

### ENVIRONMENTAL ISSUES

**PRODUCTS**

Consider specifying products locally produced with recycled content. Gypsum board is increasingly available with high amounts of recycled content. Some of it is produced within 500 miles. Synthetic gypsum is a byproduct of coal fire plants called flue-gas-desulfurization (FGD) gypsum. The use of gypsum board with synthetic gypsum reduces the amount of FGD that enters landfills. Be aware that some overseas products have been shown to have less quality control of the purity of the fly ash and have had a pyrite oxidation of the fly ash to negative affect.

Gypsum board recycling is available locally and should be included in the Construction and Demolition Waste Management Plan. Do not place leftover scraps of gypsum board in the walls as this may inhibit future plumbing or electrical work. Be aware that when using glass fiber containing products that they cannot be recycled.

If a laminating adhesive is to be used, a low-VOC product should be specified to promote better indoor air quality for construction workers and residents.

### FIRE SAFETY

Polyurethane foam structural adhesives are not allowed.

Gypsum Board installation in modular construction has historically been attached with polyurethane foam structural adhesive. Using foam adhesive rather than mechanical fasteners allows the modular units to be shipped to the site with minimal damage to the drywall due to screw or nail popping.

Polyurethane foam structural adhesives are highly flammable. Their use in the voids often present in modular construction introduces significant flammable material in these voids. Furthermore, at temperatures far below those present in a fire situation, these adhesives lose their strength, allowing the gypsum board to collapse, thus further intensifying the fire hazard.

Currently in Massachusetts ceiling gypsum board must be installed with mechanical fasteners. These standards require fasteners and no adhesive. The same standard is applied to wall construction, although the risk is somewhat less.

Fire safety can also be enhanced by going beyond current code requirements and installing draft barriers within the ceiling plenum space. Code requires draft stopping into areas of 1000 sf or less, (currently proposed to be reduced to 500 sf) but the large volume of space between modular units suggests a need for smaller areas.

### CLIMATE RESILIENCE DESIGN CONSIDERATIONS

In areas where flooding is a concern, follow wet floodproofing techniques for interior wall construction. Construct walls with a horizontal gap between the lower and upper wallboard to prevent wicking of moisture. Use non-paper-faced gypsum below the wallboard and paint it with latex based paint. Use ridged, closed cell insulation in the lower section of the wall in place of batt or cellulose. Exterior cavity wall construction can also use closed cell ridged foam insulation and non-paper-faced gypsum.

*Figure 9. Recommended wet floodproofing techniques for interior wall construction. The following flood damage-resistant materials and methods will prevent wicking and limit flood damage:*

*1) construct walls with horizontal gaps in wallboard;*

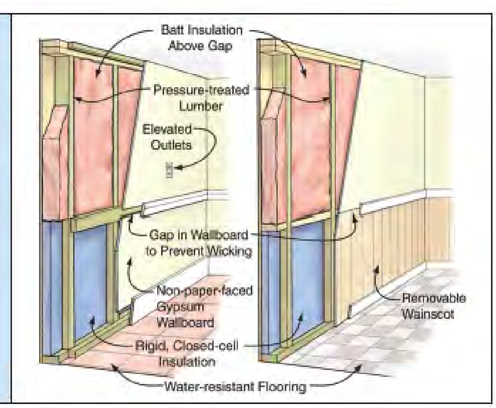
*2) use non-paper-faced gypsum wallboard below gap, painted with latex paint;*

*3) use rigid, closed-cell insulation in lower portion of walls;*

*4) use water-resistant flooring with waterproof adhesive; and*

*5) use pressure treated wood framing*

(SOURCE: LSU AGCENTER AND COASTAL CONTRACTOR MAGAZINE).




FEMA 499, 1.6 p 6 of 8

### MATERIALS

Use Interior Gypsum Board complying with ASTM C 36/C36M or ASTM 1396C 1396M. Use water-resistant gypsum board and fire-rated water-resistant gypsum board complying with ASTM C 630.

Gypsum wallboard manufacturers include American Gypsum, CertainTeed Gypsum, United States Gypsum (USG), National Gypsum and Georgia-Pacific Gypsum. Gypsum board manufacturers have several different types of gypsum wall board including standard (white board), fire rated (type X), acoustically enhanced, water resistant (green board MR), plaster base gypsum board (blue board) and mold resistant board.

When possible, used products with the following features:
-non-paper-faced drywall such as fiberglass-faced products;
-gypsum products with post-consumer recycled content; and
-third-party certified products to meet indoor air quality standards.

All gypsum drywall panels come in standard sizes, but custom sizes are available for large orders. Thickness of gypsum board varies from from ¼ to 1 inch. Most building codes mandate either 1/2- or 5/8-inch drywall for single-thickness applications. Thinner ¼ and 3/8 inch to be used to cover existing walls and ceilings. Select panel sizes and layout panels to minimize waste. Reuse cutoffs to the greatest extent possible in closets or other areas where the cutoff sizes are appropriate to the size of the space being finished. Standard drywall works well in most situations, but codes may require Type X, Type MR or other types depending on the application or the UL Fire Rating.

Moisture resistant type gypsum wall board (green board or other paper faced board) is not recommended in bathroom and laundry areas. Use Densglass or glass fiber covered panels in these areas.

Use flexible caulk to fill the gap between the rough floor and the bottom of the drywall for air sealing, to keep insects out, and to provide a backing for the vinyl base.

## GYPSUM BOARD

Use paper joint tape for interior gypsum wallboard. Self-adhering fiberglass joint tape is only permitted where veneer plaster will be used. Used with joint compound, it is not as rigid, and cracking may occur.

Joint compound for prefilling shall be interior gypsum board setting-type taping compound. Embedding, first, second & third coats shall be drying type, all-purpose joint compound. Pre-mixed compounds shall be free of antifreeze, vinyl adhesives, preservatives, biocides, and other slow releasing compounds.

### DESIGN

Drywall assembly types should take into consideration the requirements of fire ratings, wet locations, and acoustic details within the design of the overall wall construction.

Use cement board such as Durock behind tile in bathrooms and DensArmor Plus paperless gypsum board smooth finish or Fiberock Brand Tough Panel everywhere else in the bathroom. Blue board with skim coat of plaster may be used on ceilings. Install cement board full height on walls to receive ceramic tile or solid surfacing.

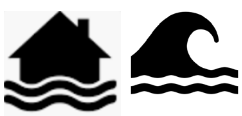
In DDS group homes, install blue board with skim coat on walls and ceilings to provide a more durable surface.

Use fire rated Type X gypsum drywall assemblies or UL rated wall assemblies for rated walls and shaft walls as required by code.

### EXECUTION

Application and Finishing of Gypsum Board is to comply with ASTM C840.

Fasten all gypsum drywall with screws, not nails at 16" on center for wall and 12" on center for ceilings. At corners, end walls and top plates use drywall clips or drywall stops to reduce the need for wood or metal blocking and to allow for a fully insulated exterior envelope. Where roof trusses are used, to mitigate ceiling cracking, the use of clips is required at ceiling to wall joints. Do not screw the ceiling gypsum board directly to the trusses within 16 inches of an interior wall.



At basement floor slabs, hold gypsum board a minimum of ½" off the floor to prevent moisture wicking into the board. Close the gap with sealant to prevent air infiltration.

Install drywall according to the requirements of the wall type. Attach corner beads with screws, do not clinch. Install expansion joints as shown on the drawings on walls and ceilings.

There are several levels of gypsum board finish that can be specified. The minimum level of finish required is for all joints and interior angles to have tape embedded in joint compound and two coats of joint compound applied over all joints, angles, fastener heads and accessories.

However, in certain locations the level of finish can be reduced for all joints and interior angles to have tape embedded in joint compound only which is referred to as "fire taping".

## NON-STRUCTURAL METAL FRAMING

### MATERIALS

### REFER TO SECTION 05 10 00 FOR STRUCTURAL FRAMING

Steel framing members for walls and partitions within 10 feet of exterior walls must have a protective hot-dip galvanized coating meeting the requirements of ASTM A653, G 40.

Steel studs and runners shall comply with ASTM C645 with a thickness of 0.0329 inch (20 gauge) and a depth of 3-5/8 inch.

Deflection track shall be manufacturer's top runner complying with the requirements of ASTM C645 and with 2 inch deep flanges.

Shaft wall studs and runners shall have a protective hot-dip galvanized coating meeting the requirements of ASTM A653, G 40. Studs, track (runner) and jamb struts shall have a minimum thickness of 0.0329 inch (20 gauge).

Steel rigid furring channels shall be hat shaped meeting the requirements of ASTM C645 and have a thickness of 0.0179 inch (25 gauge) and a depth of 7/8 inch.

Furring brackets shall be serrated-arm type, adjustable, fabricated from corrosion-resistant steel sheet complying with ASTM C645 and have a minimum thickness of base metal of 0.0329 inch (20 gauge) designed for screw attachment to steel studs and steel rigid furring channels used for furring.

Z-Furring members shall have a slotted or non-slotted web fabricated from steel sheet complying with ASTM A653 with a thickness of 0.0179 inch (25 gauge), face flange of 1-1/4-inch, wall-attachment flange of 7/8 inch and a depth required to fit insulation thickness indicated.

Steel channel bridging shall be cold-rolled steel, 0.0598 inch (16 gauge) minimum thickness, 7/16-inch-wide flanges, and 1-1/2 inch deep.

Steel flat strap and backing plate shall be made of sheet steel complying with ASTM A653 or ASTM A568 and a minimum base thickness of 0.0179 inch (25 gauge).

Fasteners for metal framing shall be of the type, material, size, quantity, corrosion resistance, holding power and other properties to fasten steel framing and furring members securely to substrates and complying with the recommendations of the gypsum board manufacturers for applications indicated.

### EXECUTION

Install non-structural metal framing to comply with ASTM C754 and with ASTM C840 requirements that apply to framing installation. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings or similar construction. Install runners at floors, ceilings and structural walls and columns where gypsum board stud assemblies abut other construction. Wood blocking and nested studs should be installed at door and window openings and in locations to receive wood trim.

## Exterior Gypsum Sheathing

### Materials

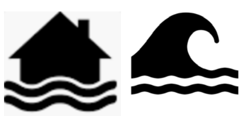
Exterior gypsum sheathing is manufactured to meet the requirements of ASTM C 1396/C 79.

Exterior gypsum sheathing can be a water-resistant gypsum board product with a treated core such as Gold Bond Brand Gypsum Sheathing by National Gypsum or a paperless product with a treated core such as Paperless DensGlass Gold Exterior Sheathing by Georgia-Pacific. ProRoc and GlasRoc by CertainTeed is another weather-resistant product which is an appropriate in stucco systems and traditional cladding systems.

### Design

Exterior gypsum sheathing can be used with either wood or cold-formed metal framing wall systems to support, stucco, brick veneer and cement. Advantages of gypsum sheathing over plywood sheathing are water resistant and fire rating.  <u>Exterior gypsum sheathing is not recommended for wood frame commercial buildings over 3 stories</u>. The use of paper faced products is not acceptable. In the selection exterior sheathing consideration should be given to the structural factors required to be achieved by the sheathing such as shear strength and pull strength of the fastening.

### Execution



Install exterior gypsum sheathing according to manufacturer's recommendations for the exterior wall cladding system.  Gypsum exterior sheathing is designed for use as a substrate that is covered by an exterior wall cladding system.  Exterior gypsum sheathing can be left exposed for up to one month but treated core gypsum sheathing should be covered immediately with a weather-resistive barrier such as building felt or equivalent.  For other specific weather resistive barrier requirements, consult the building code or cladding manufacturer.

## Backer Board

### Design

Although backer board may be specified in the Gypsum Board Specification section it is preferred to have it included in the Tile section (which is typically a filed sub trade).

Backer board is recommended in bathrooms behind tile in tub shower surrounds and walk-in showers.  Follow manufacturers design details and shower details from the Tile Council of America (TCA) *Handbook for Ceramic Tile Installation*. Fiberglass faced gypsum board is also acceptable and may even be preferred.

Backer board or abuse-resistant gypsum interior panels can also be used in areas were impact resistance is a concern where standard interior gypsum drywall will not hold up.  Backer board or abuse-resistant gypsum interior panels are recommended in corridors of fully accessible units or group homes where contact with wheelchairs is a concern.

### MATERIALS

Cementitious backer board units must comply with ANSI A108.1 & A118.9 and to ASTM D3273 for mold resistance.

There are three acceptable manufacturers of tile backerboard: DensShield by Georgia-Pacific, Cement Board by James Hardie or Durock by USG. James Hardie Cement Board and Durock are all cementitious board products. DensShield is a paperless tile backer with glass mats on the front and back sides and a proprietary water-resistant treated core and meets ASTM C 1178. Most of these backerboards are available in ¼" and ½" and some in 7/16" or 5/8" thicknesses. Thickness of backer board should match the drywall thickness used in the room for a smooth transition between adjoining materials. Coordinate backerboard section with tile section of the specifications. Use 2" wide, alkali resistant, polymer-coated glass fiber mesh for joints between cementitious backerboard units and between high-density core backerboard.

Joint compound for cementitious backer units shall be a latex-fortified Portland cement mortar.

### EXECUTION

In wet areas, install tile on cementitious backerboard and follow manufacturer installation recommendations. Extend tile with cement backerboard 6 inches past tub.

Apply glass fiber mesh joint tape and latex-fortified Portland cement mortar on cement backerboard as recommended by manufacturer.

**DO NOT** use drywall compound on Durock.

## VENEER PLASTER

**Filed Sub Bid**

**M.G.L. c.149 §44F**

*Plaster and Stucco are stipulated filed sub-bid categories under M.G.L. Chapter 149, §44F If the cumulative estimated value of the work in this section exceeds **$25,000** and the project total cost is **$150,000.00** or greater, it triggers the filed sub-bid requirement.*

### MATERIALS

When using a veneer plaster finish use plaster-based gypsum board (blue board) as the wall or ceiling underlayment such as Imperial Board by USG.

Veneer plaster shall be regular strength or high strength finish plaster, with one-coat meeting ASTM C 587.

Plaster surfaces offer better joint concealment, fewer nail pops, a hard monolithic surface which can be easily decorated, and plaster is more quickly finished than drywall.

### DESIGN

Veneer plaster finishes can offer a distinct advantage over drywall - Dust is kept to a minimum with these products. The veneer plaster is applied in a wet state and troweled to a smooth surface. No sanding is required.

Textured plaster finish is not recommended on new work due to product failure and surface peeling after repeated applications of paint over ceiling coating during building rehab.

### EXECUTION

Fasten blue board gypsum drywall with screws, not nails at 12" on center.

Apply Plaster in a thin coat directly over the gypsum panel. The plaster thickness usually ranges between 1/16th and 3/32nd of an inch. Follow installation standard of ASTM C 843.
Allow plaster to dry thoroughly (2-3 days) before applying paint. Keep the work area heated, but do not apply heat directly to the surface of the plaster to accelerate drying.

## TRIM ACCESSORIES

### MATERIALS

Trim accessories include corner beads, edge trim, LC-Beads, L-Beads, U-Beads and control joints complying with ASTM C 1047. Acceptable material for trim accessories shall be sheet steel zinc coated hot-dip process or rolled zinc.

### DESIGN

In buildings where wheelchairs will be used, protect all corners with corner trim guards.

### EXECUTION

Fasten trim accessories with back flanges to framing with the same fasteners used to fasten gypsum board.

Install edge trim where the edge of gypsum board panels would otherwise be exposed.

Corner beads are to be installed on outside corners, unless otherwise indicated.

LC-bead with both face and back flanges, face flange formed to receive joint compound. Use LC-beads for edge trim.

L-bead with face flange only, face flanged formed to receive joint compound. Use L-bead where indicated.

U-bead with face and back flanges, face flange formed to be left without application of joint compound. Use U-bead where indicated.

Use one piece control joint formed with V-shaped slot and removable strip covering slot opening.

Nails are not allowed for applying trim accessories to gypsum board.

LC-bead used at exposed gypsum board panel edges.

## ACOUSTICAL SEALANT

### MATERIALS

Acoustical sealant for exposed and concealed joints should be non-sag, paintable and non-staining latex sealant complying with ASTM C 834. The sealant is to have flame-spread and smoke-developed ratings of less than 25 per ASTM E 84.

### EXECUTION

Seal all joints between acoustical partitions work and adjoining gypsum drywall panels. Sealant should be applied around the full perimeter of the wall and at any outlets. Seal perimeters of all projections through acoustical partitions such as pipes and conduits. Seal perimeters of all frames and other items set into acoustical gypsum board installations. Seal the back of all control joints in acoustical gypsum board installations. Also, coordinate acoustical sealant of drywall penetrations with Electrical, Plumbing and HVAC sections.

Acoustic sealant should be specified in demising walls for better sound insulation. Use sealants that meet the required fire rating of the wall.

## AUXILIARY MATERIALS

### MATERIALS

Steel drill screws must comply with ASTM C 1002 for fastening gypsum board to steel members less than 0.033 inch thick and for fastening gypsum board to gypsum board. Use appropriate size screws for the thickness of the drywall to be installed.

Steel drill screws must comply with ASTM C 954 for fastening gypsum board to steel members from 0.033 to 0.112 inch thick.

Use steel drill screws of type and size recommended by panel manufacturer for fastening cementitious backerboard.

Special laminating adhesive or joint compound recommended for laminating gypsum board panels.

Spot Grout must comply with ASTM C 475 and be setting-type joint compound recommended for spot-grouting hollow metal door frames.

Drywall screws are recommended over drywall nails because they provide better holding power, minimize popping and help prevent damage to the panel.

## 09 20 00 • GYPSUM

**CLIMATE RESILIENCE RESOURCES**
Project teams can learn more about best practices for managing moisture in gypsum walls where moisture is a concern using this resource among others:

- FEMA's Guide to Coastal Construction, section 1.6, has a number of strategies and graphics that may be useful in planning updates to walls exposed to moisture. It is available here:https://www.fema.gov/media-library-data/20130726-1538-20490-2983/fema499web_2.pdf

# 09 30 00 • TILE

## SECTION INCLUDES

Interior Ceramic Wall Tile
Interior Ceramic Floor Tile
Mortar, Grout & Sealants

## RELATED GUIDELINE SECTIONS

| | |
|---|---|
| 03 30 00 | Concrete |
| 06 10 00 | Rough Carpentry |
| 07 90 00 | Sealants |
| 06 10 00 | Rough Carpentry |
| 09 20 00 | Gypsum |
| 22 00 00 | Plumbing |

**Filed Sub Bid**

**M.G.L. c.149 §44F**

*Ceramic tile is a stipulated filed sub-bid category under M.G.L. Chapter 149, §44F. If the estimated value of the work in this section exceeds $25,000 and the projects total cost is over $150,000, it triggers the filed sub-bid requirement.*

## QUALITY AND TESTING STANDARDS & REFERENCES

| | |
|---|---|
| ANSI A108-1999 | American National Standard Specifications for Installation of Ceramic Tile |
| ANSI A118.3-1999 | Epoxy |
| ANSI A118.4-1999 | Latex Portland Cement Mortar |
| ANSI A118.5-1999 | Ceramic Tile Grouts |
| ANSI A118.8-1999 | Modified Epoxy Emulsion Grouts |
| ASTM C648-84 | Standard Test Method for the Breaking Strength of Ceramic Tile |
| ASTM C1028-89 | Standard Test Method for Evaluating the Static Coefficient of Friction of Ceramic Tile |
| ASTM C627-93-1999 | Evaluating Ceramic Tile Systems using the Robinson Tester |
| ASTM C920-02 | Elastomeric Joint Sealants |

Tile Council of America Handbook for Ceramic Tile Installation-2007
See website www.tileusa.com for latest edition

Porcelain Enamel Institute (PEI) Abrasion resistance of glazed tile

### CLIMATE RESILIENCE DESIGN CONSIDERATIONS

Non-slip flooring assists in safely evacuating through corridors, entries, and common areas during or after a flooding event, and waterproof flooring can be dried and remain in place after a flood. Install slip resistant waterproof flooring such as **textured tile** in common areas to both resist flood water damage and to help prevent injury during egress in the event floors become wet. Non-slip flooring can also be installed in units with tenants aging in place, to help prevent slips and falls.

### INVESTIGATION

If the project is a modernization of existing conditions, check both the tile substrate and the structure to assure adequate structural support and stiffness.

### MATERIALS

**Interior Ceramic Wall Tile**

Where high durability, longevity and ease of maintenance are required, ceramic wall and floor tile are cost-effective interior finishes. The following guidelines should be used when specifying interior wall tile.

Wall tile for wet areas, such as tub surrounds, showers, janitor's closets or for entry vestibules/stairwells subject to freezing temperatures shall be:

- ❑ Unglazed porcelain tile with through-body color, (water absorption <0.3%)
- ❑ Polished or matte finish
- ❑ Large format tile, 12" x 12" or greater, is preferred to minimize grout joints.
- ❑ Cement backer boards and waterproofing membrane are required.

Moisture-resistant paper-faced drywall is **not** acceptable as a backer.

Wall tile for other areas, such as kitchens, laundry rooms, community rooms and wainscoting may be either porcelain as described above or:

- ❑ Vitreous (0.5%-3% absorption, per ANSI A137.1)
- ❑ Size and format which the Designer determines to be cost-effective and aesthetically pleasing.
- ❑ Cement boards or water-resistant fiberglass-faced gypsum boards are acceptable as tile backers. Moisture-resistant paper-faced drywall is not acceptable

Wall tile at entry vestibules and corridors which are subjected to high abuse, such as lower corridor walls at wheelchair user facilities, shall be porcelain with breaking strength greater than 350 lbs. and a minimum PEI wear rating of 5, (per ASTM C 1027). Impact-resistant backer boards are required to work in unison with the tile's inherent impact resistance. Use countersunk screws to install boards.

## Interior Ceramic Floor Tile

### MATERIALS

The following guidelines should be used when specifying interior floor tile:

- ❑ Designer should review the existing design and conditions of floor framing prior to designing new floor tile, particularly with larger format tile, where stiffer floors and/or more flexible grouts may be required than with traditional 2x2 mosaic tile.
- ❑ Unglazed porcelain tile with through-body color, (water absorption <0.3%)
- ❑ Matte finish
- ❑ Minimum Coefficient of friction (COF), per ASTM C 1028 of .60 (both wet and dry); except at ramps where a minimum COF of .80 is required. Where applicable, the coefficient should meet the slip resistant requirements of the ADA and MAAB Codes.
- ❑ Mud-set application preferred for new construction where floor-drains are used, or for concrete slab construction. At wood framed construction in bathrooms, waterproofing membranes such as those manufactured by Schulter Systems or by Noble Company are to be used and turned up the wall behind the cove base tile.
- ❑ ‘Heavy’ or ‘Extra Heavy’ traffic level performance per ASTM C627 or PEI rating of 4 or 5

### MORTAR, GROUT & SEALANTS

Latex-modified Portland cement mortar for plywood floors with vitreous tile.

Portland cement mortar for mud-set applications on concrete with vitreous tile.

Latex/polymer modified Portland cement mortar may be acceptable for porcelain tile, however not all brands are suitable for wet areas.

100% epoxy floor grout is preferred.

***IMPORTANT!***

Do not specify organic, (pre-mixed) adhesive for porcelain tile because the drying/curing time is too long.

### GROUT

Consult with manufacturer of tile-setting materials specified and specify the minimum amount of drying time required before grouting can occur and that the Contractor is to follow the recommendations of the adhesive manufacturer.

Epoxy grout is preferred for both floor and walls at wet areas and areas subjected to intensive use, such as floors of some public corridors and entry vestibules.

Specify low VOC epoxies.

Polymer-modified tile grout is preferred for floor tile.

Standard Portland cement grout with latex additive and sealer is acceptable at most other interior applications.

**SEALANTS**

Choose sealants carefully, based on the type of material being sealed, expansion coefficient and intended wear characteristics.

Sealants shall be either 100% silicone or polyurethane, with closed cell backer rod or bond-breaker tape. Install sealants closely adhering to the manufacturer's recommended depth to width ratios.

Use sealants with maximum VOC content of 250g/L (EPA Method 24) and complying with ASTM C920.

Specify sealant type, grade and class.

Urethane sealant, Type M, Grade P, Class 25 is recommended for all traffic-bearing floor tile joints.

Silicone sealant, Type S, Grade NS, Class 25 is acceptable for most construction, expansion, and seismic joints in tile floors and walls.

Sealants which are acceptable for porous tile, may not be acceptable for non-porous porcelain tile. Avoid specifying sealants which require edge priming porcelain tile, prior to placement.

All sealants require maintenance and should be reviewed on a regular basis for the need to be re-sealed.

**TUB SURROUNDS**

**Design**

At the tub surround, provide tile up to the ceiling. Consider specifying large format 3 mm thin porcelain panels at tub/shower ceilings where user usage patterns dictate a more water-resistant product than painted drywall. Install tile a minimum of 2 inches beyond the edges of the edge of tub/shower walls where adjacent materials are not tile.

The following design features should be specified as part of all tub/shower tile installations:

- ❑ Solid blocking at the base of the shower walls above the lip of the tub.
- ❑ Provide 2x8 wood blocking at upper and lower wall to allow installation of future grab bars at all elderly units.
- ❑ High quality sheet membrane, (not liquid applied type) for bathroom and shower floors. Detail membrane to provide a water dam at the edges of room and under tub, in case floor floods.
- ❑ Pre-formed tile or stainless steel corners at all outside corners; pre-formed cove wall base tile, (including applications where only floor tile is used).
- ❑ Bullnose tile or accent borders to mask thickness of tile and setting bed and provide finished appearance where tile finish transitions to painted wall board.
- ❑ Stainless steel or vinyl transition strips at all exposed edges or floor tile and where tile transitions to other materials

- ❑ ADA/MAAB-compliant thresholds
- ❑ Specify tile from three different manufacturers and list color selection for each manufacturer. Confirm availability of all three tile manufacturers' product and colors just prior to bidding.
- ❑ For new construction, coordinate construction, seismic and expansion joints in floors and walls to avoid having joints in tile floors. Where joints are required, coordinate with the bathroom elevations and floor plans.
- ❑ Silicone sealant, Type S, Grade NS, Class 25 is acceptable for most other construction, expansion, and seismic joints in tile floors and walls.
- ❑ Sheet applied waterproofing membrane under the tile turned up 6 inches at walls; run membrane beyond the shower area. Counter-flash sheet membrane on wet walls over the upturned base membrane.
- ❑ Floor drain located in the center of the shower and finish floor pitched gently to it (1/8 inch per ft. slope); excessive pitch or cupping at drain complicates wheelchair maneuverability. Use a prefabricated shower floor pan system with integral pan flashing and gasketing when possible.
- ❑ Preformed recessed modular niches, such as those manufactured by The Noble Company and Schulter Systems are preferred, instead of surface-mounted soap dishes, toothbrush/tumbler holders or items with hand holds; include requirement for solid wood blocking on <u>all</u> sides of niche and coordinate tile size with size and location of niche, to minimize tile cutting.
- ❑ Do not install niches on exterior walls, where thermal short circuits are created behind niche. Counter-flash waterproof wall membrane with flanges of niche. Provide rigid insulation for sound control behind niche, where wall insulation is used for sound control elsewhere in wall.
- ❑ For new construction or renovations, provide insulation at exterior walls behind tile/backer.

## ROLL-IN SHOWERS

Review the needs of the users.

Investigate different systems and provide manufacturer's details; follow Tile Council of America's latest Handbook of Ceramic Tile Installation.

Consider prefabricated shower floor pan systems which employ integral pan flashing and gasketed or factory installed floor drain clamps, to minimize potential for leaks due to poor field-installed drain flashing.

## TUB SEATS

Tub and shower seats: per ANSI A117.1, ADA and MAAB regulations and DMR guidelines for all Group 2B accessible bathrooms.

Interview the LHA and the tenant care providers, where applicable, to discuss seat alternatives such as fixed seats, fold down seats with swing down legs (such as those manufactured by Best Bath Systems) or portable seats. The seats are to be designed of durable, waterproof materials and designed to prevent tipping. Provide solid blocking in the walls to support hinged seats.

If the tenant care provider and Designer prefer a built-in tub seat then design with a large format tile or with a one-piece solid surface material. Pitch the top of the seat slightly toward tub. Install waterproof wall and floor membrane to completely seal built-out tub seats.

Provide care to have an adequately slip proof surface that will not be overly abrasive.

## CLIMATE RESILIENCE RESOURCES

Project teams can learn more about resilient flooring strategies using these resource and others:

- The Boston Planning and Development Agency discusses resilient flooring options in their “Coastal Flood Resilience Design Guidelines”: http://www.bostonplans.org/getattachment/d1114318-1b95-487c-bc36-682f8594e8b2

- FEMA’s Homebuilder’s Guide to Coastal Construction includes a set of accessible fact sheets which include graphics and resilience strategies: https://www.fema.gov/media-library-data/20130726-1538-20490-2983/fema499web_2.pdf

# 09 64 00 • WOOD FLOORING

## SECTION INCLUDES

Wood Flooring

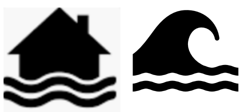
## RELATED GUIDELINE SECTIONS

06 10 00 Rough Carpentry
06 20 00 Finish Carpentry
09 90 00 Painting

## TECHNICAL STANDARDS

**National Wood Flooring Association NWFA** http://www.woodfloors.org
**Forest Stewardship Council** http://fscus.org

### CLIMATE RESILIENCE DESIGN CONSIDERATIONS



Where flooding is a concern, consider removal of existing wood flooring and/or installation of an alternative such as ceramic or other water-resistant tile, vinyl plank or VCT.

### DESIGN

For new construction, including modular construction, wood flooring can be used except in wet locations such as bathrooms, kitchens, laundries, etc.

When installing wood strip flooring over a concrete slab, provide a means to protect the flooring from moisture. Consider sleepers or a plywood sub-floor on structural slabs and concrete plank construction. In slab-on-grade construction, install a vapor barrier directly on the slab beneath the plywood sub-floor. Where sleepers are used, set each sleeper in mastic and mechanically fasten to slab before installing the vapor barrier and plywood sub-floor. Voids between sleepers may be insulated with EPS rigid insulation.

Site-finished wood flooring is preferred over prefinished wood flooring because it can be buffed and recoated without an entire sanding. It is also smooth and easily cleanable. Engineered wood (veneer plywood) is more suitable for slab-on-grade installation since it absorbs less moisture than solid wood and is less susceptible to cupping and warping.

Factory prefinished wood flooring is beveled at the edges which can hold dirt. The finish, although very durable, cannot be recoated without sanding. However, in certain situations in which the sanding, dust and fumes from installation of site-finished flooring is an issue, prefinished flooring may be considered.

Design the transitions to other flooring types to provide flat floors and eliminate tripping hazards.

### MATERIALS

Solid hardwood flooring has great longevity, is very durable, can be re-sanded up to three times and can be re-finished many times over. The lifespan of solid hardwood flooring is fifty years plus, far above the life span of other interior floor finishes. Specify FSC Certified, ¾ inch thick (min) solid hardwood flooring from North American sources or products that meet the Scientific Certification System's FloorScore criteria for Indoor Air Quality Certification (https://www.scsglobalservices.com/services/floorscore) .

Maple is very durable, better than oak which is not as impact resistant. Red or white oak strip flooring, however, is suitable for most applications. Under certain situations where the building's indoor temperature varies greatly, maple is known to shrink and leave gaps between boards.

High and medium grades are to be specified over lower grades of #2 common or #3 grade which tend to have open knots and shorter lengths. High and medium grades are to be selected based on desired style, color variation and cost effectiveness.

Engineered wood flooring which is assembled from thin layers of hardwood and a plywood backing for stability should be limited to conditions where moisture is of particular concern. Boards should be ¾ (min) thick. The top layer must be a minimum ¼" thick, solid hardwood. Binders which contain isocyanates are not acceptable. Instead, use resins that are more than 50% bio-based (e.g. soy).

Parquet flooring is not acceptable because it is too vulnerable to damage.

Laminate, veneer and bamboo flooring are not acceptable because they cannot be re-sanded and have a limited life span. Laminate flooring is most often compressed cardboard with a wood picture under a Formica surface. Laminated or veneered hardwood floorings have also been found to fail prematurely and should be avoided.

### EXECUTION

Hardwood flooring manufacturers advise that the wood flooring material be allowed to acclimate as prescribed by the manufacturer, in the same environment as the room in which it will be used prior to installation. Winter installation is preferred to avoid shrinkage.

Install flooring boards perpendicular to the floor joists over 15 pound felt or rosin paper covering the entire sub-floor. Leave a space between the wall and the floor for movement associated with expansion and contraction. Cover the space with a wood base to match the flooring material.

Site finishing should be accomplished by sanding and buffing floors to a smooth and level surface, free of sanding marks and in proper condition to receive the finish specified. Finish oak or maple flooring with a sealer and 3 coats of polyurethane. The first 2 coats are to be a gloss finish and the last coat is to be a satin finish. Sand the floor between coats with progressively finer sandpaper. Properly vent the space during the finish and curing processes.

Low to no VOC finish coatings are available and should be considered. Avoid using water-based sealers.

Flooring is to be installed after other finishing operations, including painting, have been completed. Provide certificates that products are formaldehyde free.

When re-sanding existing wood floors, verify that the wear thickness is not less than 3/32". Areas that are too thin to sand will need to be replaced.

**CLIMATE RESILIENCE RESOURCES**

Project teams can learn more about best practices for installing and selecting materials for climate resilient flooring using this resource and others:

- FEMA's Homebuilder's Guide to Coastal Construction includes a set of accessible fact sheets which include graphics and resilience strategies: https://www.fema.gov/media-library-data/20130726-1538-20490-2983/fema499web_2.pdf

# DESIGN AND CONSTRUCTION GUIDELINES AND STANDARDS

DIVISION 9 • FINISHES

## 09 65 00 • RESILIENT FLOORING

### SECTION INCLUDES

Sheet Flooring
Vinyl Composition Tile
Vinyl Strip Flooring
Base, Stair Treads

### RELATED GUIDELINE SECTIONS

02 82 00 Asbestos Remediation
03 30 00 Concrete
06 10 00 Rough Carpentry

**Filed Sub Bid**

**M.G.L. c.149 §44F**

*Resilient Flooring is a stipulated filed sub-bid category under M.G.L. Chapter 149, §44F, if the cumulative estimated value of the work in this section exceeds $25,000 and the projects total cost is over $150,000.it triggers the filed sub-bid requirement.*

### TECHNICAL STANDARDS

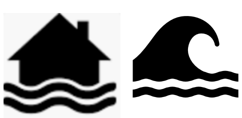
Resilient Floor Covering Institute http://www.rfci.com
ASTM F 1303 (Sheet Vinyl)
ASTM F 1066 (VCT)
ASTM F 1700 (Vinyl Strip)

Discuss products with LHA before starting specifications. Some LHAs have material preferences and have developed maintenance programs

### PREPARATION

Proper preparation is essential. Coordinate specifications so that the general contractor levels floor to 1/8 inch in 10 feet; the Resilient Flooring subcontractor levels the floor from where the general contractor stops to 1/16 inch in 10 feet. **Be clear about responsibility** to avoid loopholes in the specifications.

