

MOH Design Standards

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Acknowledgments

City of Boston

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01

Introduction & Purpose

The following DESIGN STANDARDS are intended to promote the construction of affordable residential dwellings of high quality, which are cost-effective to build and operate, use reliable materials and systems, and support the activities of renters and buyers. A major goal of these requirements and guidelines is to encourage the creation of multifamily residential dwellings which:

- Result in prudent and economical construction.
- Are sensitive to existing residential building types, existing massing, setbacks, siting, and open space elements of the neighborhood.
- Make intelligent use of the interior and exterior space to enhance the quality of life of residents and neighbors.
- Maximize accessible, welcoming, and safe spaces, with the understanding that people have different needs and abilities that can change over time.
- Encourage sustainability strategies which result in low maintenance costs, energy efficiency, and minimal environmental impact on public infrastructure.

In order to meet the goal described above, it is imperative that project teams design to feasible budgets from the initial stages of design.

02

Design Review Process

Overview

MOH Design pursues design excellence with a focus on improving life for the people of the city of Boston, particularly those with the greatest need. Through the Design Review Process, MOH partners with development teams to:

1. Create affordable, equitable, and sustainable housing for residents and newcomers using design principles that contribute to a high quality of life;
2. Preserve and enhance the urban fabric of the neighborhoods by building and supporting thriving communities; and
3. Ensure that public resources are used to help as many people as possible.

MOH reviews each project's design and pricing progress at key milestones in the architectural process. These checkpoints serve to ensure that a project is meeting MOH's goals and to provide a framework for open communication about project challenges and changes. In order to assist development teams with the Design Review Process, MOH provides Design Review checklists for each review milestone listed below. The checklists are intended to make MOH's expectations at each design phase transparent and straightforward. At each checkpoint, development teams must:

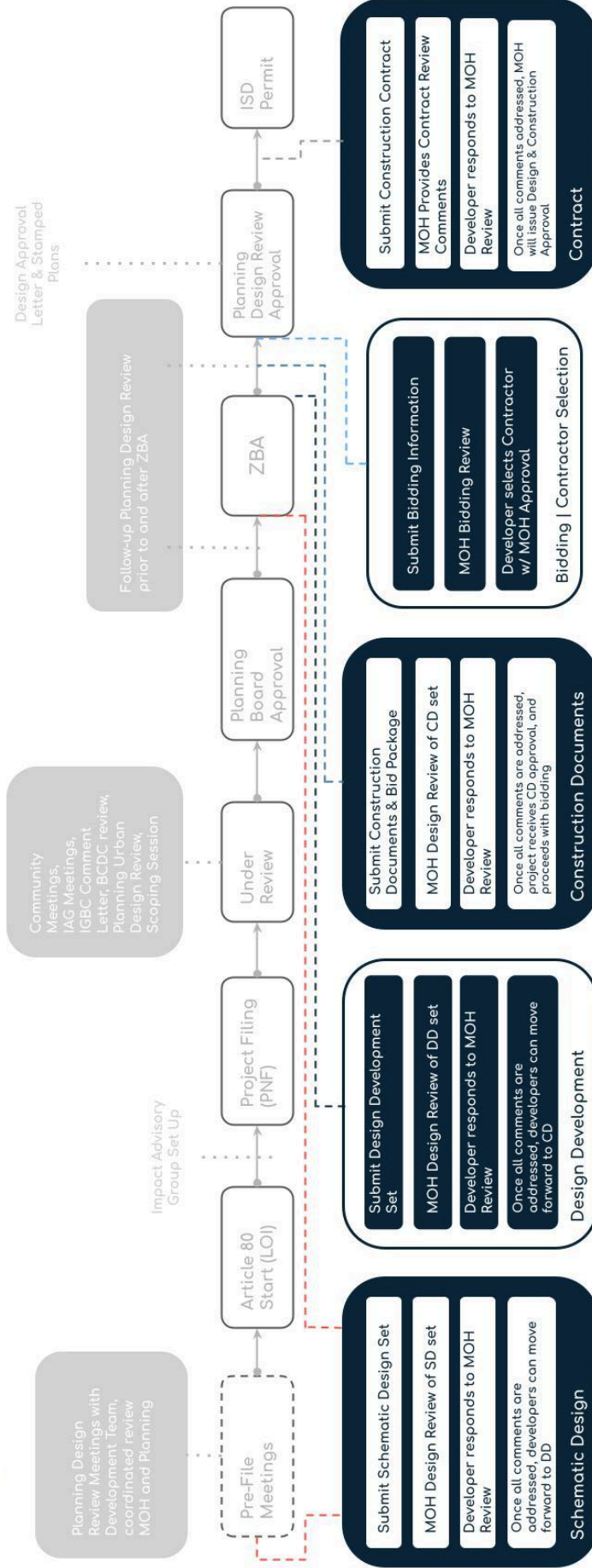
- Review the submission materials listed on the checklist for the phase of development,
- Fill out that checklist,
- Submit it along with the past checklists (for reference)
- Provide all of the submission materials including the current design drawing set and specifications.

Refer to MOH's Design Review checklists for more information. The key milestones with checklists are:

- Funding Application (if applying for funding) & Schematic Design
- Design Development
- Construction Documents & Bid Package
- Bidding & Contractor Selection
- Draft Construction Contract
- Closing

The diagram on the following page illustrates MOH's Design Review Process and how it fits into the permitting and Article 80 processes and should be used in planning the development schedule. A more detailed description of the MOH Design Review Process can be found on the MOH Housing Policies webpage (see Appendix).

During construction, MOH Design and the Planning Department Urban Design staff will review a mock-up for exterior materials and wall construction. Any design changes during construction will also need to be reviewed.



MOH Review Process

Funding Round Design Submission Requirements

At the time of application for funding, the Design Submission is to consist of the following, to be submitted in digital format on a physical device such as a memory stick, as described in the funding RFP:

- Completed Funding Application & Schematic Design checklist
- Drawings with content described in the Funding Application & Schematic Design checklist
- Renderings of the proposed design
- Outline specifications with content described in the Funding Application & Schematic Design checklist
- Preliminary description of the Net Zero Emissions and Energy strategy
- Capital Needs Assessment if the project involves any existing structures

The design submission is to focus on the best description of the physical design of the proposed project. The set is to illustrate the site planning for the development and the building(s)' proposed relationship to contextual features and existing buildings. Documentation should focus on illustrating the massing, how the building will meet the streetscape and provide an overall context in which to understand the scale of the building(s) and their exterior finishes. The set is also to include the interior spatial layout of each floor, dimensioned unit layouts, and all building elevations. Refer to the Design Review checklists for specifics.

03

Rehabilitation & Preservation

Introduction

Preservation project development teams are to provide a comprehensive rehabilitation strategy, which combines the established 20-year Capital Needs Assessment (C.N.A.) with practical green building and energy performance recommendations. Applicants are to provide a C.N.A. and the replacement reserve analysis which focuses on improving the quality of life of residents, ensuring the long-term stabilization of the building and protecting the health and safety of building occupants. Green building recommendations are to use LEED for Homes, Healthy Homes, and Energy star as a basis and pay particular attention to improving poor indoor air quality, inadequate ventilation and other unhealthy interior conditions for residents. The energy performance assessment is to evaluate where improvements can be made to reduce operating costs by improving the energy and water efficiency of the building(s). Considerable improvements can be obtained by providing workshops to introduce conservation strategies and healthy homes measures to residents. Where unit layout or reconfiguration is proposed, the rehabilitation strategy is to address these modifications.

Capital Needs Assessment

The C.N.A. is to project the potential capital costs over a 20-year period using a quantity inventory of building components (including the age and expected life of these components), data on their current cost, assumed rates of inflation and a schedule of replacement. The C.N.A. must have been conducted by a qualified professional less than 2 years prior to the submission to MOH of an application for funding. Projects with multiple buildings must complete a C.N.A. for each building.

A complete C.N.A. will include a detailed 20-year capital needs worksheet. A report summarizing the existing property conditions with color photos, a description of projected needs as reflected in the C.N.A. and final replacement recommendations are to accompany the worksheet. In addition applicants are to provide the following:

- A chart or (bar) graph to summarize costs in each building system or major work category between years 1-20 as recommended by the C.N.A.
- A narrative summary of the following priority areas as reflected by the immediate replacement recommendations in the C.N.A. This narrative is also to focus on life safety upgrades required by code:
 - Building Stabilization – exterior envelope, structure, egress
 - Mechanical, Electrical, Plumbing & Fire Protection Systems
 - Hazardous Materials & De-leading
 - Ventilation, Indoor Air Quality – bath, kitchen, common area
 - Interior Quality & Finish – including healthy homes

Replacement Reserves

The replacement reserve analysis is to project the funds required for capital improvements over a 20-year period. The analysis should include the prior 3 to 5 years reserves. Each of the following documents is to include a chart or (bar) graph to illustrate the analysis. Also include capital costs with the chart or graph for comparison:

- A replacement reserve projection based on existing reserves.

- A replacement reserve projection based on the reserves proposed in the rehabilitation strategy.

Green Building & Energy Performance

Operating expenses are to specifically include utility costs for gas (if applicable), electricity and water. Maintenance costs are to be included as an operating expense if repairs to fixtures, heating equipment, appliances, lighting, etc. can be quantified. An analysis of existing operating costs should include historical trends 3 to 5 years prior and an energy audit conducted by a qualified energy auditor or home energy rater. More extensive thermal imaging and deconstructive exploration is to be conducted when known deficiencies exist in the building envelope (roof, floors, exterior walls, etc.) Operating savings are to be determined from identifying where “energy” improvements have the greatest cost benefit (life cycle cost compared to payback period.) These operating savings are to be projected over a 20-year period based on the rehabilitation strategy.

Use LEED for Homes, Healthy Homes, and Energy star as a basis for Green building and pay particular attention to improving poor indoor air quality, inadequate ventilation and other unhealthy interior conditions for residents. A complete assessment will include a summary of the “green” and “energy” improvements with a description of expected resident benefits, operating cost reductions including utility savings. Thermal imaging, investigative photos & reports from the energy audit, and detailed spreadsheets analyzing existing operating expenses and proposed operating savings (cost benefits) are to be provided. In addition applicants are to provide the following:

- A 20-year projection of operating cost savings based on the rehabilitation strategy.

Rehabilitation Strategy Summary Chart

Please include a chart or (bar) graph, which combines operational savings, replacement reserves, and capital needs over a 20-year period in a single illustration. Capital needs improvements are to be broken into categories based on the rehabilitation strategy. This graph is to reflect an understanding of the fund allocation within the capital improvements in comparison to the funds/savings allocated to replacement reserves.

Unit Modification / Reconfiguration

Overview

Compliance with MOH’s unit size and room dimensions is not required for Moderate Rehabilitation Preservation projects where the interior layout of residential units remains unchanged and systems upgrades are the focus of the proposed project.

Rehabilitation strategies that minimize the reconfiguration of existing units are highly preferred and encouraged by MOH. However, MOH understands that there are cases where the existing residence serves a program or serves a particular target population and the existing accommodations are no longer adequate for the program. In addition, the characteristics of the building (dimensions, window locations, square footage, interior layout, circulation, etc.) provide specific constraints on the configuration of units. In these cases, the development teams are not required to meet the Target Unit Sizes listed in these Design Standards. However, the development team is encouraged to strive to meet the Target Unit Sizes and room dimensional requirements described in these Design Standards in areas that are being reconfigured where it does not greatly increase the scope of work to do so. The team is to schedule a site visit and meet with MOH design staff to explain the need for reconfiguration and discuss the approach to reconfiguration prior to submission to a funding round. The development team should reference these Design Standards and local code to assess whether proposed interior rooms are adequately sized.

