

UFC 4-711-02A, Army Family Housing Supplement

SPECIFICATION SECTION 00 01 10 – STATEMENT OF WORK

U.S. ARMY CORPS OF ENGINEERS

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SECTION 00 01 10 STATEMENT OF WORK

1.0 GENERAL

1.1 DESIGN OBJECTIVES AND CRITERIA

1.1.1 General Information.

The design and construction shall comply with the specifications and requirements contained in the Army Standard for Family Housing (see Appendix A), UFC 4-711-01, and with this Standard Design Criteria document. The design and technical criteria contained and cited herein establish minimum standards for design and construction quality. All housing units constructed in accordance with these standards shall be qualified or qualifiable as "ENERGY STAR® Homes" and meet the Army's sustainable design and development (SDD) policy minimum requirements (see Appendix A).

1.1.2 Goal and Objectives.

The Military Family Housing Goal Statement defines the ideal end-state for military communities and housing. It is not intended to be static, but responsive to the dynamics of military family housing needs. The Military Family Housing Goal is:

- To provide quality-housing neighborhoods to contribute to a strong force of skilled people who provide the readiness of our Military Forces.

Military family housing objectives support the family housing goal. These objectives are:

- To bring the existing required housing inventory up to contemporary housing standards (i.e., codes, safety, maintainability, livability, amenities) through repair, improvement and replacement.
- To meet sustainability requirements of the Army Sustainable Design and Development Policy, latest edition, EAct 05, EISA07, EO 13423 and EO 13514.

All military family housing facility programs shall, wherever programmatically possible, use a "whole house" and "whole neighborhood" approach for improvement, replacement, and repair of existing family housing units and neighborhoods, to increase the overall quality of entire Family Housing areas.

Housing Improvement projects shall [\[Designer edit the following as required.\]](#):

- Extend the useful life of facilities and infrastructure by at least 25 years.
- Be designed and constructed to minimize life cycle costs. Use Life-Cycle Cost Analysis (LCCA) set out in subpart A of 10 CFR part 436 (most recent ACSIM SDD).
- Restore housing units to structural soundness.
- Upgrade building envelopes to current energy performance standards. For FY13 and on, the military construction program will certify at LEED for Homes SILVER level and higher from GBCI and Energy Star Qualified New Homes, except where GBCI does not certify in foreign locations (most recent ACSIM SDD Policy Memo).

- Lessen impact on the environment by incorporating Low Impact Development (most recent ACSIM SDD Policy Memo).
- Incorporate SDD principles and maximize water consumption reduction and optimize energy efficiencies and performance. (Most recent ACSIM SDD Policy Memo.)
- Include utility repair and replacement, as required.
- Provide street repair and replacement.
- Provide streetscape repair and improvements.
- Provide community amenities.
- Improve heating, air conditioning, and domestic hot water generating efficiencies.
- Comply with current DoD Antiterrorism Standards for Buildings.
- Provide physical security for High Risk Personnel (HRP) where required.

The **PRIMARY CONSIDERATION** of the solicitation process is to provide the entire number of housing units identified in this Statement of Work. All proposals received **MUST** include the total number of units required to be considered for evaluation and award. In no case will a smaller number of units be accepted to allow inclusion of betterments or enhancements. Betterments and enhancements will not be considered unless the proposal includes ALL units required. Contractors are encouraged to review the statement of work to familiarize themselves with all of the available options and alternatives included herein. In many instances several finishes or materials are identified for a specific item; however, the primary consideration of this solicitation is **obtaining all units** scheduled for construction in this project.

1.1.3 Work Scope.

The objective of this project is to obtain housing complete and adequate for assignment as quarters for military personnel and their families. This contract shall consist of the design and construction of a total of [Designer insert.] housing units on Government-owned land at [Designer insert installation and location], which comply with this document. [Designer shall insert project-specific scope here, including clearly stating the number of each type of unit for each rank to be built. Also include any support structures and facilities.]

1.1.3.1 Special Utilities and Supplementary Construction.

[Designer shall insert special utility items, supplementary construction, on- or off-site]

1.1.3.2 Demolition Requirements.

[Designer shall insert special items with respect to demolition requirements. Asbestos and lead paint surveys should be included as an Attachment to this Statement of Work].

1.1.4 ENERGY STAR® Homes Program Requirements.

All Army Family Housing new construction starting with FY13 military construction program will be qualified as ENERGY STAR® New Homes, except where it is not practical to meet ENERGY STAR® standards in foreign locations, new construction shall be qualifiable as ENERGY STAR® New Homes. Achieve energy consumption at least 40% below baseline of building meeting ASHRAE 90.1-2007. See Sections 8.0 and 9.0 for further requirements.

1.1.5 Design Freedom.

Requirements stated in this document are minimums. Innovative, creative, or cost-saving proposals which meet or exceed these requirements are encouraged and will receive additional consideration in the evaluation process provided that all required units are included in the proposal. Existing housing plans or modifications thereof that meet the design and construction criteria specified herein, which a Contractor has previously constructed and priced, may be submitted for consideration. They may include designs incorporating factory fabricated components or modules.

1.1.5.1 Waivers.

Deviations from area, space and adjacency requirements are discouraged unless the changes result in improvement to the facilities and do not violate the definitions and limitations of the project's approved DD Form 1391. Both the design and construction of a facility must comply with the Army Standard for Family Housing and with this Standard Design Criteria document. A request for variance or waiver of design criteria must be submitted and approved prior to execution. For guidance on variance from this Standard Design Criteria document, contact the Center of Standardization for Army Family Housing, Norfolk District USACE.

Only the Assistant Chief of Staff for Installation Management has the authority to approve exceptions to the Army Standard.

- Waivers from the Army Standard must be requested in accordance with the AR 420-1 and the Army Facilities Standardization Program Charter, latest edition.
- All waiver requests to the Army Standard require COS conflict resolution prior to submission by the Garrison Commander or Manager through IMCOM Region to IMCOM HQ.
- Garrison Army Standard waiver request submissions must be received in sufficient time to allow completion of Facility Design Team review and development of recommendations or courses of action for the Army Facilities Standardization Committee to consider prior to implementation into project design.
- All waiver requests shall include compelling rationale of functional and operational deviations to include substantiating documentation in sufficient detail for the Army to assess implications of approving the waiver.
- All HQDA approved waivers shall be documented in installation master plans thereby serving as the installation's modified standard.

1.1.5.2 General.

To the maximum extent possible within the contract cost limitation, the buildings shall conform to the look and feel of the architectural style and shall use the same colors as adjacent facilities as expressed herein, [Designer insert: IMCOM approved,] and shall conform with the Installation's [Designer insert: IMCOM approved] Real Property Master Plan. The Government will evaluate the extent to which the proposal is compatible with the architectural theme expressed in the RFP during the contract or task order competition. The first priority in order of importance is that the design provides comparable building mass, size, height, and configuration compared to the architectural theme expressed herein. The second priority is that design is providing compatible exterior skin appearance based upon façade, architectural character (period or style), exterior detailing, matching nearby and Installation material/color pallets, as described herein. See appendix [Designer insert specific appendix] for the desired site and architectural themes for the area and the desired project look and feel based on the Installation Architectural Theme from existing and proposed adjacent building forms; i.e. building exterior skin, roof lines, delineation of entrances, proportions of fenestration in relation to elevations, shade and shadow effects, materials, textures, exterior color schemes, and organizational layout. See TI 800-01, Appendix F.

1.1.5.3 Preferences.

The design shall address the Installation's identified preferences. Implement these preferences considering the following: (a) Achievable within the Construction Contract Cost Limitation (CCL); (b) Meets Milestones within Maximum Performance Duration; (c) Achieves Full Scope identified in this Solicitation; (d) Best Life-Cycle Cost Design; (e) Meets the Specified Sustainable Design (most recent ACSIM SDD policy memo) and LEED requirements; and, (f) Complies with Energy Conservation Requirements Specified in this RFP.

[Designer shall insert no more than five (5) Installation design preferences in decreasing order of priority, beginning with Visual Compatibility and Architectural Compatibility.]

Priority #1. Visual Compatibility: Facility Massing (Size, Height, Spacing, Architectural Theme, etc.) Exterior Aesthetic Considerations: The buildings massing, exterior functional aesthetics, and character shall create a comprehensive and harmonious blend of design features that are sympathetic to the style and context of the Installation. The Installation's intent for this area is:

[Designer insert the appropriate theme description.]

Priority #2. Architectural Compatibility: Exterior Design Elements (Materials, Style, Construction Details, etc.) Roofs, Exterior Skin, and Windows & Door Fenestrations should promote a visually appealing compatibility with the desired character while not sacrificing the integrity and technical competency of building systems.

Priority #3. [Designer insert.]

Priority #4. [Designer insert.]

Priority #5. [Designer insert.]

See appendix [Designer insert specific appendix] for exterior colors that apply to Architectural character at the Installation. The manufacturers and materials referenced are intended to establish color only, and are not intended to limit manufacturers and material selections.

1.1.6 Design Quality.

The objectives are to obtain housing structures and complimentary site development within funds available and to optimize livability. Design quality is achieved through the optimization of interior planning, integration of housing structures to the site, and balancing architectural attractiveness, variety, function, and design for low-cost maintenance and operation. Contractors shall consider sustainable design applications in developing proposals. See Section 9.0.

1.1.7 Installation Real Property Master Plan.

Designers and Contractors shall consult the Installation real property master plan provided by the installation. The Installation real property master plan provides comprehensive documentation of the existing conditions of natural, man-made, and human resources. It also guides the future land-use development. The real property master plan shall be consulted as it is the mechanism for ensuring that individual projects are sited to meet overall installation goals and objectives for land use development.

1.1.8 Installation Design Guide.

Design of this project shall incorporate the design guidance and criteria contained in the Installation Design Guide, to the extent excerpts of which are contained in the standard design criteria document.

[Designer shall insert reference(s) to applicable portion(s) of the installation design guide.]

1.1.9 Energy and Resources Conserving Features.

Public Law 109-58 Energy Policy Act of 2005, Executive Order 13423 and Federal Regulations 10 CFR 435 require Federal buildings to be designed and constructed to reduce energy consumption in a life-cycle, cost-effective manner using renewable energy sources when economical. Products designed to conserve energy and resources by controlling the amounts of consumed energy or by operating at increased efficiencies shall be considered unless shown not be life cycle cost effective per 10 CFR 435. Contractors are required to provide Energy and Resource conserving improvements that at least insure compliance with the ENERGY STAR® Homes Program parameters. The Energy Independence and Security Act of 2007 (EISA 07), section 523 requires at least 30% of hot water demand to be met using solar hot water heater when life cycle cost effective. This project shall achieve 30% of hot water demand met by solar hot water heater. Section 441 of EISA 07 extends the life cycle costing period from 25 year out to 40 years). The minimum requirement for the project is to achieve a Silver certification in accordance with USGBC LEED for Homes Rating System. See Section 9.0.

1.2 STANDARDS AND CRITERIA

1.2.1 References and Glossary.

References used in this document are contained in Appendix A and a Glossary of Terms is contained in Appendix B. All referenced documents form a part of this Scope of Work and this contract.

1.2.2 Building Codes and Standards.

1.2.2.1 Criteria to be used for design and construction shall be taken from the most current references at the date of issue of the RFP. Administrative, contractual, and procedural features of the contract shall be as described in other sections of the RFP. Referenced codes and standards are minimum acceptable criteria. The following documents form a part of this solicitation to the extent specified herein. Unless otherwise indicated, copies are available from [Designer insert.]

1.2.2.2 Applicable Codes and Referenced Standards.

Except for specific environmental issues, as a rule, local and state codes do not apply. [Designer shall list applicable model codes or standards and where to get them.]

- Local. [Designer shall list applicable model codes or standards and where to get them.]
- State. [Designer shall list applicable model codes or standards and where to get them.]

For military family housing located outside the US, compliance with local codes and regulations will be IAW Status of Forces Agreements (SOFA) or other international agreements. Equivalent substitutions may be authorized in foreign locations where various elements of standards, construction methods, materials, and equipment are regionally different than those in the US. The substitutions will need to meet Host Nation codes.

2.0 NEIGHBORHOOD AND SITE DESIGN CRITERIA

2.1 NEIGHBORHOOD DESIGN

2.1.1 General.

The goal of neighborhood design for military family housing is to develop and sustain a residential environment that responds to the military family, and reinforces the connection between families and community. This project consists of [Designer insert] housing units on [Designer insert] acres of land area. See also Sec 2.3. Imaginative site design is encouraged; however, the site boundaries, project composition, and gross density are fixed. Based on the graphic and narrative description of site opportunities and constraints provided, the Contractor shall verify that the site meets the program requirements.

2.1.2 Neighborhood Development.

In designing or improving a neighborhood, an important planning element is to understand the nature of the housing area—the relationship of each dwelling unit to a cluster of units, neighborhood, and community as a whole. Housing areas shall be planned so that community members can identify “their own” place in the overall neighborhood. Plan the site so that housing units are clustered into mini- or sub-neighborhoods, or are organized around a central element, such as a cul-de-sac or common area. In existing housing areas, break up large areas into smaller clusters or neighborhoods, where feasible. Below see **Table 2-1**, "Maximum Units per Building Type and Grade," for guidance in neighborhood development and site planning.

Table 2-1 – Maximum Units per Building Type and Grade

Unit Type	Apartment	Townhouse	Duplex	Detached
O6-O7+	N/A	N/A	N/A	X
E9, W4/5, & O4-O5 - 3-4 BR	N/A	N/A	X	X
W1/3, O1-O3 - 3-5 BR	8	6	X	X
E7-E8 - 4-5 BR	8	6	X	X
E7-E8 - 3 BR	12	8	X	N/A
E1-E6 - 4-5 BR	8	8	X	N/A
E1-E6 - 3 BR	12	8	X	N/A
N/A – Not Applicable				
X – Permitted Dwelling Type				
Note: Excludes foreign mid-rise and high-rise construction.				

2.2 SITE PLANNING AND DESIGN

2.2.1 Site Planning.

Site designs shall ensure that construction avoids, to the maximum extent practicable, wetlands, coastal and shoreline zones, and natural habitats when making neighborhood improvements or executing construction projects. These projects must undergo environmental impact analyses in compliance with the 1969 National Environmental Policy Act (NEPA) as implemented by Council on Environmental Quality regulations found at 40 CFR 1500-1508.

New units shall not be constructed in a 100-year floodplain. New housing must be located in compatible areas with respect to aircraft noise, as established in DODINST 4165.57 (Nov. 1977), Air Installation Compatible Use Zone (AICUZ). Military Family Housing sites shall have a maximum Day-Night Average Level (DNL) rating of 65. These standards also apply to housing sites near heavily traveled highways or other noise generating facilities. New Military Family Housing will not be located within any runway Clear Zone or Accident Potential Zone (APZ I or APZ II).

Site preparation and site improvements, required exclusively for support of a housing project, shall be included in the design and be included in total project cost. [\[Designer edit the following to show site work required.\]](#) Site preparation work includes demolition of existing structures, correction of drainage problems and unsuitable subsurface conditions, clearing, grubbing, and rough grading as applicable. Site improvements include utility systems, roads, streets, curbs and gutters, walks, driveways, off-street parking, recreation areas, bike and jogging paths, lawns, landscaping, and finish grading as required to support function and livability of housing.

2.2.2 Site Development.

Objectives of site development are to:

- Plan and provide adequate infrastructure;
- Use residential building blocks to create neighborhood identity;
- Orient buildings and paved surfaces to optimize solar control and minimize heat-islands;
- Strengthen the neighborhood with efficient traffic patterns for vehicles and pedestrians;
- Create a full range of private and shared recreational facilities; and
- Use sustainable landscape design to minimize impact on the environment and reduce water consumption.
- Minimize disturbance to the site and surrounding areas.

2.2.2.1 Site Verification. Obtain from the installation the site analysis and the documented site opportunities and constraints to verify that the site meets the housing program requirements that are provided. In the event a site analysis has not been accomplished, then an analysis must be performed by the Contractor and the analysis results documented in a written and graphic summary of site opportunities and constraints for the housing project.

2.2.2.2 Area Development Plan. Provide a housing area development plan that shows the spatial and functional arrangement of all housing requirements. The plan shall ensure an economical, compatible and functional residential land use development that utilizes the advantages of the site, fosters visual order, and provides a sense of community. The area development plan shows consideration for the site opportunities and constraints, housing program

requirements, and specific site design criteria and guidance provided. The recommendations of the Installation Real Property Master Plan and Installation Design Guide shall be addressed.

2.2.2.3 Density. The project site is approved for [Designer select: [low density, medium density, high density] siting]. See Section 2.3. Land area for density calculations excludes slopes greater than 10 percent, major highways, flood plains and flood areas, lakes and water courses. Designated major recreation areas greater than 1.2 ha [3 acres] may be excluded from the density calculation.

2.2.2.4 Land Use. The plan for the area shall reflect an optimum balance of housing unit floor area, open space, play lots, neighborhood parks, and pedestrian and vehicular circulation. The plan shall show an efficient, organized and economical land use arrangement that is compatible and functional. This plan shall show the relationship of the area to adjacent land uses.

2.2.2.5 Noise. Use mitigation techniques to moderate predictable noise in accordance with the Installation Compatible Use Zone Program. [Designer edit the following.] All possible methods of mitigating the impact to the site and adjacent areas shall be explored.

2.2.2.6 Buffer Area. Provide appropriate buffer areas to separate and visually isolate the community from undesirable external influences and to separate adjacent officer and enlisted personnel housing areas from each other. The width of a residential street shall be a minimum acceptable buffer zone between officer and enlisted personnel housing areas. [Designer edit the following.] All possible methods of mitigating the impact to the site and adjacent areas shall be explored.

2.2.2.7 Housing Unit Grouping. Variety in groupings, arrangements, and siting configurations of housing units is encouraged to fit varying terrain conditions and to provide compatible and functional residential layouts and streetscapes. Building arrangements shall be informal and imaginative with setbacks and orientation to provide for the best view, privacy, and variety. The proper grouping of housing units will provide backyard screening, separation of pedestrian and vehicular traffic, natural open spaces, and where required under Section 2.4, play lots and neighborhood parks. The layout shall reflect simplicity of design and provide a visual sense of community.

2.2.2.8 Housing Unit Variation. Housing unit variation shall afford distinctly different exterior appearances within each housing unit type. Provide stylistic compatibility that will give the neighborhood a sense of order. Housing units shall vary in two or more of the following: Floor plans, massing, elevation, garage location, and exterior materials. One floor plan for each housing unit type is acceptable if sufficient variety is achieved by means of other variations mentioned above. In addition, housing units shall vary in color and siting. A reverse floor plan (mirror-image), although an acceptable means of creating variety, shall not constitute a housing unit change. Contractors shall comply with land-use restraints set forth in this document. To accept the design freedom objective of the RFP, Contractors are encouraged to offer 1-story and 2-story construction for detached, duplex, and townhouse units. The preferred colors are earth tones available in commonly used durable materials. The design shall reflect life cycle maintenance and energy efficiency.

2.2.2.9 Housing Unit Orientation. Housing units shall be oriented, to the maximum extent possible within the constraints of the site available, so that the building is oriented to take advantage of solar energy applications, and expose the minimum surface area to direct solar gain during the cooling season. Orientation for the potential use of solar applications shall be considered even if such applications are not included as part of this project. Additional consideration will be given during the quality evaluations with respect to unit orientations and passive solar applications considered and included. For additional orientation, passive design, and other considerations see Sections 8 & 9 of this RFP. Housing units shall be designed, to the maximum extent possible within the constraints of the site available, so that the long axis of the

building is within 20 degrees east or west of true South, and such that a majority of the roof faces within 20 degrees of South. [Designer edit if necessary where known site constraints preclude compliance with this requirement or if the project under design is a rehabilitation of existing units.]

2.2.2.10 Grading. The grading shall maintain existing topography while recognizing standard gradients for the housing units and various functions. [Designer edit the following as appropriate for the project.] There shall be a balance of the quantity of cut and fill which would create a smooth transition of graded areas into the existing natural site. The plan shall reflect selective site clearing that preserves groups of trees. Grading shall manage site runoff. The principles of positive drainage shall be applied to control the conditions that remove rainfall away from facilities and functions.

2.2.3 Unit Type.

Acceptable construction options for this project and definitions for housing unit types used in these criteria are as follows:

[Designer shall edit in accordance with project requirements and/or special instructions contained in Design Directives.]

- Site-built Housing. A residential building or housing unit wholly or substantially constructed at the site.
- Factory-built Housing. Construction consisting of components, sub-assemblies such as modules, panelized walls, roof trusses, floor joists, and other factory-assembled components, which are transported to the construction site and further assembled into completed housing units. All interior and exterior walls, regardless of whether they are structural (load bearing) or not, are plant fabricated (panelized). Panels must be fabricated to the extent that the structure of the panel or truss is factory-assembled. Finishes such as interior wall board may be site applied.
- Manufactured Housing. As defined in Public Law 93-383, Title 24, Chapter XX amended (1977, 1978, 1979, and 1980), a manufactured home is "a structure, transportable in one (1) or more sections which in the traveling mode is eight body feet or more in width, or forty body feet or more in length, or, when erected on site, is built on a permanent foundation when connected to the required utilities, and includes the plumbing, heating, air conditioning and electrical systems contained therein."
- Apartment Buildings. Housing units on a single floor served by a central corridor. Apartment buildings of this type may be one (1) to three (3) stories.
- Garden Apartments. Housing units on a single floor with direct entry from a stairway landing. Housing units shall be full depth from front to back without intervening public corridors. Buildings shall be no more than three stories high, and designed so that no more than one (1) stairway per module is required. Normally, no more than two housing units will be served by each stair landing.
- Duplex. One or two-story housing units joined together by a common party wall and each housing unit entered directly from the exterior.
- Townhouses. One, two, or three-story housing units having one (end units) or more party walls. Configurations, such as triplexes, quadruplexes and up to six housing units, are considered to be townhouses.
- Detached House. A single-family housing unit which is not attached to another housing unit.

2.3 SITE DESIGN CRITERIA.

The following specific criteria, based on site density, are to be used as guidance in site design, and proposals will be scored accordingly.

2.3.1 Site Density.

Densities for family housing projects, expressed in units per acre, are listed in **Table 2-2**. Density ranges represent minimums and maximums for new construction. The project site/s is/are [Designer shall edit.] described on the RFP drawings included as part of this solicitation and include(s) approximately [Designer insert] hectares, that is, [Designer insert] acres. Site work includes all design and construction of the site design to include grading, storm drainage, erosion control, pedestrian and vehicular circulation, utility systems, outdoor lighting, landscaping and physical security, and where required under Section 2.4, play lots and neighborhood parks

Table 2-2 – Site Densities

Density Factors – Number of Units per Acre		
Low (1)	Medium (2)	High (3)
4-6	7-10	11-15
1. Suburban, moderately developed, and rural areas. 2. Developed urban areas, not included under “High” location. 3. Dense metropolitan areas and most overseas locations where land is not available to meet at least medium density. Only in exceptional cases will high-rise building density of up to 40 units per acre or 100 units per building be programmed.		

2.3.2 Unit Types by Density.

Housing unit types by site density are shown in **Table 2-3**. The project consists of [Designer insert] housing unit(s) on [Designer insert] acre(s) of land area. The project site is approved for [low density, medium density, high density] siting. [Designer edit as appropriate.] Site development shall comply with the minimum requirements for [low density, medium density, high density] siting. [Designer insert site area, edit for appropriate site density and add any special site constraints.]

Table 2-3 – Housing Unit Types by Density

Bedrooms/ Grade	Low Density	Medium Density	High Density
3, 4, & 5 Bedrooms E-1 - E-9, W-1 - W-4 O-1 - O-3	1-2 Floor Detached Homes, Duplexes or Townhouses	1-3 Floor Duplexes or Townhouses	1-3 Floor Townhouses

Bedrooms/ Grade	Low Density	Medium Density	High Density
3 & 4 Bedrooms O-4 - O-5	1-2 Floor Detached Homes, or Duplexes	1-3 Floor Duplexes or Townhouses	1-3 Floor Duplexes or Townhouses
4 Bedrooms O-6 - O-10	1-2 Floor Detached Homes	1-3 Floor Detached Homes	1-3 Floor Detached Homes

2.3.3 Maximum Units per Building by Grade.

Maximum number of housing units per building by grade is shown in **Table 2-4**.

Table 2-4 – Maximum Number of Units per Building by Grade

Building Types	E-1 - E-6	E-7 - E-9 & O-1 - O-3	O-4 - O-5
Apartments	12	8	N/A
Townhouses	8	6	4

Housing units for this project shall be a mix of three-, four-, and/or five-bedroom housing units as shown in **Table 2-5**.

Table 2-5 – Project Housing Units by Grade

Pay Grade	Number of Bedrooms	Number of Units ^[1]
O-9 and O-10 (GFO)	4	
O-7 and O-8 (GFO)	4	
O-6 (SO)	4	
O-4 and O-5 (FGO)	4	
	3	
O-1 through O-3 (CGO)	5	
	4	
	3	

Pay Grade	Number of Bedrooms	Number of Units ^[1]
W-1 through W-4 (WO)	4	
	3	
E-7 through E-9 (SNCO)	5	
	4	
	3	
E-1 through E-6 (JNCO)	5	
	4	
	3	
[1. Designers Note: Edit/insert "Number of Units" for specific project requirements.]		

2.3.4 Parking Requirements by Site Density.

Parking shall be provided as follows. Each parking space provided in a garage, carport, or driveway counts as an off-street parking stall.

- Low density: Two off-street stalls and one guest on-street stall per unit.
- Medium density: Two off-street stalls and 0.5 guest on-street stall per unit.
- High density: Two off-street stalls and 0.25 guest on-street stalls per unit.

2.3.5 Recreational Vehicle (RV) Storage.

[Designer insert where required; prohibited at high density sites.] Provide one 3.0 m x 6.0 m [10 ft by 20 ft] space per 20 housing units. The area shall include 2.0 m [6 ft] high chain link security fencing and security flood lighting of 2.7 Lx [0.25 foot candles] at the boundary fence. Area shall have an all-weather surface and an access drive. Design shall permit access to all spaces without moving other vehicles.

2.3.6 Building Setbacks and Spacing.

Clearances between and adjacent to buildings must consider requirements for fire protection, safety, privacy, and emergency access in addition to the following minimum criteria. Setback or yard dimensions shall be from the building wall to an imaginary lot line around each building measured perpendicular to the building. Wall lengths with horizontal offsets of 1.8 m [6 ft] or more may be measured separately when determining yard depth. Distance between buildings shall be not less than the sum of setbacks or yards, as required.

2.3.6.1 Minimum setbacks and spacing for low density sites are shown in **Table 2-6**.

Table 2-6 – Minimum Setbacks and Spacing – Low Density Sites

Description	Meters	[Feet]
From front of house to curb of residential street.	7.5	25
From house to major/arterial street. (Edge of pavement)	45.0	150
From house to collector street. (Edge of pavement)	30.0	100
Side of carport or garage to curb.	6.0	20
Side of house to curb (1).	6.0	20
Between sides of carports or garages and houses (1).	1.5	5
Between outside walls of houses (1).	6.0	20
Between rear walls of houses.	24.0	80
Between side and rear walls of houses.	12.0	40
Between street face of carport or garage and curb or sidewalk when second off- street parking space is next to garage or carport.	2.4	8
Between street face of carport or garage and curb or sidewalk when second off- street parking space is between carport or garage and street.	8.5	28
1. When patios are located within a yard, separation shall not be less than 12.0 m [40 ft]		

2.3.6.2 Minimum setbacks and spacing for medium and high density sites are shown in **Table 2-7**.

Table 2-7 – Minimum Setbacks and Spacing – Medium and High Density Sites

	Wall A	Wall B	Wall C
Wall Definitions	Contains the housing unit main entrance; or the principal window(s) of the living room, dining room, family room, or a balcony	Contains window(s) other than in wall 'A'	Contains no windows

	Wall A	Wall B	Wall C
Building to Building (each yard)	1.8 m [6 ft] + 0.6 m [2 ft] for each level + 5 percent wall length	1.2 m [4 ft] + 0.3 m [1 ft] for each level + 5 percent wall length	2.25 m [7 ft 6 in] minimum
Building to Street (face of curb)	6.0 m [20 ft]	4.5 m [15 ft]	3.0 m [10 ft]
Building to retaining wall with a height of 1.2 m [4ft] or more, above a floor with windows.	4.5 m [15 ft]	2.25 m [7 ft 6 in]	1.5 m [5 ft]

2.3.6.2.1 Garage to Street (face of curb). Detached garages may be located up to the property line or the project boundary.

- Front: 2.4 m [8 ft] (without parking). [\[Designer edit to larger distance if site renders this distance impractical.\]](#)
- Side or Back: 4.5 m [15 ft].
- Driveway length for parking, measured from back edge of sidewalk.
- To park one car: 6.0 m [20 ft].
- To park two cars: 12.0 m [40 ft].

2.3.6.3 Setback Notes.

- Where the slope is 3:1 or steeper, top and toe of slope shall be a minimum of 4.5 m [15 ft] from the building.
- Courts, outer and inner, shall have dimensions not less than the sum of the required yard distances. An inner court shall have a minimum area of 9.29 m² [100 ft²] for a one-story building and an additional 4.64 m² [50 ft²] for each additional story.

2.4 PUBLIC RECREATIONAL FACILITIES AND SITE AMENITIES

2.4.1 General.

Where required below, each neighborhood or cluster of housing units shall have open areas, picnic tables, benches, children's play equipment, and other recreation facilities for common use. Each neighborhood shall have age-appropriate play lots for children, common open areas, landscaped areas with trees, picnic area, sitting areas, walking, bike and jogging paths, and other recreation activities for common use by the residents. Each housing area shall have specialized recreation facilities, including large open playfields and courts, room for support facilities, bike, jogging, and walking paths, and wooded natural landscape areas.

Provide site amenities and recreational facilities as specified in **Table 2-8** based on number of family housing units in the neighborhood. Playground equipment and surfaces must comply with the following standards:

- ASTM F1487 – Standard Consumer Safety Performance Specification for Playground Equipment for Public Use
- ASTM F1292 – Standard Specification for Impact Attenuation of Surface Systems Under and Around Playground Equipment
- ASTM F1951 – Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment
- For guidelines on safety of playgrounds, review CPSC Publication No. 325 – *Handbook for Public Playground Safety*.

Table 2-8 – Site Amenities

Item	Quantity of Amenities
School bus stop enclosures	1 per 100 housing units, as required
Benches	2 per tot lot, play lot, rec. court, and playfield
Bicycle racks	1 per tot lot, play lot, rec. court, and playfield
Trash receptacles	1 per tot lot, play lot, rec. court, playfield, picnic and sitting areas,
Play Lot(12mo.-5yrs) (5-9 years) (1)	1 per 30 housing units
Neighborhood Park	1 per 150 housing units
Picnic areas	1 per 50 housing units
Natural landscaped areas	1 per neighborhood (optional)
Common open areas	1 per neighborhood (optional)
Open playing fields	1 acre per 150 housing units
Tennis courts	1 per 150 housing units (optional)
Basketball courts	1 per 100 housing units

Walkways	1 per neighborhood
Bike paths (2)	1 per neighborhood
Jogging paths (2)	1 per neighborhood
<p>1. Both DoD & CPSC Safety Standards apply.</p> <p>2. Bike and jogging paths may be combined, and shall be connected to existing paths, where applicable</p>	

2.4.2 Support Facilities.

[Designer insert "Deleted" if not applicable or edit as appropriate to the project.] Provide support facilities as follows: Concurrent with the planning of new or improvement housing projects, consider the need for support facilities, such as housing management offices, housing maintenance facilities, self-help centers, and community centers. **Table 2-9** provides typical sizes in square feet for Support Facilities, based on Installation, activity, and housing inventory. Support Facility design shall be based on installation and activity size. The actual support facility design must be customized based on actual personnel demand and other site-specific criteria.