### CLIMATE RESILIENCE DESIGN CONSIDERATIONS



Consider flooring types and material combinations when selecting materials for areas where flooding is a concern. Materials should be able to withstand submersion for up to 72 hours if the floor is below the design flood elevation.

The following materials are not appropriate where flooding is a concern: Sheet-type floor coverings (e.g., linoleum, vinyl) or wall coverings (e.g., wallpaper) that restrict drying of the materials they cover. For further information consult *FEMA 499, 1.7*.

Consider the combination of materials when planning flood resistant floors such as tile. Using a wood subfloor however would trap moisture in the subfloor assembly, possibly leading to mold or rot.

# 09 65 00 • RESILIENT FLOORING

Building materials installed in flood-prone spaces—including framing, wallboard, flooring, and ceiling paneling—should be able to withstand water exposure without major damage, promoting mold or mildew, or absorbing contaminants. Building materials under the design flood elevation (DFE) should be able to withstand contact with flood waters for up to 72 hours without requiring more than cosmetic repairs.

## SHEET FLOORING

### MATERIALS

Sheet vinyl: .080-inch gauge, through-grained, fully adhered and with inlaid color. Wider rolls (12 feet) make for better installation. Where possible vinyl should not contain phthalates, which are used to make PVC/Vinyl flexible.

Select products that meet the Scientific Certification System's FloorScore criteria for Indoor Air Quality Certification, all of which meet low or no VOC emissions standards.

For kitchen areas, use materials that have durable and cleanable surfaces. Materials should include moisture-resistant features that do not encourage the growth of mold.

In Family units, avoid use of vinyl flooring, and instead use natural linoleum or hardwoods that are FSC Certified and meet the Scientific Certification System's FloorScore criteria (see 09 64 00 Wood Flooring). Ceramic tile with sealed grout may be used in the bathroom.

### EXECUTION

Do not apply sheet goods to concrete slabs without a bond test to ensure appropriate adhesion.

Sheet vinyl applied in bathrooms must be seamless, if possible. All seams must be sealed.

At bathrooms where the flooring will receive excessive water, such as at a bathroom with a roll in shower, a non-skid flooring with an integral, bacterial inhibitor should be used. If possible, use a product with an integral base. Slip-resistant wet room flooring systems that run into the shower may be considered to avoid the requirements of using a shower base. Provide a waterproof membrane below the sheet flooring.

Rubber sheet products may also be desirable at wet conditions. Linoleum based products should not be used in wet areas as they tend to absorb water and detach from the sub-floor.

Below grade slabs require a sealer before resilient flooring is applied.

## VINYL COMPOSITION TILE

### MATERIALS

Vinyl composition tile: 1/8-inch gauge, 12 x 12 inches, through-grained are suitable.

Include extra tiles for replacement.

Avoid placing vinyl composition tile over wood plank floors because it tends to lift and break; sheet vinyl flooring or refinishing the wood floor is preferred.

Many tiles with recyclable content and bio-based tiles are available and should be considered. If alternate products are to be selected, verify with the Housing Authority that their maintenance plan will accommodate the selected product. On occasion the more sustainable product will not tolerate wax and some cleaners and the cleaning crews are not always accommodating to understanding the specific requirements.

In areas where more durability or a textured surface is desired, such as at entry doors, rubber tiles, which are generally more expensive, may be considered for limited use.

### Execution

Follow manufacturer's recommendations for installation procedures over concrete slabs. Inappropriate temperature, humidity, and concrete density lead to tile failure.

## VINYL STRIP FLOORING

### MATERIALS

Vinyl strip flooring: linear dimensions per manufacturer's specifications, minimum gauge 0.100 inches/100 mils (2.5mm); minimum wear layer thickness 0.020 inches/20 mils (0.51mm).

Vinyl Strip Flooring is often referred to as Luxury Vinyl Plank (LVP) or Luxury Vinyl Tile (LVT).

Strip gauges of 4mm or less can be installed either by “click-lock” or glue-down methods directly over existing substrates without moisture barrier or underlayment. In “click-lock” installations, a vapor barrier underlayment is recommended for moist areas, but cushioned underlayments affect the locking system strength and should be avoided.

Strip thicknesses over 4mm may be loose-laid or glued directly to the substrate. Loose-laid strips may be laid only over underlayments specific to vinyl floors if additional thermal or sound insulation is desired. Avoid underlayments with glue-down installations. Substrates should be in good condition, smooth, clean and dust free.

Include extra strips for replacement.

### EXECUTION

Follow manufacturer’s instructions. Lay strips from the center to each edge, avoiding edge strips less than 3 inches wide. Colors and patterns should be of the same production run and planks should be of equal length, staggered to offset joint alignments.

# 09 65 00 • RESILIENT FLOORING

## BASE, STAIR TREADS

### MATERIALS

Vinyl base: .080-inch gauge and 4 inches high; rolled stock is preferred because it results in fewer seams and is easier to install corners. Provide cove base for solid floor surfaces, straight base for carpet.

For sheet flooring, consider an integral base (coved sheet flooring) for moisture protection.

Stair treads: rubber treads are preferred over vinyl, and should be manufactured from a homogeneous composition of 100% synthetic rubber with integrated tread and riser. For better traction, floor tile and stair treads may have raised round, square, diamond or other acceptable uniform textured surface patterns.

Treads for the visually impaired shall be provided with color inserts or other contrasting devices that meet ADA/MAAB design requirements.

### EXECUTION

Back cut vinyl base to form corners. Follow manufacturer's instructions for rubber stair tread/riser installation.

### CLIMATE RESILIENCE RESOURCES

Project teams can learn more about best practices for installing and selecting materials for climate resilient flooring using this resource and others:

- FEMA's Homebuilder's Guide to Coastal Construction includes a set of accessible fact sheets which include graphics and resilience strategies: https://www.fema.gov/media-library-data/20130726-1538-20490-2983/fema499web_2.pdf
- The Boston Planning and Development Agency discusses resilient flooring options in their "Coastal Flood Resilience Design Guidelines": http://www.bostonplans.org/getattachment/d1114318-1b95-487c-bc36-682f8594e8b2

# 09 68 00 • CARPET

## SECTION INCLUDES

Broadloom Carpet
Carpet Tile
Carpet Pads and Adhesives

## RELATED GUIDELINE SECTIONS

| | |
|---|---|
| 03 30 00 | Concrete |
| 06 10 00 | Rough Carpentry |
| 09 65 00 | Resilient Flooring |

## TESTING, DESIGN & INSTALLATION STANDARDS

**CRI**- Carpet & Rug Institute www.carpet-rug.org

**ASTM Test Method F 1869**- vapor transmittance of concrete slab

**ASTM Standard Practice F710**- alkalinity of concrete slab

**ASTM Test Method D 5116**- VOC content in carpets

**ADA**- Americans with Disabilities Act Federal Accessibility Guidelines

**MAAB**- Massachusetts 521CMR Architectural Access Board Regulations

## CLIMATE RESILIENCE DESIGN CONSIDERATIONS

Avoid the use of carpet in areas where flooding is a concern such as basements and below grade spaces.

## DESIGN

Carpet is discouraged in dwelling units. Alternative flooring materials which require less maintenance and do not absorb dirt, spills and odors are preferred. Furthermore, carpets release VOCs and potentially trap allergens, which negatively impacts air quality. Specifically, preferred alternatives are FSC Certified hardwoods, natural linoleum, vinyl floor coverings and ceramic tile. Discuss the needs of the local housing authority and try and find alternative, more durable flooring products which satisfy those needs.

If carpet is to be used in common spaces, do not specify broadloom carpet for public corridors, communal entry vestibules dining areas, laundry rooms, or other high traffic areas. Instead, use 50 cm x 50 cm or 24” x 24” carpet tile with integral backer.

Removable floor mats are preferred at entries

Typically, carpet should not be installed over existing vinyl, VAT or rubber flooring installation over VCT, where VCT finish is stripped and cleaned prior to carpet installation, is acceptable.

**ADA REQUIREMENTS**

Provide ADA/MAAB compliant transition~~s~~ strips, in extruded aluminum or vinyl.

Confirm that finish floor is sufficiently level prior to specifying, and require Contractor do the same prior to ordering materials for proper clearance at in-swing doors.

When carpet is used at special needs, barrier free, and adaptable units, provide direct glue-down carpet for easier wheelchair maneuvering. All edges should be continuously adhered. The carpet backing and adhesive should be waterproof.

Specify straight wall base for ease of maintenance and future carpet replacement.

Specify the seams, edge moldings, carpet direction and accessories.

Where carpet tile is used, specify a requirement for 5-10% attic stock for delivery to housing authority at substantial completion as part of the contract.

## BROADLOOM CARPET & CARPET TILE

### MATERIAL

Select a specific carpet by manufacturer and series and specify it with at least two approved equals. Review carpet submittals and do not accept substitutes that do not meet the specification.

Carpet should meet the following criteria:

- Low chemical emissions: meeting Green Label or Green Label Plus, as certified by the Carpet & Rug Institute.
- Short (1/8 to 3/16 inch), closed loop pile with an anti-ravel feature, and a minimum 11-pound tuft bind.
- Warranties should be minimum 10 year:
  - for stain resistance and colorfastness
  - for pad de-lamination warranty for carpet tile.
  - against edge-ravel, zippering or de-lamination for both carpet tile and roll carpet.
  - for antimicrobial treatment
- Solution-dyed nylon, 26+ ounce face weight, high density, level loop.
- Class 1-flammability rating and a maximum specific optical density of 450 or less during smoke generation.
- Permanent anti-microbial treatment
- Recyclable.

Select carpet colors with relatively high light reflectance, especially for interior spaces with low light levels.

Select multi-colored patterns which are varied and multi-directional, but not visually distracting, to help hide dirt and stains. Integrate patterns and borders to provide visual cues and interest, when carpet tile is used.

Specify manufacturers who have established recycling programs in place.

### EXECUTION

Acclimate and install the carpet in temperatures between 55 and 95 degrees Fahrenheit; unroll the carpet and allow carpet to relax for 24 hours minimum before installation. Maintain temperatures during curing and do not permit traffic for 48 hours on adhered carpet.

Inspect concrete and pre-cast plank floors and specify a leveling compound if required. For slab-on-grade construction, test concrete floor for moisture vapor and alkalinity per ASTM standards. High moisture content may require special primers and adhesives. Consider alternatives to carpet in these locations. Carpet is not recommended for slab-on-grade or below grade concrete floors.

Re-install fasteners and/or install additional screws if required to properly secure floor sheathing and sub-floor.

Require seaming diagrams for shop submittals from the installer before broadloom carpet work begins. Minimize seams in carpet and pad.

Avoid running broadloom carpet seams perpendicular to doorways, at pivot points or across the path of travel in corridors.

Align the carpet seams perpendicular to the pad seams or offset at least 6" between the two.

Do not carpet over expansion joints.

If an underlayment is necessary, specify either an FSC ¼" AC plywood or a recycled content gypsum-based underlayment similar to that used for tile.

Broadloom carpet installed with a pad should be power stretched.

Adhered carpet should be rolled in both directions, using manufacturer's prescribed roller weight.

Provide housing authority with manufacturers' instruction sheet on proper maintenance, including recommended cleaning methods.

### CARPET ADHESIVES

- ❑ Low VOC adhesives, (less than 10 mg/sq. meter/hr.), per ASTM D5116.
- ❑ Less than 3.00 mg/sq. meter/hr. 2-ethyl-1 hexanol
- ❑ Less than .05 mg/sq. meter/hr. formaldehyde
- ❑ Consider using tackless strips instead of adhesives

# 09 68 00 • CARPET

## CARPET PAD

- ❑ At least 25% recycled pad content.
- ❑ Total pad VOC's less than .5 mg/sq. meter/ hr.
- ❑ Total pad BHT (butylated hydroxytoluene) less than .30 mg/sq. meter/hr.
- ❑ Total pad formaldehyde or phenylcyclohexene less than .05 mg/sq. meter/hr.
- ❑ Class II fiber or rubber pad- polyurethane foam pads are not acceptable
- ❑ Pad should not contain brominate fire retardants
- ❑ High density pads should be used under broadloom carpets.

## INDOOR AIR QUALITY CONSIDERATIONS

When replacing old carpet, vacuum old carpet prior to removal and vacuum subfloor immediately after the old carpet and cushion have been removed.

When installing new carpet, provide fresh air ventilation for 48 hours minimum after the installation of carpet and adhesives.

Do not use heating with air recirculation during carpet installation.

Use low-VOC adhesives.

## RECYCLING

Specify recycling for waste carpet, and for carpeting being removed when recycling is available. Research this prior to specifying carpet. Use manufacturers and products which have high recycled content and manufacturer's recycling programs in place.

Specify carpet pads with at least 25% recycled content.

# DESIGN AND CONSTRUCTION GUIDELINES AND STANDARDS

DIVISION 9 • FINISHES

# 09 90 00 • PAINTING

## SECTION INCLUDES

Primers and Finish Paints

## RELATED GUIDELINE SECTIONS

| | |
|---|---|
| 02 83 00 | Lead Paint Remediation |
| 05 50 00 | Miscellaneous & Ornamental Iron |
| 06 10 00 | Rough Carpentry |
| 06 20 00 | Finish Carpentry |
| 07 40 00 | Siding |
| 07 90 00 | Sealants |
| 08 10 00 | Doors and Frames |
| 08 50 00 | Windows |
| 09 20 00 | Gypsum |

**Filed Sub Bid**

**M.G.L. c.149 §44F**

*Painting is a stipulated filed sub-bid category under M.G.L. Chapter 149, §44F.  If the cumulative estimated value of the work in this section exceeds $25,000 and the projects total cost is over $150,000 it triggers the filed sub-bid requirement.*

## REFERENCES

Master Painters Institute: www.mpi.net
American Coatings Association:  www.paint.org

## GOALS

A successful paint job requires proper preparation, the appropriate primers, paints or finishes, and correct application. For new construction rain screen construction is preferred for new siding installation. In general, for existing construction:

- ❑ Preparation of surfaces should include an investigation of and solution to any existing moisture problems, hazardous materials remediation, cleaning or sanding of surfaces to meet manufacturers' requirements, and all necessary repairs to materials.  A properly cleaned surface such as a ceiling or wall (or exterior wood clapboard siding) may not need painting at all.  Taking time to prepare a surface will pay off in the long run.

- ❑ The paints and primers, thinners, and other products used should be the highest quality to ensure that the surfaces are washable, and the finishes are durable.  The largest part of the cost of painting and repainting is the labor required for preparation and application.  It is therefore wise to apply the highest quality product to increase the longevity of the finish.

- ❑ Paints, primers, and finishes should be applied with the proper instrument (brush, spray or roller) and specify the number of coats to meet the mil thickness and/or number of coats listed in the specifications.

- ❑ The basic purpose of exterior painting is protection of the building from the elements. A secondary purpose is cosmetic.

Interior paints should be non-toxic and free of all VOCs (volatile organic compounds

- ❑ Avoid epoxy-based paints that contain Biphenol A.

### CLIMATE RESILIENCE DESIGN CONSIDERATIONS

If flooding is a concern, consider the types of materials to be painted and which type of paint is most appropriate. Epoxy or oil-based paints, although not commonly recommended are acceptable wall finishes when applied to a concrete structural wall to prevent moisture absorption. However, when the same paint is applied to a wood wall, it is no longer considered acceptable since low-permeability paint can inhibit drying of the wood wall. Paints resistant to mold growth may be most appropriate for areas with high humidity such as bathrooms, kitchens, and basements. Painting metal surfaces with a rust-inhibiting coating may help mitigate rusting in flood prone areas.

### INVESTIGATION

Identify the nature of the surface to be painted, including the type of existing paint or finish, in order to select the correct repainting or refinishing system. This may include doing some research or testing if there are multiple coats of existing paint.

Discuss products, colors and finishes with LHA. Verify if the LHA has any printed standards or a cycle painting program. Specify products, colors and finishes that are compatible with LHA standards.

Look for any signs of subsurface or surface moisture. Moisture problems must be solved before any painting or refinishing is undertaken. Paint will not adhere to wet surfaces.

Obtain information from LHA staff. The LHA should be aware of the painting history of the development: the materials used the subsurface preparation, and when the work was done. This information should be used by the LHA and the designer in determining the correct preparation and materials for repainting. The LHA should examine any existing paint stock and, based upon the technical standards in this chapter, properly discard any that are found to be inappropriate.

Determine if repainting or refinishing is the appropriate approach for items like wood siding or trim. If existing siding requires extensive repairs as well as refinishing, the residing or covering of trim may be the better use of funds.

# 09 90 00 • PAINTING

Verify by testing or review of abatement compliance documentation if lead paint is found on any surfaces requiring refinishing, especially siding and interior or exterior trim. Replacement or re-cladding may be the only economically feasible solution. Refer to Section 02 83 00 Lead Paint Abatement.

Where necessary investigate the number of layers of existing paint and perform pull- tests to verify that the new paint will adhere to the existing surface. If it is found that the existing interior surface is unsuitable, remove the existing paint to the substrate, or install an overlay that will provide a new substrate for the paint.

Check for calcium content. This is especially true on ceilings. In some instances, a gypsum board overlay may be necessary.

Check textured ceilings and caulking to confirm the presence of asbestos.

## OBSERVATIONS - RECOMMENDED ACTION

### AREAS OF STAINING OR DISCOLORATION.

Clean an area of stain. If it reappears in a few days, check for all possible sources of moisture. Solve moisture problems prior to painting. Clean the surface and apply a stain sealer appropriate for the stain.

### AREAS OF DIRT OR SOILING

Clean an area with appropriate solvents to see if cleaning is adequate. Proper cleaning is the key to a successful paint project. Check to determine if the surface is covered with dirt or mildew.

If the surface is covered with tobacco stains or some other similar contaminant it must be properly cleaned and sealed before painting.

### CHIPPED PAINT, EXPOSED WOOD OR METAL SURFACES

Check for presence of lead-based paint. If it is found, it must be dealt with before proceeding. See Section 02 83 00 Lead Paint Abatement.

### ROTTED TRIM, DOORS, WINDOWS, AND CRACKED OR BROKEN SIDING

Carefully inspect the entire building and components that may require paint for hidden decay, insect damage, etc., especially doors and windows. Any defects, particularly those which allow water to penetrate the exterior skin, must be corrected before finishing.

Siding and trim must be in sound, clean condition before painting. If there is an insect problem, the LHA should implement a service contract to address the issue. Further investigation may be required to determine the full extent of the problem and any repairs needed.

#### SOFT OR DETERIORATED PLASTER OR DRYWALL

Patch plaster followed by sanding and cleaning to create a sound substrate. Completely remove all dust before painting. Consider an initial coat of an appropriate sealing product to fortify substrate.

#### MOLD OR MILDEW

Follow EPA published guidelines for treating surfaces with mold and mildew.

Wash surfaces with an EPA registered disinfectant, fungicide, bactericide, mildewcide and mildewstat, rinsing thoroughly before finishing. Use products formulated for either interior or exterior use depending on the application.

## EXTERIOR SURFACES

### GENERAL EXTERIOR CONSIDERATIONS

#### PREPARATION

Determine the degree of surface deterioration and provide for the appropriate repair/preparation in the painting section and or other related specification sections. Generally the level of surface deterioration should be classified using the following assessment criteria:

- ❑ Sound Surface (may include visual defects the paint films protective properties).
- ❑ Slightly Deteriorated Surface (may show fading, gloss reduction, slight surface contamination, minor pin holes, scratches, etc. Minor cosmetic defects - runs, sags etc.).
- ❑ Moderately Deteriorated Surface (small areas of peeling, flaking, slight cracking, staining, etc.).
- ❑ Severely Deteriorated Surface (heavy peeling, flaking, cracking, checking, scratches, scuffs, abrasions, small holes, and gouges).
- ❑ Substrate Damage (repair or replacement of surface required).

The Architect or LHA should specify contract requirements after surveying all surfaces for rectifying surface preparation conditions.

Verify the location of gutters and downspouts and specify that they be removed and properly reinstalled after painting.

Identify building specialties that will need attention such as building numbers and mail boxes. Removal and reinstallation after painting typically provides the best results.

Arrange to trim shrubs and trees around buildings before painting work begins. This is best done by the LHA and not the painter, but verify that the LHA has the ability to complete the task.

# 09 90 00 • PAINTING

## MATERIALS

Specify the products of one manufacturer and list acceptable alternatives.

All paint products for exterior application shall be formulated for exterior use.

Include mildewcides in all exterior stains and paints.

Colors can be selected by the LHA or the Designer. Avoid unusual colors. Tint primers a shade lighter than finish coats.

Whenever possible use Green Seal approved products except when existing conditions may adversely affect longevity and finish product quality. Request Green Seal certificate for all such products used.

Specify that touchup should be done using product from the same batch and application temperature and method as was used for the original work.

All materials shall be lead and mercury free.

## EXECUTION

Always have Manufacturer' Safety Data Sheets (MSDS) available on site when work is in progress and keep them on file after the painting is complete.

Include the manufacturer's instructions for recommended air and surface temperature and relative humidity range during paint application and curing in the specifications.

Use primers directly from original containers; do not dilute. Tint the primer slightly lighter that the final paint color selected.

After the installation of any work is completed, the Contractor shall be responsible for its protection and for repairing, replacing, or cleaning. Any work which has been damaged by other trades or by any other cause from the contract, so that all work is in first class condition at the time of Substantial Completion.

Specify one primer coat and two finish coats to meet the dry mil thickness in the specifications.

To reduce the amount of contaminants entering waterways, sanitary/storm drain systems or into the ground require the following procedures during painting operations:

- ❑ Retain cleaning water for water based material to allow sediments to filter out. In no case shall equipment be cleaned using free draining water.
- ❑ Retain cleaners, thinners solvents and excess paint and place in designated containers and ensure proper disposal.

- ❑ Return solvent and oil soaked rags used during painting operations for contaminate recovery, proper disposal, or appropriate cleaning and laundering.
- ❑ Dispose of contaminants in an approved and legal manner in accordance with all applicable hazardous waste regulations.
- ❑ Empty paint cans are to be dry prior to disposal and recycling.
- ❑ Close and tightly seal partly used cans of materials including sealant and adhesive containers and store in protected well ventilated fire-safe area.

## New Wood Siding

### Preparation

Specify red cedar clapboards and number 1 grade red cedar shingles. Avoid exposed knots where possible.

Factory pre-dipped wood shingles can be an acceptable siding with a field application of 1 coat of solid or semi-transparent stain in certain circumstances.

Avoid tannin bleed by specifying a tannin blocking primer over unpainted siding.

Spot seal exposed knots pitch spots, etc. with a shellac based sealer.

### Materials

Primer: 100% acrylic primer with tannin block, one coat, exterior grade applied over the entire surface.

Finish: 100% acrylic exterior grade paint with mildew inhibitors, two coats applied over the primer.

In cases where showing the grain or texture of new wood siding is the goal, use a solid or semi-transparent staining, no primer; 2 finish coats. Include mildew inhibitor in stains. Semitransparent and transparent stains tend to not provide the wood with the UV blocking protection given by solid stains and paints.

### Execution

Caulk open joints at corners, trim boards and other entry points for water before painting (Refer to Section 07.90.00 Sealants).

Applying a primer back coat is highly recommended.

Primers must be completely dry in accordance with manufacturer's recoating requirements before applying finish coats. Allow adequate drying time between finish coat applications as well.

Spray application of stain is not acceptable because it doesn't penetrate the wood.

## EXISTING REPAIRED OR PATCHED WOOD SIDING

### PREPARATION

Identification of existing paint is imperative to insure compatibility.

Test any joint sealants for asbestos and follow proper abatement procedures if present (Refer to Section 02.82.00 Asbestos Remediation).

Scrape all loose and flaking paint down to bare wood. Sand surface to feather the edges of sound paint.

Hose or low pressure wash surface with appropriate solution and rinse thoroughly.

Clean any chalking and or dust.

When painting older buildings care should be taken to avoid contaminating the area and grounds. Properly dispose of all paint removed. Before bidding, test to determine if there is any existing lead based paint before sanding or scraping the wood surfaces.

### MATERIALS

Apply 1 coat primer, compatible with the existing paint, over all bare wood.

When changing color of existing siding paint, apply 1 coat of 100% stain blocking acrylic tinted primer over the entire surface. This is in addition to the primer over the bare spots. This will even out the entire surface.

Apply 1 finish coat of 100% acrylic stain or paint over the entire surface.

### EXECUTION

Primers must be completely dry in accordance with manufacturer's recoating requirements before applying finish coat.

## FIBER CEMENT SIDING

### PREPARATION

Specify factory primed fiber cement siding with a rain screen.

### MATERIALS

Apply one coat of exterior grade 100% acrylic paint in addition to the factory applied primer and finish coat of paint specifically designed for fiber cement siding after siding is installed.

# 09 90 00 • PAINTING

### EXECUTION

Prime all cuts during installation with 100% acrylic primer before nailing siding into place. This field primer should be an exact match to the factory applied primer.

Caulk all butt joints prior to applying the final field applied finish coat.

## WOOD TRIM, PVC TRIM, WINDOWS & DOORS

### PREPARATION

Seal all knots stains pitch spots, etc., with a shellac-based sealer. Do not seal entire surface.

Prime end cuts before installing or patching trim.

Note: PVC trim should not be painted and should be secured by screws with fastener plugs. Do not use nails.

Caulk all joints between trim boards.

### MATERIALS

Spot prime bare spots or new wood trim (completely back prime new trim before application). Use 100% acrylic primer unless other products are required due to existing conditions.

Apply 1 coat of 100% acrylic primer over entire surface. This is in addition to the primer over the bare spots. This will even out the entire surface.

Apply 1 coat 100% acrylic finish coat.

### EXECUTION

Provide three coats of paint (1 primer and 2 finish coats) for all accent colors.

Back prime all exposed exterior wood trim (including ends) and all wood near the ground or in contact with moisture.

Seal knots in exterior and interior wood so that they do not bleed; exterior wood siding should not have knots.

Primers must be completely dry before applying finish coats.

## METAL & FIBERGLASS DOORS

### PREPARATION

Use factory painted doors if available.

Plastic glazing beads and plastic trim on exterior entry doors **must** be painted.

Apply the finish coat to plastic trim within 2 to 3 weeks of door installation.

# 09 90 00 • PAINTING

### MATERIALS

Use 100% acrylic primer and finish coat on doors.

Alkyd paints are not recommended on metal and fiberglass doors due to the need for lengthy drying time in occupied buildings.

For dark colors on fiberglass doors use heat reflective paint to avoid surface distortion.

### EXECUTION

Apply additional coats when doors receive accent colors.

## FENCES & DECKS

### PREPARATION

Thoroughly clean existing decks with an environmentally sensitive cleaner or brightener. Use high pressure sprayer for excessive dirt. Use care not to remove excessive amounts of wood during spraying operation.

Decks with slick, shiny appearance must be scuffed or weathered and pressure washed.

Pressure-treated wood that has not been KDAT (kiln dried after treatment) should be seasoned, dry, and free of visible salts or other water soluble materials before finishing.

### MATERIALS

Apply 1 coat of a water repellent <u>penetrating</u> sealer.

Unless previously used products prohibit, use a penetrating and water repelling type stain.

Apply 1 coat anti-slip deck paint to improve traction on slippery deck surfaces.

Do not use heavily pigmented stain or other film forming finish on decks or other high traffic surfaces.

Varnish finishes are not recommended for fences because they will not withstand the wind and rain and will require frequent refinishing. Use a stain finish on wood fencing.

### EXECUTION

Most deck and fence applications are best completed using a hand pressurized sprayer (garden type sprayer). Use a roller or brush after spraying to even out the finish.

# 09 90 00 • PAINTING

## PRESSURE TREATED LUMBER

### PREPARATION

Pressure-treated wood that has not been KDAT should be seasoned for a minimum of 60 days, dry, and free of visible salts or other water soluble materials before finishing.

Clean with soapy water and remove any built up mold or mildew before finishing.

### MATERIALS

Treat cut ends of pressure treated lumber with a preservative immediately after field cutting.

Staining:  Use an oil based semi-transparent exterior stain, no primer needed.

Painting:  Use 1 coat exterior latex primer and 2 finish coats of a compatible latex paint.

Apply 1 coat of a water repellent sealer with UV inhibitor after painting or staining.  Sealer should also be applied to unfinished PT surfaces.  Avoid solid color products.

### EXECUTION

Use a stiff bristled brush to clean wood and apply preservative.

Brush-apply stains, primers and paints.  Roller may be used for paint topcoat.  Do not spray-apply.

Clean wood before seasoning.  Apply preservative after staining/painting and thereafter on a regular yearly basis.

## CONCRETE, STUCCO, BLOCK CMU, BRICK

### PREPARATION

Avoid painting exterior concrete and brick surfaces if possible.

When painting exterior concrete is necessary, patch concrete surface and clean with TSP substitute (trisodium non-phosphate or a borax alternative) before painting.

When painting brick is necessary, thoroughly clean surface, apply 1-2 coats of masonry sealer and allow sealer to dry thoroughly between applications

Concrete Block and mortar joints must be allowed to cure for at least 30 days before painting.

CMU Surfaces must be sound, clean dry, free of oil grease, efflorescence, loose aggregate and other foreign matter.

Remove efflorescence by washing with a diluted solution of muriatic acid and water. Rinse thoroughly and allow to dry.

In all cases investigate and eliminate sources of moisture causing development of efflorescence.

In cases of hydrostatic water intrusion through below grade walls, other means of waterproofing should be explored. Interior waterproofing paints have limited effect, can trap moisture and lead to mold growth.

#### MATERIALS

**Concrete and stucco:** one coat block primer and two finish coats of elastomeric masonry or concrete paint. Do not use exterior latex house paint.

**Brick masonry:** one coat primer and two coats of elastomeric masonry paint; additional finish coats may be necessary.

**Concrete masonry units:** block filler primer, exterior grade; elastomeric waterproofing paint, 2 coats.

#### EXECUTION

Apply primer with a stiff bristle brush. Paints may be brush, roller or spray applied. Mask unpainted areas to prevent overspray.

### RE-PAINTING ALUMINUM SIDING

#### PREPARATION

Verify that aluminum siding does not have a Teflon or waxy finish.

Power wash (low pressure) surface, brush surface as needed to remove chalky and shiny surfaces. Apply paint as soon as practical to prevent mildew from returning to cleaned surface.

#### MATERIALS

Prime with a product specially formulated to provide superior adhesion on chalky surfaces.

Apply two coats of spray applied 100% acrylic latex finish coat.

#### EXECUTION

Do not apply finish coats thicker than 2.8 mil. Mask unpainted areas to prevent overspray.

## NON-GALVANIZED METALS

### PREPARATION

Scrape off all old paint, surface rust and scale from ferrous metal surfaces to be repainted.

Specify factory finished components for new exterior metal installations where galvanizing is not an option.

### MATERIALS

"Direct to metal" paints are acceptable for bare, non-galvanized metal.

Ferrous metal: 1 coat zinc chromate (rust inhibiting) primer; alkyd enamel, 2 coats.

Ferrous metal (high performance): zinc rich epoxy primer 1 coat; catalyzed urethane, 1 coat.

### EXECUTION

Field touch-up: when refinishing non-galvanized metal rails, use brush, do not spray.

## GALVANIZED METALS

### PREPARATION

Galvanized handrails require cleaning with chemicals. Prime per galvanizer's recommendations and paint.

### MATERIALS

New galvanized metal should be shop-primed.  Shop applied powder finish coat is recommended for certain applications.

Existing galvanized metal: use galvanized metal primer; alkyd enamel, 2 coats.

Existing galvanized metal (high performance): use epoxy primer; catalyzed urethane, 1 coat.

### EXECUTION

Apply touch-up paint with brush when finishing railings in the field.  Do not spray.

## INTERIOR SURFACES

### GENERIC INTERIOR CONSIDERATIONS

### PREPARATION

Determine the degree of surface deterioration by surveying all rooms and provide for the appropriate repair/preparation in the painting section and or other related specification sections.  Generally the level of surface deterioration should be classified using the following assessment criteria:

## 09 90 00 • PAINTING

- ❑ Sound Surface (may include visual defects from the paint films protective properties)
- ❑ Slightly Deteriorated Surface (may show fading, gloss reduction, slight surface contamination, minor pin holes, scratches, etc.  Minor cosmetic defects - runs, sags etc.)
- ❑ Moderately Deteriorated Surface (small areas of peeling, flaking, slight cracking, staining, etc.)
- ❑ Severely Deteriorated Surface ( heavy peeling, flaking, cracking, checking, scratches, scuffs, abrasions, small holes, and gouges)
- ❑ Substrate Damage (repair or replacement of surface required)

It is imperative that the Architect specify the existing condition of, and how to rectify, surface conditions.

Porous surfaces must be primed and stains must be sealed before applying finish coats.

All surfaces must be cleaned, patched, sanded, and glossy areas dulled.

Surfaces should be clean, smooth, dull, and free of imperfections.

Care must be taken to prevent any contamination of the adjacent surfaces.

In heavily-stained "smokers" apartments surfaces should be thoroughly cleaned and two coats of stain blocking primer applied prior to painting. Allow sealer to thoroughly dry before applying subsequent coats of paint.

Test existing textured ceiling drywall compound for Asbestos.

### TYPES OF FINISH

Refer to the Master Painters Institute Gloss and Sheen Levels.

