

MIL-HDBK-1035
15 JUNE 1989
SUPERSEDING
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AUGUST 1971

MILITARY HANDBOOK

FAMILY HOUSING



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ABSTRACT

Design criteria for use by experienced architects and engineers are presented for facilities covered by category code 711. The contents include criteria for Department of Army and Navy Family Housing projects. This includes architectural, mechanical, and electrical requirements. Each Family Housing project designed according to the criteria in this text should also be a unique response to specific site constraints and project requirements.

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FOREWORD

This handbook is one of a series and has been developed from an evaluation of Department of Army and Navy Family Housing criteria and recent experiences, the availability of new materials and construction methods, and from selection of the best design practices of the Department of Army Corps of Engineers (COE), the Naval Facilities Engineering Command (NAVFACENGCOM), other Government agencies, and the private sector. This handbook uses, to the maximum extent feasible, national professional society, association, and institute standards in accordance with Department of Defense (DOD) policy. Deviations from these criteria should not be made without prior approval of COE or NAVFACENGCOM Headquarters as applicable.

Design cannot remain static any more than can the DOD functions it serves or the technologies it uses. Accordingly, recommendations for improvement are encouraged from within the Army, the Navy, other Government agencies and from the private sector. Recommendations should be furnished on the DOD form 1426 provided inside the back cover to Commander, Naval Facilities Engineering Command, Code DS02, 200 Stovall Street, Alexandria, VA 22332-2000; phone commercial (202) 325-0450, Autovon 221-0450.

THIS HANDBOOK SHALL NOT BE REFERENCED WITHIN BID DOCUMENTS FOR A COMPETITIVELY BID PROJECT. IT MAY BE REFERENCED IN DOCUMENTS FOR PROCUREMENT OF HOUSING BY THE TURNKEY PROCESS.

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Section 1: INTRODUCTION

1.1 SCOPE. This military handbook, MIL-HDBK-1035, provides criteria for the design or acquisition of Army and Navy Military Family Housing and associated facilities. These criteria may be used in developing a "whole house" project scope of work, for improvement, or repair. Serviceable existing construction or equipment shall not be replaced solely on the grounds that it does not comply with criteria set forth in this handbook.

1.2 APPROPRIATE USE. This handbook shall not be referenced within bid documents for a competitively bid project. It may be referenced in documents for procurement of housing by the turnkey process.

1.3 CANCELLATION. This handbook, MIL-HDBK-1035, dated June 15, 1989, cancels and supersedes NAVFAC DM-35 dated August 1971.

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Section 2: BASIC CONSIDERATIONS AND APPLICABILITY

2.1 LEGAL BASIS. Public Law 97-214, Title 10 USC, Section 2826 establishes net area limitations for military family housing. The law permits a 5 percent maximum increase or decrease in these limitations if such a modification will permit a turnkey proposer to offer "off-the-shelf" designs currently being constructed in the commercial marketplace.

2.1.1 Net Area Definition. Net area is defined as the space inside the exterior and party walls. Net area excludes:

- a) Exterior and party walls,
- b) Half thickness of interior walls adjacent to excluded areas,
- c) Utility and laundry rooms,
- d) Interior and exterior bulk storage,
- e) Washer and dryer closet (not to exceed 30 ft²),
- f) Furnace, domestic water heater and solar equipment spaces,
- g) Stairwells,
- h) Landings (not to exceed 10 ft²),
- i) Walls and interior spaces specifically designed for passive solar systems (other than required habitable areas),
- j) Weather vestibules (not to exceed 16 ft²) sheltering the main entry,
- k) Unfinished attic and basement space,
- l) Patios/balconies and terraces,
- m) Carports and garages,
- n) Increases required to meet accessibility standards,
- o) Open or screened porches without heating, air conditioning, or interior-type finishes. In localities subject to adverse weather conditions, such as wind-driven mist or noxious atmosphere, or both, open porches may be enclosed with appropriate fenestration or screening, or both, and not considered to increase the net area of the living units, provided that air conditioning or heating, or both, is not added and the basic character of the enclosed area is still that of a porch.

2.1.2 Statutory Floor Area Limitations. Statutory floor area limitations for living units are listed in Table 1. Net floor area may be increased by a maximum of 10 percent for officers holding special command positions as

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designated by the Secretary of Defense, commanding officers of military installations, and senior noncommissioned officers of military installations. The increase allowed for the above designations is the maximum allowed regardless of whether the units are procured by conventional design/bid or turnkey methods.

Table 1
Maximum Size of Living Units by Pay Grade

PAY GRADE	NUMBER OF BEDROOMS	NET FLOOR AREA (ft ²)
0-7 and above	4	2,100
0-6	4	1,700
0-4 and 0-5	4	1,550
	3	1,400
0-1 TO 0-3, W-1 TO W-4, and E7 to E9	5	1,550
	4	1,450
	3	1,350
	2	950
E1 through E6	5	1,550
	4	1,350
	3	1,200
	2	950

Note: Net floor area may be increased by a maximum of 10 percent for certain commissioned and noncommissioned officers as noted in para. 2.1.2.

2.1.3 Utility Metering For Military Family Housing. Metering of all applicable utilities shall be as follows:

a) Master meters for water, electricity, and gas shall be provided for all new housing units except where new units are metered by an existing meter.

b) Individual utility meters shall be provided for all new detached single family units and for other types when required by local jurisdictions.

c) Individual meter drops, sockets, and fuel oil metering points (where applicable) shall be provided for all other new dwelling units other than single family units.

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2.1.4 Site-Built, Factory-Built, and Manufactured-Housing Units. Unless otherwise stated, all continental U.S. (CONUS) project RFP's shall include the option of providing site-built, factory-built, or manufactured-housing units. Conventional designed/competitively bid projects may offer the option of using any of these three types.

2.1.4.1 Definitions. Terms for housing types used in these criteria are defined as follows.

a) Site-built housing -- a residential building or dwelling unit wholly or substantially constructed at the site. It is also commonly referred to as "stick-built".

b) Factory-built housing -- construction consisting of component subassemblies such as 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 must be fabricated (panelized). Panels must be fabricated to the extent that the structure of the panel or truss is factory-assembled in the United States. Finishes such as interior wall board may be site applied.

c) 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 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 320 or more square feet, and which is built on a permanent foundation when connected to the required utilities, and includes the plumbing, heating, air conditioning and electrical systems contained therein."

2.1.5 Energy Conservation. Public Law 100-615 and Federal Regulations 10 CFR 435 Subpart B, 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. Requests for proposal shall contain prescriptive and trade-off approaches that produce energy efficient design and construction. These approaches should be geared to prevailing local practice for energy efficient housing.

Additional criteria are provided in MIL-HDBK-1190 (Navy), and Architectural and Engineering Instructions (Army).

2.1.6 Noise Levels. The Noise Control Act of 1972, 42 USC. 4901-4918 (1976) and 49 USC 1431 (1976) requires Federal agencies and state and local governments to develop measures to control the harmful effects of noise on people. In response to this act, the Department of Defense (DOD) established DODINST 4165.57 (Nov. 8, 1977), Air Installation Compatible Use Zones. Implementation of these requirements is covered in Department of Navy OPNAVINST 11010.36A (April 11, 1988) and NAVFAC P-971, Airfield and Heliport Planning Criteria (a tri-service manual).

In general, military family housing sites including mobile home parks should be restricted to Noise Zone 1 having a rating of 0-55 Day-Night

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Average Level (DNL) in Ldn. In no case should the DNL exceed 65. These standards also apply to housing sites near heavily traveled highways.

2.1.7 Obstruction And Safety Clearances. In addition to noise zones, obstruction and safety clearances at airfields must be considered when planning housing projects. The applicable requirements stipulated in NAVFAC P-971 and in NAVFAC P-80.3, Facility Planning Factor Criteria for Navy and Marine Corps Shore Installations, Appendix E ("Airfield Safety Clearances"), shall be followed.

2.2 DOD POLICY. DOD policy and technical guidance for planning and design of military family housing is stipulated in MIL-HDBK-1190. These policies and guidelines are applicable to all military family housing projects.

2.3 BUDGET PREPARATION. The Departments of Army and Navy publish detailed planning, programming and budget guidance based on annual guidance issued by DOD. In implementing this guidance care must be exercised to ensure that the data provided is properly displayed and is reflective of current guidance.

2.3.1 DD Form 1391. This form is used to display the estimated cost for projects included in the annual request for funding to the Congress. Figure 1 is an example of a properly executed DD Form 1391. This example shall be followed in preparing DD Form 1391 for annual programs.

2.3.2 Tri-Service Cost Model. The Departments of Army, Navy and Air Force developed a family housing cost model designed to improve the accuracy of cost estimates supporting military family program request to the Congress. The cost model is based on the assumption that cost of construction is impacted by factors other than programmed number of units and cost per net square foot (net ft²). Figure 2 is the cost model depicted on the sample DD Form 1391, Figure 1.

2.3.2.1 Project Factors. The factors impacting project cost are:

a) Area Cost Factor (ACF). The ACF is used to adjust unit cost to the geographic area in which projects will be constructed.

b) Project Size Factor (PSF). The PSF indicates the impact that project size has on cost and reflects the economies of scale. The larger the project the lower the unit cost.

c) Unit Size Factor (USF). The USF assumes that like project size, unit size impacts cost and that larger units have a lower cost per square foot.

d) Project Factor (PF). The PF is obtained by multiplying the ACF by PSF and USF (ACF x PSF x USF = PF). Figure 2 illustrates this procedure.

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1. COMPONENT NAVY	FY 19 <u>91</u> MILITARY CONSTRUCTION PROJECT DATA			2. DATE		
3. INSTALLATION AND LOCATION NAS Flyway, UT			4. PROJECT TITLE Family Housing			
5. PROGRAM ELEMENT	6. CATEGORY CODE 711	7. PROJECT NUMBER H-123	8. PROJECT COST (\$000) 24,330			
9. COST ESTIMATES						
ITEM	U/M	QUANTITY	UNIT COST	COST (\$000)		
Family Housing:	FA	260	57,195	14,871		
Buildings	SF	284,500	50.30	(14,309)		
Solar System	LS			(562)		
Supporting Costs:				7,090		
Paving & Site Improvements				(3,220)		
Utilities				(2,147)		
Landscaping				(787)		
Recreation				(172)		
Special Construction Features				(644)		
Demolition				(120)		
Sub Total				21,961		
Contingency (5%)				1,098		
Total Contract Cost				23,059		
Supervision, Inspection, & Overhead (5.5%)				1,268		
Total Request				24,327		
Total Request (Rounded)				24,330		
10. DESCRIPTION OF PROPOSED CONSTRUCTION						
Two story family housing units; wood frame or masonry with stucco or pre-finished siding, covered parking, patios, exterior storage, privacy fencing and recreational facilities.						
		Net	Project	Unit	No.	(\$000)
<u>Grade</u>	<u>Bedroom</u>	<u>Area</u>	<u>Factor</u>	<u>Cost</u>	<u>Units</u>	<u>Total</u>
JEM	2	950	1.0478	\$48.00	100	4,778
JEM	3	1200	1.0478	\$48.00	50	3,018
JEM	4	1350	1.0478	\$48.00	30	2,037
SEM	2	950	1.0478	\$48.00	50	2,389
SEM	3	1350	1.0478	\$48.00	20	1,358
SEM	4	1450	1.0478	\$48.00	10	729
					260	14,309

DD FORM 1391
1 DEC 76
8/N 0102 LA 001 3910

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Figure 1
DD Form 1391 for Example Project

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DOD FAMILY HOUSING COST MODEL

SERVICE: DON	LOCATION: NAS Flyway, UFF	O'SEAS: (Y/N)	N	YEAR: (91)				
BASELINE								
(	260	) (	1094	) (	48	) =	\$13,656	(\$000)
(	# OF UNITS	) (	AVG NET SF	) (	\$/NSF	) =	5' LINE	
PROJECT FACTORS:								
(	1.08	) (	.98	) (	.99	) =	1.048	
(	ACF	) (	PROJ SIZE FAC	) (	UNIT SIZE FA	) =	PROJ FAC	
HOUSING COST:								
		(	\$13,656	) (	1.048	) =	\$14,309	
		(	5' LINE COST	) (	PROJECT FACTOR	) =	HSG COST	
(	\$2,000	) (	1.08	) (	260	) =	\$562	
(	/UNIT SOLAR	) (	ACF	) (	UNITS	) =	T. SOLAR	
(	14,309	) + (	\$562	) / (	260	) =	57.195	
(	HSG COST	) + (	SOLAR COST	) / (	UNITS	) =	AVG UNIT	
SUPPORTING COST:								
	PAVING AND SITE IMPROVEMENTS						3,220	
	UTILITIES						2,147	
	LANDSCAPING						787	
	RECREATION						172	
	SPECIAL CONSTRUCTION FEATURES						644	
	DEMOLITION						120	
	29.1% OF TOTAL HOUSE COST						SUPPORT COST:	\$7,090
SUMMARY:								
(	\$14,309	) + (	\$562	) + (	\$7,090	) =	21,961	
(	HSG COST	) + (	SOLAR COST	) + (	SUPPORT COST	) =	SUBTOTAL	
(	\$21,961	) + (	\$1,098	) + (	\$1,268	) =	24,327	
(	SUBTOTAL	) + (	CONTINGENCY	) + (	SIOH	) =	PROJ TOTAL	
					ROUND:		24,330	
(	\$24,327,000	) / (	260	) / (	1147	) =	\$81.58	
(	PROJECT COST	) / (	UNITS	) / (	ANSF*PROJ FAC	) =	PROJ \$/NSF	

PROJECT SIZE FACTOR
(= OF UNITS)

1 - 9 = 1.15
10 - 19 = 1.10
20 - 49 = 1.05
50 - 99 = 1.02
100 - 199 = 1.00
200 - 299 = 0.98
300 - 499 = 0.96
500+ = 0.95

UNIT SIZE FACTOR
(AVE NSF)

600 - 749 = 1.05
750 - 849 = 1.03
850 - 949 = 1.01
950 - 1050 = 1.00
1051 - 1150 = 0.99
1151 - 1250 = 0.98
1252 - 1350 = 0.97
1351+ = 0.96

Figure 2
Cost Model for Example Project Shown in Figure 1

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2.3.2.2 Cost/Net Square Foot. The cost of family housing to the 5-foot line is based on net ft² rather than gross ft² in order to have a direct relationship to the statutory space limitations. Annual program guidance will establish the tri-Service baseline cost/net ft² for use in generating project estimates.

