



CONNECTICUT
HOUSING FINANCE
AUTHORITY

The Key To Affordable Housing

Connecticut Housing Finance Authority

2021 Multifamily
Design, Construction
and Sustainability
Standards - CHFA

These Standards have been
adopted by the Connecticut
Department of Housing (DOH)

These Standards are effective January 2021

TABLE OF CONTENTS

<u>INTRODUCTION</u>	Page 4
<u>DESIGN STANDARDS</u>	Page 5
I. Standards, Regulations and Codes	
II. Project Design Criteria	
III. Crime Prevention Through Environmental Design (CPTED)	
IV. Building Design	
<u>CONSTRUCTION STANDARDS</u>	Page 15
02000 <u>SITWORK</u>	Page 15
02001 Site Design	
02810 Irrigation	
02980 Site Signs	
03000 <u>CONCRETE</u>	Page 19
04000 <u>UNIT MASONRY</u>	Page 21
05000 <u>METALS</u>	Page 23
06000 <u>WOOD AND PLASTICS</u>	Page 23
06100 Rough Carpentry	
06200 Finish Carpentry	
07000 <u>THERMAL & MOISTURE PROTECTION</u>	Page 27
07010 Energy Efficient Building Envelope	
07200 Insulation	
07310 Roofing	
07460 Siding	
08000 <u>WINDOWS, SKYLIGHTS & DOORS</u>	Page 35
08001 Windows and Skylights	
08100 Doors	
08710 Hardware	
09000 <u>FINISHES</u>	Page 39
09250 Gypsum Board and Acoustic Panel Ceilings	
09650 Floor Finishes	
09900 Paints and Coatings	
10000 <u>SPECIALTIES</u>	Page 43
11000 <u>EQUIPMENT</u>	Page 44
12000 <u>FURNISHINGS</u>	Page 46

Multifamily Design, Construction and Sustainability Standards – CHFA
January 2021

13000 [SPECIAL CONSTRUCTION](#)..... **Page 46**

14000 [CONVEYING SYSTEMS](#)..... **Page 47**

15000 [MECHANICAL](#)..... **Page 47**
15050 Plumbing
15470 Water Heaters
15600 Heating, Ventilation, and Air Conditioning (HVAC)

16000 [ELECTRICAL](#)..... **Page 53**

INTRODUCTION

Multifamily Design, Construction and Sustainability Standards – CHFA (the Standards):

These Standards generally define the design process and the specific requirements for multifamily housing developments seeking construction funding administered through the Connecticut Housing Finance Authority (CHFA), and the Connecticut Department of Housing (DOH). These Standards are intended to facilitate the design and construction of housing with as much quality, durability and environmental sustainability as the marketplace, resources and need will permit. It is acknowledged that individual developments may face unique site, design, financing or market constraints, for which full compliance may be difficult or impossible. It is intended that such unique constraints are identified early in the design and underwriting review process, and that the developer or owner may request a modification of specific sections of the Standards. For other Construction Guidelines regarding CHFA Construction Cost, Energy Conservation, Environmental & Hazardous Materials Review, Project Planning & Technical Services Review and Technical Services/Asset Management (TSAM) Capital Improvement Project Review, see the CHFA website.

CSI Format: The Construction Specification Institute (CSI) has developed the standard filing system used by architectural, design, engineering, and construction professionals. The CSI MasterFormat 1995 provides a uniform approach to organizing specification text by establishing a structure consisting of 16 divisions (see table of contents), and each division is divided into articles, subordinate paragraphs, and subparagraphs, with standard, five-digit codes. Project manuals organized under MasterFormat 1995 are preferred, since the Project Cost Summary (Construction Schedule of Values) and Exploded Trade Payment Breakdown exhibits in the CHFA/DOH consolidation application, construction phase payment requisition and post-construction cost certification templates are organized by 16-divisions. Use of the 50-division, six-digit code 2014 MasterFormat filing system in project manuals is acceptable, provided all information is re-organized into 16-divisions for CHFA/DOH application exhibits and forms.

DESIGN STANDARDS

I. Standards, Regulations and Codes

A. Standards:

1. The Standards are not intended to reduce or circumvent the requirements of law and current applicable codes. Some of these Standards are general, and are intended to be guidelines that must be applied to the local situation. Although these Standards apply primarily to new construction, they also apply to the rehabilitation of existing structures as applicable to the proposed scope of work. These Standards may be modified only where the particular characteristics of the site or other local conditions make compliance impractical or undesirable. When such modifications are made, additional requirements may be required. It is highly recommended that if an applicant is unable to comply with any of the items listed in the Standards, the applicant contact CHFA and/or DOH to discuss.
2. The Standards are typically revised annually, and due to the evolving nature of such factors as construction means, methods, materials, technology, codes and laws, and CHFA/DOH multifamily financing program requirements, processes and procedures, they may be revised at any time. All applications must conform to the Standards current at the time they are submitted.

B. Regulations that may apply:

1. Flood Management Certification requirements of the Inland Water Resources Division (IWRD) of the Department of Energy and Environmental Protection (DEEP), if activities will be conducted that impact state natural resources and the environment, including building in sites within floodplain or wetland areas;
2. National Historic Preservation Act (NHPA) requirements, as regulated by the Connecticut State Historic Preservation Office (SHPO) and the National Park Service (NPS), if the project impacts historic resources with alteration or demolition of structures, sites or districts listed, or eligible for designation on the state or national registry, or if the project alters an historic resource or its setting;
3. Section 504 of the Rehabilitation Act of 1973 (Section 504), the Department of Justice 2010 ADA Standards for Accessible Design and the Uniform Federal Accessibility Standards (UFAS) for all federally-assisted newly constructed developments with 5 or more units – 5% (or at least one unit, whichever is greater) accessible for persons with mobility disabilities, and an additional 2% (or at least one unit, whichever is greater) accessible for persons with hearing or visual disabilities;
4. HUD Minimum Property Standards (HUD MPS);
5. HUD MAP Guidelines, including Chapter 9 – Environmental Review and Requirements, if the project is seeking federal funding through DOH;
6. Federal Occupational Safety and Health Agency (OSHA) regulations; and
7. Fair Housing and Equal Opportunity (FHEO) including the barrier-free requirements of the Fair Housing Act (FHAct), Section 504, the Americans with Disabilities Act (ADA), the Architectural Barriers Act (ABA), and the Housing of Older Persons Act (HOPA).
8. In the event of a pandemic, the GC must follow all Federal, State and local regulations and guidance, including guidance from the CDC, for managing and maintaining safe job sites.

C. Codes:

1. Connecticut State Building, Plumbing, Heating, Electrical and Energy Codes – current editions;
2. Connecticut Fire Safety Code (CSFSC) – current edition; and,
3. Connecticut Elevator Code (CSEC) – current edition.

II. Project Design Criteria

A proposal shall demonstrate that location, orientation, and design of vehicular ways, parking areas, pedestrian routes, public outdoor space, buildings, street furnishings, service facilities, and plantings respond appropriately to the following concerns:

A. Traditional Neighborhood Development (“TND”): TND is a comprehensive planning system that includes a variety of housing types and land uses in a defined area. Typical characteristics of TND include:

1. Housing Choice: Dwelling units differ in type and/or size, and serve different market segments/socio-economic categories.
2. Mixed Uses: In addition to residential, a variety of commercial, civic, institutional and personal activities are in close proximity (within ¼ mile). Uses may be mixed horizontally or vertically, and may include:
 - a. Everyday Retail (convenience and grocery stores, pharmacies and banks);
 - b. Discretionary Retail (restaurants, department stores and specialty shops);
 - c. Entertainment (movies, music and performance venues);
 - d. Education (public and private pre-, elementary and secondary schools, continuing/higher education);
 - e. Religious (churches, schools and cemeteries);
 - f. Government Services (post office, town/city hall, fire/police, courts, detention and motor vehicle);
 - g. Other Civic Buildings (transportation stations/terminals, community center, library and museum);
 - h. Offices (small professional/personal services);
 - i. Medical (hospital, clinic, and private offices);
 - j. Public Park or Community Recreation Center (playing courts/fields, walking/hiking trails and public gardens);
 - k. Light Industrial (auto repair, warehouses, and nurseries); and,
 - l. Lodging.
3. Connectivity: Efficiency/directness of travel between any two points within the development, and to destinations outside. Optimally, three separate routes, designed to accommodate a mix of travel modes, including motor vehicles, bicycles and pedestrians, should be provided.
4. Proximity: Neighborhood activity centers accessible by foot and mass transit.
5. Location: Placement of a development should relate to the greater metropolitan or regional context, may reflect smart growth. Types of development sites include brownfield (vacant, industrial site available for redevelopment), greyfield (paved parking area available for redevelopment), infill (balancing, completing, repairing existing urban fabric), and greenfield (site in an undeveloped/natural condition). Brownfield, greyfield and urban/suburban infill developments, which primarily use existing thoroughfares, schools,

transit and other infrastructure, are generally preferable to greenfield developments in farmlands, woodlands, and any areas outside of designated growth areas not served by major transportation corridors.

6. **Streetscape:** Formal streetscape zones include private frontage (the privately-owned layer between building façade and property line), public frontage (publicly-owned layer between property line and the edge of vehicular lanes), and vehicular lanes (the space between curbs/pavement edges).
7. **Civic Space:** Publicly-accessible gathering areas may include plazas (major space enclosed by frontages, with durable pavement for parking and trees, requiring little maintenance), squares (large space enclosed by frontages at the intersection of important streets, with paved walks, lawns, trees and civic structures, requiring substantial maintenance), greens (medium space surrounded by building facades for unstructured recreation, with grassy areas and trees, requiring little maintenance), and tot lots/playgrounds/gardens (small recreational spaces within urban blocks).
8. **Architectural Aesthetics:** Developments should provide/reflect accessible, safe environments (presence and arrangement of doors and windows - permeability vs. blank walls), facade elements which relate to residents and each other through proportion, massing, scale, rhythm and articulation, and patterns of light and shade. Iconography, ornamentation and symbolism should reflect building uses and purposes, and building materials should provide/reflect durability and permanence.
9. **Development Scale:** The design of Lot Scale Developments (smaller than three acres) should consider the possibilities for Housing Choice, Mixed Uses, Proximity, Location, Streetscape and Architectural Aesthetics. In addition to all of the characteristics of TND, the design of Block Scale Developments (more than three acres, but less than fifteen acres) should also consider the possibilities for Connectivity. The design of Neighborhood Scale Developments (fifteen acres or more) should also consider all of the characteristics of TND, including the possibilities for civic space.

B. Layout and Facilities: Buildings shall be planned and located so that the spaces between them become positive elements in the site plan, and not just leftover portions of the site which happen not to be occupied by buildings. Buildings, roads, parking areas, recreational facilities, paths and landscaping of plants and site furnishings shall be related properly to each other, to the sun, to natural features, to topography and to views on and off the site, in a well-designed assembly.

1. **Vehicular Routes and Parking:** Provide vehicular routes for inhabitants, visitors and service needs, and on-site parking for each dwelling. Parking areas shall be located and sized appropriately and shielded by topography or evergreen plantings. Large, open parking lots that dominate the overall site development are not acceptable. Sufficient numbers of deciduous trees in parking areas shall be planted to avoid heat island effect. Snow storage areas shall be provided for snow cleared from the drive, parking areas, and walkways.
2. **Pedestrian Routes and Recreation Areas:** Pedestrian routes and recreation areas shall be separated from vehicular ways to the fullest extent possible so as to provide safety to the inhabitants. Family housing developments shall be designed to provide routes which cross as few vehicular ways as possible and which are appropriate for children leading from dwellings to recreation areas, school bus stops and municipal streets. Sidewalks and pedestrian crossing(s) shall be made accessible to the handicapped, and shall be located so as to enhance neighborhood walk-ability.
3. **Outdoor Seating Areas:** Handicapped accessible outdoor seating areas shall be provided in locations and numbers appropriate for the size of the development which they will serve. Exterior seating and common area seating shall have back and arm rests. Seating shall be planned in family housing developments to relate to children's play areas for use of attending adults, and in elderly housing developments to observe centers of activity on and off the site.

4. **Outdoor Recreation Facilities:** Outdoor recreation facilities shall be provided consistent with the needs and size of each development, and its site characteristics. Tot and/or play lots shall be provided in family developments. All equipment shall be constructed for durability, resistance to vandalism and misuse, and low maintenance. Playgrounds shall be located to avoid hazards and to provide handicapped accessibility, opportunity for parental supervision, and protection of privacy of nearby inhabitants.
5. **Landscaping:** Tree species shall be selected for form, size and rate of growth to provide wind barriers, shading during the summer and sunshine in the winter. Non-invasive, native, drought-resistant plants shall be selected according to conditions of exposure and according to color, texture, and other features that will enhance the aesthetics of the site. Root structures shall be considered for their required space, effects on nearby pavements, and possible interference with subsurface utilities
6. **Community Facilities:** Community facilities are required for clothes washing, social gathering, maintenance storage, management offices or other needs. Community facilities shall include a meeting room, toilet and kitchen facilities and (for elderly projects) recreation space for crafts.
7. **Garbage, Trash and Recycling Facilities:** Provide interior spaces or site-built enclosures for commercially-manufactured recycling containers for recyclable materials such as newspapers, magazines, junk mail, cardboard, glass, plastic, and aluminum, etc., in accordance with municipal recycling program requirements. Dumpsters and large bins shall be used for family housing if regular municipal collection service is not available. Dumpsters and bins shall be placed on concrete pads. Enclosures shall be provided for all collection areas to maintain orderly collection, neat appearance, and sanitary conditions, to deter access by animals and to minimize hazards to playing children. Locations and numbers shall be convenient to the inhabitants served, and accessible to the collecting vehicle, but shall be placed, screened or related to other facilities so as to be unobtrusive. Trash areas must be covered, or dumpsters must have lids, to provide protection from rain, wind and snow.
8. **Mailboxes:** Mailboxes, if provided in centralized, outdoor locations, shall be protected from weather, accessible to the mail carrier, convenient to the inhabitants, handicapped accessible, and located, screened or related to other facilities so as not to be obtrusive.
9. **Exterior Lighting:** Exterior lighting shall be provided for walkways and parking areas, independent of dwelling unit lighting and shall be integrated with features of the site to provide a coordinated, harmonious and uncluttered streetscape.
10. **Utilities:** Utilities shall be centralized wherever practicable to realize economies of efficiency in operation or maintenance. Electrical entrances shall be underground leading from a point where overhead service does not intrude upon the residential scale.

III. Crime Prevention Through Environmental Design (CPTED)

- A. **Commitment to Safe and Secure Design:** CHFA, consistent with its Vision Statement, is committed to providing affordable, safe, and quality housing. CHFA believes that project design can influence the overall security and perception of safety within a project environment. To that end, CHFA endorses the concept of *Crime Prevention Through Environmental Design (CPTED)*, a widely used design practice based on the tenets of ‘defensible space.’ These Construction Guidelines: Crime Prevention Through Environmental Design (CPTED) outline CPTED recommendations for developments funded through CHFA, and are intended to provide guidance for CPTED project planning and CHFA technical review.

- B. Crime Prevention Through Environmental Design (CPTED): CPTED requires an analysis of factors influencing crime and undesirable behavior at a given site. These factors will necessarily vary by site and the applications of CPTED principles should be scaled accordingly. Agencies including law enforcement and local institutions are capable of providing information and guidance regarding a location that can assist the design team in constructing a built environment that influences desirable use, complicates or impedes undesirable use, and decreases opportunities for crime. Thoughtful consideration of available information and resources can result in a design that enhances the residential experience and mitigates the need for subsequent remedial measures.
- C. CPTED Components: At its core, CPTED has four key components – natural surveillance; territoriality; access control; and maintenance. Incorporated into initial project design, either in new or renovation/rehabilitation construction, CPTED seeks a built environment that supports, sustains and encourages desirable activity, discourages criminal and undesirable activity, increases perceptions of safety, and facilitates a sense of ownership and responsibility among residents and legitimate users of the property.
1. Natural Surveillance: This involves the placement of physical features and a built environment that maximizes visibility – the ability to see and be seen. Building orientation, window placement, entry and exit locations, lighting, parking areas, outdoor recreation areas, common use areas such as laundry and community rooms and trash receptacles should afford maximum visual opportunities. The use of plantings or placement or orientation of objects that impede visibility or provide concealment, particularly along walkways or near entrances, exits, trash receptacles and elevators are to be avoided.

Lighting, not inconsistent with applicable CHFA standards, should be of appropriate color and temperature so as to provide an even measure of lighting minimizing glare and shadows and not impeded by obstructions, including plantings.
 2. Territoriality: A built design that clearly cues a transition from public to “owned” space. The use of pavement treatments, signage, fences, objects and landscaping to define the space as cared for by others. Persons entering the property should know that they are no longer on public space and that undesirable activity is likely to be readily observed.
 3. Access Control: The effective use of fences, signage, gates, bollards, planters, and topography to assist and guide users in navigating about the property in a proscribed manner while simultaneously impeding or discouraging undesirable movement within the property and making such movement easily recognizable.
 4. Maintenance: Natural surveillance, territoriality, and access control all contain maintenance components. A commitment to maintenance bolsters a resident’s sense of responsibility, strengthens perceptions of safety and is a visible sign to all users that the property is cared for. Opportunities to provide for ease of maintenance should be incorporated into CPTED related features of a project.

IV. Building Design

Each dwelling unit shall be designed to be a private shelter with all the amenities possible within a development budget. Construction should provide the greatest durability and economy for the term of the mortgage. The following specific features must be considered in project development:

A. Building Form (Orientation, Shape and Materials):

1. Building access, public passageways, places for social gathering, common facilities, dwelling entrances, rooms and windows shall be related to sun direction, prevailing seasonal winds, views, nearby land uses, topography, natural features, vegetation, roads, drives, parking, recreation areas, other common facilities, walks, outdoor areas or any other features as may apply. Whenever possible, orient within 20° of

north/south axis, with 90% of south-facing glazing shaded from the sun at noon on June 21st with overhangs, awnings, natural vegetation or automated shading devices, and un-shaded from the sun at noon on December 21st. All dwellings, especially elderly units, should be oriented on an east/west axis with daytime living portions related to the sun to capitalize on natural light and passive solar heat. They should also be oriented, wherever possible, to provide a daytime view, for the interior living spaces and covered exterior porches of each dwelling, of any areas on or off the site where interesting activity may be observed, consistent with maintaining privacy.

2. Buildings shall be designed and composed of materials appropriate to nearby existing development, to each other, to site improvements and to natural features. Sunlight, protection from winter winds, exposure to summer breezes and views shall be considered. Incorporate natural cooling systems: shading from deciduous trees (for east and west-facing glass), screened operable windows and radiant heat-reflective barriers installed in attic spaces. Use materials that retain heat in the winter and remain cool in the summer.

B. General Building Arrangement:

1. Dwelling units shall be equipped with covered entryways that extend a minimum of three feet out from every exterior door, not located in basement spaces or where the finish floor of the habitable area is entirely below grade.
2. Efficiency units may be acceptable on a case-by-case basis.
3. Row-house units of three-bedroom or larger size shall have their entry at grade level. Their habitable spaces may be placed on a second floor level, but not at third floor level or above. Adequate sound insulation must be provided between units on separate floor levels and adjacent/abutting units.
4. Site plans shall not concentrate three and four bedroom units into one area. Concentrating units in such a manner has an adverse impact on parking and site maintenance. Designing for diverse family types by providing a mix of single and multi-bedroom units is encouraged.
5. In all buildings that are designed to include a multiple number of dwelling units, an enclosed access shall be provided to any of those units that are located above grade. This access may be individual stair enclosures or common stair enclosures; however, if the building is served by an elevator, the elevator must provide access to all units in the building.
6. Laundry facilities in each dwelling unit are preferred. At a minimum, units with three or more bedrooms shall have a clothes washer and dryer in the unit.
7. Provide a minimum of one and one half baths in units having three bedrooms, and two full baths in four bedroom units. In case of a townhouse type unit, a half bath (min.) shall be provided on the ground floor.
8. In new buildings, all bedrooms shall be provided with screened, operable windows to the exterior of the building.

C. Common Space in Family Developments:

Family developments require community spaces for social activities, office space (including work areas) for rent up and continued property management, maintenance spaces and storage space, appropriately furnished for the intended users.

D. Buildings for Elderly Residents:

Physical limitations due to age and/or poor health shall be considered in the design of housing developments for elderly residents. Buildings designed for elderly residents shall have unit entries at grade, or a minimum of two elevators shall be provided to serve dwelling units on upper levels.