- ❑ Gloss Level 1 Matte/Flat Finish.
- ❑ Gloss Level 2 High Side Sheen Flat/Velvet-like Finish.
- ❑ Gloss Level 3 Eggshell-Like Finish.
- ❑ Gloss Level 4 Satin-like Finish.
- ❑ Gloss Level 5 Traditional Semi-Gloss.
- ❑ Gloss Level 6 Traditional Gloss.
- ❑ Gloss Level 7 High Gloss.

Use semi-gloss paint level 5 for kitchen and bathroom walls and common areas; eggshell level 3 for all other interior surfaces.

## 09 90 00 • PAINTING

Ceilings are usually flat level 1 finish unless the LHA has a standard for all Dwelling units.

Do not use textured paints, even on ceilings, because of the difficulty of later patching or repainting.

### EXECUTION

Include the manufacturer's recommendations for number of finish coats and dry mil thickness in the specifications.

Specify the manufacturer's application requirements, including minimum drying time between coats for all materials, sanding between coats, environmental conditions, surface dryness, and tinting of succeeding coats.

In general, specify two finish coats.

Most apartments will be occupied when the work is being completed, therefore, care must be taken to protect residents' furnishings and minimize any inconvenience. The LHA usually plays the major role of coordination during the painting procedure, but a resident coordinator can be invaluable in scheduling and facilitating access to units.

Store paints and thinners in a metal storage box or in a fire proof location.

### NEW DRYWALL SURFACES

### PREPARATION

Prepare all surfaces including sanding, and spot priming of drywall joint compound; include re-priming of touch-up work.

Protect all hardware, electrical outlets, switches, lights, prefinished product, floors, etc.

Caulk all open joints and hairline cracks, and spot prime.

### MATERIALS

**Dwelling Units:**

- ❑ Apply eggshell (Level 3) finish except for semi-gloss in kitchens and baths unless the LHA has a printed standard.

  1 coat of 100% acrylic primer

  2 coats of 100% acrylic finish

- ❑ Use mold & mildew-proof paint, in baths and kitchens where mold and mildew control may be an issue.

**Common Spaces**:

- ❑ Apply semi-gloss (Level 5) finish unless the LHA has a printed standard.

  1 coat of 100% acrylic primer

  2 coats of 100% acrylic finish

#### EXECUTION

Apply primer as soon as possible after cleaning surface to prevent metal drywall accessories from forming rust.

Roll the last coat of paint regardless if the preceding coats are rolled or sprayed. Rolled paint is easier to match for future touch-up. Use ¼ inch nap for drywall ceilings; 3/8 inch nap for drywall wall surfaces.

### EXISTING DRYWALL SURFACES

#### PREPARATION

Remove all hardware and hardware accessories. plates, machined surfaces, light fixtures, and similar items that are not to be painted. If removal is not practical provide surface applied protection (non-bleed tape)before surface preparation and painting.

Patch ceilings and walls to create a sound surface.

Check existing textured ceilings, calcimine ceilings and drywall joint compound for asbestos.

#### MATERIALS

Prime to all bare spots with a product that is compatible with the existing paint and has excellent adhesion qualities.

Textured ceilings or ceilings with calcimine consider 1 coat of calcimine coating ceiling paint before priming.

Apply 1 coat of 100% acrylic primer over entire surface, in addition to the spot primer to level off the surface.

Apply 1 coat of 100% acrylic finish coat.

#### EXECUTION

Specify the manufacturer's application requirements, including minimum of 24 hours between coats for all materials, sanding between coats, environmental conditions, surface dryness, and tinting of succeeding coats.

## 09 90 00 • PAINTING

Provide paint to achieve the dry mil thickness recommended by the paint manufacturer.

Roll the last coat of paint regardless if the preceding coats are rolled or sprayed. Rolled paint is easier to match for future touch-up. Use ¼ inch nap for drywall ceilings; 3/8 inch nap for drywall wall surfaces.

### NEW PLASTER SURFACES

#### PREPARATION

New plaster should cure until recommended moisture content is achieved before painting. The Ph must be 10.0 or lower.

All scratches, cracks, abrasions in plaster surfaces and openings adjoining trim shall be cut out as required then filled with spackling compound or patching plaster flush with adjoining surface.

When dry, sand smooth and seal by applying primer. Sand walls smooth and dust walls with a damp sponge to remove sanding dust.

#### MATERIALS

All new plaster surfaces should be covered with a 100% acrylic primer with excellent adhesion qualities.

Apply semi-gloss in kitchens and baths and egg shell finish in all other areas unless the LHA has a printed standard.

Apply 2 coats 100% acrylic finish.

#### EXECUTION

After application of first coat, all spots in plaster shall be touched up before second coat is applied.

Allow a minimum of 4 hours drying time between coats unless the paint manufacturer recommends a longer drying time.

Roll the last coat of paint regardless if the preceding coats are rolled or sprayed. Rolled paint is easier to match for future touch-up. Use ¼ inch nap for plaster ceilings; 3/8 inch nap for plaster wall surfaces.

### EXISTING PLASTER SURFACES

#### PREPARATION

Test for asbestos on all surfaces to be sanded.

Patch all cracks, holes etc. to create a smooth, sound surface. Sand out all rough spots.

#### MATERIALS

Prime all bare spots with a 100% acrylic primer with excellent adhesion qualities.

Apply 1 full coat of 100% Acrylic primer to the entire surface to even out the surface.

Apply semi-gloss in kitchens and baths and egg shell finish in all other areas unless the LHA has a printed standard.

Apply 2 coats 100% acrylic finish.

#### EXECUTION

After application of first coat, all spots in plaster shall be touched up before second coat is applied.

Allow a minimum of 4 hours drying time between coats unless the paint manufacturer recommends a longer drying time.

Roll the last coat of paint regardless if the preceding coats are rolled or sprayed. Rolled paint is easier to match for future touch-up. Use ¼ inch nap for plaster ceilings; 3/8 inch nap for plaster wall surfaces.

### INTERIOR WOOD TRIM

#### PREPARATION

Wash, rinse, sand, spackle existing surface as needed to create a sound surface.

Verify existing interior wood trim for lead base paint.

#### MATERIALS

Opaque finish:

- ❑ Apply primer compatible with existing surface, use a product with excellent adhesion properties. New trim use 100% acrylic primer.
- ❑ Apply 2 coats semi-gloss 100% acrylic with excellent scrub ability properties.

Transparent finish:

- ❑ Apply 1 coat oil-based wood stain.
- ❑ Apply 2 coats satin finish water based varnish.

### INTERIOR WOOD DOORS AND WINDOWS

#### PREPARATION

Painted Doors/Windows – Wash, rinse, sand, spackle existing surface as needed to create a sound surface.

Natural Finished Doors/Windows – sand and apply wood filler as need to provide a sound surface. Remove all dust and film before refinishing.

Remove and properly store hardware before refinishing – reinstall hardware and test door/window operation after new finish has properly cured.

### MATERIALS

Consider having the inside sash of windows prefinished (at the factory) so that field painting will not be required, otherwise

1 coat 100% acrylic primer.

2 coats 100% acrylic wall & trim paint– Semi Gloss finish unless the LHA has other published standards.

### EXECUTION

Paint all sides of doors, window sash, etc., but not prefinished surfaces or the tracks of windows.

## INTERIOR BRICK, CONCRETE AND CMU BLOCK MASONRY

### PREPARATION

Concrete Block and mortar joints must be allowed to cure for at least 30 days before painting.

Surfaces must be sound, clean dry, free of oil grease, efflorescence, loose aggregate and other foreign matter.

In all cases investigate and eliminate sources of moisture causing development of efflorescence.

### MATERIALS

**Concrete and stucco:** one coat block primer and two finish coats of elastomeric masonry or concrete paint.

**Brick masonry:** one coat primer and two coats of a breathable latex; additional finish coats may be necessary.

**Concrete masonry units:** block filler primer, interior grade; elastomeric interior waterproofing paint, 2 coats.

### EXECUTION

Apply primer with a stiff bristle brush. Paints may be brush, roller (3/4 inch or greater nap) or spray applied. Mask unpainted areas to prevent overspray.

## INTERIOR METALS & HANDRAILS

### PREPARATION

Determine if there may be any existing lead based paint.

# 09 90 00 • PAINTING

Sand and grind if required. Fill Dents and scratches with appropriate filler.

### MATERIALS

Ferrous metal:

- ❑ "Direct to Metal Primer" – 1 Coat
- ❑ Quick Drying 100% acrylic latex high performance enamel - 2 coats

### EXECUTION

Apply with brush or roller (1/4 inch nap) only – No spraying.

## CLIMATE RESILIENCE RESOURCES

Project teams can learn more about appropriate paint types as well as other strategies to deal with painted surfaces from this resource among others:

- EPA's guide "Moisture Control Guidance for Building Design, Construction and Maintenance" has strategies for using appropriate paint types and photos of example challenging conditions: https://www.epa.gov/sites/production/files/2014-08/documents/moisture-control.pdf

# 10 00 00 • SPECIALTIES

## SECTION INCLUDES

Wall Protection
Toilet and Bath Accessories
Postal Specialties
Wardrobe and Closet Specialties

## RELATED GUIDELINE SECTIONS

| | |
|---|---|
| 06 10 00 | Rough Carpentry (Blocking) |
| 22 00 00 | Plumbing |

## WALL PROTECTION

### MATERIALS

Wall surfaces subject to impact damage from wheelchairs, carts or routine physical abuse may be protected by sheets of acrylic, polycarbonate or PVC, surface mounted or adhered directly to the wall surface. Use polycarbonate where greater impact resistance is required.

For Special Needs projects (DDS), hallway walls require protection from wheelchair damage. Walls are best protected by installing carpet over plywood from the base to chair rail height. Many other materials have been used in these situations, but the carpet has continued to be selected by DDS as the best material. Contact DDS site representative to determine preference for specific applications.

Corner guards are also recommended at outside 90-degree corners of walls from base to chair rail height. Materials may be pre-formed metal, rubber, vinyl, polycarbonate, or any other impact resistant material having rounded edges, extending no less than 1 ½ inches wide on each side and projecting no more than 3/16 inch from the wall surface.

Wall mounted guard rails and floor bumpers may be used for added protection and safety. Handrails may be used in place of guard rails only where suitable blocking is in place at attachment points.

## BATH ACCESSORIES

### MATERIALS

In general, select commercial grade accessories. The preferred material is stainless steel; avoid ceramic accessories except in tiled areas.

Grab bars: peened or etched, not knurled. Use 1-1/4 inch diameter.

Avoid soap dishes with hand grips.

For elderly developments, specify single-hand toilet paper holders.

Include robe hooks on doors or where otherwise convenient.

Avoid recessed accessories. They have an effect on heat loss at exterior walls and if not flashed properly, can leak at both exterior and interior walls.

# 10 00 00 • SPECIALTIES

### EXECUTION

It is preferred that the General Contractor both purchase and install bath accessories. The General Contractor can sub the work back to the plumber if there is a jurisdictional problem.

Clearly indicate in the specifications who will furnish and who will install accessories. Coordinate this information with the plumbing section.

A filed sub bidder is not required to review the Specialties section unless a specific filed sub trade specification section, such as ceramic tile, clearly spells out the requirement.

Coordinate the installation of blocking to provide a sound base to which to attach all specialties.

## POSTAL SPECIALITIES

### MATERIALS

Mail slots in doors are not to be used. They may create a security problem and they are a tremendous source of energy loss.

When completing an exterior modernization that involves door replacement and new siding, give serious consideration to new mailboxes and building and unit identification numbers.

Provide mail boxes for new residential buildings. Curbside mailboxes are required unless permission for wall-mounted mailboxes is first obtained from local postmaster.

Coordinate mail delivery requirements with the local postal authorities. Consult USPS regulations governing mailbox placement and mounting height (https://www.usps.com/manage/mailboxes.htm)

Follow MAAB design guidelines for mailbox placement at accessible units.

On buildings with direct unit entry from the outside, install mailboxes on mounting blocks secured to the exterior wall sheathing adjacent to the opening side of the unit entry door. Mailboxes for multiple unit buildings with common entrances should be grouped according to the number of units served by the entrance, at a convenient location outside the locked entry door approved by the LHA and local postal authorities.

At larger developments centralized mail delivery may require clustered mailboxes at one or more locations.

All mailboxes should be lockable and have permanent unit numbers assigned and applied by the LHA.

Avoid post mounted mailboxes except where required by local postal authorities. Where used, they should be securely fixed to a post installed securely into the ground, preferably into a concrete sleeve with a depth below the frost line, or anchored securely to a paved walking surface.

# 10 00 00 • SPECIALTIES

## BUILDING NUMBERS

### BUILDING NUMBERS

Each building should be identified with the street address. Verify the postal address for each building with the local Post Office. Design the location, size, method of attachment and material for the building numbers, and include on the drawings and in the specifications. Follow the USPS and local fire department guidelines and requirements.

## WARDROBE & CLOSET SPECIALITIES

### MATERIALS

Closet shelves should be ventilated to reduce surface mold. Metal wire shelves are acceptable but must be securely fastened into wood blocking on three sides.

Closet poles should be metal secured to the wall, not connected to the shelves.

## 11 31 00 • RESIDENTIAL APPLIANCES

**SECTION INCLUDES**

Kitchen Equipment

Laundry Connections

**RELATED GUIDELINE SECTIONS**

| | |
|---|---|
| 12 30 00 | Casework |
| 22 00 00 | Plumbing |
| 23 00 00 | Heating, Ventilation & Air Conditioning |
| 26 00 00 | Electrical |

521 Code of Massachusetts Regulation ARCHITECTURAL ACCESS BOARD, Citation 32

### STOVES/RANGES

**MATERIAL**

| | |
|---|---|
| Fuel: | Electric only |
| Color: | White |
| Oven: | No Self-Cleaning or Continuous Cleaning |
| Cook top: | No Glass or Ceramic |
| Ratings: | ENERGY STAR® |

**FAMILY HOUSING**:

- ❑ Specify 30” Ranges
- ❑ Specify 30” Range Hood, DHCD preference is to be vented to outside. Sones 6 or less. Specify the ductwork in the HVAC Section (23 00 00)

**ELDERLY:**

- ❑ Specify 24” Ranges
- ❑ Specify 24” Range Hood, DHCD preference is to be vented to outside. Sones 1.0 -3 Normal, 5-6 High. Specify the ductwork in the HVAC Section (23 00 00)

**ACCESSIBLE:**

- ❑ Specify 30” or 36“Cooktop
- ❑ Specify 30” or 36 Range Hood, DHCD preference is to be vented to outside. Specify the ductwork in the HVAC Section (23 00 00). Provide countertop controls.
- ❑ Specify 27” Wall oven and mount at the appropriate height

**DEPARTMENT OF DEVELOPMENTAL SERVICES (DDS)**:

- ❑ Reference the DDS design guidelines found elsewhere on The DHCD web site.

# 11 31 00 • RESIDENTIAL APPLIANCES

## REFRIGERATORS

Check with the Housing Authority on its refrigerator policy
Specify Rollers and self-leveling features.
Refrigerators should be ENERGY STAR® certified

For modernization projects, size the refrigerator to fit the existing opening. For new construction:

**FAMILY HOUSING:** Specify a 30" wide space, depth no more than 30 "

**ELDERLY:** Specify a 24" wide space, depth no more than 30"

**ACCESSIBLE:** Specify a 36" space, depth no more than 30", bottom freezer Reference 521 CMR 32.

**DDS:** Reference the DDS design guidelines found elsewhere on The DHCD web site and 521 CMR 32.

Avoid complicated refrigerators with equipment such as ice on the door, automatic ice maker, etc.

## OTHER APPLIANCES

**Window Air Conditioners** are allowed. They are owned by the occupant. Specify the air conditioner electrical outlet in the 26 00 00 Electrical Section.

**Garbage disposals** should be avoided where possible due to safety concerns and title 5 restrictions. However, if the project requires garbage disposals specify in 22 00 00 Plumbing Section and remember to specify the electrical connection in 26 00 00 Electrical Section.

**Washer and Dryer Connections** should be specified in the 22 00 00 Plumbing Section and the 26 00 00 Electrical Section. Provide washer and dryer connections for every family unit and in the Community Room for Elderly Developments. Washing machines should be as efficient as prudently possible, including ENERGY STAR® certified. Dryers shall be electric.

**Community Rooms:** Community room appliance requirements vary due to the programs that are operated in the spaces. Check with LHA to ascertain what if special requirements need to be met.

## EXECUTION

Most Ranges, Ovens, and Cooktops come without electrical pigtails; coordinate with trades to cover responsibility for this work.

Coordinate electrical and plumbing connection requirements and location with appliance requirements.

# 12 30 00 • CASEWORK

### SECTION INCLUDES

Kitchen Cabinets
Countertops
Vanities

### RELATED GUIDELINE SECTIONS

| | |
|---|---|
| 06 10 00 | Rough Carpentry |
| 06 20 00 | Finish Carpentry |
| 09 20 00 | Gypsum |
| 09 65 00 | Resilient Flooring |
| 22 00 00 | Plumbing |
| 26 00 00 | Electrical |

### TECHNICAL STANDARDS

ANSI/KCMA A161.1 2000 Performance & Construction Stds. For Kitchen Cabinets- the industry recognized standard for residential cabinet construction.

HUD – Severe Use Specifications for Public and Indian Housing – Sept. 1993

AWI – American Woodwork Institute- materials and finish grades

ANSI161.2 1979 Performance Standards for High Pressure Decorative Laminate Countertops

NSF/ANSI 51 Performance Std. For Solid Surface Products in Food Service

UL 723,(ASTM E84) Fire Resistance Ratings for Solid Surface Materials

521 CMR MAAB Rules and Regulations, current edition (https://www.mass.gov/aab-rules-and-regulations)

Massachusetts DDS Design Guidelines (for Special Needs Housing)

## CABINETS

### MATERIAL

The following cabinet specifications are recommended:

- ❑ Sustainably sourced wood (FSC certified)
- ❑ 3/4-inch kiln-dried hardwood frames, doors, and drawer fronts
- ❑ frameless cabinets are not recommended in high stress environments
- ❑ panel doors should be ¾” stile and rail frames with minimum ¼” hardwood plywood panel.
- ❑ ½” plywood back panels and bottoms
- ❑ Particle board should not be used in any part of cabinets

- ❑ drawers should have ¼" inch minimum plywood bottoms dadoed and glued into all four sides of drawer box.
- ❑ stapled connections are **not acceptable. However glued and stapled connections are acceptable**
- ❑ dove-tailed drawer fronts and side panels are preferred.
- ❑ Epoxy-coated steel drawer guides; 100lb. min. capacity typical with two side-mounted slides per drawer. All drawer guides should be self-closing.

  A single center drawer guide is **not acceptable**
- ❑ 1/2-inch minimum plywood shelves, edge-banded with ¼" solid wood
- ❑ Wall cabinet hanging rails should run continuously along top and bottom of cabinet and be minimum ¾"x 3" nominal solid wood
- ❑ Base cabinet nailing rail shall be minimum ¾" x 7 ¼" solid wood.
- ❑ Absolutely no finger joints in any of the wood components
- ❑ The material should not contain PVC (often found in thermofoil cabinets).

Hardware must be high quality using heavy gauge metal and be easy to replace. For this reason, face-frame style cabinets with surface-mounted 170-degree hinges are preferred. Concealed hinges, if specified, should be 110 degrees minimum at most locations and 165 degree minimum opening at Lazy Susan. The Designer should note that concealed hinges are more difficult to replace and should specify those which allow adjustability and are rated for heavy duty use.

All pull-out work surfaces and drawers must have positive lever stops, which have less of a tendency to jump the tracks when the drawer is fully extended.

### DESIGN

In barrier free and elderly units, drawer and door pulls should be ergonomically designed to permit doors and drawers to be opened with a closed fist.

Consult MAAB regulations for dimensional requirements at accessible kitchens and counters unless specific information about the needs of an incoming resident are known.

If specifying aLlazy Susan confirm that all three cabinet manufacturers specified can provide Lazy Susans constructed with heavy duty wire baskets and solid wood components rather than standard plastic lazy type. Specify Lazy Susans (carousels) with a tray below carousel designed to prevent misalignment when carousel is bumped..

Designers should consider specifying cabinets manufacturered within a 500 mile radius, where possible, for reduced transportation costs and environmental benefits from local manufacture. Consider recycling existing cabinets that are to be removed.

Cabinet finishes should be catalyzed vinyl, polyurethane, or polyester; laminate finishes are not permitted.

AWI Standard Finishing Systems which are acceptable include:

- ❒ TR-5 Catalyzed Vinyl-durable and resistant to chemicals.
- ❒ TR-6-Catalyzed Polyurethane- more durable and harder than TR-5
- ❒ TR-7. Polyester-hardest finish-may crack if impacted or if wood expands; difficult to repair.

## COUNTERTOPS

For all housing types other than Special Needs (689) Housing, plastic laminate plywood substrate is the DHCD standard for kitchen applications and solid surface with integral sinks shall be the standard for bathrooms. Consult DDS Design Guidelines for countertop materials for Special Needs Housing.

LHAs desiring solid surface kitchen countertops instead of plastic laminate should evaluate the cost premium for this option with the DHCD Review Architect against the overall needs of other projects in their Capital Plan before directing the Designer to proceed. Quartz is the preferred material.

All exposed edges of plastic laminate countertops must be laminated. One-piece, post-formed counters are preferred. Countertops with a separate 4 inch high backsplash mounted to the countertop with silicone sealant are not recommended due to water penetration at seam.

Apply caulk at joint between the backsplash and wall.

Miter all inside corners.

Seal cut edge of plywood at sink cut-out with spar varnish or exterior polyurethane.

If plastic laminate is used above the backsplash to the underside of cabinets, it must be of a durable thickness, installed with trim around the exposed edge, and caulked. Where possible, use a ¼" plywood substrate. Plastic laminate is not fireproof and Designer should consider other easily cleaned, durable materials such as stainless steel and porcelain tile for side walls next to stove and walls behind stove. Where plastic laminate is specified it should be carefully detailed around sources of heat.

The three most common grades of plastic laminate are:

- ❒ **HGS**- generally used for countertops- although it can be used in vertical applications.
- ❒ **VGP**- for vertical applications- less impact resistant than HGS

- ❐ **HGP**-for postformed and vertical cabinet interiors-thickness of .039" or less

ANSI/NEMA LD3-2000 Standards should be used to specify: thickness, performance properties and appearance of plastic laminate. A variety of thicknesses up to one inch thick are available, as well as fire-rated and chemical resistant decorative laminates

Designers specifying quartz counters should carefully design details and layouts to avoid thermal expansion and stress cracks at areas such as sink cutouts and sources of heat such as stoves and dishwashers.

### DESIGN

For barrier free units with adjustable height countertops, coordinate the location of electrical outlets, trim, etc. so that they will not be in the way if the countertop is re-adjusted in height.

Consider integral sink/backsplash countertops where possible.

Drop-in and wall hung sinks are supplied by the plumber.

### VANITIES

Where additional storage is needed, vanity sinks may be substituted for wall hung sinks in bathrooms.

Maintain code required clearances from bathroom fixtures, door swings, etc.

Use countertops with integral sink and backsplash for durability and ease of maintenance.

Follow DHCD Casework guidelines and standards in base cabinet construction.

Prefabricated base units, preferably of solid wood or plywood construction, may be used in place of custom built construction. Do not use particle board. Wood veneer MDF is acceptable.

Do not use vanities in accessible units.

Provide alternate bathroom storage where vanities are not used.

# DESIGN AND CONSTRUCTION GUIDELINES AND STANDARDS

DIVISION 14 • CONVEYING EQUIPMENT

## 14 20 00 • ELEVATORS

### SECTION INCLUDES

Electric Traction Elevators
Hydraulic Elevators
Lifts

### RELATED GUIDELINES SECTIONS

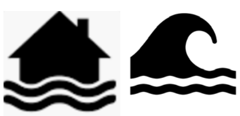
| | |
|---|---|
| 03 30 00 | Concrete |
| 04 20 00 | Unit Masonry |
| 07 10 00 | Waterproofing and Dampproofing |
| 09 20 00 | Gypsum |
| 24 00 00 | Heating, Ventilation & Air Conditioning |
| 23 00 00 | Plumbing |
| 26 00 00 | Electrical |
| 28 00 00 | Electronic Safety and Security |
| 31 00 00 | Earthwork |
| 028200 | ASBESTOS REMEDIATION |

**Filed Sub Bid**

**M.G.L. c.149 §44F**

*Elevators are a stipulated filed sub-bid category under M.G.L. Chapter 149, §44F.  If the cumulative estimated value of the work in this section* ***exceeds*** *$ 25,000.00 and the project's total cost is over$150,000.00, it triggers the filed sub-bid requirement. In general most elevator upgrades exceed $150,000therefore any Electrical, HVAC, etc. work associated with the elevator that exceeds $25,000.00in total estimated costs needs to be defined as a filed sub-bid.*

### Climate Resilience Design Considerations



Where flooding is a concern, raise elevator components that can be elevated out of sump pits and above the design flood elevation (DFE), and take steps to mitigate flooding in elevator pits by waterproofing the interior of the pit and installing sump pumps tied to a backup power source. Priority steps may include:

- Install elevators with motors and controllers above the Design Flood Elevation (DFE)
- Reinforce the shaft below the Design Flood Elevation
- Install a sump pump in the elevator pit if one is not already present
- Dry floodproof pit components that cannot be elevated
- Install flood alarms in the elevator pit
- Set controls to prevent the cab from lowering into floodwater

Projects mostly include upgrades/modernization of existing elevators or in some cases providing a second elevator in buildings with only one elevator. The design for buildings with a single elevator should incorporate features that will minimize the downtime of the buildings elevator, e.g. aggressive construction schedule, etc.

A project that will provide a second elevator or a new elevator should consider the design of holeless, roped or machine room less equipment to facilitate the installation into an existing building.

Elevators are primarily traction type for buildings 75 ft or higher and hydraulic for less than 75 ft (up to 8 stories).

## ELEVATOR UPGRADES

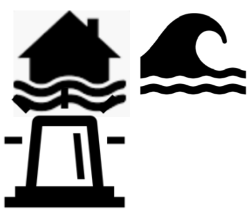
**Prior to the design of elevator upgrades/modernization:**

Evaluate all existing equipment. Identify equipment still having useful life remaining. If equipment is being reused specify cleaning, painting, refurbishing, grease and/oil, etc.

Evaluate and specify all of the fire alarm improvements required for elevators, e.g., firefighter recall.

Upgrades to existing elevators, in buildings having only one elevator, may require a relocation plan for residents being in place prior to elevator work being started. This is a major effort and requires a great deal of coordination with the LHA. In addition, there may be a requirement to work an aggressive construction schedule to minimize downtime.

Evaluate existing machine rooms lighting, electrical, ventilation, heat, etc. and upgrade with improved systems in accordance with current code.



Elevator shafts that extend below the Design Flood Elevation (DFE) should be designed and built to resist the hydrostatic pressure of floodwater.

Elevate or keep electronic elevator controls above DFE in the machine room.

Install a flood alarm to alert the operator when the pit is flooded.

Advanced elevator controls:

- Set elevator controls to prevent cabs from being lowered to a flood-prone lower floor during a power outage or flood. Install one or more float switches in the elevator pit with controls to prevent the elevator cab from descending into a flooded pit. Designate fire recall floors above the DFE
- During power outages advanced elevator controls should automatically shut down all but one elevator at a flood-safe floor. The remaining functioning elevator may run on backup power.
- Install one or more float switches in the elevator pit with controls to prevent the elevator cab from descending into a flooded pit. Designate fire recall floors above the DFE.

Backup power – Sizing of elevator motors is an important consideration when considering backup power.

Determine if the existing emergency generator is sized appropriately for the full load operating or if it is controlled by a selector switch. If the generator was sized originally to have capacity for both elevators operating, provide a selector switch control to allow for operating one elevator at a time (if permitted by code). This additional emergency generator capacity could be used for other loads, or a future replacement generator could be smaller and less costly.

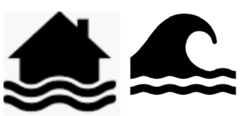
Test, to the extent possible, for disruptive harmonics to existing sensitive electrical systems such as fire alarm panels and systems.

Provide emergency generator interface and test the generator for satisfactory operation of this interface.

Check the elevator pit for water infiltration and accumulation. If it occurs determine cause and correct if possible. Possible solutions include adding a crystalline coating on the walls of the pit or adding sump pumps. If the elevator is hydraulic, include a separator for hydraulic fluid with sump pump installation.

On new hydraulic elevators or when doing an upgrade of an existing older type hydraulic elevator which has been determined not to have cylinder protection, always specify; new PVC lined cylinders, environmentally safe replacement hydraulic oils and provide additional corrosion protection such as cathodic protection. (Replacement of cylinder adds approximately 6 weeks to the downtime of the elevator)

### NEW ELEVATORS INCLUDING ADDITIONAL ELEVATORS



Hole less and roped hydraulic elevators are preferred for new installations.

Hole less hydraulic elevators are preferred where flooding is a concern as the plungers are located high off the ground and out of the reach of floodwater.

Check the elevator pit for water infiltration and accumulation. If it occurs determine cause and correct if possible. Possible solutions include adding a crystalline coating on the walls of the pit or adding sump pumps. If pumps are the solution, a dual pump system is preferred. If the elevator is hydraulic, include a separator for hydraulic fluid with sump pump installation.

Investigate the shaft and design giving consideration to existing building fireproofing and shaft wall construction. Debris from fire proofing can become problematic with new solid-state controls and microprocessors.

On new hydraulic elevators or when doing an upgrade of an existing older type of hydraulic elevator which has been determined not to have cylinder protection, always specify; new PVC lined cylinders, environmentally safe replacement hydraulic oils and provide additional corrosion protection such as cathodic protection. (Replacement of cylinder adds approximately 6 weeks to the downtime of the elevator)

In single elevator buildings that are being provided with a new (second), elevator, specify that the existing elevator should not be used for construction purposes. Synchronize controls of both elevators, existing and new, to operate in accordance with code requirements.

Design new elevators to fit the character of the existing building.

### DESIGN CONSIDERATIONS – ALL ELEVATORS

Research & reference all applicable codes, laws, regulations and standards that apply e.g., NFPA 70, 72, etc.

Use standard "off the shelf" elevator equipment (i.e. Pre-engineered and pre-manufactured) into existing buildings footprints if possible. Do not specify custom equipment unless absolutely necessary. Use current technology in elevator equipment.

**ADA REQUIREMENTS**

Provide all of the required ADA upgrades to elevators and call stations to comply with the requirements for handicap and special needs residents. If a new elevator is being provided, evaluate the need for stretcher requirements and provide the cab sizing if possible.

Interior of elevator cabs should also be upgraded to improve aesthetics. Do not use carpet in elevator cars.

Always specify new elevator pads with the appropriate hanging pins.

Specify patching and painting of hallway where elevator work occurs.

Call button replacements shall be specified, and always provide lobby lights for car direction on each floor

Provide heat and air conditioning in the hydraulic room if needed to keep oil at a reasonable operating temperature. Consider the use of a split system to simplify the installation.

Provide a scavenger pump to return the oil to the reservoir.

Provide state of the art solid state non-proprietary microprocessor controller for elevator control and operation.
Design documents should be clear that the successful bidder for the upgrade/new installation is responsible for emergency repairs and routine maintenance and inspections of all elevators covered under the contract during the entire the duration of the construction contract and warranty period (usually one year after substantial completion).

### WHEEL CHAIR LIFTS

Evaluate the alternatives and options i.e. Limited Use Limited Access (LULA) thoroughly; typically lifts do not get used much and other solutions are more effective.

Exterior stair lifts should be avoided.

## CLIMATE RESILIENCE RESOURCES

Project teams can learn more about elevator updates and system suggestions where flooding is a concern using this resource and others:

- Enterprise Community Partners provides graphics and explanations of resilient elevator systems in chapter 4 of their guide: Ready to Respond Strategies for Multifamily Building Resilience: enterprisecommunity.org/download?fid=2154&nid=4325
- The Boston Planning and Development Agency has included strategies for developing resilient elevators in their Coastal Flood Resilience Design Guidelines document: http://www.bostonplans.org/getattachment/d1114318-1b95-487c-bc36-682f8594e8b2

# DESIGN AND CONSTRUCTION GUIDELINES AND STANDARDS

DIVISION 21 ● FIRE SUPRESSION

## 21 00 00 • FIRE SUPPRESSION –SPRINKLER

### SECTION INCLUDES

Wet Pipe Sprinkler Systems
Dry Pipe Sprinkler System
Residential Sprinkler Systems
Standpipe Systems
Fire Pumps
Underground Water Mains

### RELATED GUIDELINE SECTIONS

| | |
|---|---|
| 09 20 00 | Gypsum |
| 09 90 00 | Painting |
| 22 00 00 | Plumbing |
| 26 00 00 | Electrical |
| 28 00 00 | Electronic Safety and Security |

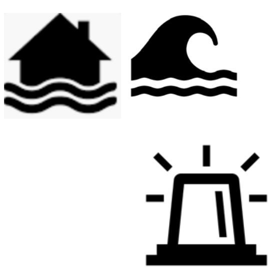
**Filed Sub Bid**

**M.G.L. c.149 §44F**

*Fire Protection –Sprinkler Systems are a stipulated filed sub-bid category under M.G.L. Chapter 149, §44F. If the cumulative estimated value of the work in this section exceeds $25,000.00and the project's total cost is over$150,000.00, it triggers the filed sub-bid requirement.*

### TECHNICAL STANDARDS

### CLIMATE RESILIENCE DESIGN CONSIDERATIONS



Fire-suppression pumps may be connected to backup power to ensure continued service during power outages. This may be especially important if the residents are expected to shelter in place during power outages. Consider installing a permanent exterior electrical connection so that temporary generators can be connected to emergency circuits if no permanent backup generator is located on site. Generator maintenance will be important to ensure quick and reliable backup power to fire suppression and other systems.

### DESIGN

The design intent should be to minimize pipe sizes, conceal as much of the piping as possible and incorporate all of the exceptions allowed in current codes and NFPA or other applicable standards.

For example, NFPA 13R does not require sprinklers for:
Small closets (< 24SF),
Small bathrooms (<55 SF), or
Attics and crawl spaces

CPVC sprinkler piping running through closets requires protection from high heat that may impair the system. Two options are available:
1) provide a sprinkler head in the closet or 2) change that section of piping

to iron. It appears to be easier to provide a sprinkler head in the closet than to change the piping.