Table 2-9 – Support Facilities

	Small (SF)	Medium (SF)	Large (SF)	Regional (SF)
Housing Management Office	2,000 - 3,400	3,500 - 5,000	5,100 - 9,000	>10,000
Community Center	2,000 - 4,000	6,000	8,000	>10,000
Self-Help Center	2,000 - 3,000	4,000	6,000	>12,000
Housing Maintenance Facility	>3,500	5,500	>6,300	

2.4.2.1 Housing Management Offices.

Housing offices support military family housing projects and shall be designed to meet the functional requirements of authorized housing management staffing levels. Housing offices located in the project area shall be architecturally compatible with the housing unit design and installation architectural standards. [Designer shall insert installation specific requirements, if any, for Housing Management Offices here.]

2.4.2.2 Community Centers.

Family and community support and service centers may be authorized as required to provide services to military personnel and their dependents. Construction of family housing community centers should not be considered when housing projects or complexes have less than 250 family units or community recreational facilities are convenient and sufficient to support the housing project. Community Centers located in the project area shall be architecturally compatible with the housing unit design and installation architectural standards. Where possible the Community

Centers and Housing Management Offices shall be co-located. [\[Designer shall insert installation specific requirements for Community Centers here.\]](#)

2.4.2.3 Housing Maintenance Facilities and Self-Help Centers.

When housing maintenance or self-help facilities are authorized to support military family housing projects, they must be designed to meet the functional requirement. Facilities located within a housing area shall be architecturally compatible with the surrounding units and installation architectural standards.

2.4.3 Children's Outdoor Play Areas.

The design of the children's outdoor play areas shall comply with the safety requirements of ASTM F 1487 and ASTM F 1292. The children's outdoor play areas are unsupervised play areas and do not have a supervised play program for child development. These areas are not part of trained recreation, youth center or child development staff support. Supervised outdoor play areas occur at youth centers and child development centers.

2.4.3.1 Child Safety and Accessibility.

- Accessibility to children and adults with disabilities. Play areas shall be accessible to children and adults with disabilities. Determination of accessibility shall be in accordance with ASTM F-1951 Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment. In addition to wheelchair users, the needs of children and adults who walk with canes, walkers, or crutches; who have limited use of the upper body; who have visual or hearing disabilities, or who have developmental disabilities shall be considered. Design criteria based on child dimensions shall be used for the proper functioning of the play area. Every part of a play area may not be accessible to all its users, but the social experience provided shall be accessible to everyone. When more than one play activity of the same type is provided, one shall be accessible. When one activity is provided, it shall be accessible. A diverse play area has the greatest potential for meeting the needs of all users. Separate play areas for the physically challenged are not acceptable. Integrating all children in the same play setting will be emphasized. Where available, guidelines from the installation or Design District for accessible routes, ramps for wheelchair access, transfer points, wheelchair accessible platforms, and accessible stepped platforms shall be followed.
- Age appropriate scale. Age appropriate scale is a term used to describe equipment which will allow safe and successful use by children of a specific chronological age, mental age, and physical ability. Play equipment height and complexity will not exceed the user's ability. The children's outdoor play areas will meet age appropriate scale for the age groups that the areas are designed to accommodate.
- Use zones. In accordance with ASTM F 1487, a use zone is a clear, unobstructed area under and around play equipment where a child would be expected to land when jumping or falling from a piece of play equipment. These zones require a playground safety surface in accordance with ASTM F 1292. Requirements for use zones vary for the age group and for different pieces of equipment. All use zones for play equipment shall be shown on the site plan to ensure there is no conflict between play activities on the ground and swinging or jumping from the equipment. Use zones will not overlap except for spring rocking equipment, balance beams, and play houses.
- Playground safety surface. A playground safety surface is constructed of a material that meets the shock absorbency criteria recommended in ASTM F 1292. Playground safety

surfaces shall be provided throughout all use zones and under all play equipment as required.

- Inappropriate play events. The following play events are not appropriate for use in unsupervised play areas; Chain walks, chain or tire climbers, fulcrum seesaws, log roles, May poles, merry-go-rounds, rotating equipment, spring rocking equipment intended for standing, swinging exercise bars, trapeze bars, and whirls.

2.4.3.2 Play Lot.

Provide play lots that are located within the site lines of the housing units to be supported. Connect play lots to the units by a walkway system. Provide shade. Each play lot shall be provided with the following age appropriate play events and equipment for the two age groups to be accommodated:

- Pathway. The pathway shall encompass the perimeter of the area, accommodate wheeled toys, and consist of different textures, colors, and patterns for games.
- Gathering place. This setting provides an open space for groups of different sizes and people of all ages. Provide an infant crawl area. The seating materials may include boulders, timbers or logs arranged with vegetation to create a room like atmosphere. A shelter may be provided.
- Sand play setting. This setting supports creative play and social interaction. It provides children with a manipulative play environment. The play elements include sand, water, sand tables, containment barriers and boulders. The sieve size for sand shall consist of a fine washed plaster sand. The sand used here is not the same sieve size as the sand used for the use zones. This setting shall be located adjacent to the play village.
- Play village. This setting supports a playhouse and a water source. It shall be located adjacent to the sand play setting.
- Dramatic play setting. This setting supports dramatic play elements such as playhouses, play platforms, and an open area for seating on the ground.
- Manufactured play equipment setting. This setting includes an age appropriate composite structure consisting of multiple play events for each of the following age groups; 12 months to 2 years of age, 2 to 5 years of age, and 5 to 9 years of age. Other play events include free standing equipment such as spring rocking equipment, swing, and balance beam. The swing shall be located as a free standing play event on the perimeter.
- Plant materials. Plants and ground cover shall be integrated into play settings. Plants provide a variety of learning opportunities, as they become a source for play material for crafts, dramatic play, and sensory experience. Plants define space and provide shade. Poisonous plants and plants with thorns are not allowed and shall be removed from the play areas.

2.4.4 Neighborhood Park.

Provide neighborhood parks that are to be located on the edge of the housing unit area to be supported. Connect neighborhood parks to the housing units by a walkway system. Provide shade and benches. Each neighborhood park shall be provided with the following age appropriate play events and equipment for the two age groups to be accommodated:

- The pathway shall encompass the perimeter of the area, accommodate wheeled toys, and consist of different textures, colors, and patterns for games.
- Gathering place. This setting provides an open space for groups of different sizes and people of all ages. The seating materials may include boulders, timbers or logs arranged to create a room like atmosphere. Additional points will be given for providing a picnic shelter.
- Manufactured play equipment setting. This setting includes an age appropriate composite structure consisting of multiple play events for children 5 to 15 years of age. Other play events include free standing equipment such as spring rocking equipment, swing, track ride, and balance beam. The swing shall be located as a free standing play event on the perimeter.
- Sports and games setting. This setting includes a turf area as the central element of the park. The turf area shall be designed to allow for various sports activities. Locate a multi-use hard surface area on the perimeter. Other design elements include surfacing, fences, drinking fountains, storage, lighting, seating, and trash receptacles.
- Basketball Court. Provide one full regulation size basketball court per 100 housing units. Provide standard basketball permanent equipment and properly lined hard playing surface.

3.0 SITE ENGINEERING

3.1 VEHICULAR AND PEDESTRIAN CIRCULATION

3.1.1 General.

Vehicular and pedestrian circulation systems shall provide convenient and safe access and circulation within the housing area, and to adjacent service areas.

3.1.2 Roads and Streets.

Street systems shall minimize through traffic in housing areas. Roads and streets must be adequate to accommodate occupant traffic, service vehicles (including maintenance, trash removal, buses, moving vans (transcontinental road tractor and trailer), and firefighting equipment), and snow removal equipment where applicable. The development of improved vehicular circulation systems is one of the best ways to strengthen identity of neighborhoods. Although the street system shall provide safe, convenient access to housing units to and from the neighborhood, it must not play a dominant role with respect to overall housing area environment. Street widths shown are exclusive of curb and gutter whether or not curb and gutter is provided. The street system shall defer to, and be supportive of, pedestrian-oriented systems and shall be designed with the following hierarchy of street types:

3.1.2.1 Residential Street.

A residential street shall have a minimum width of 6.1 m (20 ft), with 3.0 m (10 ft) wide travel lanes. A residential street carries low volumes of traffic and functions as access to each housing cluster. Where parallel on-street parking is provided, a minimum of 3.0 m (10 ft) for each lane of on-street parking shall be provided. Coordinate with Para 3.2.1.

- Loop. Both ends are open to traffic.
- Cul-De-Sac. Only one end is open to a collector street with a turnaround (T, Y, or Circle) at the other end. The circulation system may be based on cul-de-sacs a maximum 182.8 m [600 ft] long, measured from the center of the cul-de-sac to the centerline of the collector street. Cul-De-Sac shall be dimensionally sized to allow easy turn-a-round for vehicles cited in 3.1.2 Roads and Streets.

3.1.2.2 Collector Street.

Collector streets shall have a minimum width of 7.3 m (24 ft), with 3.7 m (12 ft) wide travel lanes. Collector streets handle traffic from a group of clusters and respective residential streets. Do not locate housing units or driveways on collector streets.

3.1.2.3 Arterial Street.

Arterial streets shall be a minimum of 9.1 m (30 ft) wide, with 3.7 m (12 ft) wide travel lanes, and 0.9 m (3 ft) wide shoulders on each side. Arterial streets are major streets that carry traffic from collector streets and provide access to other areas of the Installation. Do not locate housing units on arterial streets.

3.1.2.4 Intersection Design.

Provide "T" intersection offsets of at least 38.1 m [125 ft]. The preferred angle of intersection is right-angle (90 degrees).

3.1.3 Curb, Gutter, and Sidewalk.

Curbs and gutters shall, wherever programmatically possible and not in conflict with Low Impact Development, be provided on all new streets. Sidewalks are required on at least one side of each street (see 3.1.5 for additional information on sidewalks). [Designer edit the following sentence to remove greenbelt requirement if not practicable for the site.] A “greenbelt” space shall separate sidewalk and curb for pedestrian safety. Depress standing curbs at driveways, intersection corners, cross walks, and wheelchair accessibility ramps.

3.1.4 Driveways.

Driveways shall have a minimum width of 3.0 m (10 ft). The minimum length for driveways utilized for off-street parking shall be 7.3 m (20 ft), measured from back edge of sidewalk. Driveway grades shall provide safe access, and shall not exceed 12%. Driveways for handicapped individual accessible units shall have slopes less than 5%. [Designer shall change “shall” to “should” for accessible units where demonstrable specific site constraints do not permit meeting this criterion.]

3.1.4.1 Housing Unit Access Drive.

Access drives shall provide traffic safety distances which allow safe entry and exit. Access drives serving more than 8 housing units, or subject to service and emergency truck traffic shall be designed as a street.

3.1.5 Pedestrian Circulation.

Provide pedestrian-oriented circulation systems. Pedestrian circulation shall be based on pedestrian desired lines of walking between facilities and weighted to predict the most traveled routes. Pave sidewalks and walks, and provide appropriate surfaces for jogging, exercise, and bike paths. Walkways shall provide pedestrian access to and from housing units, public sidewalks, and other common use areas. Walkways shall be a minimum of 1.2 m (4 ft) wide exclusive of curb width, and made of non-reinforced concrete with a minimum thickness of 100 mm [4 in]. Where walks are adjacent to the curb, the curb width is not to be included as sidewalk. Jogging paths and bikeways shall be a minimum of 1.8 m (6 ft) wide. Pedestrian circulation shall be separated from vehicular circulation as much as possible. Walks must conform to current accessibility standards. See appendices.

3.1.6 Signage and Pavement Marking.

Provide street signs and markings according to Federal Highway Administration (FHWA) Manual on Uniform Traffic Control Devices, and Installation standards. Foreign locations must also adhere to Host Nation standards for street signs and markings.

3.2 PARKING

3.2.1 Private Parking.

Each unit shall, wherever programmatically possible, have a minimum of two off-street parking spaces. O9/10 GFOQ shall provide off-street parking for [Designer shall insert specific number] guests for entertainment functions. Indented, 90-degree, and gang parking are permitted but not desirable. Parking areas shall be designed to comply with Installation specifications and Family Housing Master Plans. Each parking space provided in a garage, carport, or driveway counts as a parking space. Provide guest parking of an additional 0.5 spaces per unit. Where necessary in high density areas, 90-degree and gang parking, and 0.25 guest parking spaces per unit, may be allowed. However, parking areas consisting of more than 4 vehicles backing into the street are

unacceptable. Design on-street parking stalls to be of sufficient length and width to allow safe movement into and out of the stall and to adequately separate the parked vehicle from the traffic flow. See Paragraph 2.3.4.

3.2.2 Off-street parking lots.

If provided, maintain two-way movement and avoid dead-end parking lots. Provide more than one entrance and exit drive. 90-degree parking is preferable. In large parking lots provide a minimum 10 percent of the total paved area for landscape plant material.

3.3 SOILS

3.3.1 Soil and Foundation Report (Geotechnical Report).

A preliminary Soil and Foundation Report is provided as part of the RFP. A drawing indicating Subsurface Explorations and Geologic Profiles for the proposed site is also provided. The report provides an overview of soils and geologic conditions, and is furnished for informational purposes only. The Contractor to whom this contract is awarded shall, with his or her consulting professional geotechnical engineer experienced in geotechnical engineering, be responsible for determining site specific geotechnical conditions. The Contractor-provided site specific geotechnical conditions report shall include, but not be limited to:

- Classification of soil and rock.
- Depth to bedrock.
- Extent of boulders.
- Bearing capacity of soil and rock.
- Settlement potential.
- Compaction requirements.
- Groundwater characteristics.
- Infiltration and permeability.
- Erosion and siltation.
- Surface and subsurface drainage.
- Soil resistivity.
- Other [\[Designer shall insert any site specific soil requirements here.\]](#)

3.3.2 Certification.

The Contractor and his or her professional geotechnical engineer consultant shall certify in writing that the design of the project has been developed consistent with the site specific geotechnical conditions. The certification shall be stamped by the consulting professional geotechnical engineer and shall be submitted with the 50 percent design submission. If revisions are made to the 50 percent design submission, a new certification shall be provided with the final design submission.

3.3.3 Soil compaction.

Soil compaction shall be achieved by equipment approved by a professional geotechnical engineer. Material shall be moistened or aerated as necessary to provide the moisture content that will readily facilitate obtaining the compaction specified with the equipment used. Compact each layer to not less than the percentage of maximum density specified in **Table 3-1** determined in accordance with ASTM D 1557 Method D. The requirements shall be verified or modifications recommended by the consulting professional geotechnical engineer in the report wherever engineering, soils, or climatic factors indicate the necessity. Any modification to the stated compaction requirements shall require the approval of the Contracting Officer.

Table 3-1 – Soil Compaction

Subgrade Preparation, Fills, Embankments, and Backfills	Compaction Requirements (Percentage of Maximum Density)
Structures & Building Slabs	90
Streets, Paved Areas, Bike Paths	90
Sidewalks	85
Grassed Areas	80

3.3.4 Capillary Water Barrier.

A capillary water barrier is required for all interior slabs on grade, including garages, carports and storage rooms. As a minimum, the capillary water barrier shall [\[Designer shall edit as required the following minimum requirements.\]](#) consist of clean, non-porous rock, crushed gravel, or uncrushed gravel. Max particle size shall be 1.5 inches and no more than 2 percent by weight shall pass the 3/16-inch size (No. 4) sieve.

3.4 STORM WATER MANAGEMENT

3.4.1 General.

Develop a storm water management system using 10-year storm frequency methodology and local requirements (for collection, detention/retention and controlled flow volume discharge). Low Impact Development (LID) principles for storm water management, such as decentralized storm water retention, shall be used in the land development process to conserve and protect natural resource systems and reduce infrastructure costs. Note: Consider children’s safety in design and construction of storm water structures.

3.4.2 Storm Water Runoff.

Areas shall be designed for positive drainage away from housing units. Finish grade around perimeter of each housing unit shall slope a minimum of 5% (15 cm (6 in)) fall in 3.0 m (10 ft)) to carry surface water away from foundation walls. Where lot lines, walls, slopes, or other physical barriers prohibit 15 cm (6 in) fall in 3.0 m (10 ft), drains or swales shall be provided to ensure drainage away from structure. The storm drainage system shall be properly coordinated with surrounding properties to ensure that runoff does not cause damage to other properties. All drainage lines, if required, shall remain in conduit to stable grade. The minimum velocity of flow in conduits during a design storm shall be 0.07 m/s [2 ft 6 in/s]. Rainfall intensities for project

locations shall be in accordance with local community/locality/State Transportation (Highway) agency design parameters.

3.4.2.1 Drainage of Roads and Pavements.

Provide a positive crown or sheet drainage to all streets and roads. Pavement collectors for storm water shall be by curb inlets and gutters. Open areas shall be drained by field inlets and an underground collection system. No roadside ditches shall be permitted unless required as part of overall plan for Low Impact Development. Overland flow shall be held to a minimum.

3.4.2.2 Pipe for culverts and storm drains shall be constructed of permanent, durable material appropriate for the soil conditions of the site.

3.4.2.3 Site specific storm drainage criteria.

[Designer shall insert site specific requirements such as local and State requirements limiting runoff, permit requirements, etc.]

3.4.3 Foundation Drains.

Drains shall be provided in accordance with IRC or IBC, whichever is applicable per project scope. Foundation drains shall be provided with cleanouts.

3.4.4 Manholes.

Manholes shall be located at intersections and changes in alignment or grade. Intermediate manhole maximum spacing shall be 76.2 m [250 ft] for pipes 0.9 m [3 ft] or less in diameter or box drains with the smallest dimension less than 0.9 m [3 ft]. Maximum spacing for intermediate manholes on larger pipes and drain boxes shall be 152 m [500 ft]. Manholes shall be precast concrete and shall conform to ASTM C 478 or AASHTO M 199. Steel ladders shall be installed where the depth of the manhole exceeds 0.9 m [3 ft]. The ladder shall be galvanized after fabrication in accordance with ASTM A 123. The wall along the ladder shall be vertical. The manhole shall have a 0.6 m [2 ft] minimum opening as measured from the face of the steel ladder.

3.5 WATER DISTRIBUTION

Water Distribution system shall be designed and constructed in accordance with State and Local Codes and regulations. [Designer shall insert specific requirements, including permitting and state approval of design, etc.] Many installations have privatized water distribution systems. Contractor to coordinate water service requirements for family housing with private utility vendor holding license to operate and maintain water distribution system. The water vendor may elect to design and construct water service requirements to supply the family housing area with domestic and fire protection requirements. Costs for these services shall be the responsibility of the Government.

3.5.1 Metering.

Meters are required for family housing areas to accurately monitor the consumption and cost data for water utilities. Metering of utilities shall be provided as required by the private utility provider or as follows:

[Designer shall insert installation specific requirements and points of contact for privatized utilities.]

Cost of all utility work is to be borne by the project and shall be accounted for and itemized in the bid schedule regardless of who performs the work.

3.5.1.1 Master meters. Master meters for water shall be provided for all new and replacement housing units except where new housing units are metered by an existing meter.

3.5.1.2 Group water meter requirements. Group water meters are required for new and replacement housing projects where total daily water demand exceeds 94.6 m³ [25,000 gal]. Meters shall be equipped with electronic or radio frequency transmitters for remote monitoring. The method of remote monitoring must be coordinated with installation utility systems. The size of the group for metering shall be at least five but no more than 20 single family detached, duplex, or townhouse units. Metering groups for apartment units shall be at least 25, but no more than 50 housing units. [Designer shall provide specific metering information when required by local jurisdictions.]

3.5.2 Water Mains and Building Service Connections.

Connection to the existing water distribution system shall be made at the locations shown on the RFP drawings. Mains shall be considered as that part of the distribution system supplying fire hydrants, or fire hydrant laterals. Service connections supply water from the main to the building. Mains shall be looped with no dead ends and be of adequate size to satisfy both domestic and fire flow requirements. Minimum main size is 0.20m [8in]. Sufficient sectional control valves shall be provided so that no more than two fire hydrants will be out of service in the event of a single break in a water main. A copper tracer wire shall be placed directly above all non-metallic mains when plastic marking tape does not provide means of determining alignment of pipe by metal detecting equipment. The pipe, valves, and all other materials shall meet the American Water Works Association (AWWA) standards for a 1,034.2 kPa [150 psi] working pressure system. Provide sacrificial anodes for all valves and metal pipe or as designed by an NACE certified (or equal) cathodic protection expert. Provide a curb stop/shut-off valve on service connections for each building that is located close to the water main. Shutoff valves in walks are prohibited. Building connections shall be designed and constructed in accordance with the National Standard Plumbing Code.

3.5.2.1 Flow requirements. Water must be supplied by mains of appropriate capacity to provide 37.9 L/s [500 gpm] at one-story units, 56.8 L/s [750 gpm] at two-story structures, and 75.8 L/s [1,000 gpm] at structures which are three or more stories high, for a flow duration of 1-1/2 hours. This mandatory flow is over and above domestic requirements. Domestic requirements shall be based on 1135.6 liters/day (300 gal/day) per housing unit for single family housing, and 946.3 liters/day (250 gal/day) per housing unit for multi-family housing. Mains shall be sized to carry this flow with a 2.5 peak hourly factor. Pressure shall be a minimum of 137.9 kPa [20 psi] at each fire hydrant, and a maximum of 1,034.2 kPa [150 psi] at each outlet after allowing for friction, elevation, and other pressure losses. Pressure at each housing unit shall not exceed 517.1 kPa [75 psi].

3.5.2.2 Trenches. Where feasible, and acceptable to local utility supplier or servicing agency, use common trenches for two or more utilities and applicable underground utility marking protocol. Water and gas mains may be installed in the same trench, with the gas main placed on a shelf at least 0.3 m [12 in] above and to one side of the water mains. (Coordinate with the local gas utility supplier to determine system acceptability). Water mains shall have a minimum of 0.9 m [3 ft] of earth cover. Minimum cover above water lines shall be 0.75 m [2 ft 6 in] in grassed areas and 0.9 m [3 ft] in paved areas. Adequate cover must be provided for freeze protection to meet local conditions. Where frost penetrates to a depth greater than the minimum above, greater cover will be required. Sufficient cover must also be provided to protect the pipe against structural damage due to superimposed surface loads. Lines laid lower than the minimums stated shall be concrete encased with a minimum concrete thickness of 0.15 m [6 in].

3.5.3 Fire hydrants.

Hydrants shall conform to AWWA C502, Dry-Barrel Fire Hydrants, or AWWA C503, Wet-Barrel Fire Hydrants, except as required by the local utility supplier. Dry-Barrel Fire hydrants must be used in areas subject to freezing. Valves shall conform to AWWA C500, Gate Valves for Water and Sewerage Systems. Fire hydrants shall be compatible with those presently in use at the installation or local jurisdiction, with similar pump and hose connections. Fire hydrant spacing shall be no greater than 152 m [500 ft] apart, by paved road. In addition, a hydrant shall be provided so that all parts of the housing units can be reached by hose lines not over 107 m [350 ft] long. Hydrant laterals shall be 0.15 m [6 in] minimum size, shall not exceed 15.2 m [50 ft] in length, and shall have an underground shutoff valve. Valve box, at each lateral, shall be located within 3 m [10 ft] of the hydrant, and shall not be located where obstructed by parked vehicles, shrubbery, etc. Guard post barriers shall be provided where hydrant locations are subject to vehicle damage.

3.6 SANITARY SEWER

[Designer shall insert specific requirements such as State and local Codes and regulations, permit requirements, and approvals. If the sanitary sewage collection system has been privatized, include requirements for coordination with the private utility company.] For family housing projects constructed on military installations the Contractor shall be aware that many installations have privatized waste water (sanitary sewer) collection systems. Contractor shall coordinate sanitary sewer services required for family housing with privatized utility vendor holding license to operate and maintain sanitary sewer collection system. Vendor may elect to design and construct sanitary sewer service requirements to serve family housing units. Costs for the design and construction of the sanitary sewer services shall be the responsibility of the Government.

3.6.1 Sewer Mains.

Connection to the existing sewage collection system shall be made at the location shown on the RFP drawings. Design shall be based on an average daily per capita flow of sanitary sewage of 378.5 L [100 Gal] per day with a 4.0 peak hourly factor. Mains shall be a minimum of 0.2 m [8 in] in diameter. Manholes are required at all changes of direction and spaced not more than 123m [400ft.] apart. Curved sewers are prohibited. If siphons are used, two lines of equivalent capacity shall be used with cleanouts. Where pumping is required, force mains shall be sized to minimize pumping head, with a 0.9 m to 1.5 m [3 ft to 5 ft] per second velocity.

3.6.2 Sewer Building Laterals.

Each building lateral shall be connected directly to a sewer main. Combining multiple building laterals is prohibited. Apartment units within a building may use a single building lateral. Cleanouts shall be provided at the 5 ft. line to allow cleaning of all lines to grade. Cleanouts, in yard areas, shall be set in a box with a hinged cover. Laterals from one building shall not cross under another building. Lines shall be sized in accordance with the National Standard Plumbing Code. Sewer laterals serving one or two housing units shall be a minimum of 0.15 m [6 in] in diameter. Laterals serving three or more housing units shall be a minimum of 0.2 m [8 in] in diameter.

3.6.3 Trenches.

Sewer and water lines, mains or laterals, shall be placed in separate trenches. The separate trenches shall maintain a minimum lateral separation of 3.0 m [10 ft].

3.6.4 Cover.

Sewer lines shall be located at a depth greater than the frost penetration. Minimum cover above the top of pipes shall be 0.6 m [2 ft] in areas not subject to vehicular loads and 0.9 m [3 ft] in all other areas. If the minimum cover cannot be met, the length of pipe shall be concrete in accordance with State Codes, or with a minimum 0.07 m [3 in] thickness of concrete.

3.7 GAS DISTRIBUTION AND FUEL OIL SYSTEM

3.7.1 General.

Fuel gas piping systems, fuel gas utilization equipment and related accessories, venting systems, and combustion air configurations must comply with applicable provisions of the IBC and the IRC as modified by UFC 1-200-01, and NFPA 54 and NFPA 58. [Designer add if applicable: Compliance with Host Nation codes and regulations is also required for overseas locations.] Many installations have privatized the natural gas distribution systems. Contractor shall coordinate natural gas service requirements with the privatized utility vendor holding license to operate and maintain the natural gas distribution system. Vendor may elect to design and construct natural gas supply and service lines and appurtenances up to the meter set. All costs associated with natural gas service to family housing units shall be the responsibility of the Government.

[Designer shall insert " ... (DELETED)" if not applicable and delete remainder of text in subparagraphs.] [Coordinate with the installation to determine the responsible agency for installation of exterior gas lines, meters, regulators, hot taps, valves, etc. The design agent shall then add a sentence to this paragraph to inform the Contractor of his or her responsibility.]

3.7.2 Metering.

Meters are required for family housing areas to accurately monitor the consumption and cost data for gas utilities. Metering of utilities shall be provided as required by the private utility provider or as follows:

[Designer shall insert installation specific requirements and points of contact for privatized utilities. Cost of all utility work is to be borne by the project and shall be accounted for and itemized in the bid schedule regardless of who performs the work.]

3.7.2.1 Master meters. Master meters for gas shall be provided for all new and replacement housing units except where new housing units are metered by an existing meter.

3.7.2.2 Individual meter and meter drops. Individual utility meter drops and fuel oil metering points (where applicable) shall be provided for all housing units. Locate utility meter drops and fuel oil metering points in an area readily accessible by service personnel. Meters and meter bases shall be sight screened, and located to provide convenient access while not distracting from building appearance. [Designer shall provide specific metering information when required by local jurisdictions.]

3.7.2.3 Gas metering. Provide for future individual housing unit metering devices. Comply with local requirements. Meter and regulator location shall be sight screened, and located to provide convenient access while not distracting from building appearance. [Designer shall provide specific metering information when required by local jurisdictions.]

3.7.3 Gas Distribution System.

Connection to existing gas distribution system shall be made at the location shown on the enclosed RFP drawings. Provide a gas distribution system, connected to existing systems and designed in accordance with local codes, utility company requirements, or installation regulations,

whichever is more stringent. Gas distribution systems shall comply with the requirements of ASME B31.8. When connecting to existing steel piping system, provision shall be made to ensure that the integrity of the cathodic protection is not compromised. Shutoff valves shall be provided on the exterior of each building. A gas regulator and provision for future installation of an individual gas meter to monitor fuel use shall be provided for each housing unit or building structure. The building service entrance shall be installed at a height sufficient to allow for future installation of the gas meter. Existing lines that are to be abandoned shall be either removed or physically disconnected from all gas sources and purged. Abandoning existing gas piping shall be done in accordance with ANSI B31.8, Gas Transmission and Distribution Piping Systems. Installation of gas piping will be in accordance with ANSI B31.8 and 49 CFR 192.

3.7.3.1 Testing. Prove that the entire system of gas mains and service lines is gas-tight by an air test, in accordance with ANSI B31.8. The test shall continue for at least 24 hours between initial and final readings of pressure and temperature.

3.7.3.2 Drips. Unless high pressure natural gas is used, drips shall be installed at the low points, immediately following reduction from high pressure to medium pressure (at supply points) and at occasional low points throughout the system to provide for blowing out the lines.

3.7.3.3 Valves. Plug valves shall be installed at intersections of mains and other locations so that interruptions to service can be confined to no more than 30 housing units.

3.7.3.4 Mains and Service Lines. Lines shall not be placed under any buildings. Lines shall be placed with a minimum of 0.6 m [2 ft] of earth cover. Protective casings shall be provided to protect lines from superimposed street or heavy traffic loads.

3.7.4 Fuel Oil Storage and Distribution.

[Designer shall insert "DELETED" if not applicable and delete remainder of text in all paragraphs.] Fuel oil storage and distribution system shall be installed to supply the fuel oil-fired heating equipment. Provide a complete fuel oil storage and distribution system designed in accordance with local codes, installation requirements, NFPA 30, and NFPA 31, whichever are more stringent. Tank size shall be determined using the ASHRAE Degree Day Method using the degree days for the coldest 30-day period for the site.

3.7.4.1 Tank storage. Each housing unit shall be provided with a separate fuel oil storage tank unless more than one housing unit is served by a single heating system, in which case each heating system shall be provided with a separate fuel oil tank. Fuel oil storage tanks may be located underground or above ground if the stored volume is less than 2006 L [530 GAL]. Storage tanks shall be placed in a location suitable for filling from a curb-side delivery truck. Above ground tanks shall not be installed on the front side of the building, and shall be concealed by a screen wall or by shrubbery. Fuel oil tanks shall be located in accordance with local codes, and shall be installed a minimum of 0.3 m [1 ft] from the edge of the tank shell to the nearest outside wall of any building or basement or from the nearest adjoining property line. Where tanks are located adjacent to exterior walls or other surfaces requiring periodic painting or other maintenance/repair requirements, a minimum clearance of 1m [3ft] from the edge of the tank is preferred. Underground tanks shall be located such that loads supported by building foundations cannot be transferred to the tank. Proposed tank location shall be clearly indicated in the design submittal.

3.7.4.2 Underground Tanks. Fuel oil storage tanks installed below grade shall be double-walled type constructed using fiberglass or steel, and installed in accordance with the manufacturer's recommendations. The top of the tank shall be at least 0.6 m [2 ft] below finished grade. Fiberglass tanks shall be constructed in accordance with UL 1316. Steel tanks shall be Type II, constructed in accordance with UL 58, with an STI-P3 coating and guarantee except that

the cathodic protection system shall be based on protecting 5 percent of the tank's metal surface. Tanks shall be provided with the necessary fill, vent, gauge, hatch, and suction connections.