Accessibility and Relocation

Applicants are to clearly explain any need to modify the existing configuration of units for any reason including accessibility and life safety. Applicants are to determine whether the renovation scope of work (when compared to the building value) triggers compliance with accessibility regulations. A unit inventory listing the unit, unit square footage and number of bedrooms is to be provided in order to assess the impact of reconfiguration on the existing unit mix. Applicants are also required to summarize temporary or permanent

displacement caused by the reconfiguration of units (Note URA requirements in the Application Process). Provide the following in addition to the narrative explanation described above:

- A unit inventory is to be provided, organized per building listing each unit's major rooms, their dimensions and square footage.

Adaptive Reuse and Gut Renovation

New construction requirements and guidelines described throughout these Design Standards are to be used where an existing building is being adapted from a nonresidential use to a residential use and when residential units are proposed to be completely gutted.

When residential units are proposed to be completely gutted, the development team must substantiate the need for this approach. The Rehabilitation Strategy narrative is the place to explain how the development team has verified that the Capital Needs and Useful life of systems and building components have reached the point of complete overhaul.

04

New Construction - Sustainability

Introduction

MOH has led the way with sustainability in affordable housing. Since 2008, MOH, working with the Planning Department, Environment Department, energy providers, architects and affordable housing developers, has successfully facilitated a number of activities in pursuit of the City's Green Building Initiatives. We have long recognized that building performance, material durability, operating savings, resident comfort and resident health can be significantly improved when appropriate energy conservation and sustainability measures are integrated into the building design.

In 2020 MOH added Zero Emissions requirements to the Design Standards in order to address climate change and the City of Boston's goals to reduce building carbon emissions to zero by 2050. These requirements work to ensure new affordable housing funded by the City of Boston is prepared to meet emissions goals and reporting requirements upon their completion as buildings between 20,000 and 35,000 square feet or residential buildings with 15 to 35 units are required to report their energy use (and will be subject to emission standards in 2030) through BERDO, the Building Emissions Reduction and Disclosure Ordinance.

MOH requires development teams to provide in the field ZEB educational and training opportunities to Boston based apprenticeship and high school workforce training programs. These partnerships help promote the ZEB principles being used within the project. These trainings should be documented via social media and publically accessible websites.

LEED

All new construction projects must be designed to be LEED "certifiable" at the Silver level at minimum. Actual certification by LEED is not required. Projects are however required to ensure all LEED prerequisites and identified credits are designed into the project and implemented during construction. Projects subject to Article 37 Green Net Zero Carbon Buildings may be required to exceed the Silver "certifiable" level; therefore projects are strongly encouraged to achieve LEED at the Gold level. Projects complying with Enterprise Green Communities must demonstrate equivalence with LEED sustainability measures. Development teams are to note the following:

- Calibrate the need for sustainability and energy consultants with the size and scope of the project. Many LEED prerequisites and credits are achieved by building code or are standard building practice. For example current energy codes may meet or exceed the Energy Performance Prerequisites of LEED. Also note that compliance and certification with the EPA's Energy Star residential programs, commissioning and in-field verification are MOH requirements. Obtain a clear scope from potential consultants and coordinate sustainability and energy consultant services.
- Incorporate available incentives from utilities such as Eversource to offset engineering and energy modeling soft costs.
- Incorporate incentives and rebates through agencies such as the Massachusetts Clean Energy Center (CEC) and MassSave. They must be integrated into the sustainability strategy for the project.
- Incorporate utility rebates and other measures which produce long term operational savings, lower rents for residents and make HOA fees (repair & maintenance reserves) more sustainable for homeowners.
- Incorporate in the field, educational and training with general contractors and subcontractors to coordinate sustainability, energy and building performance. Specific training on new exterior wall assemblies, window and wall installation methods are a priority. The mockup must be used to demonstrate the ability to perform installation methods required for energy code compliance.

Zero Emissions Building (ZEB)

Introduction

From 2020 to 2024, MOH took the lead in efforts to reduce carbon emission in affordable housing by introducing ZEB requirements. They were based on study recommendations contained within the MOH 2020 guidebook for Zero Emission Buildings. The study team developed a prescriptive path to a ZEB without extensive need for consulting and energy modeling. As of January 1, 2024 the City of Boston adopted the 225 CMR 22 & 23 MA Municipal Opt-In Specialized Energy Code. 225 CMR 22 addresses 1 and 2 Family buildings. 225 CMR 23 addresses commercial and multifamily buildings. Energy Code pathways to Zero Emissions buildings are provided for Multifamily buildings under and over 12,000 square feet in size. These energy codes meet or exceed the MOH ZEB requirements developed in 2020. Therefore we have updated this section of the design standards to provide guidance navigating these new codes. We indicate where MOH and COB emission reduction goals prioritize particular code pathways.

All new MOH construction must use electricity and on-site photovoltaics as the sole fuel source. This includes commercial and amenity spaces within a mixed use multifamily project.

Application Of ZEB Requirements

Small Buildings - R-Use buildings under 12,000 sf

Residential buildings in this category have the ability to produce energy to return to the grid. Installation of a PV system is strongly encouraged by MOH. Projects should strive to meet the Zero Energy or HERS 0 pathway found in the Specialized Energy Code or propose an above code HERS pathway. Development teams should prioritize using PV to offset the electrical loads to lower resident utility bills. In particular buildings with 6 or fewer units (including 1 & 2 Family Dwellings) must factor in solar orientation and PV KW capacity very early in the conceptual design.

Projects not subject to Article 80 review between 12,000 and under 20,000 square feet may follow the HERS Zero pathway or propose an above code HERS pathway to meet the Zero Emissions pathway in the Energy code. This pathway does not require PHI or Phius pre-certification and verification for certificate of occupancy. On site Photovoltaic system installation is required.

Large Buildings - R-Use buildings over 12,000 sf or R-Use portions over 12,000 sf in mixed use buildings

A multifamily building over 12,000 SF must comply with the following:

- Meet Passive Certifiable criteria; Modeled results must be produced using WUFI+WUFI Passive or PHPP,
- Lighting and equipment requirements are to be consistent with the PHIUS multifamily calculator (see Appendix) when applicable.
- Must submit verified energy model data and a summary (PHIUS or PHI feedback forms. see appendix) based on the general requirements above and the building assembly elements composing the building's Energy Use Intensity (EUI, the building's annual energy use relative to its gross square footage).

Projects pursuing the passive house method of demonstrating compliance must certify their projects using Passive House Institute U.S. (PHIUS) or Passive House International (PHI).

- Project teams at application and during the design review process must submit energy model data and a summary using PHIUS or PHI feedback forms with the LOI from the PHIUS verifier.
- Project teams pursuing a zero energy or HERS 0 pathway at application and during the design review process must submit modeling data and a summary verifying the project meets the criteria.

Projects are to coordinate with the energy and building code to integrate the following baseline building assembly components and measures into the building design (as applicable.) These elements and measures have the greatest impact on a building's EUI:

- Photovoltaic system capacity (KW) and Roof Area percentage

- Transformer capacity and location
- Lighting, Appliances and Metering
- Window U-value Window to wall ratio & Solar Heat Gain Coefficient
- Air Tightness (ACH50/sf² of gross envelope area)
- Heat recovery ventilation efficiency
- Domestic Hot Water System Efficiency (COP)
- Heating + Cooling System Efficiency (COP & SEER/EER)
- Roof, Wall, Floor and Slab R-Value

On-site Photovoltaics

Projects are to include on-site PV installation. The design must incorporate a clear roof area (typically 75% of the roof) free of any obstructions, chases for conduit runs, structural provisions, space allocation for converters and other equipment, etc. Where buildings can only implement a portion of the required photovoltaics to reach zero emissions, the remaining percentage must be kept clear in order to increase on-site renewables over time.

The size of the Solar PV system must be indicated in kW to produce a ZEB. At minimum, the project must submit a PV Watts report (see appendix) showing the system capacity (monthly and annual Kwh production).

Load Calculation for Transformer Size

Site and program must consider accommodating transformers, switchgear, PV, electric vehicles and other electrical equipment early in design.

The overall electrical load for the building must be determined via a kVA calculation or load letter then consult with Eversource to determine overall on-site capacity and equipment needs.

Once an on-site photovoltaic system has been designed, the hosting electrical capacity in the local area (grid) must be verified with the installer and Eversource.

On-site Electric Vehicle Supply Equipment (EVSE) shall be metered separately but must be accounted for when determining electrical equipment sizing. (Note: Buildings that will be subject to BERDO may choose to deduct Electric Vehicle Charging from overall energy use). In order to reduce electrical loads, Level 2 EVSE can have multiple charging connectors along with flexible load management for each 40 amp circuit. It is permissible to serve up to two or more spaces with one Level 2 EVSE, but each associated connector must be able to reach the individual parking space.

Lighting, Appliances, & Metering

Lighting and equipment requirements are to be consistent with the PHIUS multifamily calculator. All applicable appliances shall be Energy Star rated and meet Watersense Requirements. Individual electric metering shall be provided for units. Switched ceiling-mounted lighting fixtures are required in all interior unit rooms and in building common areas including stairwells.

Window U-value Performance, Window To Wall Ratio, & Solar Heat Gain Coefficient

All windows are to have a National Fenestration Rating Council (NFRC) rating (and be Energy Star rated.) Wood, wood-clad, aluminum, fiberglass and uPVC windows which meet the performance standards are acceptable for new construction.

The following are baseline measures for window wall ratios and window performance. Where window to wall ratios exceed the following percentages, the window u-value may be determined by energy modeling.

- 15 to 20% window to wall ratio requires a window with a u-value of .22 or less
- > 20% window to wall ratio requires a (triple glazed) window with a u-value of 0.18 or less
- All windows must have an Energy Star Air Leakage of <0.3 cfm/ft² @ 75 pascals.

- And a Solar Heat Gain Coefficient (SHGC) of .3 or less

Note: MOH prioritizes the composition of buildings fitting into their context. The building's composition is an important element of the design review process. MOH will work with architects to be certain that the window to wall ratio does not negatively impact the building design.

All windows should be sealed and receive pan flashing including pan flashing at sills, side flashing. Install pan flashing over building paper at sills using an industry approved water management system. For installation using other construction methods refer to the appendix. Caulk all window (and door) units with ethylene copolymer caulk, using backer rod, closed cell polyethylene, and fill window shim spaces with a low-expanding foam sealer as required. The warranty period is to be a minimum of 10 years and be transferable to subsequent owners. For insulating glass, the warranty period should be 5 years after the seal date permanently imprinted on the unit, but not less than 5 years after the date of substantial completion.

Air Tightness (ACH50/sf2 of gross envelope area)

Airtightness plays an essential role in terms of overall building and insulation performance. MA CMR requires all new construction to have air barriers and weather resistant barriers.

- Projects are required to provide third party Quality assurance (QA) and quality control (QC) (at the Project Management level) to ensure an air tightness as determined by the Specialized Energy Code pathway is achieved.
 - baseline air tightness of 0.06 ACH cfm/sf2 of gross envelope area @ 50 pascals

Domestic Hot Water System Efficiency (COP)

Domestic Hot Water systems with a Coefficient of Performance (COP) of 1 or greater are required. Domestic Hot Water systems may be centralized or unique to individual units. Options include:

- Instant-electric resistance hot water heaters
- Heat-pump hot water heaters

At a minimum Domestic Hot Water Systems must meet Energy Star rated performance criteria.

(https://www.energystar.gov/products/water_heaters/residential_water_heaters_key_product_criteria)

Ventilation

Compartmentalized unit ventilation in conjunction with hrv or erv with direct venting to the exterior is preferred. In the unit erv/hrv may be connected to bathroom and kitchen area ventilation (non-combustion appliance required).

- Semi centralized ventilation per floor may be an acceptable alternative.
- Bathroom ventilation must be continuous and allow for variable control for odors unless the system can be shown to operate in a way to accommodate these conditions.
- Ductless range hoods with charcoal filters are to be Energy Star rated.

Energy Recovery Ventilation systems must meet the requirements set forth under the current MA Municipal Specialized Opt-in Stretch Energy Code or as determined by the performance pathway under the Specialized Code.