All products specified shall have UL and FM approval, if applicable.

Review the proposed design with the local Fire Department and Authority Having Jurisdiction (AHJ). Do not commit verbally or in writing to local FD or AHJ any features requested or discussed that are not required by code or standards before obtaining prior approval from DHCD/LHA.

Coordinate with the local fire department and determine if a fire watch will be required during construction. When a fire watch is required, the contract documents should be structured so that the contractor owns this expense.

Do not install wet system piping in unheated areas even with insulation tented as shown in NFPA standards. It is impossible to control or obtain satisfactory installation of insulation in attic spaces to prevent freeze-ups. Install wet system piping only in warm or heated areas. The installation of dry pendent sprinklers has an application on a limited basis. Antifreeze systems are not recommended.

**DRY PIPE SYSTEMS**

Avoid dry pipe systems unless required to provide sprinkler protection in an unheated attic space having a wood roof or some other area required to have protection.

Dry system piping should be arranged to provide complete drainage of all piping. Provide proper pitch in all piping to low point drains. These low point drains should be located in locations that are heated and accessible to maintenance personnel such as janitor's closets, boiler rooms, etc. and not in resident's closets, above ceilings, etc. Designers must check the elevations and drainage features of all dry piping after construction.

A dry pipe valve trip test in accordance with NFPA procedures should be included in the specification. If this piping, including fittings and valves, is exposed to the outside or conditions of high moisture (unventilated or poorly ventilated attics) which could cause corrosion, it should be a galvanized material or other corrosion resistant material.

**SEISMIC COSIDERATIONS**

NFPA Standards 13D & 13R do not require any seismic restraints. NFPA Std. 13 does require seismic restraints if required by the building code. The Designer cannot expect a contractor to interpret the code and determine if seismic restraints are required. Please do not indicate this in the specification. Based on a review of current information (USGS seismic risk map), Massachusetts has a very low risk of earthquakes, and these residential properties are not classified as essential, e.g. hospital. Therefore, unless the Consultant has done an analysis for the need for seismic restraint do not include general statement to provide and leave it to the contractor to figure it out.

**FIRE PUMP**

For mid- or high-rise buildings with an existing fire pump, a full fire pump test is required if not done recently, i.e. within past two years. If a new fire pump is required to supply automatic sprinkler protection, then design the pump in accordance with the most recent and applicable NFPA standard # 20.

Provide ***full size*** by-pass piping for pump installations. This by-pass piping with valves will allow the use of public water supply for automatic sprinklers in the event the pump is out of service.

The sprinkler system **should not be** hydraulically designed to the maximum output of the fire pump, e.g. lower floors may be adequately supplied from available public water supply and still have optimum pipe sizing. The design should assure some level of protection if the fire pump is out of service.

The preferred driver for fire pumps is electric motor (less maintenance); however, this requires adequate electrical capacity and possible connection to an existing emergency generator. If a new fire pump is required, the fire pump controller should be compatible with the existing emergency generator. If there is no emergency generator, review other pump drivers such as diesel engine, natural gas engine, etc. Provide cost comparisons of different drivers. The intent is to have the most reliable system.

Similarly, code-required new standpipe systems should be designed in accordance with most current NFPA standard # 14.

The majority of systems should be hydraulically designed to the available water supply (with a minimum 10% allowance) in accordance with NFPA residential sprinkler standards 13R or 13D as applicable. Provide hydrant flow test information for design. If available test data is used, it should not be more than two years old. If current flow test data is not available, conduct a flow test prior to designing. Check with local FD if they will accept two year old test results for design of system or if they will require a more recent test.

**WATER SUPPLY**

NFPA 13R & 13D permit the use of combined domestic water and fire suppression systems. This design approach should be considered. This approach has a potential drawback in that it requires flows of domestic load and fire loads be combined in hydraulic calculations which may result in the available water supply being inadequate when using the preferred smaller size pipes. However, this may be overcome by the use of the NFPA permitted residential domestic shutoff valve for dual purpose systems, e.g., Tyco Model RSV-1. This arrangement may not be suitable for the local housing authority to operate and maintain and be more trouble than it's worth.

There is a potential for water hammer with high pressure water systems. Evaluate and provide for correction of hydraulic shock if anticipated, e.g. pressure reducing valves (PRV's).

If the existing connection to the public water supply is not adequate to support the installation of automatic sprinkler protection, a new and suitable water main connection will be required. This new main should be designed in accordance with NFPA standard 24 for underground water mains. Coordinate with the local water department and obtain their written requirements before beginning the water main design.

If the existing water supply cannot support the addition of a sprinkler system, provide an evaluation of why it cannot. In addition, evaluate the feasibility of providing an on-site water supply and pump system to satisfy calculated sprinkler demand.

**PIPING**

Optimize piping arrangements to minimize exposed piping. Generally, the use of sidewall sprinklers will facilitate the concealing of piping.

In finished or occupied areas in retrofit applications, where piping cannot be concealed behind existing construction, install it in a prefabricated metal or plastic soffit. Products such as Deco Shield or prepainted metal soffit material are acceptable. In unoccupied or unfinished areas, piping should remain exposed.

Escutcheons should be specified for all piping penetrations in finished areas.

Provide backflow protection in accordance with the plumbing code and Department of Environmental Protection requirements.

Commercial pipe and valve identification standards are not required on residential systems except where expressly called for by NFPA 13R & 13D. The snap-on pipe markings will be subject to vandalism. Painted markings in unfinished areas, if needed, should suffice.

CPVC piping, if exposed in finished areas and not covered with soffiting, etc., should be painted to match the wall. Use CPVC pipe manufacturer recommended paints--DO NOT USE oil-based paint.

Provide spare sprinkler cabinets and locate them where they will not be subject to vandalism.

Do not install CPVC piping in areas subject to cooking oils accumulation, such as over stoves. Specify metal piping in these locations, even if piping is to be covered in a soffit.

Access panels should be provided, if required. These panels should be properly sized to provide for adequate maintenance repair and to fit the replacement of what they are providing access to and be suitable for the construction surface fire resistance in which they are being installed.

## ALARMS

**In elderly resident locations:**

Typically, fire alarm control panels are existing and sprinkler waterflow and valve tamper alarms can be interfaced with the building fire alarm system without costly changes.

**In family developments:**

Usually, these locations do not have central fire alarm systems and the addition of automatic sprinkler protection requires that some notification system be provided. Local sprinkler waterflow alarms should be compliant with current code and standards based on the number of dwelling units unless local written ordinances supersede the code requirements.

Determine if there is a written local ordinance requiring a Fire Department connection for sprinkler water flow.   If there is no special ordinance, design to applicable codes and standards.  If there is a written local ordinance, design in compliance with this and provide a copy of the ordinance for the record.

## RECORD DRAWINGS AND TRAINING

Since fire protection sprinkler shop drawings are typically very representative of the final installation of the sprinklers, the Consultant should coordinate the contractor prepared As Builts with the Record Drawings required for the Local Housing Authorities files.

Include the system hydraulic calculations, either done by the Contractor or Designer, in the O & M Manual. Indicate this requirement in the specification section.

Specify to provide training to the housing authority on the system operation and maintenance. The intent of this training should be to familiarize the housing authority with the system and not make them sprinkler system service contractors. It would be advisable to include a service contract requirement in the specification, especially if there is a dry pipe system or fire pump. These are specialized types of equipment requiring special training.

## CLIMATE RESILIENCE RESOURCES

Project teams can find further information on maintaining backup power to critical systems using this resource and others:

- Enterprise Community Partners provides graphics and explanations of backup power options in chapter 13 of their their guide: Ready to Respond Strategies for Multifamily Building Resilience: enterprisecommunity.org/download?fid=2154&nid=4325

# DESIGN AND CONSTRUCTION GUIDELINES AND STANDARDS

DIVISION • 22 PLUMBING

# 22 00 00 • PLUMBING

## SECTION INCLUDES

Toilet
Lavatory
Tub and Shower Surround
Faucets and Fittings
Kitchen Sinks and Fittings
Washing Machine Hookups
Domestic Water Heaters
Piping
Pipe Insulation
Meters
Backflow Preventers

## RELATED GUIDELINE SECTIONS

| | |
|---|---|
| 06 10 00 | Rough Carpentry |
| 07 90 00 | Sealants |
| 09 30 00 | Tile |
| 09 65 00 | Resilient Flooring |
| 12 30 00 | Casework |
| 21.00.00 | Fire Suppression Sprinkler |
| 23 00 00 | Heating, Ventilation & Air Conditioning |
| 26 00 00 | Electrical |
| 33 00 00 | Site Utilities |

**Filed Sub Bid**

**M.G.L. c.149 §44F**

***Plumbing** is a stipulated filed sub-bid category under M.G.L. Chapter 149, §44F. For projects with a total estimated cost over $150,000 and a cumulative estimated cost for the plumbing (in all sections) **over $25,000**, the filed sub-bid requirements must be followed.*

*In addition, if **pipe Insulation** is estimated to cost **over $25,000**, the filed sub-bidders for this trade shall be explicitly instructed to list sub-subs on their Form for Sub-bid.*

## FOREWORD

**The intent of the plumbing system design should be to provide systems that conserve water, are energy efficient, are durable, have quality components from proven and reliable manufacturers, and the LHA can operate and maintain them.**

**These are residential properties that are occupied most of the time. Consider this throughout the design process.**

**Do not** provide an all-inclusive comprehensive specification that is not applicable and specific to the project.

# 22 00 00 • PLUMBING

All specifications must identify codes, regulations, and industry standards that must be followed. The design should be in accordance with the applicable codes and regulations.

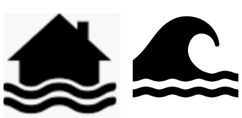
Dependent upon the complexity of the project it may suffice to provide notes & specifications on drawings without providing a separate specification section. For large projects both drawings and specifications will be required.

Drawings should include as a minimum; plan view with lines & symbols representing all new piping, connection points to existing piping, valving, all pipes should be sized, symbol legends, notes, fixture schedules identifying make & model of each, provide details of water heater venting and water piping, mixing valves piping, pipe hanging, with insulation and shields, pump arrangements, etc.

For all plumbing-related items, consult the LHA to determine if they have preferences for specific manufacturers so that they can standardize maintenance across their building stock. If there are specific manufacturer's preferences, a proprietary specification will be required. It is the designer's responsibility to prepare a resolution specifically for this project itemizing the proprietary items for a Housing Authority's Board vote before the bid documents are published. **This proprietary specification still does not preclude the specifying of "or equals" in the specification.**

**Colors, styles and finishes that are specified for fixtures should be readily available ("off the shelf") and not special order.**

## CLIMATE RESILIENCE DESIGN CONSIDERATIONS



Where flooding is a concern, raise domestic hot water heaters above the Design Flood Elevation (DFE). Install backwater valves to prevent storm and sanitary sewer backups during coastal storm surge, sea level rise, or precipitation-related flooding events. Whole-building backwater valves should be equipped with an alarm that alerts building management when activated, so that residents can be informed not to use plumbing fixtures in their units. Smaller backwater valves may also be installed on the waste line leaving individual fixtures such as sinks, toilets, showers, and bathtubs, and are recommended on the lowest fixtures in flood-prone locations.

## MATERIALS

All solid surface sink products should have low VOC content and emissions.

### TOILETS

Gravity or siphon jet flush fixtures are preferred to pressure assisted fixtures. Pressure assist (noise factor) is not excluded but should have the proper application, and suitable for the LHA to maintain and repair. The

LHA shouldn't have to call a plumber to fix a toilet. Toilets are usually made of vitreous china.

Existing flushometer valve fixtures should remain, unless extensive modernization work is undertaken.

In general, water closets within the dwelling units should be two piece close coupled elongated bowl tank-type fixtures to keep with the residential nature of the facilities. A seat should be specified with the toilet. The cold water supply line should have ball valve control and not gate valves that can be difficult to operate over time. The supply line should be acceptable to the LHA –e.g. flex lines may be requested.

**The Dual flush toilets** are a good idea for saving water, but they should not be specified (unless the LHA requests them) because these models are generally more costly and unique to maintain. If installed, the tenants need to be educated as to the operation and water-saving benefits of proper use.

Flushometer valves should be limited to public and office facilities.

The low-flow, 1.28 gallon per flush (gpf) toilets should be used at this time. If lower flow toilets are proposed, it should be discussed with the LHA and they should approve of its use. If a development is served by a septic system requiring more water flow, the 1.6 gpf models can be specified.

In elderly and special needs housing (Chapters 667, 167 and 689) a comfort height toilet >16 inch bowl height is required.

## LAVATORY

If the sink is to be integral with the countertop, it should be specified under Cabinets and installed by the General Contractor; with the plumber supplying and installing fittings and hook-up.

Both vitreous china and cast iron wall-hung lavatories are acceptable. Pedestal type lavatories are not specified because of cost of materials and installation, maintenance, and its suitability for public housing. Avoid enameled steel and PVC because they are not sufficiently durable.

PVC laundry trays(sinks) are suitable to replace existing fixtures in the basements if required.

In special needs (Chapters 167 and 689) integral sink and countertops are preferred.

## 22 00 00 • PLUMBING

### TUB AND SHOWER SURROUND

**REFER TO ARCHITECTURAL STANDARDS FOR TUB AND SHOWER SURROUNDS 06 64 00 PLASTIC TUB & SHOWER PANELS AND 09 30 00 TILE.**

A window located in the tub surround area will require architectural considerations for waterproofing and safety glass.

### TUBS

**New or replacement**:

In family housing, (Chapters 200 and 705) a durable product is required such as enameled cast iron tubs, in elderly housing Americast type materials can be used. The size and colors chosen should be standard. The tub should have slip-resistant features if available.

In special needs (Chapters 167 and 689) a composite tub is acceptable.

One piece composite showers are preferred in bathrooms with no tub.

Never reline existing tubs.  Refinishing and reglazing has been successful under certain circumstances

Provide access to bath tub traps if possible.

In elderly housing (Chapter 667), if replacing the tub, evaluate and discuss with the housing authority the use of a composite shower designed to replace a tub.

Install floor drains in wheel in showers, these floor drains will require trap primers. If code approved devices that eliminate the need for a trap primer (Sure Seal Trap Primer replacement) consider its use. Review the application of this product.

### FAUCETS AND FITTINGS

Provide mechanically fastened (adjustable or swing) traps with clean out for ease of maintenance. Plumbing traps may be chrome-plated or PVC; PVC traps should be concealed from view.

The faucets specified should be a quality product from a reliable manufacturer, suitable for public housing i.e. cost and durability must be considered, it should be easily maintained and replaced, and the LHA should approve of its choice. It should also have water saving features.

Quality flex connectors to fixtures if permitted by code and suitable for the LHA can be specified and used.

Showers should have flow rate limiting features. Use dependable, pressure balancing, anti-scald shower valves with integral service stops.

In barrier free units: provide a removable panel for access to pipes

**KITCHEN SINK AND FITTINGS**

Select a sink with an offset drain to provide additional clearance. Offset should go to end of kitchen circle and coordinate the location of the drain for ease of access to appliance and work counters.

Insulate all piping under barrier free sinks.

Sinks should be high quality, sound-deadened stainless steel; minimum 18 gauge. It is preferred to have a single bowl with a deep sink; 8-10 inches.

Select high quality, easy maintenance, single-lever faucets for elderly. The flow rate must meet current code standards. Flex water supply connectors if acceptable to the LHA are permitted. The types of faucets should be discussed with the LHA and what they want should be specified. A spray feature is recommended.

Garbage disposals are usually not provided. However, some LHA's have them already and want to replace them with new. A quality product that is readily available should be specified so the LHA can replace in the future. This component installation needs to be coordinated between trades; plumbing, electrical, & GC. For developments having septic disposal systems, garbage disposals are prohibited.

Dishwashers are usually not provided.

**LAUNDRY -WASHING MACHINE/DRYERS**

Most elderly resident developments have a common laundry usually located in the community building. The number of hook-ups is provided in accordance with the plumbing code for the number of units. Some LHAs lease the laundry equipment.

Provide one hookup in each family unit usually in the basement. If there is no basement provide hook-up in the kitchen area. Locate washing machine hookups in close proximity to dryer hookups. Do not locate laundry equipment in boiler rooms.

Clothes washer piping should be arranged to prevent back-ups in kitchen drainage systems. Provide water hammer arrestors for clothes washers and other quick closing appliance/devices that could result in water hammer.

Provide a pan under the washing machine if located other than in basement if this pan is to have a drain then it needs to be suitably trapped and vented.

All dryers are to be electric.

**Always** vent dryers with rigid metal ducts to the outside. Locate dryers on an exterior wall to keep vent/exhaust runs as short as possible. Lengthy runs tend to contribute to interior moisture problems.  Avoid common dryer ducts and do not combine dryer ducts with other exhaust systems.

Keep dryer exhausts away from kitchen exhausts and avoid long runs of concealed ducts. Do not locate dryer exhausts near makeup air for heating and hot water equipment, lint and other laundry agents (chlorine fumes) affect burners.

## DOMESTIC WATER HEATERS

The replacement of an existing system or provision of a new system should have the same design intent; to provide a quality product that will provide long reliable service. The system must have the capacity to meet the demand. The system should be efficient and not be oversized so that it uses more energy than necessary and wastes energy during off-peak times.

There are many quality products available. Some of the applications will require residential grade products (200's & 705's, small 667); others may require a commercial grade system e.g. (a large 667) with  edundancy included with the design. An existing system that works now should be improved upon by providing current quality products. Options that will provide a longer service life should be considered.

Energy Star certified products should be specified if possible.  Utility rebates may be available for these models.

Consider specifying extended warranties if cost implications are favorable.

If water heaters are failing prematurely, a water test and analysis   should be done to determine if there are corrosive constituents in the water that might be contributing to this premature failure. A water treatment system may be required to eliminate or mitigate this condition as part of the design of the water heating system. The consultant should determine the quality of the water supply with the local water department and provide an analysis if needed.

Some of these water treatment systems are maintenance intensive which the LHA may not be able to provide; therefore a service contract may need to be specified.

Size the domestic hot water systems according to a realistic scenario about the peak time demand. For special needs and elderly congregate units, heat and domestic hot water may be separate systems.  Domestic hot water use in these locations is more than average.

Design to 140°F (legionnaires disease) storage and provide mixing valves that will supply water at code required temperatures (currently 112°F at the tap); take into account line loss when designing the system.

For all large multi-unit water systems provide domestic hot water load calculations used in determining the size of equipment.

Existing boiler capacity must be evaluated and DHW priority control should be provided for indirect HW tank installation systems.

The preferred arrangement for individual residential apartments is an indirect (preferable stainless steel) tank supplied from the heating boiler because of improved service life expectancy over direct fired storage tank life expectancy. However the LHA preference should take precedence.

If replacing a direct fired water heater with its own venting arrangement with an indirect system off the boiler, the existing venting arrangement (chimney) must be evaluated in accordance with the current code.

**Tankless heaters** in hydronic boilers should be replaced with an indirect tank if the LHA agrees. Steam boilers will have to maintain the tankless arrangement.

**Instantaneous condensing type water heaters** should be evaluated for application if suitable. If the installation will have a higher cost than a conventional direct fired replacement then a cost benefit analysis should be provided to justify additional costs vs. the conventional residential approach.

For gas and oil-fired equipment, provide adequate combustion and ventilation air, it is preferred that combustion air be supplied directly from outdoors where practical and not from within the apartment. Venting of combustion gas products should be in accordance with the applicable code. The existing venting arrangement should be reused to reduce the costs. This arrangement has to be evaluated for compliance with current code and modifications needed should be included in the design.

Elevate domestic hot water heaters above the Design Flood Elevation (DFE). Elevating equipment can involve moving equipment on to a pedestal or platform to bring it above flood elevation. Relocation can include moving equipment to a floor above flood level, and may be limited by the space available. If elevation and/or relocation is not possible, protect the equipment using floodwalls or other methods.

**DOMESTIC WATER HEATERS, CONT.**

Keep water heaters on the first floor or in basement, avoid upper level installations. When unavoidable install a metal drain pan under equipment with a drain and trap suitably piped and vented with a trap primer.

**Always assess the ability to fuel switch the equipment from gas to electric, especially when multiple systems are being installed.** Natural gas-fired direct vent equipment should have a quality liner and other options that will provide longevity to the equipment. Electrically heated or oil-fired equipment should have similar performance features of materials. DHCD is evaluating more sustainable type water heating equipment, focusing on electrification.

## 22 00 00 • PLUMBING

Local water conditions will affect the longevity of domestic water heaters. If the equipment will require frequent servicing or replacement, specify simple systems that will be easy to access.

**Mixing Valves (MV)** – these can be problematic, if there is an existing one and it is working and the LHA can operate and maintain it, then there is no compelling need to replace it if it interfaces with the new water heating equipment.

However, if a new MV is required to replace an existing MV or a new MV is required, specify a quality product that has proven operating experience and is backed by a reliable manufacturer. Provide an MV that is suitable for the application and flow rate ranges anticipated. Provide a detail on the drawing of how this device is to be piped and include all valves and thermometers needed to adequately maintain, operate and adjust the device.

Include in the specification or in a note at this detail that the valve must be piped in accordance with the manufacturer's recommended piping scheme (i.e. the existing piping may have to be modified).

Include in the specification that the manufacturers rep must make all initial adjustments and settings to the mixing valve and provide training in operation and maintenance of this valve to the LHA's designated representative. Include temperature/flow settings in record drawings or in O & M's.

The preferred arrangement for provision of domestic hot water is to provide an indirect stainless steel water heater supplied from the boiler. If there is a potential for this arrangement in the replacement or modernization of an existing water heater system then it should be evaluated as an option. If ASME is a code requirement, specify the Plumbing code "equivalent ASME equipment" as listed.

If there are existing tanks (indirect or storage types) that are in good condition and have useful life remaining, it should be determined if these tanks are ASME stamped if ASME tanks are required by code.

If the system requires (code) a recirculation loop, pipe this in concert with the mixing valve. Include properly sized circulators and provide energy conservation control features, i.e. during anticipated low demand periods the system has simple controls that conserve energy usage. Problems have occurred with these recirculation systems that during the night when there is low usage the cold water somehow becomes hot at the faucets. This could cause scalding of elderly residents. Avoid any design that may result in this operation.

## 22 00 00 • PLUMBING

**PIPING**

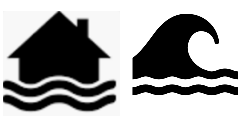
The design must clearly delineate between new and existing piping and different types of piping with suitable legend designations provided.

Do not install water piping or fixture traps in exterior walls, in overhangs or unheated spaces, or close to outdoor air openings.

Piping installed in unheated attic spaces and covered with fiberglass or blown in insulation will not be approved. This arrangement has resulted in freeze-ups, pipe breakage and subsequent water damage, because loose or fiberglass insulation can get moved or displaced over time.  A well-insulated chase that is exposed to heated areas **may be considered**, e.g. an insulated box that runs close to the ceiling below and is exposed to the heated ceilng below. Prefabricated and pre-painted metal soffits if suitable for installation in the finished heated space will be accepted.

Locate frost proof wall hydrants with keyed faucet handles in accordance with Plumbing Code requirements.

Piping that runs thru below grade foundation walls should be provided with a quality seal product to assure that a watertight penetration is provided, e.g. similar to or equivalent to a Link-Seal product.



In order to reduce or prevent flooding from sewer overflows, backwater valves should be installed in areas at risk of flooding due to storm surge, sea level rise, or stormwater/rainfall events. If it is feasible and integrated into the emergency management plan, notify residents and distribute potable water in storage containers while the backwater valve is engaged. This step could help residents minimize tap use and reduce the possibility of causing an internal backup while the valve is closed.Backwater valves should also be provided for all waste lines that are subject to sewer back-up, e.g. underground sewer lines with fixtures below grade that have in the past been subjected to sewer back-ups.

In general, type “L” copper, PEX or CPVC shall be used for domestic cold and hot water.  (Use of PEX is limited to 3 stories).

Pro-press fittings can also be specified.

The plumbing specification should indicate access panels required for all hidden valves, etc. that require access, maintenance, etc. and access panels should be specified as being provided by the plumbing contractor to the GC for him/her to install.

Gas piping can be carbon steel with CSST piping for appliances.

Consider the corrosive quality of the water when designing the system.  If there is a problem, consider Type “K” copper, PEX or CPVC for domestic water piping.

In general, exterior water piping up to 3 inches in diameter should be type "K" copper tube.  Larger pipe should be CPVC or cement-lined ductile iron.  Check with the local water department for their requirements.

**Pressure Testing and Sterilization** of new plumbing systems must be done in accordance with the code. Keep in mind that many of these units will be occupied and disruption of services should be minimized, i.e. don't specify 24 hour tests if not required by the AHJ or code and if shorter duration tests are allowable.

**Backflow Prevention** – provide a suitable type BFD in accordance with the plumbing/DEP code, include these codes required testing in the specification.

**Seismic Restraints** –do not include a general requirement for this without determining if this is actually required. You cannot require that the contractor determine this and provide what is needed. Based on limited review of available information in the industry it appears that the Commonwealth of Massachusetts for residential properties does not require seismic restraint. If the Consultant feels this evaluation is beyond the scope of the project and a sub-consultant is required, discuss this with DHCD/LHA.

**Pipe Hangers** –specify hangers to support concentrated loads such as pumps, valves, etc. Provide a pipe hanger support schedule that defines pipe sizes, support sizes, and hanger spacing. Provide a detail of the type of hanger being specified. Do not reference a piping support hanger manual type of hanger. Some of these manuals may not be available to everyone. Keep it simple and definitive so contractor knows exactly what is being specified. Specify sheet metal pipe saddles for insulated piping. Include gage of metal and dimensions of saddle.

**Specify dissimilar metal protection where needed for all components of the piping systems.**

**Piping and Equipment Identification**: do not provide this in residential units, if boiler rooms that residents have no access to are provided this identification can be specified but be specific as to what is required and where it is to be installed. Snap on pipe markers are acceptable in areas where residents have no access.

**Pumps** should be specified as to material and size (GPM, TDH), if replacing existing pumps, the existing pumps should be evaluated for previous satisfactory operation prior to replacing in kind. There is no compelling reason to replace a good pump that is working with a new pump. Provide a standard pump schedule on drawings or in specifications. Provide pump curves in the O & M's. Sizing methodology for new pumps may be required to be submitted for review.

Specify **thermometers and pressure gages** where needed (i.e. hot water supply temperatures, temperatures @ mixing valves, pump suction and discharge pressures). These should be provided with pulsation dampeners and petcocks to facilitate replacement by LHA maintenance. These should be specified with gage ranges and graduations so they are suitable for the application and can easily be read. It is desirable to know what supply temperatures are and what pump pressures are

**Storm Water Systems**: the general contractor will be responsible for the installation of gutters and downspouts. These are generally the purview of the architect and not the plumbing designer. The design of an interior rainwater storm piping system with rooftop drainage will be the plumbing designer's responsibility. This should be done in accordance with the most current and code compliant accepted practice. When roofing replacement is done, coordination is needed for the replacement of roof drains and roofing installations, especially if there are filed sub-bids for both of these trades. Replacement or repair of these systems should be done with economical and durable materials e.g. PVC piping replacing cast iron piping.

**Soil, Waste and Vent Piping**: use PVC wherever possible. Where PVC is not allowed by code, use service weight cast iron with clamp fittings above grade and gasket joints below grade. Keep waste and vent piping out of exterior walls whenever possible.

Waste traps should be adjustable (i.e., threaded, not soldered); one-piece traps are not acceptable. If PVC waste traps are used, specify threaded joints instead of solvent joints to allow for easy removal. Traps should have clean outs.

**Valves:** for ease of servicing, provide separate ball valves for: the kitchen, each bathroom, washer hook-up, domestic hot water inlet, and domestic hot water outlet.

Provide valves for pipe risers and individual apartments supply lines in multi- family installations.

Do not use gate valves for shut-offs (use ball valves) because they tend to become maintenance problems.

Provide access to all valves and other equipment requiring operation and control that may be installed behind walls, above ceilings, etc. **Provide access panels** suitable for the surface they will be installed in and sized to permit access. Coordinate who will furnish and who will install these access panels. If there is a GC the PC usually furnishes this to the GC who will install.

Although it may be difficult at times to quantify the number of access panels, consider how you think the Contractor will allow for this component. If you can estimate the number of access panels, provide an allowance and include this quantity in the specification.

Provide a complete specification for access panels including fire resistance, operating features, materials, minimum sizes, etc.

Provide high quality, keyed, frost-proof exterior wall hydrants. Some lower grade frost proof wall hydrants tend to fail prematurely. Valve off wall hydrants from inside units.

**Floor Drains** -- provide if required by code, minimize use if possible; trap primers are required for all floor drains
**Escutcheons --** Specify for all exposed piping that passes through finished floor, wall, ceiling, or cabinets. These should be heavy cast brass chromium plated.

## PIPE INSULATION

All piping insulation thicknesses and thermal properties should be in compliance with current Energy code requirements. Piping insulation should be jacketed with a vapor retarder to prevent condensation. All joints, exposed ends, etc. shall be sealed with vapor barrier cement. Provide a pipe insulation table (in specification or on drawing) describing thicknesses of insulation with pipe sizes and service duty.

Provide high density rigid fiberglass insulation for pipes. Foam rubber is not acceptable for water piping. It can be used for refrigeration piping.

Use pre-formed PVC insulation covers with fiberglass inserts on elbows and tees.

Provide pipe saddles at all hangers with insulation.

## METERS

Avoid locating meters in locations such as at the approach to the front entry; and avoid placing meters where pipe runs will be unnecessarily long. A useful strategy is to locate meters near utility rooms on the sides of the buildings. Determine if water pressures will require a properly piped pressure relief valve.

The local water department should be consulted to determine the type of water meter that is required and where it should be located. Avoid, if possible, locating a water meter in the same room as an electric meter.

Make-up water systems for large central boilers and/or systems having a lot of underground piping should be provided with a water meter that the LHA can read and determine if there is a lot of make-up water being used. This may be helpful in trouble shooting and determining underground piping system leakage.

# 22 00 00 • PLUMBING

## CLIMATE RESILIENCE RESOURCES

Project teams can find further information on elevating water heaters and installing backflow valves from sources like this and from others:

- Enterprise Community Partners has created an accessible guide to backwater valves in chapter 5 and to elevating systems in chapter 8 of their guide: Ready to Respond Strategies for Multifamily Building Resilience: enterprisecommunity.org/download?fid=2154&nid=4325

# 23 00 00 • HEATING VENTILATION & AIR CONDITIONING

### SECTION INCLUDES

Heating System
Air Supply System
Fuel Tanks
Ventilation

### RELATED GUIDELINE SECTIONS

| | |
|---|---|
| 02 65 50 | Underground Storage Tank Removal |
| 11 31 00 | Residential Appliances |
| 22 00 00 | Plumbing |
| 26 00 00 | Electrical |

**Filed Sub Bid**

**M.G.L. c.149 §44F**

*Heating, Ventilating, and Air Conditioning is a stipulated filed sub-bid category under M.G.L. Chapter 149, §44F. If the cumulative estimated value of the work in this section **exceeds $25,000** and the projects total cost is over $150,000.it triggers the filed sub-bid requirement.*

*In addition, if any subcategories of this trade, such as pipe Insulation, sheet metal, duct insulation, temperature controls, etc. are estimated to cost **over $25,000** the filed sub-bidders for this trade shall be explicitly instructed to list sub-subs on their Form for Sub-bid.*

### CLIMATE RESILIENCE DESIGN CONSIDERATIONS

When central HVAC equipment is replaced, it should be located or moved from locations where flooding is a risk to prevent water from damaging components. Equipment can be elevated, relocated or as a last option protected in place. Elevation can involve moving equipment on to a pedestal or platform to bring it above flood elevation. Relocation can include moving equipment to a floor above flood level and may be limited by the space available. Protecting equipment in place is the option of last resort and it may involve elevating equipment as much as possible and combining that with a low floodwall.

Consider reducing or eliminating central systems, particularly those at risk of flooding in basements or on first floors. This enables heating and cooling systems to be distributed and located in residential units and above the base flood elevation. Distributed systems provide heating and cooling using smaller equipment located inside each residential unit. Smaller equipment serving individual units is often more energy efficient than larger equipment serving the whole building. Options include warm-air furnaces, PTAC units, or air-source variable refrigerant flow (VRF) or ducted or ductless mini-split heat pump units.

Consider quick connects for temporary backup generator, boiler, or chiller connection. Quick connects are connection points on the exterior of the building for hooking up temporary backup heating, cooling, or electrical equipment.

Consider adding shading around exterior HVAC systems to conserve energy during summer.

## FUEL CHOICE

## SYSTEM DESIGN CONSIDERATIONS

### RESEARCH AND INVESTIGATION

The first choice of fuel is electricity with natural gas as second choice only permitted where electrification is proven impractical. Heating oil and propane are no longer eligible for capital funding from DHCD. Strategic electrification is a policy priority as well as the Mass Save® 3-Year Plan and is important to DHCD's goals of reducing greenhouse gas (GHG) emissions and making public housing more resilient to climate hazards of flooding and extreme heat.

## BOILERS

Equipment which burns fuel shall be 90 AFUE or greater and designs should follow these criteria:

- Choose a boiler manufacturer with at least 5 years of operating experience and a well-developed support organization in Massachusetts
- Provide connections for the installation of an indirect water heater.
- In multiple boiler installations, the indirect fired water heater should be piped independent of the heating loop.
- Confirm that the installed radiation is adequate for the proposed system temperature.
- The piping system should be cleaned to prevent debris from being dislodged during installation potentially causing heat exchanger failure.
- Provide low temperature operation for new construction.
- Provide outdoor reset for high efficiency equipment.
- Provide domestic hot water priority, where applicable.
- Clearly state the sequence of operation in the contract documents as required by the energy code.
- Manufacturer's start up and training is required on all installations.

Stress to the LHA that condensing technology is more sophisticated and that the manufacturer' maintenance requirements should be followed.

Make sure the existing electrical power supply is adequate for the equipment you are considering.

## AIR VS. HYDRONIC

Air and hydronic systems, including radiant floor, each have their advantages and disadvantages. Except in replacement situations, the type of system should be determined primarily by project design considerations such as expected tenancy, energy efficiency, and the ability of the LHA to maintain the system.