3.7.4.3 Above Ground Tanks. Above ground tanks shall be limited in size to a maximum of 2006 L [530 GAL]. Tank shall be provided with legs and located on a concrete pad. Tank shall be constructed of steel, primed and painted, and provided with the necessary fill with valved overflow basin, vent, gauge, and suction connections. A concrete encased tank complying with regulatory requirements may also be provided. Tank containment shall comply with applicable NFPA, EPA, and local code requirements.

3.7.4.4 Fuel Oil Piping. Underground fuel oil piping shall be of double-wall construction, installed without traps or sags. Outer, secondary containment pipe shall be non-metallic. Above ground piping shall be single-wall metallic pipe. Gate valves shall not be used in fuel oil piping systems. Pipe connectors shall be in accordance with UL 567.

3.7.4.5 Leak Detection System. A continuous surveillance leak detection system suitable for operation in an NFPA 70, Class 1, Division 1, Group D environment shall be provided to monitor the leak containment space between the interior and exterior walls of double wall pipe and tanks. The system shall detect leakage into the containment space electronically or by monitoring interstitial pressure or liquid level variations. Liquids used in the containment space for steel tanks shall have a corrosion inhibitor. Liquids subject to freezing conditions shall contain an antifreeze solution. The leak detection system shall be compatible with the piping and tank furnished. Instructions and equipment required for calibration of the leak detection system and manufacturer's recommended calibration maintenance schedule shall be provided.

3.7.4.6 Special Requirements. [Research local requirements for fuel oil systems installation and either add or delete items from this sub-paragraph.]

3.7.4.6.1 Spill containment fill. Underground tank fill connection shall be provided in a spill container of 11.4 L [3 GAL] capacity minimum. Contained spills shall be drained into the storage tank by means of a quick acting drain valve.

3.7.4.6.2 Overfill prevention valve. The overfill prevention valve shall be placed within the tank interior and be an integral part of the fill tube. The valve shall be a float actuated shut-off valve. The valve shall be constructed of the same material as the fill tube. The valve shall have two stages of shutoff. In the first stage, the valve shall restrict the flow of fuel oil into the tank to approximately 0.315 L/s [5 gpm] when the liquid level rises above 95 percent of the tank capacity. In the second stage, the valve shall completely stop the flow of fuel oil into the tank when the liquid level rises above 98 percent of the tank capacity.

3.7.4.6.3 Aboveground Tank Screening. Where fuel oil storage tanks are located above grade the design shall include sight screening for the tank to reduce the visual impact of the fuel oil storage tank. Visual screening may be vegetation or fencing to match the privacy fence at the unit patios. [Design District shall ensure that aboveground fuel oil storage tanks, when selected for use, are suitably screened from view. The requirements of this paragraph may be modified to suit local requirements.]

3.7.5 Liquefied Petroleum (LP) Gas Storage and Distribution.

[Designer shall insert "DELETED" if not applicable and delete remainder of text in all paragraphs.]

LP gas tanks shall comply with requirements of NFPA 58 and the ASME Code, Section VII, Pressure Vessels. Tanks shall be pad mounted, and shall not be located inside any building. Tanks shall be provided with all required gauges, shut off valves, safety devices, and suction connections. Shut off valves shall be installed at each tank, at the service entry to the building (if

not in sight of the tank), and at each heating unit. No shut off valve shall be installed between a safety device and tank. LP gas pressure shall be reduced to a minimum service pressure of 3.5 kPa [$\frac{1}{2}$ psi] prior to the building entrance. LP gas pipe connectors shall be in accordance with UL 567.

3.8 ELECTRICAL DISTRIBUTION

3.8.1 General.

Design and install electrical systems to conform to applicable criteria in National Electrical Code (NFPA 70) and applicable provisions of IBC or IRC, whichever is more stringent. Transformers or any other items containing PCBs are prohibited. Provide new electrical distribution systems with underground primary and secondary feeds, unless otherwise indicated. Connection to the existing electrical distribution system shall be made at the location shown on the enclosed RFP drawings. For installations with privatized electrical distribution systems, see site specific information and utility/contractor responsibilities elsewhere in the RFP in lieu of information provided in this section. [Designer add if applicable: Compliance with Host Nation codes and regulations is also required for overseas locations.]

[Designer shall insert paragraph describing how connection is to be accomplished. Clearly delineate Contractor responsibilities (materials and equipment, installation, and funding) as well as private utility responsibilities, where applicable. Include private utility company information and point of contact if applicable.]

3.8.2 Electrical Distribution System.

Provide new electrical distribution system as necessary and connect to existing system. System shall be a loop-primary radial system. Primary feeder cables shall be copper or aluminum. High voltage conductors shall have protective shielding. High voltage cable shall be buried a minimum of 1.2 m [4 ft] below the finished grade with continuous cable marker tape 0.3 m [1 ft] below grade. Cable markers shall be installed along the length of direct-burial cable runs to identify their routes from the surface. Markers will be provided at changes of direction and at intervals not to exceed 152.4 m [500 ft].

3.8.2.1 Underground connection or splices are prohibited, except in boxes or manholes. Splices shall be in a self-draining, rodent-resistant box with a cover.

3.8.2.2 The length of secondary distribution service laterals from the transformer secondary to the building service entrances shall be minimized.

3.8.2.3 Only one service entrance per building shall be provided. The service entrance conductor shall be buried a minimum of 0.9 m [3 ft] below finished grade with a minimum separation of 0.3 m [1 ft] from telephone or TV cables. System shall be designed such that the fault current available at the service entrance equipment will not exceed 10,000 amps.

3.8.2.4 Transformers. Transformers shall be pad-mounted and have two non-fused switches for the loop connection. The high voltage compartment of the transformer shall include a load break switch with fused circuit for the transformer. The transformed secondary voltages shall be 120/240 V, single-phase, three-wire, solid neutral service to housing units. In selecting a transformer, the name plate rating shall not be less than 90 percent of the kilovolt/amperes (kV/A) demand load calculated for the transformer. [Designer shall insert transformer sizing and demand requirements.]

3.8.3 Street and Area Lighting.

Guidance for minimum lighting of walkways, streets, and parking areas is available from the Illuminating Engineering Society of North America (IESNA). Provide lighting at roadway intersections, and at intervals not exceeding 60.9 m [200 ft] between intersections. Area lighting shall be provided at intervals not exceeding 60.9 m [200 ft] along area walkways not otherwise illuminated, common area walks connecting tot lots, and at all steps in area walkways. Area lighting shall be provided in accordance with the IESNA recommendations. Luminaires shall be actuated by photoelectric control, one photocell per circuit, and supplied from multiple circuits originating from a pad-mounted transformer. Coordinate light pollution reduction requirements with customer to determine acceptable luminaires.

[Designer add if applicable: Coordinate fixture and power connection requirements with local utility if exterior electrical distribution system is privatized.]

3.9 TELEPHONE DISTRIBUTION

The telephone company serving the installation is responsible for installing and maintaining the telephone distribution system up to the demarcation point (the point where the telephone company wiring connects to government owned wiring). Conduit required between underground terminal boxes and the buildings shall be provided by the Contractor. Trenching and backfill required to install the telephone company cables shall be included in the construction contract. Contractor provided boxes, conduits, and trenching shall comply with local telephone company criteria and shall be coordinated with the telephone company. It is imperative the contractor coordinate with the telecommunications company/provider (i.e. Network Enterprise Center, etc.), early on, to ensure timely installation.

[Designer shall insert specific company and point of contact information here along with any specific requirements for connection of the telephone service.]

3.10 TELEVISION AND CABLE TV SYSTEM

Where commercial cable TV (CATV) service is available, the CATV service Contractor (franchisee) shall be responsible for installing and maintaining the distribution system from signal source to final connections at building termination. The Contractor shall provide all trenching, conduit, boxes (to include a locatable entry point at the 5 foot line), and backfilling required to install commercial and/or Contractor provided distribution systems.

[Designer shall insert specific company and point of contact information here along with any specific requirements for connection of the television/CATV service.]

3.11 CATHODIC PROTECTION

Protect all ferrous materials in underground utility systems from corrosion as appropriate and required by local conditions.

Cathodic Protection (CP) is mandatory on buried ferrous metallic structures as described below. Metallic pipes that enter a building from the exterior must have an isolation flange. This will ensure that the CP system does not protect the piping in the building. Department of Transportation guidance as stated in 49 CFR, Part 192, requires that all metallic natural gas piping be coated and cathodically protected regardless of the soil resistivity.

[Designer is encouraged to provide resistivity tests as part of the RFP. Edit this section for only applicable and allowable systems.]

3.11.1 Underground Storage Tanks. Corrosion control is mandated for all metallic underground storage tanks storing petroleum or hazardous substance by 40 CFR, Part 280 and AR 200-1 and on hazardous liquid pipelines (e.g., liquid fuel) by 49 CFR, Part 195.

3.11.2 System Design. Cathodic protection systems must be designed by an NACE certified (or equal) expert to provide protective potential to meet the requirements of the National Association of Corrosion Engineers (NACE) Standard RP-0169, Control of External Corrosion on Underground or Submerged Metallic Piping Systems, or NACE Standard RP-0185, Control of External Corrosion on Metallic Buried, Partially Buried, or Submerged Liquid Storage Systems, as appropriate.

3.11.3 New or supplemental cathodic protection systems shall be compatible with existing cathodic protection systems and other adjacent structures or components. New systems shall be compatible with existing systems to allow ease of repair and maintenance.

3.11.4 When plastic pipe is used to extend a steel gas distribution main, an insulated No. 8 AWG copper wire shall be exothermically welded to the existing steel main and run the length of the new plastic main. This wire can be used as a locator tracer wire and to maintain continuity to any future steel gas main extension.

3.11.5 Application. Cathodic protection and protective coatings shall be provided for the following buried and submerged ferrous metallic structures regardless of soil or water resistivity:

- Natural gas and propane piping.
- Liquid fuel piping.
- Underground fuel storage tanks except for those coated in accordance with UL 1746.
- Fire protection piping.
- Ductile or cast iron pressurized piping under floor (slab on grade) in soil.
- Underground heat distribution and chilled water piping in ferrous metallic conduit.
- Other structures with hazardous products as identified by the installation.

3.11.6 Cast Iron. Cast iron pipe shall be treated as follows:

- For soil resistivity below 10,000 Ohm-cm at pipeline installation depth, provide CP, bonded joints, and protective coatings.
- For soil resistivity between 10,000 and 30,000 Ohm-cm at pipeline installation depth, provide bonded joints only.

3.11.7 Copper. Copper water service lines will be dielectrically isolated from ferrous pipe. Dielectric isolation shall conform to NACE RP-0286.

3.11.8 Ductile Iron. For ductile iron piping systems (except for ductile iron piping under floor in soil) conduct an analysis to determine if cathodic protection and/or bonded or unbonded coatings are required. Unbonded coatings are defined in ANSI/AWWA C105/A21.5.

3.11.9 Sewer Lines. Conduct an economic analysis to determine if cathodic protection and protective coatings shall be provided for gravity sewer lines and the following structures in soil resistivity conditions above 10,000 Ohm-cm:

- Potable water lines.
- Concentric neutral cable.

3.11.10 Other buried and submerged ferrous metallic structures not covered above.

FERROUS METALLIC PIPING PASSING THROUGH CONCRETE SHALL NOT BE IN CONTACT WITH THE CONCRETE.

4.0 FAMILY HOUSING SIZE AND FEATURES STANDARDS

4.1 UNIT SIZE BENCHMARKS

4.1.1 Family Housing Size Standards.

Table 4-1 provides family housing standards for unit sizes based on rank and number of bedrooms. Title 10 of United States Code, Section 2826 (10 USC 2826) directs the Services to design and construct military family housing to local standards. For new and replacement construction the project’s DD Form 1391 specifies the programming benchmark gross area in the scope description with a unit cost based on this benchmark gross area. The project shall be designed and constructed according to these requirements.

Table 4-1 – Unit Floor Area

Rank and Number of Bedrooms	Programming Benchmark	
	GSF (2)(3)(4)(5)	GSM (m ²) (2)(3)(4)(5)
O9-O10 - 4BR (1)	4000	372
O7-O8 - 4BR	3330	309
O6 - 4BR	2520	234
O4-O5 - 4BR	2310	215
O4-O5 - 3BR	2020	188
E9 & W4/5 - 4BR	2310	215
E9 & W4/5 - 3BR	2020	188
E7/8-W1/3-O3 - 5BR	2510	233
E7/8-W1/3-O3 - 4BR	2150	200
E7/8-W1/3-O3 - 3BR	1860	173
E1-E6 - 5BR	2300	214
E1-E6 - 4BR	1950	181
E1-E6 - 3BR	1630	151

1. Senior General/Flag Officer O9-O10 housing shall be designed to a maximum of 4000 GSF with no additional size allowances for special command positions or arctic/harsh climates.
2. For housing units other than those for O9-O10 (see note 1), add up to 27.9 m² (300 ft²) for harsh climates. Harsh climates are defined as having more than 7,500 Heating Degree-Days (HDD), annually, or 5,500 Cooling Degree-Days (CDD), annually.
3. For housing units other than those for O9-O10 (see note 1), benchmark floor area may be increased by 10% for housing units for an officer holding a special command position as defined by AR 420-1, for the commanding officer of a military installation, and for the senior non-commissioned officer of a military installation. Area shall be increased in [Designer shall insert number and type of units] for this project. See Appendix A.
4. Where required for High Risk Personnel (HRP) physical design solutions shall be included in above floor areas. HRP is determined in part by threat analysis under UFC 4-020-01. See Appendix A.
5. The applicable gross floor area considers a standard U.S. exterior wall with a total thickness of 6 inches. With ever increasing requirements for insulation and energy efficient construction in order to meet evolving sustainable design and development policies, the thickness of exterior walls exceeding 6 inches from the inside wall surface will no longer be included in the applicable gross floor area limitations.

4.1.2 Unit Floor Area Calculation.

Gross floor area shall be calculated using American National Standard for Single-Family Residential Buildings, Square Footage-Method for Calculating: ANSI Z765.

- **Note:** Appendix C contains examples for calculating floor area.

4.2 ACCESSIBILITY REQUIREMENTS

4.2.1 Installation Requirements.

Provide [Designer insert quantity] units which are readily modifiable for handicapped accessibility, at least [insert quantity] of each type [or other installation defined requirement]. Accessible housing units, inclusive of garages, shall be designed in such a way that they may be easily and readily modified to accommodate physically challenged occupants, if necessary, at time of occupancy. This means required access clearances, room sizes, bathroom layout, kitchen layout, doors and hardware, grab bars, plumbing hookups, light switches and outlets, controls, and warning devices must meet requirements at time of construction. Readily modifiable means that requirements for adjustable height cabinets and work surfaces, plumbing fixtures, and the warning devices for the hearing and visually impaired can be made either at time of construction or at time of occupancy. For the purpose of determining the number of adaptable or accessible units required, an installation means the area under the purview of the Housing Office. For each installation, a minimum of five percent (5%) of units, but not less than one unit of each type must be designed and constructed as an adaptable single-story ground level unit. Design and construct a minimum of two percent (2%) of each unit type, but not less than one unit, as adaptable for persons with hearing disabilities. [Designer insert specific project requirements here.]

4.2.2 Site Requirements.

Public elements of the site or project must be accessible, including walkways, tot-lots, playgrounds, etc. as defined elsewhere in this solicitation.

4.2.3 Construction Project Requirements.

New and replacement construction and renovation projects must comply with current accessibility standards (see appendices) and the Americans with Disabilities Act Accessibility Guidelines (ADAAG), the most stringent requirements will govern. The term “Accessible” is defined as a site, building, facility, or portion thereof that complies with the latest Code of Federal Regulations, Architectural Barriers Act of 1968, as amended, and ADAAG. The term “Adaptable” is defined as the ability of certain spaces and elements to be added or altered so as to accommodate the needs of either disabled or non-disabled persons, or to accommodate needs of persons with different types or degrees of disability.

4.2.4 Renovation Project Requirements.

Renovation projects must comply with accessibility standards when their scope of work includes “Alterations” of existing dwelling units, unless requirements for the Installation have been satisfied. Alterations are defined as work that modifies the functional arrangement of a unit, or moves load-bearing structures or members within unit. As an example, replacement of kitchen cabinets in-kind is not an alteration, but modifying kitchen and dining areas while installing new cabinets is an alteration. Specially designated units shall be constructed or improved in accordance with ADAAG.

4.3 UNIT DESIGN

4.3.1 General.

Centrally locate and arrange circulation space to serve as many functional areas as possible without the need for extended hallways. Consider multiple furniture placement layouts in determining location of windows and doors, electrical outlets and switches, and HVAC supply and return outlets (or radiators located underneath windows as commonly used in foreign construction). Habitable rooms shall not be used as halls for entry into a housing unit or for primary circulation within a housing unit. The design of housing units including the selection and specifying of exterior and interior finishes, equipment, appliances, and systems shall include consideration of maintenance ease and cost. [Designer edit/insert specific project requirements here: Contractor-furnished/Contractor-installed (CF/CI) equipment and appliances: oven/range, extinguishing range exhaust hood, garbage disposal, dishwasher, shelf for microwave oven, refrigerator/freezer with ice maker, and ice maker connection box/valve for additional separate tenant-furnished freezer. Designer edit/delete: Government-furnished/government-installed (GF/GI) kitchen equipment and appliances: refrigerator/freezer with icemaker. Tenant-furnished/Tenant-installed equipment and appliances: microwave oven, washer/dryer.] Avoid products that require continuing maintenance at high cost. Minimum area and dimensions for interior spaces are contained in **Table 4-2**.

Table 4-2 – Minimum Area and Dimensions – Interior Spaces

Space	Area		Length		Width/Depth		Height (1)	
	m ²	ft ²	m	ft-in	m	ft-in	m	ft-in
Living (2)	14.0	150	3.55	11-8	3.55	11-8	2.3	7-6
Dining (3 BR) (2)	8.4	90	2.9	9-6	2.9	9-6	2.3	7-6
Dining (4/5 BR) (2)	10.2	110	3.2	10-6	3.2	10-6	2.3	7-6
Dining (GO) (2)	13.4	144	3.65	12-0	3.65	12-0	2.3	7-6

Family Room (2)	8.4	90	3.0	10-0	3.0	10-0	2.3	7-6
Kitchen (3)(6)	6.0	64	2.45	8-0	2.45	8-0	2.3	7-6
Eating in Kitchen (4)	6.7	72	2.6	8-6	2.6	8-6	2.3	7-6
Refrigerator& Freezer	0.5	6	0.9	3-0	0.6	2-0	1.8	6-0
Washer/Dryer (5)	1.7	18	1.8	6-0	0.9	3-0	2.1	7-0
BR #1	14.0	150	3.5	11-8	3.55	11-8	2.3	7-6
BR #2	11.1	120	3.0	10-0	3.0	10-0	2.3	7-6
BR #3/4/5	9.0	100	3.0	10-0	3.0	10-0	2.3	7-6
Half Bath (6)	-	-	-	-	0.9	3-0	2.3	7-6
Full Bath (6)	-	-	-	-	1.5	5-0	2.3	7-6
Vestibule	1.2	13	1.0	3-3	1.2	4-0	2.3	7-6
Hall &Stairway (7)	-	-	-	-	1.0	3-3	2.3	7-6

1. Ceiling heights in habitable rooms shall be a minimum of 2.45 m [8 ft-0 inches]. Ceiling heights can be reduced in parts of these rooms to 2.1 m [7 ft] to accommodate ducts.
2. Room dimensions are exclusive of circulation. Circulation paths along one side of a room are permitted but add 1.0 m [3 ft-3 inches] to the minimum dimension.
3. A minimum of 1.2 m [4 ft] must be maintained in front of and between cabinets.
4. Minimum area and dimensions are measured from face of cabinets to walls.
5. Minimum area and dimensions are indicated for a washer and dryer closet. This area may also be provided in a utility room. When so provided, area and dimensions are exclusive of circulation.
6. Accessible units must conform to current accessibility standards (see appendices), which require greater minimum dimensions.
7. Clear width is measured between railings.

4.3.2 Bathrooms.

Locate full bathrooms near bedrooms and out of sight of other areas of the house. In two-story units, a half-bath shall serve the first floor. When a half-bath is provided on the main floor, consider access to both guests and family activities. Open a half-bath to circulation space rather than to a habitable room. The master bedroom shall have a private full bathroom. Include a tub with shower assembly in at least one full bathroom in each unit which is directly accessible from the bedroom hall without passing through another room.

Table 4-3 – Bathroom Requirements

Number of Bedrooms per Floor	Number of Bathrooms Per Floor
None	1/2
1 – 2	1
3 – 5	2
Note: General Officer (GO) units shall have three full bathrooms, with one on the first floor configured for accessibility.	

4.3.2.1 Provide lavatories mounted in 610-mm [2-ft] wide (minimum) countertops, with vanity bases. Countertops shall be high pressure laminated plastic, ceramic tile, marble, or homogeneous, non-porous, solid surface type materials, with minimum 100 mm [4 inches] high back splashes.

4.3.2.2 Bathroom accessories may be surface mounted or recessed, of non-corrodible metal or ceramic tile, and shall include a toilet paper holder, soap dish (at sink and at tub/shower), toothbrush and tumbler holder, and grab bar at tub or shower stall, bathrobe hook, and towel bars totaling not less than 1100 mm [42 inches] for a full bath and not less than 750 mm [30 inches] for a half bath.

4.3.2.3 A recessed medicine cabinet shall be provided in each bathroom. Cabinets shall be corrosion-resistant with plate glass mirrors, sliding or hinged door type. Do not place recessed medicine cabinets in party walls.

4.3.2.4 Tubs and showers shall not be placed under windows.

4.3.2.5 Exhaust shall be provided in all baths, shall be ducted directly to the exterior of the building, and shall be a part of an engineered ventilation system.

4.3.3 Bedrooms.

Family housing units must include a master bedroom, plus one or more additional bedrooms. Separate these sleeping areas from all other functional areas of the house, conveniently located near bathrooms. Provide access to bathrooms from bedrooms, without passage through other rooms of the house. For new construction bedrooms shall be designed to accommodate a king size bed in master bedroom, and a full size bed in other bedrooms. In new construction, units for the rank of O7 and above shall have a bedroom located on ground floor adjacent to public areas with a private full bath. Each bedroom shall be accessible without passing through another bedroom.

4.3.4 Breakfast Area.

A secondary eating area may be provided in the form of an oversized kitchen, breakfast bar, or family room and dining area. This secondary eating area may be in direct sight of food preparation areas, but not in direct sight of a bathroom.

4.3.5 Dining Room.

The primary eating area may be a separate dining room, or an extension of, or an "L" off the living room. If so, it shall be of adequate size to accommodate a table and chairs, and china cabinet or buffet. The dining room shall not be in direct sight of bathrooms or food preparation area, but

shall be directly accessible from the kitchen without passing through another room. Design the circulation pattern through the dining room so that traffic flow is directed along one wall, and not through middle of room. Provide a separate dining room for O7 and above sized to seat at least 10 persons.

4.3.6 Entrance Foyer.

Provide each housing unit with a lighted foyer and nearby coat closet. Locate entrance adjacent to living room. Provide access to other areas without passing directly through the living room, unless the living room width includes the minimum living room space and circulation width. Foyers shall have a minimum dimension of 1.2 m (4 ft) in each direction, and entrance door shall not be in direct sight of living room. For renovations and improvements consider entrance foyer requirement whenever it is economically feasible.

4.3.7 Circulation.

Hallways, stairways, and stairwells shall be dedicated to circulation. Particular attention shall be given to these areas to minimize floor space lost to circulation. Proper placement of door openings can produce more usable floor space. Design circulation areas to permit movement of a queen size box spring. Minimum hallway width of 1.1 m (3 ft 6 in) is recommended.

4.3.8 Kitchen Area.

Locate kitchen adjacent to dining room and family room, with direct access to each. Convenient access from kitchen to a covered parking area, and to interior utility and exterior service areas, is desirable. Provide 1.2 m (4 ft) minimum space between fronts of cabinets.

The kitchen shall provide an efficient work triangle. A base cabinet, minimum 380 mm [15 inches] wide, shall be provided on the handle side of the refrigerator. The range shall not be located adjacent to the refrigerator, in a corner, or adjacent to a passageway. The dishwasher shall be installed adjacent to the kitchen sink. Provide a backsplash behind the range, extending to the underside of the range hood, finished to match the countertop or range and the range hood. Space for a tenant-owned upright refrigerator/freezer, minimum 1100 mm [42 inches] wide, shall be provided adjacent to the kitchen or in area such as the laundry/utility area or garage. Space for a tenant-owned microwave oven shall be provided. In the kitchen, shoe molding (1/4 round) is required at all base cabinets where they meet the floor surface.

4.3.9 Laundry/Utility Room.

Provide a laundry/utility area large enough to accommodate side-by-side washing machine and dryer, plus shelving or cabinets for storing laundry supplies, located out of sight of entry, entertainment, and eating areas, and within conditioned space. Do not locate laundry/utility area within a bedroom, bathroom, or kitchen. Exhaust from moisture-producing equipment (e.g. clothes dryers) must be vented to the exterior. Vent-less clothes dryers are not acceptable in humid area locations. Minimum net clear door width to laundry/utility area is 800 mm [2 ft-8 inches].

4.3.10 Living/Family Room.

The living room shall have direct access to the front entrance foyer and to the dining area without passing through another room. Units shall be provided with a family room, separate from the living room, adjacent to and contiguous with the kitchen. Each room shall include one wall with a minimum length of 3 m (10 ft) to accommodate a sofa and end tables. Often several compatible living functions can be combined advantageously into a single "Great Room." However, a Great Room shall be able to accommodate multiple furniture arrangements associated with spaces that

are combined. Benefits of such arrangements are that the combined space can be used more efficiently. For adjacent spaces to be considered a combined room, a clear opening between them, at least 2.4 m (8 ft) wide, shall permit concurrent and separate use of the space. Minimum dimension of living room shall be 3.6 m (11 ft 8 in). When circulation is required along the perimeter of the space or between areas in open plans, minimum circulation space of 1000 mm [3 ft-3 inches] shall be added to the required minimum room dimension. The family room shall not be part of a Great Room.

4.3.11 Interior Storage and Closets.

Provide storage areas in the form of clothes closets, linen closets, and bulk storage in housing unit for seasonal personal effects.

4.3.11.1 A broom closet shall be provided convenient to the kitchen, and a coat closet shall be located convenient to the housing unit entrance.

4.3.11.2 Closets.

Minimum closet requirements are shown in **Table 4-4**.

- Closet shelving. Closets (except linen closets) shall be equipped with a 305 mm [12 inches] deep shelf and a clothes hanger rod. Linen closets shall be provided with at least four full-depth shelves. Closet shelving and rods in excess of 1200 mm [4 ft] shall have center supports. Shelves and supports shall be capable of carrying 52 kg/m [35 lbs/ft]. Closet shelving shall be minimum 19 mm [3/4 inch] thick solid wood, plywood, or high density particle board. Factory finished welded wire shelving meeting the capacity requirements is also permitted. Intermediate supports must be anchored to studs.
- Closet doors. Closet doors shall be located to permit placement of furniture in the corners of the rooms by providing a 460-mm [18-inch] return adjacent to a furnish-able wall. Closets 1800 mm [6 ft] or more in width shall have sliding or hinged doors, maximum 2000 mm [6 ft-8 inches] high. Wall closet width shall not extend beyond either door jamb more than 510 mm [20 inches]. Sliding doors shall be provided with both top and bottom door tracks.

Table 4-4 – Minimum Closet Widths¹

Type of Unit (1)	Enlisted		Officer (O1-O6)		Officer (O7-O10)	
	m	ft	m	ft	m	ft
Coat/ Entry Hall	0.9	3	1.2	4	1.5	5
Master BR #1 (2)	1.8	6	1.8	6	3.0	10
BR #2	1.2	4	1.2	4	1.8	6
BR #3	1.2	4	1.2	4	1.8	6
BR #4/5	1.2	4	1.2	4	1.2	4
Broom	0.9	3	0.9	3	0.9	3
Linen (3)	0.6	2	0.9	3	1.2	4

Type of Unit (1)	Enlisted		Officer (O1-O6)		Officer (O7-O10)	
	m	ft	m	ft	m	ft
1: Minimum inside clear depth for standard/broom closets shall be 600 mm [2 ft].						
2: Walk-in closet is preferred.						
3: Minimum clear inside depth for linen closets shall be 430 mm [1 ft-6 inches].						

4.3.11.3 Bulk storage. Provide each housing unit with interior and exterior bulk storage space meeting the minimum requirements of **Table 4-5**. Interior bulk storage is in addition to required closet area and exterior storage. Provide interior storage in a separate room or included as an extension of the utility room when one is provided. Provide exterior storage in a garage, a separate exterior enclosure, or within the housing unit with access from the exterior. Bulk storage space shall be at least 1200 mm [4 ft] in depth and a minimum clear height of 2000 mm [6 ft-6 inches], except that space under stairs may be counted at 1/2 area if the space is 1200 mm [4 ft] or more in height. Provide a minimum of three nominally 305 mm [12 inches] deep shelves with a combined length of 7300 mm [24 ft] within each bulk storage room. Common walls and ceilings between adjacent storage areas shall be finished on both sides.

Table 4-5 – Minimum Bulk Storage

Type of Unit	Type of Storage	Enlisted/ Officer O1-O3		Officer O4-O6		Officer O7-O10	
		m ²	ft ²	m ²	ft ²	m ²	ft ²
3 BR	Interior	3.0	32	3.7	40	-	-
	Exterior.	3.7	40	4.5	48	-	-
	Combined	7.9	85	10.3	111	-	-
4 BR	Interior	4.6	50	4.5	44	5.0	54
	Exterior.	4.6	50	5.0	54	5.6	60
	Combined	9.3	100	11.2	120	18.6	200
5 BR	Interior	4.6	50	-	-	-	-
	Exterior.	4.6	50	-	-	-	-
	Combined	10.2	110	-	-	-	-
Example: If interior bulk storage is 2.3 m ² , then exterior bulk storage must be 4.2 m ² to obtain the combined bulk storage requirement of 6.5 m ² .							

4.3.12 Interior Finishes.

Select sustainable materials and finishes to achieve a balance between occupant convenience and satisfaction, appearance, durability, maintenance cost, and life cycle cost.