E. Handicapped Accessibility, Adaptability and Visitability:

1. Housing, programs and services for qualified individuals with disabilities shall be provided in settings that are not unnecessarily separate, segregated or restricted.
2. Barrier-free (handicapped-accessible) and handicapped-adaptable units shall be provided in accordance with federal law, code and requirements from program and financing institutions; however, no less than 10% of the units shall be “Type A” barrier-free (handicapped-accessible).
3. Barrier-free units of different types and sizes shall be dispersed throughout the development.
4. All new ground floor residential spaces in multi-story units, and all new apartments in multi-story buildings shall be designed to be “visitable” – designed in such a way as to be visited by people with disabilities – with at least one no-step entrance, doors and hallways wide enough to navigate through, and a half bath (min.) sized for wheel chair access.

F. Universal Design Features: Consider providing universal design features in all dwelling units, to make them usable to the greatest extent by people of all ages and abilities, without the need for adaptation, including:

1. In dwelling units not required to be “Type A” (handicapped-accessible) units, comply with “Type B” (adaptable to handicapped-accessibility) dwelling unit requirements contained in ICC/ANSI A117.1 Accessible and Usable Buildings and Facilities (current edition).
2. Lever handles at all windows and doors; loop or lever pulls at cabinet doors/drawers.
3. Tilt-style bathroom vanity mirrors and bathtub faucets/shower controls in an off-set location close to the outside rim of tubs and showers.
4. Adjustable shelves and hanging rods in closets.

G. Common Spaces: Management, mail pick-up and primary vertical circulation functions shall be grouped at the primary entrance.

1. All common facilities shall be accessible without passing directly through the lounge. If provided, medical and social services, central dining facilities and similar common facilities (including trash removal) shall be grouped in close proximity to the main circulation elements but in such a way that it is not necessary for a resident to pass through the lobby or the lounge to reach them.
2. The design shall provide easy “way finding” cues to distinguish location within a building. These cues can include clear organization in the design of space and circulation, plants, lighting, features, color (flooring, walls, and other features), furnishings, and consistent signs.
3. Proposed furnishings for Common Spaces shall be appropriate for the spaces to be furnished and for the intended residents.

- H. Circulation:** Common corridors shall be a minimum of 5 wide, with significant visual breaks or offsets to mitigate the apparent lengths of corridors. The length of travel from a unit to an elevator, and from the farthest unit to common dining and/or office facilities shall be minimized through building arrangement. No ramps shall be used in corridors.
- I. Community rooms:** Where provided, community rooms shall be handicapped-accessible, and shall be provided with a kitchen that shall have a double bowl sink, garbage disposal, dishwasher, microwave oven, refrigerator, and a barrier-free workspace. Community room doors shall have integral glazing or sidelights, or immediately-adjacent interior windows shall be provided, so the community room and adjacent public common areas can be perceived as defensible spaces.
- J. Craft rooms:** Where provided, craft rooms shall be handicapped-accessible, shall include a large sink, with a gooseneck faucet and plaster trap, and shall have negative air pressure.
- K. Maintenance spaces:** Common maintenance space shall be provided for storage and work space. Heated and insulated maintenance buildings or maintenance spaces within residential buildings, with bathroom facilities, work benches and storage shelves for staff, shall be provided. Provision shall be made for the storage of flammable materials.
- L. Common laundry rooms:** Where provided, common laundry rooms shall be handicapped-accessible, and shall be provided with floor drains, a table for folding laundry, and a rod for hanging clothes. All laundry rooms shall have negative air pressure and, if feasible, a window to the outside. Common laundry rooms shall have a seating area within, immediately adjacent to, or in line of sight of the laundry room and doors shall have integral glazing or sidelights, or immediately-adjacent interior windows.
- M. Trash compactor rooms, trash chutes and trash rooms:** Trash compactor rooms shall be designed so that the trash gondola can be easily wheeled in and out of the space without sharp turns. A utility sink shall be provided in trash compactor areas/trash rooms for ease in cleaning. Wash-down sprayers shall be provided within the trash chute. Provide handicapped-accessible remote trash rooms as needed, so that disposal of trash is not through the main lobby. In multi-story apartment buildings, provide barrier-free resident access to the trash chute or trash room on each floor. All trash rooms shall have negative air pressure.
- N. Signs:** Interior signage at designated common permanent rooms and spaces shall be consistent with applicable codes and accessibility requirements.
- O. Dwelling unit design:** The adequacy of the design of dwelling units shall be measured by the dwelling units furnish ability, minimum room dimensions, handicapped-accessibility, and the inclusion of several key components listed below. Furniture layouts shall be provided for all unit floor plans. All units, unless otherwise noted, shall provide for:
1. Living Area (Minimum dimension of 11'-6") to accommodate: sofa: 36" x 84"; two chairs: 30" x 36" (one additional chair for three bedroom units); television on a table: 20" x 36"; Table: 18" x 30";
 2. Entrance Area (including a 2' x 3' coat closet) with 3' entry door;
 3. Secondary General Storage (near an exterior door; may be located within the dwelling unit, or in the same building accessible with sheltered passage);
 - a. Where no basement is provided: Single Room Occupancy (SRO)/one-bedroom: 15 sq. ft.; two-bedroom: 18 sq. ft.; three-bedroom: 22 sq. ft.

Multifamily Design, Construction and Sustainability Standards – CHFA

January 2021

- b. In buildings with multiple units for elderly residents, storage may be located in cubicles located in common area storage rooms;
4. Dining Area (minimum of 42" from table edge to a wall or another piece of other furniture) to accommodate: Table 3'-6" x 3'-6" or 4'-6" diameter to accommodate four (accommodate six in three-bedroom units); Buffet or sideboard: 18" x 42";
5. Kitchen (minimum of 60" between counters at dead ends) to accommodate:
 - a. Single bowl sink, with garbage disposal and 18" of counter space each side and task light above.
 - b. Dishwasher: 24" wide (18" wide acceptable for SRO/one bedroom units), adjacent to or in close proximity to the sink: Range/Oven: 30" wide (24" wide acceptable for SRO/one bedroom units), with 18" of counter space each side: Range Hood: 30" wide, re-circulating, with task light [Provide accessible controls, i.e., hard wired switches for the exhaust fan and task light where required]: Exhaust Fan: Recessed ceiling fans or ceiling grills ducted to in-line or roof-top exhaust fans for exhaust ventilation to the outside: Refrigerator/Freezer: Width as determined by dwelling unit type/storage requirements, with 18" minimum counter on latch side and cabinet above; side-by-side or bottom freezer refrigerators, or top freezer units specifically designed for accessibility in barrier-free designed units.
 - c. Natural light shall be provided; borrowed light from pass-through openings and open areas over cabinets is acceptable.
 - d. Cabinets at a pass-through shall allow a vertical opening of 24" minimum.
 - e. In housing for elderly residents, overhead kitchen cabinets shall be placed 15" above the counter top, except as otherwise required for accessibility. Exceptions to this requirement shall be at pass-through openings and ranges, where cabinets shall be placed 24" above the work surface. Provide glare-free under-cabinet task lighting.
 - f. Appliance and cabinet doors and drawers shall not conflict when operated simultaneously.
 - g. Counter top work surface shall provide a minimum of 6 lineal feet with wall cabinets above and base cabinets below (split evenly between drawer bases and door bases).
 - h. In housing for elderly residents, counter space and an electrical outlet for a counter top microwave oven shall be provided.
 - i. Pantry closets/cabinets are desirable, especially in barrier-free units.
6. Master Bedroom (Minimum dimension of 10'-6") to accommodate: queen bed: 60" x 80" (elderly housing: two twin beds: 39" x 78" each with 24" between); dresser: 18" x 52"; chair: 18" x 18"; two nightstands: 18" x 18" each; closet with six lineal feet of hanging rod;
7. Secondary Bedroom – Elderly (Minimum dimension of 10'-0") to accommodate: double bed: 54" x 80"; dresser: 18" x 42"; chair: 18" x 18"; nightstand: 18" x 18"; closet with five lineal feet of hanging rod;
8. Secondary Bedroom – Family (Minimum dimension of 10'-0") to accommodate: two twin beds: 39" x 78" each and 18" between; dresser: 18" x 42"; closet with four lineal feet of hanging rod; linen closet: near bathroom with two lineal feet and five shelves;
9. Bathrooms (visitors shall have access to a water closet and lavatory without having to circulate through a bedroom in all dwelling units) to accommodate: water closet; bathtub and/or shower; lavatory in a 42" w. vanity base (vanity top in barrier-free units) with 12" w. drawer base; mirror; medicine cabinet; toilet paper holder; (2) towel bars; grab bars, as required; ENERGY STAR-qualified exhaust fan;

Multifamily Design, Construction and Sustainability Standards – CHFA

January 2021

10. Outdoor Space: Provide a patio of 80 ft² minimum (8'-0" least dimension) at all ground floor units in low-rise developments;
 11. Circulation: All interior dwelling unit doors within units designed for elderly residents shall be 36" wide. No "winders" shall be included in stair runs; and,
 12. Efficiency Units: Where provided, living/sleeping/eating areas in efficiency units shall be one large, simple-shaped, 450 sf (min.) space, not including bathroom and any entrance/foyer spaces, and shall at a minimum accommodate a 30" x 60" sofa or two 30" x 36" chairs, an 18" x 52" dresser (for clothing and TV placement), a 60" x 80" Queen-size bed, an 18" x 18" nightstand and a table for two. Note that pull-out sofa-beds are not acceptable. Furniture plans must be included with the application drawings.
- P. Acoustical ratings**: Minimum acoustical or Sound Transmission Class (STC) ratings for wall and floor/ceiling assemblies shall be STC 34-39 (wood stud walls)/38-40 (steel-stud walls) within living units in bathrooms and bedrooms, STC 52 between living units, and between living units and public corridors. Acoustical or sound ratings for wall and floor/ceiling assemblies shall be STC 55 between living units and other noisy public spaces, such as lobbies, stairs, elevators, mechanical rooms, etc. Materials with adequate mass and sound isolation design shall be selected. Acoustical sealant shall be used to seal all joints. Sound "leakage" through openings for mechanical and electrical pipes, conduits or boxes shall be avoided. Sound isolators shall be used for mechanical equipment to prevent impact sound transmission.

CONSTRUCTION STANDARDS

01000 GENERAL REQUIREMENTS

01700 Warranties

At minimum, warranty all products, materials, fabrications and equipment in accordance with manufacturer’s warranties, or as indicated below:

- Metal roofing shall have a minimum warranty period of 30 years. The minimum warranty-period for labor shall be 10 years, No-Dollar-Limit (NDL).
- Interior sealants shall have minimum 5-year warranty, including replacement of sealant materials which fail to adhere, cure or provide a water-tight seal.
- Fiber-cement siding material shall have minimum 50 year warranty, with a factory finish warranty of 15 years.
- Asphalt fiberglass shingles shall have a minimum warranty period of 30 years for materials, and 10 years for labor, No-Dollar-Limit (NDL).
- Single-ply membrane roof covering shall have a minimum warranty period of 20 years, covering both labor and materials, with NDL.
- Vinyl Siding shall have a minimum warranty period of 20 years, covering both labor and materials, with NDL.
- Exterior Insulation & Finish System (EIFS) shall have a minimum warranty period of 10 years, covering both labor and materials, NDL.
- High-pressure laminate plank flooring shall have a minimum warranty period of 15 years.
- Carpeting shall have a minimum 10 year performance warranty including, but not limited to, abrasive wear static protection, tuft bind and delamination.
- HVAC equipment shall have a minimum warranty period of 5 years.

02000 SITEWORK

02001 Site Design

Sites shall be designed to harmonize with the natural terrain, take advantage of positive site features and characteristics (and mitigate negative site features), and such that existing trees may be saved. Comply with all federal, State, and local government erosion control and tree protection measures. All sites for proposed new and gut rehab developments must comply with the “Water Quality Volume” (WQV) storm water management requirements in the CT DEEP “*Stormwater Quality Manual*” (current edition).

- A. Low Impact Development:** Low Impact Development (LID) for sustainable storm water management, to re-use storm water as a viable resource to control storm water and conserve rainwater, is encouraged.

1. LID site design strategies address the arrangement of buildings, roads, parking areas, site features, and storm water management holistically, to retain, detain, store, change the timing of, or filter runoff in a number of different configurations and combinations.
 2. LID Technologies and Water Conservation: Depending on which level of on-site reuse and water conservation is consistent with project objectives, various LID technologies are suggested:
 - a. Level One – Distribution: Storm water runoff is distributed using open and vegetated areas to increase infiltration and reduce the amount of storm water that enters the storm drains, through sheet flow to rain gardens, bio-swales, bio-retention cells, tree box filters, soil amendments, structural soil, native and sustainable ornamental plants;
 - b. Level Two – Hardscape Materials and Curbs: Replace hardscape materials with permeable materials curb-less parking lot islands, porous concrete parking bays, and Level One technologies; and,
 - c. Level Three – Recycling Rainwater and Runoff: This level uses above-ground LID devices – disconnected roof drains, cisterns, sub-surface storm water retention facility (below parking lots), rooftop channels, rain barrels – to channel and collect rainwater from roofs, and uses sub-surface facilities to treat and collect runoff from roads and sidewalks, in conjunction with Level One and Level Two technologies. The recycled and stored water is used for irrigation and other non-potable purposes. The devices are integral with the buildings and infrastructure.
- B. Erosion Control:** Follow guidelines set forth in the current “Connecticut Guidelines for Soil Erosion and Sedimentation Control” and the “State of Connecticut Department of Transportation Standard Specifications for Roads, Bridges and Incidental Construction”, as amended and as applicable.
- C. Plant Preservation:** A tree expert (certified arborist, landscape architect, or individual with a professional degree in forestry or related field) shall be retained to create a Plant Preservation Site Plan which identifies and designates healthy trees and of different ages and sizes that to be protected during all construction activities, to coordinate with landscape architects, engineers and utility managers to place improvements where the impact on trees will be minimized, and to provide guidance for aftercare to help trees recover from the stress of construction.
1. The Plant Preservation Site Plan shall also identify healthy ornamental and native plants not included within tree-save or undisturbed areas of the site, which can be expected to survive being relocated, stored and replanted, or to be made available for relocation by others, prior to the area being disturbed, and provide notes and specifications for such relocation. In general, healthy trees 3½" in diameter or greater in the path of proposed buildings and site construction features shall be considered for transplantation.
 2. Trees that are marked to be preserved on the Plant Preservation Site Plan, and for which utilities must pass through their root zones, shall not have surface-dug trenches. The site engineer shall indicate tunnels to be dug through, or trenches around, root zones and provide details, notes and specifications.
- D. Tree Planting, Landscaping, Lawn Areas and Maintenance Strips:** Soils compacted during construction by materials and/or construction vehicles shall be rehabilitated with 6" of top soil or by tilling 6" down.
1. Site plan shall indicate new tree planting at a minimum rate of 12 trees per acre.
 2. Plants shall be sized according to proper planting practice and shall be adequate to withstand normal abuse. Selected specimen flowering and shade trees should be of the largest caliber the project can afford, but in no case should the caliber be less than 3½". Evergreen trees shall have a minimum height of 5'-0", with an average height of 6'-0", and mass plantings of evergreen seedlings should be considered for use in screening

objectionable views. Mulch all tree saucers with a minimum of 3" of finely processed shredded bark mulch.

3. Low-water landscape designs, such as xeriscaping, are encouraged. Select slow-growing, adaptable and drought-tolerant plants which withstand rainfall shortages and utilize less water for irrigation. Soil shall be tested and amended to improve the growth of plants and grasses.
4. Grades shall slope away from buildings at 6" in the first 10' (5%). Grades at lawns shall slope 2% (minimum) to 8.3% (maximum), swales and berms 33% (maximum), and "un-mowable" slopes with groundcover 50% (maximum).
5. A maintenance strip, not less than 18" in width, to protect siding from backsplash and mowing operations, shall be provided along all building facades. Provide maintenance strips with 4" to 6" (min.) of decorative stones over a weed barrier, and slope away from facades 5% (min.). Where gutters and downspouts are not provided, provide a ground gutter system in lieu of a maintenance strip. Ground gutters shall extend 12" (min.) beyond the roofline.

E. Parking Ratios, Lots and Collector Roads: Parking shall comply with local planning and zoning requirements. Unless otherwise required, parking for housing for elderly residents shall be provided at the minimum ratio of 1.2 spaces per unit or greater. Parking for developments for family residents shall be provided at the minimum ratio of 2.4 spaces per unit or greater. Parking layouts with dead ends, and parking spaces along collector roads, are discouraged.

F. Drives and Curbing: No gradients on drives shall be less than 1% or more than 8% (5% where traversed by pedestrians). Parking lots and areas shall have a cross slope or transverse slope no greater than 3%. All ADA, State of Connecticut Barrier-free, Uniform Federal Accessibility Standards, and Federal Fair Housing Act Amendment (FHAA) guidelines shall be met where applicable.

1. Drives shall comply with local planning and zoning requirements. Unless otherwise required, collector drives shall be a minimum of 22'-0" in width. Drives within parking areas shall be a minimum of 20'-0". Main drives and collector roads shall be crowned for drainage along curbs.
2. All drives, parking areas and planting islands shall be curbed. Curbing shall be concrete or granite, and curbs shall be profiled to accommodate snow plowing in identified areas.

G. Paving: Paving thickness shall be based on recommendations provided in a soils report prepared by a licensed Soils Engineer. Paving at and in front of waste disposal stations shall be designed to bear the weight of dumpster trucks, 6" thick concrete with reinforcing mesh, minimum. This paving shall be sufficiently large to provide a pad for the truck wheels (front or rear) at time of loading. The minimum width of the concrete paving shall be the width of the dumpster enclosure.

The use of pervious concrete pavement for walks and drives is encouraged, where appropriate. To mitigate heat-island effect, consider light-colored/high-albedo materials and/or open-grid pavement with a Solar-Reflective Index of 0.29 over at least 30% of the site's hard-scape areas.

H. Parking Spaces: Parking spaces shall comply with local planning and zoning requirements. Unless otherwise required, parking spaces within housing for elderly residents shall be a minimum of 10' wide x 20' long. Parking spaces within developments for family residents shall be a minimum of 9' wide x 20' long. Accessible parking shall be provided to accommodate all required ADA units, and accessible van parking shall be provided for elderly and supportive developments.

- I. Walkways:** There shall be an internal system of walkways. Barrier-free ramps shall be provided at curb crossings. In housing for elderly residents, walks shall provide easy access to secure interactions with human activity and natural surroundings. Walks shall be concrete. Asphalt bituminous "walking trails" may be provided. No gradients on walks shall be less than 0.5% or more than 5%. Cross slopes shall not exceed 2%. Accessible ramps shall be no less than 5% or more than 8.3% (landings 0.5%) Walkways along parking spaces where cars may overhang the walk shall be 6'-0" wide or as required by ADA, FHAA, or local ordinance, whichever is greater.
- J. Site Lighting:** Exterior lighting, including fixtures for required site development signs, drives, parking areas, walks, common entrances/exits, grade-level unit entrances and patio doors, shall be controlled by photocells. Patios shall have a switched light with a shielded light-source to prevent glare. All exterior luminaires shall be "Dark Sky compliant" – designed with opaque housings, baffles, reflectors and/or refractors to prevent glare and reduce light trespass into unwanted areas, adjacent properties, buildings and windows, and the night sky – and shall bear the fixture seal of approval of International Dark Sky Association (IDA).
1. Building-mounted flood-lighting for lighting parking lots, and walks to or from parking, shall not be used. Pole-mounted and bollard lights of appropriate heights shall be used for such purposes. Aluminum poles and bollards with baked-enamel painted finishes are preferred. Pole bases shall be located no less than 3'-0" from curbs where cars will be parked head-in.
 2. Exterior lamps may be of the compact/tubular fluorescent, LED or metal halide type. Underwriters Laboratories (UL) wet-listed fluorescent fixtures should also be considered.
 3. Exterior lighting fixtures for parking, roadways and walkways shall provide a minimum of ½ foot candle (fc) overall along paths to common entrances/exits, grade-level unit entrances and patio doors. Lighting shall be even; dark areas and "hot" spots are to be avoided. Light fixtures at unit entry doors shall be photocell-operated and controlled for use in conjunction with the development's street/parking/walk lighting. All designs should consider the character and location of the development. Consult the Illuminating Engineering Society of North America Recommended Practice Manual: "Lighting for Exterior Environments". Provide a separate Site Lighting Photometric Plan indicating conformance with required exterior illumination levels.
- K. Retaining Walls:** Unless an engineered wall, dry-stacked masonry (no mortar) or timber retaining walls shall be constructed such that the wall shall not exceed 4' in height without an equal horizontal setback. An adequate safety barrier shall be provided at retaining walls as required by code. Where the code is silent on retaining walls and the top of a retaining wall is 20" or greater above adjacent grade and a dangerous condition putting pedestrians at risk exists, an adequate safety barrier shall be provided.
- L. Road/Vehicle Protocols:** A vehicle washing station shall be provided in close proximity to each construction entrance and protocols describing appropriate use shall be clearly posted both at the on-site office and at the washing station (descriptions of washing station features and construction can be found in the National Pollutant Discharge Elimination System reference Green Book). Protocols for road sweeping and cleaning shall also be clearly posted at the on-site construction office.
- M. Waste Management Practices:** Dispose of construction debris only at a Connecticut or other state-approved construction and demolition landfill. No construction materials shall be burned or buried on-site.
1. The GC shall post a construction waste management plan on the job site, and each subcontractor shall be educated on the aspects of the plan that pertains to their work. Waste management plan must either provide for on-site grinding and re-use, or separation of materials to be recycled by clean-up or waste-hauling firms.