- baseline under 3 story building 57% + 0.77 watts per CFM
- baseline 4+ story building 80% + 0.77 watts per CFM

Heating & Cooling Systems

As a baseline heating and cooling systems are to meet or exceed Energy Star performance requirements. Ducts should be located entirely within the building thermal envelope. The tested duct leakage rate must meet MA Residential IECC Energy Performance Testing requirements verified by a BPI or HERS Rater. Tested duct

leakage should be less than or equal to 4.0 cfm at 25 Pascals per 100 square feet of conditioned floor area (for each installed system).

- Ducting shall run straight to the exterior, pulled tight without kinks or bends, with insulated duct discharging through a galvanized steel or aluminum wall or roof cap with a back draft damper, insect screen and wind hood.
- Range hoods shall be vented to the outdoors
- Bathroom exhaust systems should operate continuously at low speed and include switching to boost discharge ventilation following occupant use by at least 50%
- All bathroom doors shall be undercut 1/2" to promote required air changes throughout the unit. (as applicable per building code.)
- Exterior wall caps are to be detailed and located to be as inconspicuous as possible.
- Where central AC is not provided, place 20 amp circuits under windows for AC units in the living room and bedrooms. Through-wall AC units are forbidden.
- If baseboard heating is used, piping must be offset below the floor so that wall space can be kept clear of dummy trim for furniture placement. Heating element locations must be coordinated with functional furniture layouts. In bedrooms, there must be space to place beds against walls without baseboard heating.
- Note: Thermostat Controls - Heat pump thermostat control is to be based on manufacturer requirements. Where wired thermostats are used in multi-unit building systems, building level remote control is recommended. Programmable thermostats (in unit control) are to be used per Energy Star requirements.

Roof, Wall, Floor, and Slab R-Value - Thermal Bridge Free Shell & Optimized Insulation

Teams must examine the selected insulation products with low global warming potential (GWP). Many XPS products and high GWP closed-cell spray foam insulations are of concern. Excellent alternatives exist on the market that use low global warming potential blowing agents. One example includes closed cell spray insulation that uses HFOs as a blowing agent (see appendix). Cellulose (recycled newsprint), cotton, wool, low-density open-cell polyurethane foam, and recycled-content glass fiberglass are to be fully explored.

Drawings must contain a whole building and wall section diagrams illustrating a continuous insulation and air/vapor barrier without thermal bridges. Thermal bridging values are to be accounted for via Passive House modeling or section C402.7.3. Linear Thermal Bridges of 225 CMR 23.0

baseline references

- Roof R60 (IECC = R49)
- Walls R36 (R30 - Large Buildings) IECC = R20 +3.8 c.i.
- Slab R21 (IECC)

Embodied Carbon Reduction

Recognizing the global warming impacts from building raw material harvesting, manufacturing, transportation, construction, use, and end-of-life disposal, commonly referred to as embodied carbon, project teams should assess and include strategies to reduce embodied carbon. With building structure and enclosure materials contributing nearly two-thirds of new construction embodied carbon emissions, project teams should consider the following best practices:

- Existing building preservation, building reuse, and building component reuse
- Use of recycled building materials - crushed concrete aggregate, insulating glass aggregate
- Rapid renewable / plentiful materials - sustainably harvested wood, mass timber products
- Products with low global warming potential - refrigerants, insulation

All projects should identify and include low embodied carbon best practices.

Buildings 50,000 SF and larger should prepare a life cycle assessment of building structure and enclosure materials and products, AND demonstrate 10% reduction in embodied carbon compared with a baseline building.

05

Site & Building Planning

Introduction

The following section outlines commonly understood principles for the building planning and site design of residential buildings. These principles are not applicable to every context, however they provide specific guidance intended to shape a development team's proposal early in the development process. It is essential that the Developer, Architect, and Surveyor visit the project site at the beginning of the development process in order to identify any site challenges or encroachments in person.

Neighborhood Relations

Development teams should be aware of the condition of the buildings surrounding the site and strategize how to protect existing structures and communicate with neighbors. Community notifications, seismic testing, and other measures should be considered as applicable.

Provide opportunities to partner with Boston based apprenticeship, high school workforce training programs and engage immediate stakeholders of the project through social media and dedicated project websites. These are effective ways to address equity in the development process.

Concept Design Building Composition

Architects must present a **Parti** or a **Generative Concept Diagram** for the site and building design. This can incorporate principles outlined in these Design Standards.

Neighborhood Context

It is a primary concern that all housing developments fit into and enhance existing neighborhoods. In general, sites available for development in Boston are infill and set within the context of an existing neighborhood which has developed a unique character over time. Architects will be asked to demonstrate that they have analyzed the typology and composition of other buildings in the immediate vicinity of the site. The design concept should respond to the unique characteristics of this neighborhood analysis. Development proposals are to knit together the residential fabric through the project design.

Building Placement & Orientation

New buildings are to align with existing buildings and face primary and secondary streets. Buildings placed at corners are to consider how the building placement and the location of building or open space uses can enliven the street, both during the day and the evening.

Parking & Mechanicals

Parking and mechanical areas are to be placed at the side or rear of the site away from and concealed from the street. Landscape buffers are to be used to maintain separation and privacy between neighboring properties. Parking layouts are to minimize the area of impervious pavement and curb cuts.

Transformers

The location of transformers are subject to the Planning Department and MOH review. Transformers are located away from primary entries and building frontage.

Character & Materials

The building's characteristics and materials are to focus on high quality detailing and material rather than the use of many different materials for the exterior envelope. A single material should compose the majority of the building envelope. Building materials on residential buildings must employ a level of detail that conveys a human scale and residential feel. The character of the building is to be consistent on all sides of the building and offer the same engagement to the pedestrian at the front and the rear where appropriate. Blank, unfenestrated elevations will not be allowed. Materials at the ground floor are to be durable (typically composed of masonry for longevity). Pitched rooflines are to extend eaves 18 inches to 2 feet and keep water away from the building. Whether contemporary or historical in nature, cornices, parapets, and trim detailing must function to terminate the top of the building. All exterior dwelling entrances must have weather-protected entries such as canopies, covered porches, or recessed alcoves.

Foundation Wall Height

Wall heights should mirror the foundation wall height of residential buildings within the neighborhood context. Use 1 to 20 grading to lift the first floor elevation to at least 18" to 24" where accessibility is required. Projects in a Coastal Flood Resilience Overlay District (CFROD) will need to raise their floor levels according to the CFROD guidelines and meet other resiliency requirements. Refer to Article 25A in Boston's Zoning Code for more information on CFRODs.

Site Work

Demolition

If there are any existing buildings on the site, the project will need to submit an Article 85 Demolition Delay application with Boston's Landmarks Commission.

The removal of all hazardous materials such as asbestos-containing materials (ACM's) and lead-based paint must be carried out according to all applicable State and Federal regulations, including but not limited to the Massachusetts Department of Public Health, Massachusetts Department of Environmental Protection, and U.S. Environmental Protection Agency.

The Developer should have a complete understanding of the scope of shoring or other site or building stabilization should it be required.

Soil Remediation – 21 E's

A summary and an accurate estimate of the 21-E soil remediation plan is to be provided including grading plans and soil tests. The demolition and excavation scope is to include strategies which divert usable soils and debris from landfills through recycling or reuse where acceptable.

Foundation

Concrete and soil compaction tests should be performed by a qualified testing lab for all buildings where applicable. Water leakage and/or masonry tests may be required in certain buildings. Provide damp-proofed foundations resting on proper footings on undisturbed or properly compacted soil. Install exterior insulation at foundation wall from the footing to grade level, after damp proofing has dried and prior to backfill.

Basement Slabs

Install basement concrete slab on a 4" bed of 0.5" diameter or greater clean or washed gravel, covered with a minimum 6 mil polyethylene sheeting lapped a minimum of 12" at joints; or alternately a minimum of 4" uniform layer of sand, overlain with a layer or strips of geo-textile drainage matting, covered with polyethylene sheeting lapped a minimum of 12" at joints. Two inch or greater thickness of expanded polystyrene rigid insulation (EPS) or extruded polystyrene insulation (XPS) that complies with ZEB requirements is to be installed under the entire slab to inhibit heat loss and moisture problems.

Control/isolation joints should be provided in basement slabs. A thermal break must be provided between the vertical slab edge and the foundation wall.

Moisture Content

Where flooring is to be installed above concrete or other poured installations (for example to control sound or provide fire protection), the moisture content should meet flooring manufacturers' installation and warranty requirements. Adhesives used in the installation of flooring are subject to failure where concrete moisture content is present. Therefore, high performance concrete admixtures and/or spray moisture barriers free of all volatile organic compounds (VOC's) and mold and bacteria growth inhibitors should be used to ensure a moisture content acceptable for all flooring applications anticipated for the project.

PPT Lumber

Preservative pressure treated wood (PPT) should be used at all locations where framing joins exterior concrete. Where PPT lumber is used, this lumber is to be arsenic free. The use of chromated copper arsenate treated wood (CCA) is prohibited.

Building Envelope

Exterior Wall Assembly

Introduction

A drainage plane between exterior cladding and air/vapor membrane is maintained in all conventional rainscreen construction techniques. The architect must verify that the wall assembly and waterproofing details meet building code and are air and water tight.

Masonry

Masonry rainscreen walls must be designed and constructed in conformance with conventional construction techniques including among other items: 9 gauge corrosion resistant wire ties spaced a minimum of 24" on center vertically and horizontally securely attached to a backup wall (typically wood or metal stud). All penetrations and joints into the air/vapor barriers must be sealed with a membrane or coating. A 2" air space is recommended (1" min.) to be kept clear of mortar droppings. Flashing must be placed at all locations where the air space is interrupted and must be waterproof, durable and protected against corrosion or degradation.

Siding

All exterior siding materials are to be back primed as required. All cladding materials are to be installed according to manufacturer's specifications. 5/4" trim must be used with cementitious siding and panels. The use of vinyl siding is forbidden.

Vents

Vent locations on exterior walls must be limited and eliminated from street-facing elevations where possible. Where vents do occur, their layouts must be organized and coordinated with the exterior design of the building.

Fenestration and Doors

Windows

Windows are to have architecturally appropriate exterior detailing based on casings at head and jamb (on 3 sides) and a protruding sill to push water away from the window opening. Windows must be flanged and set into the wall assembly to provide depth in the facade.

Aluminum windows, wood windows, wood windows clad in aluminum or vinyl, fiberglass windows, and uPVC windows with a low u value (and excellent thermal performance) may be used, based on context and building type.

Consider the direction of window operability and location of opening hardware with safety and convenience in mind, particularly with operable windows that are low to the ground. Ideally, operable windows should not be located close to the ground.

Steel Doors

Provide 18 gauge interior door frame minimum and 16 gauge exterior door frame when set in exterior and interior masonry door sets. Do not use applied decorative molding to exterior doors.

Storm/Screen Combination Exterior Doors

The use of combination storm and screen doors at any exterior entries, front and rear, is required for rental units (Boston Sanitary code), including rental units in one-to-three-family owner-occupied houses. Frames are to be caulked (color to match) according to manufacturer instructions.

Garage Doors

Garage doors must be provided at any garage entrances; open entrances are not permitted.

Rough Carpentry & Roofs

Introduction

Wood product sheathing is to be installed in strict accordance with manufacturers' exposure, spacing, and span ratings and is to be stamped by a recognized agency to show those ratings.

Pitched Roofs

A self-adhered bituthene product should be used on the first 3'-0" of the roof sheathing on all pitched roof applications as well as 3'-0" to both sides of valleys and cheek walls prior to installing the metal drip edge, felt paper and shingles. Roof pitches less than 5 in 12 should be completely covered with the modified bitumen underlayment.

Provide step flashing at intersections of roof and walls with the exception of continuous flashing at metal and rubber membrane roofs. Use metal kick out flashing at the end of roof/wall intersections to direct water away from the wall. The use of exposed anodized aluminum flashing anywhere other than step flashing at dormer and cheek walls is strongly discouraged. Provide continuous roll flashing at shed roofs. Flashing should be factory painted – no mill finish.