4.3.12.1 Flooring.

- Carpet may be installed in all living areas except kitchens, baths, laundry room, utility areas, storage rooms, entryways, patios, porches, and areas exposed to weather elements. Install Carpet and Rug Institute (CRI) "IAQ" labeled carpet, pad, and adhesives, and underlayment that complies with flooring manufacturer's recommendations (foreign locations may adhere to local carpet standards and manufacturers guidelines).
 - Carpet shall meet requirements of 16 CFR 1630 and have a minimum average critical flux of 0.45 watts per square centimeter when tested in accordance with ASTM E648.
 - Static electricity build-up shall be permanently less than 3.5 KV at 21 degrees C [70 degrees F] with 20 percent relative humidity as determined by American Association of Textile Chemists and Colorists (AATCC) Test Method 134, Electrostatic Propensity of Carpets.
 - Properties: Tufted construction, 100 percent branded continuous filament nylon or polyethylene terephthalate, soil hiding, multi-colored, loop or cut pile, 1/8 gauge, yarn weight 800 grams per square meter [28 ounces per square yard], total weight grams per square meter [60 ounces per square yard], 5000 minimum density, synthetic primary and secondary backing.
 - Tuft bind for tufted carpet shall meet a minimum of 44 N (10 pounds) when tested in accordance with ASTM D1335, 1967; R-1972
 - Provide ten-year warranty from the carpet manufacturer against edge ravel, delamination, and tuft bind.
 - Carpet pad shall be 1/2 inch bonded urethane, minimum 6-pound density. Urethane pad will conform to ASTM.D.3676.
 - Carpet edging shall be 38 mm [1-1/2-inch] minimum width floor flange and minimum 15.5 mm [5/8-inch] wide face.
 - Carpet containing recovered material is designated in 40 CFR 247.12 as an affirmative procurement item. Products containing recovered material will be provided when price, performance, and availability meet project requirements. Various nylon and polyethylene terephthalate carpet offer the opportunity to meet this requirement.
- Kitchen and laundry/utility area flooring shall be seamless sheet vinyl. Bathrooms shall have ceramic tile flooring with ceramic tile base or seamless sheet vinyl. Interior stairs shall be hardwood with clear finish, or carpet. Additional consideration will be given to designs which incorporate ceramic tile bathroom floors and hardwood stairs with a clear finish. This material identification is not justification to exceed the mandatory price limitation set forth in this solicitation. Provide wood or wood product base unless otherwise indicated.
 - Sheet vinyl shall conform to ASTM F1303, Standard Specification for Sheet Vinyl Floor Covering with Backing, Type II, Grade 2. Flooring shall be installed as a monolithic material with seams welded or bonded for a seamless installation. No seams shall be permitted in spaces less than 12 feet in width.

- o Ceramic tile shall conform to ANSI 137.1, moderate or heavy grade.

4.3.12.2 Walls and Ceilings.

Cathedral or vaulted ceilings are encouraged to improve the visual quality of living spaces. For new construction, minimum ceiling height shall be 2.4 m (8 ft), except where minor drops occur for structural or utility soffits. Provide 13 mm [1/2-inch] gypsum wallboard, taped and smooth finished. Water-resistant wallboard shall be used in wet areas such as bath, powder, and laundry room. Cementitious backer board shall be used for ceramic tile applications. Textured ceiling finish may be provided in areas other than kitchen, laundry, or bathrooms. Combined kitchen and eating areas shall have the same type of wall and ceiling finishes. Interior finish shall have a flame-spread rating of 25 or less and a smoke-developed rating of 50 or less when tested in accordance with ASTM E84.

4.3.12.3 Paint.

Primers, paints, and stains shall meet or exceed the requirements of Uniform Federal Guide Specification 09 90 00, Paints and Coatings, provided in the Technical Specifications. [\[Designer shall edit current edition of UFGS 09 90 00 to list only the applicable finish systems\]](#). Finishes shall be lead free. All interior surfaces, except factory pre-finished material, shall be painted a minimum of one prime coat and one finish coat. Walls and ceilings in kitchen, baths, laundry, utility rooms, and all painted trim shall be painted with semi-gloss enamel. A blown-on acoustical finish is prohibited.

4.3.13 Cabinets and Countertops.

Cabinets and countertop underlayment must comply with ANSI A208.2 or ANSI/HPVA HP-1 standards for low formaldehyde emissions. Sustainable alternative materials shall be considered where they provide comparable strength, quality and durability.

Cabinets shall have magnetic catches except where spring-loaded self-closing hinges are provided. Cabinets shall include knobs/handles and or pulls and shall conform to ANSI A161.1, Recommended Performance and Construction Standards for Kitchen and Vanity Cabinets, except where modified below. Wall and base cabinets shall be essentially of the same construction and appearance.

Minimum requirements for kitchen cabinets, counters, and pantries are shown in **Tables 4-6 and 4-7**. In lieu of materials indicated, materials complying with the Woodwork Institute Manual of Millwork Premium Grade are acceptable. Flat area is shown for countertops and drawers. Combined shelf area is shown for pantry and base, wall and wall cabinets.

Table 4-6 – Kitchen Cabinet, Counter & Pantry Area

Type of Housing Unit	Wall		Base		Drawer		Counter		Pantry	
	m ²	ft ²								
Officer O6-O10	3.4	36	4.4	46	2.1	22	1.9	20	1.9	20
Other - 4/5 BR	2.8	30	3.8	40	1.7	18	1.5	16	1.5	16
Other - 3 BR	2.3	24	3.0	32	1.3	14	1.1	12	-	-

Table 4-7 – Minimum Kitchen Cabinet Specifications

Element Description	Specific Requirements
Frame Members	19 mm x 38 mm [3/4 in x 1-1/2 in] kiln-dried hardwood.
Base Cabinet Toe Space	64 mm deep x 102 mm [2-1/2 in x 4 in]. high
Cabinet Bottoms, Backs & Tops (Unexposed)	5 mm [3/16 in] hardwood plywood. Provide bottoms in kitchen sink cabinets. Brace bottoms with wood members glued in place.
Cabinet Ends & (Exposed Backs/Bottoms)	Hardwood plywood, 5 ply, good grade for natural finish. Base Cabinets: 13 mm [1/2 in] Wall Cabinets: 10 mm [3/8 in]
Doors	16 mm [5/8 in] hardwood plywood, good grade for natural finish, with hardwood trim. Raised panel or recessed panel.
Drawer Slides/Glides	20 gauge metal.
Drawer Fronts	16 mm [5/8 in] solid hardwood, matching doors.
Drawer Bottoms	3 mm [1/8 in] softwood plywood, Grade A-B veneer. Bottoms 380 mm [15 in] wide shall be braced and glued in place.
Interior Partitions	13 mm [1/2 in] hardwood or softwood plywood, Grade A-A or comparable veneer.
Shelves	16 mm [5/8 in], softwood plywood (Grade A-B Veneer), hardwood plywood (good grade veneer), or glued-up solid wood. Support shelves on ends and on 610 mm [24 in] centers. Shelf edges exposed to view shall be rounded, filled, sanded, and finished.

4.3.13.1 Countertops.

Countertops finish may be high pressure laminated plastic 1.1-mm [0.043-inch] thick for post-formed tops or 1.3-mm [0.05-inch] thick for countertops with separate backsplash, and shall be applied with heat-resistive adhesive. Countertops may also be ceramic tile or homogeneous, non-porous, solid surface materials. Minimum backsplash height is 100 mm [4 inches]. The substrate for countertops (except solid surface countertops) shall be 19 mm [3/4-inch] thick exterior plywood.

4.3.14 Appliances.

Provide the following equipment in accordance with specifications listed, one each per housing unit. A listing of currently labeled ENERGY STAR® appliances is available through the internet at the EPA website: <http://www.energystar.gov>. Appliance color shall be white/almond [Designer edit.] except disposals, and shall have matching finish.

4.3.14.1 Refrigerators.

Comply with UL 250, Household Refrigerators and Freezers and shall bear the EPA ENERGY STAR® certified label. Provide refrigerator with frost proof top freezer, automatic defrosting, and ice maker. Refrigerator shall have two vegetable bottom baskets, at least four adjustable shelves, at least two shelves and egg container in door; freezer compartment shall contain separate interior shelves, multiple door shelves, and ice maker. Provide reversible (left swing and right swing interchangeable) doors. Refrigerators shall conform to the energy compliance standards of 10 CFR 430, including those refrigerators manufactured before the code took effect. The use of refrigerants with an Ozone Depletion Potential (ODP) of .05 or less is required. Minimum refrigerator volume and maximum energy use are as follows:

- Volume: 0.58 CM, 21 CF
- Energy Efficiency: 722 kWh/yr.

4.3.14.2 Ranges and Ovens.

Ranges shall be 760 mm [30 inches] wide and provided with porcelain enamel cook-top, oven, clock and timer, oven light and cooking surface light. Oven shall have black glass window door, broiler pan, and self-lock racks. Use either gas or electric range, depending upon energy fuel source. [\[Applicable only to General Officer's housing unit. Designer shall delete remainder \[text\] if project does not include a General Officer's housing unit\(s\). \(Ranges for all General Officer's housing units shall be the double oven type with separate burner top\). Over-under microwave and conventional oven combinations will satisfy the double oven requirement.\]](#) Unit shall be listed as ENERGY STAR® compliant and shall bear the ENERGY STAR® label.

- Gas ranges shall have two, 150 mm [6-inch] and two, 205 mm [8-inch] burners, a self-cleaning oven, and AGA-approved electronic ignition. Gas ranges shall be in accordance with AGA Z21.1, American National Standard for Household Cooking Gas Appliances.
- Electric ranges shall have four tubular plug-in surface elements of 4,500 watts minimum, removable reflector bowls, infinite-control switches, and range-indicating lights. Ovens shall be equipped with one, 2,000-watt (minimum) tubular broil element and one, 700-watt (minimum) bake element, oven indicating light, thermostatic heat control, utensil drawer, and self-cleaning oven. Electric ranges shall conform to UL 858, Household Electric Ranges.

4.3.14.3 Microwave Ovens.

[\[Applicable only to General Officer's housing units. Designer insert "\(DELETED\)" and delete remainder of text if not required.\]](#) Provide microwave oven(s) for the following housing units: [\[Insert requirement\]](#). Ovens shall conform to UL 923, Microwave Cooking Appliances, and be UL listed, minimum 0.042 m³ [1.5 ft³], stainless steel interior, automatic oven light, built-in browning element, and temperature probe. Unit shall be listed as ENERGY STAR® compliant and shall bear the ENERGY STAR® label.

4.3.14.4 Range Hoods.

Provide metal range hoods, the same length and finish as the range, with separately switched light and exhaust fan. The hood shall have a washable filter. The fan shall have a capacity of not less than 78.7 L/s per meter of range hood [50 cubic ft per minute per linear foot of range hood]. The sound level shall not exceed 6 sones. Duct the fan to the exterior and provide back-draft protection.

4.3.14.5 Garbage Disposals.

Garbage disposals shall conform to UL 430; Waste Disposers; continuous feed, minimum 1/2 HP motor, stainless steel grinding elements, two 360-degree stainless steel swivel impellers, manual motor reset, and sound insulation. [Designer shall insert or delete paragraph for foreign applications: A plug connector is required.]

4.3.14.6 Dishwashers.

Dishwashers shall conform to UL 749, Household Electric Dishwashers, and be UL listed, electric type, with air gap, racks, lift-out utensil holder, spraying arms, and detergent dispenser. Unit shall be listed as ENERGY STAR® compliant and shall bear the ENERGY STAR® label. The automatic controls shall cycle through the Wash, Rinse, Dry / Heat, and Stop phases, and shall be capable of rinse and hold cycle as well as a no heat drying feature. The unit shall contain instantaneous, or in-line, water heater booster, with automatic thermostat set for 60 degrees C [140 degrees F]. Rated energy use for standard capacity models will not exceed 620 kWh/yr.

4.3.14.7 Water Heater. See paragraph 5.2.4.

4.3.14.8 Ceiling Fans. See paragraph 5.6.11.3.

4.3.14.9 Washers and Dryers. [Designer shall insert requirements for overseas locations – Delete if Not Applicable.]

4.3.15 Interior Doors.

Interior doors shall be 2050 mm [6 ft -8 inches] in height by 35 mm [1-3/8 inch] thick, hollow core wood or hollow panel. Wood doors will be painted. [Designer shall insert "Louvered doors are required for closets." This is a user and district option in areas where humidity, mold, or mildew is a problem.]

4.3.16 Builders Hardware.

Hinges, locks, and latches will comply with the specifications indicated in **Table 4-8**, and the following subparagraphs:

Table 4-8 – Hardware Specifications

Hardware Type/Specification	Specific Requirements
Hinges/BHMA 101	Hinges shall be 102 mm x 102 mm [4 in x 4 in] at exterior doors, and 90 mm x 90 mm [3-1/2 in x 3-1/2 in] at interior doors.
Locks & Latches/BHMA 601	Series 4000, Grade 2, at exterior doors. Grade 2 or 3 at interior doors. Provide trim of wrought brass, aluminum, or stainless steel.
Auxiliary Locks/BHMA 501	Series 4000, Grade 2. Provide matching trim of wrought brass, aluminum, or stainless steel.
Interconnected Lock & Latches/BHMA 611	Grade 2. Provide matching trim of wrought brass, aluminum, or stainless steel.
Closers/BHMA 301	Series CO2000, Grade 2.

4.3.16.1 Locks and keys.

Lock cylinders shall have six pin tumblers and interchangeable cores which are removable by a control key. Provide a master keying system. Locks for each housing unit, including exterior storage and garage door(s), shall be keyed alike. The Contractor shall provide one extra set of cores for each 50 housing units and furnish four keys for each key change and for master key system and control key. Locks and keys shall conform to the standards and requirements of the Builders Hardware Manufacturers Association (BHMA) listed above. [\[Designer shall include special requirements for conformity with Installation master keying system.\]](#)

4.3.16.2 Weatherstripping and Exterior Thresholds.

Provide nonferrous metal or vinyl weather-stripping for all housing unit exterior doors. Vinyl magnetic weather-stripping is acceptable for metal doors. Exterior thresholds shall be nonferrous metal.

4.3.16.3 Application.

Locks and hinges shall be applied as follows:

- Exterior hinged doors shall have 1-1/2 pair of hinges, lockset, and an auxiliary lock or interconnected lock and latch.
- Each windowless entrance door will have a viewer mounted at eye level.
- Exterior bulk storage door shall have 1-1/2 pair of hinges and lockset.
- Interior doors shall have one pair of hinges and latchset with BHMA 601, F75 or F76 operations.
- Doors in fire-rated walls, housing unit to garage, shall have 1-1/2 pair of ball-bearing hinges, lockset, auxiliary lock or interconnected lock and latch and closer.
- Garage side exterior doors shall have 1-1/2 pair of hinges and lockset.

4.3.17 Postal Service and Building Signage.

4.3.17.1 Postal Service.

All new units shall be provided with an individual mailbox. [\[Designer shall coordinate with the Installation and the local postal authority with respect to mail delivery requirements as well as installation requirements.\]](#)

4.3.17.2 Building Signage.

All new units shall be provided with building identification signage in accordance with the Installation Design Guide requirements.

4.4 OUTDOOR LIVING AREAS

4.4.1 General.

Each ground-floor family dwelling unit except for high-rises shall have an adjoining private or semi-private outdoor space, partially or completely surrounded by privacy screening, unless space is considered impracticable because of density or location. Emphasize factors that

enhance indoor and outdoor living. Consider size, layout and location of patios, balconies and yards, and features that encourage family use of outdoor areas. Minimum requirements for exterior spaces are in **Table 4-9**.

4.4.2 Balconies.

Each living unit located entirely above ground floor shall have a 72sf (min) balcony with no dimension less than 1.8 m [6 ft]. Provide direct access from balcony to living room, dining room, or family room. Construct balconies using solid decks with an impervious, non-slip surface, sloped to drain to outer edge. Balcony topping shall have a minimum thickness of 38 mm [1 1/2-inch] with welded-wire mesh reinforcement. Plastic coating or films over concrete decks, and exposed wood decks, stained or painted are not acceptable. Exposed wood rails and trim shall be treated to deter damage from moisture, decay and insect infestation.

4.4.3 Patios and Decks.

Screen patios and decks from streets, common areas, and adjacent living units. Provide direct access from patios and decks to living room, dining room, or family room areas. For each living unit that opens to the exterior at ground level, provide a minimum patio area of 11.2 m² [120 ft²] with a minimum dimension of 2.4 m [8 ft]. An acceptable alternative is a raised deck of the same size, constructed of weather-resistant materials. Consider using sustainable materials, such as post-consumer recycled plastics and certified wood, for deck and screen construction. Patios shall be sloped to drain and have a broom-finished concrete floor surface.

4.4.4 Exterior Stairs.

Design stairs to permit movement of a queen-size bed box spring. Exterior stairways serving multiple units shall be sheltered from wind and precipitation. Wood exterior stairs are prohibited. Stairs shall have a minimum width of 1.1 m (3 ft 6 in). Exterior stair treads and landings shall be constructed of concrete or steel, and provided with non-slip type treads. Exposed wood rails and trim shall be treated to deter damage from moisture, decay and insect infestation.

Table 4-9 – Minimum Area and Dimensions of Exterior Spaces

Spaces	Area		Length		Width/Depth		Height	
	m ²	ft ²	m	ft-in	m	ft-in	m	ft-in
Garage (1)	21.6	240	3.65	12-0	6.1	20-0	2.3	7-6
Balcony (1)	6.7	72	1.8	6-0	1.8	6-0	2.3	7-6
Patio – 3 BR	13.6	144	-	-	3.0	10-0	2.4	8-0
Patio – 4 BR	17.0	180	-	-	3.0	10-0	2.4	8-0
Patio – 5 BR	20.4	216	-	-	3.7	12-0	2.4	8-0
1. Ceiling heights apply when patios and balconies are covered.								

4.5 FOUNDATIONS

4.5.1 General.

Design foundations in accordance with UFC 1-200-01 and the International Residential Code (IRC). Fiber reinforced concrete is not an acceptable material for use in this project.

4.5.2 Basements.

Basements may only be provided when proven to be cost effective on a life-cycle cost basis related to economics, energy efficiency, operations and maintenance, structural integrity, and site constraints.

4.5.3 Slabs-on-Grade or Crawl Spaces.

Type, thickness, and location of insulation shall comply with applicable provisions of ASCE 32-01 (Frost-Protected Shallow Foundations), and IBC or IRC.

4.5.4 Tornado Protection Shelter.

[Designer shall include the following paragraph only when the project is being constructed in a location which is considered by FEMA guidelines (FEMA 320) to be "High Risk", the provision of tornado shelters must be included in the DD Form 1391 and all project programming to support inclusion of this technical requirement. For guidance in determining the probability of tornadic gust winds, refer to ASCE 7 – Commentary, Figure C6-1A. Tornadic Gust Wind Speed Corresponding to Annual Probability of Occurrence, and the following publications:

- FEMA 320 – Taking Shelter from the Storm: Building a Safe Room Inside Your House.
- FEMA 361 – Design and Construction Guidance for Community Shelters.
- FEMA – National Performance Criteria for Tornado Shelters.]

The design of the housing unit shall include the provision for a tornado shelter to protect the occupants during tornado events. This shelter shall be sized and designed as recommended by the FEMA National Performance Criteria for Tornado Shelters, dated May 28, 1999. The tornado shelter shall be incorporated into the building design whereby an interior space shall be designated as the tornado shelter. This interior space shall be constructed in accordance with FEMA criteria to provide protection from wind, airborne debris missiles, and shall include ventilation considerations.

4.6 ROOF AND ATTIC CONSTRUCTION

4.6.1 Roofs.

Shingle and tile roofs shall have a minimum slope of 4:12 for maintainability, and to provide residential scale to the neighborhood. Metal roofs shall have a minimum slope of 2:12. Install fall protection anchor points on all roofs with a slope greater than 2:12. Wood shingles and shakes are prohibited. Design roof overhangs, gutters and downspouts, roofing materials, and attic ventilation in accordance with roofing installation standards to conserve energy and reduce maintenance costs. See UFC 3-190-04FA Roofing and Waterproofing, for additional guidance. Roofs shall have minimum eave overhangs of 30 cm [12 in], and gable overhangs of 15 cm [6 in]. Roofing material shall comply with ENERGY STAR® recommendations. Parapet walls are prohibited.

4.6.2 Gutters and Downspouts.

Gutters and downspouts shall be provided for all roof areas. Downspouts draining onto a lower roof shall have metal or plastic splash deflectors. Concrete splash blocks shall be provided under downspouts if not connected to the storm drainage system.

4.6.3 Materials.

Roofing shall be limited to the following:

- Minimum of 102 kg [225 lb] Class A wind-resistant fiberglass shingles conforming to ASTM D3018, Specification for Class A Asphalt Shingles Surfaced With Mineral Granules.
- Minimum of 245 kg [540 lb], standing or flat seam, metal roofing with 0.7 mm [0.027 inch] thick zinc-copper-titanium alloy factory finish.
- Clay, concrete, metal, or fiberglass tile. [Designer shall add information when allowed for use.]
- Aluminum standing seam roofing 0.8 mm [0.032 inch] thick.
- Copper [Designer shall add minimum thickness for roofing.]

4.6.4 Attics.

Attic solar power ventilation shall be provided when proven to be life-cycle cost effective; otherwise provide traditional power ventilation. Do not terminate exhaust fans or plumbing vents in attic, unless plumbing vents have air admittance valves (AAV) that comply with IRC provisions.

4.7 EXTERIOR CONSTRUCTION

4.7.1 General.

Use sustainable, low maintenance finish materials, such as brick, integrally-colored concrete masonry, integrally colored stucco, factory pre-finished siding, steel siding, vinyl siding. Materials shall be residential in size, scale, and texture. Avoid materials requiring field finishing. Provide vapor barrier/diffusion retarder as required by dew point analysis. Aluminum siding, hardboard and cement asbestos shingle siding shall not be used. Exterior finish materials for exterior bulk storage buildings and garages will match the primary dwelling unit. The following siding materials may be used, but are listed in declining order of preference: [Designer shall edit order of preference to reflect installation preferences and edit out materials not to be used below and in this paragraph.]

- Brick. Brick shall conform to ASTM C216, Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale). Provide brick cap and flashing for all offset brick veneer. For grade beam design, the brick shall run a minimum of one course below the finished floor and shall be flashed at that level.
- Concrete masonry units. Concrete masonry units shall conform to ASTM C90, Specification for Hollow Load-Bearing Concrete Masonry Units, and shall be factory scored, fluted, or striated.
- Stucco. Portland cement plaster or synthetic stucco shall have integral color. Stucco total surface area shall be divided into panels with control joints spaced no more than 300 mm [10 ft] apart to form a panel of less than 14 m² [150 ft²]. Contractor shall follow manufacturer's

installation instructions explicitly and shall certify accurate and correct installation of all stucco type materials. [Installations on the East Coast and all those installations where high humidity is typical in the climate, extreme caution shall be exercised with consideration to the correct specification and installation of this type finish material in a humid climate. [\[Designer shall suitably investigate the benefits and potential problems with this material selection prior to its inclusion in the solicitation.\]](#)

- Factory-prefinished siding. Factory-prefinished siding shall have a minimum non-prorated 15-year warranty on the finish. Aluminum or steel siding with or without backing are acceptable only on the second story of a structure or at least 2000 mm [6 ft] above finish grade. Siding shall be kept a minimum of 150 mm [6 inches] above finish grade. Lap siding shall be either single pieces with 203 mm [8 inches] maximum width course or single pieces shaped to simulate 200 mm [8 inches] maximum width courses (double-four, double-five, triple-four sidings are acceptable). Siding shall be installed in accordance with manufacturer's recommendations. A manufacturer's representative shall instruct the installer of the siding, appurtenances, and accessories as to the manufacturer's required installation procedures. The Government construction inspectors responsible for the job shall be included in their instruction. Panel materials in large surfaces shall be avoided unless surfaces are broken with textures or battens. Battens for prefinished materials shall also be factory finished. Requirements for various siding materials are as follows:
- Aluminum siding shall conform to the requirements of AAMA 1402.3, Standard Specification for Aluminum Siding, Soffit, and Fascia, except aluminum substrate shall be a minimum of 0.6 mm [0.024 inch] thick if it is not fiberboard backed. For fiberboard backed aluminum siding, the aluminum substrate shall be a minimum of 0.5 mm [0.019 inch] thick. Aluminum siding shall not be installed within 1.6 km [1 mile] of open saltwater or in other highly corrosive atmospheres.
- Steel siding material shall be a minimum of 0.017-inch thick [29 gage], zinc-coated steel conforming to ASTM A653, Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality, and ASTM G90, Standard Practice for Performing Accelerated Outdoor Weathering of Nonmetallic Materials Using Concentrated Natural Sunlight. Siding panels shall be formed to provide full-length edge interlock, so that after installation, fasteners will be concealed from view. Siding shall be pretreated and either factory-primed and finish-painted or factory-laminated with a weather-resistant polymer film. When tested for 500 hours in accordance with ASTM B117, Method of Salt Spray (Fog) Testing, the siding finish shall show no signs of cracking, blistering, peeling or significant color change, and shall show no loss of adhesion from the metal more than 1.6 mm [1/16-inch] beyond a line scratched or scribed through the coating. Steel siding shall not be installed within 1.6 km [1 mile] of open saltwater or in other highly corrosive atmospheres. Steel siding materials shall be separated from aluminum surfaces with a coating of bituminous paint or asphalt varnish.
- Vinyl siding shall conform to the requirements of ASTM D3679, Rigid Poly (Vinyl Chloride) (PVC) Siding and shall be a minimum of 1.16 mm [0.044 inch] thick.

4.7.2 Structural Design.

Structural design for apartment housing (materials and construction) shall comply with the International Building Code (IBC). One and two family housing, including townhouses, shall comply with International Residential Code (IRC). Structures which qualify as "Manufactured Homes" shall comply with the Federal Manufactured Housing Construction and Safety Standards Act (FMHCSS) [USC Title 42], except as modified herein.

4.7.2.1 Lateral Resistance. Walls used or required for lateral resistance to wind or earthquake, shall be considered bearing walls and shall have full foundations.

4.7.2.2 Embedded Steel. Nonstructural steel (handrails, etc.) embedded in concrete shall be galvanized or painted wrought iron. All damaged galvanized areas shall be repaired prior to embedment.

4.7.2.3 Wood Flooring Systems. Wood flooring systems shall be glued and nailed. Glue lines shall not be considered for stress transfer.

4.7.2.4 Subfloor. Plywood is preferred as subfloor material, and is required for wet areas (i.e., bathrooms, kitchens, utility rooms). The subfloor will be rated for exposure 1 or exterior use.

4.7.2.5 Underlayment: Sanded face underlayment (plywood) is required with vinyl tile, sheet vinyl, and carpet. Underlayment must be a minimum thickness of 8.7 mm (11/32 inches). Acceptable sanded face underlayment panels can be APA rated A-C, B-C, A-D, B-D, or C-C plugged. Underlayment shall be rated for Exposure 1 or exterior use. Underlayment shall be installed after interior finish work is complete to avoid damage to the underlayment. Ceramic tile shall be installed on mortar bed or cement board underlayment.

4.7.3 Trim

Aluminum, vinyl clad wood or solid polymer trim is preferred over painted or stained wood trim. Painted exterior surfaces shall be minimized. When exterior exposed wood trim is used, the following requirements apply:

- Wood fascia and rakes are required and shall be 25 mm [1 inch] nominal boards with solid blocking or 50 mm [2-inch] nominal boards without blocking. Plywood, hardboard, or gypsum board are not permitted for fascias or rakes.
- Exposed wood, such as window trim, door sills, window sills, railings and balusters, wood fencing, solar shading devices including louvers, arbors, and trellis shall be treated for rot resistance in accordance with NWWDA Industry Standards I.S.4, Water Repellent Preservative Treatment for Millwork.
- Exterior surfaces requiring painting shall receive a minimum of one prime coat and two finish coats of paint. Wood trim frames, etc., shall be back-primed. Exterior semi-transparent stains, two coats, are acceptable, where appropriate for wood, plywood, etc.

4.7.4 Exterior Ceilings and Soffits.

Exposure of roof framing and underside of roof/floor decks is not permitted. Exterior ceilings and/or soffits will be trimmed or otherwise architecturally treated and coordinated with siding. Exterior ceilings and/or soffits may be pre-finished metal, vinyl, cement board, plywood, or 9.5 mm [3/8-inch] 303 medium density overlay siding material, EXT-APA conforming to American Plywood Association Standard B840, 303 Siding Manufacturing Specifications. Cement asbestos ceiling and/or soffits are not permitted.

4.7.5 Windows and Glazed Doors.

Provide windows and glazed door (50 percent or more glass) that meet minimum egress requirements in the Life Safety Code (NFPA 101). Operable windows must be manually operated and lockable. Provide non-ferrous screens for operable windows. Maximize amount of natural light in living areas. Consider passive solar energy impact on heating and cooling loads when selecting, sizing, and locating windows. Window energy performance shall comply with ENERGY

STAR® recommendations. Tilt-in windows are recommended to facilitate cleaning by occupants. Provide glass door and window treatments for occupant privacy. Window screens shall be provided for operable windows in habitable rooms and spaces. Windows above ground floor shall have screens capable of withstanding a minimum force of 60 pounds (27 kg) as a concentrated load applied to the middle of the screen. Screens must be removable for window cleaning and emergency egress purposes without the use of any special tools. Removable window guards or child safety locks may be provided in lieu of reinforced window screens. Window guards shall be in compliance with ASTM F2090-10 – *Standard Specification for Window Fall Prevention Devices With Emergency Escape (Egress) Release Mechanisms*.

4.7.5.1 Window Operation. Windows that slide (double-hung, single-hung, and horizontal sliding) and glass exterior doors shall meet the standards for hung units. Standards for casement windows shall apply to all hinged or fixed windows. Other window types may be used if they have been tested and conform to the standards for hung windows. The Contractor shall provide the manufacturer's certification that the window provided meets the following test requirements:

- Pressure. Hung units will meet a National Fenestration Rating Council (NFRC) design pressure rating of 25. Casement windows will meet NFRC design pressure rating of 40. Evidence of passing the following specific tests and minimum standards are required to achieve these design pressure standards.
- Strength. Using ASTM E330 test results shall demonstrate no glass breakage, damage to hardware, or permanent deformation that would cause any malfunction or impair the operation of the unit. Residual deflection of any member shall not exceed 0.4 percent of its span. Hung windows shall be tested at pressures of 1796 Pa [37.5 lb/ft²], and casement windows shall be tested at pressures of 2873 Pa [60.0 lb/ft²].
- Operating force. The force necessary to unlatch and open units shall not exceed 13.6 k [30 lb] for hung units and 15.9 k [35 lb] for casements.
- Air infiltration. Using ASTM E283 leakage rate shall not exceed 0.65 l/min/m² [0.25 ft³/min/ft²] for hung units and 0.39 l/min/m² [0.15 ft³/min/ft²] for casements, at a test pressure of 7.66 k/m² [1.57 lb/ft²].
- Water penetration. Using ASTM E547, no leakage shall be evident when tested in three, five-minute cycles with a one-minute rest period between cycles at 18.3 k/m² [3.75 lb/ft²] for hung units and 29.3 k/m² [6.0 lb/ft²] for casements.
- U-Value. U-values shall be calculated using ASTM E1423 and NFRC 100-91. See Section 8.0 for additional information.

4.7.5.2 Glazed doors. Glazed doors shall have insulated steel, vinyl-clad wood or thermally broken aluminum frames conforming to the above requirements. Finish shall be factory applied and conform to 44-C-22431 in accordance with the requirements of the National Association of Architectural Metal Manufacturers (NAAMM) Metal Finishes Manual. Operable panels shall be equipped with screens. Sliding panel screens shall have extruded aluminum tubular frames mitered at corners, channel-shaped corner angle reinforcement, and nylon bottom rollers. Doors shall have interior operated latch, and securing pin or throw-bolt in frame.

4.7.5.3 Glazing. Units shall be double glazed with low E-glass. [Requirement may be deleted in weather zones 9 and 10.]

4.7.5.4 Window Stools. Interior window stools shall be solid-wood, paint grade with a minimum thickness of 19-mm [3/4-inch]. Marble or ceramic tile sills are preferred in masonry construction. Solid surfacing is an acceptable window stool.

4.7.5.5 Screens. Screens shall be provided at all operable sashes and sliding doors. Screens shall be nonferrous, of window manufacturer's standard design, and conform to AAMA 1002.10, Voluntary Specification for Aluminum Insulating Storm Products for Windows and Sliding Doors.