Consult your local jurisdiction for allowable materials and appropriate practices.

2. Construction waste includes plastics, wood, cardboard and paper, drywall and ceiling panels, metals, shingles, fluorescent bulbs, concrete and dirt - materials that may be reused or recycled if properly prepared. Identify the types and quantities of materials generated at the job site, and contact local recycling facilities and haulers to determine terms and conditions required for recycling them. Allocate space for recycling materials.

02810 Irrigation

Every effort shall be made in the design and plant specification for landscapes to prevent or minimize the need for irrigation. Where irrigation is provided, utilize techniques and systems designed to conserve water, including water-smart landscaping, drip and micro irrigation, high-efficiency dishwashers, faucets, and showerheads and clothes washing machines, alternative water sources, including on-site rainwater collection/retention, graywater collection/retention.

A. Irrigation Design, Controls and Smart Water Application Technologies (SWAT): If irrigation must be provided, the system shall be designed by an EPA WaterSense®-certified professional. The irrigation plan must conform to the landscape plan, as well as other site features. Appropriate equipment and design principles shall be practiced regarding terrain, planting materials, exposure and obstructions. As much as practical, provide separate zones for sun and shade, and limit daily total run-times and over-spray onto walks, public roads, parking areas, and buildings. Separately zone sprinklers with differing precipitation rates, such as drips, sprays and rotaries. Where it is not practical to separately zone full and part circle rotaries, use matched precipitation rate sprinklers, or increase the nozzle size of the full circle sprinklers to more nearly match the precipitation rate of the part circle sprinklers. Booster pumps shall be approved by the local municipality.

1. Irrigation controls shall not be located within residential units. Control timers located outdoors are to be in a weather-resistant locking metal enclosure; "hybrid"-type mechanical controllers with solid-state circuitry are preferred.
2. "Smart", climate-based irrigation controllers, as recommended by the Irrigation Association SWAT initiative and the EPA WaterSense® Program, are encouraged in lieu of traditional "timer" controls. Program controllers to apply the right amount of water to maintain healthy growing conditions for specific plant materials, based on real-time weather data, soil types, slope, root zone storage, plant types, irrigation types, irrigation efficiency, precipitation rate, moisture, rain, and wind, etc.

02980 Site Signs

A. Construction Sign: A construction sign shall be erected on site and remain for the duration of construction work. The construction sign shall be constructed of ¾" x 4'-0" x 8'-0" marine-grade AC plywood. Based on the funding program(s) under which the project has been underwritten the appropriate project sign design template will be provided that reflects the participating state financial institution(s), which will generally include the following information:

1. Development name, town and state;

2. “State of Connecticut” with current Governor’s name; Please note when administrations/governors change during the course of construction, the sign would need to be updated to reflect the change.
3. Participating state finance organization(s) name(s) and logo(s), with Executive Director’s/Chairperson’s/Commissioner’s name(s);
4. “Equal Housing Opportunity” with logo(s) and “Equal Employment Opportunity” logo(s).

03000 CONCRETE

Where required, provide concrete in accordance with the following guidelines:

A. Footings: Concrete footings shall be constructed on undisturbed material unless approved contract documents indicate otherwise. All fill placed under footings must be engineered fill, designed, compacted and certified by a professional engineer before placement.

1. Apply a capillary break (damp-proofing or membrane) to the tops of concrete footings at all new basements and crawlspaces.
2. Footing drains shall be provided outside all new foundations surrounding basement and crawlspaces. Outside drains shall drain to daylight or a storm system where possible or to an engineered drywell. All daylight drains must have their outfalls screened and protected from erosion.
3. In renovations, footing drains may not be present, and retrofitting a new exterior drainage system may not be practical. In such cases, interior perimeter drainage may be used in conjunction with sump pumps. Sump pits must be fitted with airtight, gasketed covers to prevent soil gas entry.
4. Fill compaction and concrete testing shall be conducted by an approved independent testing agency.

B. Foundations: Concrete foundation walls shall be extended to 8" min. above exterior grade. Provide details for means to protect the building against moisture penetration and insect infestation where entry walks, ramps and platforms are less than 8" below the bottom edge of exterior finishes. Wood foundations will not be permitted.

C. Foundation Drains: Styrene or corrugated polyethylene piping shall not be suitable for foundation drains, leaching fields or other below grade applications, except as otherwise required by local authorities. PVC perforated pipe is permissible, provided the minimum wall thickness for 4" diameter pipe is 0.075", and for 6" diameter pipe 0.10". Drainage lines shall be sized and pitched to provide velocities of at least 2.5 feet per second in storm drainage lines and 2.25 feet per second in sanitary lines. If cast iron pipes are not chosen for storm and sanitary lines, PVC schedule 40 (solid core) shall be specified.

D. Slabs: Crawlspace vermin barrier slabs shall be a minimum of 3" thick, and shall be finished with a top-side semi-permeable coating or chemical sealer. Floor slabs, patios provided as outdoor space for grade level dwelling units and walks shall be reinforced concrete a minimum of 4" thick. Concrete drives and aprons at the front of dumpster shall be a minimum of 6" thick reinforced concrete.

E. Concrete Materials:

1. Design, erect, support, brace and maintain formwork to support vertical and lateral loads that might be applied. Design formwork to be readily removable. Construct forms to sizes, shapes, lines and dimensions

required to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required.

- a. Re-use Wood Form Boards: Where utilized, carefully remove and separate wood form boards for re-use.
- b. Metal Forms: Consider utilizing metal forms to reduce wood use.
- c. Insulated Concrete Forms (ICFs): Consider utilizing ICFs for poured concrete walls, which stay in place as a permanent part of the wall assembly.

2. Provide a polyethylene vapor barrier not less than 10 mils thick under all crawlspace vermin-barrier slabs. The Standards encourage drying mechanisms over wetting prevention mechanisms in the design of wall assemblies, i.e.: avoidance of using vapor barriers where vapor retarders will provide satisfactory performance, avoidance of using vapor retarders where vapor permeable materials will provide satisfactory performance, and avoidance of the installation of vapor barriers such as polyethylene vapor barriers, foil-faced batt insulation and reflective radiant barrier foil insulation on the interior of air-conditioned assemblies.

- a. For all new slabs-on-grade, and basement or below-grade spaces designed and constructed to be occupied, install a vapor barrier not less than 10 mils thick with taped seams, or continuous vapor-impermeable rigid insulation with taped joints. All pipe penetrations shall be sealed to prevent water infiltration.
- b. In existing buildings, under-slab stone and/or a polyethylene vapor barrier may not be present and over-slab control of water vapor may be required. If basement or below-grade spaces in existing buildings to be renovated are intended to be occupied, install a vapor barrier not less than 10 mils thick with taped seams, or continuous vapor-impermeable rigid insulation with taped joints, over floor slabs in conjunction with a floating floor. Carpeting should not be installed in below-grade spaces in renovated developments. All pipe penetrations shall be sealed to prevent water infiltration.

F. Slab Insulation: Provide R-15 (min.) vapor-impermeable rigid foam thermal break insulation with taped joints under slabs and at slab edges.

G. Strength: Concrete shall be, at a minimum, 3500 psi 28-day compressive strength, with reinforcing materials as required. Exterior concrete shall be air-entrained, and walks and porch/patio slabs shall be, at a minimum, 4000 psi 28-day compressive strength, with reinforcing materials as required. Where structural conditions or exposure to the weather warrant, provide concrete with higher compressive strength(s) as required. Slump limits shall meet ACI Standards. The concrete shall be used at a degree of plasticity which would produce the required slump(s). Do not increase the water ratio in concrete for easier movement.

H. Backfill: The use of recycled concrete rubble for backfill and drainage at the base of foundations is encouraged.

I. Concrete with Fly Ash or Slag and Recycled Concrete Used as Aggregate: The use of fly ash and slag as inexpensive substitutes for 15% - 40% of the Portland cement used in concrete for footing, foundation walls, and slabs is encouraged. Demolished concrete may be used as an aggregate in poured concrete structures.

J. Air Conditioner Condensing Unit Pads: The outdoor pads for air conditioner or heat pump condensing units shall have a minimum of 50% recycled material content (such as plastic or rubber tires), as verified by the manufacturer.

K. Concrete Finishing Materials:

1. Provide a two-coat Portland cement parge coating, type L, M, or P, in compliance with ANSI A422 and ASTM C150, continuous from the sill to 12" (min.) below finished grade.

2. Waterproofing shall be applied to all foundation walls enclosing a basement or crawlspace. At a minimum, provide asphalt-bituminous coating from the outside edge of the top of footings to finished grade, per manufacturer's printed instructions. Where below-grade habitable spaces are planned, and/or severe underground water conditions warrant, provide more sophisticated systems incorporating rubber membranes, rigid insulation, protection board, bentonite, etc.
3. All exposed concrete floors within residential buildings shall be sealed. If salts are not present in the ground, epoxy and acrylic polymer coatings, or chemical sealers may be used.

L. Concrete Placement Crack Control and Expansion Joints: Comply with applicable provisions of the current editions of ACI 301 specifications and documents for hot weather placement and ACI 306 for cold weather placement. Exterior contraction joints shall be tooled joints. Interior joints shall be made within 24 hours of concrete placement. Expansion joints in interior slabs shall be full depth and located beneath walls.

M. Cementitious Underlayment: Cementitious underlayment, where required, including poured gypsum and lightweight concrete, shall be installed in accordance with manufacturer recommendations.

04000 UNIT MASONRY

Set masonry units, plumb and true to line in specified bond patterns, with joints pointed to uniform cross section, and well bonded to adjacent construction. Set units, both bottom and end, in full bed of mortar with joints uniform in thickness and head joints in alternative courses plumb over the ones below. Keep air spaces clean of mortar droppings and other materials during construction. Strike joints facing air spaces flush. Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges and other obstructions to the downward flow of water in the wall or where indicated on the drawings. Provide weep holes as specified – every effort must be made to keep weep holes clear during subsequent installations. Provide lintels, flashing, weep holes, anchors and other accessories where required in compliance with the highest standards of masonry practice and professional workmanship. Where colored mortar is desired, specify natural and synthetic iron oxide and chromium oxide pigments proven satisfactory for masonry mortars. Do not use calcium chloride or masonry cement.

A. General Installation Guidelines: Comply with the provisions of the current editions of Brick Industry Association (BIA) recommended procedures, as applicable:

1. Disconnect “reservoir” materials that collect and store moisture, such as stone, brick, and stucco, to prevent migrate to other components of exterior wall assemblies. Disconnect masonry veneer “reservoirs” by back-venting or by using a condensing surface.
 - a. To effectively disconnect a masonry veneer from a wall system by back-venting, a cavity must be provided between the masonry and drainage plane, with air inlets at the bottom of the masonry veneer and air outlets at the top. BIA recommends a 2" air space between brick/block and stud back-up framing systems, to prevent encroachment into the wall cavity. Keep wall cavities clean, prevent mortar from “bridging” across the cavity and rendering flashing and weeps ineffective.
 - b. To effectively disconnect masonry veneer from a wall system by using a condensing surface, the drainage plane must also be a vapor barrier, or a vapor impermeable layer (i.e., rigid insulation) must be installed between the masonry veneer and drainage plane. When a condensing surface is used, a ventilated air space is not necessary, and the presence of mortar droppings is not a concern. Provide a drainage space ¼" or greater and drainage openings at the bottom of the masonry veneer.
2. To prevent mortar droppings from blocking drainage weeps, pour a 2 - 3" layer of pea gravel (larger than weep openings) over flashing, or plastic 1 – 2" plastic mesh net mortar collection devices, per BIA

recommendations.

3. Through-wall flashing should extend a minimum of 8" up the concrete block or stud back-up, per BIA recommendations. Flashing should extend to the outside face of the wall and form a drip edge.
4. Provide weather-resistive barriers, air barriers and/or vapor retarders.
5. Ensure that weeps let air in, as well as let water out as quickly as possible. Open-vent systems are preferred over rope wicks and small diameter plastic tubes, to allow walls to dry out faster. Space open head joints at 24" o.c., and provide vents or mesh for insect control.
6. Provide adequate caps or copings at the tops of walls and parapets. Caps should slope downward 15° (min.) from the horizontal – caps away from the face of the wall above and copings in one or both directions – and should provide overhangs such that the inner lip of the drip is at least 1" from the face of the wall.
7. Clear coatings that “breathe” (such as silanes and siloxanes), and coatings that form a film (such as acrylic and stearates) are not recommended.
8. Install stucco over two layers of building paper, or over an appropriate capillary break such as foam sheathing.

B. Cold/Hot Weather Procedures: Comply with applicable provisions of the current editions of the Portland Cement Association reference standard: “Table 501: Recommendations for Cold Weather Masonry Construction” and ACI 530.1/ASCE 6/TMS 602 for cold weather installations, and protect unit masonry work when temperature, humidity and wind conditions produce excessive evaporation of water from mortar and grout during hot weather installations.

C. Masonry Materials: Comply with applicable provisions of the current editions of the ASTM Standards for all specified masonry materials, including concrete masonry units, brick, lintels, mortar, grout, joint reinforcement, steel bar reinforcing, anchors and ties, embedded flashing and all required miscellaneous masonry accessories, including compressible fillers, control joint gaskets, bond-breaker strips, round plastic weep tubing, cavity drainage material, cavity-wall insulation and masonry cleaners, etc.

D. Sustainable Masonry Practices: The use of on-site, indigenous Connecticut and New England earth materials, such as common clay, dimensional stone (granite, quartzite and sandstone), crushed stone, construction sand and gravel, and lime, and locally/regionally-produced brick and concrete masonry units, is encouraged.

05000 METALS

A. Specifications: Comply with current applicable American Institute of Steel Construction (AISC) steel design and structural standards and provisions.

B. Materials: Comply with applicable provisions of the current editions of the ASTM Standards for all specified metal materials, including W-shapes and WT-shapes, channels and angles, plates and bars, cold-formed hollow structural steel sections, steel pipe, welding electrodes, bolts, nuts, and washers, shear connectors, anchor bolts, un-headed anchor rods, threaded rods and welded wire fabric, etc.

The use of metal studs is generally discouraged. Where utilized, metal stud framing above grade must be provided with continuous rigid foam insulation with taped or sealed joints. If basement or below-grade spaces are designed and constructed to be occupied, metal studs should not be used, unless separated from floor slabs

with sill gaskets and from perimeter foundation walls with continuous, vapor-permeable rigid insulation with taped or sealed joints, and should not be filled with cavity insulation. Metal Roof shall have a minimum warranty-period of 30 years. The minimum warranty-period for labor shall be 10 years, No-Dollar-Limit (NDL).

06000 WOOD AND PLASTICS

06100 Rough Carpentry

Provide rough carpentry work as required by job conditions, including but not limited to the following: wall, ceiling framing, roof framing and sheathing; fasteners, attachments and accessories; blocking, bracing, shimming, furring, firestops, sleepers and nailers; and additional framing required to introduce the work of other contractors and trades. All materials, methods and details shall comply with current National Design Specifications, Wood Frame Construction Manual, and the Special Design Provisions for Wind and Seismic Supplement by the American Wood Council (AWC). Erect all work true to line, dimension, level, squared, plumb and securely fastened. All work shall conform to the highest standards of quality workmanship.

A. Framing Requirements:

1. Where flush framing is indicated, method of fastening shall be by means of Code-approved, manufacturer recommended galvanized/stainless steel joist/beam hangers attached with required fasteners, and as specified by the structural engineer.
2. Do not impair integrity of structural members by improper drilling or cutting. All work shall be adequately braced until all portions of the building affecting its stability are in place and securely fastened. All drilling and notching of joists shall be in accordance with applicable codes/pre-engineered framing manufacturer requirements.
3. Wall framing studs – interior and exterior – shall be installed on 12", 16", 19.2" or 24" modules, as required by structural conditions. Spacing of framing shall conform to specifications on construction documents, except for variations needed to accommodate window and door openings. Coordinate window and door openings with the specified framing module. Provide double studs at all window and door openings; install additional studs only as specifically indicated on the structural engineering drawings. Provide blocking at windows and doors for adequate nailing of siding and trim materials.
4. Where provided, double walls should be two, independently-framed walls, with all framing off-set (except at window and door openings), to minimize thermal bridging and allow for continuous insulation.
5. Below-grade Floors:
 - a. In new construction, finished wood or carpeting may be installed over ¾" plywood subfloor on 1 x 4 furring at 16" o.c. Install furring over ¾" un-faced extruded polystyrene rigid insulation. Expanded polystyrene may be used if the spacing of the furring is reduced to 12" o.c., or if tongue and groove plywood with biscuit-joined narrow edges is supported directly by the foam. Provide a semi-permeable coating or chemical sealer on top of the floor slab. Do not use this assembly with visibly wet slabs or where salty efflorescence is visible.
 - b. In new construction and renovations finished wood may be installed over ¾" tongue and groove plywood, with biscuit-joined narrow edges. Install plywood over, but not mechanically fastened to, un-faced extruded polystyrene rigid insulation. Provide a dimpled plastic sheet membrane between the rigid insulation and the slab, with all joints taped and the membrane sealed to the perimeter foundation to isolate the airspace from the interior. Groundwater leakage can be handled with this approach by

draining the airspace to a sump or floor drain.

6. **Below-grade Walls:** If basement or below-grade spaces are designed and constructed to be occupied, wood studs should be separated from floor slabs with sill gaskets and from perimeter foundation walls with vapor-permeable rigid insulation with taped or sealed joints. Below-grade wall framing should be pressure-treated.

B. Engineered Wood Products: The use of engineered wood for headers, joists, and sheathing is encouraged. Large size lumber can be replaced with engineered lumber, such as microlams, paralams, and glulams. All materials, methods and details shall comply with Engineered Wood Construction Guidelines by the American Plywood Association (APA). Where structural loads allow, single-piece 1¾" structural engineered wood headers provide room in the wall cavity for insulation (provide full-depth horizontal blocking at window head). Solid wood framing lumber shall be Western Wood Products Association (WWPA) grade-stamped and stress-graded. Framing lumber shall be graded "S-dry," max MC=19% and free of warping, checking or other defects. Load-bearing stud framing shall be #2 grade or better. Finger-jointed studs (graded equivalent to full dimensional studs - 1997 UBC Standard, Chapters 23 and 35) may be used. Spanning members shall be graded F_b=1400; E=1.4. Framing lumber abutting concrete or masonry shall be WWPA grade stamped pressure-treated unless otherwise required. All framing lumber at exposed exterior locations or which abuts concrete or foundations, such as sill plates, shall be pressure-treated. Solid white spruce framing lumber shall not be used.

1. Whenever possible, use reclaimed lumber for nonstructural applications, in place of new material.
2. Where wood "stick" framing is provided, utilize resource-efficient Advanced Framing Techniques (AFT) to minimize material usage, while meeting model code requirements:
 - a. Evaluate the use of 24" modular dimensions, rather than standard 16" modules at exterior wall framing.
 - b. Utilize 2 x 6 exterior wall studs rather than standard 2 x 4 studs.
 - c. Evaluate the use of 19.2" or 24" o.c. modular dimensions, rather than the standard 16" o.c. at floor and roof framing. To compensate for the increased panel span, provide floor and roof sheathing that is ⅛" (min.) thicker than may otherwise be required.
 - d. Use floor and roof trusses, rather than stick framing.
 - e. Use "in-line" or "stack" framing to transfer loads directly to the foundation and minimize headers
 - f. Use 2-stud "California" corner framing with furring or drywall clips or equivalent alternative framing technique, rather than 3-stud corners.
 - g. Use horizontal ladder framing, full-length furring, drywall clips or equivalent alternative framing technique at wall "T" intersections, rather than 3-stud corners.
 - h. Up-set exterior wall headers into floor framing above to allow for full insulation immediately above windows and doors.
 - i. Eliminate interior wall headers in non-bearing walls, and engineer headers in bearing walls to adequately support loads with the smallest members possible.
3. The use of recycled content materials for decking, and outdoor amenities such as picnic tables, mail kiosks, gazebos, and playgrounds is encouraged. Recycled plastic lumber contains only recycled plastic resins, while composite lumber is made by combining recycled wood fiber and recycled plastic resins that are then formed into deck boards. Both products may be used in place of old-growth redwood, cedar and pressure-treated pine. Follow manufacturer recommendations closely regarding the amount of expansion that will occur when using recycled-content plastic lumber.
4. The use of sustainably-harvested Forest Stewardship Council (FSC) Certified Wood for new framing materials is encouraged.