In replacement situations, the type of system should be determined by the existing distribution system. The exception is steam systems, which should be reconfigured to hydronic or air.

Provide combustion air/ventilation to the mechanical room as required by the manufacturer's installation requirements and the applicable codes.

The type of Development will dictate the distribution system:

| | |
|---|---|
| ❑ Family | Air or Hydronic |
| ❑ Elderly | Air, Hydronic or ASHP |
| ❑ Special Needs, Congregate | Air with cooling, or ASHP |

## LHA CAPACITY

**Routine LHA maintenance** and service requirements of the installed equipment need to be reviewed. Equipment that requires extraordinary maintenance procedures or require the services of specially trained service technicians (technicians that require significant additional training for a specific piece of equipment) should be avoided.

The LHA should be consulted regarding the capabilities of their maintenance staff as well as the availability and capability of local service companies. The specified equipment should be able to be serviced by at least three vendors located within 30 miles of the installation.

## HYDRONIC SYSTEMS

### DESIGN

Correct design of HVAC systems is critical to their performance, the comfort of the residents, and ease and infrequency of maintenance. As such, all HVAC installations should follow relevant codes requirements, including (but not limited to) IECC 2015.

Size, location and construction of the mechanical room are critical. Where central boilers are utilized, mechanical rooms located directly adjacent to tenant spaces should be avoided unless given significant consideration to noise and vibration control.

Ensure adequate service space is provided around equipment (not necessarily limited to the minimum manufacturer's requirements).

All boiler room components and zone valves are to be installed with isolation valves to facilitate replacement.

Boilers and equipment should be located off the floor on concrete blocks or poured in place concrete pads a minimum of 4" thick.

Through the roof, flues are preferred.

Pumps should be selected for low noise.

Air separation devices are mandatory.

Membrane expansion tanks are mandatory.

If the existing pumps are to be reused, have the pumps tested to ensure the required flow is being achieved.

In multiple boiler installations, two or more boilers should be piped to service the indirect water heater independent of the heating loop.

A primary, (building loop)/secondary, (boiler loop) piping/pumping configuration is required for condensing boiler installations.

**Calculate heating loads:** use the most current standards for residential construction e.g., ASHRAE, ACCA Manual J etc., using the following assumptions:

- ❑ Do not assume the existing equipment is sized correctly. Replacement equipment should be sized to the larger of the current design load or the connected load.
- ❑ Confirm that the installed radiation is adequate.
- ❑ Heating plants should be sized at the design load required by the energy code.
- ❑ Where two or more boilers are installed, with one as primary and one as backup, each boiler shall be sized for 2/3 capacity of the design or connected load, whichever is larger.

Where piping passes through walls or floors, holes should be large enough that the piping does not touch the structure directly. If necessary, provide appropriate sleeves at penetrations to prevent pipe from rubbing against the structure.

Fire stop and water seal these penetrations as applicable.

Locate zone valves in accessible locations, e.g. within the unit under the baseboard radiator cover, in the boiler room, not in crawl spaces.

Heating zones should be piped in series loops for ease of balancing. Branch loops should be piped in a reverse return configuration. Monoflow fittings should be used if no other alternative exists.

Two story apartments should be separated into two heating zones where practical. Self-contained control valves should be avoided.

Lay out residential baseboard radiators for economy, ease of construction, and efficiency of operation.

- ❑ Baseboard radiation should be located under windows or at exterior walls.

- ❑ Do not locate baseboard heaters near toilets especially in family units. They tend to rust. Use durable products that minimize this tendency.

- ❑ Piping should not be installed in unheated spaces that are subject to freezing temperatures. If unavoidable, provide insulation above that required by code and provide heat to keep above freezing.

- ❑ Piping should always be concealed in finished spaces. This may be accomplished by concealing the piping in walls or floors, or by providing baseboard enclosures. If piping is run in walls or floors, it should be located such that accidental puncturing by nails, screws, etc. can be avoided.

- ❑ Piping runs should be as short as possible.

### MATERIALS

Equipment manufacturers should be able to provide documentation demonstrating that their products have proven reliable for a significant period in similar installations.

Equipment manufacturers must also be willing to inspect the finished installation and certify in writing that the installation is in accordance with their requirements.

Solder containing lead is not allowed.

PEX piping is suitable for underground piping applications and should be considered to facilitate retrofitting existing systems if piping needs to be replaced. If PEX tubing is specified, require the contractor provide the LHA with the tools and training to be able to repair the tubing.

PEX tubing is permissible for distribution piping in concealed areas. For exposed basement ceiling distribution piping, copper tubing is preferred.

Ball valves should be used for shut-offs.

Outdoor reset and hot water priority are two preferred control options, where applicable.

Thermostats for elderly units should be non-programmable, with ½” numbers and have operating limit features.

Baseboard radiation for family developments should be heavy gauge materials with a top that is narrow, be sloped and have no damper.

Baseboard radiation for elderly developments should be rust-resistant, galvanized steel

Low water cut offs and high temperature alarms are required for all boiler systems

## AIR SUPPLY SYSTEMS

### DESIGN

Reference SMACNA standards for duct construction.
http://www.smacna.org

Place the mechanical equipment in a central location to simplify the duct layout and reduce duct size. The equipment should be easily accessible for service.

Provide slightly more fresh air than what is being mechanically exhausted.

All air systems should be balanced.

Thermally insulate ducts and locate them below the attic, if possible, in order to maximize energy conservation and eliminate ceiling penetrations.

Duct joints should be sealed with mastic. Do not use duct tape.

For non-sleeping spaces, provide a common return in the hall or ideally in the entry.

Provide bedrooms with their own return and supply; venting through a closet door helps to ventilate that space.

Undercutting or louvering of bedroom doors compromises acoustic privacy.

Avoid floor registers.

For DMH units which will be occupied by cigarette smokers, consider providing at the return air handler a rack of filters including an electrostatic air cleaner.

If you are scoping a forced hot air replacement project, make sure the existing ductwork is properly sized and is of sound construction and repair. Also, investigate how long it has been since the ducts have been cleaned. If more than five years will have elapsed between the when the ducts were cleaned and when the project is underway, include duct cleaning as part of your project.

## COOLING

Cooling load calculations should reflect residential occupancy, not commercial standards, and account for shading of windows.

Locate air conditioning condensers in shade to maximize operating efficiency. Minimize pipe runs. Ensure that the equipment is accessible for maintenance and repair by providing service access on at least three sides. The condenser should be located away from bedroom windows so that residents are not disturbed by the noise.

Whenever feasible use the efficient ductless air conditioners for cooling Community Buildings, office space and public areas.

## EQUIPMENT VENTING

### DESIGN

**Condensing Equipment Venting** should preferably terminate through the roof where practical.

Each piece of equipment should be vented separately.

The lengths of vents on high efficiency equipment must be per the manufacturer's recommendations.

Where equipment is sidewall horizontally vented, attempt to locate the vent termination not less than seven (7) feet above finished grade. Where this cannot be accomplished, comply with NFPA-54 Chapter 10 requirements.

When removing a combustion appliance from a chimney confirm the chimney is not too big for the remaining combustion appliance.

The reuse of chimneys, particularly exterior masonry chimneys, must be in accordance with code. If you are planning to use an existing chimney, make sure, the chimney is the proper size for the equipment being considered and that the chimney is of sound construction and repair.

When converting from oil to gas check to see if the chimney needs to be cleaned.

Confirm that the existing flue does not need to be relined.

Do not use any material containing asbestos.

Combustion air requirements must be provided in accordance with code.

## BUILDING VENTILATION

### DESIGN

**ANSI/ASHRAE STANDARD 62.2-2400:** Is the recommended guide for residential ventilation:

Mechanical bathroom ventilation must be provided, particularly in new or modernized building envelope construction even if the bathroom has a window.

Utilize fans that will operate on some type of timing device, unless installed in a high-rise stack. Systems that are controlled solely from a light switch or wall switch do not operate for sufficient lengths of time to adequately remove the moisture generated from showering (particularly in family housing). Some switches will allow the fan to operate for a fixed period of time (field adjustable) after the lights have been turned off.

In exceptionally humid situations, it may be necessary to install a humidistat.

Kitchen fans should be vented to the exterior.

**MATERIAL**

Fans should be as quiet as possible (<1.0 sones) to resist attempts at tampering by the residents.

Fans should be rated for the intended uses i.e., UL rated for bath and shower area.

Use ENERGY STAR® certified products if possible.

Ductwork should be rigid and corrosion resistant. Flexible ductwork is not acceptable.

Small capacity in-line fans installed in attic spaces that are not accessible by the residents but are accessible to the LHA staff have been used effectively.

Ductwork in unheated space should be insulated and sealed with mastic.

### ROOF TOP VENTILATION UNITS (REPLACEMENT AND NEW)

Evaluate electric systems to be converted to natural gas or to more efficient systems. Gas piping sizing for roof top units should consider other potential conversions i.e., if they have electric water heaters, clothes dryers, etc.

Ventilation rates should be based on current code requirements.

Exhaust fan operation for multiple unit mid and high-rise buildings in conjunction with the operation of make-up air ventilation should provide a positive pressure within the building.

### FUEL TANKS

Wherever possible, fuel oil tanks should be located within the buildings or other above ground locations.

When the work requires the removal of existing tanks this work is best done by separate contract.

When converting to gas, remove all fill piping and all accessory piping. Fill in wall penetrations and patch exterior walls. DHCD does not financially support these conversions, and they are not eligible for funding.

### ERV SYSTEMS

ERV systems are practical when the exhaust air is available and in quantities that justify the initial investment. These systems pre-heat or pre-cool the outside air thru an air-to-air heat exchanger.

## CLIMATE RESILIENCE RESOURCES

Project teams can learn more about protecting HVAC systems from water and extreme heat using resources such as these:

- The City of Boston's "Coastal Flood Resilience Design Guidelines" has strategies to protect systems from flooding and to shade mechanical equipment http://www.bostonplans.org/getattachment/d1114318-1b95-487c-bc36-682f8594e8b2
- Enterprise Community Partners has created an accessible guide to distributed and elevated HVAC systems: Ready to Respond Strategies for Multifamily Building Resilience: enterprisecommunity.org/download?fid=2154&nid=4325

# DESIGN AND CONSTRUCTION GUIDELINES AND STANDARDS

DIVISION 23 • HEATING VENTILATION AND AIR CONDITIONING

## 23 80 00 • AIR SOURCE HEAT PUMP

### SECTION INCLUDES

Air Source Heat Pump System (Ductless Mini-Splits)

### RELATED SECTIONS

26 00 00 Electrical

**Filed Sub Bid**

**M.G.L. c.149 §44F**

*Heating, Ventilating, and Air Conditioning and as a separate category, associated Electrical are stipulated filed sub-bid categories under M.G.L. Chapter 149, §44F. If the cumulative estimated value of the work in this section **exceeds $**25,000 and the projects total cost is over $150,000 it triggers the filed sub-bid requirement.*

*In addition, if any subcategories of this trade, such as pipe Insulation, sheet metal, duct insulation, temperature controls, etc. are estimated to cost **over $25,000** the filed sub-bidders for this trade shall be explicitly instructed to list sub-subs on their Form for Sub-bid.*

### INTRODUCTION

The capacity and efficiency of air source heat pumps (ASHPs) has improved dramatically in the past several years with the notable introduction of "cold climate" versions that are now acceptable for all temperature zones in the Commonwealth (IECC climate zone5). ASHPs are a cost-effective alternative to electric baseboard heat, and for oil and propane-fired equipment. Compared with all equipment noted and with gas fired equipment, ASHP are the lowest emitters of greenhouse gases. They are most favorable in one- and two-story buildings.

### ASHP SUSTAINABILITY GRANTS & STUDY

#### DHCD'S SUSTAINABILITY PROGRAM

DHCD's Sustainability Initiative works with housing authorities interested in installing ASHPs for the first time, with supplemental funding from the sustainability fund when available. In some cases, housing authorities may be approached by third party administrators.

#### THIRD PARTY ADMINISTRATORS AND INSTALLERS

The Low Income Energy Affordability Network (LEAN), also commonly referred to as the Low Income Multi-Family program, is funded by the Mass Save® Program Administrators to install energy efficient and cost effective ASHPs at LHAs. The installation is administrated through two major entities – Action, Inc. (in NGrid territory) and ABCD (in Eversource and Eversource West territory). More than 4,000 systems have been installed at LHAs as of August, 2021. ASHPs can provide significant savings on electric usage/costs. However, we have learned that close attention needs to be paid to the design, installation, and maintenance of these systems to avoid potential performance issues and reduce excessive greenhouse gas emissions.

### ASHP Study

In 2022, DHCD conducted a study to look at ASHP installed at LHAs to understand issues occurring at some housing authorities, and to provide installation and maintenance recommendations related to the specific conditions at LHA developments. The installation recommendations are included herein, but the study also includes Appendices which may be helpful in understanding further best practices. *The Air Source Heat Pump Study for Local Housing Authorities* can be found on the Design Guidelines webpage, as well as on the Sustainability website.

## System Design Considerations

### Climate Resilience Design Considerations

Reducing or eliminating central heating systems and baseboard electric resistance heating equipment, which are often located in basements or near the floor at first-floor locations and at risk of flooding, enables heating and cooling systems to be located in residential units and above the base flood elevation. As climate change causes more extreme heat days, the need for air conditioning will increase. Distributed systems like Air Source Heat Pumps (ASHPs) provide heating and cooling, eliminating the need for window air conditioning. In flood prone areas, external components of ASHPs should be located on platforms anchored to concrete footings above the Design Flood Elevation (DFE).

### Selecting Models

DHCD typically installs residential, ductless wall-hung models, as these are the most applicable to the residential heating loads of our units. On a case-by-case basis other types of indoor units may be acceptable Ducted systems are also acceptable if the domestic hot water requirements can be met for the unit. A hybrid system in a two-story unit may be another option, which would allow for a ducted ASHP to feed the first floor and wall-hung units for the second floor, eliminating wall opening and insulating of old ducts.

The engineer shall also verify if the existing walls and attic are insulated. If insulation is not present, the engineer may need to subcontract with an architect to provide insulation along with the ASHP project.

### Performance Criteria

Cooling and heating load calculations are required to be submitted at the Schematic Design Phase of the project. DHCD is using minimum performance criteria as specified in the Northeast Energy Efficiency Partnerships' (NEEP) Version 3.1 Cold Climate Air Source Heat Pump Specification. This specification is shown, in part, below in Table 1. These models are generically referred to as "Cold Climate" systems.

### TABLE 1

| | |
|---|---|
| Capacity | 100% capacity at 5◦ F |
| Seasonal Cooling Efficiency | [1]SEER ≥ 20 for single head, ≥ 17 for multi-head |
| Static Cooling Efficiency | [2]EER ≥ 12 @ 95◦ F |
| Seasonal Heating Efficiency | [3]HSPF ≥ 10 for non-ducted systems<br>HSPF ≥ 9 for ducted systems |
| Static Heating Efficiency | [4]COP 5◦ F ≥ 1.75 @maximum capacity |
| ENERGY STAR Certification | Must be ES Certified |

[1]SEER = Seasonal Energy Efficiency Rating: BTU cooling output during a typical cooling season/watt-hours electricity used during that season

[2]EER = Energy Efficiency Ratio: output cooling energy/electrical energy

[3]HSPF = Heating System Performance Factor: BTU heat output over the heating season/watt-hours of electricity used during that season

[4]COP = Coefficient of Performance: heat transferred/electrical energy supplied

### INTERIOR FAN COIL UNITS

All indoor units are connected to each other (in the case of multi-head systems) and to the outdoor unit via a four-line, line set - electrical, two refrigerant and condensate – which are housed in Line-Hide™. UV-resistant tape or other mechanical protection shall be installed as needed for exposed insulation. **All penetrations through the shell of the home shall be sealed with insulating sealant/spray foam.**

Indoor units should be installed as high on the wall as is practical to allow sufficient air flow around the units – typically 12" below the ceiling when conditions allow but no less than 6". The units need to be unimpeded by any fixed feature (e.g., cabinets), or movable features (swinging doors) to allow for uninterrupted air flow and should also not block passageways. The location within the apartment where the indoor unit is hung will be unique to the apartment lay-out and should take into consideration the use of space needed by the resident. The objective is to install the unit in the optimal spot to minimize the run length of the line set that will connect to the outdoor unit, as long as any single head unit is located in the room with the highest heat load.

Any of the following are acceptable installations of the line hides that house the line set:

- a direct through-wall penetration from the unit to the exterior; or
- directed out the back of the unit into the wall cavity and then down into a crawl space.

**Single head:** Single head systems refer to one outdoor unit and one indoor unit. To qualify for this configuration, the apartment must have a common wall between the two major rooms that are being heated and cooled – i.e., the living room and bedroom. Single head interior units should be located in the living room – not the bedroom. The location of the unit in the living room is critical because the unit will work most effectively in heating/cooling the largest space, and then transferring that heated/cooled air via a switch-controlled fan located in the common wall.

**Multi-head:** multi-head systems refer to multiple indoor units and one outdoor unit. These systems will be required in several situations:

- when there is not a common wall between the bedroom and living room;
- when closet or cabinet obstructions restrict or prevent the installation of the unit; or
- in apartments with multiple bedrooms.

**Fan in common wall for single head installations:** A fan with a sone rating of 1.0 or less is acceptable. This fan should be installed within the top one-third of the wall in order to allow optimal air transfer. This fan should be controlled by an ON/OFF switch which is located in the bedroom, on the same wall as the fan. Fan shall be ON all the time. We discourage the installation of transfer fans next to kitchens, as cooking fumes can be sent by the fan into bedrooms.

**Thermostat control for the interior unit:** Most of the interior units come supplied with a remote-control thermostat. DHCD's experience is that the remote can be confusing and instead, requires a fixed, hard-wired wall-mounted thermostat with direct visual sight to the unit. This thermostat should be configured to sense temperature at the thermostat and be simple for residents to use. The thermostat should be configured by the installer to run the fan in auto speed mode. In multi-head installations there will be a thermostat for each indoor unit in the same room as the wall unit. For elderly residents, a thermostat with a simple large digital readout similar to the below is preferred.


*A Basic Easy Function Thermostat*

**Condensate removal:** The condensate lines are to be installed to use gravity to remove the condensate. Condensate lines shall be rigid PVC. Corrugated drain line, clear or flexible vinyl or polyethylene tubing should be avoided. Install condensate lines to avoid sagging and secure with hangers, not cable staples. No insulation is needed unless special conditions occur, however aesthetic consideration should be taken into consideration where possible, and the use of wall hide at a minimum is appropriate. Condensate pumps usage shall be avoided.

**Operation Settings:** To maximize the likelihood of a positive experience for both Housing Authorities and their residents, DHCD strongly requests certain operational settings be enacted upon installation of new equipment. These are:

- Lock the fan in auto speed mode
- Lock out “dry mode” (dehumidification) to keep the condensate pan from flooding
- Set maximum heating temperature of 78F and minimum cooling temperature of 69F
- Enable “efficient home” setting if available
- Enable the system to retain installer settings during a power outage

### OUTDOOR UNITS

**Location relative to the building orientation:** Whenever practically feasible, the outdoor units should be located at the rear of the building – primarily for aesthetic and for noise considerations. Placement at the front of the building can sometimes be accepted, in order to avoid creating an extensive run of the line set within the apartment or if preferred by the Housing Authority.

Ideally the outdoor units would not be installed directly under any drip line from the roof which would subject them to falling snow or extensive rain. This is especially important if the roof has no gutters on it. If this cannot be avoided, a shield should be installed (see topic below).

All cold climate outdoor units have heated drip pans, which are essential to prevent the condensate from freezing within the drip pan. However, the drainage from the perforated pan can cause frozen puddles during winter conditions. Outdoor units should not be installed near a walkway where there is insufficient clearance to allow for drainage water to flow away from the walkway and prevent pooling and freezing. The outdoor unit should be located to protect against the direct throw path of snow from a snow blower or grass clippings from a lawn mower.

**Location on the ground**: Exact placement of outdoor units should be determined to minimize noise, vibration, and make maintenance easier. Placement should comply with manufacturer's recommendations, local code requirements, and consider housing authority preferences. If located on the ground, the outdoor units should be placed on a stand which is installed on a 3" heavyweight concrete pad. The stand should be a minimum of 24" tall and located 12" from walls. Plastic pads should be avoided. The stand needs to be no wider than the outdoor unit to allow proper drainage. The most commonly used stand for residential applications is made by a local company called Quick-Sling, LLC.

Ideally outdoor units will not be installed on a balcony or patio. When this can't be avoided, outdoor units need to be installed on a stand which sits on the balcony or patio. Some arrangement for defrost drip from the drip pan needs to be made to contain the water so that it doesn't flow to the path of travel on the balcony and freeze into ice. A curb or pan system which distributes the water off the balcony should be used.

In no case should the outdoor unit block a window.

The color of exterior line-hides should be chosen to match the aesthetics of the building.

Wall-hung units should be avoided.

**Shields:** Outdoor units need to be installed with shields approved by the manufacturer when there is any possibility of snow or water drip from the roof – i.e., under a roof valley or a roof without gutters.

## MATERIALS

Models which qualify are those which comply with the above requirements in Table 1.

For each manufacturer, several sizes exist, as identified in the within the model number (e.g., AQU9RLFC has a 9,000 MBTU capacity). Multi-zone systems can accommodate up to 8 interior heads. In multi-head systems, one outdoor unit is connected to multiple indoor units.

### Refrigeration Line Sets

The following are requirements for refrigeration line sets:

- White polyethylene insulation (PDM Gelcopper line sets) is not allowed
- Insulation shall be closed-cell elastomeric foam (Armaflex, Aeroflex, K-Flex, etc.)
- Exposed insulation outside the line set cover shall be covered with PVC or aluminum jacket (polyethylene and paint are not allowed)
- Insulation ends shall be taped or sealed
- Insulation shall extend all the way to the outdoor unit, with no refrigeration piping exposed
- Refrigeration piping shall be ASTM B280 seamless copper tube, annealed (soft) temper
- Line set covers shall have duct end fitting to prevent last cover piece from sliding
- Pitch drain line in direction of flow, do not create sags or traps
- Terminate condensate drain outside of line set cover, between 6" and 18" above grade

### EXISTING ELECTRIC BASEBOARD HEAT

The bathroom heat should remain operational. All other electric baseboards should be made non-functional but be capable of being restored by the LHA maintenance staff in the event it is needed during an emergency.

## LHA MAINTENANCE & INSTALLATION RESOURCES

*Quick Guide to ASHP Maintenance* - A short guide to ASHP maintenance can be found on the Sustainability webpage. This guide is based on DHCD's experience of LHAs.

*The Air Source Heat Pump Study for Local Housing Authorities* – The study provides installation recommendations and information on routine maintenance. The Appendices includes a NEEP companion guide.

Northeast Energy Efficiency Partnerships' (NEEP) Version 3.1 Cold Climate Air Source Heat Pump Specification.

# DESIGN AND CONSTRUCTION GUIDELINES AND STANDARDS

DIVISION 26 • ELECTRICAL

# 26 00 00 • ELECTRICAL

## SECTION INCLUDES

Electrical Service
Standby Generators
Wiring and Panel Boxes
Interior Lighting
Exterior Lighting
Emergency Egress Lighting

## RELATED SECTIONS

07 07 00 Solar Photovoltaic Systems
08 70 00 Hardware
14 20 00 Elevators
22 00 00 Plumbing
23 00 00 Heating, Ventilation & Air Conditioning
33 00 00 Site Utilities

*The following Section should be included as part of Section 26 00 00 when you have a project that has both electrical work and Electronic Safety equipment. Should the work just be, for example, Fire Alarm work then it can be bid as section 28 00 00.*

*28 00 00* Electronic Safety Equipment – including
Fire Alarm (Smoke & Carbon Monoxide Detectors)
Telephone
Cable TV
Intercom
Emergency Call System

**Filed Sub Bid**

**M.G.L. c.149 §44F**

*Electrical is a stipulated filed sub-bid category under M.G.L. Chapter 149, §44F. If the project total cost is $150,000.00 or greater and the cumulative estimated value of the work in this section exceeds $25,000, it triggers the filed sub-bid requirement.*

**For Contracts estimated over $100,000 that are predominately Electrical Work the DCAMM category for the General Contractor should be Electrical.**

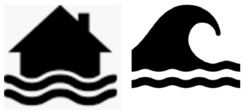
### TECHNICAL STANDARDS, LAWS, ORDINANCES AND CODES

All materials furnished and all work installed shall comply with the rules and recommendations of:

- MA Electrical Code (MEC)
- National Board of Fire Underwriters
- Local Utility Company
- All Federal, State, Local, Town, City or County Departments having jurisdiction

# 26 00 00 • ELECTRICAL

## CLIMATE RESILIENCE DESIGN CONSIDERATIONS



Raise electrical equipment, conduit, panels, and wiring above the Design Flood Elevation (DFE), and seal penetrations through buildings in order to prevent water intrusion. Update emergency lighting to LEDs for efficiency and add wayfinding maps and reflective strips to help residents during power outages and emergency conditions. Consider the backup power needs of residents, especially if they are expected to shelter in place during power outages. Size backup generators to the critical loads identified.  For any backup generators, plan for regular generator maintenance and operator training. Consider installing a permanent exterior electrical connection so that temporary generators can be connected to emergency circuits if no permanent backup generator is located on site.

All buildings in a development which are susceptible to flooding may not themselves be vulnerable. Improvements should be considered on a building-by-building basis.

## ELECTRICAL SERVICE

### DESIGN

Coordinate the design with the local utility company prior to finalizing bidding documents.  Check with the local utility to determine whether pole or pad-mounted transformers are preferred and determine the concrete encasement requirements.

Underground wiring and pad-mounted transformers are recommended for electrical service, if economically feasible.  Underground service is preferred mainly for appearance considerations.  It may be possible to have overhead service to the site with underground distribution to the buildings.

Evaluate the service connection for capacity and reuse.
Where three-phase equipment is installed, e.g., septic system pumps, etc, confirm that three-phase power is available on-site.

If residents will *not* be paying for their own electric consumption, the site should be centrally metered in order to take full advantage of the utility company's time of use rates.

Consult with the LHA to determine whether there is a likelihood in the near future that the residents will be individually billed for electricity.  If that is the case, consider adding empty meter sockets.

During design, the consultant shall contact the electric utility to inform them of the impending electrical work and determine whether any utility primary side work is anticipated.  If an agreement for utility work needs to be completed between the utility and the LHA before the electrical contractor starts construction, assist the LHA to obtain this agreement from the utility.  This will avoid time delays once the electrical contractor's construction contract is signed.

### EXECUTION

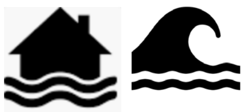
The Contractor is responsible for the coordination of utilities, including installation and scheduling.  Coordinate the Contract Documents accordingly.

All local utility connection fees should be billed to the housing authority which will pay the utilities directly. Backcharges should not be included in the bid.

Provide spare conduit where utilities crossroads and paving to make future installation easier.

**GENERATORS**

Provide a generator only where required by the building code or as directed by DHCD and/or the LHA.



Consider the need for backup power if residents are expected to shelter in place during power outages. Local codes may require a generator to power certain systems during an outage. In addition to those systems, consider adding backup power to circuits running the items listed below, especially if residents are expected to shelter in place.

- Emergency outlets to charge cell phones and computers
- Electronic igniters for gas- or oil-fired heating systems
- Fans and pumps for heating systems
- Water-booster pumps to deliver potable water to upper floors in taller buildings
- Sump pumps
- Telecom systems
- Cable modems and wireless routers
- Alarms and security equipment
- A central washer and dryer
- Refrigeration
- Key fob egress systems

Generator maintenance:

Develop a maintenance plan that periodically runs the generator, and consume or replace liquid fuel according to a schedule so that it is not low or stale when it is needed. Train staff in equipment maintenance and operation. A maintenance log system can be useful to keep system maintenance current and well documented.

The generator may be powered by fuel oil, natural gas, or propane. Use of natural gas shall be with the approval of the local authority only. In addition to the mandatory loads to be carried by the generator per code, the consultant may include a few receptacles on each floor to support the residents' medical equipment and the AC/Heat and common kitchen facilities in the community room. Consult with the LHA to determine if there are any other special needs required to be added to the generator load.
Avoid oversizing the generator.

Where diesel fuel is used to run the generator, provide a sub-base fuel oil storage tank with a run capacity of a minimum of 24 hours unless otherwise directed by the LHA or the authority having jurisdiction.

Consider the installation of a fence around the generator.

Consider whether the development will support a solar battery storage system in lieu of a generator.

### WIRING & PANEL BOXES

**DESIGN**

Raise electrical equipment, conduit, panels, and wiring,above the Design Flood Elevation (DFE) and seal penetrations through outside walls, especially where the service runs underground. Electrical equipment below the DFE that is not rated for wet installation should be encased in a non-corroding conduit or enclosure if code allows. Encasing will also make replacement easier should equipment be damaged in a flood. Conduits should be installed vertically so that they drain after a flood. For specific guidance consult FEMA P-259 5W.8 Electrical Systems.

Unit load calculations should consider at least two window air conditioners per apartment.  A separately circuited (120v, 20amp) air conditioner receptacle should be considered in the living room and master bedroom.  The receptacles should be in addition to the receptacles required by code.

Mounting heights:

- ❑ Wall Receptacles — 18" AFF (except @ kitchen counters)
- ❑ Light Switches — 48" AFF
- ❑ Thermostats, etc. — 54" AFF to top of dials for side reach and 48" AFF for forward reach

For Kitchen and Bath upgrade projects, confirm that the unit loadcenter does not require replacement due to the need for additional circuits or lack of accessibility.

In most bathroom applications, bathroom exhaust fans shall be run intermittently.  The bathroom lights and exhaust fan shall be controlled by a single switch.  The switch shall be a time delay switch, that when turned off, allows the fan to continue to operate for a field adjusted period of time.

In some bathroom applications, where high humidity may be a problem, design alternates such as continuous bathroom fan operation or humidistat controls should be evaluated.

If there are no bathroom fans, provide one (less than 2 sones).  Avoid fans that can be unplugged inside the fan unit by the residents.  New bathroom exhaust fans shall be Energy Star rated.

For new homes certified to meet Energy Star or Stretch code requirements, bathroom exhaust fans may need to run continuously.

Where new electric baseboard is installed, baseboard should not be located below wall receptacles per the MEC. Do not locate electric baseboard under toilet tanks.

Evaluate the existing construction features of the building to determine whether wires can be fished in walls and ceilings. Determine whether there is strapping in the ceilings, block walls, fire blocking in walls, blown-in insulation in the attics, etc. These are all factors that impact the contractor's ability to run wires in the building. Selective demolition by an electrical contractor may be required to determine feasibility of fishing wire in a building.

Determine whether the existing underground wires are direct buried or installed in conduit. Also determine whether any interior wiring may be old knob and tube type and evaluate its suitability for continued use.

### MATERIALS

Aluminum wire should only be considered for use for site power distribution if recommended by the local electrical utility.

Use copper wiring within buildings; aluminum is not acceptable even if it is permitted by code.

Main panel boxes must be lockable.

Panelboard bus bars shall be copper.

All unit loadcenters shall meet the accessibility requirements of the Massachusetts Electrical Code. When new unit loadcenters are being installed, the minimum size should be 100 amps. New loadcenters should have spare poles in accordance with the MEC.

Existing load centers located in closets may need to be relocated outside of the closets due to the accessibility requirements of the MEC. Consult with the authority having jurisdiction.

As an alternative to replacing the entire loadcenter, replacing just the internals of the existing loadcenters shall be investigated.

Unit loadcenters shall have Arc Fault Circuit Interruption (AFCI) breakers as required by code. Where AFCI breakers are to be installed in older existing panels, confirm AFCI breaker will fit in existing panels during Construction Document preparation. Also, AFCI breakers have been shown to be problematic when installed, even though they are required by the MEC. Confirm with the authority having jurisdiction that they are required to be installed.

Federal Pacific Electric Co. (FPE) panels are no longer manufactured and replacement breakers are difficult to obtain. FPE (Stab Lok model) panels also have a history of problems. If FPE panels are in use at an LHA, assess whether these panels should be replaced based on the LHA's experience with these panels and whether additional breakers are to be added to the existing FPE panels.

Run site electrical lines underground in PVC conduit. Encase underground conduit in concrete as required by MEC.

Electrical manholes should be kept to a minimum.

When working with or replacing light fixtures as part of a modernization project, for example, re-siding, bath modernization or fire alarm system upgrades, check wiring to existing fixtures. Insulation around wires may be old and brittle and could create problems when an electrician tries to rework the wires.

For re-siding projects, review the exterior electrical equipment, i.e., meters, disconnects, etc., to determine whether they are suitable and can be reused or should be replaced.

Surface metal raceways, e.g., Wiremold, installations in family housing must consider vandalism abuse. Concealed wiring in finished spaces of family units is preferred.

## INTERIOR LIGHTING

### DESIGN

Install a bathroom light fixture on the wall or medicine cabinet above the bathroom sink.

Avoid wall-mounted fixtures except for fixtures above the bathroom sink.

Verify that gypsum/plaster walls and ceilings and popcorn type ceilings do not have asbestos containing joint compound.

Energy Star fixtures which accept screw-based lamps or standard T8 type lamps are preferred. Avoid fixtures that require lamps with specialized bases. Use LED lamps where possible.

New lighting levels, especially in kitchens and baths, should not be less than existing levels and should be improved above existing if needed. Measure existing lighting levels as required by the project.

## INTERIOR LIGHTING, CONT

### MATERIALS

Recessed lights and track lights are not recommended. Recessed lights may be considered in certain applications such as above kitchen counters or sinks, etc.

Consult with the Housing Authority on lamp and ballast preferences.

Consider light fixtures with plastic globes to minimize breakage.

Provide economical, residential fixtures suitable for public housing.

Install switched receptacles or switched ceiling lights in bedrooms.

In kitchens, provide full spectrum, fluorescent lamped fixtures with high quality, energy efficient, electronic ballasts. Provide fluorescent task lighting above the sink.

In bathrooms, provide full spectrum, fluorescent lamped fixtures with high quality, energy efficient, electronic ballasts.