2.4 HOUSING ACQUISITION PROGRAMS. For detailed guidance see NAVFAC P-930, Navy Family Housing Manual, and Army Regulation 210-50, Family Housing Management. The criteria in this handbook apply to all acquisition programs for military family housing programs.

2.4.1 Military Construction Program. Projects for the construction of military family housing are included in the annual program presented to the Congress by DOD.

2.4.1.1 CONUS (Continental U.S.). Construction may be accomplished either by conventional or turnkey methods. Conventional construction involves the use of in-house effort or contract architect-engineer services for the planning and design of a construction project. On the basis of the approved plans and specifications, bids are solicited and a contract is awarded for the new construction. The turnkey method provides for the solicitation of proposals from contractors based on the requirements for housing and design criteria. Based on a review of the plans that are submitted, an award is made and the contractor then undertakes the execution of the project. Upon satisfactory completion, the units are turned over to DOD.

2.4.1.2 Overseas. Construction projects in overseas locations shall utilize to the greatest extent possible "factory built" or "manufactured housing" or "concrete housing" in accordance with Public Law 98-407, August 28, 1984. Overseas housing--including materials, equipment, appliances and systems--shall be procured in the United States, unless prohibited by country-to-country agreements.

2.4.1.3 Purchase of Existing Housing. When a construction program is authorized by the Congress, existing private housing (for projects of 35 units or more) may be acquired in lieu of construction if the Office of the Secretary of Defense (OSD) determines it is in the best interest of the Government to do so. NAVFAC P-930 provides detailed procedures for acquiring existing family housing in lieu of construction.

2.4.2 Build to Lease Program (801). Public Law 98-115 as amended allows the services to procure housing using private sector funding. Section 801 housing may be constructed on Government or private land. Housing must be new construction built for the purpose of lease to the Government. The lease term is for 20 years, after which the private developer is free from any obligation to the Government. Lease cost to the Government will be capped on a project by project basis.

2.4.2.1 801 Request for Proposals (RFP). A request for proposals shall be carefully structured to allow consideration of a wide range of housing. RFP's should clearly indicate:

- a) The required location of housing.

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b) That rent is to exclude operation and maintenance and utility cost. In metered units, the cost of utilities normally shall be the responsibility of the government.

c) Detailed DOD technical requirements and cost.

d) Administrative requirements including how to receive a proposal number, where to submit the proposal, late submission information and the number of copies required.

e) Bid bonding requirements normally equal to 10 percent of the first years rent but not to exceed one million dollars (\$1,000,000).

2.4.2.2 Proposals. Proposals shall be in three parts as detailed below.

a) Part 1 -- Location. The location proposal consists of a description of the proposed site and certification that the site will be able to support the proposed housing. It will include details concerning required zoning permits, applicable codes, availability of utilities, and evidence that the offeror controls the property. This part will also address a list of environmental concerns.

b) Part 2 -- Technical. The technical proposal will contain information to allow evaluation of the design, construction, and maintenance aspects of the proposal. This part of the proposal will be at level of detail consistent with preliminary design and will show the proposed layout, materials, equipment, and the maintenance plan.

c) Part 3 -- Price. The price proposal requires information concerning the proposed rent schedule. This section also requires acknowledgement of all amendments to the RFP, acceptance of the terms of the RFP and the provision of information on the qualifications and experience of the development team. The rent schedule, which is essentially the cost of the proposal, consists of shelter rent, which corresponds to reimbursement for construction, land purchase, debt service, and other capital expenses, and profit. If the government should waive the requirement that maintenance be provided under a separate contract, the maintenance rent corresponds to reimbursement for operation (except Government-paid utilities) and maintenance of the occupied units. The shelter rent will remain constant throughout the life of the lease (20 years) while the maintenance rent will be adjusted each year to reflect an economic indicator. To ensure that sufficient funds are available for maintenance, the maintenance rent must be greater than 17 percent of the shelter rent. Bid bond must be included.

2.5 FOREIGN SOURCE HOUSING. Various host countries provide facilities to support the U.S. military presence in that country. When the host country provides military family housing, it shall be constructed to the standards provided herein to the extent practical. Adjustments may be made to accommodate local conditions (i.e., local density practice, car parking, utility systems requirements, etc.) so long as they do not exceed the standards for normal U.S. military construction. To the extent practical

in order to avoid delays to the host country's schedules. Architectural design shall be sensitive to local aesthetic tastes.

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Local building codes and standards may be used, except that U.S. life safety and fire protection standards shall not be waived or otherwise compromised. Security fencing and lighting standards shall be commensurate with the need. When the lawful or "normal construction practice" of the host country will not allow provision of certain amenities, such as air conditioning, supplemental funds shall be programmed for timely completion of the additional work.

Particular attention should be given to the local practice of long-term facility maintenance, which may differ from U.S. standards and provisions be made for selection of materials and finishes that can be easily maintained.

2.6 HANDICAPPED REQUIREMENTS. No less than five percent of each unit type at each site shall be single-story ground floor units. These units shall be designed in such a way that they may be easily converted to accommodate handicapped occupants, if necessary at a future time, i.e., blocking in walls for future grab bars, etc. Doors between habitable rooms shall be a minimum 2 ft-10 in. wide, and front entry doors shall be a minimum of 3 ft wide (0.9 m). Unit entrances, bathroom and kitchen design, room size, garages (if provided), plumbing fixture layout, light switches and thermostats shall conform to Uniform Federal Accessibility Standards and ANSI A117.1, Buildings and Facilities -- Providing Accessibility and Usability for Physically Handicapped People.

Handicap requirements do not apply to overseas locations.

2.7 APPLICABILITY TO EXISTING FACILITIES

2.7.1 Improvement Projects. The criteria contained in this handbook shall be used to the extent possible in the development of projects to correct health, safety or major livability problems. Projects should not be generated for the sole purpose of meeting the criteria in this handbook.

2.7.2 Repair Projects. The technical criteria in this handbook should be used as guidance in developing repair projects where applicable.

2.8 HEALTH AND COMFORT REQUIREMENTS. Indoor air quality shall be maintained by specifying non-air polluting materials, by maintaining adequate levels of outdoor ventilation and by filtering air sufficiently.

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Section 3: PROJECT DEVELOPMENT

3.1 GENERAL. This section addresses the process of project development in general. More detailed coverage of the topic occurs in Army Regulations AR 210-50, AR 415-15, Military Construction, Army (MCA) Program Development, NAVFAC P-930 and other sections of this handbook. The process includes:

- a) Advance Planning -- Identifying what needs to be done and setting the goals and objectives for satisfying these needs.
- b) Programming -- Translating goals and objectives into action while considering alternatives, tradeoffs, and the need to balance requirements against limited resources.
- c) Budgeting -- Developing detailed funding estimates to support plans and programs and obtaining resources needed to execute them.

3.1.1 Project Development. The development and execution of the Army and Navy Family Housing MILCON Program is the responsibility of the Chief of Engineers for the Department of Army and COMNAVFACENGCOM for the Department of Navy.

3.1.1.1 Family Housing Survey and Advance Planning. The Departments of Army and Navy rely on the local community as the primary source of suitable housing for military families. When the local community is not capable of meeting the need, acquisition of family housing will be programmed. The family housing requirements survey is the first phase in the planning process. Properly executed, it will be the basis for determining the family housing requirements and supporting acquisition programs. When the requirements survey is approved at headquarters level it triggers the balance of the advance planning activity. Figure 3 shows project development process and normal time line.

In planning, consider the following:

- a) Project scope and cost limits. The scope of each family housing construction project shall provide for land acquisition, planning, site preparation, design, construction, initial equipment, and support facilities such as roads, streets, walks, utility systems, landscaping, and parking areas. The maximum development cost, including supervision, inspection, and overhead, and number of dwelling units for each project is fixed by law for each construction project location.
- b) Preliminary Planning. It is particularly important that close attention be given to the thoroughness and soundness of preliminary planning actions taken on proposed family housing construction projects. DOD relies on the results of the preliminary planning actions by the military departments to support what they present and defend before the Congress. After legislative enactment, DOD gives close attention to any changes or problems which arise during the design and development period and which relate to decisions made during the preliminary planning period.

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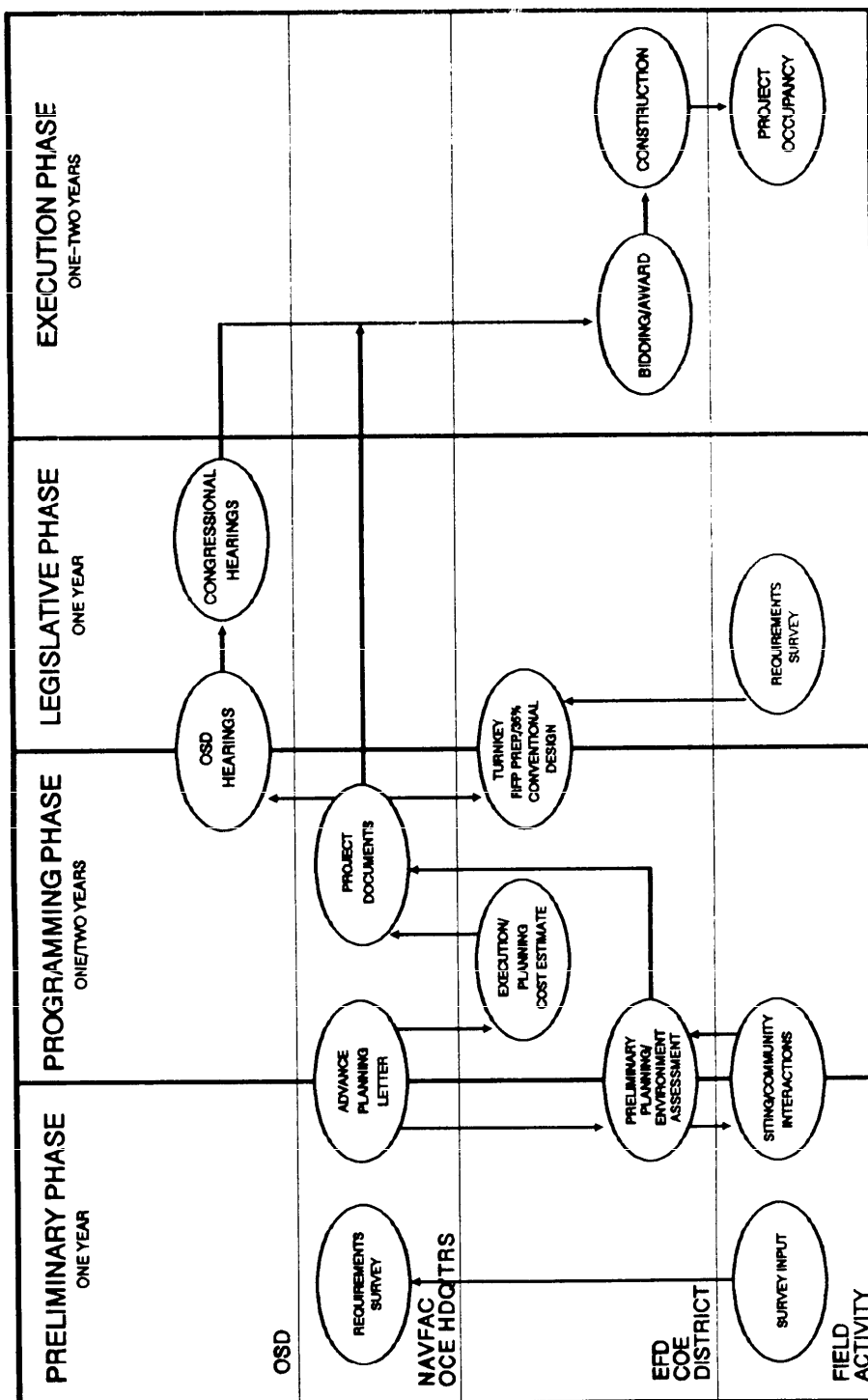


Figure 3
Project Development Process and Normal Time Line

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3.1.1.2 Site Selection. The selection of a housing site will be in accordance with specific guidance issued for each project for the Department of Army and NAVFACINST 11010.63, Planning Services for Navy and Marine Corps Activities, for the Department of Navy.