5. Wood products containing urea formaldehyde (UF) resin binders shall be avoided. Consider products manufactured with adhesives which decrease or eliminate formaldehyde content and emissions, such as phenol formaldehyde (PF), phenol urea formaldehyde, melamine urea formaldehyde, methyl di-isocyanate (MDI), hybrid UF/MDI and PF/MDI, and natural tannin and soy-protein resins. All composite wood products must be labeled for compliance with California Air Resources Board (CARB) No Added Formaldehyde (NAF), No Added Urea Formaldehyde (NAUF) and Ultra-Low Emitting Formaldehyde (ULEF) Airborne Toxic Control Measure (ATCM) emission standards.
6. The use of treated wood that does not contain chromium or arsenic for decking and sill plates, and outdoor amenities such as picnic tables, mail kiosks, gazebos, and playgrounds is encouraged. All materials, methods and details shall comply with American Wood-Preservers' Association (AWPA) standards.
7. Where possible, use solvent-free products in place of standard adhesives for all interior applications such as installation of flooring, countertops, wall coverings, paneling, and tub/shower enclosures. Laminating adhesives, and all other construction adhesives used indoors shall have a maximum Volatile Organic Compound (VOC) content of 50 g/L, or as otherwise noted below:
 - a. Multipurpose construction adhesives, subfloor adhesives, drywall and panel adhesives, vinyl composition tile (VCT) and asphalt tile adhesives, cove base adhesives, carpet pad adhesives and indoor carpet adhesives: maximum VOC content of 70 g/L;
 - b. Rubber floor adhesives: maximum VOC content of 60 g/L;
 - c. Ceramic tile adhesives: maximum VOC content of 65 g/L;
 - d. Structural glazing adhesives: maximum VOC content of 100 g/L;
 - e. Wood flooring adhesives: maximum VOC content of 100 g/L;
 - f. Outdoor carpet adhesives: maximum VOC content of 150 g/L; and,
 - g. Single-ply roof membrane adhesives: maximum VOC content of 250 g/L.

C. Energy Heel Trusses/Raised Top Plates: To ensure installation of the full depth of required attic insulation above exterior wall top plates, without being compressed by insulation baffles, provide energy heel trusses with raised top chords, or raised top plates for joist/rafter assemblies.

06200 Finish Carpentry

All millwork and exterior finishes shall be carefully cut, erected, and secured with finishing nails for tight-fitting joints. All materials, methods and details shall comply with American Woodwork Institute (AWI), American Hardboard Association (AHA), Hardwood Plywood and Veneer Association (HPVA), National Particleboard Association (NPA), National Electrical Manufacturers Association (NEMA), and Builders Hardware Manufacturers Association (BHMA) standards. Exposed nails shall be set for putty. All work shall be installed plumb, level, square, true to line and plane, and in conformance with the highest standards of quality professional workmanship.

- A. Interior Trim:** All interior finish woods shall be kiln dried to maximum moisture content of 12% and free from knots, defects, and warping. Where painted finishes are desired, the use of non-solid sawn wood (such as finger-jointed) or non-wood material (such as cellular PVC) for interior trim is encouraged. Interior wood trim can be paint-grade, finger-jointed poplar or #1 pine. Polystyrene molded door casing and baseboard shall not be used. All rooms with floor coverings shall have base trim. Except where wall base trim abuts wall-to-wall carpeting, or vinyl cove base trim is provided at VCT flooring, all joints between interior trim and other adjoining finish materials should be caulked.
- B. Exterior Trim:** Low-maintenance trim materials such as vinyl, cellular PVC, or pre-finished cement boards are preferred. All exterior wood trim shall be solid wood free from knots, defects and warpage or finger-jointed wood. Un-clad wood trim, wood columns or other high-maintenance materials shall not be permitted.

Aluminum flat stock material, exceeding 6" in width, shall not be used for trim bands, unless a break in the aluminum stock is provided. This required break must be substantial enough to mitigate the effect of oil canning. A formed siding piece may be used in lieu of stock with a break.

C. Laminates: Shelf, cabinet and countertop substrate material for plastic laminate shall be exterior-type, hardwood-faced plywood, or other material approved by the manufacturer of the plastic laminate. If particleboard is used, all 6 sides must be coated with a sealant having a maximum VOC content of 250 g/L. Consider particleboard panels that are manufactured with 100% recycled wood fiber or post-consumer waste, and a urea formaldehyde-free adhesive system. Whenever possible, eliminate new particleboard inside houses by using formaldehyde-free medium density fiberboard for shelving, cabinets and substrates for countertops and exterior panels. Sharp edges shall be avoided. Cut-out edges shall be sealed prior to the installation of sinks. Counter tops shall not have sharp exposed edges; provide chamfered or rolled edges. Corners protruding in excess of 1-1/2" shall be rounded or chamfered (45°). Consider providing alternative counter top materials, such as bamboo, lyptus wood and composites with recycled content, in lieu of plastic laminate or thermo-set plastic solid surface counter top materials. Regardless of countertop material(s) specified, protect abutting walls with back- and side-splashes; minimum ¾" w. x 4"h. at bathroom vanity tops, and ¾" w. x 6"h. at kitchen countertops.

D. Railings and Stairs: Handrails shall be easy to grasp and able to withstand 300 pound lateral and vertical loads, without damage or permanent set. Handrails shall meet the "graspability" requirements of, and be located in accordance with, all applicable codes. In buildings designed for elderly residents, handrails shall be provided on both sides of all corridors, and shall return to the walls at all interruptions such as doors and cased openings, and fire hose or fire extinguisher cabinets.

Guard rails not less than 36" in height shall be provided at all decks, porches, balconies or raised floor surfaces, including those provided with insect screen enclosures, more than 18" above the floor or grade below. Open sides of stairs with a total rise of more than 18" above the floor or grade below shall have guards not less than 34" in height. Guard rail openings shall comply with all applicable code limits.

Consider providing stair parts such as stringers and treads made from engineered wood, rather than solid hardwoods.

07000 THERMAL & MOISTURE PROTECTION

07010 Energy-Efficient Building Envelope

Comprehensive measures to reduce energy consumption due to air leakage, avoid moisture condensation problems and uncomfortable drafts, and provide high indoor air quality through reduced indoor air pollution shall be employed in the design and construction of all rehabilitated and new residential facilities. Applicants for funding shall submit a Thermal Efficiency and Energy Conservation Plan which reflects all of the applicable types of construction to be included in proposed developments/re-developments, as indicated below:

A. Minor, Moderate and Substantial Rehabilitations: All proposed energy performance-related fabrications, equipment, fixtures, controls and appliances must meet or exceed the prescriptive requirements of ENERGY STAR Multifamily New Construction (MFNC) certification program (current version), or as otherwise indicated in these Standards or other programmatic funding requirements. ENERGY STAR performance standards for individual fabrications, equipment, fixtures, controls and appliances can be found on the ENERGY STAR website. Development teams shall prepare and submit a Thermal Efficiency and Energy Conservation Plan with the Design Development Submission, which takes into consideration pre-development testing and energy audits of existing buildings and data produced by pre-development energy modeling prepared

by a Professional Engineer Residential Energy Services Network Home Energy Ratings Systems (RESNET HERS) or ENERGY STAR-certified assessor/rater. The Energy conservation plan shall include current and post-construction projected residential and common area energy usage data, a summary of proposed energy performance-related improvements, and post-construction building performance summary data. The proposed energy performance-related improvements shall provide for projected reductions in annual energy use as follows: $\geq 10\%$ for minor rehabilitations, $\geq 15\%$ for moderate rehabilitations and $\geq 20\%$ for substantial rehabilitations.

B. Gut Rehabilitations and New Construction: Proposed gut rehabilitation and new construction projects shall be designed and constructed to meet or exceed the ENERGY STAR Multifamily New Construction v. 1.1 (MFNC) or ENERGY STAR Certified Homes v. 3.1 (ESCH) program certification requirements, as applicable. In general, two-family homes and townhouses may use ESCH, and all other multifamily buildings must use MFNC. In order to determine which program a project is eligible for, use the “ENERGY STAR Multifamily New Construction Decision Tree v. 2.0 on the ENERGY STAR website. Development teams shall prepare and submit a Thermal Efficiency and Energy Conservation Plan that indicates which ENERGY STAR Program(s) will be used to certify the completed project, whether ENERGY STAR certification will be achieved through the Energy Rating Index (ERI) or ASHRAE 90.1 Paths, and provide a summary of proposed energy performance-related measures. Although ENERGY STAR MFNC offers a Prescriptive Path to certification, since EnergizeCT financial incentives are performance-based, the Prescriptive Path is not acceptable to CHFA. Upon completion, all gut rehabilitation and new construction projects shall be ENERGY STAR-certified by the EPA.

1. Design, construction inspection, testing, measurement, independent verification and certification requirements for ENERGY STAR Multifamily New Construction v 1.1 (MFNC) are outlined in the “National Program Requirements – ENERGY STAR Multifamily New Construction, Version 1/1.1/OR-WA 1.2” document, which can be found on the ENERGY STAR website.
2. Design, construction inspection, testing, measurement, independent verification and certification requirements for ENERGY STAR Certified Homes Version 3.1 are outlined in the “National Program Requirements ENERGY STAR Certified Homes Version 3.1 (Rev 09)” document, which can be found on the ENERGY STAR website.

C. Air Infiltration: Provide air barriers and other air sealing measures as required for creating a complete exterior building envelope. Install air infiltration barriers to control air leakage into and out of building envelopes. Air barrier products may include mechanically attached membranes “housewraps”, self-adhered membranes, fluid-applied membranes, closed-cell spray polyurethane foam, open cell spray polyurethane foam, or board-stock. , When specified, spray foam must be Greenguard-rated. Some air barriers may be water vapor permeable, while others may also function as vapor barriers. Provide all air barrier accessories required to connect and maintain air tightness between air barrier materials, assemblies and components, and to fasten them to the structure of the building; i.e., sealants, tapes, backer rods, transition membranes, nails/washers, ties, clips, staples, strapping and primers. Inspect materials and accessories as they are installed, to verify that the air barrier has no punctures and is completely sealed.

1. All dwelling units in multifamily buildings shall be compartmentalized, in order to reduce the transfer of moist air, smoke, odors, pests and noise from adjacent dwelling units and common spaces.
 - a. Provide air barriers and other air sealing measures at common walls between dwelling units, and between dwelling units and common spaces;
 - b. Seal all plumbing chases, exhaust ventilation and heating system components, electrical outlets and controls, window and exterior door rough openings, and intersections between interior, party and demising partitions with exterior walls, etc.; and,

- c. Air Infiltration rates shall be less than or equal to 0.30CFM50, as determined by a certified rater using a RESNET HERS-approved protocol.
 2. If a housewrap is the air barrier material chosen, follow manufacturer's recommendations for installation.
 3. Exterior sheathing shall be a nail-able wood product, with a minimum nominal thickness of ½". Structural, APA grade-stamped CDX fir plywood is preferred. Panels shall be stress-rated for job conditions; ½" (min.) at walls, and ⅝" (min.) at roofs.
 - a. If OSB panels are specified, provide high-performance, water-resistant panels bonded with phenolic resin.
 - b. Consider using all-in-one structural sheathing and water-resistive barrier engineered wood roof and wall sheathing panels with integrated protective barriers and manufacturer's seam tape.
 4. Floor sheathing shall be ⅝" (min.) thick, tongue and groove, APA grade-stamped structural panels. Veneer-faced or sanded-face plywood panels are preferred.
 - a. If OSB panels are specified, provide high-performance, water/mold/fungus/termite-resistant tongue and groove panels bonded with phenolic resin. Screw underlayment @ 8" o.c. (min.). All joints shall occur over structural framing members.
 5. Install Class II vapor retarders with a vapor permeability of 0.1 to 1 perm (as tested by ASTM E-96 Test Method A – desiccant or dry cup method) in above-grade exterior wall assemblies. In new construction and significant renovations, paper-faced cavity insulation may be used, or provide un-faced cavity insulation, dry-blown/loose-fill/spray cellulose or low-density spray foam insulation in conjunction with a Class II vapor retarder. A Class III vapor retarder with a vapor permeability of 1.0 to 10.0 perms may be used in exterior walls with a vented exterior cladding or with insulated sheathing with R-value \geq R5 over a 2 x 4 wall or \geq R7.5 over a 2x6 wall.
 6. Flashing/insect barriers at wall bases shall be detailed and specified for all conditions where the outside grade is less than 8" below the interior floor elevation. The flashing material used shall be compatible with the surface it is attached to.
 7. Use termite-resistant building materials, or provide termite control through physical barriers between subterranean termites and wood-framed structures. Physical barriers include termite shields, aggregate, stainless steel mesh, and plastic impregnated with a termiticide. Isolate particularly vulnerable elements of a house, such as beneath concrete slabs on grade, along the interior and exterior of perimeter foundation walls, and around plumbing and wiring penetrations. Wherever finished grade will be less than 8" below the bottom of the sill plate, apply borate to wood framing materials from the bottom of the sill to 3' high (min.).
- D. Air Sealing Measures:** Dwellings must provide the air sealing measures indicated below, as may be applicable to the proposed design and building material assemblies. Note that many of the required air sealing measures involving the use of caulking, to seal construction joints in fiberglass batt-insulated walls and ceilings, may be obviated through the use of spray-on and/or pour-fill foam insulation.
1. If basement or below-grade spaces are designed and constructed to be occupied, basement walls should be perimeter- insulated with R-10 (minimum) vapor-impermeable rigid insulation panels with taped, sealed joints or with \geq 1" closed cell foam to prevent interior air from contacting cold masonry walls. No interior vapor barriers should be installed in basements. Provide sealant at joints between wood wall and first floor rim framing members, perimeter rigid insulation panels and interior finish panels.

2. Framed spaces that connect conditioned areas to unconditioned attics, basements or crawl spaces shall be sealed on both sides with sheet material and/or sealant. These areas include chases for plumbing, duct work, chimneys and flues. If soffits are to be installed adjacent to unconditioned spaces e.g. unconditioned attics a sealed air barrier shall be installed to the unconditioned space before the soffits are framed. For chases with high temperature heat sources, noncombustible sheet materials, such as sheet metal and high temperature caulk, shall be used. Where the code prohibits sealing this gap (such as with fireplace flues) manufacturer-supplied sheet metal shall be used that fits the flue pipe as closely as allowed. Breaks in framing and interior finish materials that connect unconditioned and conditioned areas, such as for dropped soffits and changing ceiling heights, shall be sealed with blocking or sheet material and sealant.
3. All holes in the floor assembly for plumbing, wiring, ductwork, and other purposes connecting conditioned and unconditioned (and exterior) areas shall be sealed. Penetrations for flues and other heat-producing items shall be sealed with noncombustible sheet materials and high temperature sealant.
4. Air-impermeable insulation blocking shall be installed between joist cavities underneath kneewalls to seal the floor joist cavities. Align the outside face of the blocking with the inside face of the kneewall framing, to allow cavity insulation to extend under the kneewall. Seal seams at any location where attic air may enter the band area between conditioned floors.
5. Bottom plates shall be sealed to foundations and floors with a foam gasket beneath the bottom plate and a suitable sealant. Apply sealant between the interior of wall plates and gypsum board wall panels and between the exterior of wall plates and exterior wall sheathing.
6. The shim space between the framing for window or door (including attic access) rough openings and the installed units shall be sealed with non-expanding spray foam sealant, closed cell foam backer rod, spray applied insulation, or other suitable sealant. Cellulose, fiberglass or rock wool batt insulation is not acceptable as a sealant but can be used as a backing for a sealant (such as caulk). Thresholds for exterior doors shall be sealed to the subfloor.
7. All gaps in exterior sheathing, such as seams between adjacent sheets, shall be sealed with a proper sealant. All penetrations, such as holes drilled for condensation lines and utility boxes, shall be sealed with an expanding “J” or equivalent. Tape all joints in foam sheathing. Extend sheathing below bottom plate and seal.
8. All holes drilled for piping, conduit, wiring and other penetrations through the rim joists, must be sealed.
9. All duct, electrical, plumbing and other penetrations through insulated floor systems (such as basements, crawlspaces, and garages) over unconditioned areas must be sealed.
10. All penetrations through insulated ceilings, including HVAC duct boots, bathroom fans, light fixtures, sprinkler heads, security, and audio speakers must be sealed.
11. Recessed can or high hat lights in ceilings with unconditioned areas above, must meet the energy code specification (2000 IECC section 502.1.3 section 1 or 3) for air tightness, and must be Insulation Contact-rated.
12. Floors with conditioned area over unconditioned open areas shall have the floor joist cavity sealed with air-impermeable insulation blocking and sealant above the top plate of the bearing wall.

13. Doors in kneewalls and attic scuttle holes that connect conditioned space to unconditioned attic areas shall be weather-stripped and latched to provide an airtight seal against the door trim and wall drywall.
14. All seams in band joists between conditioned floors shall be sealed.
15. Plumbing penetrations shall be blocked with air-impermeable insulation and sealed at edges with proper sealant. Rockwool, or similar products, shall not be used. An interior air barrier shall be installed behind tub and shower units on insulated walls before installing bath and shower assemblies. The air barrier material must be sealed with a proper sealant and the exterior wall must be insulated to the requirements of the energy code.
16. All penetrations of drywall in insulated walls, including wall switches, electrical outlets and kneewall door rough openings shall be sealed.
17. Drywall shall be sealed to the top plate of all walls at ceilings separating attic from conditioned space. Gaskets, caulk or foam can be used to air seal the top of the walls at any stage of the installation.
18. To reduce the potential for air infiltration in fire-rated party walls, walls separating unit envelopes to be constructed using rated construction systems that do not require the use of airspace or “gap” between two independent walls are encouraged. One such system is the U370 system, which also may provide superior sound abatement qualities.

E. Sealants and Caulking: Furnish and install sealants according to Section **07010.D.**, and as otherwise required, to provide a complete and finished installation of building systems, components, fixtures, fittings and accessories, and to protect building systems, components, fixtures, fittings and accessories from water and/or air penetration. Caulk all exterior joints between dissimilar materials, around the exterior frames of all windows and doors, and all control joints. Organic-type caulking is not acceptable. Take extra care to provide a smooth, consistent, and clean application of sealant in all areas where the sealant bead is exposed. Consult the sealant manufacturer prior to installation to verify the proper type and chemical composition of sealant for each type of application.

1. The contractor shall furnish and install backer rods in all expansion joints or any joint where movement is to be expected prior to installation of sealant to ensure the correct hour glass profile of the sealant, and to provide a suitable stop for the sealant in deep joints.
2. All interior sealants shall have a maximum VOC content of 50 g/L, and exterior sealants shall have a maximum VOC content of 100 g/L. Provide a 5-year manufacturer’s standard material warranty, including replacement of sealant materials which fail to adhere, cure or provide a water-tight seal.

F. Exterior Envelope Air Infiltration Testing: Before insulation and interior finishes have been installed, carefully examine joints and penetrations in the exterior building envelope assembly, including duct, conduit, and pipe penetrations. It is strongly recommended that a blower door test be performed at this stage, while the framing and insulation are visible and accessible, so corrections can be made. The air-tightness of the dwelling unit must also be tested by a professional energy auditor using a calibrated blower door test prior to occupancy, to ensure that air sealing measures have been effective, in order to verify ENERGY STAR compliance and to qualify for Connecticut Energy Efficiency Fund (CEEF) energy incentives.

07200 Insulation

A thermally-protected building envelope shall be provided with insulation material having the minimum thermal-resistant values listed, not including windows and doors. Provide roof/attic floor details that allow for the full depth of attic ceiling insulation to extend over the exterior wall plate. Where roof framing is insulated, full-width baffles shall be placed between framing members in all framing bays to allow for cold air movement across the bottom of the roof sheathing and to prevent insulation from migrating in to the vented soffit area. Minimum insulation levels shall meet or exceed ENERGY STAR Multifamily New Construction (MFNC) program performance requirements for Climate Zone 5 & 4 Marine. Note that each of the individual minimum energy efficiency requirements indicated in the MFNC requirements should be evaluated as parts of a comprehensive building thermal envelope, in accordance with the best current building science practices. For all new and gut rehab projects, and any less-than-gut rehab projects that will be retrofitted with additional insulation, the building envelope must be evaluated by a professional engineer, and/or RESNET HERS, BPI or ENERGY STAR certified assessor/rater, to ensure that the specified building assemblies will allow for adequate drying to the interior and/or exterior, and don't create a conditions for chronic moisture saturation, which might lead to a reduction in energy performance, or deterioration of materials.