[Designer may wish to discuss and consider "sunscreen" material with the installation if in hot climates. Sunscreens (screen composed of more dense mesh screening material than standard insect screens) fit in the same screen track and continue to act as an effective insect screen and also as a Solar Heat Gain Coefficient (SHGC) reducer shall be considered for installation in west- and east-facing windows, and in south-facing windows that do not have passive solar overhang shading. In hot climates solar heat gain through the windows is often responsible for 50% or more of the air conditioning load, and sunscreen is an effective, low-cost, passive and persistent means of reducing it. This is not a mandatory requirement.]

4.7.5.6 Window Treatments. Provide 25 mm [1 inch] metal blinds at windows and glazed hung doors. Color shall be manufacturer's standard off white, and shall be coordinated with wall color. Provide single-draw traverse rod and draperies at sliding glass doors. [Designer shall edit to indicate drapery specification.]

4.7.6 Wall Framing.

Use of "Advanced Framing Techniques - Optimum Value Engineering (OVE)" framing is recommended.

4.7.7 Exterior Doors.

- Provide insulated exterior doors for increased energy performance. Provide dead-bolt locks on all hinged entry doors. Provide impact-resistant side light at entry door, or a wide-angle viewer. Door energy performance shall comply with ENERGY STAR® recommendations. See Section 8.0 for additional information on thermal performance requirements. Do not use a sliding glass door as the primary housing unit access.

4.7.7.1 Entrance Doors. The housing unit primary entrance door shall be 900 mm [3 ft] in width by 2050 mm [6 ft-8 inches] in height by 45 mm [1-3/4 inch] thick, thermal metal. Other housing unit entrance doors shall meet this requirement but may be of lesser width.

4.7.7.2 Bulk Storage Door. Exterior bulk storage door shall be a minimum 900 mm [3 ft] in width by 35 mm [1-3/8 inch] thick, exterior grade, thermal or hollow core metal. Doors may be omitted when storage areas are located in garages.

4.7.7.3 Aluminum Screen and Storm Doors. [Designer shall insert "Not Used" and delete remainder of text if not applicable.] Screen and self-storing storm doors shall be provided for all housing unit exterior hinged doors. Frames shall be a minimum of 32-mm [1-1/4-inch] thick and 51 mm [2 inches] wide. Aluminum alloy materials shall be not less than 1.27-mm [0.05-inch] thick and 51 mm [2 inches] wide. Doors shall have solid bottom panels and midsection protective grills. Screening materials shall be nonferrous.

4.7.8 Main Entry.

Design main entries to provide a sense of identity for each individual unit. Visual impact from the street is extremely important. Avoid a common entry to several units. Each unit shall have an appropriate number or letter designation. Provide each front entrance with a door chime or door knocker. Provide a slip-resistant finish for porch surfaces. Protect entry door with a minimum 0.6 m (2 ft) overhang, or covered porch. Provide interior and exterior lighting at each main entrance.

4.7.9 Garages or Carports.

For new construction, a minimum of one-car garage shall be provided for each unit. [Designer edit appropriately where project requirements prevent provision of a garage.] For renovation projects, garages or carports shall be provided as the site allows. Enclosed bulk storage may be included in the garage or carport as discussed in paragraph 4.3.11.3. If trash or bulk storage areas are included in the garage or carport, such areas are in addition to the required car storage area. Refer to Table 4-6 for minimum dimensions. Garages shall be attached to housing unit they serve. If garages cannot be attached, locate them as close as possible to kitchen and service area of house. Provide convenient access between garage and service area, and between kitchen and service area. Design garages to compliment architectural features, materials, and roof slopes of house. Provide light switches and duplex convenience outlets in each garage. Garage floor surface must be a minimum of 10.2 cm [4 in] lower than finished floor of attached housing unit and the floor of the adjoining exterior storage; slope floor to drain liquids away from unit walls. Design and construct attached garages to prevent infiltration of contaminants into housing units. Garage doors shall have hardware that can be opened and locked from inside and outside of the garage. Automatic garage door operation shall be provided.

For accessible units or units designated to be adaptable for access, the garage shall allow space for accessible path of travel (with automobile and other items in the garage) from vehicle into house. For attached garages, path shall be interior. The required step down from the housing unit into the garage shall be maintained; adaptability may be achieved by structural provision for future ramp.

4.7.10 Exterior Storage.

Provide an outside service door opening to exterior storage areas, wide enough to accommodate lawn mowers and typical lawn tools, except when storage is provided in garage. Locate outside service door near outdoor living and lawn areas. Provide paved access to the door. Provide a switch-controlled light at outside service door. Recommended exterior storage space is 3.7 m² [40 ft²] for three-bedroom units and 4.7 m² [50 ft²] for four- and five-bedroom units.

4.7.11 Trash Area.

Provide each living unit with a paved pad area large enough for two 114-liter [30-gallon] containers, plus any recycling containers required by the installation. Locate pad near trash pickup point but behind the front of the house, and provide paved access for occupant. Locate trash area outside living unit envelope. Provide with a trash enclosure or screening, if trash area is visible from street, common area or other living unit. Garages and carports may be designed to provide adequate trash container enclosures. Locate dumpster areas, if provided, in areas least offensive to housing occupants, and provide adequate shielding with fencing or screening.

5.0 BUILDING SYSTEMS

5.1 WATER

5.1.1 General.

Comply with International Residential Code (IRC), latest edition.

5.1.2 Water Supply and Distribution.

Connection to the existing water distribution system shall be made at the locations shown on the RFP drawings. Provide an interior shut-off valve on water supply line entering each housing unit, readily accessible to maintenance and emergency personnel.

5.1.3 Exterior Hose Bibs.

Provide hose bibs in easily accessible locations at front and rear of each ground floor living unit, and provide frost-proof hose bibs in areas subject to freezing temperatures and provide an integral vacuum breaker.

5.1.4 Domestic Hot Water.

Water heaters shall be ENERGY STAR® labeled and shall be storage or tankless as described. Where fuel-fired water heaters are provided, sealed combustion units are recommended. Water heater sizing for storage type water heaters shall be in accordance with Table 5-1. Additional consideration in the technical evaluation will be given to designs which include water heaters which exceed the minimum energy efficiency requirements, which use power vented or sealed combustion water heaters. At least 30% of hot water demand must be met using solar hot water heater.

Table 5-1 – Water Heater Sizing

Requirements by Fuel Type	3 BR	4 BR		5 BR	
	2 Bath	2 Bath	3 Bath	2 Bath	3 Bath
Gas & Oil:	-	-	-	-	-
Storage (L [gal])	151 [40]	151 [40]	194 [50]	194 [50]	194 [50]
1 hour draw (L [gal])	265 [70]	273 [72]	310 [82]	341 [90]	341 [90]
Recovery (L/h [gph])	114 [30]	121 [32]	121 [32]	151 [40]	151 [40]
Electric:	-	-	-	-	-
Storage (L [gal])	189[50]	189[50]	250 [66]	250 [66]	250 [66]
1 hour draw (L [gal])	273 [72]	273 [72]	333 [88]	333 [88]	333 [88]
Recovery (L/h [gph])	83 [22]	83 [22]	83 [22]	83 [22]	83 [22]

5.1.4.1 Gas fired water heaters. Gas fired water heaters shall be in accordance with ANSI Z21.10.1, Water Heaters, Gas, Volume I, Storage Type, 22 kW [75,000 BTUH] Input or less, and shall be sealed combustion high efficiency type. Water heaters with powered ventilation shall be vented in accordance with manufacturer's instructions.

5.1.4.2 Oil fired water heaters. Oil fired water heaters shall be in accordance with UL 732.

5.1.4.3 Electric water heaters. Electric water heaters shall comply with UL 174, Water Heaters, Household Electric Storage Tank Type, and shall have an Annual Energy Use (kWh) of 4,773 or less based on DOE test procedure 10 CFR430, Sub-Part B, Appendix E.

5.1.4.4 Tankless Water Heaters. Whole home gas tankless water heaters shall have a minimum recovery efficiency of 83%, minimum gallons per minute of 0.0 and maximum gallons per minute of 3.9 at 77 degrees F temperature rise.

5.1.5 Plumbing.

Plumbing system shall be designed and installed in accordance with the International Residential Code (IRC). Inspection and testing of the plumbing system shall be performed as prescribed in the Plumbing Code. Additional consideration in the technical evaluation will be given to systems which incorporate measures beyond the requirements of this Statement of Work which are designed to increase energy conservation, ease of maintenance, or occupant comfort such as water filtration and purification, higher efficiency water heating systems, higher grade plumbing fixture materials (such as enameled cast iron tubs as opposed to enameled steel or plastic), etc.

5.1.5.1 Water Piping. Under slab supply piping shall be limited to housing unit service entrance only. Service line to each housing unit shall be no less than 25 mm [1 inch] diameter. All water piping shall be sized in accordance with methods outlined in the International Residential Code (IRC), to limit water velocity in the pipe to 2440 mm/sec [8 ft/sec] unless a lower velocity is recommended by the plumbing fixture manufacturer(s). An isometric diagram of the water system shall be included in the design submittal. Allowable pipe materials are listed below:

- Copper tubing. Water piping under concrete slabs shall be copper tubing, type K, annealed. Joints under the slabs are prohibited. If copper tubing is selected for interior water piping, it shall be type K, L, or M hard-drawn copper. Type M copper tubing shall not be installed in exposed areas where the tubing may be exposed to external damage. Additional consideration in the technical evaluation shall be given to designs using copper types K or L. Fittings for soft copper tubing shall conform to ANSI B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes, and for hard-drawn to ANSI B16.22, Wrought Copper and Copper alloy Solder Joint Pressure Fittings.
- Chlorinated Polyvinyl Chloride (CPVC) Plastic Pipe. [Determine the acceptability of CPVC and edit text as required.] If plastic pipe is selected for interior water piping, it shall be Chlorinated Polyvinyl Chloride (CPVC) plastic pipe, conforming to ASTM D-2846, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Hot- and Cold-Water Distribution Systems. CPVC thicknesses shall meet Standard Design Ratio 11 for sizes 13-mm [$\frac{1}{2}$ -inch] to 51 mm [2 inches] and shall be schedule 80 pipe for sizes larger than 51 mm [2 inches].

5.1.5.2 Soil, Waste, Vent, and Drain Piping. Soil, waste, vent, and drain, piping may be cast iron, copper, steel, or plastic suitable for installation in a residential waste, soil, vent, and drain system. Each fixture and piece of equipment, except water closets, requiring connection to the drainage system, shall be provided with a trap. Soil, waste, and drain piping installed below floor slabs shall be service weight hub and spigot cast iron or plastic pipe. Building waste main lines shall be no less than 102-mm (4-inch) diameter. All soil, waste, and drain piping shall be sized in

accordance with the methods outlined in the International Residential Code (IRC). An isometric diagram of the complete sanitary sewer system shall be included in the design submittal.

Air conditioner condensate drains, refrigerant suction, and exterior refrigerant liquid lines shall be insulated with 25 mm [1 inch] (minimum) thick cellular glass or unicellular foam pipe insulation. (See subparagraph 10.f. for pipe insulation requirements in humid areas.) Exterior refrigerant line insulation shall be encased in either an aluminum or PVC jacket to prevent damage. Condensate lines shall be one size larger than the drain pan connection, deep-seal trapped, and shall not be directly connected to a sanitary sewer system (air gap fitting required).

5.1.5.3 Plumbing Fixtures. Fixtures shall be provided complete with fittings, and chromium- or nickel-plated brass (polished bright or satin surface) trim. All fixtures, fittings, and trim in a project shall be from the same manufacturer and shall have the same finish.

- Water closets. Water closets shall have regular bowl with inclined tank, close coupled siphon jet, floor outlet with wax gasket, closed-front seat and cover, and an anti-siphon float valve. Water consumption shall be no more than 6 L [1.6 gal] per complete flushing cycle. Water closet trim shall conform to ANSI A112.19.5, Trim for Water-Closet Bowls, Tanks, and Urinals (Dimensional Standards). Water conservation to include dual flush technology is strongly encouraged.
- Lavatories. Lavatories shall be rectangular counter top type, minimum 508 by 457 mm [20 by 18 inches] in size or oval minimum 480 by 410 mm [19 by 16 inches] in size. Lavatories shall be vitreous china, cast iron rimless type (without rings), or cross-link acrylic molded counter top with integral bowl. Lavatories shall have pop-up drains.
- Bathtubs shall be slip resistant and shall be constructed of enameled cast iron, porcelain enameled formed steel, or gel-coated, glass fiber reinforced polyester resin with wainscot. Metal bathtubs shall have fiberglass, porcelain-on-steel panels, or ceramic tile wainscot.
- Shower stalls shall be of ceramic tile, floor to ceiling, over membrane waterproofing on a cementitious substrate; or gel-coated, glass-fiber-reinforced polyester. Shower receptors shall be slip resistant cast stone or gel-coated, glass-fiber-reinforced polyester. Shower stall wainscots shall be ceramic tile or gel-coated, glass-fiber-reinforced polyester.
- Kitchen sinks. Kitchen sinks shall be Type 302 stainless steel, 20-gauge minimum, seamless drawn, and sound deadened. Sinks shall be double bowl, self-mounting without mounting rings, complete with cup strainer and plug. Food waste disposers, where provided, shall be in accordance with UL 430 and ASSE 1008, and shall have a minimum motor size of 370 watts [$\frac{1}{2}$ horse power]. Strainer and plug shall be eliminated where food waste disposers are provided.

5.1.5.4 Plumbing shall meet the following criteria:

- Exposed traps shall be chromium-plated, adjustable-bent tube, 20-gauge brass. Concealed traps may be plastic (ABS).
- Faucets shall be single-control type, with seals and seats combined in one replaceable cartridge designed to be interchangeable among lavatories, bathtubs and kitchen sinks, or having replaceable seals and seats removable either as a seat insert or as a part of a replaceable valve unit. Water flow shall be no more than .158 L/s [2.5 gpm] from any faucet.
- Shower and bath combination shall be controlled by a diverter valve. Baths and shower and bath combinations shall be provided with waste fitting pop-up, concealed with all parts removable and renewable through the overflow and outlet openings in the tub. Showers and

shower and bath combinations shall be equipped with a combination valve and flow control device to limit the flow to 0.158 L/s [2.5 gpm] at pressures between 137.9 to 413.7 kPa [20 and 60 psi].

- Piping shall be concealed. Individual shutoff or stop valves shall be provided on water supply lines to all plumbing fixtures except bathtubs and showers. Shutoff valves shall be provided for each bathroom group. In multi-story units, additional consideration shall be given in the technical evaluation to designs which provide separate shutoff valves for each floor.
- Fixtures shall be water conservation type, in accordance with the International Residential Code (IRC).
- Vitreous china plumbing fixtures shall conform to ANSI A112.19.2, Vitreous China Plumbing Fixtures. Stainless steel fixtures shall be in accordance with ANSI A112.19.3, Stainless Steel Plumbing Fixtures (residential design). Plastic fixtures shall conform to ANSI Z124. Enameled cast iron plumbing fixtures shall comply with ANSI A112.19.1, and enameled steel fixtures shall comply with ANSI A112.19.4.
- Where tubs are installed in an end-to-end configuration in adjacent bathrooms the shower valve faucet end of the tubs shall not be back to back, but shall be located at opposite ends of the tubs to allow for maintenance and repair.

5.1.5.5 Clothes Washer Connections. Drainage and hot and cold water supply shall be provided for automatic clothes washers. Washer connection, complete with 50-mm [2-inch] drain, 20-mm [3/4-inch] hose thread supplies shall be provided in standard manufactured recessed wall box with single-face plate. Boxes shall be constructed of plastic or sheet steel. Steel boxes shall have a corrosion-resistant epoxy enamel finish. Boxes shall be mounted a minimum of 865 mm [2 ft-10 inches] above the finish floor. Electrical outlets for both washer and dryer shall also be provided.

5.1.5.6 Refrigerator Ice Maker Connection. Cold water supply shall be provided for GF refrigerator ice makers. Ice maker connection shall include an angle valve and a 1/4 inch hose thread supply, and shall be provided in standard manufactured recessed wall box with single-face plate (plastic or steel). Boxes shall be mounted a minimum 2 ft-10 inches above the finish floor.

5.1.5.7 Piping Location. Water piping running in crawl spaces and attics shall be installed on the warm side of insulation and shall be wrapped with insulation and a vapor barrier jacket. Determination of the warm side shall be the same as determined for vapor barrier location. No water piping runs in exterior walls shall be allowed, except in climates where the 99 percent dry bulb temperature is 1.7 degrees C [35 degrees F] or higher.

5.2 SANITARY SEWER

5.2.1 General.

Provide Drain-Waste-Vent (DWV) plumbing that complies with the International Residential Code (IRC). Locate vent stacks to rear of housing units, and consolidate or eliminate through-the-roof penetrations, when possible.

5.2.2 Sanitary Sewer System.

Connection to the existing sewage collection system shall be made at the location shown on the RFP drawings. Sewage collection systems shall be designed and constructed in accordance with the International Residential Code (IRC). Pipes shall be designed to flow full and maintain a minimum velocity of 0.6 m [2 ft] per second.

5.2.3 Condensate and Overflow Drains. Provide drains for air-conditioning condensation, humidifier overflow, occupant-supplied washing machines, and water heater drain and relief valves. Drains shall discharge to exterior whenever possible. Drainage to waste water drain shall be coordinated with local sewer authority for availability.

5.2.4 Cleanouts. Cleanouts shall be provided at each change in direction of sanitary sewer lines, at the intervals specified in the International Residential Code (IRC), and at the building service entrance. All cleanouts shall be permanently accessible. Ground cleanouts shall be installed in a 305-mm by 305-mm [12-inch by 12-inch] concrete pad, flush with grade.

5.3 GAS AND FUEL OIL

5.3.1 General.

Fuel gas piping systems, fuel gas utilization equipment and related accessories, venting systems, and combustion air configurations must comply with applicable provisions of the IBC and the IRC as modified by UFC 1-200-01, and NFPA 54 and NFPA 58. [Designer delete if not applicable: Compliance with Host Nation codes and regulations is also required for overseas locations.]

5.3.2 Gas Distribution System.

[Designer shall insert " ... (DELETED)" if not applicable and delete remainder of text in subparagraphs.] [Coordinate with the installation to determine the responsible agency for installation of exterior gas lines, meters, regulators, hot taps, valves, etc. The design agent shall then add a sentence to this paragraph to inform the Contractor of his or her responsibility.]

5.3.2.1 Materials. Materials and appurtenances shall be free of defects and suitable to accomplish the stated objectives of gas distribution systems. Pipe shall be polyethylene or steel as described below.

- Polyethylene pipe shall conform to ASTM D2513, Standard Specification for Thermoplastic Gas Pressure Piping Systems, with fittings complying with either ASTM D2513 or ASTM D2683, Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing. Connections to metal pipe shall comply with ANSI B16.5, Pipe Flanges and Flanged Fittings, or manufacturer's recommended standards.
- Steel pipe shall conform to ASTM A 53, Grade A or B, Type E or S, Schedule 40; or seamless or electric resistance welded, Schedule 40; black, as specified in ASME B31.8. Furnace butt welded pipe may be used in sizes 40 mm [1-1/2 inch] and smaller. Fittings 40 mm [1-1/2 inch] and smaller shall conform to ASME B16.11. Pipe flanges and flanged fittings larger than 40 mm [1-1/2 inch], including bolts, nuts, and bolt patterns shall be in accordance with ASME B16.5, Class 150. Butt weld fittings shall be in accordance with ASME B16.9. Weld neck flanges shall be used.

5.3.2.2 Testing. Prove that the entire system of gas mains and service lines is gas-tight by an air test, in accordance with ANSI B31.8. The test shall continue for at least 24 hours between initial and final readings of pressure and temperature.

5.3.2.3 Drips. Unless high pressure natural gas is used, drips shall be installed at the low points, immediately following reduction from high pressure to medium pressure (at supply points) and at occasional low points throughout the system to provide for blowing out the lines.

5.3.2.4 Gas Connections. The use of semi-rigid tubing and flexible connectors for gas equipment and appliances is prohibited, except that the final connections to the kitchen ranges shall be made using flexible connectors conforming to ANSI Z21.45, Flexible Connectors of Other

Than All Metal Construction for Gas Appliances, not less than 1000 mm [40 inches] long. Provide accessible gas shutoff valve and coupling for each gas equipment item. Comply with UBC or model code seismic requirements. Exposed horizontal piping shall not be installed farther than 150 mm [6 inches] from the nearest parallel wall in laundry room or areas where clothes hanging could be attempted. See paragraph 4.e. for gas line distribution requirements.

5.3.3 Fuel Oil Storage and Distribution.

[Designer shall insert "DELETED" if not applicable and delete remainder of text in all paragraphs.]

- Fuel oil storage and distribution system shall be installed to supply the fuel oil-fired heating equipment. Provide a complete fuel oil storage and distribution system designed in accordance with local codes, installation requirements, NFPA 30, and NFPA 31, whichever are more stringent.

5.3.4 Liquefied Petroleum (LP) Gas Storage and Distribution.

[Designer shall insert "DELETED" if not applicable and delete remainder of text in all paragraphs.]

LP gas pressure shall be reduced to a minimum service pressure of 3.5 kPa [$\frac{1}{2}$ psi] prior to the building entrance. LP gas pipe connectors shall be in accordance with UL 567.

5.4 INTERIOR ELECTRICAL SYSTEMS

5.4.1 Unit Electrical System.

5.4.1.1 Service Entrance. Service entrances, exterior meters, and panels shall be enclosed or sight screened. Service feeders shall be underground with exterior meters. Panel boards shall be painted galvanized steel and furnished with main breakers. Panel board doors shall be flush one-piece fronts. Provide main circuit breaker in the main panel for each housing unit, sized in accordance with the NEC.

5.4.1.2 Service Panel. Provide 200 amp minimum electrical service to each living unit

5.4.1.3 Metering. Provide meter bases to facilitate installation of individual electric meters at a later date. Automated Meter Reading (AMR) meters, complying with ANSI/NEMA standard, C12.1 Code for Electricity Metering, shall be installed. Provide visual screening for meters and meter bases, and do not locate meters adjacent to unit entrances.

5.4.1.4 Panel Locations. Housing unit panels shall be located in the utility or laundry room, attached garage, or hallway. Panel boards may be surface or recessed mounted depending on their location. In hallways, panel boards shall be recessed. Offset a minimum of 400 mm [16 inches] horizontally back-to-back panel boards. No recessed panel boards are to be located in party walls and fire walls.

5.4.1.5 Conductors. Conductors shall be copper. Branch circuit conductors and over current devices shall be as rated by NEC. A minimum of one spare circuit space in the panel shall be provided per housing unit. Individual circuits shall be provided for the washer, dryer (with receptacles located behind the washer and dryer), dishwasher, garbage disposal, freezer, electric range, furnace or air handling unit, air conditioning unit, and water heater. Two utility circuits (20 amp) shall be provided in the kitchen area for the convenience outlets for small appliances serving the kitchen, dining area, and family room area.

5.4.1.6 Outlet Circuits. Lighting and convenience outlets shall be on separate circuits. Outlets on party walls shall be offset to maintain integrity of the fire wall and sound deadening rating of the wall. No more than ten convenience outlets shall be placed on a branch circuit.

5.4.1.7 Convenience Outlets. In addition to outlets required by NEC, provide convenience outlets in the following areas:

- Utility Room
- Hallway outside bedrooms
- Garage

5.4.1.8 Special Outlets. Provide 240 V electric outlets for electric dryer, electric range, and window air conditioner units. [Designer shall edit or delete reference to window air conditioners, if not applicable.]

5.4.1.9 Maximum use shall be made of nonmetallic sheathed cable for branch circuit wiring, and of service entrance cable for heavy-duty interior circuits and for service entrance conductors. Installed conductors in conduit shall be used only where specifically required by the NEC.

5.4.1.10 Engine Block Heaters. Provide 20 amp outlet on separate circuit for occupant-owned engine block heater. Locate the outlet on exterior adjacent to the garage door opening. [Designer shall edit or delete if not applicable.]

5.4.1.11 Lighting.

Unit lighting fixtures shall have a minimum overall Light Efficacy Rating (LER) of 65, including ballasts. For further guidance, see standards and Lighting Handbook published by the Illuminating Engineering Society of North America (IESNA). Wall switch operated and ENERGY STAR® labeled ceiling fans in living/dining area, family room, and bedrooms are desirable. Fans should be provided with compact fluorescent fixtures with T-4 827 lamps.

5.4.1.11.1 Exterior Lighting and Outlets. Provide energy efficient high quality lighting for each housing unit. The minimum efficiency standard for lighting is 50 lumens/watt. This efficiency can be achieved with fluorescent and compact fluorescent lighting. Lighting must also be color corrected with a Color Rendering Index (CRI) of 60 or better. Provide a minimum of one light fixture and one ground-fault-protected outlet in each housing unit's entry, garage or carport, and patio or balcony area(s). Light fixtures at entry and patio or balcony areas shall be switched from the housing unit interior. Entry ways serving two or more housing units, and common carports, may have a common light, photo-electric cell activated, in lieu of individual switched lights. In addition, common trash areas shall be lighted. These lights shall be controlled by photo-electric cell, activated by minimum light levels of 5.4 Lx [0.5 foot-candle]. Provide a fixture in the patio area, except that the patio area light shall not be provided where the patio is adjacent to an exterior entrance and is adequately served by the lighting fixture required at the entrance. Lights for common areas as in gang carports and apartments shall be photo-electric cell controlled. Lights in common areas shall have high impact-resistant plastic lenses, and/or be otherwise made vandal-proof.

[Designer may consider outdoor security (corner of house and patio floodlighting, not "streetlight-type fixtures") be equipped with motion detectors in addition to photo-electric cell activation. The motion detector capability can be overridden by the occupant. This is not a mandatory requirement.]

5.4.1.11.2 Interior Lighting and Switched Outlets.

[Designer is encouraged to review <http://www.energystar.gov/products/> for additional information]

- Efficiency. Interior lighting will be both efficient and color corrected. Color Rendering Index (CRI) of 85 or better and a standard lighting color or color temperature of 3500 K or higher are required. Minimum efficiency standard for lighting are as follows:
 - Fluorescent tubes 1220 mm [4 ft] and longer: 90 lumens/watt.
 - Fluorescent tubes less than 1220 mm [4 ft]: 80 lumens/watt.
 - Compact fluorescent and other lamps: 50 lumens/watt.
- Locations. Provide light fixtures operated by wall switches for all rooms except living rooms. Living room shall have a convenience outlet, half controlled by a wall switch, located at the room entrance. Wall-switch operated ceiling lights shall be provided in dining and utility rooms, halls, bedrooms, kitchens, dinette areas, and basements. Additional light fixtures shall be provided in rooms whose configuration requires them for adequate lighting. Wall-switch operated wall-mounted lights shall be provided in bathrooms and half baths located above the mirror over the lavatory. Walk-in closets and interior and exterior bulk storage rooms shall be provided with ceiling lights, operated by a wall switch. A minimum of one lighting fixture, ceiling- or wall-mounted, as appropriate, shall be provided in the garage or carport. Where exterior bulk storage is located within the enclosed walls of a garage, each space shall be lighted separately. Garage lights shall be controlled by a switch (switches) located at each door opening into the garage.

[Designer may consider and coordinate with the Installation staff equipping certain indoor lighting fixtures that have tendencies to be inadvertently left on (e.g., utility rooms, children's bathrooms, garages) with occupancy sensors. These can be overridden by the occupants. This is not a mandatory requirement.]

- Dining room ceiling light fixtures (hanging type) shall be movable by means of a track, chain and hooks, or other means in order to accommodate other than the typical dining room furniture arrangement. Fixtures may be designed for incandescent use, and do not have to meet the 50 L/Watt requirement.
- The general lighting intensity in kitchens shall be 320 to 540 Lx [30 to 50 foot-candles]. Supplementary lighting shall be provided at the sink and under one of the wall cabinets for a work center to produce a composite lighting level of 210 Lx [75 foot-candles] using either down-lights, fluorescent fixtures surface-mounted below wall cabinets or wall-mounted fixtures (1520 mm [5 ft] and higher above the floor) as appropriate. Kitchen range hood shall be provided with a light, fan, and switches.
- The ceiling light fixtures boxes in the living room, dining room, and all bedrooms shall be provided with a metallic fixture box suitably supported from the ceiling structure so that it may support a ceiling fan, and with additional wiring to allow for independent wall switch control of the fan and light. Ceiling fan/light combination may be provided in these rooms as a betterment.

5.4.1.12 Arc-Fault Circuit-Interrupter Protection

Provide protection from the effects of arc faults with Arc-Fault Circuit Interrupter (AFCI) devices per latest NEC (NFPA 70) requirements for dwelling units. Note that this includes all 120-volt single phase 15A & 20A branch circuits supplying outlets in locations listed in the NEC. Outlet types

include receptacles, lights, fire detectors, ceiling fans, and any other devices on applicable branch circuits in listed locations.

5.4.2 Telephone System.

Pre-wire housing units in accordance with local telephone company requirements. Provide outlets in kitchen, dining, or family area, living room and bedrooms of each housing unit, compatible with furniture arrangements. Eight position modular jack connectors shall be provided at all outlets. The jacks provided in the kitchen shall be for a wall-mounted phone. Install a 2.5 cm (1 in) diameter conduit from telephone house connection location to attic, basement or crawl space, to facilitate future telecommunication wiring.

Wiring methods shall comply with EIA/TIA Standard 570, Residential and Light Commercial Telecommunications Wiring Standard. Cable and jacks shall be a minimum of Category 6 per TIA/EIA 568A, Commercial Building Telecommunications Cabling Standard. Each housing unit shall be pre-wired separately from other housing units in the same building. All wiring shall terminate in a surface mounted, weatherproof, protected telephone terminal located on an outside wall adjacent to the building meter equipment (demarcation point). The protected telephone terminal cover shall be provided with means for padlocking, shall be accessible from the outside, and shall be permanently labeled, "Telephone". Only one protected telephone terminal shall be required for each separate building. A single #10, CU, green equipment grounding conductor shall be run in 1/2-inch non-metallic conduit from the building metering equipment to the protected telephone terminal box. Number of pairs and type of cable, type of modular jacks, and sizes of protected telephone terminals and outlet boxes shall be coordinated with [\[local telephone company – Designer shall insert applicable information here\]](#).

5.4.3 Television System.

5.4.3.1 Commercial Cable Television. Cable Television (CATV) outlets shall be located in the living room, family room, and all bedrooms. Units shall be pre-wired in conformance with all local CATV company requirements. Ensure that outlet locations are compatible with various furniture arrangements.

5.4.3.2 Wiring. Each housing unit shall be pre-wired separately from other housing units in the same building. All wiring shall terminate in a surface mounted, weatherproof, protected television terminal ("Demarcation Box") located on an outside wall adjacent to the protected telephone terminal. The protected television terminal cover shall be provided with means for padlocking, shall be accessible from outside and shall be permanently labeled "Television". Only one protected television terminal shall be required for each separate building. A single #10, CU, green equipment grounding conductor shall be run in 1/2-inch non-metallic conduit from the building metering equipment to the protected telephone terminal box. Type of cable, type of tapoffs, and sizes of protected television terminals and outlet boxes, shall be coordinated with local cable TV Company.

[\[Designer shall insert if CATV is not available.\]](#)

[An antenna system or connection to a TV distribution system shall be provided for each housing unit. The TV system shall provide for UHF and VHF reception for color TV. The antenna system may be either a common antenna serving the entire project \(mast or dish\), an attic antenna system for each separate building, or attic antenna for each housing unit.\]](#)

5.5 HEATING, VENTILATING AND AIR CONDITIONING (HVAC) SYSTEM

5.5.1 General.

Design HVAC systems in accordance with applicable provisions of UFC 3-410-01FA, *Design: Heating, Ventilating, and Air Conditioning*, International Residential Code, and ACCA Manuals D, J, and S. Equipment shall be ENERGY STAR® labeled and meet the requirements of ASHRAE 90.2. Sealed combustion heating units are recommended. Portable room heaters, floor furnaces, and heat lamps are prohibited. Electric resistance heat is not permitted, except as backup for heat pump systems, or when determined cost-effective on a life-cycle basis. Bedrooms shall have a return air register, transfer grill, or undercut door to maintain pressure balance within the house. Design shall be based on the weather data contained in UFC 3-400-02, *Engineering Weather Data*.