3.1.1.3 Site Data. For proposed on-post/station projects, the Corps of Engineers (COE) District for Army projects, the Engineering Field Division (EFD) for Navy projects provides the Chief of Engineers and COMNAVFACENGCOM respectively with data on the candidate sites. Such data should include:

a) Field activity general development map showing the proposed family housing sites.

b) Large-scale plan of the housing site showing the site boundaries and acreage, the number, and types of units to be situated on the land, any waivers required, and the points of connection to the station basic utility systems. Location of the housing structures and street patterns within housing site boundaries is not required.

c) Identification of potential problems associated with candidate sites and their impact on site engineering, construction execution, abnormal cost increases, environmental impacts, community relations, required waivers, and any other applicable impacts, in the preliminary planning submittal. The alternatives available and the estimated cost impact should also be presented. These steps must be taken with each project to reduce the possibility of having projects rejected by the OSD and the Office of Management and Budget (OMB).

d) If land acquisition is required, a map showing the proposed location, parcel boundaries, estimated acreage, estimated acquisition cost, and other pertinent information.

e) Waivers required from planning, design and construction criteria. These may include runway centerline distances, Air Installation Compatible Use Zones (AICUZ), and explosive safety quantity distances. Include the impact of these factors on the estimated project development cost.

3.1.1.4 Master Plans. Post/station Master Plans shall include family housing requirements. Comprehensive Master Plans provide guidance for DOD management of installation resources and provide a systematic process to control orderly growth of the installations. Family Housing Master Plans shall document existing assets and conditions, and identify future development plans and the ability to respond to changing conditions. Master planning shall be in accordance with MIL-HDBK-1190 and Army Regulation AR 210-20, Master Planning of Army Installations, TM-5-803-1, NAVFACENGCOM Instruction 11010.63B, Planning Services for Navy and Marine Corps Activities, and the applicable portions of this handbook.

3.1.1.5 Environmental Effects. Environmental effects of alternative approaches to providing required family housing and supporting facilities shall be analyzed and evaluated with a view toward enhancing the environmental effects. In accordance with the requirements of the National Environmental Policy Act (NEPA) 42 USC 4321-4361 and MIL-HDBK-1190, environmental effects shall be considered in the planning of projects and proposals including those

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for family housing. A preliminary environmental assessment should be made at the earliest stages of project development. A written environmental assessment shall be proposed for all family housing projects and made a part of the planning record. For those projects having a significant impact on the environment, or anticipated to be controversial, an environmental impact statement shall be prepared and processed in accordance with DOD Directive 6050.1, Environmental Effects in the United States of DOD Actions.

These statements shall be developed as soon as sufficient project information is available. The annual submission of the Military Construction Program shall include a statement that the necessary environmental studies have been performed and considered in project designs.

3.1.1.6 Land Procurement Options. It is preferable to utilize Military Department owned on-station or off-station sites for family housing projects. When neither of these options are feasible, land may be procured from other Government agencies or non-Government sources.

3.1.1.7 Site Evaluation. Selection of candidate sites for procurement shall be based on the following criteria.

a) Transportation. Public transportation should be adequate to satisfy the work schedules and other requirements of parents and school children.

b) Commuting Time. Off-station sites should be located within one hour commuting distance (one-way) during rush hours by private transportation, preferably much less. (Toll charges, if any, should be noted.)

c) Terrain. Sites requiring excessive cut and fill, elaborate drainage system, or extensive excavation in bed rock should be avoided.

d) Proximity to existing utilities. Because of the high cost of constructing utility mains, consideration must be given to the proximity of the site to existing utilities such as water, electricity, gas, storm and sanitary sewer, and to gravity flow in storm and sanitary sewers. The impact of the proposed project on the existing utility systems should be evaluated.

h) Clearance for sewage treatment plants.

e) Proximity to community facilities. Consideration should be given to the distance to schools, churches, stores, and fire protection facilities.

f) Ordnance Explosive Safety Distances.

g) Proximity to airfields, highways and other sources of noise and hazards.

h) Freedom from soil contamination.

i) Potential for passive solar orientation.

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3.1.1.8 Procurement of Sites Near Airfields. When considering sites near civilian or military airfields, the acoustical requirements and safety clearances criteria stipulated in Section 2 are applicable.

3.1.1.9 Land Exchanges. Prior to requesting authority to procure land with appropriated funds, the feasibility of a land exchange with local entities should be thoroughly investigated.

3.1.2 Site Engineering Investigation. Prior to purchasing a site for military family housing projects or designing projects for government-owned land, a thorough site engineering investigation should be considered. Such an investigation shall consider the following factors:

a) Existing utilities on the site, adjacent to the site or the non-existence of utility support. In each instance the cost of providing appropriate utility support for the proposed project(s) shall be addressed.

b) Infrastructure items such as existing access roads and existing on-site streets.

c) Geotechnical conditions. A geotechnical investigation should be conducted for each project. The resulting report should be based on a subsurface exploration plan designed to incorporate a unique set of project-specific factors.

d) Radon and other contaminants. An investigation should be conducted to determine if the site contains radon or other contaminants that will impact on the safe use of the site for family housing.

e) Archeological potential. An archeological investigation should be conducted for sites being considered to ensure that the site does not include anything that will prohibit its use as a housing site.

f) Defense access roads. A determination should be made as to whether Defense Access Roads Programming is required to make the project feasible.

3.1.3 Cost Estimates. Cost estimates for the procurement and/or development of sites shall reflect the impact of the findings from all investigations.

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Section 4: FAMILY HOUSING CRITERIA

4.1 GENERAL REQUIREMENTS. Family housing projects shall be designed to be compatible with the environment in which they are to be constructed. For projects to be compatible with the environment, they must respect and be in harmony with the architectural character of their neighbors. The design and technical criteria contained and cited in this handbook are intended to set minimum standards for design quality.

4.1.1 Definitions of Housing Types. Terms for housing types used in these criteria are defined as follows:

a) Apartments -- living units on a single floor served by a central corridor. Apartment buildings of this type may be 1 to 3 stories.

b) Flat -- living units on a single floor with direct entry from a stairway landing. 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 stairway is required. Normally, no more than two units will be served by each stair landing.

c) Duplex -- two one- or two-story living units joined together by a common party wall and each unit entered directly from the exterior. (Refer to Table 4).

d) Townhouses -- living units with the walls on two opposite sides of which are party, lot line or common walls. Configurations such as quadruplexes and triplexes containing living units with two-party, lot-line or common walls not necessarily opposite to each other may be considered townhouses.

e) Detached house -- a single-family dwelling which is not attached to another dwelling.

4.2 SITE. A major site planning objective is to ensure an interesting, attractive, livable residential environment and to utilize the potential advantages of the site. Planning shall take into consideration topography, existing trees worth retaining, natural characteristics of the environs, climatic conditions, and prevailing winds. Design should capitalize upon economics inherent in the natural character of the site, using existing terrain to minimize cut and fill, reducing street frontage, and consolidating utilities and common open spaces. Variety in groupings, arrangements, and siting configurations of houses is encouraged to fit varying terrain conditions and to provide attractive residential patterns and streetscapes. Building arrangements should be informal and imaginative with setbacks and orientation to provide for the best view, privacy and variety. The proper grouping of units will provide backyard screening, separation of pedestrian and vehicular traffic, recreation, and natural open spaces.

The environment and natural setting of the sites should be maintained during and after construction by providing houses that accommodate the existing topography and by selective cutting of the trees and/or shrubs.

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Excessive cutting, filling, and recontouring of the site is not desired. Avoid site clearing which removes and/or destroys trees without preserving groups of trees in front of, between, behind, and/or around the houses.

Where appropriate, housing should be oriented within 20 degrees east or west of true South, so that a major section of roof faces within 20 degrees of South.

4.2.1 Land Use. Provide an optimum balance of unit floor area, open space, recreation space, and pedestrian and vehicular circulation consistent with good land planning practices and economics. Minimize paving area.

4.2.1.1 Density. 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 3 acres (12,000 m²) may be excluded from the density calculation and services may use midrise construction if special conditions exist which require departure from these standards. Density guidelines are listed below:

a) Low density siting -- appropriate when existing Government land is readily available for residential use.

b) Medium density siting -- appropriate when Government land is in short supply, private sector land can be purchased for reasonable prices (less than 15 percent of unit cost) or local land use practice dictates.

c) High density siting -- required when Government land is in extremely short supply or unavailable, land purchase is costly (greater than 15 percent of the unit cost), the surrounding zoning is urban, or local land use practice dictates.

Tables 2 through 6 present design considerations according to density. Table 2 lists numbers of dwelling units per acre to be provided for various grades. Table 3 lists building types and Table 4 lists maximum number of units per building. Table 5 lists required parking spaces and Table 6 lists minimum recreation requirements.

4.2.1.2 Noise. Use site design techniques such as building location and orientation, window placement, and barriers to moderate predictable undesirable noise.

4.2.1.3 Floodplains and Flood Areas. Family housing should be sited beyond the hundred-year-flood water line. A hundred-year flood is a flood of such extent that it may be expected to occur only once every hundred years. Maps of flood-prone areas and flood lines mapped before 1972, streamflow data, and engineering properties maps are available from the U.S. Geological Survey, its local field offices, and some State geological surveys. More recent flood zone maps are available from the Federal Emergency Management Agency.

If siting in a floodplain or flood area is considered necessary, follow the procedures stipulated in MIL-HDBK-1190.

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Table 2
Dwelling Units Per Acre by Density

RATE/RANK	LOW	MEDIUM	HIGH
E6 & LOWER	4-7	8-10	11-15
E7 - E9 01 - 03	3-5	6-9	10-12
04 - 05	2.5-3	4-5	6-9
06	2	3	4-6
GO/FLAG	1	2	3-4

Table 3
Dwelling Unit Type by Site Density

CONFIG.	LOW DENSITY	MEDIUM DENSITY	HIGH DENSITY
2 bedroom E-1 - E-9 W-1 - W-4 0-1 - 0-3	Detached or duplex	1-2 story apartment, flat or townhouse	2-3 story apartment, flat or townhouse
3, 4, or 5 bedroom E-1 - E-9 W-1 - W-4 01 - 03	Detached or duplex	1-2 story apartment, flat, or townhouse	1-2 story apartment, flat or townhouse
3 or 4 Bedroom 04 - 05	Detached or duplex	1-2 story duplex or townhouse	1-2 story duplex or townhouse
4 Bedroom 06 - 09	Detached	Detached	Detached

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Table 4
Maximum Units Per Building by Grade

	E6 & LOWER	E7-E9, CGO	FGO
APARTMENTS/FLATS	12	8	---
TOWNHOUSE	8	6	4
DUPLEX	2	2	2

Table 5
Parking Requirements by Site Density

Low Density	Two off-street spaces and 1 on-street guest space.
Medium Density	Two off-street spaces and 0.5 on-street guest spaces (1 on-street guest space per 2 units).
High Density	Two off-street spaces and 0.25 on-street guest spaces (1 on-street guest space per 4 units).

Table 6
Recreational Facility Requirements Per Number of Units

Tot lots	One tot lot per 30 dwelling units
Basketball Court	One full court per 50 dwelling units
Handball Courts	One per 50 dwelling units
Recreation Field	One 5 acre parcel per 100 dwelling units (may be omitted at high density sites.)
Jogging Path	One per project, with exercise stations.
Recreational Vehicle Storage (Where Required -- Prohibited at High Density Sites)	One 10-ft x 20-ft (3 x 6 m) space per 20 dwelling units. Area shall include 6 ft (2 m) high chain link security fencing and security flood lighting of 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.

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4.2.2 Building Setbacks and Spacing. Clearances between and adjacent to buildings must consider requirements for fire protection, safety, privacy, and emergency access.

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 6 ft (2 m) 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. Table 7 presents minimum required separations for low density sites. Table 8 presents building setbacks and spacing for medium and high density sites.

Table 7
Minimum Setbacks and Spacing -- Low Density Sites

From front of house to curb:	25 ft (7.6 m)
From house to major highway (edge of pavement):	150 ft (45 m)
From house to collector street (edge of pavement):	100 ft (30 m)
Side of carport or garage to curb:	20 ft (6 m)
Side of house to curb:	20 ft (6 m)
Between sides of carports or garages attached to houses:	16 ft (5 m)
Between outside walls of houses:	20 ft (6 m)
Note: When patios are located within the side yard, provide a 40-ft minimum separation.	
Between rear walls of houses:	80 ft (24 m)
Between side wall and rear wall of houses:	40 ft (12 m)
Between street face of carport or garage to curb when the second off-street space is perpendicular to the carport or garage:	8 ft (2.5 m)
Between the street face of carport or garage and curb when the second off-street parking space is tandem to the carport or garage:	28 ft (8.5 m)

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Table 8
Minimum Setbacks and Spacing -- Medium and High Density Sites

Building to Building (each yard)	
Wall A	6 ft (2 m) + 2 ft (0.6 m) for each level + 5 percent wall length)
Wall B	4 ft (1.2 m) + 1 ft (.03 m) for each level + 5 percent wall length)
Wall C	7-1/2 ft (2.3 m) minimum
Building to street (face of curb)	
Wall A	20 ft (6 m)
Wall B	15 ft (4.5 m)
Wall C	10 ft (3 m)
Carport to street (face of curb)	
Front	8 ft (2.5 m)
Side or Back	15 ft (4.5 m)
(Detached carports may be located up to the property line or project boundary).	
Driveway length for parking, measured from face of curb.	
To park one car	20 ft (10.5 m)
To park two cars	40 ft (12 m)
Building to retaining wall with a height of 4 ft. or more, above a floor with windows.	
Wall A	15 ft (4.5 m)
Wall B	7-1/2 ft (2.3 m)
Wall C	5 ft (1.5 m)
WALL DEFINITIONS:	
Wall A	Contains the dwelling unit main entrance; or the principal window(s) of the living room, dining room, family room, or a balcony.
Wall B	Contains window(s) other than in wall 'A'.
Wall C	Contains no windows.