Investor-owned utilities have funded a Low Income Multifamily Energy Retrofit program targeted to public and affordable housing. The program conducts an energy audit and typically provides many interior and exterior lighting fixtures and bulbs **at no cost** to the housing authority. Designers should inquire whether the housing authority has applied to this program as a complement to the resources available to any capital project involving electrical services. Program guidance is found at www.leanmultifamily.org. This program does not apply to housing authorities in communities with municipal electric companies.

## EXTERIOR LIGHTING

### DESIGN

Provide a site lighting map showing proposed point-by-point lighting levels.

Design exterior lighting to avoid excessive contrast. The Illuminating Engineering Society (IES) www.iesna.org maximum/minimum ratio should be 1:3.

For site lighting, e.g., walkways and parking lots, evaluate the advantages of high pressure sodium, LED and metal halide fixtures and make a recommendation for the specific application to DHCD and the LHA. Consider light output, longevity, cost, light quality and environmental impact.

Entries are of particular concern for safety during routine access and emergency situations. Entry safety lighting should be maintained in good condition.

### MATERIALS

Site, exterior lighting should have underground wiring, suitable poles, and light fixtures.

Specify fixtures with shielded lamps to prevent glare to adjoining property and night sky.

Photocells, dusk to dawn, are recommended.

## EMERGENCY EGRESS LIGHTING

### MATERIALS

For emergency egress lighting, the following options are acceptable:

- ❑ Headlamps on a battery
- ❑ Recessed "butter dishes" with remote battery
- ❑ Converted PL fixture with emergency ballast
- ❑ Floor fixture

Emergency egress lighting is required immediately outside the exterior egress door.

All exit signs must be illuminated. To improve energy efficiency, replace existing non-LED exit signs with low wattage LED signs. In addition to code-

# 26 00 00 • ELECTRICAL

required exit signs, add wayfinding maps and reflective strips on the edge of stairs and ramps to enable safe egress from the building.

## CLIMATE RESILIENCE RESOURCES

Project teams can learn more about the requirements and benefits of generator backup and protecting wiring and systems through resources like these and others:

- Enterprise shares best practices for maintaining backup power in chapter 13 of their Multifamily Building Resilience Guide: https://www.enterprisecommunity.org/download?fid=2154&nid=4325
- FEMA guidance for designing and installing electrical systems may be found in FEMA P-259, "Engineering Principles and Practices for Retrofitting Flood-Prone Residential Structures": https://www.fema.gov/media-library-data/20130726-1506-20490-2593/fema259_complete_rev.pdf

# 28 00 00 • ELECTRONIC SAFETY AND SECURITY

## SECTION INCLUDES

Service Connections
Wiring
Telephone
Cable TV
Fire Alarm
CO Detection
Intercom
Surveillance Cameras

## RELATED GUIDELINE SECTIONS

23 00 00 Heating, Ventilation & Air Conditioning
26 00 00 Electrical

**Filed Sub Bid**

**M.G.L. c.149 §44F**

***The work covered by this section should be part of the Electrical work which is a stipulated filed sub-bid category under M.G.L. Chapter 149, §44F.*** *If the total project amount exceeds $150,000.00 and the cumulative estimated value of all Electrical and Electronic Safety work exceeds $25,000 it triggers the filed sub-bid requirement. It may be better to specify Electrical and Electronic Safety and Security in a single section to avoid confusion.*

## SERVICE CONECTIONS

### DESIGN

Coordinate the design with the local utility companies (telephone, cable television) prior to finalizing bidding documents.

Provide a common mounting panel for the service connections to the building(s).

#### Climate Resilience Design Considerations

Raise electrical equipment, conduit, panels, and wiring above the Design Flood Elevation (DFE), and seal penetrations through buildings in order to prevent water intrusion.

### EXECUTION

The Contractor is responsible for coordination of utilities, including installation and scheduling. Coordinate Contract Documents accordingly.

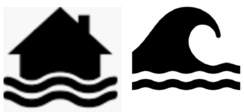
All local utility connection fees should be billed to the housing authority that will pay the utilities directly.

Provide spare conduit where utilities crossroads and paving to make future installation easier.

### WIRING

#### DESIGN

Service entrances should be coordinated so that all utilities enter the building from the same location.



Raise electrical equipment, conduit, panels, and wiring above the Design Flood Elevation (DFE) and seal penetrations through outside walls, especially where the service runs underground. Equipment located below the DFE that is not rated for wet installation should be encased in a non-corroding conduit if code allows. Encasing equipment in a waterproof enclosure or a waterproof conduit will also make replacement easier should it be damaged in a flood. Conduits should be installed vertically so that they drain after a flood.

For specific guidance consult [FEMA P-259 5W.8 Electrical Systems].

### TELEPHONE

Telephone cable shall be a minimum Category 5, 4 pair, copper 24 AWG jacketed cable. Now that new products such as fiber optic phone service are available, consult with the telephone company as required.

When the telephone system is being upgraded as part of a full electrical upgrade, make provisions for the cases where there may be more than one telephone service provider and that a tenant may have more than one phone line to their unit.

Provide one telephone jack in the living room and one in each of the bedrooms. Provide one wall mounted phone jack in the kitchen.

### CABLE TV

TV cable shall be dual RF-6 Quad Shield coaxial cable. Consult with the cable TV company as required.

When the cable TV system is being upgraded as part of a full electrical upgrade, make provisions for the cases where there may be more than one cable TV service provider.

Provide one cable TV jack in the living room and one in each of the bedrooms.

### FIRE ALARM

#### DESIGN

The precise configuration of the fire alarm system will be determined by the requirements of the various codes and regulations, including:

- Building Code 780 CMR
- NFPA 72, MGL c.148 §26B-26E
- Board of Fire Prevention Regulations 527 CMR 24.00

The requirements of the local fire department and building inspector should always be solicited and considered. The consultant should not commit to any features which exceed that required by code without discussing with the LHA and DHCD and receiving approval.

Avoid systems and equipment that can only be serviced by the original manufacturer's service organization. Replacement parts should be available to independent service contractors. Systems whose components are interchangeable with other manufacturer's components offer the most flexibility to the LHA for repairs and service.

Include removal of old equipment with the installation of new equipment. Never leave existing inactive equipment in place. The existing Fire Alarm system shall remain active until the new Fire Alarm system is tested and accepted. If there are existing detection devices such as attic or crawl space devices which may not be required by current code, evaluate their replacement with the new fire alarm system. It is not the intent to reduce the level of protection with the upgraded system. If cost is a consideration, then these devices costs to replace should be determined.

Include hardwired carbon monoxide detectors into fire alarm upgrades if required.

Many cities and towns are changing from a master box on a municipal loop to radio-controlled master box. When new fire alarm control panels are being installed confirm with the fire department the type of master box or fire department connection required.

As a minimum, fire alarm systems should include the following:

- ❑ Whenever installing completely new fire alarm systems, the new system shall be addressable. Consult with the local fire department in naming points for the addressable system.
- ❑ Every dwelling unit should be provided with 120v, hard-wired, interconnected smoke detectors inside each bedroom and immediately outside the sleeping areas. As an alternative, system-connected smoke detectors are acceptable if they are mounted on sounder bases and configured to activate a local alarm only. Confirm this approach with the local fire department and local inspector.
- ❑ In multi-level units, e.g., townhouse apartments, interconnected smoke detectors should be provided on each level of occupancy.
- ❑ In buildings required to have fire alarm systems, system-connected heat detectors are required within six feet of the unit entrance door *only* if the unit entrance opens to a common corridor. These heat detectors are not required in buildings where the dwelling units are equipped with <u>residential</u> sprinklers that when activated will activate the fire protective signaling system.
- ❑ In buildings required to have fire alarm systems, system-connected smoke detectors are required in lobbies, common hallways, and stairways.
- ❑ Manual pull stations are *only* required in buildings with 13 or more units, or four or more stories in height regardless of the number of units or more than one story below the highest level of exit discharge of exits serving the dwelling units.
- ❑ Fire department notification is *only* required in buildings with 13 or more units. For fire alarm systems in elderly developments, however, DHCD requires fire department notification regardless of the number of units.

## 28 00 00 • ELECTRONIC SAFETY AND SECURITY

- ❑ In multi-unit elderly developments provide mini horn/strobe in each unit in order to ensure audibility requirements are satisfied.
- ❑ In units for the hearing impaired (5% of the units) provide additional system annunciation in the bathroom and living room of each unit and provide integral strobes on the local smoke detectors. All handicapped units must also have this additional annunciation.
- ❑ In 689/167 buildings, provide a full fire alarm system with Fire Department notification. These buildings may-- also be fully sprinklered.
- ❑ For developments for the elderly, provide a full fire alarm system with fire department notification regardless of the number of units in the building or whether the units exit directly to the exterior or an interior corridor. In ranch style 667s with front and rear egress directly to the outdoors, a minimum of one system connected heat detector shall be provided within 6 feet of either the front or rear egress doors.
- ❑ Beacons should also be provided on the exterior of each building within sight of approaching fire apparatus.

  The existing underground fire alarm wiring should be considered for replacement if the LHA indicates any problems with the current wiring. It is prudent to replace this existing wiring with the new fire alarm system however, costs to do so should be indicated as a consideration.

  The quantity of the existing telephone lines being used for fire alarm connection should not be increased without the LHA being advised. This may result in the increase in the monthly charges for this service to the LHA.

In developments for the elderly emergency call systems are sometimes interconnected with the fire alarm system. When a fire alarm system upgrade is done at one of these developments, the emergency call system interconnection shall be maintained unless the local fire department or authority having jurisdiction grants approval for the segregation of the emergency call system from the fire alarm system. If removal of this system is permitted or requested by the AHJ/LHA then removal should be included in the project.

### EXECUTION

Every reasonable effort should be extended to conceal wiring. Where wiring cannot be concealed, it should be installed in surface metal raceways (e.g. Wiremold) within the building.

Conduit installed outside the building should be provided with water-tight fittings. Buried conduit should be PVC40. At road crossings use PVC80 with concrete cover.

Fire alarm panels or remote annunciators should be located at the main entrance to the office or community building, whichever is appropriate. Confirm location with the local fire department.

## CO DETECTION

### DESIGN

The precise configuration of the CO detection system will be determined by the requirements of the various codes and regulations, including:

- 527 CMR 31.00
- NFPA-54 section 10.8.3

The requirements of the local fire department should always be solicited and considered. All recommendations that exceed code requirements, whether initiated by the fire department, designer or others, must be discussed with the LHA and DHCD prior to incorporation into the scope of the project.

## INTERCOM

### DESIGN

Intercom entry systems installed are generally the conventional type with a vandal proof intercom entry panel located at the front door only and an apartment station located in each apartment. Alternatively, telephone entry systems are also available. Prior to installing a telephone entry system, fully investigate the advantages and disadvantages of the telephone entry systems and related costs.

If a lobby video camera exists at the front entrance, replacement of a nonfunctional video camera should be done coincident with the intercom replacement.

Installation of video systems may be considered where security has been a problem.

Every reasonable effort should be extended to conceal wiring. Where wiring cannot be concealed, with prior LHA and DHCD approval, design the system to be installed in surface metal raceways (e.g., Wiremold) within the building. The Designer should also consider the use of a wireless intercom system if desired by the LHA.

## SURVEILLANCE CAMERA

### DESIGN

Surveillance Camera installations whether adding to existing system or providing new should be reviewed with the LHA and they should be advised of; proposed location of cameras, types of cameras (fixed, PAN, zoom, etc,) their operation, maintenance of equipment, and how the system will be monitored. The LHA should give approval to the systems and equipment proposed. This information should be detailed on any proposed documentation submitted for review. Include schematic arrangement of cameras, wiring, and monitoring equipment. Provide site drawing showing camera locations and types.

## CLIMATE RESILIENCE RESOURCES

Project teams can learn more about protecting wiring and systems through resources like these and others:

- FEMA provides a number of electrical system retrofit strategies in section 5W.8 of their Engineering Principals and Practices For Retrofitting Flood-Prone Residential Structures: https://www.fema.gov/media-library-data/20130726-1506-20490-2593/fema259_complete_rev.pdf

# 31 00 00 EARTHWORK

## SECTION INCLUDES

Survey, Investigations and Testing
Construction Engineering
Inspection and Testing
Municipal and State Requirements
Earthwork Materials
Tree Protection
Stripping of Loam
Ledge Removal
Excavation and Filling
Design Details
~~Tree Protection~~
~~Dewatering~~

## RELATED GUIDELINE SECTIONS

| | |
|---|---|
| 02 61 00 | Contaminated Site Material Removal |
| 03 30 00 | Concrete |
| 07 10 00 | Waterproofing and Dampproofing |
| 07 20 00 | Building Insulation and Moisture Protection |
| 31 01 00 | Site Preparation |
| 31 31 00 | Soil Treatment |
| 32 12 00 | Asphalt Paving |
| 32 30 00 | Site Improvements |
| 32 31 00 | Chain Link Fences |
| 32 80 00 | Site Irrigation |
| 32 90 00 | Landscaping |
| 33 00 00 | Site Utilities |
| 33 36 00 | Septic Systems |

## TECHNICAL STANDARDS

### SURVEY, INVESTIGATIONS AND TESTING

Provide an existing conditions and topographic survey of the site. The survey shall thoroughly document all existing exterior building and site features, topographic contours and spot elevations to a level of detail that allows for the proper design, bidding and construction of earthwork and site improvements. If any subsurface work is anticipated, i.e., utilities, trenching, general excavation, structure foundation construction, support footings, tree planting, etc., the survey shall document existing subsurface utilities.

Perform subsurface soils research and investigations depending on the proposed scope of the project. Research archived property records, plans, mappings, soils data, and testimony of the historic use of the land, occurrence of past land filling, problems with surface water runoff, drainage infiltration, high groundwater, depth to bedrock, proximity to wetlands resource areas, and so forth. Where deep excavations are proposed such as building foundations or deep utility trenches, perform exploratory test pits to observe and analyze subsurface conditions. These exploratory findings will influence the earthwork materials used and their installation.

For larger paving projects, perform enough pavement borings for sampling and analysis to determine the thickness and composition of pavements and their base course materials.

If designing on-site sewage disposal systems, perform the necessary deep hole observations, soil evaluations and perc testing. Coordinate and schedule this testing with the local board of health.

### CONSTRUCTION ENGINEERING

Require that during construction, the lines and grades of the work be established by a MA registered civil engineer or land surveyor, employed by the contractor. For critical topographic elevations and slopes, i.e., accessible ramps, curb cuts, accessible pavements, etc., require that the contractor provide as-built finish grade elevations determined by a MA registered civil engineer or land surveyor employed by the contractor.

### INSPECTION AND TESTING

Describe the roles and responsibilities for earthwork inspections and testing during construction. Describe the materials test and compaction test requirements that are required during construction.

For family development projects, require the lead testing of all imported topsoil, and on-site topsoil within the project's limit of work.

### MUNICIPAL AND STATE REQUIREMENTS

Where connecting travelled ways or utility connections from the LHA developments to state or local streets and to utility infrastructures, comply with the requirements of the appropriate authority having jurisdiction for work within the right-of-way.

Indicate that the contractor must comply with all federal, state, and local codes and regulations regarding blasting.

### EARTHWORK MATERIALS

The specifications for aggregate earth materials used for supportive base courses, utility pipe bedding, trench backfilling, footing or foundation backfilling, filling, drainage infiltration, sewage disposal systems, and aggregate ground surfacing shall refer to and conform with applicable sections of the MA Department of Transportation, Highway Division, Standard Specifications for Highways and Bridges (SSHB), latest edition, including Supplemental Specifications to the SSHB. Indicate the SSHB section and paragraph for each material specified.

Reference may also be made to the American Association of State Highway and Transportation Officials (AASHTO) which publishes specifications, test protocols and earthwork-related guidelines.

Ordinary borrow may be used for general filling to subgrades unless a more structural fill material is required. Indicate that the use of processed glass aggregate as provided for in the Supplemental Specifications to SSHB is prohibited.

Require that the contractor provide the Designer with a gradation analysis or sieve test for each type of aggregate material specified, for approval. Verify that test reports are current, project specific, and performed by a recognized testing laboratory.

Indicate that unsatisfactory soil materials, including those defined in AASHTO M145 soil classification Groups A-2-6, A-2-7, A-4, A-5, A-6, A-7, peat and other highly organic soils are not acceptable for use on the project.

Provide a durable, nonwoven geotextile fabric as a soil separator to prevent contamination of a larger aggregate material by an overlying or adjacent finer soil material. Encapsulate larger aggregate material such as crushed stone in trenches, leaching beds or drywell pits with geotextile fabric.

## Tree Protection

Indicate on the plans the existing trees that are to remain and be preserved. Show protection fencing around the perimeter of the preserved tree(s) on the plans.

Avoid disturbing existing grades within the drip line (canopy) of the preserved trees. If raising grades within the drip line of preserved trees, and depending on the depth of filling, specify a shallow-footing tree well, and crushed stone fill over the extent of the root spread to subgrade for aeration. Overlay crushed stone fill with geotextile fabric. If the preserved tree is of specimen quality, include perforated PVC piping around the tree root system perimeter within the crushed stone layer, with several vent risers. If lowering grades within the drip line of preserved specimen trees, specify a retaining wall or similar slope stabilization located as far from the base of the tree as possible.

Include specification provisions that the contractor is responsible for replacing preserved trees that are damaged and include a liquidated damages clause related to the tree size.

## STRIPPING OF LOAM

Provide specifications describing the stripping, stockpiling, amending, and/or removal of existing loam (topsoil). Specify the requirements for stockpiled loam that allow for its re-use in the project, i.e., absence of deleterious materials, maximum stone size, mechanical screening requirements, etc. Indicate that an adequate quantity of suitable, stockpiled loam shall be maintained on the site for reuse in lawn and landscape areas. Also specify that excess loam shall become the property of the Contractor and removed from the site unless the LHA prefers to maintain ownership.

### LEDGE REMOVAL

Include provisions for ledge removal. Distinguish between types and class of ledge removal, i.e., open and trench ledge, and removal by bulldozer, backhoe or power shovel (Class A) or removal only by blasting or pneumatic equipment (Class B). Describe procedures to be followed by the contractor upon encountering ledge, particularly those to be followed prior to the ledge removal.

If the presence of ledge is indicated in subsurface soil exploratory test pits or borings, include this information in the construction documents.

### EXCAVATION & FILLING

The extent of earthwork excavation, filling, trenching, backfilling and grading shall be made quantifiable by the existing and proposed spot elevations and contours, and detailing shown on the drawings.

Include procedures to follow for over-excavation by the contractor.

Include provisions for protecting, shoring, bracing and dewatering trenches. Specify that trenches should be suitably backfilled or plated at the end of each working day.

In areas where existing pavements are being removed and replaced if the proposed pavement elevations are equal to or higher than the existing elevations the Designer may consider preserving the existing aggregate base material in place. This is predicated on (1) the Designer's having enough test borings performed to verify the depth and composition of the existing base material to determine whether it meets the requirements of the DHCD Design Standards and (2) there is no evidence of base course failure. If pursuing the preservation of base courses, the Designer may elect to specify a shallow-depth levelling course of fine aggregate over the preserved existing base material. If the proposed pavement elevations are lower than the existing elevations, the existing aggregate base material and subsoil shall be excavated and removed to the depth that allows for the construction of a full-depth base course.

Indicate the percentages of dry maximum densities required for subgrades and base courses under buildings footings and slabs, pavements, utility trenches, utility structures, landscape areas, etc.

If the removal of ledge or other unsuitable materials are anticipated either by field observations, record documents and/or test pits or subsurface borings, prepare a list of unit prices for the removal and disposal of ledge and unsuitable materials.

Indicate grading parameters and requirements related to proper surface drainage, soil stabilization and handicap accessibility.

Include provisions for dust control.

# 31 00 00 EARTHWORK

## DESIGN DETAILS

The drawings shall include cross-section details that illustrate the earthwork materials, their dimensions, their purpose and their relationship to the adjacent materials. The terminology used on the details should be coordinated with the plans and specifications.

For roadways, utility mains, and septic systems, include engineered elevation profiles on the drawings that illustrate the depths of excavation, filling and backfilling required for the project.

Indicate on the drawing details that the aggregate base course under pavements shall extend beyond the edge of pavement by 6-inches as measured horizontally. The exception to this requirement is where pavements abut vertical curbs, walls, or other pavement.

Indicate in the specifications and drawing details that post footings for fencing, signs, lights, bollards, drying posts, site furnishings, etc. shall be tubular-formed concrete and shall be backfilled and compacted to subgrade with gravel or other suitable, aggregate material.

Specify and detail the installation of tree root barriers along the edges of pavements in the vicinity of existing trees, over a distance as defined by the tree canopy extent at tree growth maturity. The exception to this requirement is where pavements adjoin 18” min. height, vertical curbs or walls.

# 31 31 00 • SOIL TREATMENT

## SECTION INCLUDES

Termite Control

## RELATED GUIDELINE SECTIONS

| | |
|---|---|
| 02 61 00 | Contaminated Site Material Removal |
| 03 30 00 | Concrete |
| 06 10 00 | Rough Carpentry |
| 07 20 00 | Building Insulation and Moisture Protection |
| 07 40 00 | Siding |
| 31 00 00 | Earthwork |
| 32 90 00 | Landscaping |

## SOIL TREATMENT

### Design

Soil treatment should be used on all new construction jobs, unless environmental concerns (for example, wetlands or an aquifer zone) preclude treatment.

A termite shield must be used on all jobs, including renovations, so that future inspections can determine whether infestation has occurred and to prevent future infestations. If an infestation is discovered, investigate and retain the services of a pest control company before making repairs.

### Execution

The contractor that performs the work must be certified and provide a certificate of treatment.

Prior to pouring the slab(s), spray soil treatment under interior slab areas and bottom of excavations. Pressure inject outside the perimeter of the building after finish grading and landscaping is complete.
Avoid disturbance to treatment by construction or landscaping activities.

# DESIGN AND CONSTRUCTION GUIDELINES AND STANDARDS

DIVISION 32 • EXTERIOR IMPROVEMENTS

## 32 12 00 • ASPHALT PAVING

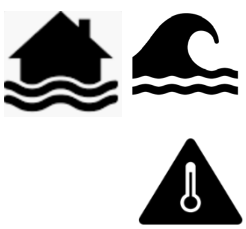
### SECTION INCLUDES

Bituminous Concrete Paving of Roads and Walkways

### RELATED GUIDELINE SECTIONS

| | |
|---|---|
| 02 41 00 | Demolition |
| 03 30 00 | Concrete |
| 22 00 00 | Plumbing |
| 26 00 00 | Electrical |
| 31 00 00 | Earthwork |
| 32 30 00 | Site Improvements |
| 32 80 00 | Site Irrigation |
| 32 90 00 | Landscape |
| 33 00 00 | Site Utilities |

### Climate Resilience Design Considerations



Pavement presents an opportunity to address heat island effects and manage stormwater. Some pavement types can help mitigate both concerns. Light colored pavement (high albedo) and open grid pavement help reduce heat impacts. Open grid and permeable pavements help absorb stormwater. Some materials will require modified maintenance practices. All pavement should be graded away from buildings and in accordance with a site-wide stormwater management plan, to direct stormwater to storm drains, culverts, or bioswales.

### RESEARCH AND INVESTIGATION

**Document Research**: Research the history of past paving upgrades for the site using biddocsonline archives and the LHA drawing archives.

**Pavement evaluation:** Thoroughly examine the site for all evidence of damaged and deteriorating pavement including pavement heaving and settling, pavement cracking and types of cracking, tree root damage, level changes, tripping hazards, potholes, aggregate mix decomposition, overlayment separation, vehicle load rutting, slopes, abutting materials, etc. In addition, examine the site for any damaged or miss-aligned curbing that is abutting the pavement.

Evaluate the existing grading, drainage and storm water management measures in place.

All existing features within the projected limit of work, including building structures, pavements, pavement markings, curbing, curb cuts, walls, steps, ramps, fencing, guard rails, bollards, light standards, vegetation, site furnishings, utility covers/gratings, valve box covers, etc., should be surveyed and plotted on an existing conditions and topographic plan which will serve as the base plan for the pavement replacement or upgrade. If subsurface storm drainage work is anticipated following the site evaluation, include subsurface utilities within the scope of survey services.

This topographical plan shall also include contours at intervals of one (1) foot and spot elevations at sufficient locations to determine slopes, accessibility, drainage patterns and otherwise to define the slopes and directions of all pavement planes.

A thorough investigation and evaluation of existing pavement conditions, base course conditions, subsoils, drainage, ~~and~~ groundwater levels, storm water management measures, and accessibility conditions prior to design will help to determine the methods to be used to repair or replace the damaged or deteriorated pavement. For larger pavement projects, i.e., those exceeding 50,000 S.F. in area, have test borings performed during the site investigation to determine the depths and material compositions of pavements and their base courses.

## ROADS & WALKWAYS

### DESIGN

The design and grading of all parking areas shall comply with MA 521 CMR 23.00.

The design and grading of walkways shall comply with MA 521 CMR 22.00.

Municipal and State Requirements: Where connecting driveways or walkways from the LHA developments to state or local streets, materials and methods of construction shall comply with the requirements of the municipality or state for work within the public right-of-way.

Tenant Relocation: <u>Unless otherwise directed, indicate there will be no tenant relocation associated with the project, and that the</u> dwelling units will be occupied continuously during the pavement construction. Develop and coordinate a phasing plan with the LHA to always ensure access to units and to communal services within the development during construction.

Horizontal dimensions of pavement where curbing is proposed should be as measured from the bottom, front face of curb, and this should be indicated in the drawings notes. Zoning compliance determinations shall consider the travel width of driveways and parking areas, and not include the curbing width in the dimension.

For walkways, provide curved pavement edges at all walkway intersections and changes in walkway direction. At 90$^{o}$ walkway intersections provide 3-ft. minimum radius edges. Increase the radius as the intersection angle increases. At walkway changes of direction, provide a large-radius curved walkway based on site conditions.

Unless abutting a wall, step or deep curb, support the pavement edges by indicating that the width of the pavement's aggregate base (shoulder) shall extend beyond the pavement edge by 4- to 6-inches.

Compact pavement edges by angle-tamping the asphalt pavement edges where the pavement abuts lawns or other soft surfaces.

Where asphalt curb or cape cod berm are proposed, indicate the bituminous concrete binder course extending 2"± beyond the back face of the curb/berm.

To fend against pavement settlement, where new asphalt paving abuts and is flush with either existing asphalt pavement, concrete pavement, or concrete steps (top tread), provide a 3-ft. horizontal zone where the pavement cross section of walkway is the same as a driveway cross section, consisting of a 12-in. aggregate base, 2-in. of binder course and 1.5-in. of top course.

To provide a bond between materials, and prevent water penetration, specify a joint sealant where new bituminous concrete paving abuts existing paving, curbs, walls, building foundations, steps, landings, etc.

Where walkways meet building entry steps or landings, they shall either be (1) flush with the landing or bottom stair tread, or (2) otherwise provide for a uniform, compliant stair riser height.  At building entries, where existing concrete landings do not exist, or do exist and are being removed or modified, provide new landings. Comply with applicable 521 CMR and building codes requirements.

Where there is no paving under and around existing benches that are adjacent to walkway pavements, provide new paving at the benches. New paving shall extend from the benches to the walkway and be accessible.

### MATERIALS

Consider using light colored, permeable, and/or open grid pavements where possible to reflect sunlight and reduce the heat island effect. Light colored pavements such as high solar reflectance concrete, chip seals/seal coating, stone and others can have albedos twice as high as standard pavements and can help reduce area ambient temperatures.

Permeable pavement and open grid pavement can reduce surface runoff and increase water infiltration rates into soils which may be useful in managing stormwater. Permeable pavements are available in different forms and can be used on roadways, parking lots and sidewalks. Pavement areas should also be designed to direct stormwater flow to simple bioswale areas that have the dual benefit of absorbing stormwater and providing attractive green areas to residents, or to culverts or storm drains in accordance with a site-wide stormwater management plan. Enterprise Green Communities has resources related to surface stormwater management including permeable pavement and infiltration strategies.

All bituminous concrete (asphalt) pavement materials shall make reference to and conform with applicable sections of the MA Department of Transportation, Highway Division, Standard Specifications for Highways and Bridges (SSHB), latest edition, including Supplemental Specifications to the Standard Specifications for Highways and Bridges. Indicate the SSHB section and paragraph for each material specified.

Recommended minimum course thickness for roadways and parking lots:

- ❑ 12 inch processed gravel or reclaimed paving base course
- ❑ 2 inch binder course
- ❑ 1-1/2 inch finish course

Or:

- ❑ 8 inch processed gravel or reclaimed paving base course
- ❑ 4 inch dense graded crushed stone
- ❑ 2 inch binder course
- ❑ 1-1/2 inch finish course

Recommended minimum course thickness for walkways:

- ❑ 8 inch processed gravel base (No reclaimed material)
- ❑ 2 inch binder course
- ❑ 1 inch finish course

Mix designs should be provided as part of the design submittal process during construction. All mixtures delivered to the job site shall be accompanied with a certificate of compliance provided by the asphalt batching plant and countersigned by the paving contractor.

**Subgrade –** See Earthwork section.

**Base–** See Earthwork section.

**Reclaimed base –** See Earthwork section.

**Bituminous Concrete:** Bituminous concrete shall be Class I, type I-1 as specified in SSHB.

**Asphalt Berms or Curbs**: specify the SSHB “Dense Mix composition.

**Sealant:** Sealant used for bituminous concrete pavement joint and crack filling and sealing shall be a hot-applied, poly-fiber, asphaltic-based sealant.

**Pavement Markings –** markings may be either painted or composed of thermoplastic and shall be used to delineate onsite parking, handicap parking, and traffic markings. Pavement striping and markings shall comply with MA SSHB.

## EXECUTION

**Construction Engineering:** Require that during construction, the lines and grades of the pavement work be established by a MA registered civil engineer or surveyor, employed by the contractor.

Construction procedures shall conform to MA SSHB, Section 420.

**Testing**: Specify and coordinate the testing requirements.

**Preparation:** Specify the preparation requirements for the subgrade and base course. Specify the requirement to adjust existing utility gratings and covers to finish grade.

**Tack Coat:** Include a tack coat when the binder course has been used as a temporary construction road, when presence of material prevents proper adhesion of finish course, or when the top course is not constructed within 3-days following the binder course construction. Thoroughly sweep or power wash before applying the tack coat.

**Bituminous concrete:** Specify mix placing, compaction, and seasonal installation restrictions.

## CLIMATE RESILIENCE RESOURCES

Project teams can learn more about strategies to manage flooding from resources such as these and others:

- Chapter 10 of Enterprise's "Strategies for Multifamily Building Resilience" provides a number of accessible strategies and example images of how to adapt hard surfaces to reduce heat and stormwater impacts: https://www.enterprisecommunity.org/download?fid=2154&nid=4325
- Toronto's "Wet Weather Flow Management Guidelines" provides a number of lessons learned on low impact development practices related to stormwater management in appendix F: https://www.toronto.ca/wp-content/uploads/2017/11/9191-wwfm-guidelines-2006-AODA.pdf

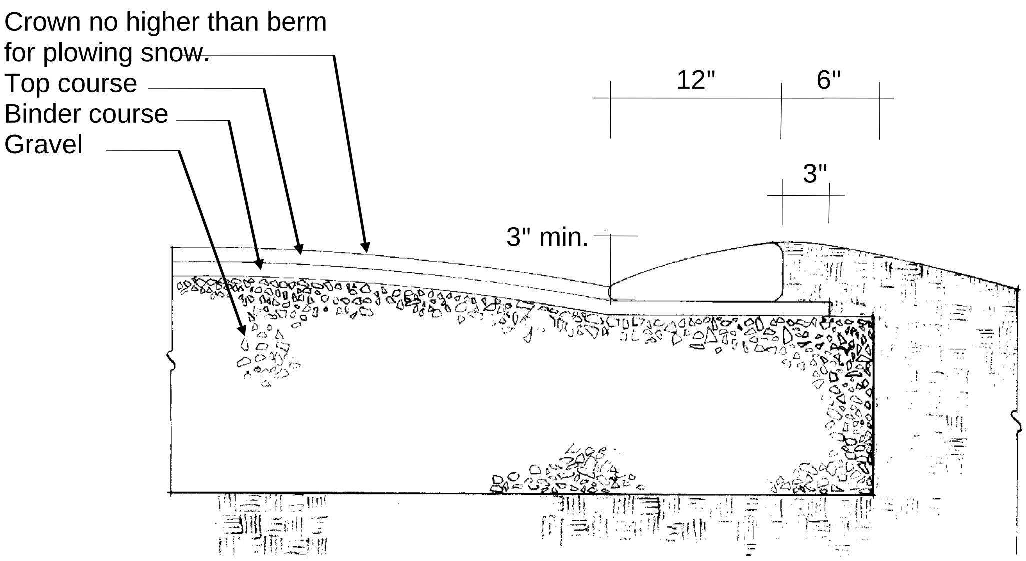



Figure 1

**32 12 001 ● PAVING** | **ASPHALT CURB (CAPE COD BERM)**

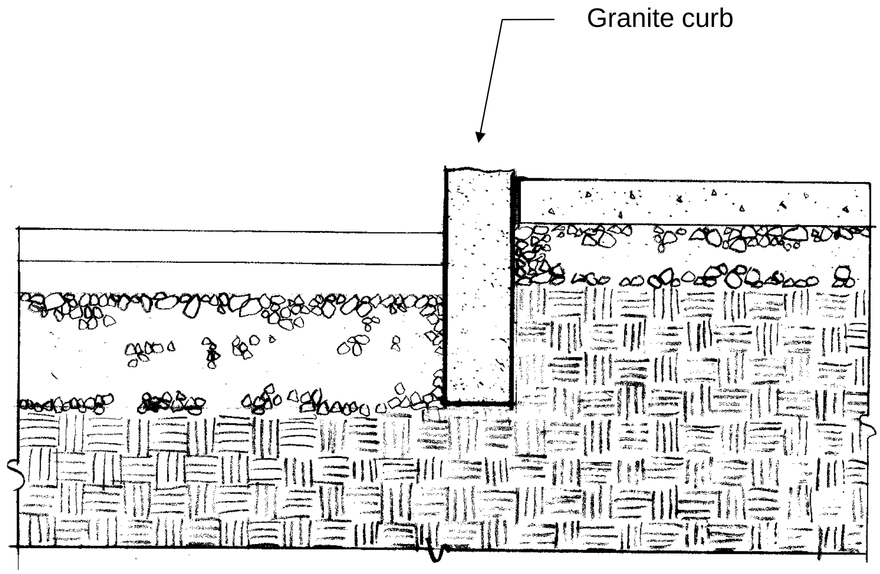



Figure 2

NOTE:
When curb is not backed up by concrete sidewalk, place a backwash of concrete to provide vertical support

**32 12 002 • PAVING** | **GRANITE CURB @ SIDEWALK**

# DESIGN AND CONSTRUCTION GUIDELINES AND STANDARDS

DIVISION 32 • EXTERIOR IMPROVEMENTS

## 32 30 00 • SITE IMPROVEMENTS

### SECTION INCLUDES

Site Improvements
Fences and Gates
Railings
Retaining Walls
Temporary Barriers
Seating
Signage
Site Lighting
Traffic Control Devices
Security
Trash Management
Snow Removal
Drying Yards
Recreational Facilities
Playground Equipment

### RELATED GUIDELINE SECTIONS

| | |
|---|---|
| 03 30 00 | Concrete |
| 22 00 00 | Plumbing |
| 26 00 00 | Electrical |
| 31 00 00 | Earthwork |
| 32 10 00 | Asphalt Paving |
| 32 80 00 | Irrigation |
| 32 90 00 | Landscaping |
| 33 00 00 | Site Utilities |

**Climate Resilience Design Considerations**

## SITE IMPROVEMENTS

Site improvements play an important role in a resilient community. Spray parks can be used to keep cool, emergency site lighting helps wayfinding during an emergency, and retaining walls can be used to manage flood landslide risk.