Each housing unit shall be provided with central heating [and air conditioning] system[s]. Systems shall be designed, installed, balanced, and adjusted to distribute heat [and cooling] to all habitable rooms, as well as bathrooms, in proportion to the calculated load requirements of these spaces. Fans in air handlers and furnaces shall be multi-speed, direct drive type. System installation shall conform to SMACNA Installation Standards for Residential Heating and Air Conditioning Systems except as altered by this document. Additional consideration in the technical evaluation will be given to systems utilizing modular components, plugged power, drawer-type burner assemblies, additional space in the mechanical room, and other features which contribute to ease of system maintenance. Additional consideration will also be given to designs which provide measures beyond the requirements of this Statement of Work to increase energy conservation or occupant comfort such as division of each housing unit into more than one conditioning zone for increased control.

5.5.2 Air Conditioning.

Provide air conditioning in locations where during the six warmest months of the year dry bulb temperature is 26.7 degrees C (80 degrees F), or higher for over 650 hours; or wet bulb temperature is 19.4 degrees C (67 degrees F), or higher for over 800 hours in accordance with OMB Circular A-45. Window or through-wall units should not be used to provide air conditioning.

[Designer shall delete all references to comfort cooling where air conditioning is not authorized. Delete references to inapplicable systems throughout the following paragraphs. The installation shall determine the allowable fuel types to be used for housing. All reasonably equivalent fuel options within a range of 10 percent based on life cycle cost analysis shall be allowed. The designer may assist the installation in preparation of the fuel life cycle cost comparison.]

5.5.3 Equipment Sizing.

Equipment sizes selected for installation shall not oversized more than 125 percent of the calculated loads.

[Designer may review and incorporate reference to ACCA Manual S HVAC equipment sizing guidelines, or EPA equipment sizing recommendations at <http://www.epa.gov>.

5.5.4 Mechanical Room.

Mechanical space shall be provided to house all mechanical equipment. [Designer shall coordinate with the installation to determine preferred location of mechanical space, and shall then edit this paragraph to indicate the desired location. Factors such as ease of maintenance, cost considerations, and possibility of freezing shall be considered.] Exterior air conditioning units shall be concrete pad-mounted, with location selected based on site specific conditions and

intended uses of outdoor space. Effort shall be made to locate the unit(s) out of the occupant's direct line of sight (screen with shrubbery or wall, locate on sides of housing unit, avoid placement under windows, etc.). However, the primary concern shall be coordination with the mechanical area location. Mechanical equipment shall be located in an externally accessible utility room, and shall be arranged to allow for ease of maintenance, and for proper venting if required. This utility room shall be provided with a light and electrical receptacle. See paragraph 6.1.5 for additional requirements for mechanical spaces containing fuel-fired heating equipment.

5.5.5 Load Calculations.

Computer generated load calculations shall be performed for each possible orientation up to four representative orientations for each building type included in the project. Room air flow requirements shall be computed based on the individual room load. However, the minimum acceptable air flow shall be 2.5 (L/s)/m² [0.5 cfm/ft²] for all spaces. The design for each individual housing unit shall be based on the heating and cooling loads as well as room airflow requirements computed for the building type and orientation which it most closely matches. Internal loads shall be included in the computerized load calculations in accordance with ASHRAE recommendations for residential analyses and ACCA Manual J Residential Load Calculation.

5.5.6 Equipment Safety and Efficiency.

5.5.6.1 All material and equipment shall be the standard cataloged product of manufacturer's regularly engaged in production of such materials and equipment, and shall be the manufacturer's latest standard design. Each major component of the heating [and cooling] system[s] shall have the manufacturer's information on a plate secured to the equipment.

5.5.6.2 Equipment shall comply with the requirements of American Gas Association (AGA), American National Standards Institute (ANSI), Air Conditioning and Refrigeration Institute (ARI), American Society for Testing and Materials (ASTM), Gas Appliance Manufacturers Association (GAMA), National Electric Manufacturers Association (NEMA), National Fire Protection Association (NFPA), Underwriters Laboratories, Inc. (UL) or other national trade associations as applicable.

5.5.6.3 All equipment shall be ENERGY STAR® labeled and meet ENERGY STAR® specifications for efficiencies. Energy conservation as it relates to equipment operating costs will be considered in the evaluation process. Additional consideration in the technical evaluation will be given to designs which include higher than minimum efficiency equipment. [Designer: Verify that all available fuel sources have been compared on a life cycle cost basis prior to preparation of the RFP documents. Table 10-3 shall be edited, based on these comparisons, to retain all fuel options which fall within a range of 10 percent based on life cycle cost analysis. Fuel types which are proven to be ineffective through life cycle cost analysis shall be deleted from Table 10-3.]

5.5.7 Mechanical Systems.

[Designer shall edit the following list as applicable to the particular project. If not required, insert "... (Deleted)" following subparagraph letter and delete remainder of text.]

5.5.7.1 Forced warm air systems. Warm air furnaces shall be [induced combustion, up flow natural gas or No. 2 fuel oil-fired furnaces, or electric furnaces]. Furnaces shall be equipped with electronic ignition. [Natural gas or oil-fired furnaces shall be equipped with a flue to exhaust flue gases above the building roof. Units shall be vented in accordance with NFPA 211. Where high efficiency (AFUE > 90 percent) gas furnaces are selected for use these units shall be vented in accordance with AGA requirements and the manufacturer's instructions. Condensate drains for high efficiency units shall be manufacturer approved, and shall be indirectly connected to the

building sanitary sewer system. Combustion air shall be provided from the outside in accordance with the appliance listing. For areas with a 97.5 percent outdoor dry bulb design temperature below -6.7 degrees C [20 degrees F], combustion air shall be provided in accordance with SMACNA Installation Standards for Residential Systems.] [Electric furnaces shall be sized to within 3 kW of the calculated load demand.] Furnaces shall be equipped with centrifugal fan, disposable filters, controls, and transformer. Fans shall be multi-speed, direct-drive type. It shall be possible to service and replace all controls and internal components from one side of the furnace. Heat exchangers shall be guaranteed for a minimum service life of 10 years. [In areas authorized for air conditioning, furnaces shall be equipped with a cooling coil by the same manufacturer, matched to the selected air conditioning equipment.]

5.5.7.2 Forced hot water systems. Convectors and baseboard or wall radiation units shall have steel core and fin or nonferrous core and fin construction. Heating hot water shall be produced by [natural gas, No. 2 fuel oil-fired or electric] boilers. A single boiler or multiple modular boilers shall be provided for each building with each housing unit in multi-family housing individually, and thermostatically controlled based on heating water temperature setpoint. Each boiler shall be provided with its own circulating system. Circulation shall be by means of a two-pipe reverse return system with the circulating pump(s) prevented from operation when the outside temperature is above 18 degrees C [65 degrees F, adj.]. Any sub-slab hot water distribution piping shall be installed without joints beneath the slab. Minimum acceptable individual convector control shall be accomplished by means of dampers at each unit. Additional consideration in the technical evaluation shall be given to designs which treat each convector as an individual heating zone by means of self contained or thermostatically controlled valves located at each unit. Greatest consideration shall be given to systems incorporating thermostatically controlled valves. Hot water piping shall be vented at all high points, and shall be provided with isolation valves at each vent to facilitate servicing. A minimum velocity of 0.61 m/s [2 fps] shall be maintained in the hot water piping. Strainers shall be provided as required to protect system equipment.

5.5.7.3 Split system air conditioning and air to air heat pumps. [Heat pump data bracketed]. [Air to air heat pumps shall only be considered for use in locations with heating design temperatures (97.5 percent basis) greater than -11 degrees C [12 degrees F]. The use of heat pumps shall be allowed only after a thorough analysis of all available energy sources and systems. Geothermal heat pumps shall be used in any geographical location where their equipment efficiencies will exceed those listed for air to air heat pumps and they are life cycle cost effective.

- Electric air conditioning [Heat pump system] equipment shall consist of an air-cooled condensing unit and evaporator [evaporator/blower] as matched components with the furnace, all by the same manufacturer. Refrigerants used shall have an Ozone Depletion Potential (ODP) of .05 or less. The condensing unit shall contain, as a minimum, the features indicated below. Equipment shall be sized to meet the total load determined by computer calculation. Equipment may be oversized to no more than 115 percent of the computer generated load. [Evaporator/blower for heat pump systems shall be provided complete with centrifugal fan, disposable filters, controls, and transformer.] Fans shall be multi-speed, direct drive type.
 - High and low pressure compressor protection.
 - Filter-drier.
 - Hermetically sealed compressor with built-in overloads and locked rotor protection.
 - Electric crankcase heaters.

- Reversing valve. (heat pump only)
- Start and run capacitors.
- Anti-short-cycle timer. (factory installed)
- Testing and charging refrigerant connections.
- Compressor guaranteed for a minimum service life of 5 years.
- Dipped and baked Phenolic coating on condenser coil (for equipment installed within 16 km (10 mi) of the ocean or other large body of water).
- Fan and coil guards.
- The evaporator coil [evaporator/blower] shall be provided with a liquid strainer, expansion device, pre-insulated housing, copper or aluminum coil, and insulated condensate drain pan. [Centrifugal blower and electric resistance supplemental heaters.] Coil face velocity shall be limited to 2.8 m/s [550 fpm].
- The condensing unit and matched coil [evaporator/blower] shall deliver a Seasonal Energy Efficiency Rating (SEER), consistent with the minimum requirements shown in Table 10-3.
- [Supplementary electric heat. Each heat pump shall be provided with supplementary electric resistance heat. Electric resistance heat shall be sized to provide 100 percent of the calculated heat loss of the particular unit. Electric resistance heaters in excess of 5 kw shall be staged by means of an outdoor thermostat. Outdoor thermostat shall be installed and operated in accordance with the heat pump manufacturer's instructions.]
- [Heat pumps shall only be considered for use in locations with heating design temperatures (97.5 percent basis) greater than -11 degrees C [12 degrees F]. The use of heat pumps shall be allowed only after a thorough analysis of all available energy sources and systems.]
- Refrigerant Charge Verification: When split-system air conditioning systems are selected for installation, the Contractor shall check, calibrate, and charge the refrigerant system following installation and start-up of the equipment. These tests shall be accomplished on the same 15% of the units which undergo blower door and duct tightness testing. If the tested units show a low or excessive refrigerant charge, all new systems shall be checked after start-up, but prior to acceptance by the Government.

5.5.7.4 Packaged Air Conditioning Systems. Packaged air conditioning systems shall consist of a single, self-contained, exterior unit containing the burner, heat exchanger, compressor, condenser, evaporator, and blower. Unit shall be factory pre-piped, pre-charged, and pre-wired. Refrigerants used shall have an Ozone Depletion Potential (ODP) of .05 or less. The unit shall contain, as a minimum, the features indicated below. Length of exterior ducts between the unit and the building shall be limited to 610 mm [2 ft] maximum. Exterior duct shall be constructed of internally insulated sheet metal. Exterior duct shall also be provided with a sheet metal weather cover attached to the unit and the building, covering a minimum of the top and both sides of the ductwork. Equipment shall be sized to meet the total load determined by computer calculation.

- High and low pressure compressor protection.
- Filter-drier.
- Hermetically sealed compressor with built-in overloads and locked rotor protection.

- Electric crankcase heaters.
- Start and run capacitors.
- Anti-short-cycle timer. (factory installed)
- Testing and charging refrigerant connections.
- Compressor guaranteed for minimum service life of 5 years.
- Dipped and baked Phenolic coating on condenser coil (for equipment installed within 16 km (10 mi) of the ocean or other large body of water).
- Accessory electric heat (as required).
- Insulated casing.
- Fan and coil guards.
- Drain outlet.
- Duct adapter as required for interface with supply and return ductwork.

5.5.7.5 Evaporative Coolers. [Evaporative coolers shall be considered only at installations which traditionally use evaporative cooling, and comfort conditions can be maintained through their use. Determine whether evaporative coolers will be allowed as a design option to the Contractor. In the event that evaporative coolers are allowed, designer shall edit the Minimum Equipment Efficiencies for single stage evaporative coolers. Set minimum efficiency at 80 percent, and add the following text.] Units shall be a self-contained, single stage, weather-resistant type, and shall conform to UL 507 and UL 746C. The fan shall be centrifugal type and shall be complete with motor, drive equipment, and vibration-isolation supports between motor and fan housing on single phase motors. Water distributor or rotary wheel motor shall be provided with a time delay in the fan circuit to allow media to be thoroughly wetted before air flow starts. Manual or automatic reset type thermal overload protection shall be provided. Evaporative cooler fans shall have air delivery ratings based on AMCA 210 tests by an AMCA approved laboratory. An ultraviolet retarding agent shall be part of or applied on exterior nonmetallic components susceptible to ultraviolet degradation from sun rays and conforming to UL 746C. Evaporative media shall be specifically manufactured for use with evaporative coolers. Media shall be honeycombed type, fabricated such that no moisture entrainment shall occur. Face velocities shall be limited to those recommended by media manufacturer. Indirect coolers shall consist of an air-to-air heat exchanger, water distribution header, scavenger fan and motor, recirculating water pump, supplemental cooling coil (as required), drain, overflow and makeup water lines and an accessible damper to allow change-over from heating to cooling. Air from the conditioned space shall be exhausted through the attic space with a backdraft damper provided at the ceiling exhaust register. Cooler shall be drainable, and shall be provided with a mounting frame. Evaporative coolers shall be controlled by an on-off switch, with a thermostat provided for heating only.

5.5.7.6 Integrated Domestic Water Heating and Space Heating Systems. [Designer is cautioned that application of this system type is limited to Weather Regions 6 through 11. Installation staff shall be consulted and agree that these type systems are acceptable. These systems are acceptable for use only where natural gas is available at the site.] Units shall be provided with a dual-integrated system which consist of a domestic water heater (specifically approved for dual use) and a fan/coil equipped with hot water heating coil, centrifugal fan, disposable filters, controls, [air conditioning evaporator coil] ,and transformer. Fans shall be

multi-speed, direct-drive type. It shall be possible to service and replace all controls and internal components from one side of the fan/coil. If this system type is selected for use, the domestic water heater must be sized in accordance with the requirements set forth below and not in accordance with the size indicated in paragraph 8 of this Statement of Work. Water heater size shall be in accordance with manufacturers guidelines, ASHRAE Transactions, Vol. 95, part 2, 1989 "Equipment Sizing Procedures for Combination Space-Heating/Water-Heating Systems", and current industry practice. The integrated system must be able to recover from a large hot water draw in one hour or less while still supplying the required heating load. Both the water heater recovery rate and the storage capacity need to be adjusted to suit the integrated system. The water heaters proposed as a part of this system must have a minimum recovery efficiency level of 78%. Additional consideration during the evaluation will be given to proposals which include high efficiency water heaters.

5.5.7.7 Engineered High Velocity Duct Systems. [Designer is cautioned that application of this system type is limited to Weather Regions 6 through 11. Installation staff shall be consulted and agree that these type systems are acceptable.] Units shall be provided with an engineered, high velocity duct system for the distribution of heated [and cooled] air throughout the unit. This system shall be the product of a manufacturer regularly engaged in the manufacture of these type systems. Systems will contain a fan/coil specifically designed for this type system which include a heating coil, high pressure blower, [refrigerant coil for heat pump or cooling applications]; rigid rectangular or round trunk ducts, and 50 mm [2 inch] round, pre-insulated, sound dampened, flexible duct run-outs to outlets. Outlets shall be paintable plastic finished to match the ceiling color. All outlets shall be located in the ceilings. This type system is suitable for use with hot water heating systems (not integrated with the domestic water heater) or heat pump systems.

5.5.8 Unacceptable Systems.

Room unit heaters, space heaters, room (window) air conditioning units; floor furnaces, gravity warm air systems, and electric resistance heaters are not permitted.

- Exception 1. Room unit heaters may be used where required by outdoor design conditions to maintain a minimum temperature of 4.5 degrees C [40 degrees F] in mechanical rooms where required for equipment protection.
- Exception 2. Electric resistance heaters may be used for supplemental heat in air-to-air heat pumps.

5.5.9 Air Distribution.

For a given building type, a single zone duct layout may be used regardless of orientation, provided that the system is sized to provide the required air flow for each room at its worst case orientation and a maximum allow temperature difference of 4 degrees F is not anticipated. Balancing dampers and motorized zone dampers (multizone system) shall then be used to reduce air flow to the appropriate level as required to meet space temperature requirements. Permanent access to dampers shall be provided. Ducts shall be placed within the conditioned building envelope. Maximum duct leakage is six percent (6%), when tested in accordance with ASTM E-1554.

Provide systems conforming to the recommendations of the ACCA Residential Duct systems, Manual D or the SMACNA Residential Comfort System Installation Standards Manual. For two-floor housing units with a single air conditioning unit, provide separate minimum of, main supply ducts with volume control dampers for each floor. These main ducts shall be run directly from the air handler or furnace to the appropriate building level. As a minimum, provide a separate ducted return for each floor level. Two-floor housing units with 93 m² [1,000 ft²] or greater net floor area on each floor shall be provided with a separate heating and cooling unit and supply and return

ducted system for each floor. Additional consideration in the technical evaluation will be given to designs which incorporate air distribution systems totally within the conditioned envelope.

5.5.9.1 Supply Diffusers. Wall, ceiling, and/or baseboard supply diffusers shall be located to ensure that the air distribution will completely cover all surfaces of exterior walls with a blanket of conditioned air or may be of a compact design so long as 'dead spots' within the units are avoided. At least one diffuser shall be provided in each habitable room. Diffusers shall have louvered faces with individually adjustable blades, and shall be provided with integral opposed blade damper. Dampers at diffusers shall not be the means of achieving air balance point. Diffusers shall be provided with air deflectors as required for proper air flow in the space. Plastic diffusers are prohibited. Core velocity shall be limited to 3 m/sec [600 fpm] maximum, with a maximum pressure drop of 0.82 Pa/m [0.1 inch water]. Airflow from any single diffuser shall be limited to 94.4 L/s [200 cfm] maximum. Ceiling mounted units shall have factory finish to match ceiling color, and be installed with rims tight against ceiling. Sponge-rubber gaskets shall be provided between ceiling, or wall and surface-mounted diffusers for air leakage control. Diffuser boots shall be sealed tight to the wall or ceiling they penetrate using duct mastic or caulking. Suitable trim shall be provided for flush-mounted diffusers. Duct collar connecting the duct to diffuser shall be airtight and shall not interfere with volume controller. Wall supply registers shall be installed at least 150 mm [6 inches] below the ceiling.

5.5.9.2 Return and Exhaust Registers. Grilles shall be fixed horizontal or vertical louver type similar in appearance to the supply diffuser face. Plastic units are prohibited. Core velocity shall be limited to 2 m/sec [400 fpm] maximum, with a maximum pressure drop of 0.5 Pa/m [0.06 inch water]. Registers shall be provided with sponge rubber gasket between flanges and wall or ceiling. Register boots shall be sealed tight to the wall or ceiling they penetrate using duct mastic or caulking. Wall return registers shall be located at least 150 mm [6 inches] above the floor. Return registers shall be located in hallways, finished basements, or other normally unoccupied spaces to minimize the sound level in occupied spaces.

5.5.9.3 Ductwork. Ductwork shall be externally insulated sheet metal or flexible metal. Length of flexible duct shall be limited to 1.8 m [6 ft]. Flexible ductwork shall not be spliced or joined and shall be a single continuous piece from diffuser boot to trunk/branch duct. Systems composed entirely of flexible ductwork with distribution boxes are prohibited. Sub-slab, intra-slab, or crawlspace ductwork is also prohibited. Volume dampers shall be provided at each branch take-off. All ductwork shall be concealed. No portion of the building construction (such as joist space in a floor or ceiling, wall stud space, etc.) shall be used as a duct. The requirements for ductwork set forth below apply to all ductwork installed in the housing unit, supply systems, return systems, exhaust systems, ventilation systems, and outside air supply ductwork.

5.5.9.4 Velocity. Maximum velocity in supply ducts shall be limited to 4.6 m/s [900 fpm] for mains and 3.1 m/s [600 fpm] for branches. Return, exhaust, and ventilation air ductwork shall be sized for a maximum velocity of 4.6 m/sec [900 fpm]. Short runs of return air duct (1525 mm [5 ft] or less) which directly precede the air handler or furnace shall be acoustically lined to minimize noise.

5.5.9.5 Air Tightness and Sealing. Ducts shall be airtight with no visible or audible leaks to ensure quiet, economical system performance. Ductwork in conditioned spaces shall be constructed for a 250 Pa [1 inch] static pressure construction class with seal Class C, as described in the SMACNA HVAC Duct Construction Standards for Metal and Flexible, Second Edition, unless a higher pressure class and/or seal class is required by actual, system operating conditions. Ductwork in unconditioned spaces shall be constructed for a 500-Pa [2-inch] static pressure construction class with seal Class C unless a higher pressure class and/or seal class is required by actual, system operating conditions. All duct seams and joints shall be sealed using duct mastic. Tape shall not be used as a means for sealing ductwork.

5.5.9.6 Flexible Ductwork. For flexible ductwork, the inner core shall be mechanically fastened to all fittings, preferably using drawbands installed directly over the inner core and beaded fitting. If beaded fittings are not used, then the inner core shall be fastened to the fitting using #8 screws equally spaced around the diameter of the duct, and installed to capture the wire coil of the inner liner (3 screws for ducts up to 300 mm [12 inch] in diameter and 5 screws for ducts over 300 mm [12 inch] in diameter). The inner core must be sealed to the fitting using mastic or tape. Tape used for sealing the inner core shall be applied with at least 25 mm [1 inch] of tape on the duct lining and 25 mm [1 inch] of tape on the fitting, and shall be wrapped at least three times. The outer sleeve (vapor barrier) must be sealed at connections with a draw band and three wraps of approved tape. The vapor barrier must be complete without any holes or rips, and seams shall be sealed with mastic or approved tape. Pressure sensitive tapes used in conjunction with flexible duct connections shall be as recommended by the duct manufacturer and shall be UL 181A listed and so indicated with a UL 181A mark or aluminum-backed butyl adhesive tape (15 mil minimum). Drawbands shall be stainless steel worm drive hose clamps or UV resistant nylon duct ties.

5.5.9.7 Duct Insulation. Provide a minimum of 51-mm [2-inch] thick mineral fiber insulation (or other listed insulation with an equivalent R value) on the exterior of all ducts in unconditioned spaces. Exhaust ductwork does not require insulation. Insulation shall be faced with a vapor barrier material having a performance rating not to exceed 1.0 perm. Insulation, vapor barrier, and closure systems shall be non-combustible as defined in NFPA 255, with a flame-spread rating of not more than 25, and a smoke development rating of not more than 50, as defined in ASTM E-84.

5.5.9.8 Dampers. Fire dampers shall be located and installed in accordance with NFPA requirements, and shall conform to the requirements of UL 555. Fire dampers shall be automatic operating, and shall be rated for the maximum system velocity and pressure. Fire dampers shall be equipped with a steel sleeve or adequately sized frame installed in such a manner that disruption of the attached ductwork, if any, will not impair the operation of the damper. Dampers shall not reduce the duct or the air transfer opening cross-sectional area. Access doors shall be provided at all fire dampers.

5.5.9.9 Filtration. Provide a pleated 25 mm [1 inch] panel filter, sized for and installed in the return air system in accordance with UL 900. Filter shall be rated for 20 percent efficiency as determined by ASHRAE 52, Method of Testing Air Cleaning Devices used in General Ventilation for Removing Particulate Matter. All filters shall be easily accessible for changing and maintenance and shall be installed in the return grilles whenever possible. Additional consideration in the technical evaluation shall be given to designs utilizing electrostatic filters. Kitchen exhaust hoods shall be provided with aluminum grease filters sized to fit the exhaust duct.

5.5.10 Temperature Control.

5.5.10.1 Location. Thermostats shall be located on interior partitions, approximately 1530mm [5 ft] above the finished floor. Locating a thermostat on the wall adjacent to a stairway, on an exterior wall, or where it is subject to unrepresentative temperatures is unacceptable.

5.5.10.2 Thermostats. Thermostats shall be microprocessor-based, with built-in key pads for scheduling of day and night temperature settings. Thermostats shall be programmable for heating only, cooling only, or heating and cooling as required. When out of the scheduling mode, thermostats shall have continuous display of time, with AM and PM indicator, continuous display of day of week, and either continuous display of room temperature with display of temperature set point on demand, or continuous display of temperature set point with display of room temperature on demand. In the programmable mode, the display shall be used for setting and interrogating time program ON-OFF set points for all 7 days of the week. The time program shall allow two separate temperature-setback intervals per day. Thermostats shall have a means for temporary

and manual override of the program schedule, with automatic program restoration on the following day. Thermostats shall have a replaceable battery to maintain the timing and maintain the schedule in memory for one year in the event of a power outage. Maximum differential shall be ± 1 degree C [± 2 degrees F]. For a listing of ENERGY STAR® labeled thermostats refer to ENERGY STAR® Website at <http://www.energystar.gov>. [When used for heat-pump applications, the thermostat shall have an emergency heat switch.]

5.5.10.3 Humidistats. Where required, humidistats shall be designed for indoor application and shall have a measurement range from 15 to 90 percent relative humidity (RH). The instrument shall be of the wall-mounted or return duct-mounted type, as required by the application, and shall be provided with any required accessories.

5.5.11 Ventilation.

Provide an exhaust fan (maximum 1.5 sone) in each bathroom, and an exhaust fan (maximum 5.0 sone) in each kitchen. Exhaust fans must discharge to exterior; discharging into attic or crawl space is prohibited. Provide mechanical ventilation in accordance with ASHRAE 62.2.

5.5.11.1 Exhaust Fans. Bathroom and kitchen range hood exhaust fans shall be ducted to the outside. Exhaust fans shall not discharge near the air conditioning condensing unit, entry doors, patio or balconies, carports, or garages. Fans shall be tested and rated in accordance with AMCA 210, and shall operate with 120-volt, single-phase power supply. Exhaust fans shall be provided with backdraft damper. Bathroom exhaust fans shall be ceiling mounted and shall be sized to provide not less than 10 air changes per hour in the space served. Maximum allowable noise level for bathroom exhaust fans shall be 2 sones as installed. Kitchen range exhaust fans shall be two-speed, and shall be sized for an exhaust rate of 7.6 (L/s)/m^2 [1.5 cfm/ft^2]. Maximum allowable noise level for range hood exhaust fans shall be 6 sones as installed.

5.5.11.2 Dryer Vents. A 100-mm [4-inch] diameter dryer vent shall discharge to the exterior, and provide connection to occupant-owned dryer (one dryer per vent). The vents shall be rigid aluminum with exterior wall cap and backdraft damper. Vent pipes shall be a maximum of 6100 mm [20 ft] long, with no more than three right angle elbows (with minimum radius of 150 mm [6 inches]), and have a maximum vertical run of 3660 mm [12 ft]. Dryer vents shall not exhaust near the air conditioning condensing unit, entry doors, patio or balconies, carports, or garages. Dryer vents shall not run through non-accessible spaces or garages.

5.5.11.3 Ceiling Fans. [Ceiling fans are an optional feature which may be requested by the Installation. Designer shall delete paragraph if not required.] Provision of ceiling fans is encouraged as a means of increasing occupant comfort and as an aid to improve the performance of heating and cooling systems. Ceiling fans with lights may be substituted for ceiling fixture requirements in bedrooms and in the dining room. Ceiling fans will be low profile 1050-1350 mm (42-52 inch), four blade type. Motors shall be three speed reversible, with air volume range between 613 and 2832 lps (1300 and 7000 CFM) and speeds between 75 and 225 rpm. Maximum power consumption shall be 80 Watts and 0.7 amps. Manufacturer's 20 year warranty is required.

5.5.11.4 Active Ventilation Engineered IAQ. ASHRAE 62-2-2004, "Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings" shall be used to determine ventilation air required. Infiltration shall not be counted as ventilation air. Calculations shall be provided to the government showing that the ventilation rates meet ASHRAE 62-2 based on dedicated supply system or intake, with no infiltration credit taken. All ventilation air that enters the house must be conditioned before it enters the space. All exhaust fan switches shall be clearly labeled.

5.5.12 Humid Area Design.

[Climates which have 3000 hours or more of 19.4 degrees C [67 degrees F] or higher wet bulb temperature in combination with an outside design condition of 50 percent or higher relative humidity, or climates which have 1500 hours or more of 22.8 degrees C [73 degrees F] or higher wet bulb temperature in combination with an outside design condition of 50 percent or higher relative humidity shall be considered humid areas.] In humid areas, all air heating and cooling systems shall be provided, and economy cycles will not be allowed. Closet and storage spaces shall have louvered doors, and building return air shall be drawn through these spaces to a ducted return air system. Cooling coils shall have a maximum of 315 fins/m [8 fins/inch] to allow for easy cleaning, and shall be sized for a maximum face velocity of 2.8 m/s [550 fps] to preclude moisture carryover. Heating and cooling equipment in humid areas shall be designed to meet the load determined by computer calculation. However, a larger fan may be required to meet minimum air flow requirements than would be anticipated based on the computer load. Equipment may be oversized by no more than 15 percent of the computer generated sensible load.

5.5.13 Humidification.

[Designer shall use the requirements of this subparagraph to determine the allowable use of humidification. Humidification is optional. If not required, insert "... (Deleted)" following subparagraph letter and delete remainder of text. If humidification is required, edit this subparagraph to instruct the Contractor to provide humidification. Humidification shall be provided for all central forced air systems in areas having less than 1800 hours of 19.5 degrees C [67 degrees F] or higher wet bulb temperature in combination with annual heating degree days in excess of 1666 on an 18 degrees C base [3000 on a 65 degrees F base]. Humidifiers may be of the bypass or duct insertion type. Humidifiers shall be controlled by wall-mounted or return duct mounted humidistat. Humidification shall be allowed to a maximum of 30 percent relative humidity.]

5.5.14 Testing, Adjusting, and Balancing.

Adjusting and balancing of each housing unit shall be the Contractor's responsibility. Following adjusting and balancing, testing of air and water systems shall be performed on 10 percent of the project buildings (not to exceed 10 buildings), which have been randomly selected by the Contracting Officer. If buildings are to be turned over in phases, testing shall be performed on 10 percent of the buildings completed in each phase (not to exceed 10 buildings per phase). No additional testing will be required if at least 90 percent of the tested buildings pass the test requirements. If less than 90 percent of the tested buildings pass the test, an additional 10 percent of the project buildings (not to exceed 10 buildings) shall be tested. This process shall continue until 90 percent of the total number of tested buildings pass. The Contractor shall correct all housing units not found in compliance, and shall be responsible for all labor and materials required for this effort. AABC MN-1, NEBB-01, SMACNA-07 or ASHRAE 111 shall be used as the standard for providing testing of air and water systems. The selected standard shall be used throughout the project. Instrumentation accuracy shall be in accordance with the standard selected. Testing shall be accomplished by a firm certified for testing by the Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB). Prior to testing, adjusting, and balancing, the Contractor shall verify that the systems have been installed and are operating as specified. Where specific systems require special or additional procedures for testing, such procedures shall be in accordance with the standard selected. Approved detail drawings and all other data required for each system and/or component to be tested shall be made available at the job site during the entire testing effort. Testing shall not commence until approved by the Contracting Officer. The facility shall be essentially complete with final ceiling, walls, windows, doors, and partitions in place. Doors and windows surrounding each area to be balanced shall be closed during testing and balancing operations. Air systems, hydronic systems, and exhaust fans shall be complete and operable. All data, including deficiencies

encountered and corrective action taken, shall be recorded. Following final acceptance of certified reports by the Contracting Officer, the setting of all HVAC adjustment devices shall be permanently marked by the Contractor's balancing engineer so that adjustment can be restored if disturbed at any time.