- NOTES:
1. Projections into required yards shall not exceed 40 percent of the setback (yard) distance.
 2. Where slope is 3:1 or steeper, top and toe of slope shall be a minimum of 15 ft (4.5 m) from the building.
 3. Courts, outer and inner, shall not be less than the sum of required yard distances. An inner court shall have a minimum of 100 ft² (9.3 m²) for a one-story building and an additional 50 ft² (4.6 m²) for each additional story.

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4.2.3 Streets, Roads, and Parking. The street system shall provide convenient and safe access and circulation (including collections, deliveries, and fire protection) within the housing area. Terms for street and road types used in these criteria are defined as follows:

a) Nonresidential Streets

Arterial: Major road/street systems external to residential area.

Collector: Feeder street connecting external street system with residential streets in the subdivision and adjoining areas subject to future development. No houses shall be located on collector streets.

b) Residential Streets

Loop: Both ends open to traffic.

Cul-de-sac: Only one end open to traffic and a turnaround (T, Y, or circle) at the other end.

Court: A compact cul-de-sac providing common parking for overflow.

4.2.3.1 Street Layout. In designing streets and roads for family housing, the following criteria shall be considered.

a) Avoid rigid gridiron-like street and building layouts. Layout should relate to the natural contours of the site and should take into account adverse weather conditions such as snow and ice.

b) Avoid street patterns which encourage on-post vehicular traffic through housing areas. Circulation plans based on cul-de-sacs are more desirable. Houses should be clustered around cul-de-sacs and courts whenever possible. Cul-de-sacs shall be maximum of 750 ft (180 m) in length measured from the center of the cul-de-sac to the centerline of the pavement of the connecting streets.

c) Avoid loop streets that are either excessively long or excessively short (forming small islands with few dwelling units surrounded by streets).

d) Limit the number of intersections. Avoid four-way intersections and intersections near the crests of hills. Provide 'T' intersection offsets of at least 125 ft (38 m). The preferred angle of intersection is 90 degrees; the minimum angle permitted is 60 degrees.

e) Minimize paved areas as much as possible to increase the green space in the community; large areas of paved parking should be broken up by green islands or dividers in such a way as to not adversely effect routine ground maintenance.

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f) 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. A street separation is a minimum acceptable buffer zone between officer and enlisted personnel housing areas.

g) Pedestrian circulation should relate to housing units, parking and community facilities, and should be safe and attractive.

h) Local streets should provide convenient access to housing and all housing shall be accessible by emergency vehicles, service vehicles and moving vans.

i) Housing unit entrances should relate to parking spaces to provide convenient and safe access.

j) Orient buildings to take advantage of passive solar techniques.

4.2.3.2 Street Dimensions. Streets shall conform to minimum dimensions presented in Table 9.

Table 9
Minimum Street Dimensions -- Face to Face of Curb (ft)

<u>Type of Street</u>	<u>On-Street Parallel Parking</u>		
	<u>None</u>	<u>One Side</u>	<u>Both Sides</u>
Width, main collector road:	28 (7.3 m)	32 (9.8 m)	40 (12 m)
Width, all residential streets:	28 (8.5 m)	28 (8.5 m)	36 (11 m)
Curb radius at intersection:	20 (6 m)	20 (6 m)	20 (6 m)
Minimum cul-de-sac radius:	45 (13.7 m)	55 (16.8 m)	(See Note)
Minimum 'T' turn-around size:	60 x 15 (18.3 x 4.5 m)	60 x 15 (18.3 x 4.5 m)	60 x 15 (18.3 x 4.5 m)

NOTE: If center planting circle is provided in a cul-de-sac, the maximum diameter of the planting circle shall be 26 ft (8 m).

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4.2.3.3 Other Design Features. Streets shall be provided with concrete curbs and gutters. Curbs shall be depressed at entrances to driveways unless the rolled type of curbs are provided throughout; all gradients shall provide positive drainage (no ponding). Streets shall be designed for vehicles with not less than a 6,000-pound (2700 kg) or local governing agency code wheel load. Pavement shall be asphaltic concrete.

4.2.3.4 Drives/Driveways. Driveways shall be at least 9 ft (2.8 m) wide for each lane of traffic. Pavement for the driveways shall be in accordance with soils report. Common drives/driveways serving more than eight units, or subject to service/emergency truck traffic shall be designed as a street. Such drives shall provide adequate turnarounds.

4.2.3.5 Parking. Parking space shall be provided at a rate of two off-street spaces for each dwelling unit, including required garage/carport. Open parking spaces shall be a minimum of 9 ft x 20 ft (2.7 m x 6 m). Indented gang parking of more than four spaces backing into street, is prohibited. Parking lots and common parking areas of more than five spaces shall be provided with two-way drives and shall be designed as a street for paving purposes.

Angle spaces shall be provided with separate entrance and exit drives.

4.2.3.6 Walks. Walks shall be provided to allow pedestrian circulation between various elements of the project including units, parking, streets, recreation, etc. Sidewalks are required on both sides of the street. Walks shall be a minimum of 3-ft wide (0.9 m) exclusive of curb width, and made of nonreinforced concrete with a minimum thickness of 4 in. (102 mm).

4.2.3.7 Handicapped. Ramps for the handicapped shall be provided at intersections by depressing street curbs and adjacent sidewalk.

4.2.4 Recreation Areas.

4.2.4.1 Tot Lots. Provide tot lots including appropriate equipment, in easily accessible, convenient and safe locations within the housing area. Connect tot lots to the units by a walkway system. Provide shade or shelter for parental supervision. Each tot lot shall be provided with the following minimum items of playground equipment:

- a) One 4-way climber
- b) One 6-unit swing set, 8 ft (2.4 m) high
- c) One slide, 6 ft (1.8 m) high
- d) One kindergarten swing set, 8 ft (2.4 m) high

4.2.4.2 Playgrounds for Teenagers. For low- and mid-density sites, provide approximately 5 acres of land for each 100 housing units to be used for baseball, football or similar outdoor activities for teenage children. The land areas shall be located centrally for easy access for children. The ground shall be cleared, levelled and either seeded or sodded.

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4.2.5 Landscaping. Provide complete landscaping consisting of lawn, ground cover, trees, shrubs, bushes and irrigation system, when required. Lawn or ground cover shall be provided for the entire site, except undisturbed areas that may remain natural.

Choose plant materials on the basis of plant compatibility, climate, soil conditions, low maintenance, and aesthetic suitability. All plants shall be guaranteed for a period of one year after final acceptance. Landscaping shall be maintained under the contract for the period designated by the contract requirements.

When necessary, provide a complete permanent automatic irrigation system with controllers covering all common areas and slopes. Design system to function with available water pressure.

4.2.6 Water Distribution System

4.2.6.1 Mains. Mains shall be considered as that part of the distribution system supplying fire hydrants, or fire hydrant laterals. Water distribution mains shall be looped with no dead ends and be adequate size to satisfy both domestic and fire flow requirements. Minimum main size is 8 in. (203 mm). 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. The pipe, valves, and all other materials shall meet the American Water Works Association (AWWA) standards for a 150 psi (1034.2 kPa) working pressure system. Provide sacrificial anodes for all valves and metal pipe.

4.2.6.2 Flow Requirements. Water must be supplied by mains of appropriate capacity to provide 500 gpm (1892 L/min) at one-story units, 750 gpm (2840 L/min) at two-story structures, and 1,000 gpm (3785 L/min) at three-story structures, for a flow duration of 1-1/2 hours. This mandatory flow is over and above domestic requirements. Pressure shall be a minimum of 20 psi (137.9 kPa), and a maximum of 150 psi at each outlet after allowing for friction, elevation, and other pressure losses. Pressure at each housing unit shall not exceed 75 psi (517.1 kPa).

4.2.6.3 Trenches. Water and gas mains may be installed in the same trench, with the gas main placed on a shelf at least 12 in. above and to one side of the water mains. (Coordinate with local gas utility supplier to determine system acceptability). Water main shall have a minimum of 3 ft of earth cover.

4.2.6.4 Fire Hydrants. Hydrants shall conform to AWWA C502, Dry-Barrel Fire Hydrants, or AWWA C503, Wet-Barrel Fire Hydrants, except as required by local utility. Valves shall conform to AWWA standard C500, Gate Valves for Water and Sewerage Systems. Fire hydrants shall be compatible with those presently in use at the activity or city, with similar pump and hose connections. Fire hydrant spacing shall be no greater than 500 ft (152 m) apart, by paved road, with no dwelling unit more than 350 ft (107 m), by paved road, from a hydrant. Hydrant laterals shall be 6 in. (152 mm) minimum size, shall not exceed 50 ft (15 m) in length, and shall have an underground shutoff valve. Valve box, at each lateral, shall be located within 10 ft (3 m) of the hydrant, and shall not be located where obstructed by parked vehicles,

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shrubby, etc. Guard post barriers shall be provided where hydrant locations are subject to vehicle damage.

4.2.6.5 Shutoff Valve. Curb stops are prohibited. Each building shall be provided with a separate service and main shutoff valve, readily accessible to maintenance and emergency personnel. Shutoff valves in walks are prohibited.

4.2.6.6 Metering. Metering shall be provided as stipulated in Section 2 of this handbook.

4.2.7 Sanitary Sewage System

4.2.7.1 Design Criteria. Sewage system shall be designed and constructed in accordance with the Uniform Plumbing Code, community, or base requirements. All design flow will be calculated using the Manning formula. Manholes are required at all changes of direction and spaced not more than 500 ft (152 m) apart. Mains shall be a minimum of 6 in. in diameter. Curved sewers are prohibited. Pipes shall be designed to flow full and maintain a velocity of 2.0 ft (0.6 m) per second. If siphons are used, two lines of equivalent capacity shall be used with cleanouts. Force mains shall be sized to minimize pumping head, with a 3.0 to 5.0 ft (0.6-1.5 m) per second velocity.

4.2.7.2 Sewer Mains. Design shall be based on an average daily per capita flow of sanitary sewage of 100 gallons per day (gpd) with a peak hourly factor of four.

4.2.7.3 Sewer Laterals. Each building lateral shall be connected directly to a sewer main. Combining multiple building laterals is prohibited. Units within a building may use a single building lateral. Cleanouts shall be provided to allow cleaning of all lines to grade. Cleanouts, in yard areas, shall be set in a box with hinged cover. Laterals from one building shall not cross under another building. Lines shall be sized in accordance with the Uniform Plumbing Code. Sewer laterals serving one or two housing units shall be a minimum of 4 inches in diameter; laterals serving three or more housing units shall be a minimum of 6 inches in diameter.

4.2.7.4 Trenches. Sewer and water lines, mains or laterals, shall be placed in separate trenches. The separate trenches shall maintain a minimum lateral separation of 10 ft (3 m).

4.2.8 Gas Distribution System. Provide a gas distribution system, connected to existing systems and designed in accordance with local codes, utility company or station regulations. Shutoff valves shall be provided on the exterior of the buildings. A gas regulator shall be provided for each dwelling unit or building structure.

4.2.8.1 Drips. Unless 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.

4.2.8.2 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 units.

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4.2.8.3 Mains/Service Lines. Lines shall not be placed under any buildings. Lines shall be placed with a minimum of 24 in. (610 mm) of earth cover. Protection shall be provided from superimposed street or heavy traffic loads.

4.2.8.4 Materials. Materials and appurtenances shall be free of defects and suitable to accomplish the stated objectives of gas distribution systems. Pipe shall be polyethylene conforming 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 American National Standards Institute (ANSI) B16.5, Pipe Flanges and Flanged Fittings, or manufacturer's recommended standards.

4.2.8.5 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, Gas Transmission and Distribution Piping Systems. The test shall continue for at least 24 hours between initial and final readings of pressure and temperature.

4.2.8.6 Metering. Provide a master meter and provisions for future individual unit metering devices. Comply with local requirements. Meter and meter bases shall be sight screened, and located to provide convenient access while not distracting from building appearance.

4.2.9 Electrical Distribution. Provide new electrical distribution system as necessary and connect to existing system. Underground distribution is required unless otherwise directed.

4.2.9.1 Design Criteria. The electrical on-site distribution system shall be designed in accordance with ANSI C2, National Electrical Safety Code, and NFPA 70, National Electrical Code, and applicable local codes.

Service drops shall be underground.

4.2.9.2 System Design. System shall be radial or looped in design with disconnects on each major feeder. Primary feeder cables shall be copper or aluminum. High voltage conductors shall have protective shielding. High voltage cable shall be buried a minimum of 48 in. (1.2 m) below grade with cable markers 12 in. (305 mm) above cable.

4.2.9.3 Transformers. Transformer shall be pad-mounted. The high voltage compartment of the transformer shall include a load break switch with fused circuit for the transformer and for the loop feed system; it shall have two nonfused switches for the loop connection. 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 ninety percent of the kilovoltamperes (kV/A) demand load calculated for the transformer. The transformer overcurrent protection shall be sized in accordance with NFPA 70, Article 450-3 (a).

4.2.9.4 Service Entrance. Only one service entrance per building shall be provided. The service entrance conductor shall be buried a minimum of 36 in. (0.9 m) below grade with a minimum separation of 12 in. (305 mm) from

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telephone or TV cables. Fault current at the unit service entrance must not exceed 10,000 amps.

4.2.9.5 Length of Service Laterals. The length of secondary distribution service laterals from transformer secondary to building service entrances shall be minimized.

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

4.2.9.7 Street/Area Lighting. Residential street and area lighting shall be provided throughout the site(s). Street lights shall be provided at each street intersection and at a maximum interval of 200 ft (60 m) between intersections. Mercury vapor or sodium vapor lamps, photo cell actuated, shall be installed at all locations. Area lighting shall maintain a minimum level of illumination of 0.5 footcandles (fc) for walks, tot-lots, and open/common parking areas.