- A. ENERGY STAR Building Envelope Insulation Recommendations for Climate Zone 5 and 4 Marine:**
1. Top Floor Ceiling Assemblies: R-38 – R-60
 2. Floor Assemblies: R-25 – R-30
 3. Wall Assemblies: R-19 – R-21
- B. Insulation Installation Requirements:** Installation of all insulation shall be performed with the utmost care, with the highest standard of professional workmanship, in strict compliance with manufacturer's specifications and insulation instructions, and RESNET HERS "Grade I" standards. Third-party verification by a RESNET HERS accredited RESNET HERS Rater as "Grade I" insulation is required for ENERGY STAR compliance and to qualify for CEEF energy incentives.
- C. Continuous Insulation:** Where continuous insulation is required over framed areas with fully-insulated cavities, provide rigid foam insulation panels, such as expanded polystyrene, extruded polystyrene, or polyisocyanurate, as required. Follow manufacturer's recommended means and methods of installation, including proper adhesives, fasteners and joint-sealing tape.
- D. Insulated Sheathing Panels:** Where exterior finishes are to be installed over continuous insulation, consider composite insulating sheathing panels consisting of 4' x 8' closed cell polyisocyanurate foam bonded to fiber-reinforced facers on one side, and 1/2" or 5/8" CDX plywood or OSB sheathing on the other, or panels consisting of 4' x 8' closed cell polyisocyanurate foam bonded to fiber-reinforced facers on one side, a middle layer of 1", 1 1/2" or 2" solid wood ventilation spacers, and a top layer of 1/2" or 5/8" CDX plywood or OSB sheathing. Follow panel manufacturer's recommended means and methods of installation, including proper adhesives, fasteners and joint-sealing tape.
- E. Plumbing:** Avoid installing pipes that carry water – hot and cold supply pipes, steam lines, hydronic heat pipes and air conditioner condensate lines - in exterior walls. If plumbing in the exterior wall cannot be avoided, a separate plumbing chase wall shall be provided inside the insulated exterior wall.
- F. Interior Walls with Plumbing Intersecting Exterior Walls:** Where unit separation walls or other interior walls with plumbing intersect exterior walls, insulation shall be placed in the first framing bay of the framed interior wall to minimize the chance for frozen pipes in other framing bays.
- G. Insulated Headers:** Provide R-10 (min.) insulated headers. Consider pre-fabricated insulated headers, with engineered lumber framing and rigid-foam cores.

- H. Energy Heel Trusses/Raised Top Plates:** Extend full depth of the required attic insulation over exterior wall top plates at energy heel trusses with raised top chords, and raised top plates at joist/rafter assemblies.
- I. Attic Ventilation:** Eave soffit and continuous ridge ventilation and/or through-wall gable-end vents shall be provided in sizes required to vent attic spaces. Install equal capacities of clear ventilation in the soffits/eaves and the gable ends/ridges. Provide 2 ft² of net free area of venting for every 150 ft² of attic floor (min.). Keep insulation from blocking the soffit vents.
- J. Attic Access Doors:** Adhere R-20 (min.) rigid insulation onto the back of attic access doors and scuttle covers.
- K. Foundation Walls:** Provide R-15 (min.) vapor-impermeable rigid foam insulation with taped joints.
- L. Bond-break at Contiguous Slab Locations:** Concrete slabs in unconditioned areas that are in contact, or may come into contact, with slabs in conditioned areas due to settlement, shall be separated with an insulating material covering the entire surface of potential slab contact.
- M. Insulated Corners:** Extend required exterior wall insulation into the outside corner of two insulated walls framed with two-stud “California” corner framing with furring or drywall clips, or equivalent alternative framing technique.
- N. Insulated T-Walls:** Provide continuous insulation at the intersections of an interior and insulated exterior walls framed with horizontal ladder framing, full-length furring, drywall clips or equivalent alternative framing technique.
- O. Alternative Insulation Products:** Consider the use of alternative insulation products, such as recycled content, formaldehyde-free fiberglass, dry-blown, loose-fill or spray cellulose, spray-on/pour-fill cellular plastic insulation and/or a hybrid Insulation and air-sealing system (fast-setting, low-expanding two-part foam framing envelope sealant and fiberglass batt insulation infill).

07310 Roofing

Where four-sided recesses are provided for screening mechanical equipment, the depth of such recesses should not exceed the installed height of the tallest specified piece of equipment intended to be screened.

- A. Material Standards:** Provide materials complying with governing regulations, and which can be installed to comply with the factory mutual requirements for Class 1 of Noncombustible, including zoned resistance, and the UL Fire Classified and Class 1-90 wind uplift resistance. Comply with published recommendations of shingle manufacturer details and recommendations of NRCA Roofing Manual for installation of underlayment and shingles, using number of nails and coursing of shingles in accordance with manufacturer’s standards.
- B. Underlayment:** Roofing felt: 15 lb., asphalt-saturated non-perforated organic roofing felt, complying with ASTM D226, 36" wide, approximate weight 18 lbs. per square. Provide an adhesive ice and water protection membrane where roof slopes are less than 4:12 pitch, and at all valleys, roof penetrations, eaves, intersections of walls and roofs, hips, and wherever else required by job conditions. Apply sufficient layers of ice and water protection membrane at the eaves to cover the sheathing from drip edge to 24" inside any heated spaces below. Follow all the manufacturer's specifications for installation. Separate dissimilar metals with an ice and water protection membrane.
- C. Flashing:** Provide copper or pre-finished aluminum drip edge flashing at roof eaves and rakes, roof to chimney/wall/skylight connections, other horizontal roof material transitions, fastened with compatible metal

fasteners.

- D. Asphalt Cement:** Provide fibrated asphalt cement complying with ASTM D1822, designed for trowel application where required.
- E. Shingles:** Provide asphalt fiberglass shingles on sloped roofs. Install mineral surfaced, self-sealing, fiberglass asphalt shingles with a 30-year warranty. Provide manufacturer's standard factory-precut ridge shingles units to match shingles or job-fabricated units cut from actual shingles used. Asphalt shingles shall meet ASTM D3462 standard verified by UL, and have a minimum warranty-period of 30 years. The minimum warranty-period for labor shall be 10 years, No-Dollar-Limit (NDL).
- F. Shingle Fasteners:** Provide aluminum or hot-dip galvanized 11 or 12 gauge sharp pointed conventional roofing nails with barbed shanks, minimum 3/8" diameter head, and of sufficient length to penetrate minimum 3/4" into solid decking or to penetrate through plywood sheathing. Provide minimum 6 nails per shingle.
- G. "Cool" Roofing:** All roof coverings shall meet ENERGY STAR criteria for cool roof products:
1. Low slope applications (2:12 or less - as defined in ASTM Standard E 1918-97): initial solar reflectance ≥ 0.65 and 3-year aged minimum solar reflectance ≥ 0.50 . Products that are typically installed on low-slope surfaces include single-ply membranes, built-up-roofs, modified bitumen, spray polyurethane foam, roof coatings, and. Some products that are typically installed on low-slope roofs may also be installed on steep-slope roofs (e.g., single-ply membranes and roof coatings).
 2. Steep slope applications (greater than 2:12 pitch): initial solar reflectance ≥ 0.25 , and 3-year aged minimum solar reflectance ≥ 0.15 . Products that are typically installed on steep-slope surfaces include composite shingles, clay, concrete, or fiber-cement tile, slate, shakes, architectural profiled metal, standing-seam profiled metal and individual metal roof components.
 3. To avoid condensation under light-colored, reflective membrane roofing, insulate fastener heads from the building exterior and eliminate air flow through the system. Mechanically-fasten the first layer of insulation over a vapor barrier into the decking, adhere the second layer of insulation to the first layer of insulation, and then adhere the roof membrane to the top layer of insulation.
 4. Consider providing light-colored metal roofing for long-term reduced maintenance and increased useful life. For re-roofing projects, metal roofing may be able to be applied over the original roof, saving removal and disposal costs.
- H. Membrane Roofing:** Single-ply membrane roof covering shall have a minimum warranty period of 20 years, covering both labor and materials, with NDL. Minimum slope to drains shall be 1/4" to 1'-0".
- I. Gutters and Downspouts:** Where on-site rainwater collection/retention is not provided, rain from the roof shall be collected in a roof gutter system and directed via downspouts such that water is discharged at least 5' away from the foundation. The minimum thickness for aluminum gutters shall be 0.032", and 0.027" for aluminum flashing material.
1. Where gutters are not desirable, roof overhangs shall be no less than 24", and a ground gutter system, not less than 12" wider than the overhang shall be provided. Ground gutters shall have 4" to 6" (minimum) of decorative stones over 16" (minimum) of processed stone, with (2) filter fabric-protected 4" perforated PVC pipes draining to rainwater collection/retention cisterns, drywells or approved outfalls.

07460 Siding

Low-maintenance siding materials, such as vinyl, recycled-content hardboard, and pre-finished fiber-cement boards and panels are preferred. Solid-stained wood, applied over rainscreen panels or other pressure-equalizing, venting materials/assemblies may be used; pre-primed pine or cedar boards/battens, or cedar shakes/shingles shall be free from knots, defects and warpage. Where wood siding is provided, prime all cut ends, and back-prime before installation, to protect against dampness.

- A. Vinyl Siding:** When provided, vinyl siding shall be solid color virgin vinyl, with all required accessories and trim pieces, and may include decorative siding products. Standing and running trim may be solid PVC trim boards or siding manufacturer-provided vinyl components. Where horizontal vinyl siding is continuous across two or more stories of wood construction, an expansion joint shall be provided at the floor line to absorb the vertical shrinkage of the wood framing. Vinyl siding shall be at least 0.044" thick; horizontal siding shall have no vertical splice joints unless the width of the wall exceeds the standard 12' length. All splice joints in horizontal siding shall be offset a minimum of 2' from siding joints directly below. Warranty period shall be 20 years, NDL.
- B. Exterior Insulation & Finish System (EIFS):** When provided, EIFS shall not be permitted unless rain-screen panels or other pressure-equalizing, vented back-draining system is specified. EIFS shall not be permitted on any walls at ground-floor level. Where walls are easily reachable by residents from private exterior stairs, balconies, decks, etc., provide heavy-duty reinforcement mesh. EIFS warranty period shall be 10 years, NDL.
- C. Texture 1-11:** Texture 1-11 is not acceptable as the siding/sheathing material for any new construction or gut rehabilitation projects.
- D. Fasteners and Anchorage:** Provide nails, screws, and other anchoring devices of type, size, material, and finish suitable for intended use and as required to provide secure attachment. Conceal fasteners where possible. Hot dip galvanized fasteners for work exposed to exterior and high humidity's to comply with ASTM A153. Staples shall not be used.
- E. Recycled-content Siding:** Recycled-content hardboard siding includes varying amounts of recycled content materials, and may be used wherever wood siding would be desirable.
- F. Fiber-cement Siding:** Fiber-cement siding and panels, composed of cement, sand, and cellulose fibers, may be used wherever wood siding or a stucco finish would be desirable. Fiber-cement siding material warranty shall be 50 years, with a factory finish warranty of 15 years.
- G. Flashing:** Provide 20 oz. copper or 0.027" th. pre-finished aluminum drip edge flashing at window and door head casings and other horizontal siding transitions, column/trim/ledge caps, and at all exposed locations where required, fastened with compatible metal fasteners nails. Aluminum flashing shall not be permitted where flashing is in direct contact with masonry or concrete materials. Provide moldable flashing tape over 20 oz. copper or 0.027" thick pre-finished aluminum head flashing/drip edges/nailing flanges at all windows and doors. Provide soldered copper sill pan flashing, a pre-fabricated recycled polypropylene pan system, or moldable flashing tape at all sills. Provide moldable flashing tape at all jambs.

08000 WINDOWS, SKYLIGHTS & DOORS**08001 Windows and Skylights**

Double-hung and single-hung windows are preferred. Awning and casement windows are acceptable, but their use should be limited due to hardware functioning concerns related to heavy and/or long-term use. For maximum energy performance and resistance to air leakage is desirable, consider tilt/turn sash with multi-point locking operating hardware. The use of awning and casement windows in elderly developments is discouraged; however, where such windows are determined to be the best option available, provide accessible hardware, installed in accordance with current ICC/ANSI A117.1 requirements. Sliding windows are not acceptable. Basement windows shall be operable awning units with insulating glass and vinyl insect screens. Size all window units as required to meet code requirements for natural light, ventilation and egress.

A. Window Materials: Vinyl and aluminum-clad wood, vinyl and fiberglass sash materials are preferable, but extruded aluminum frames may also be acceptable. Where aluminum is provided, hollow sections of frames and sash shall be thermally-broken and insulated. Provide argon gas-filled, low-E-coated, insulating glass. Latching devices and fiberglass screens in aluminum frames shall be provided for all operable windows. Screen frame corners shall be mitered and reinforced with concealed aluminum “L” reinforcing; vinyl corner splines are not acceptable. Where full screens are specified, provide intermediate screen mullions. Where half screens are specified, and where window air conditioners are to be utilized, provide sliding, locking screens. Manufacturer’s warranty for window assemblies shall be 10 years (min.). All windows shall conform to all code requirements, including those for safety glazing and emergency egress. Provide emergency exit and rescue openings as defined by IBC Section 1030 for all sleeping areas where there is only one exit from a story. This includes townhouse units and multistory units over flats following the IBC.VOC

B. Energy and Performance Requirements: All window, door and skylight areas and U-factors must comply with all energy code and ENERGY STAR requirements, unless otherwise noted. Windows, skylights, and glass doors shall be manufactured in accordance with National Wood Window and Door Association (NWWDA), American Architectural Manufacturers Association (AAMA), Window and Door Manufacturers Association (WDMA) and Canadian Standards Association (CSA) standards, rated by the National Fenestration Rating Council (NFRC), and labeled accordingly. All windows shall have been tested according to AAMA/WDMA/CSA 101/I.S.2/A440-08 standards, within the past four years, and shall have met or exceeded the following performance standards: minimum performance grade LC-PG40; minimum design pressure 40 psf; minimum structural test pressure 60.5 psf; minimum water penetration test pressure 6 psf; positive test pressure 75 Pa (1.6 psf); and maximum allowable leakage 0.30 cfm/sf.

1. All windows shall have a maximum Thermal Transmittance Coefficient (U) value of 0.27 (R-3.7) and a maximum Solar Heat Gain Coefficient (SHGC) value of 0.40. In air-conditioned units, with southeast-, south- and southwest-facing windows that are unshaded in the summer, the maximum SHGC shall be 0.30.

a. The required U value for windows in homes with a window area to above-ground conditioned floor area (WFA) ratio greater than 15% shall be adjusted according the following formula:

$$\text{Adjusted U value} = [0.15/\text{WFA}] \times 0.27$$

2. All skylights shall have a maximum U value of 0.50 (R-2) and a maximum SHGC value of 0.40.

a. The required U value for skylights in homes with a window area to a WFA ratio greater than 15% shall be adjusted according the following formula:

$$\text{Adjusted U value} = [0.15/\text{WFA}] \times 0.50$$

C. Design Pressure Rating (DPR): All windows shall comply with Design Pressure Ratings (DPR) as required by code. Analyze the building site for exposure category, based on the quantity and spacing of wind obstructions. Determine the required DPRs based on the basic wind speed for the local municipality/code, the height and width of the building, the sizes and locations of windows on the building and the height and exposure adjustment coefficient. Provide manufacturer’s standard, or manufacturer-modified, structurally upgraded window sash, frames, mullions and fasteners to meet the required DPR(s).

- D. Security and Operation:** Windows within eight feet of grade, or otherwise accessible without the use of a ladder, shall be forced entry resistant meeting AAMA/WDMA/CSA 101/I.S.2/A440-08 standards.
- E. Materials/Finishes:** All wood windows shall be clad with solid-color vinyl, or factory-finished aluminum with a high performance baked enamel paint finish, except as may be required in historic preservation projects. All fiberglass and/or fiberglass and wood windows shall be factory-finished with high performance paint finishes. Aluminum windows shall have a high performance baked enamel paint factory finish; anodized aluminum finishes are not acceptable.
- F. Vinyl (PVC) Windows:** When selected, vinyl (PVC) windows shall be manufactured by a single manufacturer having a minimum of ten (10) years of experience producing PVC windows. Window units shall have a minimum frame material thickness of 0.070", a minimum sash thickness of 0.065", factory-balanced block and tackle sash balances in compliance with AAMA-902 and cam-type sash locks.
- G. Fiberglass Windows:** Consider fiberglass windows for dimensional stability and thermal performance which may outperform wood and vinyl. When selected, fiberglass windows shall be provided by a single manufacturer having a minimum of ten (10) years of experience producing fiberglass windows.
- H. Extra-high-performance Glazing:** Consider optimizing window performance by providing extra-high-performance glass. Triple glazing with suspended film coatings, and double interior interspaces with argon/krypton gas, can provide superior insulating values (U values $\leq .20$ and R-values ≥ 5), UV blockage, sound control, condensation resistance, and radiant comfort. Glazing options can be directionally "tuned" for natural lighting and solar energy conditions on northern, eastern, southern and western building orientations, to provide passive solar heating benefits in the winter, and moderate mid-day and afternoon overheating in the summer.
- I. Acoustical Windows:** Where development properties are located near train lines, highways and/or airports, windows with a minimum Sound Transmission Rating of STC 34 shall be provided.
- J. Installation:** Comply with manufacturer's instructions and recommendations for installation of door, window, and skylight units, hardware, accessories, and other components of work. Set units plumb, level, and true to line without warp or rack of frames or sash. Provide proper support and anchor securely in place. Provide joint fillers and sealants as required. Check for proper operation, adjust for proper closure and lubricate hardware.

08100 Doors

All unit entrance doors, and all interior passage doors in elderly housing, shall be 36" wide. All interior passage doors in family developments shall be 32" wide (min.), or as otherwise required for accessibility.

- A. Insulated Steel, Fiberglass and Composite Doors:** Provide foam core insulated steel, fiberglass, or wood veneered steel composite exterior unit entry doors, with thermally-broken, adjustable, barrier-free thresholds. Sides and tops of doors shall be provided with foam-filled, compression-type weather-stripping, and bottoms of doors shall be provided with triple-contact (min.), extruded vinyl compression tube and blade sweeps. When selected, provide metal exterior unit entry doors with 25 gauge (min.) galvanized steel facings and thermally-broken, interlocking steel edges. Hinge stiles, lock stiles and top rails shall be solid, finger-jointed or laminated wood. Bottom rail reinforcement shall be rot-resistant, wood/fiberglass composite. Door jambs shall be reinforced with 2 x 4 horizontal bracing at strike and latch heights. Wood jambs at exterior and unit entry doors shall be rabbeted and finger-jointed.

1. Unit Entry Door (U) and SGHC values:
 - a. All opaque doors shall have a maximum U value of 0.17
 - i. The required U value for opaque doors in homes with a WFA ratio greater than 15% shall be adjusted according the following formula: Adjusted U value = $[0.15/WFA] \times 0.17$;
 - b. All doors $\leq \frac{1}{2}$ Lite shall have a maximum U value of 0.25 and an SHGC-value of 0.25
 - i. The required U value for opaque doors in homes with a WFA ratio greater than 15% shall be adjusted according the following formulas: Adjusted U value = $[0.15/WFA] \times 0.25$
Adjusted SHGC-value = $[0.15/WFA] \times 0.25$; and,
 - c. All doors $> \frac{1}{2}$ Lite shall have a maximum U value of 0.30 and an SHGC-value of 0.30
 - i. The required U value for opaque doors in homes with a WFA ratio greater than 15% shall be adjusted according the following formulas: Adjusted U value = $[0.15/WFA] \times 0.21$
Adjusted SHGC-value = $[0.15/WFA] \times 0.30$.

B. Wood and Molded Wood Fiber Doors: All interior passage doors shall be solid-core flush wood or molded wood fiber. Provide doors with wood stiles, MDF top and bottom rails, and low-VOC particleboard cores. Sliding doors and pocket doors are not acceptable. Bi-fold doors are not acceptable, unless they meet the 1994 HUD guideline (or most current) spec for custom, fully-adjustable “heavy-duty bi-folding closet doors”.