Gutters are to be sized per code requirements and made of seamless 0.032 Ga., factory-painted aluminum (not vinyl) securely fastened with straps of the same material and color as the gutters and sealed per manufacturer's recommendations. Do not discharge water from a gutter directly to the ground nor into another gutter nor onto a lower roof below. Size downspouts based on the required roof surface area. Downspouts are to be .027 Ga. minimum aluminum. Downspouts with type 'A' and 'B' elbows should be securely fastened to the sidewall with straps of the same material and color as the downspouts. Downspouts must divert water away from the building by connecting to the stormwater drainage system. Splash blocks, dry wells and other methods to divert water away from entryways or sidewalks may be required by MOH where appropriate.

At minimum, fiberglass/asphalt roof shingles or equivalent, with a minimum 25 year warranty, are to be used.

Flat Roofing

Flat roof applications should receive light colored, fully adhered compounded rubber sheet elastomeric (EPDM) single membrane 0.060" thick sheets installed by the manufacturer's certified installer, and applied per manufacturer's warranted specifications. Large roof areas may consist of mechanically fastened and ballasted EPDM. Roof parapet cap flashing should be .050 Ga. factory-painted aluminum min.

Sealing Materials

All plumbing, electrical and other penetrations of walls and floors should be sealed with polyurethane caulk. All sealants should consist of low or no VOC's.

Open Space

Programming

Open space areas for active and passive outdoor activities such as play space, sitting areas, and areas dedicated for gardening are to be designed into the site planning. These spaces are to be accessible, attractive and inviting to residents, particularly for families and children. Patios, front yards, porches, or balconies are smaller open spaces that assist in creating the community interaction of larger open spaces.

Trees and Landscaping

A landscaping plan must be provided. Fencing, planting beds, trees and shrubs (with species and sizes noted) to be retained and removed, play areas, lighting, seating, and all features adding to the aesthetic quality of the site are to be shown.

The city places great value on maintaining Boston's tree canopy. Refer to Boston's Public Tree Protection Ordinance. No trees on city-owned land or rights of way can be removed without approval from the Tree Warden. For all projects on city-owned land that propose tree removal, a tree survey must be provided that includes tree size, location, and species for all trees 3" or greater in DBH (diameter at breast height, 4.5 feet above the ground). Existing street trees are to be protected and missing trees replaced according to Parks Department and Complete Streets requirements. Typically this is one tree per 25 lineal feet of street frontage and the caliper width is 3" in diameter or greater.

For all projects, whether on city-owned land or not, Development teams are to survey the condition of existing trees on and adjacent to the site and make every effort to design around existing mature trees. New trees are to be provided for every tree removed from the site. These new trees are to provide shaded areas and be spaced appropriately based on the species.

Graded areas must consist of a 6" minimum deep planting bed of clean loam/topsoil. Loam and topsoil is to be clean, screened and raked free of 1" or larger stones, building debris and other non-organic materials. All lawns (including the 6" plant cover) must be maintained by the general contractor to establish planting. Terracing and retaining walls are required where there is evidence of washout and erosion.

Stormwater Management

Areas around the building must be graded away from foundations and compacted to ensure proper surface drainage. Swales and drains may be designed to carry water away from the foundation and abutting properties. Landscape strategies designed to reduce the heat island effect, assist in stormwater management, reduce the overall irrigation water demand such as rain gardens, bioswales, and permeable paving are encouraged. Refer to Boston's Green Infrastructure Department for more information about landscape strategies for stormwater management.

Subsurface drainage systems must comply with BWSC requirements. Perimeter drainage is to be surrounded with washed or clean gravel that is fully wrapped with fabric cloth. Sump pumps, if required, should have mechanically attached covers with full gasket seals.

Retaining Walls

Cast-in-place concrete, concrete interlocking concrete masonry units or fieldstone may be considered. The use of pressure-treated timbers is not allowed.

Fencing and Buffers

Fencing, walls, hedges, lines of trees, or other landscaping can assist with defining the street edge and perimeter of the site. Fencing and buffering material and height should complement similar elements in the neighborhoods.

If any fencing is used at the street edge and other areas visible from the street, multifamily projects are to use decorative metal fencing and gates at these locations. Heavy-duty vinyl-covered chain link fencing or wood stockade fencing should be restricted to property edges that do not face a public street. Chain link fencing should include 2" diameter, black, hot-dipped galvanized posts no more than 10'-0" apart and set in concrete

footings 8" in diameter and at least 30" below finish grade. Provide top and bottom rails according to manufacturer's requirements. Gates are required at accessways and walkways.

Walkways

Walkways should be 4" thick 4,000 psi (air-entrained) w/ broom finish, set on a 6" base of 3/4" crushed stone at all front entrances.

Curb Ramps

Any existing curb ramps adjacent to the project site must be inspected for accessibility compliance and updated if not compliant. Missing curb ramps must also be constructed. Use the city's ADA Curb Ramp Inspection Manual to inspect the existing curb ramps and check for missing curb ramps. Notify the city of the inspection results through the Third Party Ramp Submission form after construction is complete. (see Appendix).

06

Interior Building & Unit Layouts

Introduction

This section sets forth principles for the interior common spaces and layout of units in new construction. They are also applicable, to the extent possible within the existing constraints, to major renovation projects where the common areas or unit layouts are being modified (refer to the Rehabilitation & Preservation section). We have provided interior layout diagrams demonstrating the application of the dimensional and use requirements toward the goal of creating livable, cost effective, quality housing. Furniture plans are required to ensure rooms can be reasonably furnished with clear space to maneuver.

Universal Design

Introduction

Universal design and accessibility requirements have been incorporated in cooperation with Age + Strong and the Disabilities Commission. These requirements are expressly intended to normalize Universal Design principles in all projects funded by MOH over time in order to plan for the long term livability of dwelling units, common areas, and outdoor spaces over the lifetime of residents. (Refer to the Enterprise Aging in Place guidelines and the state's Age and Dementia Friendly Design Considerations for Physical Infrastructure in the Appendix.)

Accessibility

Accessible units provide essential housing to people with a range of disabilities, not solely those who use wheeled mobility. In order to increase the number of accessible dwelling units in the City of Boston, MOH requires a minimum of 10% of units, rounded up, to be fully accessible. This requirement is applicable to new construction rental projects and home ownership projects consisting of 3 or more units. MOH requirements are more stringent than MAAB 521 CMR. These project dwelling units similarly must comply with 521 CMR 9.4 Group 2A Dwelling Units. In Group 2A units with one bathroom, roll-in showers should be installed instead of tubs. In Group 2A units with two bathrooms, one should have a roll-in shower and one should have a tub. Where roll-in showers are installed, floor drains must be installed in the main space of the bathroom and not solely in the roll-in shower. Under cabinet clear spaces do not have to be in place at construction completion unless it is known that the incoming owner or tenant requires that clear space.

Group 1 units are required for any rental or ownership building of three or more units. If the building has an elevator, all units must be at least Group 1. In buildings without elevators, only the ground floor units must be at least Group 1, but all units (not just ground floor units) are required to provide blocking required by Group 1 Bathrooms MAAB for future installation of grab bars and shower seats. If the ground floor is for parking or commercial use, the first floor of residential use counts as the "ground floor".

Accessible units sometimes lack storage when compared with non-accessible units due to efforts to meet the accessibility requirements, so it is important to increase storage in other locations within accessible units. Consider including additional features that will increase the functionality of accessible units, such as lazy susans cabinets, faucet motion sensors, and technology interventions that allow control of unit appliances, window treatments, and switches from a central device.

To facilitate aging-in-place and accommodate life events that may present physical and mental challenges to residents of MOH-funded projects, MOH encourages all projects to exceed the minimum accessibility

requirements outlined in this document. MOH encourages adding features of Group 2A Dwelling Units into all units in consultation with MOH design staff.

The percentage of dwelling units required by 521 CMR 9.7 Sleeping Accommodations for Persons who are Deaf or Hard of Hearing remains unchanged at 2% of the project dwelling units. These “sensory” units should be distinct from the “mobility” units in order to best match residents with units; it is less common to find a resident who needs both types of modifications. However, all units must be capable of being adapted (through future modification of the unit) for those with hearing and visual impairments.

In addition to the accessibility of the dwelling units, accessibility should be incorporated into the entirety of the project design. (Refer to the Article 80 Accessibility Checklist for specific guidance.) All new buildings with three or more units must have accessible entrances and accessible routes to all common areas. If parking is provided, there must be at least one accessible parking space with an accessible path to the main building entrance.

Townhouse-Style Units in Multifamily Dwellings

MAAB 521 CMR has clarified the definition of a townhouse. Multi-level units within multifamily (three or more unit) buildings can be either townhouses, where each unit extends from foundation to roof with a yard or public way on not less than two sides; lofts, where a bedroom is on another level; or “townhouse style” units with multiple levels within a unit without extending from foundation to roof. In each of these types of units within a multifamily building, there must be accessible routes between the different levels inside of each unit at the time of occupancy. The conventional way to provide this access is with an elevator or a lift, and these are typically cost-prohibitive for projects that include affordable housing. MOH does not typically support MAAB variances for new construction and recommends that single-level units be provided instead of multi-level units in multifamily buildings. Refer Boston’s Disabilities Commission’s Townhouses and Accessibility Fact Sheet for more information about multi-level units and accessibility.

Broadband Access

All buildings are required to provide broadband (high-speed data network) access in addition to appropriate technology for telephone, data, and other communications within individual units to residents. Residents should be provided choice in terms of the broadband service provider. In response to the challenges experienced with COVID, MOH sees that providing whole-building broadband/wifi access for seniors, individuals who have lost jobs, and families & students who may need additional bandwidth to work from home or attend school from home is critical building infrastructure. Where the number of units (typically 4-10) require the project to utilize an intercom and closed circuit security camera system to allow unit occupants to observe who is seeking entrance to the building (780 CMR 1010.1.9.12) the project should consider systems that also provide overall building broadband/wifi access to residents within common areas. Projects may also consider providing hotspots within the building. These “hotspots” must be indicated on the floor plans or the specification narrative must describe the system/method being used to satisfy the broadband access requirement.

MOH Target Unit Sizes

The square footage amounts below represent target sizes. Units significantly larger or smaller than these targets will be questioned in terms of livability or excess cost. The goal of indicating target sizes is to provide guidance without imposing fixed minimum and maximum sizes; this should help to simplify the architect’s design process and MOH Design’s review. Units within approximately 100sf of the target sizes in either direction meet MOH’s overall unit size requirements.

Unit square footage is measured from the inside face of the units’ bounding walls and includes usable storage space, stairwells and hallways inside the unit, as well as space occupied by interior walls within the unit. Fifty percent of the area under sloped ceilings with greater than 5’-0” clearance and less than 7’-6” clearance should be included in the unit square footage when considering the following size guidelines:

Studio 500 square feet

One bedroom	600 square feet
Two bedroom	750 square feet
Three bedroom	1,000 square feet
Four bedroom	1,100 square feet

Unit Layout Best Practices

- Circulation spaces are to be designed efficiently. Access to bedrooms and bathrooms is only to be from circulation spaces.
- Living, dining, and kitchen areas should be proportional to the number of bedrooms. For example, 3 bedroom units should have larger common living spaces than 2 bedroom units. In family units, the living and dining areas must be distinct spaces.
- Bedrooms and living/dining areas must have direct access to natural light. Kitchens should also have direct access to natural light where possible, but if necessary can receive indirect natural light.
- Bathrooms and closets/mech. spaces are the best elements to locate farthest from natural light.
- Layout of buildings and units should optimize the use of space, provide spacious, furnishable main living areas, and provide adequate storage. Development teams must provide furniture plans and demonstrate compliance with general principles for efficient layout of furniture commensurate with the probable number of occupants.