4.2.9.8 Metering. Provide a master and individual unit metering bases. Meters and meter bases shall be sight screened, and located to provide convenient access while not distracting from building appearance.

4.2.9.9 Telephone. The telephone company will furnish and install distribution cables. Conduit required between underground terminal boxes and the buildings shall be provided by the contractor at his own expense. All trenching and associated backfill required to install the telephone company cables shall be included in the construction contract. Boxes, conduits, and trenching shall comply with local telephone company criteria and shall be coordinated with the telephone company.

Overseas conventional design and improvement projects may require different applications of this requirement.

4.2.9.10 Television. Provide commercial cable TV or site distribution system(s) when feasible. The contractor shall provide all trenching, conduit, boxes, and backfilling required to install commercial and/or contractor-provided distribution systems.

4.3 UNIT DESIGN. Unit design shall be within the net areas authorized for the various type units.

4.3.1 Functionality. Rooms shall be sized and arranged for efficient use, good circulation and furniture placement. The distribution of space for food preparation living/dining, sleeping, bathing, halls, closets and services should be balanced and should enhance the intended functions.

a) Habitable rooms shall not be used as halls for entry into a unit or for primary circulation within a unit.

b) Provide convenient access between carport/garage and service area and between kitchen and service area.

c) Do not use a sliding glass door as a primary unit access.

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4.3.1.1 Indoor/Outdoor Integration. Emphasize factors that enhance indoor/outdoor living. Consider size, layout and location of patios, balconies and yards, and features that encourage family use of outdoor area.

4.3.2 Fire Safety. Housing projects should be designed to ensure the maximum feasible fire protection to life and property. Protective features shall be provided according to the requirements of pertinent, recognized fire safety codes. Non-combustible materials should be used for interior finishes to the greatest extent practicable. Adequate means of exit to afford prompt and unobstructed egress shall be provided for each living unit. Conform to NFPA 74, Household Fire Warning Equipment and NFPA 101, Life Safety Code.

4.3.2.1 Fire Resistance of Party Walls and Roof Material. Party walls (walls separating housing units) shall have a minimum fire resistance rating of one hour. Party walls shall extend without opening, from ground to 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. Minimum weight of Class A shingles shall be 225 pounds (102 kg).

4.3.2.2 Party Floors. Party floors shall have a topping slab of 1-1/2 inch lightweight concrete, "gyp-crete," or similar material. Party floors shall have a minimum one-hour fire resistance rating, in accordance with ASTM E119. Floor/ceiling construction between dwelling units (party floors) shall be designed to provide sound transmission ratings as described in para. 4.3.3 and Table 10.

Table 10
Sound Transmission Standards

Habitable Areas (Living, Dining, Bedroom, Halls, etc.)	
Airborne sound	STC = 52
Impact of tapping	IIC = 60
Wet Areas (Kitchen, Bath, Utility, Laundry, etc.)	
Airborne sound	STC = 52
Impact or tapping	IIC = 52
Habitable Areas Over Garage	
Air-borne sound	STC = 52
Party Walls Separating Housing Units	
	STC = 55

4.3.2.3 Heater Rooms. Heater rooms in housing units shall be lined with gypsum board or other noncombustible material.

4.3.2.4 Egress Stairs. Egress stairs from second floor units shall be constructed in accordance with NFPA 101.

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4.3.3 Sound Attenuation. 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, Standard Test Method for Measurement of Airborne Sound Insulation in Buildings, or ASTM E90, Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions. Tests for impact sound shall be made in compliance with ASTM E1007, Standard Method for Field Measurement of Tapping Machine Impact Sound Transmission Through Floor-Ceiling Assemblies and Associated Support Structures. 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.

Any wall or floor 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.

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. Refer to Table 10 for sound transmission standards.

4.3.3.1 Party Walls. Party walls separating housing units shall provide sound attenuation with a minimum Sound Transmission Class (STC) rating of 55.

4.3.3.2 Floor Construction. Floor construction between occupancies shall be designed to provide sound transmission class and impact isolation class (IIC) as presented in Table 10.

Materials used in obtaining the required sound attenuation for the floor construction shall not be liquid-soluble or softened by moisture. Sound insulation shall have a flame-spread rating of 25 or less and a smoke-development rating of 50 or less when tested in accordance with ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.

4.3.3.3 Plumbing and HVAC Equipment. Design of plumbing and Heating, Ventilating, Air-Conditioning, and Dehumidifying (HVAC) 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.

4.3.4 Minimum Interior Dimensions and Areas. Dimensions and areas presented in Tables 11 through 15 are the minimum requirements.

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Table 11
Minimum Dimensions/Areas

Kitchen dimension	4 ft (1.2 m) in front of cabinets and/or between cabinets
Washer/dryer space	3 ft D x 6 ft W (0.9 m x 1.83 m)
Note: Washer/dryer space requirement may be waived in SJEM units, in lieu of central laundry facilities consisting of 2 washers, 2 dryers, 1 table and 1 sink for each 8 dwelling units.	
Freezer space	2 ft D x 3 ft W x 6 ft (0.6 m D x 0.9 m W x 1.83 m H)
Refrigerator space	2 ft D x 3 ft W x 6 ft H (0.6m D x 0.9 m W x 1.83 m H)
Eat-in-kitchen space (Auxiliary dining)	8 ft-6 in. (2.59 m) (face of cabinets to wall)
Family Room	9 ft-6 in. (2.89 m)
Dining Area:	
(2 and 3-BR units)	9 ft-6 in. (2.89 m)
(4 and 5-BR units)	10 ft-6 in. (3.2 m)
Flag Dining Area	12 ft-0 in. (3.66 m)
Living Area	11 ft-8 in. (3.55 m) / 150 ft ² (14 m ²)
Carports/Garages	12 ft x 20 ft x 7 ft-6 in. H (3.66 m x 6 m x 2.3 m H)
Balconies (if provided)	6 ft (1.83 m) / 72 ft ² (6.7 m ²)
Patio	8 ft (2.5 m) / 120 ft ² (11.2 m ²)
Bedrooms:	
Master bedroom	11 ft-8 in (3.55 m) / 150 ft ² (14 m ²)
2nd bedroom	10 ft (3 m) / 120 ft ² (11.2 m ²)
All others	9 ft-6 in. (2.9 m)
Bathrooms:	
Half	3 ft (0.9 m)

Note: Minimum dimension for vanity cabinet is 2 ft W (0.6 m).

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Table 12
Square Footage for Kitchen Cabinets, Counters, and Pantry

	WALL	BASE	DRAWER	COUNTER	PANTRY
Flag, SO	32 (3 m ²)	32 (3 m ²)	17 (1.6 m ²)	22 (1.6 m ²)	20 (1.9 m ²)
Other					
4&5 BR	28 (2.6 m ²)	28 (2.6 m ²)	15 (1.4 m ²)	20 (1.9 m ²)	20 (1.9 m ²)
2&3 BR	24 (2.2 m ²)	24 (2.2 m ²)	12 (1.1 m ²)	16 (1.1 m ²)	---

Table 13
Minimum Closet Width Requirements (ft)

	COAT	MASTER BR*	2nd BR	OTHER BR	LINEN	BROOM
Flag, SO	5	10	8	5	4	3
FGO4	4	8	6	4	3	2
Other	3	6	6	4	2	2

*Walk-in closet preferred.

Note: Minimum inside clear depth dimension for standard closets shall be 2 ft (0.6 m). Minimum inside clear depth dimension for linen closets shall be 1 ft-6 in. (0.45 m).

Table 14
Minimum Dimensions and Square Footage (ft²) for Bulk Storage

Interior: 2 ft-6 in. (0.75 m) x 2 ft-6 in. (0.75 m) x 6 ft-6 in. (2 m)					
	<u>Minimum ft²</u>	<u>2BR</u>	<u>3BR</u>	<u>4BR</u>	<u>5BR</u>
All Units:		16	20	30	40
Exterior: 4 ft (1.2 m) x 4 ft (1.2 m) x 6 ft-6 in. (2 m)					
	<u>Minimum ft²</u>	<u>2BR</u>	<u>3BR</u>	<u>4BR</u>	<u>5BR</u>
EM/CGO		30	40	50	60
FGO		NA	50	60	NA
Flag, SO		NA	NA	120	NA

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Table 15
Dimensions for Ceilings, Halls, Stairs, and Doors

Ceiling heights of habitable rooms:	7 ft-6 in. (2.3 m)
Ceiling heights of halls, baths, utility rooms, etc., for utility and duct space:	7 ft-0 in. (2.1 m)
Front entry vestibule width:	4 ft-0 in. (1.2 m)
Hall width:	3 ft-4 in. (1.3 m)
Door opening height:	6 ft-8 in. (2.03 m)
Inside stairway width, between railings:	3 ft-2 in. (0.97 m)

4.3.5 Major Zones -- Living/Dining, Kitchen, Family Room, and Bedrooms

4.3.5.1 Living/Dining. The living room should have direct access to the front entrance foyer and to the dining area without passing through another room.

The dining area may be an extension of, or an ell off the living room. The dining area shall be directly accessible from the kitchen without passing through another room. For Flag Officer and Senior Officer units, provide separate dining rooms or areas to accommodate furniture and seating for not less than 10 persons. Refer to para. 4.3.4, Table 11, for minimum dining area dimensions.

4.3.5.2 Kitchen/Auxiliary Dining Area. The kitchen shall provide an efficient work triangle. A base cabinet, minimum 15-in. wide, shall be provided on the handle side of the refrigerator. Range shall not be located adjacent to the refrigerator, directly in a corner or adjacent to a passageway. The dishwasher shall be installed adjacent to the kitchen sink. Provide a backsplash behind range, extending to underside of range hood, finished to match countertop or range and range hood. Space for tenant-owned upright freezer shall be provided adjacent to the kitchen or in areas such as the utility room or garage. Refer to para. 4.3.4, Table 11 for minimum kitchen dimensions. Refer to Table 12 for minimum square footage for kitchen cabinets, counters, and pantry, and to Table 22 for kitchen cabinet dimensions.

Provide auxiliary dining areas in the form of table space in the kitchen or in a family room adjacent to, or as an extension of, the kitchen. The auxiliary dining area shall not be located in the living or dining rooms.

4.3.5.3 Family Room. Provide a separate family room, adjacent to and contiguous with the kitchen, for all three-, four-, and five-bedroom units. Refer to para. 4.3.4, Table 11 for minimum family room dimensions.

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4.3.5.4 Bedrooms. Bedrooms shall be designed to accommodate king size beds in master bedrooms and twin beds in other bedrooms. Window, door, and closet placement should enhance furnishability. Each bedroom shall be accessible without passing through another bedroom.

One bedroom with connecting bath, handicapped accessible, shall be provided on the ground floor of each Flag or General Officer quarters. This bedroom shall be accessed from a public area of the unit separate from the other bedrooms.

Refer to para. 4.3.4, Table 11, for minimum bedroom dimensions.

4.3.6 Minor Zones -- Bathrooms, Laundry, Closets, and Bulk Storage

4.3.6.1 Bathrooms. Emphasis shall be placed on size, furnishings, layout, and privacy. Direct access to a bathroom from the master bedroom is required for three-, four-, and five-bedroom units. Compartmented bath design, for family and guest use, is encouraged. Refer to para. 4.3.4, Table 11, for minimum bathroom dimensions. Refer to Section 2 for handicapped requirements. Determine the number of bathrooms based on the number of bedrooms, as shown in Table 16. Other design considerations are listed below.

a) A full bath shall contain a water closet, lavatory, and either a tub with shower assembly or a shower stall. One full bath in each unit shall include a tub with shower assembly. A half bath contains a lavatory and a water closet. Showers, and tubs with shower assemblies, shall include tempered glass or plastic enclosures and doors. At least one full bath with tub shall be directly accessible from a hall without passing through another room.

b) Provide lavatories mounted in 2-ft wide (minimum) countertops, with vanity bases. All countertops shall be laminated plastic, ceramic tile, or molded cross-linked acrylic plastic, with minimum 4-in. high (102 mm) back splashes.

c) Bathroom accessories may be surface mounted or recessed, of noncorrodible metal or ceramic tile, and shall include a toilet-paper holder, soap dish, combination tumbler and toothbrush holder, soap dish and grab bar at tub or shower stall, bathrobe hook, and towel bars totaling not less than 42 in. (1.1 m) for a full bath and not less than 30 in. (0.75 m) for a half bath.

d) 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 use recessed medicine cabinets in party walls.

e) Tubs and showers shall not be placed under windows.

f) Exhaust fan shall be light-switch operated and shall be ducted directly to the exterior of the building.

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Table 16
Determination of the Number of Bathrooms

NUMBER OF BEDROOMS ON FLOOR	NUMBER OF BATHROOMS ON FLOOR
None	1/2
1 to 2	1
3 to 5	2

Note: Flag and General Officer's units shall have three full bathrooms, with one, on the first floor, configured for handicap access.

4.3.6.2 Laundry. Washer/dryer space may be provided in an enclosed recess off the hall in two-bedroom units. Three-bedroom and larger units shall have a separate utility room.

The space provided shall have doors that provide full access when open. Two full-length shelves of 10-in. minimum nominal depth are required above washer and dryer. The dryer shall be located so that the length of run of the vent from the dryer to the outside vent cap shall be no more than 20 ft (6 m) and contain no more than three 90-degree turns.

Minimum net clear door width to washer/dryer space when open is 5 ft-4 in. (1.6 m) for an enclosed recess and 2 ft-8 in. (0.8 m) if located within a utility room.