C. Aluminum and Glass Entrances, Curtain Walls and Storefronts: For projects requiring aluminum and glass entrance doors and storefront windows, provide single acting, offset pivot or butt hung aluminum and glass doors in thermally-broken framing with low-emissivity, double- or triple-pane insulated glazing. Provide assemblies with ENERGY STAR maximum thermal resistance and solar heat gain coefficient values: U-0.35/SHGC-0.40 metal-framed curtain wall/storefront; U-0.70/SHGC-0.40 metal-framed entrance doors; U-0.45/SHGC-0 at all other metal framing. Baked enamel paint finishes for aluminum and glass doors are preferred to anodized finishes, and sliding doors are discouraged due long-term operation and maintenance issues. Aluminum and glass doors shall be tested for air infiltration in accordance with ASTM E283, and for thermal performance in accordance with ASTM C236 and AAMA 1503, and forced entry resistant in accordance with AAMA/NWWDA/CSA 101/I.S.2-/A440-08 requirements.

D. Patio Doors: In-swing French doors are preferred. In areas where the crime of breaking and entering is prevalent, swing doors in lieu of sliding doors shall be used as access to ground level patios. Sliding glass doors with panels more than 3'-0" wide (nominal) shall not be used. Where sliding doors are desirable, provide minimum factory-finished AAMA Performance Grade CW-40 aluminum sliding doors meeting ENERGY STAR requirements for doors with $>1/2$ lite (≤ 0.30 U-Value & ≤ 0.40 SHGC), with a minimum water resistance of 12 psf and maximum air leakage ≤ 0.10 cfm. In housing for elderly residents, provide swinging French doors to patios in lieu of sliding glass doors. Where vinyl French doors are desirable, provide minimum DP-35 rated single and double swing doors with continuous metal core construction (reinforcement in stiles, rails and corners), stainless steel multi-point locksets and adjustable hinges tested ANSI Grade 3 requirements (220 lbs.). Particular attention during should be made toward addressing accessibility requirements for thresholds and 32" (min.) clear opening widths for egress.

E. Screen and Storm Doors: When selected, provide pre-hung, heavy-duty, pre-finished aluminum screen and storm doors with foam-insulated frames, heavy-duty extruded aluminum corner gussets, hinges and closers, tempered glass and weather-stripping. Sliding screen doors with roll-formed frames are not acceptable.

08710 Hardware

Provide all required finish hardware, including, but not be limited to all butts, hinges, locksets, mortise locks, passage sets, privacy sets, push-pulls, door stops, catches, coordinators, flush-bolts, shutter hardware, hooks, house numbers and peep-hole viewers. All hardware shall be Grade 2 (minimum) per ANSI/BHMA Standards, which

should be reflected in each individual BHMA product number. All door hardware, including sliding glass door roller assemblies, door hinges, handle sets, door locks/multipoint locking hardware, etc. shall meet current AAMA Performance Requirement standards. All hardware shall be installed with the screws, bolts, and fasteners provided by the manufacturer and packaged with the hardware.

- A. Entrance Doors:** All entrance doors shall have Mortise-type locks. A hotel-type electronic card-key security system is preferred for apartment buildings. Peepholes with fish-eye viewers are required for front doors of apartment units and townhouses if the doors have no sidelights. Barrier-free units shall have a second peephole at 42" above the finish floor. Doorbells or door-knockers shall be provided at the main entrance door to all dwelling units.
- B. Locksets:** All unit entries shall have door locks with simultaneous retraction of the dead bolt and dead latch from the inside and a single key operation from the exterior. The dead bolt shall have a 1" throw. The dead latch shall have a 1/2" throw. Unit entry hardware shall not have parts made of plastic.
 - 1. Bathrooms and master bedrooms shall have door locks that are non-locking against egress, with panic release operation;
 - 2. Stair tower doors, first through sixth floors, to the corridor shall have self-locking dead latches and trigger bolt protection prohibiting entry from the stair tower to the corridor. In buildings over three stories, these doors shall also have electric strike releases that will unlock upon signal from the fire alarm; and,
 - 3. Rated exterior doors from common spaces, stairs, maintenance areas etc. shall have adjustable self-closing devices, self-locking dead latches and trigger bolt protection.
- C. Door Hardware:** Handles, pulls, latches locks and other operable parts on Accessible doors shall have a shape that is easy to grasp with one hand and does not require tight grasping, pinching or twisting of the wrist to operate. Lever handles shall be provided at all doors in buildings designed for elderly residents, and in all barrier-free units.
- D. Hinge Pins:** Out-swinging exterior doors shall have non-removable hinge pins or shall have security type hinges that prevent unauthorized door removal.
- E. Electric Locksets:** Exterior doors intended for common entry, in buildings designed for multiple dwelling units for elderly residents, high-rise developments in large metropolitan areas, and all buildings designed for multiple dwelling units in areas where security from trespass is anticipated as a substantial problem, shall have code-compliant electric security with multi-point entry door locks, multi-point exit door locks and exit devices. Such doors shall be electronically-controlled by telephone-based intercom/remote entry and key fobs, key cards, etc.
- F. Alarms:** Exterior doors intended only for emergency exit from buildings designed for multiple dwelling units for elderly residents, high-rise developments in large metropolitan areas, and all buildings designed for multiple dwelling units in areas where security from trespass is anticipated as a substantial problem, shall have door-ajar alarms wired to a central control panel. Such doors shall be provided with panic hardware and signage which clearly indicates "Emergency Exit Only – Door Alarm Will Sound". Door-ajar signals shall require manual re-setting.

09000 FINISHES

09250 Gypsum Board and Acoustic Ceiling Panels

- A. Gypsum Board:** Manufacturer’s recommendations shall be followed in specifying ceiling drywall adequate for supporting the weight of specified attic insulation. Only gypsum board panels manufactured in the United States, and labeled “made in the U.S.A.” with the manufacturers name and manufacturing site location, shall be provided.
1. Provide the following materials as required by code, the Standards, project design and job conditions:
 - a. Gypsum Wall Board: ½" (min.) gypsum-core wall panels surfaced with paper on front, back, and long edges in compliance with ASTM C 36 and C 1396;
 - b. Gypsum Ceiling Board: ½" (min.) gypsum-core ceiling panels with additives to enhance the sag-resistance of the core; surfaced with paper on front, back, and long edges; in compliance with ASTM C 1395 and C 1396;
 - c. Fire-rated Gypsum Board: ⅝" (min.) gypsum core wall panels with additives to enhance fire resistance of the core and surfaced with paper on front, back, and long edges; in compliance with ASTM C 36 and C 1396, Type “X”;
 - d. Mold-resistant Gypsum Board [bathroom walls and ceilings, kitchen walls and wherever wall tile is indicated (except within tub and shower enclosures)]: ½" (min.) gypsum core wall panels with additives to enhance water resistance of core; surfaced with moisture/mold/mildew-resistant paper on front, back, and long edges; in compliance with ASTM C 630 and ASTM C 1396, and having a mold and mildew resistance ASTM 3273 panel test score of 10;
 - e. Fire-rated Mold-resistant Gypsum Board: ⅝" (min.) gypsum core wall panel with additives to enhance fire resistance of the core; surfaced with moisture/ mold/mildew resistant paper on front, back, and long edges; and complying with ASTM C 630 and ASTM C 1396, Type “X”, , and having a mold and mildew resistance ASTM 3273 panel test score of 10;
 - f. Cement Backer Board [tub and shower wall enclosures]: ½" (min.) cementitious, water durable panels, surfaced with fiberglass reinforcing mesh on front and back, with long edges wrapped; and complying with ANSI A118.9 and ASTM C 1325; and,
 - g. Gypsum Sheathing Board: ½" (min.) gypsum core wall panels with additives to enhance the water-resistance of the core; surfaced with water-repellant paper on front, back, and long edges; and complying with ASTM C 79 and C 1396.
 2. Consider providing soundproof fire-rated and non-fire-rated ½" and ⅝" thick drywall panels, with STC ratings ranging from 49 to 74, in lieu of standard sound attenuation techniques such as resilient channels and clips.
- B. Gypsum Board Accessories:** Provide gypsum board accessories in compliance with ASTM C 1047. Use corrosion-resistant steel furring channels to attach drywall to inside faces of concrete or C.M.U. walls, except in below grade spaces. Use corner beads at all outside corners and edges. Use J-trim as required by details/job conditions. Use drywall screws to fasten panels to studs as recommended by the drywall manufacturer. Use manufacturer's recommended reinforced tape and joint reinforcement at all seams, corners and screw heads. In order to eliminate or reduce shrinkage and expansion cracking, manufactured drywall expansion joints shall be placed in long corridor walls above each jamb of all door openings, and elsewhere as required by details/job conditions.
- C. Acoustic Ceiling Panels:** Consider using acoustic ceiling panels with recycled content, low or zero formaldehyde emissions, anti-microbial treatments and high light reflectance values for resource conservation and indoor air and light quality.

09650 Floor Finishes

Floor finishes must be provided over all substrates of plywood, "gypcrete" or lightweight concrete. Where gypcrete is provided, follow the manufacturer's recommendations for compressive strength(s) based on the substrate(s) provided.

A. Resilient Flooring: 1/8" thick (min.) resilient flooring or vinyl composition tile (VCT) is acceptable for use in kitchens, bathrooms, laundry areas and storage rooms (except at slabs-on-grade with no vapor barrier).

1. 1/4" thick (4.0 mm) tongue and groove, high-pressure laminate plank flooring with melamine resin/water repellent-treated core material, a 20 mil wear layer and a minimum 15 year warranty is acceptable. Laminate floor products are rated using AC ratings after manufacture to determine the products durability. Choose AC-rated laminate flooring products according to their intended installation location:
 - a. Bedrooms and Closets: AC₂
 - b. Unit Hallways and Living Areas: AC₃
 - c. Community Spaces: AC₄
 - d. Common Lobbies and Corridors: AC₅
2. Consider providing resilient flooring tile made from limestone and ethylene acrylic polymers as a PVC-free alternative to VCT.

B. Rapidly-Renewable Flooring Materials: Consider using bamboo and cork flooring as alternatives to hardwood flooring and carpeting. Provide products made without the use of UF binders, such as bamboo flooring and panel products made with polyisocyanurate or phenol formaldehyde binders.

C. Ceramic Tile: Ceramic tile is acceptable as a wall and floor finish in kitchens, bathrooms, laundry areas, storage rooms and mechanical rooms. Conform to standards and methods in Tile Council of America, Inc. (TCA) Handbook for Ceramic Tile Installation, current edition, and ANSI Standard Specifications for Installation and manufacturer's instructions and recommendations for installation. Use setting materials according to the recommendations of the tile manufacturer. Stone saddles at bathroom doors shall be beveled. Transitions between floor materials shall occur at centerline of doors. Provide sealant at joints where and as recommended by TCA and approved by architect. Tile in wet areas shall be laid on 1/2" waterproof cement backer board at walls, and over 3/4" subfloor at floors. Consider using recycled content ceramic tile in lieu of standard tile.

D. Carpeting: Carpeting in dwelling units is acceptable in living and dining areas, bedrooms and bedroom closets; however, hard-surface flooring with the option for area rugs is preferable to wall-to-wall carpeting. Do not install carpets in basements, entryways, laundry rooms, bathrooms or kitchens. Floor areas designated for carpeting shall be covered with material having a minimum 10 year performance warranty including, but not limited to, abrasive wear static protection, tuft bind and delamination.

1. For all carpeting in moderate traffic areas (inside units) and heavy traffic areas (common corridors, community rooms and public spaces) consider:
 - a. Construction: Tufted level & textured level loop
 - b. Fiber: 100% Nylon
 - c. Dye Method: 70% or greater solution dyed
 - d. Face Weight: 24 oz. or greater
 - e. Standards: HUD UM44d and Green Label Plus Certification Program
 - f. Carpet Emission Limits:
 - i. VOC: 0.50 mg/m² • hr
 - ii. 4-Phenylcyclohexane: 0.05 mg/m² • hr
 - iii. Formaldehyde: 0.05 mg/m² • hr
 - iv. Styrene: 0.40 mg/m² • hr

- v. Standard: Green Label Plus Certification Program
- g. For all cushioning, consider:
 - i. Material: synthetic fiber
 - ii. Standard: Green Label Plus Certification Program
 - iii. Emission Limits:
 - o TVOC's: 1.00 mg/m² • hr
 - o BHT: 0.30 mg/m² • hr
 - o Formaldehyde: 0.05 mg/m² • hr
 - o 4-PCH: 0.05 mg/m² • hr
 - o Standard: Green Label Plus Certification Program
- 2. Moderate Traffic Areas consider:
 - a. Secondary backing: Action backing or unitary backing with 20 lb. tuft or equal;
 - b. Gauge: 1/8 (min.); and,
 - c. Cushion (recommended, but not required) Thickness/Weight: .25" th./6-8 lbs.
- 3. Heavy Traffic Areas consider:
 - a. Secondary backing: unitary backing with 20 lb. tuft or equal;
 - b. Gauge: 1/10 (min.);
 - c. Cushion (recommended, but not required) Thickness/Weight: .33" th./ 6-8 lbs. ;
 - d. Recycled-content carpet, padding, and underlayment made from recycled plastic bottles, wool or cotton; and,
 - e. Floor coverings with PVC-free backing systems, which may be retrieved by their manufacturers at the end of their life cycles free of charge, and nylon fibers in the carpeting may be recycled into new carpet fiber.

09900 Paints and Coatings

- A. Non-toxic Paint Strippers:** In lieu of paint strippers with methylene chloride as the active ingredient, consider using water-soluble, non-caustic and non-toxic paint strippers with the organic solvent N-Methylpyrrolidone.
- B. Low-VOC and Formaldehyde-free Paint and Water-based Wood Finishes:** Specify low-VOC, formaldehyde-free paints. Where wood finishes are required, consider using low-VOC, water-based wood finishes with a maximum VOC content of 250 g/L.
- C. Low-VOC Paint and Architectural Coating Standards:** “Low- VOC” (Clean Air) paints, which meet the regulatory limits in the South Coast Air Quality Management District (AQMD) Rule 1113, are manufactured and sold by numerous companies; however many manufacturers have reformulated to levels well below these limits. Those that meet a VOC standard of <10 g/L are referred to as super-compliant by the AQMD, which maintains a list of manufacturers of super-compliant products on their website.
 - 1. Paints and other architectural coatings shall comply with the following VOC Standards:
 - a. Driveway sealer, flat coatings, floor coatings, non-flat coatings, sacrificial anti-graffiti coatings, and roof coatings: maximum VOC content of 50 g/L;
 - b. Non-sacrificial anti-graffiti coatings, primers, sealers and under-coaters, roof coatings (aluminum,) rust preventive coatings, specialty primers, stains, traffic coatings, waterproof sealers and waterproofing (concrete)/masonry sealers: maximum VOC content of 100 g/L;
 - c. Low-solids coatings: maximum VOC content of 120 g/L;
 - d. Concrete surface retarder, form release compound and stains (Interior): maximum VOC content of 250 g/L;

- e. Clear wood finishes: maximum VOC content of 275 g/L;
- f. Mastic coatings: maximum VOC content of 300 g/L;
- g. Bond breakers, reactive penetrating sealers, roof primers (bituminous) and wood preservatives: maximum VOC content of 350 g/L;
- h. Pre-treatment wash primers: maximum VOC content of 420 g/L;
- i. Metallic pigmented coatings: maximum VOC content of 500 g/L;
- j. Shellac (pigmented): maximum VOC content of 550 g/L; and,
- k. Shellac (clear): maximum VOC content of 730 g/L.

D. Natural Paints and Finishes: Consider using paints and finishes made from natural raw ingredients such as water, plant oils and resins, plant dyes and essential oils; natural minerals such as clay, chalk and talcum; milk casein, natural latex, bees' wax, earth and mineral dyes.

E. Paint: Paint shall be the highest quality grade, and shall be delivered to the site in original containers labeled by the manufacturer, with seals unbroken.

1. Painting Schedule:

- a. Exterior Siding: 2 coats solid-body stain over pre-primed siding;
- b. Exterior Trim: 1 coat primer, 2 coats semi-gloss paint;
- c. Interior Partitions & Walls: 1 coat primer, 2 coats satin or eggshell latex paint;
- d. Interior Ceilings: 1 coat primer, 2 coats flat latex paint; and,
- e. Interior Trim/painted woodwork: 1 coat primer, 2 coats semi-gloss latex paint.

F. Interior Painting Requirements:

- 1. All paint over interior drywall shall meet or exceed the limit of 400 strokes on the scrub ability testing standards established in the most recent version of ASTM D-2486.
- 2. Kitchens and baths shall be painted with a washable semi-gloss paint. Satin sheen or egg shell finish paint may be used if a satin or egg shell finish is used throughout the residential unit. Using one paint type (satin or egg shell) throughout is preferable.
- 3. Dwelling units shall have painted drywall ceilings. Painted concrete ceilings are acceptable where the concrete is part of the structural system, but only where sprayed-on popcorn texturing has been applied.

G. Exterior Painting Requirements:

- 1. If the exterior is stained wood, the finish shall be a solid-body stain, not the transparent or semitransparent type.
- 2. Vents penetrating roofs, with the exception of stainless steel vents, shall be painted with appropriate paint to match the roof shingles.

H. PVC-free Peel and Stick Wall Covering: Where wall coverings are desired, consider using PVC-free self-adhered textile wall covering containing 100% recycled polyester wall coverings in lieu of standard vinyl wall coverings.

10000 SPECIALTIES

A. Interior Signs: Provide interior signs consistent with current IBC and ICC/ANSI A117 requirements.

- B. Mailboxes:** In buildings designed for elderly residents, mailboxes shall be mounted with the bottom of the lowest box no less than 28", and the top of the highest box no more than 58" above the floor, or to meet applicable ADA requirements. Boxes shall have keyed locks, and shall be numbered sequentially. If necessary, boxes for barrier-free units shall be located separately to maintain the sequential numbering. Boxes shall have labeling sized for easy reading.
- C. Bath Accessories:** Provide and install all required bathroom accessories, including paper holders, towel bars, grab bars and robe hooks. Confirm and coordinate all blocking with accessory locations prior to installation of insulation and drywall. Install all accessories plumb, level, true to line and dimension, securely anchored and fastened to solid blocking.
1. Provide grab bars in all "Type A" accessible dwelling units as required by code. Provide solid wood blocking for grab bars in all "Type B" adaptable dwelling units as required by code.
 - a. In buildings designed for elderly residents, grab bars shall be provided at all bathtubs. One 24" long, 1" minimum diameter grab bar shall be placed at 45°, centered on the side opposite the accessible side, and with the lowest point of the bar 12" above the tub rim. The highest end of the diagonal bar shall be at the control end of the bathtub. An alternative to this diagonal grab bar may be proposed. One 24" long, 1" minimum diameter grab bar shall be placed vertically at the control end of the bathtub at the outside edge, with the top of the bar 4'-6" above the floor.
 - b. In buildings designed for elderly residents, grab bars shall be provided at all showers. One 24" long, 1" minimum diameter grab bar shall be placed at 45°, centered on the side opposite the accessible side, and with the lowest point of the bar 29" above the shower floor. The highest end of the diagonal bar shall be at the control end of the shower. An identical bar shall be placed vertically at the control end of the shower at the outside edge, with the top of the bar 4'-6" above the floor.
 - c. Tub/shower enclosures with integral grab bars substantially complying with the aforementioned grab bar requirements may not be used without approval.
 2. Medicine cabinets with beveled-edge mirror doors shall be provided at all bathrooms.

11000 EQUIPMENT

- A. Residential Appliances:** All dwelling unit kitchen appliances, including range/oven, refrigerator, and dishwasher, shall be by a single manufacturer. Clothes washers and dryers shall be by a single manufacturer. All appliances including range and ovens, refrigerators, water heaters, washers, dryers, dishwashers, ventilation fans, furnaces and air conditioners shall be listed by Underwriter's Laboratories. Refrigerators, water heaters, washers, dishwashers, ventilation fans, furnaces and air conditioners must be ENERGY STAR-qualified. Choosing the most energy-efficient ENERGY STAR-qualified appliances may qualify for CEEF incentives.
1. Refrigerators: All refrigerators shall be ENERGY STAR-qualified, frost-free refrigerator/freezers with separate compartment doors. Minimum acceptable sizes acceptable are 15 cubic feet for studio and one-bedroom units, 17 cubic feet for two-bedroom units, 19 cubic feet for three-bedroom units and 21 cubic feet for four-bedroom units. Refrigerators shall be placed so that the door will be able to swing at least 135° to allow removal of all drawers. Where refrigerators other than side-by-side type are used, this requirement may be met by selecting a refrigerator with a door design which allows removal of all drawers with a 90° door swing. In elderly units, the refrigerator/freezers shall be side-by-side. In barrier-free units, the refrigerators shall have a two-door refrigerator compartment with a bottom freezer drawer compartment, unless otherwise specifically designed by the manufacturer for handicap-accessibility.
 2. Range/Ovens: All ranges and ovens shall be four (4) burner electric appliances with a minimum width of 30 inches. Gas range/ovens may be used where they have automatic ignition and automatic pilot shutoff. Ranges in units designed as barrier-free or for elderly residents shall have front controls with indicator

lights, and shall be self-cleaning, unless a roll-under access space is located adjacent to the appliance. Some jurisdictions may require separate cook-tops and wall oven; confirm all local requirements.