Unit Dimensional & Use Requirements

The dimensions and square footage amounts indicated below are required as minimums. Other applications of use and unit layout principles indicated within this section are also requirements.

Bedrooms

Primary Bedroom

- 12' x 10' clear dimension minimum (120 square feet minimum) with no obstructions such as columns, mechanical spaces, closets, and walls within the clear space
- 2 occupants

Secondary Bedrooms

- 10' x 10' clear dimension minimum (100 square feet minimum) with no obstructions such as columns, mechanical spaces, closets, and walls within the clear space
- 2 occupants

Bedroom Closets

- 2' x 4' clear dimension minimum (8 square feet minimum)
- Closet shelving shall allow for a full-bearing, white, vinyl coated steel shelf or similar with an integral clothes rod. Refer to Closet Build-Out under Interior Unit Specifications for more information about closets.

Application of Bedroom Requirements

- Bedrooms may not be located at the street facing corners of multifamily units. Locate bedrooms away from noisy conditions such as driveways and parking areas in 1 to 2 Family dwellings.
- The entry door to a bedroom must be oriented to provide privacy and may not open directly into a living area.
- Switched control of one receptacle in a duplex receptacle box must be provided for connection to an occupant-furnished lamp.

Living Areas

Living Room

- 12' x 12' clear dimension minimum (but also 150 square feet minimum) with no obstructions such as columns, mechanical spaces, closets, and walls within the clear space
- Accommodates a 6 foot couch, 2 easy chairs, coffee table, 2 side tables and a place for a television in a location viewable from the seating without blocking windows.

Dining Room

- 10' x 10' clear dimension minimum (100 square feet minimum) with no obstructions such as columns, mechanical spaces, closets, and walls within the clear space
- Accommodates an 8 person table in a 3 bedroom, 6 person table in 2 bedroom, 4 person table in 1 bedroom.

Entry "Coat" Closets

- 2' deep dimension minimum (6 square feet minimum)
- Configured for coats and storage. (see bedroom closets)

Application of Living Area Requirements

- Locate living and dining areas in the street facing corners of multifamily units.
- In studios, 1 and 2 bedroom units, only the dining room may overlap with the living room as long as functional furniture layouts (and circulation) can be maintained and the following conditions are met. The total living and dining square footage must exceed 200 square feet and maintain a 12' clear width.
- Switched control of one receptacle in a duplex receptacle box must be provided for connection to an occupant-furnished lamp.

Kitchens

Provide 18" (15" minimum cabinet size) to 24" minimum linear counter space on both sides of the range and sink. Avoid dead corner cabinet locations; lazy susans should be located at corner base cabinets to provide accessible storage. Task lighting accessories should be considered post occupancy to address low light conditions.

A dishwasher is required in three and four bedroom units. Double bowl sinks are required where dishwashers are not provided. A 30" minimum range is required in a 1 to 3+ bedroom unit. Garbage disposals and range hoods are required. The cabinet for the sink must be 30" minimum (36" recommended), and a 20 gauge stainless steel sink size (roughly 22" x 30" x 6") with a single handle faucet with spray attachment must be maximized within that cabinet size. A 18 to 20 Cu ft frost-free refrigerator with a separate freezer door is the minimum required. Finish flooring shall continue under refrigerators, stoves, dishwashers, and base cabinets in kitchens. Countertops should be one-piece square-edged, .050" thick minimum high pressure laminate, with 4" integral "post-formed", coved backsplash. Adhesives should be water-based. Stone or solid surface countertops may also be used if cost effective.

Application of Kitchen Requirements

- The type and configuration of kitchens in a development are to be standardized to the greatest extent possible in order to create efficiencies for purchasing cabinetry, appliances, equipment, and finishes.
- Unit circulation can not pass through the kitchen work area (except in some studio layouts). The work area (triangle) within the kitchen may not be obstructed by furniture.

Linen Storage & Pantries

A dedicated linen closet is no longer required. Linen storage is to be provided as cabinetry or organized within shelving in another closet. Linen storage of towels is acceptable within a full bathroom. Residents may be reluctant to store other linens there due to moisture concerns even if the bathroom is well-ventilated, so primary linen storage should be outside of bathrooms.

Pantries are not required. When used, a vertical cabinet instead of a closet is recommended as a more cost effective option.

Bathrooms

No more and no fewer than one full bathroom can be provided in 0, 1, or 2-bedroom units.

One full-bathroom and one half-bathroom are required in 3-bedroom units. If cost effective, a 3-bedroom unit may provide a shower in the half bathroom.

Two full bathrooms are required in 4-bedroom units.

All half and full bathrooms shall receive a vanity cabinet and sink, two 24" towel bars, one robe hook, a shower curtain rod (in a full bath), a toilet paper holder, and a mirror-front medicine cabinet with lighting over the mirror.

Application of Bathroom Requirements

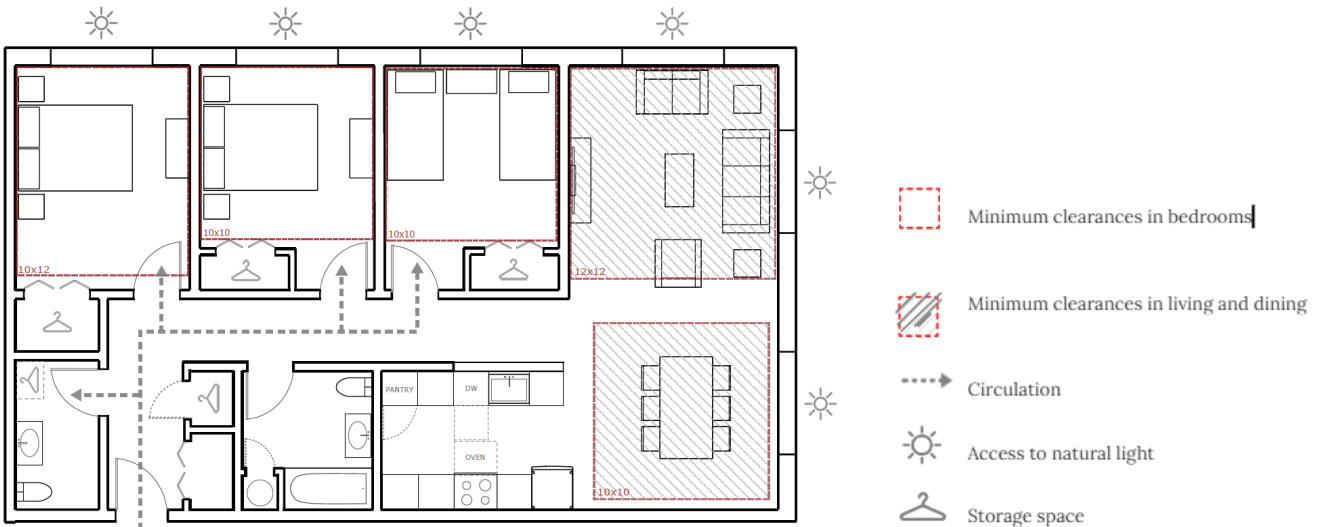
- A shower stall may be substituted for one bathtub where 2 full bathrooms are provided.
- All bathrooms must be entered from a common hallway. Entry to the bathroom (full or half) may also be accessed from the bedroom (en suite) if an entry from a common hallway is also provided.
- All bathrooms must comply with Group 1 MAAB.
- Multi-level units in any kind of building are subject to and must apply these requirements. In a 2 bedroom two level unit, a half bath is to be placed on one level and a full bathroom placed on the other level.

Laundry

Laundry facilities or services should be provided in all buildings. In-unit Washers and Dryers are permitted in Homeownership units and discouraged in rental units. Connections must have stainless steel braided lines to prevent potential overflow and leaking and plumbed drain pans to prevent damage to the unit and other units below. In common laundry rooms, consider providing seating or space for seating to make it easier for residents to use the laundry facilities. Water heating required for laundries should be integrated into the Zero Emissions Strategy for the project.

Unit Layout Considerations Diagram

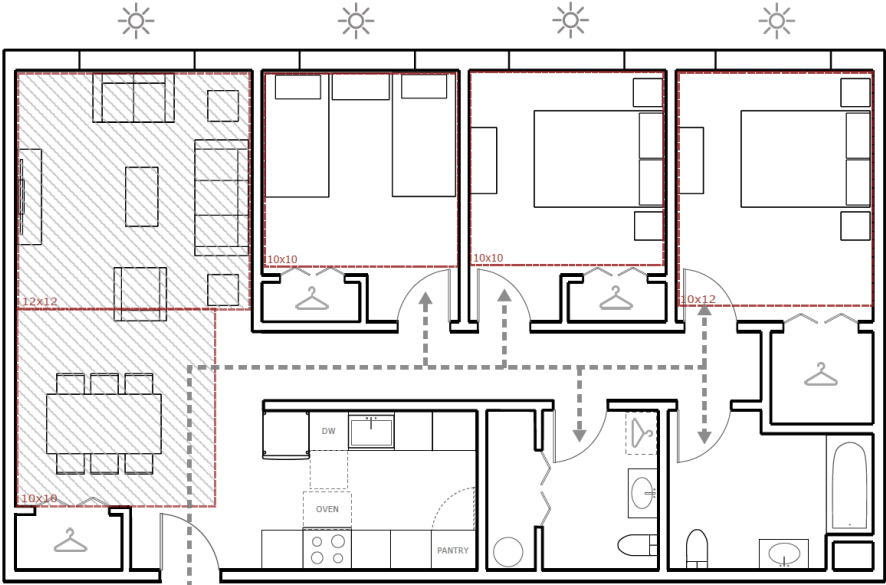
Example Unit (3 Bedroom Corner Unit, 1,160 sf) illustrating typical unit layout considerations



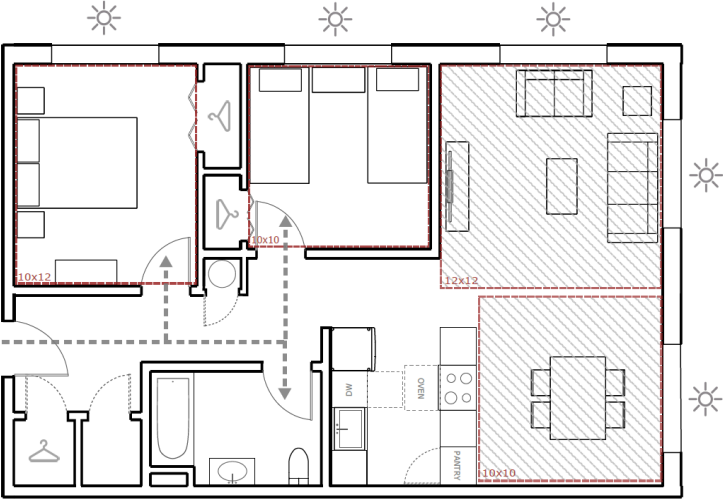
1. **DO** locate bedroom and bathroom doors off of hallways for privacy
DO NOT locate bedroom and bathroom doors off of the living area
2. **DO** provide bedroom closets with minimum dimensions 4' x 2'
3. **DO** provide larger living and dining areas in larger units
4. **DO** locate living and dining areas at the corner in corner units
5. **DO** provide furniture plans showing functional spaces and appropriate clearances
6. **DO** provide a distinct dining area, especially in family units
DO provide larger living and dining areas in larger units
7. **DO** provide access to natural light in living rooms, dining areas, and bedrooms
8. **DO** create a defined area for the kitchen
DO provide a line of sight from the kitchen to natural light where possible
DO NOT require unit circulation to pass through the kitchen work area
9. **DO** provide coat closets near the entry with minimum dimensions 3' x 2'
10. **DO** provide linen storage as a utility cabinet or as shelving built into a closet. A separate linen closet is not required.
DO NOT locate linen storage in full bathrooms due to moisture concerns