## FENCES AND GATES

### DESIGN

Provide concrete footings, to frost depth, for chain link and wrought iron fence and gate posts. Top of footing must be tooled so as to slope away from fence post. For wrought iron fencing, flange mounted posts anchored to the footings are preferred to sleeve mounting. Chain link fence posts may be directly embedded in the footing. Where used, sleeve mountings should be filled with non-shrink grout and tooled in a weathered joint at the post to shed water. Except for chain link fence posts, avoid setting metal posts directly into the footings. Wood posts should be anchored in concrete footings with strap anchors. They may also be directly buried on a crushed stone footing or encased in a concrete collar with the end of the post in 4 to 6 inches of gravel below, to allow moisture to drain and avoid rot.

Set height of fence appropriate to its function on the site. Barrier fences should not exceed 6ft, domestic fences 4ft, and delineation fences 30in.

Standard 2in diamond mesh is acceptable for most chain link fence uses. Close weave (1in) mesh may be used for more decorative applications.

Avoid rail fences and any type of fence design with horizontal members that allow or encourage climbing. Vertical pickets should not project above the top rail. Fence posts may be flattened, weathered, or rounded, but must not be pointed. Spacing of fence pickets must follow the opening limitations specified in the Mass. State Building Code.

Provide top and bottom rails.

Provide diagonal bracing and latching or locking hardware for all gates.

Chain link mesh selvages must be knuckled into top and bottom rails. Exposed selvages are not acceptable. Pickets may not project above the top rail of the fence.

Provide continuous concrete mowing strips for protection and weed control along the length of wrought iron fences, and crushed stone mow strips along the length of chain link fences. Install mow strips over post footings.

Check local planning/zoning regulations governing fence height, placement, design and installation. Permits and/or approvals may be required.

**MATERIALS**

Chain link should have a fused vinyl coating for durability and appearance. Specify a minimum 9-gauge mesh fabric exclusive of coating. Specify matching vinyl coated or color galvanized posts and rails and precise minimum size and weight. Avoid mesh insert strips.

Metal picket fences may be steel, wrought iron or heavy duty aluminum. Avoid light aluminum fences as they are not as durable. Weld pickets to top and bottom rails. Secure rails to posts with tamperproof mechanical fasteners.`

Wood board and picket fences must be sealed or stained. Posts may be pressure-treated or cedar. Metal fittings and fasteners must be hot-dipped galvanized or stainless steel.

Wood stockade fences are acceptable where privacy is needed but are not as durable as chain link. Posts may be cedar or pressure treated pine directly buried, or metal pipe in concrete footings. Fence panels are usually spruce and may either be treated with preservative or left to weather naturally. Secure panels to posts with galvanized metal fasteners.

PVC fence systems are an acceptable substitute for wood only where they are not exposed to impact damage. Do not use in situations where such damage is likely to occur. PVC is also subject to ultraviolet light deterioration over long periods of time and will eventually become brittle under prolonged exposure to direct sunlight unless manufactured with a high content of Titanium Dioxide as a UV inhibitor.

## RAILINGS

### INVESTIGATION

Refer to Mass State Building Code and MAAB/UFAS design standards for design applications.

### DESIGN

Flange or side mounted railing supports anchored into concrete are preferred to sleeve mountings. Where used, sleeve mountings should be filled with non-shrink grout and tooled in a weathered joint at the support to shed water. Do not set metal supports directly into the footings.

Exterior stair railing design shall conform to all regulations and standards governing interior stair railing design.

### MATERIALS

Use Schedule 40 galvanized steel pipe, 1 1/4in min diameter for rails and supports. Guard rail pickets to be Schedule 40 galvanized steel pipe, 5/8in diameter.

Galvanizing is required on all metal railings. Where galvanized railings are to be painted, they shall always be shop-primed and then either shop painted or field painted depending on project requirements. Proprietary color coating processes may also be applied in lieu of shop painting. Field touch-up only with paint specially formulated for galvanized surfaces.

Fused, vinyl pipe rail coatings are acceptable but costly. Metal reinforced, vinyl railing systems are acceptable for elderly housing use but lack sufficient durability for family housing use.

## RETAINING WALLS

### DESIGN

If landslide is a concern during flooding, a retaining wall could be added at the perimeter of areas prone to wash out.

Retaining walls must be designed to withstand earth load and hydrostatic pressure to insure a long-lasting installation. Depending on the installation, they may be either of flexible (unit assemblies requiring no frost footings) or rigid (monolithic structures carried to frost depth) construction. Design for retaining walls over six feet in height must be stamped by a Massachusetts registered Structural Engineer.

Flexible retaining wall construction should not exceed 8ft in height, subject to manufacturer's limitations.

Face of rigid walls may be vertical or slightly battered. Flexible walls should be battered to a vertical slope of 1:6.

Provide a drainage swale or an impervious gutter at the foot of all slopes above surcharged walls to direct runoff away from the top of the wall.

Submit engineering calculations to DHCD for all retaining walls during design.

Provide expansion joints no farther than 30ft apart in rigid construction.

Provide 12in min drainage layer of crushed stone backfill behind rigid walls only for the grade-to-grade height of the wall with continuous perforated PVC underdrain or weepholes at 6ft on center. Seal top of drainage layer with 4in layer of clay and 6in of topsoil. For flexible walls, provide 18in min drainage layer for the full height of the wall with the underdrain at the lowest point of the drainage layer. Isolate drainage layers and pipes from surrounding soil with filter fabric. Connect underdrains to the local storm drainage system or to a suitable outfall.

Design should carefully consider termination details that meet the grade in such a way as not to leave the ends of retaining walls exposed.

Install guard rails at locations where retaining wall height exceeds 30 inches.

Consider installing aluminum clips at retaining wall edges for protection at locations subject to skateboarding damage.

### MATERIALS

Acceptable materials include:

- reinforced concrete (4000 psi recommended)
- interlocking precast units
- landscape timbers (crib wall construction) pressure-treated with a non-toxic solution conforming to AWPA P9-74 (not recommended as a long-term solution due to potential for eventual rot and insect infestation)
- galvanized wire mesh basket systems
- on-site field stone for riprap or walls

Temporary flood barriers may be installed at entrances and deployed in advance of anticipated flood events. Permanent flood barriers can help mitigate unexpected flooding events and can be attractively integrated into the area landscape.

### FLOOD CONTROL STRUCTURES AND WALLS

Site equipment and furniture not permanently affixed to a base should be tied down in areas prone to high wind or flooding to avoid damage to buildings, risk to people during extreme events or theft.

- Permanent barriers can include floodwalls and berms. These are built on solid foundations and are engineered to support hydrostatic pressure from a flood, or the stresses of a landslide. These are especially useful in protecting against unanticipated events, events which develop rapidly, or at properties where staffing resources may be limited during an emergency event or a short notice period. The width of berms may mean they are impractical at certain sites or in urban developments.

- Permanent barriers can be integrated with the area landscape design to provide seating and other recreational uses as well as erosion control, and can be attractive additions to the landscape.

- Flood waters will also keep in any water that gets behind the wall. Consider the need for pumps or an outlet for water that is retained.

- The addition of permanent barriers may also affect local drainage, possibly causing water problems for nearby buildings.

- Consider ingress and egress for residents and emergency personnel. Steps, ladders, or ramps may be necessary additions when floodwalls or berms are added.

FEMA P-312 Chapter 8.0 *Barriers* may be a useful resource when considering the addition of a permanent barrier.

**Full Perimeter Moveable Barriers**

Temporary flood barriers may be installed at entrances and deployed in advance of an anticipated flood events. Some types of temporary flood barriers may be integrated into the structure. Temporary barriers can be quickly deployed, generally in less than 24 hours depending operational availability and size of deployment. However, a flood must be anticipated with sufficient warning time, and buildings must be evacuated prior to installing barriers which prevent egress. Consult an engineer to see if this is a viable strategy as flood barriers may put stresses on the building structure and may be in conflict with the building code. Consider a sewer line check valve to prevent backflow through sewer lines when planning for flood mitigation barriers.

Temporary/deployable flood barrier types include panelized systems, moveable walls, sandbags and other systems such as “sand-less sandbags” filled with expandable media. These systems will need to be stored on-site and may require considerable storage space. Some systems may require periodic maintenance and inspection, as well as continued recurring training for deployment. Panelized systems are temporary flood panels which are fitted to permanently installed slots to form flood resistant walls. Moveable flood walls are available at various heights and can be used to protect a perimeter or a portion of a perimeter. They can be collapsed and stored/stacked in between uses. Sandbags and sandbag alternatives are inexpensive and can be effective, but can be hard to transport. Portable stairways may useful where sandbags are planned for use to allow for ingress and egress. (Note: Water-inflated tube systems are also available on the market, but often have to be filled from fire hydrants with fire department supervision. Fresh water filled tube systems will also become buoyant in salt water floods, so water-inflated tube systems are not recommended.)

The ANSI/FM 2510 approval standard for flood mitigation equipment may be of use when selecting barriers. The National Flood Barrier Testing and Certification Program maintains a list of flood barrier products and the product standards that they meet.

### Door Opening and Window Well Coverings

Integrated waterproof flood doors or flood gates may be installed at entryways and if paired with sump pumps connected to a backup power source, may prevent interior flooding, pending that the rest of the structure is flood tight. Consult an engineer to see if this is a viable strategy.

Window well coverings: Low window openings at or below ground level should have a wall constructed around the opening to above the flood protection elevation. An alternative is permanently sealing the window opening if it is not required for safety egress.

For further information FEMA P-259 Chapter 5D may be a useful resource.

### Design

Location criteria:

- Convenience and views
- Sheltered from wind and sun
- Set back from circulation paths
- Coordinated with landscaping
- Accessible for the disabled

Settings:

- Formal groupings
- Informal conversation areas
- Single benches
- Steps, stoops, seat walls

Seating should be anchored to or integral with walks, walls or foundations. Where possible, provide a paved base around seating area.
Bench design should incorporate arm rests, back supports and sufficient heel space to facilitate use by individuals with limited strength. Allow for proper seat drainage.
Seating design should discourage undesirable uses. Provide arm rests at intervals to deter napping.

# 32 30 00 • SITE IMPROVEMENTS

Structures intended to serve as seating should allow a seat width of 15in to 18in. Seat surface should be a minimum of 18 inches above grade and pitched slightly to shed water.

### MATERIALS

Benches: Metal frame and slats preferred. Mesh seating and composite slats are acceptable. Avoid wood slats and contoured plastic. Finishes should be graffiti, flame, and weather resistant.

## SIGNAGE

### DESIGN

Signage is required for traffic control, direction finding and identification. Information should be displayed for quick, easy and understandable viewing by either motorists or pedestrians. Simplicity, clarity and visibility are the three criteria for design.

Consult local public safety authorities for any specific local requirements relating to size, location and display of building address numbers.

Traffic control signage and pavement markings shall conform to the official standards of the Federal Highway Administration, U.S. Department of Transportation, as described in the most recent edition of the Manual on Uniform Traffic Control Devices (MUTCD).
http://mutcd.fhwa.dot.gov

Signage required for handicap accessibility under 521 CMR23.6 shall conform to the Massachusetts Office of Disabilities (MOD) publication “Handicapped Parking Regulations”.

Consult the most recent edition of MAAB Rules and Regulations (521 CMR) for any ADA related signage height limitations and visibility requirements.

### MATERIALS

Metal signs shall be 18ga galvanized reflective steel with a graffiti resistant finish.

Signposts may be galvanized U-channel or galvanized square tube for adjustable height signs, or galvanized Schedule 40 tubular steel for fixed height signs. Breakaway bases may be considered for certain signposts subject to vehicular impact.

Wood signposts are not allowed for traffic control signs, but may be used for directional of informational signage at the discretion of the designer.

### INVESTIGATION

Effective site lighting facilitates the safe movement of pedestrians and vehicles, assists in creating a secure environment and minimizes the risk of property damage and personal injury after dark.

The designer should thoroughly analyze the lighting requirements of the site before developing a lighting plan. The analysis should address security as well as visibility and environmental concerns. The local electrical power provider should also be engaged in the investigative phase to determine if any rate savings programs apply.

Site furniture not permanently affixed to a base should be tied down in areas prone to high wind or flooding, to avoid damage to buildings, risk to people during extreme events or theft.

The designer should consult recommended practices for exterior lighting developed by the Illuminating Engineering Society of North America (IESNA) in the preparation of site lighting designs (www.iesna.org ).

Site Lighting design submissions must include product cuts with photometric charts for each type of light fixture proposed.

### SITE LIGHTING

#### DESIGN

The following are considered acceptable levels of illumination in footcandles:

- Active building entries: 5.0 avg.
- Inactive entries: 1.0 avg.
- Roadways: 0.4 to 0.9
- Walkways along roadside: 0.6 to 1.0
- Residential walkways: 0.2 to 0.5
- Parking areas: 0.6 to 2.4
- Playgrounds: 1.0 to 5.0
- Basketball courts: 5.0 to 10.0

Maintain uniformity ratios of 4:1 or lower [avg. illumination (fc) / min illumination (fc)] at all walkways and parking lots to ensure a consistent level of illumination and avoid “hot spots”.

Locate light fixtures at regular intervals to reinforce circulation paths with a clearly defined lighting pattern.

Mounting heights should be between 10-15ft (walkway and pedestrian lighting), 20-30ft (parking lot) and 20-50ft (roadway). Pedestrian and parking lot lighting may be either building or pole mounted. Walkway and roadway lighting should be pole mounted to maintain a uniform and consistent level of illumination. Avoid low mounting heights (under 12ft) in family housing developments.

Vertical light spreads of walkway fixtures should overlap at a height of 7ft above the walkway surface to enable visual recognition.

Avoid shadows, glare and light pollution by proper selection, placement, shading and shielding of light fixtures.

Focus light downward and away from buildings and window/door openings to minimize glare. Avoid outside light spill into building interiors and adjacent properties.

Coordinate lighting design with site security requirements. Direct light away from points of surveillance. Highlight building entrances. Illuminate vertical surfaces to generate silhouettes.

Design submissions should include a photometric plan for any site lighting that may be proposed.

#### MATERIALS

Street luminaires shall be high intensity discharge (HID) fixtures of the following types:

1. Light Emitting Diode (LED) lamps are preferred.
2. Metal Halide (MH) lamps are acceptable, but problematic due to higher cost and excessive light intensity

Avoid High Pressure Sodium (HPS) lamps due to poor light quality.

Mercury vapor lamps are prohibited under the Energy Policy Act of 2005. They should be replaced by LED luminaires wherever possible.

All luminaires are to be are to be of the high angle cutoff type to minimize light pollution. Fully shielded luminaires with downward facing reflectors are preferred.

Building-mounted luminaires should be accessible for easy lamp changing and maintenance. Specify fully shielded wall packs for wall applications and flush mounted fixtures for canopy applications to minimize light pollution. Avoid drop-lens canopy fixtures.

Utilize automatic "shut-off" controls (sensors, timers, motion activated devices, etc.) wherever possible. Select fixtures compatible with Instant start compact fluorescent lamps for all automatic control applications.

Avoid reusing or remounting existing luminaires that may not comply with current DHCD standards.

### TRAFFIC CONTROLS

#### DESIGN

**Fixed Pipe Bollards:** Set in concrete footings to frost depth, with the post buried a minimum of 3ft. Fill with concrete and provide a reinforcement cage in the footing around the pipe when used for parking and vehicular control. Provide a 4in min white reflective band 6in from top where required for visibility. Crown the bollard with 1in of concrete to shed moisture. Parking bollards should be tall enough to be seen from a backing vehicle. Avoid linking bollards with chains.

**Removable Pipe Bollards:** Set in sleeved concrete footings to frost depth. Provide locking mechanism and lifting handles. Coordinate placement with site requirements for emergency and public safety access.

**Guard Rails:** Use only when necessary at the head of steep embankments and as protection against vehicular impact damage to structures and landscaping.

**Wheel Stops:** These may be used in the absence of curbs at the head of parking stalls but may impede snow removal. Avoid unless requested by the Housing Authority. Anchor with 12-inch-long rebar 2ft 6in min from head of stall.

**Security Gates:** Specify only as part of a comprehensive site security and access/circulation control plan developed with local police and fire department approval. Gate booms and stanchions must have 12in wide bands of reflective tape applied 18in on center over their entire length. Provide locking mechanisms at both open and closed positions of the gate. Provide lock box for each gate.

**Traffic Islands:** Avoid where possible. When used, minimum dimension should not be less than 22ft and sloped granite curbing provided.

**Medians:** Avoid where possible. When used, provide sloped granite curbing around the entire median. Do not landscape or seed medians under 5ft in width; instead, pave with cobbles, Belgian block or similar paving material. Decorative fencing and lighting along the centerline may be added where appropriate. Consult local planning and zoning regulations for any required approvals or design guidelines.

### MATERIALS

**Fixed bollards:** Concrete filled schedule 80 galvanized or painted steel pipe. Bury pipe 3ft min in 4000 psi concrete footing. Crown the concrete at the top for drainage.

**Removable Metal Bollards:** Schedule 80 galvanized (shop painted) steel pipe with formed steel cap inserted in Schedule 40 flanged metal sleeve set in 4000 psi concrete footing.

**Guard Rails:** galvanized metal or heavy timber rails on steel posts as specified in the Mass DPW Standard Specifications.

**Wheel stops:** Precast concrete, 6in high by 8ft long with two galvanized steel anchor rods per stop. Plastic stops are also acceptable.

**Security Gates:** Gate booms, stanchions and pivot posts to be galvanized steel pipe. Footings are to be cast-in-place concrete, 6ft min deep. Bury pivot post 3ft min into footing.

## SECURITY

### INVESTIGATION

LHAs should thoroughly investigate and analyze their own particular security requirements. If necessary, a comprehensive security master plan should be developed with the assistance of a security specialists and the cooperation of local law enforcement agencies. Case studies of successful security plans implemented by other LHAs should be central to the preparation of the master plan.

LHAs should be prepared to devote the necessary resources to maintain sufficient staffing and enforcement means to support the implementation of the master plan.

Pathway lighting helps reduce the risk of trips and falls on exterior pathways. Entries are of particular concern for safety during routine access and emergency situations.

Refer to CPTED (Crime Prevention Through Environmental Design) design strategies in preparing the security master plan.
www.cpted.net/home.html

### DESIGN

Identify and illuminate all building entrances.

Maintain proper illumination levels and placement of site lighting.

Provide identification for the addresses of buildings and units that is clearly visible from the street or parking lot. Coordinate with local police and fire department requirements.

Keep parking areas visible from units where possible.

Use landscaping to highlight building entrances and screen private areas. Avoid opportunities for concealment.

Utilize site security cameras only in conjunction with established LHA security protocols and in consultation with a security design specialist. Consider tenant privacy concerns when planning camera layouts.

### MATERIALS

Lettering for building identification should be of non-reflective material and no less than 5 in. high.

Site security cameras may be a combination of fixed and PTZ (pan-tilt-zoom) and may be mounted on security camera poles, utility poles or building walls. Mounting height should be no less than 16ft above grade.

### INVESTIGATION

Coordinate design and location of trash collection areas and receptacles with LHA trash collection operations. Development of a comprehensive waste collecting plan may be necessary.

Determine whether waste collecting vehicles (WCVs) are front loading, side loading or rear loading. Most large housing developments utilize dumpsters that are emptied by front loading WCVs. Developments not serviced by dumpsters usually rely on individual pickups by rear loading WCVs.

Review the routes through and points of access into the site used by WCVs. These may have to be altered to support a more efficient or less disruptive waste collection process.

Incorporate locally mandated recycling policies into the waste collecting plan. Provide separate collection areas for recyclable goods containers and review access and loading requirements for recycling WCVs.

## TRASH MANAGEMENT

### DESIGN

- Locate dumpsters and outside trash container storage areas where they will be accessible to WCVs with a minimum of turning and maneuvering. Locations should also be convenient to residents, and travel distances minimized as much as possible.
- Avoid locating dumpsters next to Community Buildings or where they will conflict with snow removal operations.
- Enclose dumpsters with screens sufficiently high to conceal them from view. Consult local planning or zoning regulations for any requirements or design guidelines.
- The loading side should be left open. Provide gates only if required by local regulations. Where used, gates should be equipped with latches and cane bolts to avoid uncontrolled swinging, and the enclosure provided with separate resident access for easy trash disposal. Design of screens and gates should be able to withstand considerable abuse.
- Dumpsters must be set on reinforced concrete pads.
- Provide fenced or screened trash barrel collection areas for each residential unit or unit group where dumpsters are not used.
- Provide adequate WCV access to buildings that are serviced by internal trash collecting means.

### MATERIALS

Dumpsters and trash receptacles are furnished by the LHA and should not be included in capital projects.

Use heavy duty steel pipe (Sched 80) or steel posts for enclosure screen supports. Masonry enclosure walls may be used if subject to heavy use.

Provide fixed metal pipe bollards at rear of dumpster pad and at all impact points to protect enclosure from damage.

## SNOW REMOVAL

### INVESTIGATION

Interview LHA to determine existing snow removal procedures, on-site retention/disposal areas and the type of equipment used. Discuss any improvements that may be incorporated into the design.
Evaluate LHA de-icing materials and practices and design accordingly.

Conduct site analysis to identify snow stockpiling areas and locations where winter icing is a problem. Avoid manholes and drainage structures.

### DESIGN

Avoid potential plow obstructions (curb stops, permanent speed bumps, parking lot peninsulas, traffic islands, etc.).

Avoid circular or sharply curved roadway configurations.

Use sloped granite curbing where impact damage from snow plows is likely.

Design walkways with straight runs and adequate width for the LHA's snow removal equipment.

Provide impervious areas of adequate size for snow retention. Where possible, locate these areas at the ends of straight snow plow runs. Do not locate snow retention areas where accumulated snow will obstruct drainage structures or surface drainage channels.

## DRYING YARDS

### DESIGN

Drying yards are no longer utilized except when specifically requested by the LHA. Size and location vary according to demand.

Locate drying yards on level pavement within clear view of the buildings they are serving. Do not locate drying yards in unpaved areas.

Clothesline rails should be no higher than 6ft above grade and supported by posts set in concrete footings to frost depth. Locate posts no more than 12ft apart on center. Provide intermediate posts where rails are greater than 12ft in length.

Weld eyelets for clothesline to rail at 15in to 18in on center.

When demolished, drying yard posts should be completely removed, including the foundation. Cutting the post off at the base and leaving the foundation in place is not acceptable.

#### MATERIALS

Use galvanized steel pipe for posts and rails.

Clothesline is furnished by the LHA.

## RECREATIONAL FACILITIES

#### INVESTIGATION

Conduct a site and user analysis for potential locations of all recreational facilities being considered. The analysis should include, but not be limited to, target users, maintenance, lighting and security requirements, times of use, topographical and solar orientation, proximity to vehicular traffic, potential noise disruption to residents and neighbors, and possible hazards and liabilities.

#### REFERENCE STANDARDS

While each professional sports association has its own rules and regulations governing the layout, delineation and construction of their respective facilities, the standard design guidelines found in reference books such as *Timesaver Standards for Landscape Architecture* by Harris and Dines and *Architectural Graphic Standards* are sufficient for the level of performance required.

Recreational facilities are defined as public areas and as such shall be considered barrier free locations subject to ADA/MAAB regulations.

#### DESIGN

Recreational facilities at public housing sites are usually limited to basketball (full or half court) and handball courts, though other uses, such as softball, soccer, volleyball, shuffleboard, lawn bowling or bocce may be considered.

Hard surfaced playing courts should be level, drained side to side, end to end or corner to corner diagonally (full court), or front to end (half-court) at 1in per10ft.

A north-south orientation of the long axis is preferred for most playing courts.

Basketball hoops should be mounted at a rim height of 10ft above the court surface.

Handball courts should allow an overhead clearance of 20ft.

#### MATERIALS

Playing courts (basketball and handball) may be paved with bituminous concrete and delineated with color coat or traffic paint.

Basketball hoops should be secured to metal poles set in concrete footings to frost level.

Walls of handball courts should be concrete laid plumb to the playing surface.

## PLAYGROUND EQUIPMENT

### INVESTIGATION

Determine what age groups will be served and what activities and type of play will be encouraged.

Conduct site analysis to determine the location and extent of play area as well as the size and placement of play structures.

Integrate play area with other site features (walks, seating, lighting, water service, recreational facilities).

Research specific play structure manufacturers and equipment to determine use zones, fall zones, play sequences and safety requirements.

Include a playground design specialist on the design team.

Consider a proprietary specification for play structures to ensure adherence to specific design and performance criteria.

### REFERENCE STANDARDS

Playground design in the U.S. is not governed by any specific code or regulation. The following are the accepted standards for equipment design, installation and maintenance:

- *Handbook for Public Safety,* U.S. Consumer Product Safety Commission, Publication No. 325
- ASTM F 1487-95 (Standard Consumer Safety Performance Specification for Playground Equipment for Public Use).

### PLAY STRUCTURE DESIGN

Play structures may be freestanding or system-designed.

Locate play structures in central, visible, common-use areas away from roads and moving vehicles. Avoid locating at exit discharge points from buildings. Allow for maximum surveillance by residents.

Identify appropriate age groups within the Development's population. The Development's recreational needs are specific to its population, so not all age groups necessarily have to be accommodated or separated.

Play structures are generally designed to be age-appropriate for the following age groups:

- Infants (0 -1½ years)
- Toddlers (1½ - 3 years)
- Pre-school (3 - 5 years)
- Elementary (5 - 8 years)
- Pre-teen (8 – 12 years)

Play structures may be designed for the following combinations of age groups:

- Infant/pre-school (0 – 5 years)
- Toddler/pre-school (2 – 5 years)
- Older children (5 – 12 years)

Set support posts in sleeved concrete footings carried to frost depth.

Sill plates must rest on leveled subgrade, stone drainage course or resilient play surface.

All play surfaces must meet accessibility standards and be compatible with an accessible route through the site.

Provide curbing or other edge containment for play surface where it meets unpaved grade.

Paved surfaces must not encroach into the fall zones of play structures.

Provide seating for parents and adult supervisors.

Enclose play areas with a fence 48in min in height provided with latchable gates. Fence design should allow for maximum visibility to be maintained.

#### PLAY STRUCTURE MATERIALS

Do not install play equipment on hard or paved surfaces. Do not use wood bark mulch or wood chips. Rubber safety surfacing is preferred. Avoid engineered mulch (fibar or similar), as it must be maintained regularly and may offer concealment for weapons, drug paraphernalia and other hazardous materials.

Safety surfacing should be thickened at all impact areas.

Fabricate structural components of play structures from heavy steel tubing (11ga), steel pipe, channel, angle, plate and flat stock, galvanized and powder coated prior to installation.

Use composite plastic, cellulose-polymer material (Trex or equal) for platform planks, stair treads or other dimensional material. Encourage use of materials with recycled content.

Use tamperproof stainless-steel fasteners and hardware.

Plastic components, where used, shall be polyethylene with UV light inhibitor, and installed according to manufacturer's specifications.
Do not use wood or treated wood on any play structure or equipment, or as a containment curb for the play surface.

### PLAY STRUCTURE INSTALLATION

Play structures should be installed according to manufacturer's specifications, either by the site contractor, certified installer or in a Community Build event initiated and organized by the LHA and supervised by the Playground Design Specialist.

### SPRAY PARK/SPLASH PARK DESIGN

Determine area requirements. Allow 20SF per child based on an estimate of the LHA as to the typical number of children housed at the development.

Locate spray and splash parks in central, visible, common-use areas away from roads and moving vehicles. Isolate from areas adversely impacted by water. Allow for maximum surveillance by residents.

Utilize potable water system design. Tie-in to potable irrigation system (if present) is acceptable. Avoid recirculating systems.

Install operation controls to conserve water use as much as possible. Button operated activation is preferred. A timed water shutoff is recommended.

Surface may be broom finished concrete, colored concrete, poured in place rubber, or an applied skid resistant coating system.

Follow equipment manufacturer's instructions for proper installation and maintenance.

### CLIMATE RESILIENCE RESOURCES

Project teams can learn more about strategies to incorporate flood control structures from resources such as these:

- FEMA P-312 Sections 7 *Floodproofing* and 8 *Barriers* may be a useful resource when considering the addition of a barrier. It is available here: https://www.fema.gov/media-library-data/1404148604102-f210b5e43aba0fb393443fe7ae9cd953/FEMA_P-312.pdf
- For further information on door opening coverings FEMA P-259 Chapter 5D may be a useful resource. It is available here: https://www.fema.gov/media-library-data/20130726-1506-20490-2593/fema259_complete_rev.pdf

# 32 80 00 • SITE IRRIGATION

## SECTION INCLUDES

Site Irrigation

## RELATED GUIDELINE SECTIONS

| | |
|---|---|
| 07 45 00 | Gutters and Downspouts |
| 22 00 00 | Plumbing |
| 26 00 00 | Electrical |
| 31 00 00 | Earthwork |
| 32 12 00 | Asphalt Paving |
| 32 30 00 | Site Improvements |
| 32 90 00 | Landscaping |
| 33 00 00 | Site Utilities |

## INVESTIGATION

Site irrigation systems are advisable for large site improvement projects that include extensive areas of lawn and shrub/groundcover planting.  Irrigation systems help ensure the survivability of plantings and help protect the owner's investment in plant materials.  Site analysis and development of the preliminary site design program should include an assessment of the need for a site irrigation system.

Site analysis considerations include rainfall, wind patterns (evaporation), topography and soil characteristics (percolation and precipitation rates).

Plant selection should be made with site irrigation needs in mind.  Native or drought-tolerant plant species require less water and would reduce the need for irrigation.

Identify areas on the site where irrigation would be appropriate.

Identify the water source.  Explore alternative sources of water (effluent water, roof drainage and rainwater runoff, capture tanks, etc) and other means of water conservation.  Develop a site water management plan.

Research local regulations governing water use.  Determine permitting requirements.  Some communities impose water bans or other rationing measures that may affect site irrigation during dry spells.

Obtain any signoffs that may be required by local water district board or other authorities having jurisdiction.

Determine static pressure in municipal water service lines at both high and low levels.

Note existing water meter size and the size and type of service line coming into the meter.

Calculate meter capacity and available working pressure.

Determine available electrical power supply.

Investigate local water and sewer rates based on meter readings.

Evaluate maintenance and potential vandalism considerations.

# 32 80 00 • SITE IRRIGATION

## DESIGN

Sprinkler systems (water distributed by sprinkler heads) are preferred for most areas.

Avoid drip/trickle systems (water distributed by permeable tubing, either on surface or below grade) since they require high maintenance and proper filtration to avoid clogging.

Provide separate meters for sprinkler systems.

Utilize non-potable water (roof runoff, “gray” water) whenever possible.

Design to the limit of water pressure and availability according to the most restrictive of the following criteria:

- Velocity of water in the service line should not exceed 5 fps.
- Pressure loss through the meter should not exceed 10% of the minimum static water pressure.
- Maximum gpm flow through the meter should not exceed 75% of the maximum safe flow as specified by the meter manufacturer and the American Water Works Association.

Install a pressure regulator when static pressure is greater than necessary for the sprinkler heads.

Use large radius heads and triangular spacing where possible to maximize efficiency.

Minimize areas of overthrow.

Do not mix different types of sprinkler heads on the same circuit.

Maintain consistent precipitation rates in the same sprinkler zone. Where fixed sprinkler heads are used, place fractional spray heads on different circuits from full circle heads and balance controls to equalize spray coverage. Where rotary heads are used, make sure that nozzles are sized and located appropriately to ensure consistent coverage. Rotary heads with fractional coverage will have a smaller nozzle size and a reduced radius than will full circle heads.

Locate controls in areas accessible only to maintenance staff.

Locate valves where they will be accessible for adjustment and maintenance. Avoid locations that are within spray range of sprinkler heads if possible.

Ball valves are preferred over gate valves for emergency shutoff.

Provide automatic drain valves at all low points in the system.

## 32 80 00 • SITE IRRIGATION

Allow for proper blowout of sprinkler lines at end of watering season.

Install backflow preventors at cross connections between sprinkler and potable water.

Provide rigid pipe sleeves for sprinkler lines under paved surfaces.

### MATERIALS

Use PVC pipe for subsurface distribution lines, class and size to be determined by design pressure ratings.

Polyethylene (PE) pipe may be used for lateral lines.

Use Type K copper pipe where sprinkler lines are exposed to sunlight.

# 32 90 00 • LANDSCAPING

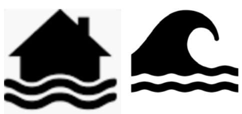
### SECTION INCLUDES

Soils
Sod, Seed and Mulches
Plant Materials

### RELATED GUIDELINE SECTIONS

| | |
|---|---|
| 03 30 00 | Concrete |
| 31 00 00 | Earthwork |
| 32 12 00 | Asphalt Paving |
| 32 30 00 | Site Improvements |
| 32 80 00 | Site Irrigation |

### CLIMATE RESILIENCE DESIGN CONSIDERATIONS



When planning landscaping, consider the potential flood mitigation and cost savings opportunities that Low Impact Development (LID), or green infrastructure, may present. LID techniques, such as implementation of bioswales or rain gardens (for stormwater management) also have co-benefits including area beautification and localized temperature moderation.