3. **Microwave Ovens:** Where microwave ovens are provided as an amenity, they shall provide a minimum cooking area of 1.0 ft³. An electrical outlet shall be provided directly behind the microwave location. In housing for elderly residents, an electrical outlet shall be conveniently placed for a counter top microwave oven.
4. **Garbage Disposal Units:** Garbage disposal units shall be provided at all unit kitchens and common area kitchen sinks.
5. **Kitchen Ventilation:** All kitchens shall be provided with an ENERGY STAR-qualified means of exhaust ventilation to the outside. Provide recessed ceiling fans for kitchen ventilation, or ceiling grills ducted to in-line or roof-top exhaust fans for kitchen ventilation. Re-circulating range hoods with integral task lighting shall be provided to match the width of the range below. Kitchen exhaust fans shall be sized to provide a rate of > 5 ACH continuous ventilation, or an intermittent rate of > 100 cfm. Sound ratings for kitchen ventilation fans shall be < 1 sone at minimum flow rate, and < 3 sones at maximum flow rate.
6. **Bath Ventilation:** All full and half baths, and common area toilet rooms, shall be provided with an ENERGY STAR-qualified means of exhaust ventilation to the outside. Ceiling grills ducted to in-line, roof-top or side-wall exhaust fans for bathroom ventilation are preferred. Dwelling unit bathroom exhaust fans shall be sized to provide a rate of > 20 cfm continuous ventilation, or an intermittent rate of > 50 cfm. Sound ratings for bath ventilation fans shall be < 1 sone at minimum flow rate, and < 3 sones at maximum flow rate. Bath exhaust fans shall be switched separately from bathroom lighting, and shall be timer-controlled to run for a minimum of twenty minutes of use, or humidity sensor-controlled. Recessed bath fan/light/night light fixtures, with both humidity sensor and manual odor control modes of operation, may also be available.
7. **Washers and Dryers:** Recessed washer and dryer hook-up assemblies shall be provided in each dwelling unit of family housing. Convert washers to rinse with cold water only. If washers and dryers are provided within dwelling units, side-by-side, or full-size stacking washers and dryers shall be provided for units up to two bedrooms. For units with more than two bedrooms, extra-large capacity side-by-side units must be provided. Front-loading, side-by-side or under-cabinet combination units must be provided in barrier-free units. All washer hoses shall be braided stainless steel.
 - a. Where in-unit washer and dryers are provided, use ENERGY STAR-qualified appliances. Consider providing high-performance machines with a Modified Energy Factor ≥ 2.0 and a Water Factor ≤ 5.5 .
 - b. Where in-unit washers and dryers are not installed, common laundry facilities shall be provided in a minimum ratio of one washer for every 8 units, and one dryer for each 12 units, rounding up to the next whole number for any fractions. Common laundry facilities provided in the first phase of a development must be sized to accommodate the future installation of additional appliances during future phases. Provide a floor drain at all common laundry facilities.
8. **Dryer Ventilation:** All dryers shall vent to the outside. Where in-unit appliances are provided and dryers are not located on an exterior wall (or within the dryer manufacturer's recommended maximum distance to a screened, louvered vent), and in common laundries, provide in-line, roof-top or side-wall dryer booster fans with pressure-sensitive controls. In such cases, rigid metal ductwork shall be used for venting; with the exception that flexible metal ductwork may be used as a final connection to the appliance. Ductwork shall not be left exposed. Where dryer connections are left for occupant installation of the washer/dryer, vents shall be temporarily capped on the interior and exterior to prevent air infiltration.

- B. Kitchen and Bath Cabinets:** Kitchen and bath cabinetry constructed of plywood boxes with hardwood stile and rail face frames is preferred. In barrier-free units, and units designed for elderly residents, kitchen and bath cabinets shall have easily-grasped door and drawer pulls.
1. Kitchen and bath cabinetry for family developments shall be certified by the Kitchen Cabinet Manufacturers Association (KCMA) as meeting ANSI/KCMA A161.1 severe use standards, including the following minimum components:
 - a. Face Frames: 3/4" x 1-3/4" solid hardwood, mortised and tenoned, glued and fastened
 - b. Tops and Bottoms: 1/2" thick hardwood plywood
 - c. Back: 1/4" thick hardwood plywood
 - d. End Panels: 1/2" thick hardwood plywood
 - e. Shelves: 3/4" thick edge-banded hardwood plywood with side edges dadoed and exterior glued into the side panels
 - f. Hanging Rails:
 - Wall cabinets: 5/8" x 3" softwood lumber dadoed to receive tops, bottoms, sides and backs
 - Base cabinets: 5/8" x 6" softwood lumber dadoed to receive tops, bottoms, sides and backs
 - g. Toe Kick: 3/4" pressure-treated lumber
 - h. Support Brackets: 3/4" x 1-1/2" solid hardwood
 - i. Drawer Boxes: 5/8" sides and backs of solid lumber; dove-tailed into drawer fronts, with 1/2" thick hardwood plywood bottoms
 - j. Drawer Fronts and Doors: 3/4" thick edge-banded hardwood plywood
 - k. Drawer Glides: 100 lb. capacity, 3/4 extension, heavy-duty epoxy-coated ball-bearing slides
 - l. Hinges: Heavy-duty semi-concealed
 2. If particle board is used for any cabinet components, all exposed cut edges at sink cut-outs must be coated with a water-based polyurethane sealant or a specialty low-formaldehyde sealant. Particleboard sealant shall have a maximum VOC content of 250 g/L. Whenever possible, eliminate new particleboard inside dwelling units by using formaldehyde-free medium density fiberboard (MDF) for cabinet components and shelving.
 3. Verify access and clearance required for the installation of each cabinet. Install materials and systems in accordance with manufacturer's instructions and approved submittals, in proper relation with adjacent construction and with uniform appearance. Anchor securely in place; coordinate with countertop installation and other sections. Adjust and lubricate hardware. Restore damaged finishes and test for proper operation.
 4. All dwelling unit bathrooms shall have 42" wide vanities (min.), with a 30" removable sink base and 12" fixed drawer base. In bathrooms designed to be barrier-free, provide a lavatory set in a counter top, in order to provide "roll-under" access. In such cases, storage shelving at appropriate heights shall be provided elsewhere in the bathroom.
 5. Countertops and vanities made natural stone can range from granites, limestones, marbles, slate and sandstone each requiring specific type of seal. Unsealed stone can absorb stains, chemical discolorations or darkening spots. Considered the time and cost of maintenance before selecting natural stone use in kitchen and vanities, in lieu of more cost effective materials. CHFA discourages the use of quartz and tile due to the risks and moisture issues.

12000 FURNISHINGS

- A. Shades and Blinds:** Shades or blinds shall be furnished for all windows. Spring-loaded, roll-up shades are not acceptable. For elderly developments, and in units designed for barrier-free occupancy, or anywhere fire suppression of the units is not provided, shades or blinds shall not be made of PVC. Safety cord stops shall be installed on all window treatment cords to prevent injury.
- B. Furniture and Accessories:** In housing for elderly residents, exterior seating and common area seating shall have backs and arms, or some other means of support for rising. In common Laundry Rooms, provide a hanging rack and a laundry folding table 30" to 34" in height.

13000 SPECIAL CONSTRUCTION

- A. Alternative Construction Systems:** Consider using alternative construction systems, such as panelized framing, structural insulated panels and modular box construction. Note that finance application threshold requirements related to design, construction and environmental/energy sustainability apply equally to all projects, regardless of proposed construction methods (see the CHFA Construction Guidelines: Project Planning & Technical Services Review).
- B. Zero Energy Ready Home:** Consider designing and constructing projects to meet or exceed the more-stringent EPA Zero Energy Home certification program, which may result in additional rating and ranking points under certain funding programs, and additional utility-administered financial incentives. Projects designed and constructed to meet or exceed Zero Energy Ready Program requirements are 25% more energy efficient than projects designed and constructed to meet or exceed ENERGY STAR Home v. 3, since they are modeled against the more-stringent 2015 energy code. In addition to the ENERGY STAR Certified Homes Version. 3.1 design and construction inspection, testing, measurement and independent verification requirements, Zero Energy Ready Homes must also include optimized energy efficient building components and water distribution systems, comprehensive indoor air quality systems and optimized duct locations, and must be ready for the future installation of a solar PV system. Funded Zero Energy Home projects that earned rating and ranking points must be certified upon completion by the EPA.
- C. Passive House Design:** Consider designing and constructing projects to meet or exceed more-stringent Passive House certification programs, which may result in additional rating and ranking points under certain funding programs, and additional utility-administered financial incentives. Projects using Passive House design and construction strategies provide extraordinarily low-energy buildings that optimize both first cost, and operational costs. Developed in Germany in the late-1980s by Prof. Bo Adamson and Dr. Wolfgang Feist, the Passive House design concept is based on systematically reducing the factors that normally cause a building to need a heating or cooling system. In the United States, Passive House design and certification programs are provided by the Passive House Institute (PHI) and the Passive House Institute United States (PHIUS). The performance-based, verifiable energy conservation criteria and goals built-into the modeling, analysis and certification of buildings through the Passive House Planning Package as developed by PHI, or WUFI Passive as developed by PHIUS, can result in highly-durable construction, an 80-90% reduction in heating demand, a 60-70% reduction in overall energy requirements, and metrics that define the optimum economics between energy conservation measures, and energy production measures. Funded Passive House projects that earned rating and ranking points must be certified upon completion by the Passive House Institute (PHI) or the Passive House Institute United States (PHIUS).
 - 1. The principle characteristics of buildings designed to Passive House standards include:
 - a. Highly- and continuously-insulated thermal building envelopes, with minimized thermal bridging in roofs, walls, foundations and ground floors;
 - b. Air-tight construction, from continuous exterior air/moisture barriers and interior moisture barriers;

- c. Optimized winter daylighting and solar heat gain, and summer shading, based on building orientation, high-performance windows and doors, and building-integrated shading devices;
- d. Indoor air quality, from balanced heat and moisture recovery ventilation; and
- e. Minimized heating/cooling needs, with simple, compact, high-performance mechanical systems that result in reduced installation and operating costs. Due to the tight, insulated building envelope, the heat generated from the use of electronic equipment, lighting and appliances reduces mechanical system operating time.

14000 CONVEYING SYSTEMS

A. Elevators: In order to provide accessibility/visitability to all floors, a minimum of one elevator shall be provided in all three-story apartment buildings; in buildings with four stories or more, two shall be provided. Where elevators are provided, at least one shall be a service elevator of a sufficient size (approx. 5' x 7'), and be so located as to facilitate tenant move-ins/outs and emergencies (able to accommodate evacuees in prone position on EMS stretchers/folding gurneys). Provide hooks and removable pads in service elevators. In buildings with one elevator, provide an “attic stock” of long lead-time maintenance parts in order to minimize service outages. Non-hydraulic elevators are preferred, but for servicing existing elevators, or in situations in which a hydraulic elevator is the only option, consider using a biodegradable fluid.

15000 MECHANICAL

15050 Plumbing

A. Plumbing Design: Furnish a complete hot and cold domestic water distribution system. Furnish and install all service, distribution, drainage and vent piping within the building(s), including vent flashing at roof connections. Provide all fixtures, fittings, devices, and accessories as required. Supply, vent and drain piping shall be sized as indicated or required to meet all codes and standards of authorities having jurisdiction, and to comply with highest accepted practices of the trade.

1. Lay out the plumbing system in careful coordination with the drawings and existing conditions, determining proper elevations for all components of the system and using only the minimum number of bends to produce a satisfactorily functioning system. Lay out all pipes to fall within partitions, walls or roof cavities, and not to require furring other than as shown on the drawings.
2. Do not cut into or reduce the size of any load-carrying member without the prior approval of the Architect or structural engineer.
3. Provide pipe and pipe fittings – such as Hub and Spigot Cast Iron and Hubless Sewer Pipe, PVC Sewer Pipe, Underground (Type K) and Aboveground Copper, Cross-linked Polyethylene plastic flexible tubing and Chlorinated Polyvinyl Chloride Water Pipe and Tracpipe Black Iron Underground Gas Pipe – in compliance with applicable ASTM Standards.
4. All drainage and vent piping shall be ASTM D2836-72 solvent welded PVC or ASTM D2751 solvent welded ABS plastic. Cellular foam core PVC shall not be used.
5. Provide hose bibbs with freeze-proof cast brass valves.
6. Provide proper labeling of equipment and piping in conformance with the latest industry standards.

7. In finished spaces, and within sink and vanity base cabinets, furnish a chromium-plated sectional escutcheon on each pipe or hanger rod penetrating the wall, floor or ceiling. Plates shall fit snugly.
8. Upon completion of rough-in, fully test supply system at full pressure. Verify and ensure that system is free from leaks. Obtain all approvals and certificates of inspection from all authorities having jurisdiction upon the work.

B. Pipe Insulation: Insulate all plumbing piping. Insulation shall be continuous over pipes, valves and fittings, etc. Insulate all soil, waste and storm drainage stacks for their entire length, unless cast iron is specified. Provide the following minimum R-Values: $\frac{3}{8}$ " diameter to $\frac{1}{2}$ " diameter - R-5; $\frac{5}{8}$ " diameter to $\frac{3}{4}$ " diameter - R-7; $\frac{7}{8}$ " diameter to 2" diameter - R-9; $2\frac{1}{2}$ " diameter to 4" diameter - R-8.

Heating Piping: Insulation shall be securely applied to all steam heating and hot water heating supply and return piping exposed or concealed, except short run-outs above the floor to terminal units, except dead end loops.

1. Domestic Water Supply Piping: All water piping in unconditioned spaces, such as basements, crawl spaces, attics and exterior walls shall be covered with universal insulating jacket.
2. Barrier-free Design: Insulate exposed piping below kitchen sinks and bathroom lavatories in units designed as barrier-free to insure residents in wheelchairs do not touch exposed metal piping. Provide factory-made decorative insulating covers specifically designed for this purpose.

C. Plumbing Fixtures and Trim: All exposed pipe fittings, trim, faucets, traps and exposed connections shall be chrome-plated brass. Faucets shall be heavy brass, compression type, with replaceable seats and discs or cartridges. Provide a stop or shut-off valve in the water connection(s) to each water heater, water closet, group of fixtures and main riser.

1. Kitchen sinks shall be single bowl and shall be stainless steel, 20 gauge or thicker. Pull-out spray hoses shall not be provided. A garbage disposal shall be provided.
2. Lavatories shall not be made of fiberglass. Wall hung lavatories shall not be used in dwelling units. In common areas where wall hung lavatories are used, wall chairs to support the lavatories shall be provided.
3. In buildings designed for elderly residents, except in barrier-free designed units, bathtub rim heights above finish floor shall not be higher than 16". Bathroom floors and the bottoms of all bathtub basins shall have slip-resistant finishes. In Type B units for elderly residents, it is preferable to have water closets located adjacent to a wall 48" (min.) in length (perpendicular to the plumbing wall) to facilitate the future addition of a grab bar, in the event that the resident's needs change. Faucet controls at bathtubs and showers shall be offset toward the entry side of the fixture for ease of access. In housing for elderly residents and for barrier-free designed units, all showerheads, whether in bathtubs or showers, shall be height adjustable on a slide bar device. In non-barrier-free units for elderly residents a flexible, detachable head, with brackets allowing several mounting heights, is an acceptable alternative. All kitchen and bathroom water controls shall be single lever controls, and all toilets, shall comply with barrier-free design requirements.
4. Provide plumbing fixtures, fittings and controls which comply with the EPA WaterSense® Program, which labels products that are about 20% more water-efficient than average comparable products. WaterSense®-labeled products include bathroom faucets, aerators and showerheads.
5. Consider providing a graywater lavatory water recycling system for toilet water, in lieu of fresh water.

D. Fire Protection Sprinkler Systems: All required fire protection systems shall be wet-pipe sprinkler systems.

Fire Sprinkler Heads: All fire sprinkler heads in finished residential spaces shall be white in color and have a minimal cowling. Heads recessed into ceilings and walls are preferable.

15470 Water Heaters

A. Residential Water Heaters: All dwelling units designed for family occupancy shall have individual water heaters. All water heaters shall be gas-fired. Water heaters used as the heat source shall be installed per manufacturer's recommendations with particular attention paid to the outlet locations. Water heater tanks shall have an insulating jacket equal to or greater than R-5. Jacket(s) must be installed according to manufacturer's recommendations.

1. Where permitted, shutoff valves for inlet and outlet lines shall be provided for ease of replacement. Heat traps are required on all water heaters.
2. Water heater drains from pressure-temperature relief valves shall not be discharged onto the floor. A separate protective pan, connected to a floor drain shall be installed under all water heaters.
3. ENERGY STAR-qualified tank type domestic hot water equipment shall meet or exceed the following Energy Efficiency (EF) requirements:
 - a. Gas Units (preferred): ≤ 50 gallons - 0.67 EF; ≥ 50 gallons - 0.77
 - b. Oil Units (where natural gas is not readily-available): 40 gallons - 0.62 EF; 60 gallons - 0.58 EF; and,
 - c. Electric Units (if no other fuel energy source can be provided): ≤ 50 gallons - 0.95 EF; ≥ 50 gallons - 2.0 EF.

B. Tankless Water Heaters: Consider using ENERGY STAR-qualified tankless natural gas or propane domestic hot water heaters (DHW) to conserve heating time and energy use. Install "right-sized" tankless water heaters with variable-set thermostats as close to the point of use as possible. Specifying the most energy-efficient ENERGY STAR-qualified equipment may qualify for CEEF incentives:

1. Natural Gas Tankless DHWs: Energy factor ≥ 0.82 with electronic ignition;
2. Natural Gas Condensing Storage Tanks: Thermal efficiency $\geq 90\%$; and,
3. Heat Pump Hot Water Heaters: COP ≥ 2.0 .

C. Commercial Water Heaters: Where required, commercial water heaters shall be gas-fired. All common water heaters shall be of the continuous recirculation design.

15600 Heating, Ventilation, and Air Conditioning (HVAC)

A. HVAC Design: Heating equipment and fuel sources shall be selected based on efficiency ratings and life-cycle costs.

1. It is preferable that all dwelling units shall have individual HVAC units. All heating systems shall be designed so that each living unit has at least one programmable thermostat to control space temperature. Dwelling unit thermostats shall be placed on an interior wall, at 48" above the finish floor, away from the direct flow of forced air and drafts. In apartment buildings, smaller, sectional boilers for all apartments may be provided, which shall be located in a centralized boiler room. Thermostats in common areas shall have automatic setback controls.
2. Interior design temperatures for calculations shall be for 70° F (max.) for heating and 75° (min.) for cooling when the outside temperature is the appropriate outdoor design temperature for each development location, as specified in accordance with the ASHRAE 99% scale. Warranty period for equipment shall be 5 years minimum.
3. Fresh air by mechanical means shall be provided in all public corridors and other community spaces in apartment buildings.
4. Common spaces in developments designed for elderly residents shall be air-conditioned. Corridor make-up air shall maintain corridor temperature at 75° F in the summer, and 72° F in the winter. Common laundries, craft rooms and trash and trash compactor rooms shall all be designed to have negative pressure.
5. All roof-top equipment shall be installed on 12" high (min.) curbs. Heavy-duty radiator covers, 18 gauge or better, shall be used when a hydronic heating system is specified. Where unit entries are located at grade for units that have living areas above grade, i.e.: individual entry stacked units, a supply air duct run shall be provided at the grade level entry foyer.
6. Where applicable, the use of zoned hydronic radiant heating is encouraged.
7. Utilize the Air-conditioning Contractors of America (ACCA) System Design Process for the proper design and installation of "right-sized" residential HVAC systems, including Manual J (load calculation), Manual T (air distribution), Manual S (equipment selection), and Manual D (duct size calculation).
 - a. All dwelling units shall be provided with a mechanical ventilation system meeting current ASHRAE 62.2 minimum ventilation requirements. Intake of ventilation air directly from the outdoors is preferred. Air inlets shall be located $\geq 10'$ from stacks, exhaust vents/hoods, or vehicular exhaust, $\geq 3'$ from dryer exhaust, and such that they will remain unobstructed by snow, plantings or other materials. Screen air inlets with mesh with openings $\leq \frac{1}{2}"$.
 - b. Only sealed combustion, direct-vented, power-vented or induced-draft combustion appliances should be installed inside conditioned spaces for space conditioning or for domestic hot water. The combustion safety of combustion appliances shall be verified according to current ASTM, ANSI and NFPA standards for assessing depressurization-induced back-drafting and spillage from vented combustion appliances. Gas ovens, gas stoves or gas cooktops should only be installed where exhaust range hoods vent directly to the exterior.
 - c. Residences should be constructed to have a low building envelope air leakage rate and a controlled mechanical ventilation system. The ventilation system should slightly pressurize the dwelling unit when the air handler unit blower is operating, restricting air exchange to exfiltration. Ducts shall be located in conditioned spaces. Appliance and occupant heat gain should be factored into the design process. For the outdoor design temperature, use the cooling dry bulb temperature listed in the

ASHRAE 2013 Handbook of Fundamentals. The building design load shall be calculated for the worst case elevation at the solar orientation that produces the highest heat gain. For equipment selection, indoor and outdoor coils should be matched. The equipment should be selected to meet the design sensible load at the actual outdoor and indoor design conditions (not ARI standard conditions). Avoid over-sizing cooling equipment to try to compensate for high occupancy, large thermostat setbacks, unusual loads, poor initial design, or inadequate distribution. Perform room-by-room load calculations according to ACCA Manual J guidelines: calculate the required cubic feet per minute (CFM) based on loads and select equipment based on loads and required CFM. Size the cooling system to appropriately meet the design load calculated according to ACCA Manual J, to provide good air distribution for improved indoor air quality and thermal comfort. The total capacity of the cooling system should be no greater than 110% of the ACCA Manual J total load. Size the equipment based on 100% of the total cooling load (not the sensible cooling load) at the actual outdoor design condition (not the ARI rated condition) and for the realistically-expected evaporator air flow.