4.3.6.3 Closets. Closets should be located to permit placement of furniture in the corners of the rooms by providing an 18-in. return adjacent to a furnishable wall. Closets (except linen closets) shall be equipped with a 12-in. (0.3 m) deep shelf and a clothes hanger rod. Linen closets shall be provided with at least four full-depth shelves. Refer to para. 4.3.4, Table 13, for minimum dimensions. Other design considerations are listed below. Minimum inside clear depth dimension for standard closets shall be 2 ft (0.6 m). Minimum inside clear depth dimension for linen closets shall be 1 ft-6 in. (0.45 m).

- a) Closet shelving and rods in excess of 4 ft (1.2 m) shall have center supports.
- b) Closets 6 ft or more in width shall have sliding doors, maximum 6 ft-8 in. (2.2 m) high. Wall closet width shall not extend beyond either door jamb more than 1 ft-6 in. (0.45 m).
- c) A broom closet shall be provided convenient to the kitchen.
- d) A coat closet shall be located convenient to the unit entrance.
- e) Wardrobe closet doors shall be provided with both top and bottom door tracks.

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4.3.6.4 Bulk Storage. Provide each dwelling unit with an interior and exterior bulk storage space. Provide interior storage in a separate room. Provide exterior storage in a garage, a separate exterior enclosure, or within the living unit with access from the exterior. Refer to Table 14 for minimum dimensions and square footage for bulk storage areas.

4.3.7 Interior Finishes

4.3.7.1 Walls and Ceilings. Provide 1/2-in (12.7 mm) gypsum wallboard, taped and smooth finished; textured ceiling finish may be provided in areas other than kitchen, laundry or bath. Prefinished plywood paneling with suitable hardwood finish may be applied as a design feature to a single wall of the living room, family room, or dining room, provided a noncombustible backing material is used. 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.

4.3.7.2 Flooring and Stairs, Base, and Carpet. Kitchen, laundry, and utility flooring shall be vinyl with wood or vinyl base. Bedroom, hall and living-dining area flooring shall be carpet or 3/32-in. (2.38-mm) vinyl composition tile with wood base. Bathroom flooring shall be of ceramic tile, terrazzo, or seamless sheet vinyl; bases shall be ceramic tile, terrazzo or premolded vinyl. Sheet vinyl shall conform to Fed. Spec. L-F-475, Floor Covering Vinyl, Surface (Tile and Roll with Backing), Grade A, and shall be installed using the manufacturer's recommended adhesive applied continuously at all seams in accordance with the manufacturer's instruction. All interior stairs shall be hardwood with clear finish, or soft wood with carpeting.

Carpet shall be tufted-back and shall be in accordance with Fed. Spec. DDD-C-0095, Carpets and Rugs, Wool, Nylon, Acrylic, Modacrylic Polyester, Polypropylene, Type IV, Class I, Subclass C, and meet the following criteria:

a) Pile material shall be 100 percent soil-hiding continuous filament nylon with 28-oz (794-g) minimum pileweight and 4000 pile density.

b) Carpet shall be treated to control static build-up to less than 3.5 kV at 70 degrees F and 20 percent relative humidity as determined by the American Association of Textile Chemists and Colorists (AATCC) Test Method 134-1986, Electrostatic Propensity of Carpets.

c) Carpet shall conform to Consumer Product Safety Commission standard CFR 16-1630, Standard for the Surface Flammability of Carpet and Rugs.

d) Carpet padding shall be Type II (40-oz. rubber-coated hair and jute) conforming to Fed. Spec. DDD-C-001023, Cushion, Carpet and Rug (Hair Felt and Rubber Coated Jute and Animal Hair or Fiber).

e) Standard aluminum binder bars with 1-5/8-in. (41 mm) minimum width floor flange and minimum 11/16-in. (17.46-mm) wide face will be used.

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f) Carpet grippers shall be exterior grade Douglas fir plywood, with minimum dimensions of 1-1/8-in wide x 9/32in-thick (29 mm x 7 mm), 4-in (102 mm) lengths, with two rows of staggered pins.

4.3.8 Carports and Garages. Provide a single carport or garage for each dwelling unit. 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 para. 4.3.4, Table 11, for minimum dimensions. Additional design considerations are listed below.

a) Common gang carports (three or more) may be provided for 2 bedroom apartments only, and the size per space may be reduced to 11 ft x 20 ft (3.3 m x 6 m).

b) Set the garage or carport slab a minimum of 4 in. (102 mm) below the level of the housing unit floor and the floor of adjoining exterior storage.

c) Slope carport slabs to drain away from housing units.

d) Garage doors shall be openable and lockable from inside and outside of garage.

4.4 UNIT ENGINEERING

4.4.1 Structure. Structural design (materials and construction) shall comply with the Uniform Building Code (U.B.C.), except for structures which qualify as "Manufactured Homes" under the Federal Manufactured Housing Construction and Safety Standards Act (FMHCSS), or except as modified herein. Design shall meet the following criteria and the minimum load standards presented in Table 17.

a) Walls, when used or required for lateral resistance to wind or earthquake, shall be considered bearing walls and shall have full foundations.

b) Allowable variations from level, or specified slopes, shall be as follows:

(1) For overall length, or surface of 10 ft or less: plus or minus 1/8 in.

(2) Up to 20 ft: plus or minus 1/4 in.

(3) Up to 40 ft: plus or minus 3/8 in.

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

d) Wood flooring systems shall be glued and nailed. Glue lines shall not be considered for stress transfer.

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Table 17
Minimum Load Standards

Floor live load:	40 psf
Balcony live load:	60 psf
Roof live load:	As required by local codes
Dead load:	Actual
Wind load:	As required by local codes
Seismic zone:	As required by local codes

NOTE: Loads may be reduced as permitted by the U.B.C.
These criteria are not waived by FMHCSS
structural criteria.

4.4.2 Thermal Performance

4.4.2.1 Thermal Insulation. 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 side of exterior wall and ceiling insulation.

4.4.2.2 Polyurethane. 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.

4.4.2.3 R-Values. Housing units shall be provide, as a minimum, the R-values presented in Table 18. These values may be modified if a life cycle cost analysis indicates that a more cost effective value should be used. The life cycle cost analysis shall be based on Department of Energy (DOE) Federal Energy Management Program (FEMP) criteria according to the provision of the latest version of Code of Federal Regulations, 10 CFR 436A. For guidance on the methodology, refer to National Bureau of Standards Handbook 135, Life-Cycle Costing Manual for the Federal Energy Management Program.

4.4.2.4 Air Infiltration. Air infiltration is a major concern around windows, doors, sill plates and electrical switches and outlets. In this regard, caulking, gaskets or other sealants shall be provided at all exterior walls to prevent leaks at windows, doors, sill plates and electrical switches and outlets.

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Table 18
Nominal R Values for Floors, Ceilings, and Walls

HEATING DEGREE DAYS		WALLS	CEILING/ ROOF	FLOOR
0 - 2000		R-11	R-30	R-11
2001 - 4000		R-13	R-30	R-11
4001 - 6000		R-19	R-30	R-19
6001 - 8000		R-19	R-45	R-10
8000+		R-24	R-60	R-30

4.4.3 Plumbing

4.4.3.1 Piping. Water piping under concrete slabs shall be copper tubing, type K, annealed. Joints under the slabs are prohibited. Interior water piping shall be type K or L, hard-drawn copper or chlorinated polyvinyl chloride (CPVC) plastic pipe, conforming to ASTM D2846, SDR 11, Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems. Fittings for soft copper tubing shall conform to ANSI B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes, and for hard-drawn ANSI B16.22, Wrought Copper and Copper alloy Solder Joint Pressure Fittings. CPVC pipes larger than 3/4 in. (19 mm) to be schedule 40, in accordance with ASTM D1785, Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 with schedule 80 fittings. Solvent cement used for joining CPVC pipe and fittings shall bear the seal of approval for use in frictional type (threaded or union). Underslab supply piping shall be limited to unit service entrance only. Service line to each housing unit shall be no less than 3/4 inches in diameter.

4.4.3.2 Gas Connections. The use of semirigid 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 40 in. (1.01 m) long. Provide accessible gas shutoff valve and coupling for each gas equipment item. Comply with local/seismic codes.

4.4.3.3 Plumbing Fixtures. Fixtures and trim shall comply with Fed. Spec. WW-P-541, Plumbing Fixtures, Accessories, (Detail Specification). 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.

Plumbing shall meet the following criteria:

a) Traps for lavatories and sink shall be chromium-plated, adjustable-bent tube, 20 gauge brass, or plastic (ABS).

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b) All faucet handles shall be single control type, with seals and seats combined in one replaceable cartridge designed to be interchangeable among similar fixtures such as 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.

c) Shower/bath combination shall be controlled by diverter valve. Waste fitting Type II pop-up, concealed with all parts removable and renewable through the overflow and outlet openings in the tub. Showers and shower/baths shall be equipped with a combination valve and flow control device to limit the flow to 2.5 gpm (9.5 L/min) at pressures between 20 and 60 psi (137.9 to 413.7 kPa).

d) All piping shall be concealed. Stops will be provided on water supply lines to all plumbing fixtures except tubs and showers.

4.4.3.4 Water Closets. Water closet shall be in accordance with ANSI A112.19.2, Vitreous China Plumbing Fixtures, with trim conforming to ANSI A112.19.5, Trim for Water-Closet Bowls, Tanks, and Urinals (Dimensional Standards). Water closets shall have regular bowl with inclined tank, close coupled siphon jet, floor outlet with wax gasket, white closed front seat and cover, and an antisiphon float valve. Water consumption shall be no more than 3 1/2 gallons (plus or minus 1/2 gallon) per complete flushing cycle.

4.4.3.5 Lavatories. Lavatories shall be in accordance with Fed. Spec. WW-P-541/4, Plumbing Fixtures (Lavatories) (Detail Specification), type IV (counter top), class 1 (rectangular), minimum 20 x 18 in. in (0.5 x 0.45 m) size or class 2 (oval) minimum 19 x 16 in. (0.48 x 0.4 m) in size. Lavatories shall be vitreous china, molded plastic or cast iron rimless type (without rings), or cross-link acrylic molded counter top with integral bowl. Lavatories shall have Type I pop-up drains.

4.4.3.6 Bathtubs. Bathtubs shall conform to specification, ANSI A112.19.1, Enameled Cast Iron Plumbing Fixtures, ANSI A112.19.4, Porcelain Enameled Formed Steel Plumbing Fixtures, or ANSI Z124.1, Plastic Bathtub Units, for gel-coated, glass fiber reinforced polyester resin bathtub unit with sectional wainscot. Metal tubs shall have fiber glass, porcelain-on-steel panels, or ceramic tile wainscot. One-piece tub/shower/wainscot units are prohibited.

4.4.3.7 Showers. Shower stalls shall be of ceramic tile over membrane waterproofing on a cementitious substrate; or gel-coated, glass-fiber-reinforced polyester, conforming to ANSI Z124.2, Plastic Shower Receptors and Shower Stalls. Shower receptors shall be cast stone or gel-coated, glass-fiber-reinforced polyester. Shower stall wainscots shall be ceramic tile or sectional gel-coated, glass-fiber-reinforced polyester. One-piece wainscots are prohibited.

4.4.3.8 Kitchen Sinks. Kitchen sinks shall meet specification ANSI A112.19.3, Stainless Steel Plumbing Fixtures (Designed for Residential Use), for 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 (strainer and plug to be eliminated where garbage disposals are provided).

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4.4.3.9 Clothes Washer. Drainage and hot and cold water supply shall be provided for occupant-owned automatic clothes washers. Washer connection, complete with 2-in. (51 mm) drain, 3/4-in. (19 mm) hose thread supplies, and electrical outlets for both washer and dryer, shall be provided in standard manufactured recessed wall box with single face plate.

Boxes constructed of sheet steel shall have a corrosion-resistant epoxy enamel finish. Boxes shall be mounted a minimum 2 ft-10 in. above finish floor.

4.4.3.10 Hose Bibbs. Hose bibbs shall be provided at the front and rear of each building, for each ground level living unit, and shall be frost proof in areas subject to freezing.

4.4.3.11 Piping Location. Water piping running in crawl spaces, attics or exterior walls shall be installed on the warm side of insulation and shall be wrapped with insulation and a vapor barrier jacket.

4.4.3.12 Shock Absorbers. Shock absorber units, to control water hammer, are required at clothes washer and dish washer supplies. Air chambers are unacceptable.

4.4.4 Electrical System and Equipment

4.4.4.1 Conformance to Code. The electrical system shall conform to ANSI C2 and NFPA 70 except as provided below. Provide a 100 or 150 amp circuit breaker in the main panel.

4.4.4.2 Service Entrance. Service entrances, exterior meters and panels shall be enclosed or sight screened. Service feeders shall be underground with exterior meters. Panelboards shall be painted galvanized steel and furnished with main breakers. Panelboard doors shall be flush one-piece fronts. Panelboards may be surface or recessed mounted depending on their location. In hallways, panelboards shall be recessed. Offset a minimum of 16 in. horizontally.

4.4.4.3 Panel Locations. Unit panel shall be located in the utility or laundry room, attached garage, or hallway.

4.4.4.4 Conductors. All conductors shall be copper.

4.4.4.5 Outlet Circuits. Lighting and convenience outlets shall be on separate circuits. Outlets on party walls shall be offset.

4.4.4.6 Separate Circuits. Separate branch circuits shall be provided for clothes washer, clothes dryer, electric range, dishwasher, and the freezer outlet. Two branch circuits shall be provided for small kitchen appliance outlets, electric hot water heater and air conditioner.