Example Unit Layouts

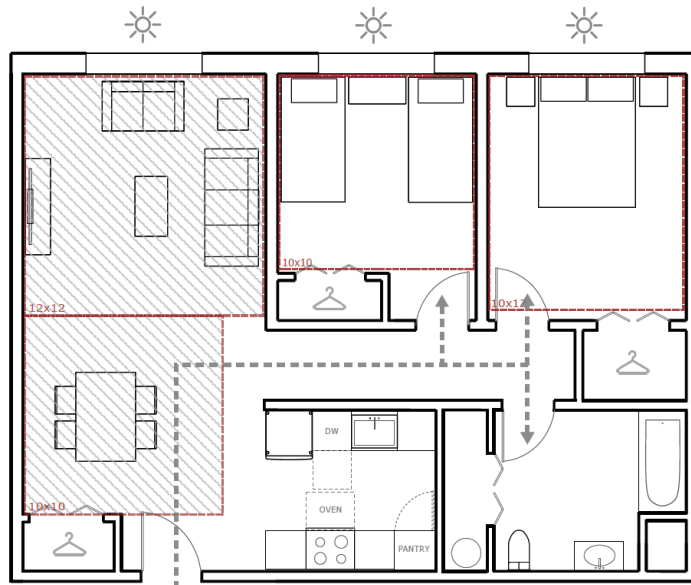
3 Bedroom
Example
Unit, 1,100 sf



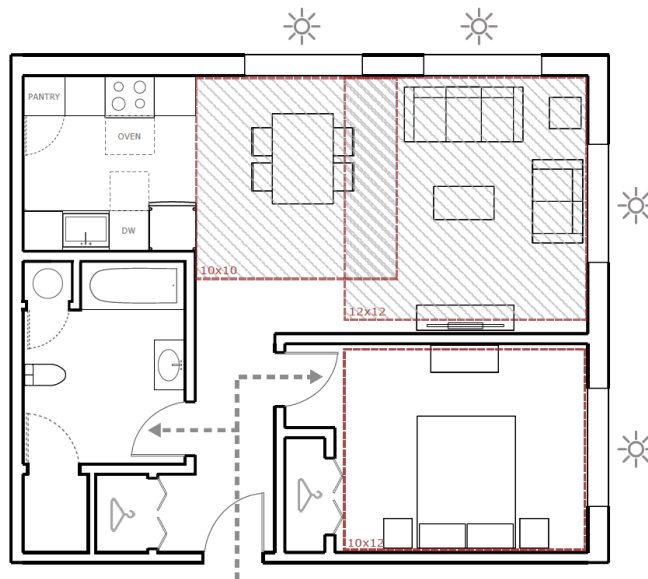
2 Bedroom
Example
Corner Unit,
805 sf



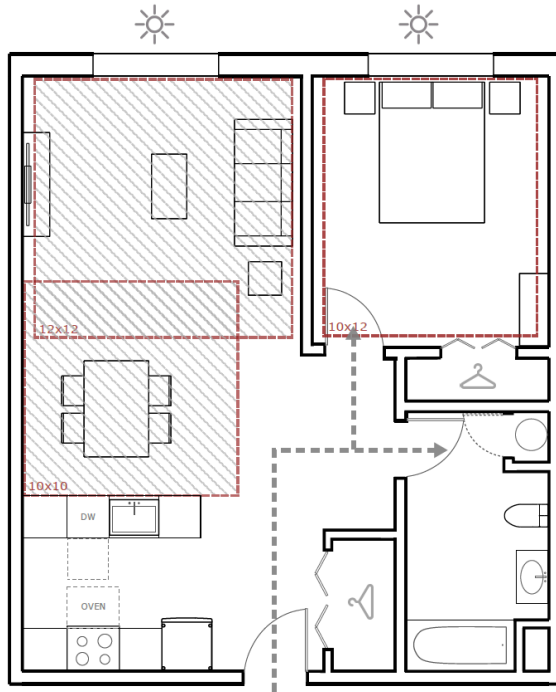
2 Bedroom
Example
Unit, 830 sf



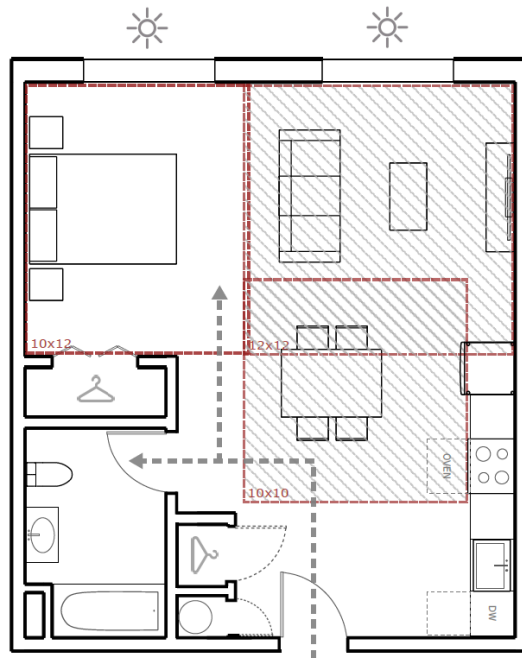
1 Bedroom
Example
Corner Unit,
640 sf



1 Bedroom
Example
Unit, 670 sf





Studio
Example
Unit, 530 sf

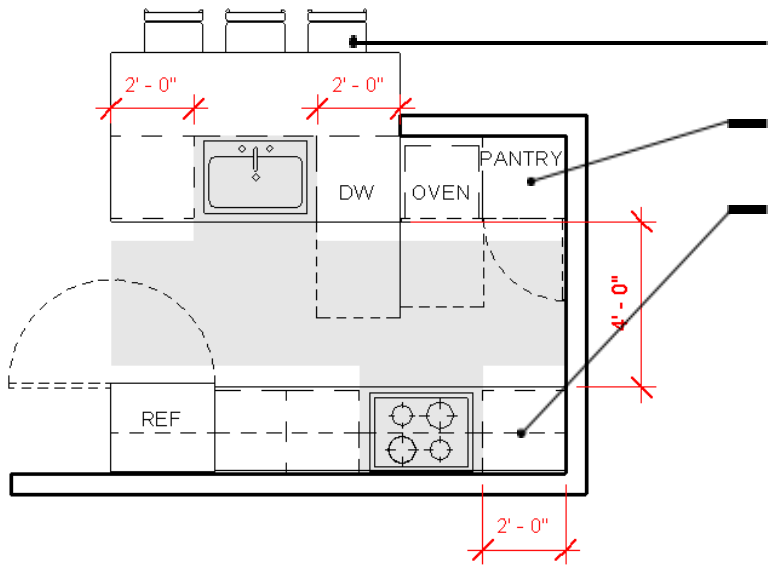


Kitchen Design Consideration Diagrams

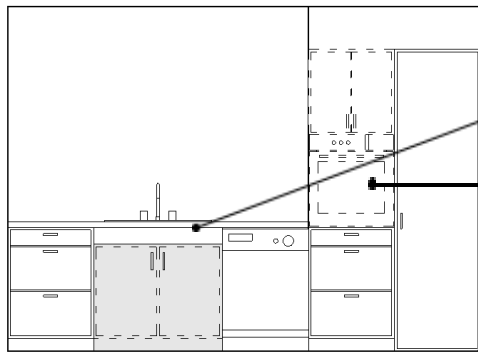
Key

-  Accessible maneuvering space
-  Clearances for appliances

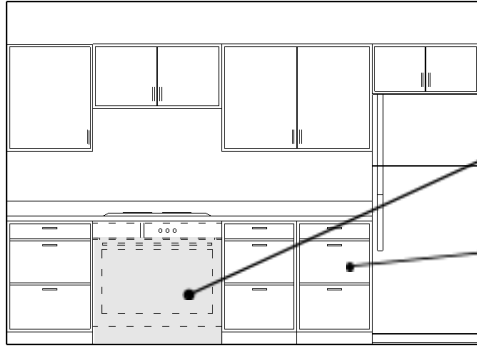
Example Kitchen Layout



- DO** provide counter seating
- DO** provide a tall pantry cabinet
- DO** provide 18" – 24" linear counter space on both sides of the sink and cooktop
- DO** consider where trash and recycling storage will be located, whether inside or outside of a cabinet



- ### Accessibility
- The cabinet below the sink must be removed to ensure maneuvering clearances if required for the occupants.
 - A wall oven must be installed. Note: the location of the wall oven on this elevation is for representational purposes only; its actual height should comply with accessibility requirements.

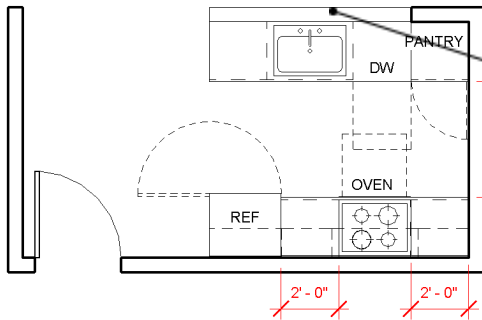


Universal Design

The range must be replaced by a cooktop with clearance below if required for the occupants.

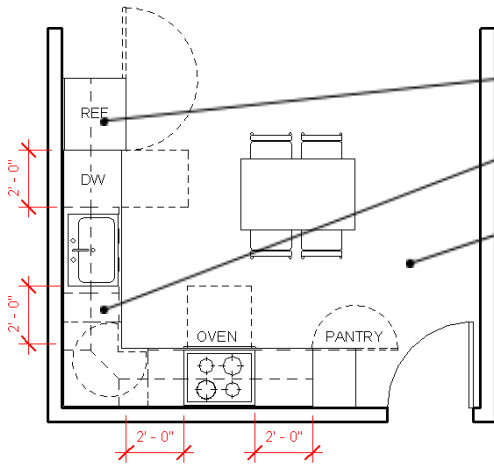
Provide drawers instead of below counter cabinets for more accessible storage.

Note: microwaves, if provided, must be at or below counter height.



Galley Kitchen

DO consider opening the kitchen with a half wall or extending the counter

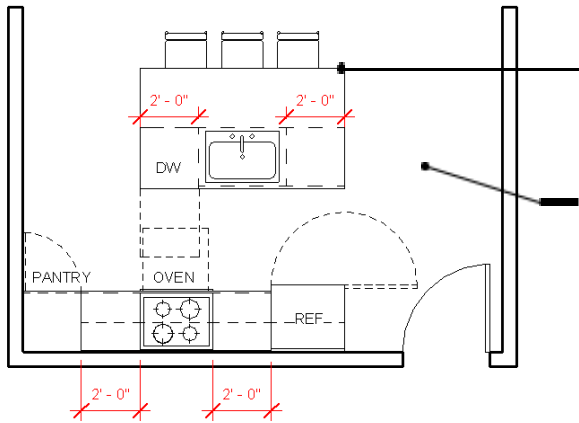


L Shaped Kitchen

DO place the refrigerator away from the corner

DO provide a corner lazy Susan base cabinet for more accessible use of below counter space

DO NOT require unit circulation to pass through the kitchen work area. If the dining table is placed within the "L" area, the primary circulation path must not require passing between the dining table and kitchen.

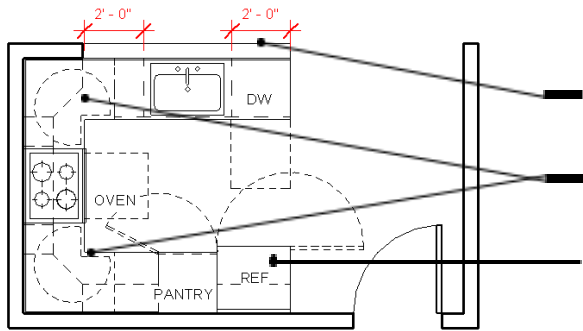


Island Kitchen

DO provide counter height seating at island

DO NOT consider island seating as a replacement for a distinct dining area

DO NOT require unit circulation to pass between the kitchen and island.