- d. The capacity of cooling and heating systems should be specified based on the building orientation that creates the highest total load. At a minimum, the four N, E, S, W orientations should be considered. It may be advisable to also consider the four off-angle orientations of NE, SE, SW, NW as well, especially if there is significant off-angle, un-shaded glass.

B. Furnaces, Boilers and Heat Pumps: Provide ENERGY STAR-qualified, AHRI-rated heating equipment. Natural gas-fired equipment is preferred.

1. **Furnaces:** Choosing the most energy-efficient ENERGY STAR-qualified equipment may qualify for CEEF incentives. Provide gas-fired zoned forced air furnaces with a minimum 95% annual fuel utilization efficiency rating ($AFUE \geq 95$) and $\leq 2\%$ average annual auxiliary electrical energy consumption. Where natural gas is not readily available, ENERGY STAR-qualified oil-fired furnaces ($AFUE \geq 85$) may be provided. Furnaces shall have variable-speed blowers and programmable thermostats. Each zone shall have a separate temperature control and wired damper controls. Air handlers shall be located within conditioned space (vented combustion closets are not considered conditioned space) is preferred. Furnace filters shall not be made of fiberglass. All furnaces shall bear all applicable UL-listed and AGA-certified labels.
2. **Modular Boilers:** Gas fired boilers shall be used where heating systems are not provided for each dwelling unit. Where provided, boiler systems shall have two or more gas-fired boilers and shall be furnished with a control panel designed to reset the supply water temperature based on the outdoor temperature. The control panel shall step fire the boilers in sequential order. Boiler drains from pressure-temperature relief valves shall not be discharged onto the floor. A separate protective pan, connected to a floor drain shall be installed under all boilers. Provide ENERGY STAR-qualified gas-fired boilers ($AFUE \geq 90$). Where natural gas is not readily available, ENERGY STAR-qualified oil-fired boilers ($AFUE \geq 86$) may be provided.
3. **Heat Pumps:** Where air-source heat pumps are specified, provide ENERGY STAR-qualified units ($SEER \geq 15/EER \geq 12/HSPF \geq 9.25$) with electric back-up, or ENERGY STAR-qualified units ($SEER \geq 14.5/EER \geq 12/HSPF \geq 8.2$) with ENERGY STAR-qualified dual-fuel back-up. Where ground-source heat pumps are specified, provide ENERGY STAR-qualified, AHRI/ISO-rated units (closed loop water-to-air $\geq 3.6 COP/17.1 EER$; closed loop water-to-water $\geq 3.1 COP/16.1 EER$; open loop water-to-air $\geq 4.1 COP/21.1 EER$; open loop water-to-water $\geq 3.5 COP/20.1 EER$; and direct geo-exchange $\geq 3.6 COP/16 EER$).

C. Air Conditioning: Provide ENERGY STAR-qualified, AHRI-rated air conditioning equipment. Zoned, central air-conditioning systems with programmable indoor thermostats, with each zone having separate temperature and wired damper controls are preferred. Otherwise, room air-conditioners in through-wall sleeves shall be provided in living rooms and bedrooms. Choosing the most energy-efficient ENERGY STAR-qualified

equipment may qualify for CEEF incentives; specify central air conditioning units with a seasonal energy efficiency rating (SEER) ≥ 14.5 or energy efficiency ratio (EER) ≥ 12 . Air conditioners shall have variable-speed blowers and a cooling sensible heat fraction (SHF) of 0.75 or less. All cooling equipment shall be charged with refrigerants not containing CFCs or HCFCs, such as HFC-410A (< 100 tons), HFC-134a (>100 tons), and HFC-407C (DX chillers). Where room air conditioners are provided, pre-manufactured, demountable insulated molded plastic air conditioner covers, shall be provided on interior walls for use during cold weather months to prevent air infiltration. ENERGY STAR-qualified room air conditioners shall bear an energy efficiency rating (EER) ≥ 13 .

- D. CEE/AHRI Verified Directory:** The Consortium for Energy Efficiency (CEE) and the AHRI have developed an online database which identifies high efficiency equipment that has been tested to ARI 210/240 and verified by AHRI. The CEE/AHRI Verified Directory identifies a list of equipment (less than 65 MBtuh) that the manufacturers represent as meeting energy performance tiers established by the CEE as part of the Residential Air-Conditioner and Heat Pump Initiative and the High-Efficiency Commercial Air-Conditioning Initiative. The CEE/AHRI Verified Directory lists equipment that meets the performance levels specified in the ENERGY STAR Central Air-Conditioner and Air-source Heat Pump Specification; however, only equipment listed by an ENERGY STAR partner are officially recognized as ENERGY STAR-qualified. The list of ENERGY STAR partners and the CEE/AHRI verified directory are available on the ENERGY STAR website (www.energystar.gov).
- E. Ductwork and Flues:** Comply with Sheet Metal & Air Conditioning Contractors' National Association (SMACNA) HVAC Duct Construction Standards. Fiberglass ductwork or fiberglass insulation within ductwork shall not be used. Rigid glass fiber insulation with a factory applied vapor barrier on the side facing the air stream is acceptable if all requirements of UL 181 for a Class 1 Air Duct System are satisfied. All ductwork terminating at the exterior shall be equipped with a back draft damper. Vertical flue vent pipe shall be double-wall vent type in order to prevent condensation due to the high-efficiency furnaces, boiler and water heaters. Vent pipes shall not extend more than 6" above a chimney or chimney enclosure. Horizontal direct venting is acceptable for equipment specifically designed for that purpose.
1. Ductwork design shall comply with the ACCA Manual D guidelines. Duct work made of rigid sheet metal materials is preferred. Different size rooms may require different size ducts. Avoid excessive duct lengths, loops, hard turns and compression in flexible ducts. Support flexible ducts at intervals recommended by the manufacturer, but not $\leq 5'$, and with a maximum sag of $\frac{1}{2}''$ /ft of spacing between supports. Where possible, an extended supply plenum with enough room to make mostly homerun run-outs is the preferred duct layout method, so final air balancing is not dependent on the limitations and difficulties of cascading supply branches. Airflow for each duct run shall be measured and balanced to comply with Manual D specifications to within 15 cfm of design air flow.
 2. All air handlers shall be installed with a ducted return plenum sealed to the unit and any associated ducts with mastic or mastic tape.
 3. All duct systems shall feature at least one long supply trunk with multiple take-offs. "Octopus" systems, with all duct runs originating at the supply plenum, are not acceptable.
 4. Each bedroom shall have a dedicated return duct, or, for apartments with no return ducts located in bedrooms, all supply air shall have a direct path back to a return grill even when doors are closed. In order to keep supply air from pressurizing closed rooms by more than 3 Pa, provide transfer grills, jump ducts or interior bedroom doors with additional clearance between the bottom of door when closed, and the finished floor surface, to allow supply air to flow back to the central system return.

5. All ductwork for heating or cooling shall be run through conditioned space inside the insulated envelope. No exposed duct runs shall be installed within habitable spaces. Duct runs within chases shall be incorporated into the design as required. Seal all joints and seams in air handler and ductwork with mastic or mastic tape. Use removable tape for filter door. Seal collars to plenum with mastic or mastic tape. All duct trunk lines located outside conditioned space, such as crawl spaces and attics, shall be insulated. Supply ducts in unconditioned attics shall have insulation \geq R-8; all other ducts in unconditioned space shall have insulation \geq R-6.
6. All ducts and air handlers shall be located in conditioned space, and ductwork must be sealed and insulated according to the IECC. Total duct leakage shall be \leq 4 CFM₂₅/100 ft² of conditioned floor area at rough-in (max.), verified through RESNET HERS-approved testing protocol. All unions between components of HVAC system including joints between ductwork and the air handler shall be sealed with mastic or mastic tape. Flex-to-flex duct connections must have a metal collar connecting them and be sealed with mastic. All transverse seams in supply and return ducts, including supply and return plenums and leakage sites in the air handler, shall be sealed with duct mastic and fibrous reinforcing mesh according to SMACNA specifications. Duct tape is not an acceptable sealant for ducts, but may be used for sealing leakage sites at the air handler's removable access panels and at filter access panels.
7. Clean or vacuum all ducts prior to occupancy, before carpet is laid and finishes are applied.
8. Test and balance all mechanical systems in conformance with Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB) Standards.
9. Size the air handler to accommodate the reduced air pressure caused by the filter. Provide \geq MERV 8 high-efficiency particulate air (HEPA) filters in the return air stream at the air handler, located so that return and ventilation air pass through prior to conditioning.
10. Designing heat recovery ventilation units (HRVs) into HVAC systems, to recover heat from exhausted indoor air and transfer it to the incoming fresh air stream, is encouraged. Use of HRVs is particularly appropriate in units with blower door test results of less than 0.35 ACH.

16000 ELECTRICAL

A. Electrical Design: Furnish and install all wire, cable, conductors, connectors, conduit, junction boxes, electrical services and other rough-in equipment, fixtures, outlets, lamps, and trim requires to render a complete and fully operating, inspected and approved electrical power distribution and lighting system as required. All work shall be in accordance with Underwriters' Laboratories, National Electrical Manufacturers Associates, Illuminating Engineer Society, National Fire Protection Association and the Connecticut Electrical Code.

1. Provide and install sufficient electrical service to all equipment, appliances, and devices indicated in the drawings and specifications, including, but not limited to: residential appliances, HVAC equipment, light fixtures, receptacles, alarm system, telephone system, cable system, doorbells, etc. Ground the entire system, providing ground-fault interrupters and interrupting capacity of circuit breakers as required by the code.
2. Electrical service shall be designed so that all dwelling units can be metered separately; a separately-metered electrical load center with a capacity of 100 amps (min.) for each dwelling unit is preferred. A maximum of six service-main disconnects in the same location or room will be allowed. Rated fire assemblies separating main disconnects shall not be penetrated with circuiting. Energy load data for heating and electrical energy loads comprised of summary loads of each type of dwelling shall be provided. Branch

circuit load calculations for general lighting and receptacles in dwelling areas shall be a maximum of 80% of branch circuit capacity.

3. Copper wiring shall be used throughout except that aluminum wiring may be used for wiring #6 or larger. Wire size shall be based on 75° Celsius. Solid aluminum conductors, stranded aluminum conductors smaller than #8 Awg, stranded aluminum #8 Awg without antioxidant paste at lugs, and aluminum conductors as a ground for antenna systems are not permitted.
4. Controls for garbage disposal unit and range hood switches are required to be within reach for access by elderly and handicapped persons, on a side wall or at the front of the cabinet. An electrical outlet shall be conveniently placed for a counter-top microwave oven, unless a built-in microwave is being provided.
5. Exterior doors in buildings designed for multiple dwelling units for elderly residents, or any apartment buildings in areas where security from trespass may be problematic, shall have door-ajar alarms wired to a central control panel, requiring manual reset.
6. Main entrance doors to buildings designed for access to multiple dwelling units shall have electric door release hardware. Such controls shall be located near the entry space and shall not be integrated with the intercommunication system for remote operation.
7. Stair tower doors to corridors (on first through sixth floors) shall have self-locking dead latches and trigger bolt protection prohibiting entry from the stair tower to the corridor. In buildings over three stories, provide electric strike releases that unlock when signaled by the fire alarm.
8. The use of ceiling fans and/or ceiling fans equipped with lighting fixtures in living rooms and bedrooms, to reduce the need for air conditioning and heating is encouraged. If provided, ceiling fans must be adequately supported between framing members, and ENERGY STAR-qualified.
9. The use of alternative energy sources to supplement the operation of common area features, amenities, and fixtures is encouraged.
 - a. Lower future energy costs may justify the initial installation cost of a PV system for signage, parking area lighting or common area and hallway lighting, etc. If not immediately viable financially, siting, designing, engineering and wiring the development to make the development “PV-ready” is encouraged; and,
 - b. Passive and active (pumped) solar hot water systems for washing and bathing, or to supplement home heating in conjunction with auxiliary energy sources, are encouraged.

B. Emergency Generator: Except in buildings with multiple townhouses, an emergency generator shall be provided in any building with 4 or more dwelling units and 3 or more stories, to provide support for life safety systems for safe egress. Additionally, any building that is required to have a fire pump for the fire protection system shall be provided with an emergency generator, unless a diesel fire pump is provided. At a minimum, systems shall be sized to include egress lighting, emergency elevator (with cab size capable of handling a stretcher horizontally), emergency call systems, and recirculation pumps on boilers. The emergency generator shall be provided with a fuel supply – natural gas (preferred) or diesel – that will allow operation for a minimum of 24 hours. No underground storage tanks shall be used.

C. Lighting: Lighting fixtures shall be selected to provide a minimum of glare.

1. Average (min.) illumination levels at task surfaces, in foot-candles (fc), shall be: 50fc at Office desk surfaces; 30fc at kitchen counter top, sink and range surfaces and bathrooms vanity tops; 15fc at bathroom bathtubs and corridors, lobby, stairs and common area bathrooms; 10fc at store rooms, mechanical rooms

and electrical rooms. Egress emergency lighting shall be maintained at a 1fc inside the building, and to any point 20 feet outside the building exits.

2. Provide ENERGY STAR-qualified CFL, LED or pin-based lighting in 90% of qualifying light fixture locations.
3. Provide a night light, or an outlet for a night light, near the bedroom/bathroom area in all units designed for the elderly.
4. Provide Insulation-Compatible (IC) lighting fixtures with fluorescent or LED lamps wherever recessed fixtures are installed in insulated framing.
5. Automated lighting controls, such as sensors and timers, to turn lights off in unused areas or during times when lighting is not needed, are strongly encouraged. Large multipurpose rooms and corridors shall be wired so that half of the fixtures may be shut off, and a uniformly reduced lighting level is achieved with the balance of the lighting.
6. Bare bulb porcelain fixtures shall not be used.
 - a. Common area lighting shall be ENERGY STAR-qualified fluorescent/CFL, LED or pin-based lighting;
 - b. Dwelling unit and common area kitchen lights shall be fluorescent/CFL or LED. Each kitchen shall have a task light above the sink, a CFL/LED-compatible light above the range (integrated into the range hood) and a centrally located general kitchen light; and,
 - c. Exit lights shall be ENERGY STAR-qualified LED or light-emitting capacitor (LEC) fixtures.

D. Alarm and Detection Systems:

1. Carbon Monoxide and Smoke Detectors: Provide carbon monoxide detectors as indicated below, and as otherwise required by code:
 - a. A minimum of one carbon monoxide alarm shall be installed on each habitable level of all residential facilities, and on each habitable level of a dwelling unit or sleeping unit, that are equipped with fossil-fuel burning heat and hot water equipment or appliances, in use groups R-1, R-2, R-3, R-4, I-1 and I-4, whether regulated by the IBC or the IRC. In addition, approved carbon monoxide alarms must be installed within 10 feet of each room used for sleeping purposes;
 - b. For new construction, carbon monoxide alarms must receive their primary power from the building wiring, with either battery or emergency electrical system backup. Exceptions to this provision may be made for projects involving only minor revisions to buildings where hard-wiring would require removal of interior wall or ceiling finishes;
 - c. All carbon monoxide alarms within large multi-unit facilities must be interconnected so that all alarms will sound on the activation of one alarm;
 - d. Multiple alarms within dwelling units must be interconnected, so that the activation of one alarm will activate all of the alarms. Unit smoke detectors shall not be wired in a "buddy" or "zoned" configuration with other dwelling units, nor shall they initiate the general building alarm.
 - e. Smoke detectors must be installed in every level of all dwelling units (including basements), inside every bedroom, outside every bedroom and on levels without bedrooms near the stairway to upper levels;
 - f. If mounted on the ceiling, the detector must be > 4" from the wall; if mounted on the wall, the detector must be > 4" but < 12" from the ceiling; detectors installed in basements must be ceiling mounted at the bottom of the stairs leading to the next level;
 - g. Detectors must be installed at least 10' from cooking appliances, and should not be installed near windows, doors or air ducts, where drafts might interfere with operation;
 - h. All dwelling unit smoke detectors shall be photoelectric-type;

- i. In buildings for elderly residents, the unit smoke detectors shall be part of a “fully addressable” system (see below), and shall be wired to activate an audible alarm in the unit and at the primary annunciator panel. The system shall also activate a remote signal in the manager's unit if a secondary panel is provided. Unit smoke detectors shall not be wired in a "buddy" or "zoned" configuration with other dwelling units, nor shall they initiate the general building alarm. The system must require a manual reset at the annunciator panel. The system shall also have the capability to send the same identifying information to a remote location off-site to a monitoring agent, pager, etc.; and,
 - j. The operation of the alarm system shall be discussed during the design stage with the local emergency medical service provider determine their system operation requirements, in compliance with service provider regulations, such that the capabilities of the system shall not be diminished.
2. Visible alarms shall be provided when new fire alarm systems are installed, and when existing systems are upgraded or replaced.
 3. Fully addressable emergency call systems shall be installed in all buildings designed for elderly residents.
 - a. Pull cord stations shall be provided in bathrooms and bedrooms (with bathroom fixture and accessory locations and bedroom furnish ability dictating station placement), with a colored light (no bell or alarm) over the unit entry door;
 - b. An annunciator panel shall be located in the manager's office or reception area, on which a light displays and a sound is emitted to indicate the dwelling unit in which the emergency call was pulled, or a remote annunciator panel located in the manager's unit; and,
 - c. To be fully addressable, the display at the office annunciator panel(s) shall differentiate between smoke detector alarm and emergency call signals, be able to identify the dwelling unit from which the call originated, have the capability to send the same identifying information to a remote location off-site to a monitoring agent, pager, etc. and must require a manual reset at the annunciator panel(s).
 4. Intrusion alarms shall be installed within residential units with grade level entrances or where otherwise vulnerable to intrusion, in buildings designed for multiple dwelling units for elderly residents, or any apartment buildings in areas where security from trespass is anticipated as a substantial problem.
 5. Where approved by the Fire Marshal, wireless fire alarm systems are acceptable, if an on-site emergency generator will maintain power to it during storm outages.

E. Telecommunications Systems:

1. Provide concealed-wired telephone systems, with outlets located in the kitchen, living room, and master bedroom, in locations suitable for convenient use based on likely furniture placements.
2. All dwelling units shall be provided with a Local Area Network (LAN) connection in the living or dining room, capable of providing a high-speed internet connection. All community rooms must be equipped to provide residents with free, high-speed wireless internet access.
3. All buildings that are designed to include a multiple number of dwelling units accessible through a common entry shall have a two-way intercom between the main entry and the individual units; however, door releases at common entries shall be at the door and not remotely operated. Intercom communications shall not result in additional costs to the resident.
4. Concealed-wired television cable systems shall be provided in all developments. Install one jack in master bedrooms and two in living rooms (min.), based on likely furniture placements.

Multifamily Design, Construction and Sustainability Standards – CHFA

January 2021

5. Doorbells or door-knockers shall be provided at all unit entrance doors. Provide a stable source of power to connect doorbells at units designed for audio/visual accessibility.
- F. Electric Heating:** Electric baseboard heat is not allowed. Use of small electric space heaters is also not allowed, unless justifiable by a life-cycle cost analysis.