4.4.4.7 Exterior Lights/Outlets. Provide a minimum of one lighting fixture and one ground-fault-protected outlet in each unit's entry, garage/carport and patio/balcony area(s). Light fixtures at entry and patio/balcony areas shall be switched from the unit interior. Entry ways serving two or more living units, and common carports, may have a common light, photocell activated, in

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lieu of individual switched lights. In addition, common trash areas shall be lighted. These lights shall be controlled by photocell, activated by minimum light levels of 0.5 foot candle.

4.4.4.8 Special Outlets. Provide 240 V electric outlets for electric dryer and electric range.

4.4.4.9 Lighting Fixtures. Provide light fixtures operated by wall switches for all rooms except living room. Living room shall have a convenience outlet, half controlled by wall switch, located at room entrance.

4.4.4.10 Smoke Detectors. Provide smoke detectors in accordance with NFPA 74 and NFPA 101.

4.4.4.11 Light Fixtures. All building light fixtures, interior and exterior, shall be fluorescent.

4.4.4.12 Telephone. Prewire dwelling units in accordance with local telephone company requirements. A minimum of three outlets, located in kitchen/dining/family area, living room, and master bedroom, shall be provided in each unit. Standard miniplug connectors shall be provided at all outlets. The plug provided in the kitchen/dining/or family area shall be for a wall mounted phone.

4.4.4.13 Television. Television (TV) outlets shall be located in the living room, family room, and bedrooms. An antenna system or connection to a TV distribution system shall be provided for each living 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 unit. Unit TV wiring shall originate at back board, with switchable connection between antenna and commercial cable TV system.

4.4.4.14 Door Bell. Front entrance to each unit shall be provided with a low voltage bell or buzzer.

4.4.5 Heating, Ventilating, and Air Conditioning

4.4.5.1 Equipment. All materials and equipment shall be the standard cataloged products of manufacturers regularly engaged in production of such materials and equipment, and shall be manufacturers' latest standard design. Equipment shall comply with the requirements of Underwriters Laboratories, Inc. (UL), American Gas Association (AGA), Air-Conditioning and Refrigeration Institute (ARI) (ARI 210, Standard for Unitary Air-Conditioning Equipment, and ARI 240, Air Source Unitary Heat Pump Equipment), National Electric Manufacturers Association (NEMA), American National Standards Institute (ANSI), or other national trade associations as applicable.

4.4.5.2 Air Conditioning. All air conditioning systems shall deliver Energy Efficiency Ratings (EER) consistent with the requirements listed below.

9.5 EER for less than 65,000 Btu/hr

8.9 EER for greater than 65,000 Btu/hr but less than 135,000 Btu/hr

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To establish these ratings, the latest edition of the Directory of Certified Unitary Air Conditioners, Unitary Heat Pumps and Sound Rated Outdoor Unitary Equipment, published by the Air-Conditioning and Refrigeration Institute (ARI), shall be the sole determination; only the information for units coded RCU-A-C shall be used.

4.4.5.3 Standards. The heating/cooling systems shall comply with Uniform Mechanical Code, except as provided below. Design of the systems shall be based on criteria and weather data contained in MIL-HDBK-1190.

4.4.5.4 Heat Output. Output of heating units shall be adequate to maintain interior design temperature of 68 degrees F (20 degrees C).

4.4.5.5 Heating Equipment. For projects developed for gas forced air heating, the forced air unit shall incorporate an AGA-approved electronic ignition, centrifugal fan and vented furnace, exhausting combustion air above the building roof. Standing pilots are prohibited. Room unit heaters, room A/C units, floor furnaces, and heat lamps are prohibited.

For projects developed for an oil- or gas-fired cast iron boiler, with forced-circulation hot water baseboard system or radiators, a single boiler shall be provided for each building, with each individual living space (living/dining, kitchen/eating/family, bedrooms, etc.) thermostatically controlled by means of a three-way diverting valve, or similar approved method. Circulation shall be by means of a three pipe reverse return system. All boilers shall include; automatic ignition systems, solenoid shutoff valves, stainless steel weather/draft vent stack and cap, and shall be accessible from the building exterior (not requiring entry to unit for service).

Minimum efficiency for oil-fired furnaces shall be 78 percent Annual Fuel Efficiency Utilization (AFEU); efficiency for gas furnaces shall be 82 percent AFEU. Minimum efficiency for oil-and-gas-fired boilers shall be 80 percent AFEU.

4.4.5.6 Thermostats. Thermostats shall be wall-mounted, low-voltage type conforming to NEMA DC3, Wall-Mounted Room Thermostats. Thermostats shall have an operating range from 55 degrees F to 90 degrees F (13 degrees C to 32 degrees C) with a temperature setting scale legibly and permanently marked indicating either degrees F, with a maximum increment of 5 degrees F (3 degrees C).

The thermostat housing shall afford the operating mechanism reasonable protection from physical abuse and shall include an outer cover made of either corrosion-resisting metal or metal with a corrosion-resistant finish, or molded, heavy-duty, high impact resistant plastic. The mounting plate or base shall be made of thermal insulating material or shall support the thermal element not less than 1/4 in. (4.6 mm) from the wall. The control unit of the thermostat shall consist of a temperature sensing element, control switch, and anticipating heater. The sensing element shall activate the control switch, and anticipator heater. The sensing element shall activate the anticipator heater, and the control switch to provide single or multistage control for heating and/or cooling equipment as required. The control switch shall be a hermetically-sealed switch.

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The thermostat shall be designed for an operating differential per stage of not less than 0.8 degrees F for cooling and not more than 2 degrees F for both heating and cooling. The thermostat shall have provisions for calibrating the unit to accuracy specified in NEMA DC 3. The design shall prevent calibration adjustment with ordinary tools, such as a screwdriver or pliers. When mercury switches are used in the control unit a leveling surface which is an integral part of the thermostat shall be provided for use in leveling the thermostat during installation. When dual compressor condensing units are provided, the thermostat shall be two-stage cooling type. Criteria for different types of thermostats are listed below.

a) A heating-only thermostat shall have a single control unit and shall have an adjustable heating anticipator or other means for maintaining operating differential. Unless otherwise specified, a system selector switch having "HEAT" and "OFF" positions, and a fan selector switch having "AUTO" and "ON" positions shall be provided integral to or mounted on a subbase of the thermostat.

b) A cooling-only thermostat shall have a single control unit and fixed cooling anticipator or other means for maintaining operating differentials. A system selector switch having "COOL" and "OFF" positions, and a fan selector having "AUTO" and "ON" positions shall be provided integral to or mounted on a subbase of the thermostats.

c) Heating-cooling thermostats shall have two separate control units or other proven means integral to the thermostatic control switch designed to prevent simultaneous activation of the heating and cooling circuits. Switches shall have manual changeover from heating to cooling. The heating control unit shall have adjustable heat anticipator, or other means of maintaining operating differentials, and the cooling control unit shall have fixed cooling anticipator, or other means of maintaining operating differentials. A system selector switch and a fan selector switch shall be provided integral to or mounted on a subbase of all heating-cooling thermostats. The fan selector switch shall have "AUTO" and "ON" positions. Heating-cooling thermostat shall have a system selector switch having "HEAT", "OFF", and "COOL" positions.

d) Heating-cooling thermostats for heat pump systems shall be multi-stage as required by the heat pump design. When the heat pump system is operating (except during defrost operation), the temperature control shall be capable of regulating the indoor temperature at the thermostat to within one degree F of the control setting when only compression heating is being provided and to within 2 degrees F (1.1 degree C) of the control setting when compression and supplemental heating is required. Heat pump thermostats shall include an "emergency heat" position for the system selector switch. The emergency heat position shall activate an emergency heat relay whose contacts shall only by-pass the outdoor thermostats contacts used to stage the supplementary resistance heaters.

e) Setback thermostats shall not be permitted for systems using heat pumps. A setback thermostat shall provide means for a minimum of one automatic temperature setback period every 24 hours. The setback cycle temperature and time period shall be occupant-adjustable and shall have means to bypass, on demand, any given setback cycle with return to normal program on

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the next setback switching cycle. When the multiple setback programming design uses removable program pins, two sets consisting of a high temperature setting pin and a low temperature setting pin shall be provided. Pin storage shall be designed into the thermostat. A clock timer shall be provided integral with the thermostat which shall indicate time and shall operate on AC voltages of 15 V to 30 V.

4.4.5.7 Air Distribution. Provide systems conforming to recommendations of the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) Air Distribution Manual. Provide returns at each floor level. Supply registers shall have front fixed directional fins and rear volume dampers, operable from the face of the register. Plastic registers are prohibited. Ducts shall be sheet metal or fibrous glass, rigid or flexible. Where metal ducts are located in unconditioned spaces, provide a minimum of 1-in. (2.4-mm) thick exterior insulation faced with 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, Method of Test of Surface Burning Characteristics of Building Materials, with a flame-spread rating of not more than 25, and a smoke-development rating of not more than 50, as defined in ASTM E84. Fibrous glass duct wall thickness shall be not less than 1 in., nominal. Fibrous glass ducts shall be the standard products of a manufacturer regularly engaged in the production of fibrous glass ducts. Ducts are prohibited in crawl spaces and beneath, or in, concrete slabs on grade.

4.4.5.8 Exhaust Fans. Exhaust fans and ducts. Bathroom and kitchen fans shall be ducted to the outside. Fans shall be tested and rated in accordance with AMCA 210, Laboratory Method of Testing Fans for Rating, and shall operate with 120 V, 60 Hz, single-phase power source. Bathroom exhaust fans shall be wall or ceiling mounted and shall be sized to provide not less than 10 air changes per hour in the space to be ventilated.

4.4.5.9 Dryer Vents. Four-in. diameter dryer vents shall discharge to the exterior, and provide connection to occupant-owned dryers (one dryer to a vent). The vents shall be rigid aluminum, with exterior wall cap and damper. Vent pipes shall be a maximum 20 ft (6 m) long, with no more than three right angle elbows (with minimum radius of 6 in.), and have a maximum vertical run of 12 ft (3.6 m). Dryer vents shall not exhaust in the immediate vicinity of the air conditioning compressor units, entry doors, patio/balconies, carports, or other undesirable areas.

4.4.5.10 Humidification. Humidification equipment shall be installed in all warm air heating systems in military family housing units located in areas having more than 3,000 F (1,648 C) heating-degree days. Humidistats or direct ON-OFF controls may be provided.

4.4.6 Solar Energy

4.4.6.1 Passive Solar. Passive solar architectural application should be routinely considered as a part of all project designs. Elaborate or unique applications such as attached sun spaces, earth sheltering, mass or water trombe walls, solar chimneys, solar dehumidifiers, solar envelopes, and other innovations may be provided if supported by the same rigorous life-cycle-cost analysis as an active system.

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4.4.6.2 Active Solar. Active solar applications proposed for domestic water heating should be evaluated for life-cycle cost effectiveness using a recognized process design program. The analysis should be made for 25 years or the known useful life of the system, whichever is less, using the most current guidance on discount factors, escalation rates, and other factors. The system should be designed based on the optimum cost-effective size and percentage of load provided on a year around basis.

Energy factors may be evaluated with energy simulation software such as BLAST (Building Loads Analysis and System Thermodynamics) and the SOLFEAS (Solar Feasibility) computer programs developed by the Army Corps of Engineers. BLAST performs hourly simulations of buildings and provides the building designer with accurate estimates of the energy requirements of different design alternatives. SOLFEAS evaluates the feasibility and sizing of active solar domestic water systems.

Because of the state of current technology, solar space heating and cooling systems need not be considered.

4.4.6.3 Maintenance and Compatibility. Whether site mounted or unit mounted, systems should be designed for maximum ease of maintenance and to be architecturally compatible with the total military family housing environment.

4.4.7 Roofing and Drainage

4.4.7.1 Minimum Slopes. Minimum slopes for roofs shall be as follows:

Shingle/Tile roofs:	4 inches (102 mm) in 12 inches (305 mm)
Metal:	2 inches (51 mm) in 12 inches (305 mm)
Detached Carport/Garage:	1/2 inch (13 mm) in 12 inches (305 mm)

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

4.4.7.3 Roof Surface. Wood shake or shingle roofs are prohibited. Roofing shall be limited to the following:

a) Minimum of 225-lb (102-kg) Class A wind-resistant fiberglass shingles conforming to ASTM D3018, Specification for Class A Asphalt Shingles Surfaced With Mineral Granules.

b) Minimum of 540-lb (245 kg), standing or flat seam, metal roofing with 0.027-in. (0.69 mm) thick zinc-copper-titanium alloy factory finish.

c) Clay, concrete, metal, or fiberglass tile.

d) Aluminum standing seam roofing 0.032 in. (0.81 mm) thick.

4.4.7.4 Common Roofs. Parapet walls are prohibited.

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4.4.8 Exterior Finishes. Emphasis shall be placed on low maintenance and durability for exterior finish materials. Materials shall be residential in size, scale and texture. The following materials may be used.

4.4.8.1 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.

4.4.8.2 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.

4.4.8.3 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 10 ft (3 m) apart to form a panel of less than 150 ft² (14 m²).