## SOILS

### INVESTIGATION

Conduct testing to determine acidity (pH) level, permeability and moisture content of existing soil.  Minimum of 1 test per 4,000 SF.

Determine depth of topsoil and whether it can be stockpiled and reused.

Assess suitability of soil for healthy plant growth.

Determine any soil amendments that may be required.

Investigate any local regulations relating to soil removal and disposal.

### REFERENCE STANDARDS

*Standard Specifications for Highways and Bridges,* Mass. Department of Public Works, latest edition
AASHTO, various material designations for soils
ASTM D-1556 or D-1557 for compaction

### DESIGN

Coordinate the application of soil amendments with the nutritional requirements of proposed plantings.

### MATERIALS

Reuse existing loam where possible. Screen to eliminate stones, roots, weeds, clay lumps and other debris. Provide unit prices for stockpiling and reusing existing loam and spreading additional material if necessary.

Topsoil should not contain less than 4% or more than 10% organic matter.

Topsoil borrow should conform as closely as possible to the characteristics of the on site topsoil.

In extremely acid soils (pH levels below 4.5) add lime in sufficient quantity to raise the pH level to the neutral range (between 6.0 and 7.5 in mineral soils, 5.5 and 6.0 in peats). Where low acid soils occur (pH above 8.5, rarely in the northeast), add iron sulfate or aluminum sulfate.

Add sandy loam to heavy, organic soils to improve drainage. Add humus or sphagnum peat moss to sandy or excessively drained soils to improve water retention. Humus also improves drainage in clay soils and aids root growth.

Use varying proportions of Nitrogen, Phosphoric Acid and Potash as fertilizer to suit the needs of the plant materials proposed. Modify nitrogen levels according to the amount of stem and foliage growth desired.

Comply with local regulations regarding the application of nitrogen (e.g. Cape Cod is a nitrogen sensitive area)

### EXECUTION

Loosen subgrade to 4 in min prior to placement of topsoil (6 in in planting beds). Rototill subgrade that has been compacted where pavements and other structures have been removed.

Place topsoil at a minimum depth of 6 in and add soil amendments just prior to installation of plant materials. For shrub planting beds, increase depth to a minimum of 18 in.

Compact topsoil to 83% to 88% of dry maximum density.

Add soil amendments within one week of planting.

Comply with local regulations regarding soil removal and disposal.

## SEED, SOD AND MULCHES

### REFERENCE STANDARDS

ISTA (International Seed Testing Association) International Rules for Seed Testing

# 32 90 00 • LANDSCAPING

## DESIGN

Apply seed to all designated lawn areas and portions of existing lawn that have been disturbed by construction operations. Apply only during specified seasonal germination periods (see Installation).

Apply hydroseed to lawn areas where site conditions, excessive slopes or seasonal limitations prevent normal germination of grass seed.

Apply sod only to selected lawn areas that require immediate grass coverage or when seasonal conditions do not allow proper germination of seed.

Apply 2 to 4 inches of mulch to groundcover and shrub beds to control weed growth and retain moisture. Mulch may also be applied at the bases of tree trunks where grass will not germinate.

Use at least three varieties of grass seed in all lawn applications to avoid monocultures.

Anchor mats may be needed for steep slopes.

## MATERIALS

- Seed:
  - Newly seeded lawns: mix of Kentucky Bluegrass, Red Fescue and Perennial Ryegrass. Supplement with creeping red fescue in shaded areas.
  - Restored lawns: mix of Kentucky Bluegrass, Tall Fescue and Perennial Ryegrass
- Hydroseed:
  - Dyed, pulverized wood cellulose fiber mulch mixed in water slurry with seed blend and fertilizer
- Sod:
  - blends of Kentucky Bluegrass, Fine Fescue and Perennial Ryegrass not less than 2 years old
  - uniform pad sizes machine cut to 3/4in thick
- Mulch:
  - Treated, aged tree bark of natural color, containing no shredded pieces larger than 4in.

## INSTALLATION

Seed new lawns in early spring or mid September for best germination and growth.

Sow seed into loosened topsoil using a seed slicing machine at a coverage of 6lbs seed per 1,000SF. Reseed bare spots in existing lawn areas with a seed spreader according to seed supplier's recommended settings.

Protect newly seeded slopes from erosion. Use geotex fabric anchor mat such as burlap on slopes greater than 8% and plant groundcover or low spreading shrubs where grass cannot germinate.

Water newly seeded areas with 3 to 4 light applications per day until germination occurs. Water should total ½" per day. Best times for watering are in the morning and early afternoon.

Lay sod within 24 hours from time of stripping.

Do not mow newly seeded, hydroseeded or sodded areas until grass reaches a height of 3 in. Maintain a 1½ to 2in grass height during turf establishment period (60 days).

## PLANT MATERIALS

### INVESTIGATION

Conduct Site Analysis to determine appropriate locations and growing environments for tree, shrub and groundcover plantings. Analysis should include the effects of solar exposure, soil types, landforms, drainage, existing vegetation, utilities and hardscape/structural elements present on the site.

Analyze existing and proposed uses of the site, including pedestrian and vehicular circulation, location of building entries, views, noise, service access, security, lighting, recreational activities and resident populations served.

Review local planning ordinances and guidelines that relate to landscaping requirements for new construction.

Determine if any pruning of existing trees is necessary. Comply with any local tree preservation regulations.

### REFERENCE STANDARDS

ANSI Z60.1 American Nurserymen and Landscape Association's Standard for Nursery Stock

### DESIGN

Including Low Impact Development (LID)/green infrastructure in landscape planning can reduce vulnerability to climate change by managing stormwater and contributing to localized temperature benefits. Green infrastructure can also provide aesthetic benefits and be a source of pride for neighborhoods, playing a role in both community and climate resiliency. These landscaping measures can often be simple in nature and design. For example, trench bioswales can be designed and built to retain runoff from roof downspouts or roadways. Consider using this NOAA tool to assess the costs and benefits of including green infrastructure. Green infrastructure may have economic benefits to the local community, and, in some cases, is a more cost-effective option than replacing hard infrastructure. For more information on potential cost savings, this report from the American Society of Landscape Architects is available.

Where possible retain existing trees. Analyze individual trees for shape fullness and proximity to buildings as well as the presence of damaged, undesireable or dead wood in order to determine the necessity for pruning.

Select plant materials that require as little care and maintenance as possible.

Native plant species are preferred since they are generally more adaptable to local environmental conditions.

Specify a variety of plant materials that are compatible with the conditions found on the site.  Avoid monocultures.

As a general rule, locate deciduous plants on the east, south and west sides of buildings where they can offer shade in the summer but not block sun in the winter.  Locate evergreen plantings on the north side to protect against prevailing winter winds.

Anticipate the size of plantings at maturity when choosing locations and spacings.  Do not locate tree plantings less than 10 feet, and shrub plantings less than 2 feet, from buildings.  Allow more space for larger varieties of trees and shrubs.  Avoid situations where tree branches at maturity will overhang roofs.  Do not plant trees where their root system will intefere with pavements, sewer lines or septic fields.

Maintain a minimal 4ft distance from car bumpers when installing trees adjacent to parking areas.

Avoid installing trees with shallow, spreading root systems adjacent to walkways and roadways where root growth will damage pavement.

Avoid fruit- producing tree varieties.

Coordinate location of new tree plantings with site lighting design.

Height of tree canopy should be at least 6ft above grade.

Locate trees and shrubs where they will not obstruct signs, entrances or windows.  Maintain an unobstructed view of at least 4ft above grade at all vehicular turning and maneuvering points and at pedestrian crossings.

Avoid curbside “tree pit” plantings at sidewalks.  For best growth, keep pavement clear of the drip line of the tree or install plantings in unpaved areas.  Where sidewalk plantings are used allow a clear area of at least 6ft around the base of the tree or provide a 6ft wide tree belt between sidewalk and curb where possible.

Avoid steel or aluminum edging around planting beds because of problems encountered in mowing and maintenance.

Pay attention to adjacency of below grade foundations or structures that may affect plant root development, or that may be subject to damage from root growth.

Where possible, route underground and overhead utility lines away from existing trees. Do not plant new trees and shrubs where they will interfere with existing and/or new utility lines.

### MATERIALS

Use only nursery-grown plant stock selected and tagged by the project's designer/landscape architect. Tagging should be limited to one tagging visit by the Designer to a nursery designated by the Contractor. Any changes by the Contractor in the selection of tagged plant materials must be approved by the Designer, and any associated cost absorbed by the Contractor.

All trees and shrubs must be balled and burlapped, and delivered to the site undamaged with the root ball intact. Groundcovers must be container grown stock. Root bound container stock is not acceptable.

Only trees greater than 3½in caliper should be specified.
Native species of plant materials are preferred.

Install only male or sterile varieties of certain tree species such as Honey Locust and Ginkgo. Fruit and seed pods from female varieties of these trees cause litter problems.

Avoid specifying invasive plant species, such as:

Norway Maple *(Acer platanoides)*
Bradford Pear *(Pyrus calleryana "Bradford")*
Tree of Heaven *(Ailanthus altissima)*
Siberian Elm *(Ulmus pumila)*
Burning Bush *(Euonymous alata)*
Japanese Barberry *(Berberis thunbergii)*
Japanese Spiraea *(Spiraea japonica)*
Bamboo *(Phyllostachys spp.)*

## EXECUTION

### EXISTING PLANTINGS

Survey existing trees for overhanging branches, dead branches, or signs of physical decline that may require pruning or removal. For roof and siding replacement projects, prune back all branches within 6 feet of the work surface.

Survey foundation plantings and carefully cut back or remove plant materials that are overgrown or interfere with access to the work area.

Identify personal landscaped areas that are maintained by tenants, and coordinate work operations with the LHA that may require protection or removal.

Existing trees should be pruned, if necessary, before construction only by an arborist certified by the International Society of Arboriculture (ISA).

Where existing trees are to be removed, they should be removed completely and the stump ground down to 12in below grade. Stump shavings should be removed and properly disposed of offsite.

Protect existing trees and shrubs within the limit of work line that are designated to remain. Install barriers of high visibility plastic mesh fence around the drip line of each individual or cluster of trees and grouping of shrubs. Provide more substantial protection barriers (battens, fencing, etc.) where required by construction operations.

Stockpile construction materials as far as possible from protected trees and shrubs to avoid soil compaction and root damage.

Do not attach signs, wires, pulleys, or any other devices requiring mechanical fasteners to trees. Use temporary posts instead.

Use tarps or other protection over soil when mixing concrete, cleaning brushes, cutting sheetrock or doing similar exterior work.

Avoid cut/fill operations around tree roots.

#### NEW PLANTINGS

The Contractor is responsible for bringing water on site for plantings and lawn even when a local water ban is in effect. Water may be available from LHA, verify with LHA and local water department before committing LHA. Provide water meters where municipal hydrants are used as a water source.

Complete all rough grading operations and verify location of all utility lines and structures prior to installation of plant materials.

Stake location of all trees and shrubs for designer's approval prior to installation.

Plant materials are best installed in the spring (mid-April to mid-June) or fall (mid-August to mid-October). The designer should verify growth requirements of each type of tree and shrub to determine the best time to install and include any seasonal limitations and other restrictions in the specifications.

Do not allow plant materials to dry out between delivery to the site and installation.

Excavate pits, beds and trenches to a point slightly less than the depth of the root ball to allow for settling. Width of excavation should be no less than three times the diameter of the root ball. Fill excavation with water and allow to percolate fully into the soil prior to planting. Place root ball at base of excavation so that base of trunk (after settling) is even with surrounding landscape grade, and loosen the soil around it for drainage. Completely remove any wire baskets, plastic netting or other non-biodegradable root ball containments. Cut and peel back top third of burlap ball covering and prune any unusually long or broken roots prior to backfilling. Backfill excavation with topsoil and water thoroughly when two-thirds full. Repeat watering when backfilling is complete.

Final grade at base of trunk should allow for 3in settlement of soil. Dish top of backfill for installation of bark mulch.

Thin crowns of all plant materials by approx. one third after installation.

Apply antidessicant within 24 hours after installation using power spray to ensure complete coverage over trunk, branches, stems and foliage.

Under normal circumstances, stakes and guy wires are not necessary to support newly planted trees. Where trees over 6 ft in height are subject to abuse or severe conditions, however, stakes and guy wires may be installed at third points around the diameter of the tree. Stakes should not penetrate the root ball, and may be vertical or set at an angle as site conditions permit. Provide rubber hose for guy wires at all contact points with trunk. Flag wires with bright colors for visibility. Tree wrap may also be installed on trunk at the discretion of the Designer.

W

Water all plant materials thoroughly twice during the first 24-hour period after installation, and weekly thereafter during the first growing season. Provide for additional waterings during dry spells. Observe any local regulations and restrictions governing water use.

All tree wrap, stakes and guy wires must be removed one year after installation.

LHAs are encouraged to involve residents in the ongoing maintenance of lawns and plant materials.

#### GUARANTEES

Lawn and planting guarantees can be troublesome if LHA cannot take care of new landscaping. Review capacity of LHA before writing Guarantee section

One year guarantee should include complete replacement (materials and labor) of all plant materials that do not survive the first growing season. The designer shall inspect the installation at the end of this period to determine the nature and quantity of any replacements that may be required.

Substitution of replacement plant materials other than those originally specified may be made only with the approval of the designer. Otherwise, replacements must be of the same species and size as the materials originally specified.

# 32 90 00 • LANDSCAPING

## CLIMATE RESILIENCE RESOURCES

Project teams can learn more about the costs, savings and benefits of green infrastructure through resources such as these. Also included is a green infrastructure maintenance guide that gives residents agency in maintenance while providing for oversight.

- NOAA provides tools to evaluate the benefits and costs of green infrastructure in their Guide to Assessing Green Infrastructure Costs and Benefits for Flood Reduction: https://coast.noaa.gov/data/digitalcoast/pdf/gi-cost-benefit.pdf
- The American Society of Landscape Architects have included easy- to-read guidance on how green infrastructure can reduce infrastructure costs, help mitigate flooding, and improve public health outcomes in their report: Banking on Green: A Look at How Green Infrastructure Can Save Municipalities Money and Provide Economic Benefits Community-wide: https://www.asla.org/uploadedFiles/CMS/Government_Affairs/Federal_Government_Affairs/Banking%20on%20Green%20HighRes.pdf
- Portland, Oregon shares lessons learned about maintaining green infrastructure in their carefully edited, informative, and brief guide: Green Street Stewards Maintenance Guide: https://www.portlandoregon.gov/bes/article/319879

# DESIGN AND CONSTRUCTION GUIDELINES AND STANDARDS

DIVISION 33 • UTILITIES

# 33 00 00 • SITE UTILITIES

### SECTION INCLUDES

Domestic Water
Fire Water Service
Water Well
Sanitary Sewer
Storm Drains
Foundation Drainage

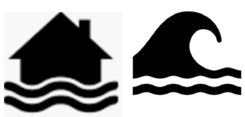
### RELATED GUIDELINE SECTIONS

| | |
|---|---|
| 03 30 00 | Concrete |
| 21 00 00 | Fire Suppression - Sprinklers |
| 22 00 00 | Plumbing |
| 26 00 00 | Electrical |
| 31 00 00 | Earthwork |
| 32 12 00 | Asphalt Paving |
| 32 80 00 | Site Irrigation |
| 33 36 00 | Septic Systems |

### REFERENCES

Standard Specifications for Highways and Bridges, Commonwealth of Massachusetts, Current Edition

### CLIMATE RESILIENCE DESIGN CONSIDERATIONS



Flooding can put low lying site utilities at significant risk, and residents will be impacted if building systems are offline due to flooding or power outages. Protecting site utilities will help protect buildings during flooding and will help speed recovery and building re-occupancy after a flooding event. Consult FEMA P-348: Protecting Building Utilities from Flood Damage when making site utilities updates for further guidance.

## DOMESTIC WATER

### MATERIALS

Check with the local water department for specific requirements and any special conditions.  Generally, water pipe is to be ductile iron manufactured in accordance with the requirements of ANSI/AWWA C 153/A21.153. The pipe shall be special thickness Class 52 with a minimal wall thickness of 0.31 inches for 6-inch, 0.33 inches for 8-inch, 0.35 inches for 10-inch and 0.37 for 12-inch diameter pipe.

Pipes are to have cement mortar lining and seal coating in accordance with ANS A21.11/AWWA C111, latest version and will be push-on joint, provided with enough accessories and of standard 18- or 20-foot lengths.

All fittings are to be ASTM A-536 ductile iron, cement lined mechanical joint and will meet or exceed the requirements of AWWA C-110, with fittings 4 inches to 24 inches, pressure rated at 350 psi.

All accessories (glands, gaskets, T-bolts, and nuts) are to be in accordance with AWWA C-111. All mechanical bolts (T-bolts) are to be Cor-Ten or equal.

Curb stops, corporations, valves and appurtenances are to conform to the requirements of the local water department and be compatible with their stock.

#### DESIGN

Test the town water supply for mineral content and pressure; design the system accordingly. Check with the local water department to see if the town has test data available.

Test new domestic pipelines for strength and for leakage at the pressure specified by the local water authority or NFPA Standard 24 for one hour minimum in accordance with standard testing protocols. At the successful completion of testing, send the results to the local authority and, if necessary, DEP.

The domestic water line is to be chlorinated in accordance with the local authority's requirements.

### FIRE WATER SERVICE

#### DESIGN

Check with local fire AHJ for fire suppression requirements that may exceed code requirements so that they can be considered during design. This inquiry should include a check of any hydrant requirements.

### WELL WATER

#### GUIDELINES

The current Commonwealth of Massachusetts, Department of Environmental Protection, Drinking Water Program, Guidelines for Public Water Systems

### SANITARY SEWER

#### MATERIALS

Sewer (septic) pipe and fittings (gravity) are to be polyvinyl chloride (PVC) conforming to ASTM D 3034 for 4 inch through 15 inch diameter. Fittings are to be rubber ring conforming to ASTM D 3212.

Sewer and septic force main are to be PVC conforming to ASTM D1784 D2241 and commercial standard PS22-70, latest revisions. Pipe is to be class 150 (DR 18) and joints are to be elastomeric ring, bell and spigot type meeting ASTM D3139-77 or latest revision.

Gravity lines for septic leaching trenches are to be PVC schedule 40 NSF.

Pressure distribution lines are to be PVC 160 psi pipe SDR 26, with rubber rings and conform to ASTM F477.

PVC non-pressure pipes are to be furnished in standard lengths.

PVC gravity sewer tees, wyes, and tee wyes to be used for service connections are to be PVC SDR 35 fittings with ring tight joints.

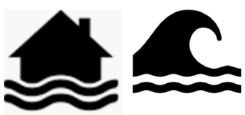
Push-on joints shall consist of

- A single continuous, molded rubber ring gasket;
- A bell socket cast integrally with the pipe or fitting; and
- A pipe or fitting plain end.

Push-on joints are to have the same pressure rating as the pipe or fitting of which they are a part.

Gaskets for push-on joints shall be vulcanized natural or synthetic rubber and be free of porous areas, foreign materials and visible defects.

### DESIGN



When updating sewer lines to a building, consider including backwater valves. Backwater valves are installed where the wastewater pipe exits the building, so sewage only flows outward. Valves have a hinged flapper that remains open to allow outward flow, but seals tightly if there is backpressure. Install individual backwater valves on the lowest fixtures in the building, or whole-building backwater valves for storm sewer and sewer lines. A manhole may be required if the installation cannot be done at an interior basement. For further guidance on backwater valves consult FEMA 259 section 5D.10.

Gravity pipes shall be designed using standard sanitary engineering procedures in order that continuous “positive” flow is always present between all manholes. Flow will be established from the highest point to the lowest point on the sewer line. Maintain minimum design slope of 1/4 inch per foot for pipe 3 inches in diameter or less and 1/8 of an inch per foot for pipe larger than three inches in diameter to meet 248 CMR 10.05.2. Confirm that the minimum scouring velocity of 2.0 feet/ second (fps) will be maintained at all times.

Take soil borings along the pipeline at intervals no greater than 300 feet to confirm bearing capacity of the soils. Provide this information on the plans or in the specifications including depth to groundwater and any ledge, boulders or other physical obstructions noted. In any event it is the Designer’s job to design the project according to the investigative information.

Profile plans should include manhole number, stationing, invert(s) in, invert(s) out, slope and type of pipe material. Layout plans should include any and all topography, structures, other utilities, as well as all previously mentioned information and any other information needed to design and construct the project.

## SEPTIC SYSTEMS

### REFERENCES

# 33 00 00 • SITE UTILITIES

Design septic systems in accordance with both 310 CMR 15.000 Title V and the regulations of the local Board of Health, whichever governs. For further discussion on Septic Systems, go to Design Standards and Guidelines section 33 36 00 Septic Systems.

## STORM DRAINS

### GUIDELINES

Conform to the description, materials and construction methods of the requirements of appropriate sections of the latest edition with current amendments of the Standard Specifications for Highways and Bridges, Department of Public Works, Commonwealth of Massachusetts.

### MATERIALS

Use the following guidelines and refer to the local DPW official's requirements for drainpipe sizes and materials:

- ❑ 12-inch diameter (minimum) reinforced concrete for paved areas (designed to meet the load of traffic)
- ❑ 8-inch diameter schedule 40 PVC for landscaped areas

Acceptable materials for manholes and catch basins include precast concrete and solid concrete block.

All frames, grates and covers should be traffic-bearing H-20 rated cast iron, 24 inch inside diameter as manufactured by E.L. LeBaron Co. or an approved equal. Covers should be labeled "DRAIN”.

Where possible and feasible, install “cascade” style grates, especially on sloped, paved areas. In all other locations, use common engineering practice.

Avoid grates:

- ❑ With long narrow slots that could be a hazard for bicycle and wheelchair wheels
- ❑ That are smaller than 12” because they are easily removed by vandals - creating a hazard.

Trench drains may have either concrete or fiberglass boxes; fiberglass is less expensive.

### DESIGN

The storm drainage system should be designed in accordance with the latest hydrological engineering techniques and incorporate all “Best Management Practices” as outlined by The Massachusetts Department of Environmental Protection, current edition. Storm water design should be calculated using the 25-year design storm with characteristics for the region in which the system will be located. A copy of the calculations, including water shed analysis map(s) will be submitted to DHCD as part of the design review process.

Consult with the local officials as to when and where it may be necessary to submit plans for their review and approval especially where the Conservation Commission and/or Planning Board may have to get involved.

Consult the local Conservation Commission and Department of Public Works for requirements for gas traps for catch basins at roads, driveways, and parking lots.

Avoid locating manholes, catch basins, curb valves, or other obstructions in pedestrian pathways, especially in the middle of curb cuts.

#### EXECUTION

All pipes shall be laid to the lines and grades shown on the drawings or as directed by the engineer.  Verification of lines and grades will be done prior to any further work commencing and any variations noted and addressed.

All pipes to be laid in open trench excavation shall be bedded and uniformly supported over their full length on foundations of the types specified and shown on the drawings.

Flat bottomed trenches shall be excavated and dewatered prior to preparing the specified foundation.

After the trench has been brought to the proper grade, the pipe shall be laid carefully in the trench using ropes, slings and proper equipment to accomplish the task.

Pipes will be laid true to the grades shown on the drawings and the interior and ends thoroughly cleaned of any debris and/or soil. When the engineer has been satisfied, backfilled and compacted in accordance with the contact documents.

### FOUNDATION DRAINAGE

#### MATERIALS

Acceptable pipe materials include perforated schedule 40 PVC and slotted polyethylene tubing.

Provide a soil separator. Use a non-woven geotextile fabric.

#### DESIGN

Pipes should be a minimum of 4 inches in diameter.  Consider 6 inch diameter pipe for areas prone to vermin infestation.

#### EXECUTION

Line trenches with drainage fill and a non-woven geotextile fabric.

Wrap the non-woven geotextile fabric all the way around the gravel, not just around the pipe.

**OTHER UTILITIES**

Describe the Contractor's scope of work with regard to installation and coordination of all utilities, including those of outside parties, i.e., cable, telephone, gas, electric, etc. Coordinate this information for the appropriate trades in the mechanical and electrical sections of the specifications. Clarify whether the Contractor, city, town or other outside party will supply labor and materials.

Utility back charges, permits and connection fees should be paid by the LHA.

## CLIMATE RESILIENCE RESOURCES

Project teams can learn more about backwater valves and sealing septic systems through resources such as these and others:

- FEMA provides info on types of backwater valves and when conditions call for their installation in section 5D.10 of their guide: FEMA P-259 Engineering Principals and Practices For Retrofitting Flood-Prone Residential Structures: https://www.fema.gov/media-library-data/20130726-1506-20490-2593/fema259_complete_rev.pdf
- Enterprise provides access to graphics and the value of backwater valves in chapter 5 of their guide: Ready to Respond Strategies for Multifamily Building Resilience: enterprisecommunity.org/download?fid=2154&nid=4325

# DESIGN AND CONSTRUCTION GUIDELINES AND STANDARDS

DIVISION 33 • UTILITIES

## 33 36 00 • SEPTIC SYSTEMS

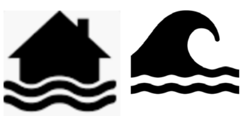
### SECTION INCLUDES

Septic Systems

### RELATED GUIDELINE SECTIONS

| | |
|---|---|
| 03 30 00 | Concrete |
| 22 00 00 | Plumbing |
| 26 00 00 | Electrical |
| 31 00 00 | Earthwork |
| 32 12 00 | Asphalt Paving |
| 32 90 00 | Landscape |
| 33 00 00 | Site Utilities |

### CLIMATE RESILIENCE DESIGN CONSIDERATIONS



When refurbishing or relocating septic tanks it may be appropriate to seal septic tanks to prevent groundwater infiltration if the water table rises. Leach fields may not be appropriate in flood prone areas. In cases where backflow may be possible based on elevations and potential flooding, consider including backwater valves.

### REFERENCE

- 310 CMR 15.000: The State Environmental Code, Title 5: Standard Requirements for The Siting, Construction, Inspection, Upgrade And Expansion Of On-Site Sewage Treatment And Disposal Systems And For The Transport And Disposal of Septage, hereinafter Title V.

### RESEARCH AND INVESTIGATION

Determine if there is municipal sewer connection availability (present or future) and (1) whether replacement of septic system(s) triggers the requirement by the municipality or other governing authority to tie into the municipal system, and if not, (2) whether it is cost effective to tie into the municipal system in lieu of an on-site disposal system.

Confirm in CPS whether the development and building are subject to extreme precipitation and flooding.

Evaluate existing as-built information available from the Housing Authority and the local board of health. Field-verify that the as-built information does in fact represent the actual existing conditions.
An existing condition and a topographic survey is required for all septic disposal system projects, even if as-built drawings exist. Typically, a site has changed over time and the elevations need to be verified for the new design.

The level of survey detail shall meet the MA Title V requirements, local board of health requirements, DHCD requirements, and all other requirements related to the replacement of septic systems such as those for accessibility compliance, storm water management, conservation commission compliance, zoning compliance, and so forth. The survey will serve as the base plan for the system replacement, or repair (as determined by the governing authority).

From information provided by the LHA and from DHCD resources, determine the history of system repairs and replacements, and past life cycle durations.

If a pump station or emergency generator are part of the scope, verify the electrical service at the site (single phase vs. 3 phase) and design accordingly.

**SITE INVESTIGATIONS**

Every proposed disposal area shall be assessed based on the following field test and analysis criteria:

- deep observation hole testing,
- soil profile determination,
- percolation testing,
- landscape and topographic position, and
- hydrogeologic properties.

Investigate soil and percolation conditions and groundwater levels prior to design. This will help to determine the size, capacity, and elevation above seasonal high groundwater of the septic system.

These soil tests must be performed by a Massachusetts DEP Licensed Soil Evaluator in accordance with the latest version of Title V in the presence of an official from the local board of health or a representative of the Massachusetts Department of Environmental Protection (DEP). Percolation tests shall be performed by a MA Registered Professional Engineer, MA Registered Sanitarian, or a MA Soil Evaluator.

The official from the local board of health or representative of DEP shall approve of the quantity and location(s) of test pits for performing these investigations. Additional tests may be required where soil conditions vary, or as determined by the said Approving Authority, or where system design flow exceeds 2,000 gpd.

Tabulate the soil investigation on standard Title V soil evaluation sheets and submit them as part of the site investigation report.

**DESIGN**

Septic systems, whether they be new or upgraded, must be designed according to:

- the current edition of Title V, and
- any local regulations that supersede or replace Title V.

## 33 36 00 • SEPTIC SYSTEMS

Design Systems using the Title V System Sewage Flow Design Criteria, as follows:

**Family (Chapter 200 and 705): .................................. 110 GPD/BR**
**Elderly (Chapter 667): .........................110 GPD/BR for 1 BR units**
**Elderly (Chapter 667): ................................150 GPD for 2BR units**
**Elderly (Chapter 667): ....... 110 GPD/BR for more than 2BR units**
**Special Needs (Chapter 167 and 689): ...................... 110 GPD/BR**
**(DMR Design Guidelines for Special Needs Housing)**
**Office: .......................... 75 GPD/1,000 S.F. (Minimum of 200 GPD)**

DEP no longer requires including the GPD criterion for Clothes Washer at community buildings.

DEP has allowed the use of 2 times the actual water usage when calculating design flows. Using actual numbers, however, this could result in requiring a larger system than the standards listed above.

When replacing sewer lines to a building, consider including backwater valves for buildings that are prone to flooding and back-up conditions. Backwater valves are installed where the wastewater pipe exits the building, so sewage only flows outward. Valves have a hinged flapper that remains open to allow outward flow, but seals tightly if there is backpressure. There are advantages and disadvantages to interior and exterior installations of backwater valves. Consider these and coordinate with the LHA when determining whether the location of backwater valves. Buildings that do not have readily accessible basements should use exterior backwater valve assembly installations in conjunction with downstream clean-outs. Exterior backwater valves shall be the removable and re-insertion type used with a riser sleeve pipe and be located between the exterior cleanout and the building structure. Include the periodic maintenance requirements for backwater valves in the Study/Investigation Report. For interior-located backwater valves, i.e. in basements, the backwater valves should be located in easily-accessible areas for simplified maintenance. If valves are already present, determine whether they are fully functional. For further guidance on backwater valves consult FEMA 259 section 5D.10. Also consider sealing septic tanks in areas where flooding is a concern to prevent contamination per FEMA 259 5W.12.

The Designer shall also do an analysis of the existing water usage in the development to determine if the LHA should consider water conservation measures such as low flow toilets or changes to the laundry equipment. Although the use of the conservation measures may not be considered in the design of the new or upgraded septic system, they may have an impact on the longevity or efficiency of the new system.

Design Calculations and location of the groundwater table should be well documented on the Contract Documents prior to bidding.

**For flows less than 2,000 gallons/day**
The standard, one-and-two family house, DHCD septic system typically consists of a septic tank, distribution box and soil absorption system (SAS leaching area). Design the SAS or leaching area consistent with Title V and any additional local regulations.

**For flows greater than 2,000 gallon/day**
Title V requires a dosing system consisting of those items referenced above and a pump chamber and dual dosing pumps designed in accordance with the current edition of the DEP Dosing System Design Guidelines. The designed system may employ innovative alternative (**I/A**) technology, such as FAST®, BIOCLERE®, drip distribution system, and other DEP Approved **I/A** systems.

**For flows greater than 10,000 gallons/day**
A groundwater discharge permit and review will be required by the DEP Regional Office in which the Housing Authority is located. Most likely the designed system will employ innovative alternative (**I/A**) technology, such as FAST®, BIOCLERE®, and other DEP Approved **I/A** systems.

On large portions of Cape Cod and some other areas in Massachusetts, I/A systems are required to further remove any nitrates from the wastewater flow regardless of the daily flow rate. These areas are deemed Nitrogen Sensitive Zones per the Mass DEP. These will also be designed using current **I/A** design methods and procedures.

## PUMPS AND CONTROLS

### MATERIALS

Design pumps for dosing and I/A systems in accordance with Title V.

The standard pump system should be an effluent pump system. When designing the pump, pick the one that's design flow best fits the pump curve. This could be an effluent, submersible, or grinder pump.

The pump controls and associated electrical connections will be designed by a Massachusetts Registered Mechanical and Electrical Engineer. This also includes any provisions for backup standby power.

It is strongly recommended that controls and panels be placed in either a building with restricted maintenance personnel access only, or a secure, weatherproof exterior cabinet.

## PLAN REVIEW

Submittal to the reviewing and approving agency and all municipal and State boards, agencies, and commissions will be required before final design approval is granted by DHCD. Changes, suggestions, and comments must be incorporated into the final Contract Documents prior to issuance of the approval to bid.

Any conditions issued by these agencies should be incorporated into the bid documents.

### CONSTRUCTION

Title V requires the Designer ***MUST*** be present during certain phases of the septic system construction. The Designer will certify that the system has been built in accordance with the plans and specifications and complies with Title V.

### AS-BUILT DRAWINGS

All specifications shall include a provision that requires the Contractor to provide a set of marked-up Contract Documents documenting the location of all the new system components and the corresponding grades. These mark-ups will then be used by the Designer to prepare a set of certified as-built drawings of the system to be provided to the municipality, the LHA and DHCD upon completion of the system and will show all system components and offsets to those components. The Designer shall upload the certified as-built drawing(s) to Cap Hub.

### CLIMATE RESILIENCE RESOURCES

Project teams can learn more about backwater valves and sealing septic systems through resources such as these and others:

- FEMA provides info on types of backwater valves and when conditions call for their installation in section 5D.10 of their guide: FEMA P-259 Engineering Principals and Practices For Retrofitting Flood-Prone Residential Structures: https://www.fema.gov/media-library-data/20130726-1506-20490-2593/fema259_complete_rev.pdf
- Enterprise Community Partners provides access to graphics and the value of backwater valves in chapter 5 of their guide: Ready to Respond Strategies for Multifamily Building Resilience: enterprisecommunity.org/download?fid=2154&nid=4325