5.5.14.1 Duct Tightness Testing Requirements. The installation of the supply and return ductwork within the units is an item of prime concern with respect to the energy efficient operation of the housing unit as a whole. With that consideration in mind, for heating and air conditioning designs which include ductwork outside of the conditioned envelope, the Contractor will be required to test the proto-type units and all units which are blower door tested for tightness to ascertain the leakage levels from the ductwork in accordance with the following requirements. For system designs which place all the ductwork within the conditioned envelope of the structure or systems which utilize evaporative cooling, no ductwork testing will be required.

- Duct tightness testing shall ensure that the leakage rate from ductwork (where the ductwork system is not entirely within the conditioned envelope) shall not exceed 0.15 (L/s)/m^2 [0.03 cfm/ft^2]. If the units tested fail to meet this requirement, the ductwork installation shall be examined, corrections made, and the test redone until the installation passes this requirement. No ductwork systems may be installed in other units until the proto-type units' ductwork systems have been validated. Several methods to accomplish this testing are acceptable
- Testing may be done in accordance with ASTM Standard E 1554-94, "Determining External Air Leakage of Air Distribution Systems by Fan Pressurization". This method describes the process and methodology required to accomplish basically a 'blower door subtraction' method of duct tightness testing.
- Testing may also be accomplished utilizing "Duct Blaster" methodologies and pressurizing the ductwork to 25 Pascal [0.1 inch of water].

5.5.14.2 EPA Testing. The Contractor is advised that the EPA may test, or hire a consultant to test randomly selected housing units constructed in this project. These tests will be completed without cost to the Contractor; however, the Contractor will be required to coordinate access to the selected unit. If accomplished, this testing is not expected to interfere or delay the construction Contractor in any manner.

6.0 FIRE AND LIFE SAFETY

6.1 FIRE AND LIFE SAFETY

6.1.1 General.

Design, construct, and improve family housing projects to comply with IBC, as modified by UFC 01-200-01, UFC 3-600-01, and IRC.

[For housing units located off-post and for privatized housing, the construction features may comply with model codes in lieu of the above, if model codes require compliance with a nationally recognized building code.] [Designer add if applicable.]

6.1.2 Flame-Spread and Smoke-Developed Indices.

Materials must have flame-spread (FS) and smoke-developed (SD) indices in accordance with UFC 3-600-01.

6.1.3 Smoke Alarms.

Provide hard-wired smoke alarms in accordance with UFC 3-600-01. Interconnect alarm devices in such a manner that actuation of one alarm will activate all other alarms in an individual unit. Provide an audible-visible type smoke detection device in housing unit where there is a vision or hearing impaired occupant.

6.1.4 Automatic Sprinklers.

Provide sprinkler protection in accordance with UFC 3-600-01. [Designer: Delete the following sentence and replace with appropriate language if sprinklers are a program requirement.] Single family and duplex units are exempted per the UFC. For four units or more in a single building, residential type sprinkler systems must be used. Apartment units shall be fully sprinkled. Sprinkler systems for garden apartments (one through four floors) will comply with NFPA 13R. Sprinkler systems for apartment buildings of over four floors will comply with NFPA 13. [Designer: Delete the following sentence and replace with appropriate language if sprinklers are a program requirement.] Townhouse construction with two-hour fire walls between each unit and duplex construction with a one-hour fire wall between the units will not require sprinklers.

6.1.5 Fire-Resistant Separation.

Provide fire and smoke separations in compliance with UFC 3-600-01.

6.1.5.1 Fire Resistance of Party Walls and Roof Material. Party walls shall extend without openings, from ground to the underside of roof sheathing. Provide firestops at floor, and ceiling or roof line. Provide Class A (ASTM E108, Standard Methods of Fire Tests of Roof Coverings) roof covering material throughout. Party walls (walls separating housing units) shall have the minimum fire-resistance ratings shown below:

- Duplexes, one hour.
- Townhouses, two hour.
- Apartments, one hour with approved sprinkler system.

6.1.5.2 Party floors. Party floors shall have a topping slab of 50 mm [1-1/2 inch] lightweight concrete, or similar material. Party floors shall have a minimum one-hour fire-resistance rating, in accordance with ASTM E119.

6.1.5.3 Heater rooms. Rooms equipped with fuel-fired equipment such as boiler rooms, furnace rooms, and rooms with fuel-fired water heaters, which serve more than one housing unit shall be separated by one-hour fire-rated construction. Direct access to these rooms from the exterior is preferred. Rooms with fuel-fired equipment that serve only one housing unit shall be lined with 13 mm [1/2-inch] gypsum board or equivalent noncombustible material.

6.1.6 General Alarm Systems.

When a general building alarm system is required by NFPA 101, such as those required for housing units four stories or higher, the required systems shall transmit alarms to the installation fire department. Exceptions are made for housing units not located on military installations and for housing units located on installations without an installation-wide or central fire reporting system. Smoke detectors which are located within the housing unit and which sound an alarm only within the housing unit are not required to be transmitted.

6.1.7 Carbon Monoxide (CO) Alarm.

Provide a CO alarm hard wired with battery back-up on each habitable floor of units with combustion equipment, appliances, or fireplace, in accordance with UL 2034, NFPA 720, and NFPA 101. Seal existing homes with attached garages to prevent air infiltration, or provide a CO alarm. See Paragraph 4.7.9.

6.1.8 Fire-Retardant-Treated (FRT) Plywood.

Use of FRT plywood is prohibited, except as permitted by the IBC. FRT plywood must not be used in any part of the roof or roofing system.

6.1.9 Overseas and Leased Housing Requirements.

Overseas family housing, whether constructed or leased, must comply with *UFC 3-600-01, Design: Fire Protection Engineering*. Additionally, provide CO alarms in accordance with paragraph 6-1.7, above.

7.0 ENVIRONMENTAL

7.1 ENVIRONMENTAL

7.1.1 General.

Construct facilities in compliance with Federal, State, interstate, and local requirements, both substantive and procedural, with respect to lead-based paint, asbestos, radon, and any other housing-related environmental requirements.

7.1.2 Environmental Planning.

Housing improvement and construction projects must comply with environmental laws and regulations, including NEPA. Appropriate environmental analyses in compliance with NEPA must be completed prior to initiating an improvement or construction project.

7.1.3 Asbestos.

Follow OSHA and EPA regulations and guidance for asbestos management, remediation, and abatement. The Department of Defense Environmental Cleanup Program provides insight into this issue. Asbestos materials must not be used in construction, repair or maintenance at shore facilities. Use asbestos -free substitute materials.

7.1.4 Lead-Based Paint.

Follow OSHA, EPA, and HUD regulations, statutes, and guidance for inspection, assessment, in-place management, and abatement of lead-based paint, lead-in-dust, lead-in-soil, and related hazards. The Department of Defense Environmental Cleanup Program provides insight into this issue.

7.1.5 Volatile Organic Compounds (VOC).

Paints shall have a maximum VOC concentration of 100 grams per liter (g/l). Use sealants and adhesives that have a maximum VOC concentration of 250 g/l.

7.1.6 Radon.

Follow EPA recommendations for construction and mitigation. Family housing shall be designed, constructed, and improved in accordance with EPA document - *Model Standards and Techniques for Control of Radon in New Residential Buildings*, 59 CFR 13402 (March 1994). Guidelines for evaluation and need and required testing can be found in UFC 3-490-04A, *EPA Radon Mitigation Standards*, and UFGS 13287 *Radon Mitigation* (August 2004).

The design and construction of foundation walls, slabs, and crawl spaces shall include provisions for the reduction of radon entry and facilitate its removal. Radon mitigation shall comply with the requirements of ASTM E1465. [\[If not required, Designer shall insert "Deleted." and delete remainder of text. Designer can contact Mr. David Price of EPA's Indoor Environments Division, 202-564-9447 regarding suggested language concerning indoor air quality and radon mitigation. Design Districts may also review: United States Environmental Protection Agency criteria are available from National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161, \(703\) 487-4650: EPA/600/8-88/087, Radon-Resistant Residential New Construction; EPA/625/5-88/024, Application of Radon Reduction Methods; and EPA/625/5-87/019, Radon Reduction Techniques for Detached Houses.\]](#)

7.1.7 Freon and Chlorofluorocarbons (CFCs).

Specify CFC-free refrigerators, air conditioning systems, and insulation options.

7.1.8 Termiticides.

In revitalization projects, replace all HVAC ducts in or below the floor slab with an above floor system, to avoid contamination of interior space. Follow OSHA and EPA regulations, statutes, and guidelines for inspection, assessment, and abatement of chlordane. [Designer shall insert "(DELETED)." and delete remainder of text if not required.] Soil treatment for termites shall be by the chemical method. Methods and extent of protection required are as follows: [Designer shall insert project specific requirements.]

7.1.9 Mold.

Prevention of mold must be considered during design, and be adhered to throughout construction. Humidity and moisture must be controlled to prevent mold growth in buildings.

7.1.10 Decay Treatment.

Decay treatment shall apply to the following: [Designer shall insert project specific requirements.]

7.2 SOUND ATTENUATION

7.2.1 Air-Borne Sound.

Walls, partitions, and floor/ceiling assemblies separating dwelling units from each other or from public or service areas shall have a Sound Transmission Class (STC) rating of not less than 50 (45 if field tested) for air-borne noise when tested in accordance with ASTM E 90. Field test assemblies in accordance with ASTM E 336. Do not apply this requirement to dwelling unit entrance doors. However, assure that frames and sills of such doors are tight fitting. [Compliance with Host Nation codes and regulations is also required for overseas locations.]

7.2.2 Structure-Borne Sound.

Floor/ceiling assemblies shall be provided between dwelling units, or between a dwelling unit and a public or service area within the structure. These assemblies shall have an Impact Insulation Class (IIC) rating of not less than 50 (45 if field tested), when tested in accordance with ASTM E 492. Assemblies shall be tested on site in accordance with ASTM E 1007.

7.2.3 Testing.

Certified proof-of-performance field tests will be conducted to demonstrate that the floor and wall systems as constructed provide the required sound isolation. Tests for air-borne sound shall be made in compliance with ASTM E336. Tests for impact sound shall be made in compliance with ASTM E1007. Testing of 10 percent (minimum) of each type of floor and wall system is required. Location of test sites will be chosen at random by the Contracting Officer.

7.2.3.1 Correction of Deficiencies. Any wall or floor/ceiling system found to be inadequate shall have the deficiencies corrected and the additional qualifying tests conducted at the Contractor's expense. Testing at the Contractor's expense of greater than 10 percent of each system may be required if the Contracting Officer determines that the quality of construction requires this additional testing. In cases where the field tested performance of the systems does not meet the designed performance, the maximum acceptable difference between field tests and

sound transmission ratings shall be 2 decibels (dB) for airborne sound ratings and 5 dB for impact sound ratings.

7.2.4 Plumbing and HVAC Equipment.

Design of plumbing and Heating, Ventilating, Air-Conditioning (HVAC), and dehumidifying equipment shall include design provisions such as location, enclosure and acoustical treatment, to minimize transmission of noise generated by equipment within each housing unit and to eliminate transmission of noise to other housing units.

8.0 ENERGY EFFICIENCY AND WATER CONSERVATION

8.1 ENERGY EFFICIENCY

8.1.1 General.

Energy and water conservation standards and policies for new construction have been established to minimize energy and water consumption through applications of developed sustainable energy-efficient designs, construction, improvement, and appliance equipment selections and replacement. Building systems operation shall not require special attention by unit occupants. Materials and equipment shall be readily available and manufactured by firms of established performance in their field. If it is not practical to meet ENERGY STAR® standards in foreign locations, new construction shall be qualifiable as ENERGY STAR®. If an alternative energy generation method is intended for use as the project's primary energy source, documentation shall be submitted to the Contracting Officer, verifying the system's reliability and ability to meet the project's peak demand. See Paragraph 9.3.3.

8.1.2 Energy Performance.

Contractor shall meet the requirements of EISA 2007, 10 CFR 435, Public Law 109-58 Energy Policy Act of 2005, Executive Order 13423. Federal Regulations 10 CFR 435 requires that the proposed building energy consumption shall be at least 40% below the consumption of a baseline building meeting the minimum requirements of ICC International Energy Conservation Code (IECC), 2004 Supplement Edition, January 2005 if life-cycle cost-effective. The energy consumption calculation shall be based on Section 404 of the 2004 IECC, the Simulated Performance Alternative. Life-cycle cost effectiveness shall be determined in accordance with 10 CFR 436. Energy consumption for the purposes of calculating the 30% savings shall include space heating, space cooling, and domestic water heating systems. If a 30% reduction is not life-cycle cost effective, the design of the proposed building shall be modified so as to achieve an energy consumption level at the maximum level of energy efficiency that is life-cycle cost effective. The Energy Independence and Security Act of 2007 (EISA 07), section 523 requires at least 30% of hot water demand to be met using solar hot water heater when life cycle cost effective. Section 441 of EISA 07 extends the life cycle costing period from 25 year out to 40 years). Uncontrolled air leakage (infiltration) shall be limited to a maximum of 2.5 ACPH at 50 Pascals, in accordance with ASHRAE 119. Use of renewable forms of energy shall be used for all projects, when life cycle cost effective. Compliance with ENERGY STAR® standards is desirable in overseas locations.

8.1.3 ENERGY STAR® Qualified Home Inspections.

Contractor must provide certification that all new homes have an ENERGY STAR® label. If a sampling protocol is used for post-construction inspections, and a sample home does not pass, inspection and testing of all homes in the group is required. The Contractor is responsible for any repairs necessary to ensure all homes pass inspection.

8.1.4 Water Conservation.

Contractor must meet the requirements of EO 13423. Executive Order 13423, *Strengthening Federal Environmental, Energy, and Transportation Management*. This Order was designed to improve energy management in the Federal Government, thereby saving taxpayer dollars. Specific requirements include reduction of water use relative to the baseline of the agency's water consumption in FY 2007, through life-cycle cost-effective measure by 2% annually through the end of the fiscal year 2016 or 16 percent by the end of FY 2015. Apply all DOE Water Conservation Best Management Practices (BMPs) appropriate to family housing.

8.1.5 Building Products and Appliances.

New and replacement building products and appliances shall be ENERGY STAR® qualified and labeled.

8.1.6 Specific Energy Conserving Practices.

The following paragraphs suggest energy conservation techniques which are considered desirable. The listing is not all inclusive, and the techniques suggested may not be cost effective at a given location or site. Additional consideration in the technical evaluation will be given to designs which incorporate valid energy conservation techniques. Systems and techniques which take advantage of rebates and incentives offered by utilities are preferred and shall be stated by the government and local utility districts.

8.1.6.1 Passive Solar Applications. Passive solar architectural applications shall routinely be considered as a part of all project designs. Unique applications such as attached sun spaces, earth sheltering, mass trombe walls, solar chimneys, solar dehumidifiers, and other innovations may be considered. Operational controls, such as shading and venting mechanisms, to control the amount of heat admitted into the housing unit during the day, reduce the amount of heat escaping from the housing unit at night, and provide for thermal comfort of the occupants, are parts of this system.

8.1.6.2 Additional South Glazing. If used as part of the solar energy system, glazing shall be of the commercially available off-the-shelf type and shall face within 15 degrees of solar south. The glazing shall be architecturally compatible with the housing unit and the environment, face directly into the living space so that the walls, floors, ceiling, and other massive objects can absorb the entering solar energy, and shall have a whole-window U value less than 1.6 square meter-kelvin (K)/watt [0.28 ft²-degrees F/BTUH]. The optimum amounts of solar glazing that will admit enough solar energy are shown in **Table 8-1**.

Table 8-1 – Optimum Solar Glazing¹

Average Winter Outdoor Temperature	36° latitude	40° latitude	44° latitude	48° latitude
Cold Climates	GA/FA	GA/FA	GA/FA	GA/FA
20°	0.24	0.25	0.29	0.31
25°	0.22	0.23	0.25	0.28
30°	0.19	0.20	0.22	0.24
Temperate Climates	GA/FA	GA/FA	GA/FA	GA/FA
35°	0.16	0.17	0.19	0.21
40°	0.13	0.14	0.16	0.17
45°	0.10	0.11	0.12	0.13
1. Sizing South facing Glazing, GA/FA = glazing area/floor area. Window area on the other sides of the house shall total no more than 5% of the floor area.				

8.1.6.3 Storage mass. If thermal performance calculations indicate a need for additional mass (beyond that provided by the housing unit structure) substantiating data will be submitted. The storage mass will be well integrated into the housing unit design. The thermal mass surface area in the space must be a minimum of three times the glazing area. Six to nine times the glazing area is recommended to control temperature swings. The surfaces to absorb solar energy must not be more than 10% covered.

8.1.6.4 Shading. Movable window treatments are required. These can take the form of heavy draperies to be drawn by the occupants at night and opened in the day. Movable thermal insulation is considered the optimum installation. Cooling season shading of glazed surfaces on the west and south elevations shall be considered.

8.1.6.5 Pre-engineered Active Solar Applications. Pre-engineered active solar applications proposed for domestic water heating shall be evaluated for life-cycle cost effectiveness using a recognized process design program. Whether site-mounted or unit-mounted, systems must be designed for maximum ease of maintenance and for architectural compatibility with the total family housing environment. Systems shall be designed to provide no more than 60 percent of the housing unit's annual water heating load.

8.1.6.6 Geothermal. Geothermal energy sources such as wet or dry steam sources, geothermal hot water, hot dry rock, etc., when determined cost effective, may be considered in regions with established geothermal sources. Each design utilizing geothermal sources shall address the project's environmental impact relating to discharge of hazardous, non-condensable gases or other hazardous effluents, noise emission, heat rejection, ground water contamination, land use, etc.

8.1.6.7 Wind. Wind power may be considered in regions where determined cost effective. Factors such as average wind speed, available wind power, and wind variability shall be considered when investigating the annual useful energy production potential. New wind project must be coordinated with HQDA (G-3).

8.1.6.8 Condenser Heat Recovery. In regions authorized for cooling, consideration shall be given to installation of a heat exchanger to recover condenser heat and de-superheat for use in heating domestic water. A standard, domestic water heater shall be provided in conjunction with this system to provide hot water during the heating season. Heat pump water heaters can be considered in hot climates.

8.1.6.9 Energy Recovery Ventilator. Energy recovery ventilators shall be considered for use with systems designed to introduce outside ventilation air into the housing unit to address indoor air quality concerns, particularly in extreme cold climates. The increased cost and system complication associated with the introduction of outside air shall be carefully weighed against severity of indoor air quality deficiencies before the decision is made to supply outside air at the air handler. When utilized, energy recovery ventilators shall pre-condition outside air by permitting energy transfer from exhaust air. Units shall have easily accessible controls and filters.

8.1.7 Insulation.

Insulation shall comply with thermal performance guidelines of ENERGY STAR®.

8.1.7.1 Characteristics. Thermal insulation shall have a flame-spread rating of 25 or less and a smoke-development rating of 50 or less, exclusive of the vapor barrier, when tested in accordance with ASTM E84. A vapor barrier shall be provided on the warm-in-winter side of exterior wall and ceiling insulation, except in humid areas as defined below. Polyurethane is

allowed as an insulation material for slabs and outside concrete or unit masonry walls. It is prohibited as an injected insulation material in walls or floor cavities or within the building envelope.

8.1.7.2 Humid Area Design. [\[Designer edit.\]](#) Climates which have 3000 hours or more of 19.4 degrees C [67 degrees F] or higher wet bulb temperature in combination with an outside design condition of 50 percent or higher relative humidity, or climates which have 1500 hours or more of 22.8 degrees C [73 degrees F] or higher wet bulb temperature in combination with an outside design condition of 50 percent or higher relative humidity shall be considered humid areas. [\[Designer edit.\]](#) Climates In humid areas, interior surfaces of ceilings and exterior walls shall be covered with materials which allow escape of water vapor from inside the walls into the conditioned space to prevent the growth of mold on interior surfaces. The vapor barrier in humid areas shall have a maximum perm rating of 0.5, and shall be located on the outside face of the exterior wall or ceiling insulation.

8.1.8 Air Infiltration.

To limit air infiltration buildings will be sealed with an air infiltration barrier, installed in accordance with the manufacturer's recommendations. The building envelope shall be caulked, gasketed, weatherstripped or otherwise sealed: around window and door frames, between wall cavities and frames, between walls and ceiling and roof, between walls and floors, at access doors and panels, at utility penetrations through walls, floors, and roofs, and at any other exterior envelope joint which may be a source of air leakage. These steps, in combination with provision of a continuous vapor barrier and sealed ductwork as specified in paragraph 5.6.9 shall constitute tight building construction.

[\[Design District Technical specialists can review additional information from the EPA.\]](#)

8.1.8.1 Testing. A blower door test, performed in accordance with ASTM E 779, Measuring Air Leakage by the Pressurization Method, shall be performed on 15 percent of the project buildings, which have been randomly selected by the Contracting Officer. If buildings are to be turned over in phases, the blower door test shall be performed on 15 percent of the buildings completed in each phase (not to exceed 10 buildings per phase). No additional testing will be required if ALL of the tested buildings pass the test requirements. If less than 100 percent of the tested buildings pass the test, an additional 10 percent of the project buildings (not to exceed 10 buildings) shall be tested. This process shall continue until 100 percent of the total number of tested buildings pass the blower door test. All proto-type units will be included in the required blower door testing procedures.

- Before beginning the test, all combustion devices shall be turned off, and all intentional openings in the building envelope (dryer vent, bathroom and kitchen exhausts, etc.) shall be sealed. All doors and windows shall be closed and latched.
- To pass the blower door test, the building shall have an air tightness rating within the range of 3 to 4 ACH at 50 Pa [0.2 inch of water]. The Contractor shall correct all housing units not found in compliance, and shall be responsible for all labor and materials required to reduce air leakage to within acceptable parameters. All testing shall be performed by a firm certified by the Associated Air Balance Council, the National Environment Balancing Bureau, or State licensed to perform such tests within the state where the project is being constructed.
- Any measures taken to reduce the air leakage to acceptable values shall be permanent, and shall be implemented on all similar housing units.

8.2 WATER CONSERVATION AND LANDSCAPING

8.2.1 General.

Incorporate environmentally and economically beneficial landscape practices in support of Executive Order 13423, Strengthening Federal Environmental, Energy and Transportation Management, dated 24 Jan 07. Landscaping may consist of shrubs, trees, decorative fencing, earth sculpting, rocks or special gardens, and identification signs. Trees, natural areas, and native plant species shall be preserved where possible. Grade sites so that slopes follow natural contours as much as possible.

8.2.2 Landscape Planting Plan.

The Contractor shall obtain and use the services of a qualified landscape architect, experienced in site planning and planting design. A complete, integrated landscape planting plan shall be provided for the overall housing project. The design shall reflect appropriate groupings, variety, foundation plantings, and street tree plantings to define the open spaces to ensure a complete landscaped project. Choose plant materials on the basis of plant hardiness, climate, soil conditions, low maintenance, and quality. Selected plant materials shall be easily maintained and tolerant of the specific site conditions. Planting or seeding shall occur only during periods when beneficial results can be obtained.

8.2.3 Boundaries.

Landscape boundaries of neighborhoods to create buffers [and](#) separate neighborhoods and clusters from major streets or incompatible off-site activities, and use landscaping to emphasize and reinforce sub-areas within the community.

8.2.4 Measurement.

Plant measurements shall be in accordance with ANSI/ANLA Z60.1.

8.2.4.1 Percolation Test. Test for percolation shall be done to determine positive drainage of plant pits and beds. All soil and drainage conditions detrimental to the growth of plant material shall be identified and a proposal correcting the conditions shall be submitted.

8.2.4.2 Soil Test. A soil test shall be performed for pH, chemical analysis, and mechanical analysis to establish the quantities and type of soil amendments required to meet local growing conditions for the type and variety of plant material specified.

8.2.5 Plants.

- Plants shall be native species that will require minimum maintenance and watering. Xeriscaping design principles, and plants of differing heights, shapes, color, and texture, shall be used in landscaping. Well shaped, well grown, vigorous, healthy plants having healthy and well branched root systems shall be provided. Plants shall be free from disease, harmful insects and insect eggs, sun-scald injury, disfigurement, and abrasion. Plants shall be provided that are typical of the species or variety, and conforming to standards as set forth in ANSI/ANLA Z60.1.

8.2.5.1 Trees, Shrubs, and Ground Cover. Plant varieties shall be nursery grown or plantation grown stock conforming to ANSI/ANLA Z60.1. They shall be grown under climatic conditions similar to those in the locality of the project.

- Shade and Flowering Trees. A height relationship to caliper shall be provided as recommended by ANSI/ANLA Z60.1. Height of branching shall bear a relationship to the size and variety of tree specified, and with the crown in good balance with the trunk. Trees shall not be "poled" or the leader removed.
 - Single Stem. Trunk shall be reasonably straight and symmetrical with crown and have a persistent main leader.
 - Multi-Stem. All countable stems, in aggregate, shall average the size specified. To be considered a stem, there shall be no division of the trunk which branches more than 150 mm [6 in] from the ground level.
 - Specimen. A plant shall be provided that is well branched and pruned naturally according to the species. The form of growth desired, which may not be in accordance with natural growth habit, shall be as indicated.
- Deciduous Shrub. Plants shall be provided that have the height and number of primary stems as recommended by ANSI/ANLA Z60.1. An acceptable plant shall be well shaped with sufficient well-spaced side branches recognized by the trade as typical for the variety grown in the region.
- Coniferous Evergreen. Trees shall be provided that have the height-to-spread ratio as recommended by ANSI/ANLA Z60.1. Trees shall not be "poled" or the leader removed. An acceptable plant shall be exceptionally heavy, well shaped and trimmed to form a symmetrical and tightly knit plant. The form of growth desired shall be as indicated.
- Broadleaf Evergreen. Plants shall be provided that have ratio of height-to-spread as recommended by ANSI/ANLA Z60.1. An acceptable plant shall be well shaped and recognized by the trade as typical for the variety grown in the region.
- Ground Cover. Plants shall be provided with the minimum number of runners and length of runner as recommended by ANSI/ANLA Z60.1. Plants shall be furnished that have heavy, well developed, and balanced top with vigorous well developed root system, and shall be furnished in containers.

8.2.5.2 Turf. Turf consists of seed, sod, and sprigs. There may be several different types of turf mixtures applied; one for lawn areas around housing units and one for field or recreation areas. The boundaries of each area shall be clearly defined on the planting plan. [\[Seed mix or sod type shall be approved by the installation.\]](#) [\[Designer add if applicable.\]](#)

- Seed quality. State approved seed of the latest season's crop shall be provided in the original sealed packages bearing the producer's guaranteed analysis for percentages of mixture, purity, germination, hard seed, weed seed content, and inert material. Labels shall be in conformance with applicable State seed laws. Seed mixtures shall be proportioned by weight. Weed seed shall not exceed one percent by weight of the total mixture.
- Sod. State approved sod shall be provided as classified by applicable State laws. Each individual sod section shall be of a size to permit rolling and lifting without breaking.
 - Quality. The sod shall be relatively free of thatch, diseases, nematodes, soil-borne insects, weeds or undesirable plants, stones larger than 50 mm [2 in] in any dimension, woody plant roots, and other material detrimental to a healthy stand of turf. Sod that has become dry, moldy, or yellow from heating, or has irregular shaped pieces of sod and torn or uneven ends shall be rejected.

- Thickness. Sod shall be machine cut to a uniform thickness of 306 mm [1ft 1/4 in] within a tolerance of 6 mm [1/4 inch] excluding top growth and thatch. Measurement for thickness shall exclude top growth and thatch.
- Time Limitation. The limitation of time between harvesting and placing sod shall be 36 hours.
- Sprig Quality. The cultivar shall be provided as healthy living stems, stolons, or rhizomes with attached roots, including two or three nodes, and shall be from 100 mm to 150 mm [4 in to 6 in] long, without adhering soil. Sprigs shall be provided which have been grown under climatic conditions similar to those in the locality of the project. Sprigs shall be obtained from heavy and dense sod, free from weeds or other material detrimental to a healthy stand of turf. Sprigs that have been exposed to heat or excessive drying shall be rejected. The time limitation between harvesting and placing sprigs shall be 24 hours.
- Temporary Turf Cover. When there are contract delays in the turfing operation or a quick cover is required to prevent erosion, the areas designated for turf shall be seeded with a temporary seed. When no other turfing materials have been applied, the quantity of one-half of the required soil amendments shall be applied and the area tilled.
- Satisfactory Stand of Turf.
 - Seeded Lawn Area. A satisfactory stand of turf from the seeding operation for a lawn area is defined as a minimum of 160 grass plants per square meter. Bare spots shall be no larger than 150 mm [6 in] square. The total bare spots shall not exceed two (2) percent of the total seeded area.
 - Seeded Field Area. A satisfactory stand of turf from the seeding operation for a field area is defined as a minimum of 100 grass plants per square meter. The total bare spots shall not exceed two (2) percent of the total seeded area.
 - Sodded Area. A satisfactory stand of turf from the sodding operation is defined as living sod uniform in color and texture. Bare spots shall be no larger than 50 mm [2 in] square.
 - Sprigged Area. A satisfactory stand of turf from the sprigging operation is defined as a minimum of 20 sprigs per square meter. Bare spots shall be no larger than 225 mm [9 in] square. The total bare spots shall not exceed two (2) percent of the total sprigged area.

8.2.6 Installation.

Verify the location of underground utilities. When obstructions below ground or poor drainage affect the planting operation, proposed adjustments to plant location, type of plant, and planting method or drainage correction shall be submitted. The plant material shall be installed during appropriate planting times and conditions recommended by the trade for the type and variety of plant material specified. Drainage patterns shall be maintained. Plant pits shall be excavated and backfilled as recommended by the trade and ANSI/ANLA Z60.1. The planting operation shall be performed only during periods when beneficial results can be obtained. When special conditions warrant a variance to the planting operations, proposed planting times shall be submitted.

8.2.6.1 Pruning. The total amount of foliage shall be pruned by one-fourth to one-third on installed trees and shrubs to compensate for loss of roots and transplanting shock. The typical growth habit of individual plants shall be retained. Trees shall not be poled or the leader removed, nor shall the leader be pruned or "topped off."

8.2.6.2 Maintenance During Planting Operation. Installed plants shall be maintained in a healthy growing condition. Maintenance operations shall begin immediately after each plant is installed and shall continue until the plant establishment period commences. The maintenance of turfed areas shall include eradicating weeds, eradicating insects and diseases, protecting embankments and ditches from erosion, maintaining erosion control materials and mulch, protecting turf areas from traffic, mowing, watering, post-fertilization, and replacing unsatisfactory turf areas.

8.2.6.3 Protection. Immediately after turfing, the area shall be protected against traffic or other use by erecting barricades and providing signage as required.

8.2.7 Plant Establishment Period.

On completion of the last day of the planting operation, the plant establishment period for maintaining installed plants in a healthy growing condition shall commence and shall be in effect for the remaining contract time period not to exceed 12 months. When the planting operation extends over more than one season or there is a variance to the planting times, the plant establishment periods shall be established for the work completed. The turf establishment period for establishing a healthy stand of turf shall begin on the first day of work under the turfing contract and shall end three months after the last day of the turfing operation. An unsatisfactory stand of turf shall be repaired as soon as turfing conditions permit.