U Shaped Kitchen

DO consider opening kitchen with a half wall or extending the counter

DO provide lazy Susan base cabinets in the corners for more accessible use of below counter space

DO place the refrigerator away from the corners

DO NOT block natural light with the refrigerator.

Artist Live Work Considerations

Introduction

Artist Live-Work housing addresses the core functions of contemporary artistic practices, providing artists the opportunity to work, live, convene, and present. These core functions are interrelated and often integrated. They are present in buildings dedicated entirely to artists, and also in buildings where only a portion of the development is dedicated to artist work-live units.

Projects must follow unit layout standards described elsewhere in this document in addition to the specific Artist Live-Work principles outlined here.

Artist Live Work Housing Preference - Tenant Selection & Home Buying Eligibility

In order to prioritize one population over another for tenant selection or eligibility, there needs to be something that serves that particular population. In this way, housing with a preference or requirement for artists is similar to accessible units delivered for residents with mobility disabilities - there has to be a demonstration of a specific design or operational provision to allow for a population to be prioritized in the allocation of units.

MOH Artist Live-Work units must provide appropriate, useful live work and presenting space for artists on-site in-unit and/or elsewhere within the same development. This includes specific design, fit out and operational considerations as set out in the Mayor's Office of Arts and Culture's (MOAC) Artist Housing Guidelines.

Units without space and specific provisions unique to artists on-site in-unit and/or elsewhere within the same development artists cannot be a prioritized group for housing allocations. While MOH will not consider these Artist Live Work Projects, these projects can however use targeted marketing and outreach to ensure that artists are better represented in the general pool of applicants.

Unit Dimensional & Use Requirements

The dimensions and square footage indicated are required as minimums. Other applications of use and unit layout principles indicated within this section are also requirements.

Amenity Space

Arts amenity spaces must be provided, either through enhanced common spaces or distinct arts amenity spaces. The amount of arts amenity space provided should be equivalent to 6% of the square footage of live-work space in the project. Arts amenity spaces are to enable artists to convene, collaborate, create specialized work, and present their work to one another and to the public. These spaces are also to address shared production needs that cannot be accommodated by individual studios and provide specialized space or tools, equipment, etc. which are cost prohibitive for individuals to acquire.

In Unit Workspace

Units are to be sized based on the number of bedrooms and the work space needs. At least 150 sq.ft of workspace must be provided in addition to the living and sleeping areas, for the use of the artist. Artist units are to be distinct from other residential units not intended for artist use.

Unit Layout Best Practices

The considerations below are intended to guide the design of buildings that incorporate artists. They may not be applicable to every building type or artist community but distinct provisions for artists must be included in some combination. Artist Live-Work Housing development teams should reference and follow design and operational guidelines as set out in the Artist Housing Guidelines issued by the Mayor's Office of Arts & Culture. See Appendix for more information .

- A range of bedroom types (and unit sizes) should be provided.
- Studio doorways, and hallways shall be oversized in width to accommodate shipping of large works (at least 8ft wide corridors and 4ft wide entry doors).
- Loading bays shall be located directly adjacent to a direct route to elevators.

- Freight elevators shall be provided to carry oversize/overweight objects; and allow for noise, weekend and late night deliveries.
- Ceiling heights shall allow for the creation of large works and large equipment, including machinery and lighting (at least 9ft).
- Wall and floor construction shall have adequate sound insulation to prevent the transmission of sound from machinery, equipment, or repetitive tasks.
- Floors must be composed of very durable finishes such as concrete floors and/or structured to provide extra weight-bearing capacity.
- Service sinks are to be located close to other wet areas.
- Fire protection systems shall include the ability to address industrial accidents.
- Fire insulation shall be adequate for open flames.
- Special ventilation and air handling techniques shall be tailored to ensure the safety and health of residents, visitors, and neighbors. All workspaces shall be vented to the exterior. Oversized dumpster capacity shall be provided.
- Containers shall be provided for the disposal of toxic/hazardous materials (turpentine, paints, etc.)
- Access to outdoor work areas shall be provided to all tenants.
- Security systems and entry video systems shall reflect the needs of artists who may have on-site sales, employees, and customers.

Single Person Occupancy Types

This section sets forth the minimum Design Requirements for SPO Units. SPO Housing is defined as a residential property that includes single room dwelling units. Each unit is for occupancy by a single eligible individual.

SPO Types 1, 2 and 3 must contain 150 sf of basic living/sleeping area and are to be furnished with a single bed space, dresser, mirror, nightstand, writing desk, 2 chairs, small table and a shelf with space for tv/radio.

SPO Type 4 must contain 240 sf of basic living/sleeping area and is to be furnished with a single bed space, dresser, mirror, nightstand, writing desk, 2 chairs, a dining table, 4 chairs and a shelf with space for tv/radio.

The four (4) SPO types are described below:

SPO Type 1

SPO Type 1 must contain a closet (15sf), small sink, under counter refrigerator, and microwave oven (may be permitted) within the unit.

- Cooking facilities and a private bath are not contained within the unit.
- Congregate cooking, bath (or shared), dining and support facilities such as TV rooms, reading areas, community living rooms, etc. must be located on-site.

SPO Type 2

SPO Type 2 must contain a private bath with shower (40sf), a closet (15sf), small sink, under counter refrigerator, and microwave oven (may be permitted) within the unit.

- Cooking facilities are not contained within the unit.
- Congregate cooking, dining and support facilities such as TV room, reading areas, community living rooms, etc. must be located on-site.

SPO Type 3

SPO Type 3 must contain a private bath with shower (40sf), a closet (15sf) and 35 sf of cooking facilities with a sink, 2 linear feet counter, 2 burner stove and an under-counter refrigerator. The square footage of the cooking area includes a 3' clearance in front of the counter.

- Congregate dining and support facilities such as TV rooms, reading areas, community living rooms, etc. are not required to be located on-site. Some support facilities are, however, recommended.

SPO Type 4

SPO Type 4 must contain a full kitchen and a private bath with shower (40sf) and closet (15sf) within the unit. This SPO type may require on-site and/or off-site special needs services.

- 35 sf of cooking facilities with a sink, 2 linear feet counter, a small 4 burner stove and a 12 cu. ft. upright refrigerator. The square footage of the cooking area includes a 3' clearance in front of the counter.
- Congregate dining and support facilities such as TV rooms, reading areas, community living rooms, etc. are not required to be located on-site. Some support facilities are, however, recommended.

Interior Unit Specifications

Rough Carpentry - Wood Blocking

Prior to insulating and finishing walls, solid 2" nominal blocking should be installed where accessories such as grab bars, towel bars, soap dishes and toilet paper holders are to be located. Insulation materials should be cut to fit around such blocking. Solid blocking should also be installed for future access accommodations such as installation of grab bars, adjustable counters, and hardware in conformance with FFHAA and MAAB.

Finish Carpentry & Millwork

Cabinetry

Cabinetry and millwork elements shall be designed and constructed to provide long lasting durability and contribute to healthy indoor environments. Cabinet faces and frames shall be made of solid wood or high-pressure laminate on 3/4" min composite wood substrate. All cabinetry shall comply with ANSI/KCMA A161.1 cabinetry specifications. Thermofoil is not allowed.

All composite wood materials (MDF or PB) must be EPA TSCA Title VI certified at a minimum with preference for NFA and ULEF certification. All cabinet interiors should be treated with a water resistant substance

- Cabinet drawers should be full-length (minimum of 18") and designed with a durable, full length, side-mounted, double runner suspension system with manual positive stops. A full-length steel system with nylon wheels is preferred. Monorail systems are not recommended.
- Drawer bottoms should have a minimum thickness of: 1/8" tempered hardboard or plywood, or 1/4" inch hardboard. Drawer sides should have a minimum thickness of 7/16".
- Cabinet bottoms should have a minimum thickness of: 1/4" tempered hardboard or plywood, or 3/8" if hardboard. Cabinet sides should have a minimum thickness of 1/2". Toe kicks should be totally enclosed.
- Wall cabinets should have a minimum of two wood nailing strips (top and bottom). Minimum dimensions for nailers should be 3/4" x 1/2".
- Cabinet boxes shall be constructed of material with a minimum thickness of 3/4". Other regulatory bodies such as HUD may have their own standards which will need to be complied with. When in conflict, the more stringent standard shall be applicable.

Closet Build-out

Ownership units must have high quality closet shelving with wood supports all around. Walk in Closets are to have lighting.

Sealants

All sealants should consist of low or no VOC's. Seal all wall, floor, and joint penetrations with rodent-proof materials. All visible pipe penetrations through walls, floors, and cabinets (including interiors) should be sealed and covered with escutcheons.

Interior Door & Window Casing

Window aprons and casings should be painted softwood such as pine. Head and jamb trim should have a minimum dim of 11/16"x2-1/2". All window trim is to be back primed.

Baseboard Trim

One piece softwood such as pine molding, finger-jointed and primed, is preferred for baseboard trim. Wood base should be used within units and is acceptable in all areas. “Speed-Base” or approved equal medium-density fiberboard (MDF) is also acceptable for painted applications. Wood baseboard is preferred in all applications, but vinyl baseboard may be used in common areas and in rental units. Wood baseboard must be used in ownership units.

Doors

Unit Entry Doors

- Steel or Solid Wood Unit Entry Doors are acceptable if they are rated to code and are durable. A peep hole shall be provided.
- Interior unit doors are to be solid core wooden doors.
- Doors opening onto patios or decks should swing in and have flush thresholds for accessibility. Drainage is to be provided at decks to prevent water and snow build-up. Sliding doors accessing the exterior are discouraged at ground floor conditions where they pose a security concern.

Door Hardware

- Lever door handles are to be provided throughout for universal design. Peep holes shall be provided.
- Exterior and Interior unit entry doors should be provided with 2-3/4" backset, lever handle hardware locksets, keyed-alike deadbolts; aluminum and hardwood adjustable thresholds and weather-stripping, as appropriate.
- Bathrooms and Primary bedrooms should be provided with privacy sets. Exterior and interior doors should have a baseboard-mounted stop to prevent damage to wall finishes. Stop finish should match door hardware finish.

Window Safety & Security

Window treatments must be provided in all units, regardless of affordability. All window treatments must be cordless for child safety. All windows should receive properly-sized window shades: fiberglass-coated, vinyl plastic, fire-retardant, fade-resistant roller shades with large diameter cotton cord attached to slat. Mini-blinds are discouraged since the blinds themselves may pose a choking risk, but if used, it must be verified that the selected product is safe for children. Refer to the Boston Public Health Commission’s Curtain and Window Cover Safety to ensure that window treatments are child-safe.

Exterior security bars and grills are not permitted. Where safety is of concern, provide door and window contacts for security alarm systems at ground floors and easily accessed lower floors.

Window guards must be incorporated. Window limiters may not take the place of window guards. In the City of Boston, special concern must be paid to window guards where children age 10 or under will be living or visiting, which may be any unit. Guards should be operable-type interior aluminum or steel bars, clear window opening should be fully protected with no openings greater than 4 inches, tested to withstand 150 pounds pressure; with quick-release mechanism for emergency exiting without use of tools or force. Guardian Angel Window Guards meet the requirements of the “Kids Can’t Fly” standard and are preferred by some fire departments. Guards should be located where the sill height is accessible to children (either from the ground or from furniture placed against the exterior wall) and is more than 10 Ft. above the finish grade at the window. Heavy gauge “safety” screens do not meet guidelines for fall protection as suggested above. Refer to the Boston Public Health Commission’s Window Guards Program and Window Safety Tips for reference and resources.

Finishes

Introduction

All finishes should be durable, easy to maintain, provide a long useful life, and eventually be recyclable. In addition, finishes should not contribute to respiratory ailments due to off-gassing over time. All adhesives should consist of low or no VOC’s. Flooring must extend under any cabinets.

Ceramic Tile

Bathroom floors are to be ceramic tile, non-slip glazed or unglazed, and include a ceramic sanitary base (tile trim piece or cap) at all wall and floor junctures.