8.2.7.1 Maintenance During Establishment Period. The maintenance of plants shall include straightening plants, tightening stakes and guying material, repairing tree wrap, protecting plant areas from erosion, maintaining erosion material, supplementing mulch, accomplishing wound dressing, removing dead or broken tip growth by pruning, maintaining edging of beds, checking for girdling of plants and maintaining plant labels, watering, weeding, removing and replacing unhealthy plants.

8.2.7.2 Unhealthy Plant. A plant shall be considered unhealthy or dead when the main leader has died back, or 25 percent of the crown is dead. Determine the cause for an unhealthy plant. Unhealthy or dead plants shall be removed immediately and shall be replaced as soon as seasonal conditions permit in accordance with the following warranty paragraph.

8.2.8 Warranty.

Furnished plant material shall be guaranteed to be in a vigorous growing condition for a period of 12 months regardless of the contract time period. A plant shall be replaced one time under this guarantee. Transplanting existing plants requires no guarantee

8.2.9 Irrigation.

Design irrigation systems to minimize water consumption. Provide a complete permanent automatic irrigation system with controllers covering all common planting areas and slopes. Design the system to function with available water pressure.

[Use of a sprinkler and/or irrigation system should be included only in arid regions for the protection of landscape plantings. Coordinate requirements with the installation. Designer insert "(DELETED)." and delete remainder of text if not needed.]

9.0 SUSTAINABILITY

9.1 GENERAL.

Executive Order 13423, Strengthening Federal Environmental, Energy and Transportation Management, dated 24 Jan 07, It is the policy of the United States and Federal agencies conduct their environmental, transportation, and energy-related activities under the law in support of their respective missions in an environmentally, economically and fiscally sound, integrated, continuously improving, efficient, and sustainable manner.. Energy Independence and Security Act (EISA 2007) is to move the United States toward greater energy independence and security, to increase the production of clean renewable fuels, to protect consumers, to increase the efficiency of products, buildings, and vehicles, to promote research on and deploy greenhouse gas capture and storage options, and to improve the energy performance of the Federal Government, and for other purposes. The Energy Policy Act of 2005 is to ensure jobs for our future with secure, affordable, and reliable energy. The following paragraphs define the goals and general objectives for inclusion of sustainable design considerations in this project. The listing is not all inclusive, and the techniques suggested may not be cost effective at a given location or site. Additional consideration in the technical evaluation will be given to designs which incorporate and identify Sustainable Design techniques included in the proposal.

9.1.1 Objectives

Objectives of this sustainability directive include: reduction of greenhouse gas emissions attributed to facility energy use, water conservation, use of recovered and recycled materials, waste reduction, and maintenance of healthful indoor environments. Results will reduce life cycle operating costs and improve quality of life for families.

9.1.2 Other Federal Requirements and Guidelines.

Executive Order 13101, *Greening the Government Through Waste Prevention, Recycling, and Federal Acquisition (Sep. 1998)*, establishes affirmative procurement requirements to promote the acquisition and use of products that contain recycled or recovered materials, and environmental services which key components of sustainable development. Many products designated by EPA *Comprehensive Procurement Guidelines* are commonly used in family housing construction including insulation, carpet and carpet cushion, cement and concrete, latex paint, structural fiberboard and laminated paperboard, non-pressure drainage pipe, roofing materials, landscaping products, and playground equipment and surfaces.

Executive Order 13148, *Greening the Government Through Environmental Leadership (April 2000)*, establishes requirements to use environmentally and economically beneficial landscaping practices to promote sustainable management of Federal facility lands and reduce adverse impacts to the natural environment.

Federal Energy Management Program (FEMP) - *Greening Federal Facilities: An Energy, Environmental, and Economic Resource Guide for Federal Facility Managers and Designers (May 2001)*. This Guide can assist stakeholders in reducing energy consumption and costs, improving working environment of those facilities, and reducing environmental impacts of their operations.

9.1.3 Sustainable Design and Construction of the Built Environment.

Design and construction of sustainable housing shall be in accordance with the following concepts:

9.1.3.1 Site Work and Planning. Environmentally sensitive planning looks beyond the boundary of the project site to evaluate linkages to transportation and infrastructure, ecosystems and wildlife habitat and community identification. Site planning evaluates solar and wind orientation, local microclimate, drainage patterns, utilities and existing site features to develop optimal siting and appropriate low maintenance landscape plant material.

9.1.3.2 Building Layout and Design. Optimize building size, and maintain an appropriate building scale for the environment and context of the building or a building component. Layout rooms of a building for energy performance and comfort, and design for standard sizes to minimize material waste. Pay careful attention to the location of exterior windows. Avoid structural over-design and the resultant waste. Design components of the building environment for durability and for waste recycling.

9.1.3.3 Energy. Building orientation and massing, natural ventilation, day-lighting, shading and other passive strategies, can all lower a building's energy demand and increase the quality of the interior environment and the comfort and productivity of occupants.

9.1.3.4 Building Materials. Environmentally preferable building materials are durable and low maintenance. Within the parameters of performance, cost, aesthetics and availability, careful selection and specification can limit impacts on the environment and occupant health.

9.1.3.5 Indoor Air Quality. Indoor air quality is most effectively controlled through close coordination of architecture, interiors and mechanical, plumbing, and electrical design strategies that limit sources of contamination before they enter the building. Construction procedures for IAQ and post-occupancy user guides also contribute to good long-term IAQ.

9.1.3.6 Water Usage. Site design strategies that maximize natural filtration of rainwater are desirable. Water conservation is enhanced by the use of low flow plumbing fixtures and water appropriate landscaping.

9.1.3.7 Recycling and Waste Management. Waste and inefficiency can be limited during construction by sorting and recycling demolition and construction waste, reuse of on-site materials and monitoring of material use and packaging. Accommodating recycling into building design reduces waste while generating revenues.

9.1.3.8 Building Commissioning, Operations and Management. Effective building commissioning is essential to ensure proper and efficient functioning of systems. Facilities operations benefit from energy and water saving practices, waste reduction and environmentally sensitive maintenance and procurement policies.

9.2 BUILDING COMMISSIONING

9.2.1 General.

Commission dwelling units that are tested for ENERGY STAR® Labeled Home Performance (except foreign locations where ENERGY STAR® standards may not be practical), to ensure that building shell and systems function as proposed and specified for ENERGY STAR®. Repairs or adjustments made in test homes must also be made to remaining homes in each group. At a minimum, commissioning includes:

- Testing for envelope and duct leakage: Paragraphs 8-1.2 and 5-6.1 specify performance standards,
- Testing for air pressure relationships under operating conditions: Paragraphs 4-7.6 and 5-6.1 specify requirements for garage-to-unit separation and “balancing” indoor pressure,

- Testing for proper ventilation of all combustion equipment and appliances under operating conditions, to ensure they meet manufacturer's specifications,
- Testing of carbon monoxide output of combustion equipment and appliances, to ensure they meet manufacturer's specifications, and
- Ensuring that Operation and Maintenance documentation is complete for building shell and systems (see manufacturer's documents).

9.3 SUSTAINABLE DEVELOPMENT WORKBOOK AND RATING SYSTEM

9.3.1 General.

Project shall use the US Green Building Council Leadership in Energy and Environmental Design for Homes (LEED for Homes) criteria. Homes shall comply with the current policy memo for Sustainable Design and Development (SDD). Homes shall be a minimum LEED for Homes Silver rating. For purposes of this project, the house lot lines shall be assumed to be: Rear = 40 feet; Side = 10 feet or 1/2 the distance between units whichever is greater; Front = from structure to sidewalk or if no sidewalk, 10 feet from curb to structure. Common space is excluded by definition from house lot.

[Designer edit as appropriate.] Refer to solicitation paragraph 01 33 16 for additional requirements for LEED.

9.3.2 Documentation and Validation

Like other Army construction projects, Army Family Housing projects shall utilize the US Green Building Council sustainability tools. Formal LEED for Homes certification is not required except that all Army Family Housing new construction starting with FY13 military construction program will be certified at the LEED for Homes SILVER level or higher from the GBCI, except where GBCI does not certify in foreign locations, new construction shall be certifiable; however, the Contractor shall fulfill the role of the LEED for Homes provider and see that the project is fully documented and rated according to USGBC requirements. The supporting Engineering District, as Authorized Design and Construction Agent will be responsible for reviewing the project documentation and validating all credits, in accordance with the USGBC standard, from design through construction close-out.

9.3.3 ENERGY STAR® Homes Program Requirements.

All Army Family Housing new construction starting with FY13 military construction program will be qualified as ENERGY STAR® New Homes, except where it is not practical to meet ENERGY STAR® standards in foreign locations, new construction shall be qualifiable as ENERGY STAR® New Homes. The required information can be submitted to EPA in several methods:

- Through the Internet by clicking on the certificate automation system icon at the World Wide Website <http://yosemite.epa.gov/appd/eshomes/eshomes.nsf> and following the instructions
- By emailing to certificates@epa.gov
- By mailing to the EPA Customer Service Manager (address and telephone number below).

9.3.3.1 Submission Requirements.

The following information shall be submitted for each home **[Designer add note: homes may be submitted individually (each home individually tested/rated) or in a "batch" (for batches of homes,**

[particular unit types](#)]. The following data shall be provided for each home (note: this can be in the form of a spreadsheet, database, word processing file or email; if the format changes in the future EPA will inform the Contractor of the changes):

- Contractor company name (ex. Jones Construction Co.)
- Contractor telephone number (ex. 703-123-4567)
- Name of company/organization performing testing/rating (ex. Jones Construction Co.)
- Telephone number of company/organization performing testing/rating (ex. 703-123-4567)
- Street address of home being submitted, including city, state & zip code (ex. 123 Smith St., City, State 12345)
- Type of verification:
 - “FEP” --- if this particular home underwent infiltration testing (and possibly duct leakage testing). Please list the tested infiltration value in ACH/nat (natural air changes per hour) and if tested, the duct leakage to non-conditioned spaces in cfm and % of air handler flow at a pressure of 25 pascals.
 - “SEP” --- if this particular home did not undergo infiltration and/or duct leakage testing, but was a member of a batch out of which at least 15% DID; if so, then the address of a home that was a tested member of this batch shall also be identified as the tested member of the batch.
- The following statement: “This home qualifies as an EPA ENERGY STAR® Home by conforming to the residential energy efficiency specifications and quality control confirmation of Army Family Housing Standard Design Criteria [[Designer shall fill in date of edition](#)], which has been determined by the EPA and USACE to be an Equivalent Program to the EPA ENERGY STAR® Homes Program.” In addition, the “checklist” of home specifications that the USACE Contracting Officer’s Representative uses to ascertain if the specifications and testing results were met shall be submitted. The statement and checklist shall have the USACE Contracting Officer’s Representative’s signature affixed.
- The year the house was built (ex. 2001)
- The year the house was submitted for ENERGY STAR® certification (ex. 2001)
- The name and title/rank, mailing address, email address, telephone number and fax number of the USACE Contracting Officer’s Representative overseeing the Contractor’s adherence to construction specifications, quality control of construction and testing/rating activities.

The Contractor will make arrangements with the EPA for receipt of the “ENERGY STAR® Homes” certificates and unit plaques and shall provide the certificates to the USACE Contracting Officer’s Representative and include in the project the installation of the plaques on each of the housing units. Coordination point with the EPA regarding ENERGY STAR® certification and plaques shall be as follows:

United States Environmental Protection Agency
Climate Protection Division
US EPA 6202J
Washington DC 20460
ENERGY STAR® Homes Customer Service Manager

ATTN: Mr. Brian Ng, Ng.Brian@epa.gov, 202-564-9162, fax: 202-565-2079
<http://www.energystar.gov/homes>

Technical questions on the ENERGY STAR® Homes Program in general can be addressed to:

ENERGY STAR® Homes Technical Coordinator
ATTN: Mr Glenn T. Chinery, Chinery.Glenn@epa.gov, 202-564-9784, fax: 202-565-2079

APPENDIX A REFERENCES

GOVERNMENT PUBLICATIONS

Consumer Products Safety Commission (CPSC), <http://www.cpsc.gov>

CPSC Publication 325 – *Handbook for Public Playground Safety*, <http://www.cpsc.gov>

Department of Defense (DoD)

ACSIM Police Memorandum (July 2010) – *Sustainable Design and Development*

DoD Memorandum, Unified Facilities Criteria (Ref. MIL-STD-3007)
http://www.hnd.usace.army.mil/TECHINFO/UFC/052902_SignedUFCImplementationMemo.pdf

DoD Instruction 4165.57 (Nov 1977) – *Air Installation Compatible Use Zones (AICUZ)*,
<http://www.dtic.mil/whs/directives/corres/pdf/416557p.pdf>

DoD Directive 4165.63-M (Sep 1993) – *Housing Management*

DoD Directive 4710.1 (Jun 1984) – *Archeological and Historic Resources Management*

DoD Instruction 4715.3 (May 1996) – *Environmental Conservation Program*

MIL-STD-3007 – *DOD Standard Practice for Unified Facilities Criteria (UFC) and Unified Facilities Guide Specifications (UFGS)*
http://www.acq.osd.mil/ie/irm/irm_library/milstd3007b_042302.pdf

TM 5-805-4 – *Technical Manual - Noise and Vibration Control*

UFC – Unified Facility Criteria http://65.204.17.188/report/doc_ufc.html.

UFC 1-200-01 – Design: General Building Requirements

UFC 2-600-01 – Installation Design

UFC 3-190-04FA – Roofing and Waterproofing, Chapter 11 – Steep Roofing

UFC 3-400-01 – Design: Energy Conservation

UFC 3-400-02 – Engineering Weather Data

UFC 3-410-01FA – Design: Heating, Ventilating, and Air Conditioning

UFC 3-420-01 – Design: Plumbing Systems

UFC 3-600-01 – Design: Fire Protection Engineering For Facilities

UFC 4-010-01 – Design: DoD Minimum Anti-terrorism Standards for Buildings

UFC 4-020-01 – DoD Security Engineering Facilities Planning Manual

UFC 4-020-01 – Sustainable Development

UFC 4-711-01–Family Housing

Department of the Air Force

Air Force Family Housing Guide for Planning Programming, Design and Construction
<http://www.afcee.brooks.af.mil/dc/dch/mfhguide/toc.doc>

Department of the Army

Army Standard for Family Housing, latest document
<https://eportal.usace.army.mil/sites/COS/Pages/Default.aspx>

USD (AT&L) Memorandum, *Department of Defense Unified Facilities Criteria*
http://www.hnd.usace.army.mil/TECHINFO/UFC/052902_SignedUFCImplementationMemo.pdf

AR 200-1 – *Environmental Protection and Enhancement May 1990*
http://www.apd.army.mil/pdf/files/r200_1.pdf

Department of the Navy

NAVFACINST 11101.85H.1, *Appendix A – Navy Housing Project Standards*
http://www.housing.navy.mil/pubs/85H_Rev1_30Oct01.pdf

U.S. Marine Corps

MCO P11000.22 – *Marine Corps, Housing Management Manual*
<http://www.usmc.mil/directiv.nsf/0dce83e13c9c8aa685256c0c0066c2e0/a2213818c030ffdb85256497006b1211?OpenDocument>

Department of Energy (DOE)

Million Solar Roofs Initiative, <http://www.millionsolarroofs.com/>

National Environmental Policy Act (NEPA) of 1969
<http://ceq.eh.doe.gov/nepa/regs/nepa/nepaeqia.htm>

Environmental Protection Agency (EPA)

Comprehensive Procurement Guidelines (for recycled content standards)
<http://www.epa.gov/cpg/products>

EPAct 05 – *Energy Policy Act of 2005*
http://www.epa.gov/oust/fedlaws/publ_109-058.pdf

Federal Emergency Management Agency (FEMA)

National Performance Criteria for Tornado Shelters.
www.fema.gov/doc/library/ts5-28.doc

FEMA 320, *Taking Shelter from the Storm: Building a Safe Room Inside Your House,*
www.fema.gov/fima/tsfs02.shtm

FEMA 361, *Design and Construction Guidance for Community Shelters.* www.fema.gov/fima/fema361.shtm

Federal Highway Administration (Fhwa), Department of Transportation

Manual of Uniform Traffic Control Devices, <http://mutcd.fhwa.dot.gov/>

Office of Management and Budget (OMB), <http://www.whitehouse.gov/omb/>

OMB Circular A-45 - *Rental and Construction of Government Quarters*

U.S. Government Printing Office (GPO)

Architectural Barriers Act of 1968, <http://www.access-board.gov/about/ABA.htm>

Code of Federal Regulations, <http://www.gpoaccess.gov/cfr/index.html>

10 CFR 430 – *Energy Conservation Program for Consumer Products*,
http://www.access.gpo.gov/nara/cfr/waisidx_05/10cfr430_05.html

10 CFR 435 – *Energy Conservation Voluntary Performance Standards for New Buildings; mandatory for Federal Buildings*, http://www.access.gpo.gov/nara/cfr/waisidx_05/10cfr435_05.html

16 CFR 1630 - *Standard for the surface flammability of carpets and rugs (FF 1-70)*,
http://www.access.gpo.gov/nara/cfr/waisidx_05/16cfr1630_05.html

40 CFR 247.12 - *Comprehensive Procurement Guideline for Products Containing Recovered Materials, Construction Products*, http://www.access.gpo.gov/nara/cfr/waisidx_05/40cfr247_05.html

40 CFR 280

40 CFR 1500-1508 - *Regulations for Implementing NEPA*, http://ceq.eh.doe.gov/nepa/regs/ceq/toc_ceq.htm

49 CFR 192

49 CFR 195

49 CFR 1500-1508 - *Regulations for Implementing NEPA*, http://ceq.eh.doe.gov/nepa/regs/ceq/toc_ceq.htm

Executive Orders (EO)

EO 12902, *Energy Efficiency and Water Conservation at Federal Facilities*, (revoked by E13123)

EO 13101 – *Greening the Government Through Waste Prevention, Recycling, and Federal Acquisition*,
<http://www.epa.gov/epp/pubs/13101.pdf>

EO 13123 – *Greening the Government through Efficient Energy Management*,
<http://www.ofee.gov/eo/eo13123.pdf>

EO 13148 – *Greening the Government Through Leadership in Environmental Management*

EO 13423 – *Strengthening Federal Environmental, Energy, and Transportation Management*
http://www.fedcenter.gov/Bookmarks/index.cfm?id=6585&pge_prg_id=20692&pge_id=3286EO 13514 –
Federal Leadership in Environmental, Energy, and Economic Performance
<http://www.fedcenter.gov/Bookmarks/index.cfm?id=13641>

National Historic Preservation Act of 1966 (16 USC 470)

<http://www2.cr.nps.gov/laws/NHPA1966.htm>

Public Law 104-113, *National Technology Transfer and Advancement Act of 1995*.

United States Code (USC), <http://uscode.house.gov>

10 USC 2826 – *Military Family Housing: Local Comparability of Room Patterns and Floor Areas*

16 USC 470 – *National Historic Preservation Act of 1966*

<http://www2.cr.nps.gov/laws/NHPA1966.htm>

NON-GOVERNMENT PUBLICATIONS

Air Conditioning Contractors of America (ACCA), <http://www.acca.org/>

ACCA – Manual D - Duct size design

ACCA – Manual J - Heating and cooling load calculations

ACCA – Manual S - Residential HVAC equipment selection

American National Standards Institute (ANSI),
<http://www.ansi.org> and <http://www.nssn.org/search.html>

ANSI A161.1 – HUD Approved Construction Specifications

ANSI A208.2 – Medium Density Fiberboard (MDF) For Interior Use

ANSI B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

ANSI B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes

ANSI/HPVA-HP-1 – Hardwood and Decorative Plywood

ANSI/NEMA C12.1 Code for Electricity Metering.

ANSI Z765 – American National Standard for Single-Family Residential Buildings, Square Footage-Method for Calculating.

ANSI Z21.10.1 – Gas Water Heaters

American Society of Civil Engineers (ASCE), <http://www.pubs.asce.org>

ASCE 7, Minimum Design Loads for Buildings and Other Structures

ASCE 32-01, Design and Construction of Frost-Protected Shallow Foundations

American Society of Heating, Refrigerating, and Air Conditioning Engineers
(ASHRAE) <http://www.ashrae.org/>

ASHRAE 62.2 – Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings

ASHRAE 119 – Air Leakage Performance for Detached Single-Family Residential Buildings

American Society of Testing Materials International (ASTM)
www.astm.org and <http://www.nssn.org/search.html>

ASTM A653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM B117 – Standard Practice for Operating Salt Spray (Fog) Apparatus

ASTM C90 – Standard Specification for Loadbearing Concrete Masonry Units

ASTM C216 – *Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale)*

ASTM D1335 – *Standard Test Method for Tuft Bind of Pile Yarn Floor Coverings*

ASTM D1557 – *Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort – Method D*

ASTM D3018 – *Specification for Class A Asphalt Shingles Surfaced with Mineral Granules*

ASTM D3679 – *Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Siding*

ASTM E84 – *Standard Test Method for Surface Burning Characteristics of Building Materials*

ASTM E90 – *Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements*

ASTM E283 - *Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen*

ASTM E330 - *Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference*

ASTM E336 – *Standard Test Method for Measurement of Airborne Sound Insulation in Buildings,*

ASTM E413 – *Classification for Rating Sound Insulation,*

ASTM E 492 – *Standard Test Method for Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine*

ASTM E547 - *Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Cyclic Static Air Pressure Difference*

ASTM E648 – *Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source*

ASTM E1007 – *Standard Test Method for Field Measurement of Tapping Machine Impact Sound Transmission Through Floor-Ceiling Assemblies and Associated Support Structures,*

ASTM E1321 – *Standard Test Method for Determining Material Ignition and Flame Spread Properties*

ASTM F1292 – *Standard Specification for Impact Attenuation of Surface Systems Under and Around Playground Equipment*

ASTM F1303 – *Standard Specification for Sheet Vinyl Floor Covering with Backing*

ASTM E1423 - *Standard Practice for Determining Steady State Thermal Transmittance of Fenestration Systems*

ASTM F1487 – *Standard Consumer Safety Performance Specification for Playground Equipment for Public Use*

ASTM F1951 – *Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment*

ASTM F2090-10 – *Standard Specification for Window Fall Prevention Devices With Emergency Escape (Egress) Release Mechanisms*

ASTM G90 - *Standard Practice for Performing Accelerated Outdoor Weathering of Nonmetallic Materials Using Concentrated Natural Sunlight*

AWWA C500 – *Metal Seated Gate Valves for Water Service Supply*

AWWA C502 – *Dry Barrel Fire Hydrants*

AWWA C503 – *Wet Barrel Fire Hydrants*

International Code Council (ICC), <http://www.iccsafe.org/>

IBC – *International Building Code*TM

IRC – *International Residential Code*TM

National Electrical Manufacturer's Association (NEMA), <http://www.nema.org>

NEMA C12.1, *Electric Meters; Code for Electricity Metering*
<http://www.nssn.org/search.html>

National Fire Protection Association (NFPA), <http://www.nfpa.org/catalog/home/index.asp>

NFPA 13 – *Installation of Sprinkler Systems*

NFPA 30 – *Flammable and Combustible Liquids Code*

NFPA 31 – *Standard for the Installation of Oil Burning Equipment*

NFPA 54 – *National Fuel Gas Code*

NFPA 58 – *Liquefied Petroleum Gas Code*

NFPA 70 – *National Electrical Code (NEC)*

NFPA 101 – *Life Safety Code*

NFPA 720 – *Household Carbon Monoxide (CO) Warning Equipment*

NFRC 100-91 – *Procedure for Determining Fenestration Product U-factors*

TIA/EIA-570 – *Residential Telecommunication Infrastructure Standard*

Underwriters Laboratory (UL), <http://www.ul.com/>

UL 58 – *Standard for Safety for Steel Underground Tanks for Flammable and Combustible Liquids*

UL 250 – *Household Refrigerators and Freezers*

UL 430 – *Waste Disposers*

UL 567 – Emergency Breakaway Fittings, Swivel Connectors and Pipe-Connection Fittings for Petroleum Products and LP-Gas

UL 732 – Oil-Fired Storage Tank Water Heaters

UL 749 – Household Dishwashers

UL 923 – Microwave Cooking Appliances

UL 1315 – Metal Waste Paper Containers

UL 1746 – External Corrosion Protection Systems for Steel Underground Storage Tanks

UL 2034 – Standard for Single and Multiple Station Carbon Monoxide Alarms

Woodwork Institute (WI), <http://www.wicnet.org>

Manual of Millwork

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APPENDIX B GLOSSARY

- AABC – Associated Air Balance Council
- AAV – Air Admittance Valve or Vent
- ACPH – Air Changes Per Hour
- ADA – *Americans with Disabilities Act*, <http://www.usdoj.gov/crt/ada/adahom1.htm>
- ADAAG – *ADA Accessibility Guidelines*, <http://www.access-board.gov/adaag/html/adaag.htm>
- AICUZ – *Air Installations Compatible Use Zones*
- AMR – Automated Meter Reading
- BMP – Best Management Practice
- CATV – Cable Access Television
- CEQ – Council on Environmental Quality
- CFC – Chlorofluorocarbon
- CO – Carbon Monoxide
- CPG – *Comprehensive Procurement Guidelines* (see EPA)
- CRI – Carpet and Rug Institute, <http://www.carpet-rug.com/>
- DD Form 1391 – Department of Defense internal planning document delimiting project cost and defining functional parameters
- DNL – Day Night (average sound) Level
- ENERGY STAR[®] – Government-backed program helping businesses and individuals protect the environment through energy efficiency, <http://www.energystar.gov/>
- FEMP – Federal Energy Management Program
- FIIC – Field Impact Insulation Class
- FPL – Forest Products Laboratory, <http://www.fpl.fs.fed.us>
- FRT – Fire-Retardant-Treated (plywood)
- FS – Flame-spread (index)
- FSTC – Field Sound Transmission Class
- HPVA – Hardwood Plywood and Veneer Association
- HUD – U.S. Department of Housing and Urban Development, <http://www.hud.gov/>

HVAC – Heating Ventilation and Air Conditioning

IAQ – Indoor Air Quality

IBC – *International Building Code*TM

IEEE – Institute of Electrical and Electronics Engineers, <http://www.ieee.org/>

IESNA – Illuminating Engineering Society of North America, www.iesna.org

IIC – Impact Isolation Class

IRC – *International Residential Code*TM

LER – Light Efficacy Rating

LID – Low Impact Development

NEBB – National Environmental Balancing Bureau

O&M – Operations and Maintenance

OSHA – Occupational Safety and Health Administration, <http://www.osha.gov/>

OVE – Optimum Value Engineering, <http://www.toolbase.org/PATH-OVE>

PCB – Polychlorinated Biphenyl

SD – Smoke-developed (rating)

SHPO – State Historic Preservation Office

STC – Sound Transmission Class

TV – Television

UFAS – *Uniform Federal Accessibility Standards*

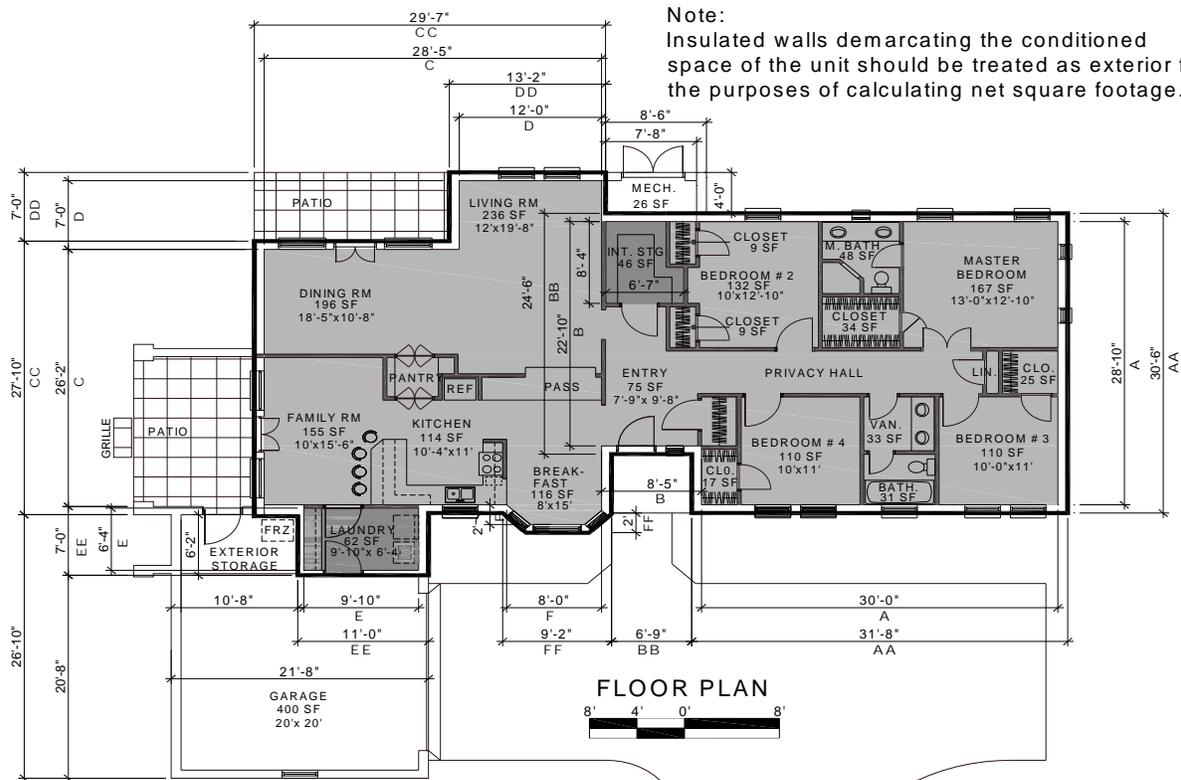
UFGS - *Unified Facilities Guide Specifications*

VOC - Volatile Organic Compounds

APPENDIX C-1 NET AND GROSS AREA CALCULATIONS – SINGLE STORY

(Mechanical Room and Exterior Storage excluded from Gross SF)

- Bold line defines limits of Gross area
- Dark shading = excludable areas from the Net
- Light shading = defines Net scope area
- A Designates a Net dimension
- AA Designates a Gross dimension



Note:
Insulated walls demarcating the conditioned space of the unit should be treated as exterior for the purposes of calculating net square footage.

Total Gross		
AA	31'-8" x 30'-6"	= 966 SF
BB	6'-9" x 24'-6"	= 165 SF
CC	29'-7" x 27'-10"	= 823 SF
DD	13'-2" x 7'-0"	= 92 SF
EE	11'-0" x 7'-0"	= 77 SF
FF	9'-2" x 2'-0"	= 18 SF
(Less corners) 2'-0" x 2'-0" x 2 x 1/2		= - 4 SF
Total Gross		2,137 SF
Garage	21'-8" x 20'-8"	= 448 SF
Ext. Stg	10'-8" x 6'-2"	= 66 SF
Mech. Rm.	8'-6" x 4'-0"	= 34 SF

"Benchmark" 2,310 SF

Total Net		
A	30'-0" x 28'-10"	= 865 SF
B	8'-5" x 22'-10"	= 192 SF
(Less Int. Stg.) 6'-7" x 8'-4"		= - 46 SF
C	28'-5" x 26'-2"	= 744 SF
D	12'-0" x 7'-0"	= 84 SF
E	9'-10" x 6'-4"	= 62 SF
(Less Laundry) 9'-10" x 6'-4"		= - 62 SF
F	8'-0" x 2'-0"	= 16 SF
(Less corners) 2'-0" x 2'-0" x 2 x 1/2		= - 4 SF
Total Net		1,851 SF

"Benchmark" 1,860 SF