Ceramic wall tile is to be installed in a thin-set mortar on a cement backer board of 1/2" thick glass fiber-reinforced cement tile backer substrate installed per manufacturer's recommendations. Tiles should be at least 4 1/4" square. Moisture resistant drywall (MR board or 'green board') is to be used in areas without wall tile. At bathtubs, the tile should extend a minimum of 6'-0" above the finish floor, complete with all necessary trim pieces and caps, including a soap dish without a grip bar. Seal all openings behind tub and shower enclosures to minimize airflow.

Engineered Wood & Hardwood Flooring

Engineered wood/hardwood floors are allowed throughout the dwelling unit except for in bathrooms. It is required in homeownership units and is acceptable in rental units. Materials which place a laminated imitation wood or laminated wood veneer (which is not able to be refinished) over a thin material backup are not allowed.

Linoleum

Within multifamily buildings, linoleum flooring is allowed in common stairs and hallways, the kitchen area, the bathroom, and entry vestibules within dwelling units.

Vinyl Plank & Vinyl Composition Tile (VCT)

High quality vinyl composition planks are allowed in rental units. VCT is only approved for high traffic areas or where VCT is being replaced. Vinyl plank and VCT products should be composed primarily of recycled materials that are easily recycled.

Water based adhesives should be used. VCT adhesives should have VOC content less than or equal to 50 g/L less water. Vinyl composition flooring where provided is recommended to be a minimum 1/8 inch thick in conformance with "high traffic" recommendations of HUD Minimum Property Standards.

Carpet

The use and location of carpeting should be limited sharply due to asthma, respiratory, maintenance, and life cycle concerns. All carpeting and padding should meet the Carpet and Rug Institute (CRI) indoor air quality guidelines and "Green Label Plus Program", refer to the appendix.

Painting

All paint or stains or varnishes should be limited to low (50g/L) or no VOC except as noted below. Paint products should be applied at the rate specified by the manufacturer with the following minimum applications.

- Gypsum Drywall – Ceilings – 1 coat of latex-base primer and 1 coat latex-base interior flat (ceiling white) paint. Kitchens and bathrooms should receive 1 coat primer and 2 coats semi gloss odorless Alkyd enamel. Existing ceilings should receive stain/mold kill primer. Sand finish ceilings should not be applied in kitchens or bathrooms.
- Gypsum Drywall – Walls – 1 coat latex-base primer and 2 coats interior latex-base eggshell paint. Kitchens and bathrooms should receive 1 coat primer and 2 coats semi gloss odorless Alkyd enamel. Existing ceilings should receive stain/mold kill primer.
- Plaster Ceilings – 1 coat latex-base primer and 2 coats latex-based interior flat (ceiling white) paint. Kitchens and bathrooms should receive 1 coat primer and 2 coat semi gloss odorless Alkyd enamel.
- Plaster Walls – 1 coat latex-base primer and 2 coats latex-based eggshell paint.
- Stained Woodwork – 1 coat oil-based interior wood stain and 2 coats satin or semi gloss polyurethane varnish. VOC content less than or equal to 250 g/L. All stains should be low or no VOC.
- Natural Finish Woodwork – 1 coat sanding sealer and 2 coats satin or semi gloss polyurethane varnish. Clear wood finishes should contain VOC content less than or equal to 350 g/L (varnish) and 550 g/L (lacquer). All varnish should be low or no VOC.
- Painted Woodwork – 1 coat interior enamel undercoat and 2 coats interior semi gloss odorless alkyd enamel.
- Ferrous Metal – 1 coat rust-inhibiting (such as by Rust-o-leum or equal) primer, 1 coat interior enamel undercoat and 1 coat interior semi gloss odorless alkyd enamel. Anti Corrosive and anti rust paints applied to interior ferrous metal substrates should contain VOC contents less than or equal to 250 g/L.
- Painted Wood Finish (Exterior) – 1 coat exterior primer and 2 coats semi gloss alkyd enamel. All new exterior trim and siding should be back primed.
- Transparent Wood Finish (Exterior) – 1 coat oil-based sealer and 2 coats spar varnish.
- Zinc Coated Metal – Whenever using galvanized metal, the surfaces should be cleaned with a non-petroleum-based solvent, removing pre-treatment, oil and contaminants from the surface prior to

applying 1 coat galvanized metal primer, 1 coat interior enamel undercoat and 1 coat interior semi-gloss odorless alkyd enamel.

Plumbing

All sanitary lines below floor slabs should be cast iron bell and spigot or equal. PVC is not recommended. Spaces with appliances and equipment that may leak substantial amounts of water such as water heaters and clothes washers should be provided with a floor drain or floor pan and drain. Air cushions should be provided at every set of fixtures to prevent water hammer.

- Bath lavatory and faucet: 'cultured marble' integral bowl with front overflow and backsplash. U.S. Environmental Protection Agency (EPA) WaterSense labeled single lever chrome washerless faucet with aerator, flow restrictor, lift rod, and pop-up drain. 0.5 gpm is recommended.
- Kitchen faucet: Single handle faucet with spray attachment, 1.75 gpm is recommended.
- Toilet: two piece close-coupled siphon jet vitreous china (white), EPA WaterSense labeled, round bowl toilet, 12" rough, solid plastic closed seat and cover, chrome supply and flexible riser. 750 minimum solid gram removal is recommended.
- Bathtub and fittings: white porcelain finish steel with sound-deadening polymer backing, non-slip bottom, chrome plated drain/waste/overflow with strainer. Enameled steel tubs and fiberglass tubs with integral surrounds are discouraged. EPA WaterSense labeled chrome, pressure-balancing, anti-scald bath/shower valve and diverter, spout, and shower head.

Water Supply

- Underground water service: Type K copper $\frac{3}{4}$ " minimum diameter
- Hot and cold water piping: Type L
- Drain, waste, and vent piping: Type DWV.
- Hose bibs should be of the freeze-proof type and lockable for water conservation

Electrical & Fire Protection

Meters and Type "T" gang boxes at exterior walls should be mounted on backer boards such as molding-trimmed MDO fastened to the sheathing.

Fire Sprinkler Systems drawings are to be fully engineered based upon recent hydrant flow tests and bear the stamp of a licensed fire protection engineer. Standpipes and sprinkler piping are best when not exposed below finished ceilings. Use concealed pendent type sprinkler heads and trim plates.

06

Appendix

This section contains other relevant codes and standards which may be associated with a project. Projects must comply with the design and construction requirements of the most recent prevailing Federal, State and local codes and regulations, as applicable without limitation to the following list. Where there is conflict, the more stringent requirement should be applied.

Other MOH Resources & Policies

The following MOH resources, in addition to others, can be found on MOH's Housing Policies webpage (<https://www.boston.gov/departments/housing/policies>):

Bidding

Contract Proviso

Design Review Checklists

Design Review

Section 3

Federal

Federal Fair Housing Amendments Act

Section 504 of the Federal Rehabilitation Act

Uniform Federal Accessibility Standards

Americans With Disabilities Act

U. S. Department of Energy

Federal HUD Section 8 Housing Quality Standards

Federal Environmental Protection Agency Regulations

State

MA State Building Codes

MA Department of Environmental Protection

MA Department of Public Health/ State Sanitary Code

State HOME, HSF, FCF, and LIHTC Programs

Local Municipal

Municipal Zoning Ordinances

Inspectional Service Department among other Departments required for permitting.

Zoning Board of Appeals, Article 80 Project Review and Article 37 U.S. Green Building Council's LEED Certification (Equivalency)

Historic and Parks Commission Reviews and Approvals

Mayor's Office of Arts & Culture

Artist Housing Guidelines: <https://www.boston.gov/arts-and-culture/artist-housing-guidelines>

Curb Ramps:

ADA Curb Ramp Inspection Manual

Third Party Ramp Submission Form:

<https://docs.google.com/forms/d/e/1FAIpQLSddCZRdR9DIebYMxKR2T8iSkHPYJsqhWI5DcMp9uK2YKHjOw/viewform?vc=0&c=0&w=1&flr=0>

Public Tree Protection Ordinance

Disabilities Commission Townhouses and Accessibility Face Sheet

Green Infrastructure

Boston Public Health Commission

Window Guards Program

Window Safety Tips

Curtain and Window Cover Safety

Existing Buildings/Structures

Where projects incorporate existing structures, the following also may apply:

Federal Department of the Interior Standards for Rehabilitation

Federal HUD Cost Effective Energy Standards in Rehabilitation Projects

MA Historic Commission, Local Historical Commissions

Universal Design Resources

Boston's Disabilities Commission

Boston's Age Strong Commission

Enterprise's Aging in Place Guidelines - refer to the Example Unit Layout Diagrams and reference the Enterprise Aging in Place guidelines 2016 <https://www.enterprisecommunity.org/resources/aging-place-design-guidelines-18245>

Institute for Human Centered Design (Refer to Data on Disability in States, Cities and Sub-Groups in New England from the Institute of Human Centered Design for more information.)

Article 80 | ACCESSIBILITY CHECKLIST

<http://www.bostonplans.org/getattachment/2b173503-a553-4880-974f-a25270e8ff34>

MA Senior Housing Aging in Place Guidelines

<https://www.mass.gov/service-details/design-construction-guidelines-standards>

Massachusetts' Age and Dementia Friendly Design Considerations for Physical Infrastructure

<https://www.mass.gov/doc/af-df-design-considerations-for-physical-infrastructure-0/download>

Zero Emissions, Building Enclosure, & Other References

2020 Guidebook for Zero Emission Buildings

https://www.boston.gov/sites/default/files/file/2020/03/200306_DND%20book_FOR%20WEB.pdf

PHIUS and PHI feedback forms - refer to the guidebooks. The feedback forms are generated per project as part of the process

https://www.phius.org/PHIUS+2018/PHIUS+%20Certification%20Guidebook%20v2.0_final.pdf

https://passiv.de/downloads/03_building_certification_guide.pdf

PHIUS multifamily calculator

This is intended to make the inputs equal between all models and is also based on Energy Star requirements.
http://www.phius.org/Tools-Resources/Protocols-Calculators/PHIUS+2015_Multi-Family_Calculator-04_05_16.xlsx

PV Watts Calculator report <https://pvwatts.nrel.gov>.

- For Reference: Average PV panel generates 250 watts. 4 hours of sunlight (for example) during a day. 1 panel will generate a 1000 watts or 1kwh of electricity. Over 30 days in a month, 1 panel would generate 30kwh of electricity. A 4 panel system would be a 1 KW system.

Windows Installation

For installation using other construction methods, such as remodeling, replacement, and recessed openings refer to “ASTM E2112-19c, Standard Practice for Installation of Exterior Windows, Doors and Skylights,” for installation suggestions. Information for ASTM E2112 can be found on the ASTM website, www.astm.org.

Air Source Heat Pumps

Refer to NEEP's guidelines for ASHP. <https://neep.org/ashp>

Duct Air Leakage

Refer to Resnet standards or ASTM E1554 for air leakage.

<https://www.masssave.com/-/media/Files/PDFs/Partners/Duct-Envelope-and-Ventilation-Certificate.pdf?la=en&hash=56A54A118D14FAB2EDA09B4E1F7F13E31E282685>

Closed cell spray insulation that uses HFOs as a blowing agent

<https://www.demilec.com/products/closed-cell-insulation>

Please refer to <http://www.buildingscience.com/resources> and resource within the guidebook for residential wall assemblies.

Thermal Bypass Checklist Guide

https://www.energystar.gov/ia/partners/bldrs_lenders_raters/downloads/TBC_Guide_062507.pdf

Masonry veneer walls

See the Brick Institute of American Technical Note 28 and 28B.

Carpet

“Green Label Plus Program” and conform with with HUD Bulletin, UM 44-D
(http://portal.hud.gov/hudportal/HUD?src=/program_offices/administration/hudclips/bulletins/umbs):

Boston Building Emissions Reduction and Disclosure Ordinance (BERDO)