4.4.8.4 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 is acceptable only on the second story of a structure or at least 6 ft (2 m) above finish grade. All siding shall be kept a minimum of 6 in. (152 mm) above finish grade. Lap siding shall be either single pieces with 8 in. (203 mm) maximum width or single pieces shaped to simulate 8 in. maximum width courses (double-four, double-five, triple-four sidings are acceptable). Siding shall be installed in strict accordance with manufacturer's recommendations. 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:

a) 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 0.024 in. (6.1 mm) thick if it is not fiberboard backed. For fiberboard backed aluminum siding, the aluminum substrate shall be a minimum of 0.019 in. (4.8 mm) thick.

b) Hardboard siding shall conform to the requirements of ANSI A135.6, Hardboard Siding.

c) Steel siding material shall be a minimum of 0.017-in. thick (29-gage), zinc-coated steel conforming to ASTM A526, 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 1/16

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in. (1.6 mm) beyond a line scratched or scribed through the coating. Steel siding shall not be installed within 1 mile (1.6 km) 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.

d) Vinyl siding shall conform to the requirements of ASTM D3679, Rigid Poly (Vinyl Chloride) (PVC) Siding.

4.4.8.5 Other Surfaces. Criteria for patios, balconies and porches, and exterior stairs are listed below.

a) Patios shall be sloped to drain and have a broom-finished concrete floor surface.

b) Balconies and porches located directly above other balconies, porches, or patios, shall be sloped to drain and have a concrete floor surface which provides a waterproof and nonslip surface. Plastic coating or films over concrete decks are not acceptable. Exposed wood decks, stained or painted, are not acceptable. Balcony topping shall have a minimum thickness of 1-1/2-in. (38 mm) with welded wire mesh reinforcement.

c) Wood fascia and rakes are required and shall be 1-in. nominal boards with solid blocking or 2-in. nominal boards without blocking. Plywood, hardboard, or gypsum board are not permitted for fascias or rakes.

d) Exterior stair treads and landings shall be constructed of concrete or steel and provided with non-slip type treads.

e) Cement asbestos shingle siding, ceiling or soffit will not be permitted. If exterior ceilings are provided, all joints will be trimmed or otherwise architecturally treated. If exterior ceilings are not provided, the exposed framing and underside of deck in these areas shall be painted or stained. If exterior ceilings and/or soffits are provided, vinyl, plywood, prefinished metal or 3/8-in. (9.5-mm) 303 medium density overlay siding material, EXT-APA conforming to American Plywood Association Standard B840, 303 Siding Manufacturing Specifications, shall be used.

4.4.9 Painting

4.4.9.1 Interior Surfaces. Interior surfaces, except factory prefinished material, shall be painted a minimum of one prime coat and one finish coat. All walls and ceilings in kitchen, baths, laundry, utility rooms, and all painted trim shall be painted with semi-gloss enamel. Blown-on acoustic finish is prohibited.

4.4.9.2 Exterior Surfaces. All exterior surfaces requiring painting shall receive a minimum of one prime coat of paint. Wood trim frames, etc., shall be back primed. Exterior semitransparent stains, two coats, are acceptable, where appropriate for wood, plywood, etc.

4.4.9.3 Federal and Military Specifications. Paints shall meet or exceed the latest issue of the following Federal and Military Specifications as noted in Table 19.

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4.4.9.4 Color Selection. Colors shall be submitted by the Contractor and approved by the Contracting Officer.

4.4.9.5 Lead Content. All paints and stain, including color pigments, shall be lead-free.

4.4.9.6 Kitchen/Eating Area Walls and Ceiling. Combined kitchen/eating rooms shall have same type of wall and ceiling finishes.

4.4.10 Windows. Windows above the first floor shall have operable sections that tilt out or are removable for cleaning. Weatherstripping shall be factory applied. Thermal breaks shall be provided when required. Windows shall conform to the following criteria and to industry standards listed in Table 20.

a) All windows shall have solid-wood, paint-grade interior sills, with a minimum thickness of 3/4 in. (19 mm).

b) All windows shall be double glazed with low E-glass.

c) Screens shall be provided at all operable sashes. 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.

4.4.10.1 Drapes. Drapes shall be medium weight, mildew-resistant and color-fast synthetic fabric, and shall be in accordance with NFPA 701, NFPA 701, Standard Methods of Fire Tests for Flame Resistant Textiles and Films.

4.4.11 Exterior Doors

4.4.11.1 Entrance Doors. Exterior doors shall be 1-3/4 in. (44 mm) thick, thermal metal or solid core wood.

4.4.11.2 Garage/Carport/Unit Door. Door between garage/carport and dwelling unit shall be 1-3/4 in. (44 mm) thick, thermal metal or solid core wood.

4.4.11.3 Bulk Storage Door. Exterior bulk storage door shall be a minimum 1-3/8-in. (35 mm) thick, exterior grade, solid core wood, or hollow core metal. Door may be omitted when storage area is located in garage.

4.4.11.4 Sliding Glass Doors. Sliding glass doors, shall be aluminum conforming to AAMA 101, Voluntary Specification for Aluminum Prime Windows and Sliding Glass Doors, for Type SGD-R15 and provided with an anodized finish or factory baked enamel finish conforming to 44-C-22431 in accordance with requirements of the National Association of Architectural Metal Manufacturers (NAAMM) Metal Finishes Manual. Sliding panels shall be equipped with screens having 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. Screening shall be nonferrous, with lower protective grill. Sliding glass doors shall be double glazed with Low E-glass (hard coating); "E" shall not exceed 0.40.

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Table 19
Specifications for Primer, Paint, and Stain

<u>SURFACE</u>	<u>COAT</u>	<u>MIL/FED. SPEC.</u>	<u>MIL/FED. SPEC.</u>
Exterior Wood	Primer	MIL-P-28582	<u>Primer Coating, Exterior, Lead Pigment-free (Undercoat for Wood)</u>
	Finish	TT-P-102	<u>Paint, Oil, Alkyd Modified, Exterior, White and Tints</u>
	Stain	TT-S-708	<u>Stain, Oil, Semitransparent, Wood, Exterior</u>
Interior Wood	Primer	TT-P-645	<u>Primer, Paint, Zinc-chromate, Alkyd Type</u>
	Finish	TT-E-489	<u>Enamel, Alkyd, Gloss, (For Exterior and Interior Surfaces)</u>
Exterior Masonry	Primer	TT-P-19	<u>Paint, Latex (Acrylic Emulsion, Exterior Wood and Masonry)</u>
	Finish	TT-P-19	
Interior Masonry	Primer	TT-P-29	<u>Paint, Latex Base, Interior, Flat, White and Tints</u>
	Finish	TT-P-29	
Metal, Exterior or Interior	Primer	TT-P-645	<u>Primer Coating, Latex Base, Interior, White (For Gypsum Wallboard)</u>
	Finish	TT-E-489	
Gypsum Wallboard	Primer	TT-650	<u>Primer Coating, Latex Base, Interior, White (For Gypsum Wallboard)</u>
	Finish (gloss)	TT-P-1511	<u>Paint, Latex (Gloss and (Semigloss, Tints and White) (For Interior Use)</u>
	Finish (semigloss)	TT-E-509	<u>Enamel, Odorless, Alkyd, Interior, Semigloss, White and Tints</u>
Plaster	Sealer	TT-S-179	<u>Sealer, Surface, Pigmented Oil for Plaster and Wallboard</u>
	Finish	TT-P-1511	
	Finish	TT-E-509	

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Table 20
Standards for Windows

Aluminum Windows:	AAMA-101, grade R15, Class 15.
Wood Windows:	NWWDA I.S.2-87 Class B.
Vinyl Clad Wood Windows:	NWWDA I.S.2-87 Class B.
Aluminum Clad Wood Windows:	NWWDA I.S.2-87 Class B.
All Vinyl Windows:	AAMA 101V
Aluminum screens:	AAMA 1002.10

4.4.11.5 Aluminum Screen and Storm Doors. Screen and self-storing storm doors shall be provided for all dwelling unit exterior hinged doors. Frames shall be a minimum of 1-1/4-in. (32 mm) thick and 2 in. (51 mm) wide. Aluminum alloy materials shall be not less than 0.05 in. (1.27 mm) thick and 2 in. wide. Doors shall have solid bottom panels and midsection protective grills. Screening materials shall be nonferrous.

4.4.11.6 Weatherstripping/Exterior Thresholds. Provide nonferrous metal or vinyl weatherstripping for all unit exterior doors. Vinyl magnetic weatherstripping is acceptable for metal door. Exterior thresholds shall be nonferrous metal.

4.4.12 Locks and Keys. Lock cylinders shall have six pin tumblers and interchangeable cores which are removable by control key. Provide a master keying system. Locks within each family unit, including exterior storage and garage door(s), shall be keyed alike. Contractor shall provide one extra set of cores for each 50 units and furnish four keys for each key change and for masterkey system and control key.

Locks and keys shall conform to the standards and requirements of the Builders Hardware Manufacturers Association (BHMA) listed in Table 21.

4.4.12.1 Applications. Locks and hinges shall be applied as follows:

a) Exterior hinged doors shall have 1-1/2 pair of hinges, lockset complying with BHMA 601 (Bored and Preassembled Locks and Latches), and auxiliary lock complying with BHMA 501 (Auxiliary Locks and Associated Products), or interconnected lock and latch complying with BHMA 611, (Interconnected Locks and Latches), and a viewer mounted at eye level.

b) Exterior bulk storage door shall have 1-1/2 pairs of hinges and lockset BHMA 601.

c) Interior doors shall have 1 pair of hinges and latchset BHMA 601 with F75 or F76 operations.

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Table 21
Hinges, Locks, and Latches

Hinges:	Comply with BHMA 101 (<u>Butts and Hinges</u>). Hinges shall be 4-1/2 by 4-1/2 in. at exterior doors, 3-1/2 by 3-1/2 in. at interior doors.
Locks and Latches:	Comply with BHMA 601, series 4000, grade 2 at exterior doors, grade 2 or 3 at interior doors. Provide trim of wrought iron construction.
Auxiliary Locks:	Comply with BHMA 501, series 4000, grade 2. Provide trim of wrought iron construction.
Interconnected Lock and Latch:	Comply with BHMA 601, grade 2. Provide trim of wrought iron construction.
Closers:	Comply with BHMA 301, <u>Door Controls, Closers</u> , series C02000, grade 2.

d) Doors in fire-rated walls, unit to garage/carport, shall have 1-1/2 pairs of ball-bearing hinges, lockset BHMA 601 and auxiliary lock BHMA 501 or interconnected lock and latch BHMA 611 and closer.

e) Garage side doors shall have 1-1/2 pair of hinges and lockset BHMA 601.

4.4.13 Kitchen Cabinets. Cabinets shall be factory manufactured of wood or metal. Wall cabinets shall have adjustable shelves. Cabinets shall have magnetic catches except where spring-loaded self-closing hinges are provided. Cabinets shall conform to ANSI A1.61.1, 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. Cabinets and countertops shall have a flame-spread rating that does not exceed 200 when tested in accordance with ASTM E84 and ASTM E162, Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source. Refer to para. 4.3.4, Table 11, for minimum kitchen dimensions.

4.4.13.1 Wood Cabinets. Construct cabinets with frame fronts and solid ends, or of frame construction throughout. Frame members shall be mortised and tenoned, dove-tailed or doweled, and glued together. Brace top and bottom corners with hardwood blocks that are glued with water-resistant glue and nailed in place. Materials and minimum dimensions and thicknesses for cabinet construction materials are given in Table 22.

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Table 22
Wood Cabinet Materials and Dimensions

Frame members:	3/4 x 1-1/2 kiln-dried hardwood
Toe space (base cabinets):	2-1/2 in. deep x 4 in. high (minimum)
Cabinet backs, bottoms, and tops:	Back and bottom of base cabinets and backs and tops of wall cabinets: 3/16-in. hardwood plywood, sound grade or 1/8-in. tempered hardboard. Brace bottoms with wood members glued in place. Bottoms shall be provided under kitchen sinks.
Cabinet ends:	Hardwood plywood, good grade for natural finish. Base cabinets: 1/2-in. 5-ply material. Wall cabinets: 3/8-in. 5-ply material.
Doors	5/8-in. hardwood plywood, good grade for natural finish.
Drawers	
Side guides	20-gauge metal
Fronts:	5/8-in. solid stock hardwood, matching doors.
Bottoms:	1/8-in. softwood plywood, Grade A-B veneer or 1/8-in. tempered hardboard. On drawers over 15 in. wide, bottoms shall be braced and glued in place. Sides and backs: 1/2-in. hardwood
Interior partitions:	1/2-in. softwood plywood, Grade A-A veneer; or 1/2-in. hardwood of comparable grade.
Shelves:	1/2-in. softwood plywood, Grade A-B veneer; 1/2-in. hardwood plywood, good grade veneer, or 1/2-in. glued-up solid wood. Support shelves on ends and on 24-in. centers. Plywood shelf edges which are exposed when cabinet doors are open shall be rounded and finished by sanding and filling prior to finishing.

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4.4.13.2 Plastic-Laminated Cabinets. Exposed surfaces of laminated plastic-faced cabinets shall be high-pressure-laminated sheet not less than 0.028 in. (0.71mm) thick. Interior face of hinged doors shall be covered with laminated plastic with a minimum thickness of 0.020 in. (0.51 mm). Shelf-edge bands shall be not less than 0.028 in. thick.

4.4.13.3 Metal Cabinets. Metal cabinets shall have double-wall, sound deadening doors and drawer fronts, adjustable hinges and baked enamel exterior finish. Cabinet interiors shall be either enameled metal finish or molded-plastic lined. Construction shall conform to ANSI A161.1, Recommended Construction and Performance Standards for Kitchen and Vanity Cabinets.

4.4.13.4 Countertops. Countertops shall be ceramic tile or high pressure laminated plastic. Laminate countertops shall be 0.043 in. (1.1 mm) thick for post-formed tops or 0.05-in. (1.3mm) thick for countertops with separate backsplash, and shall be applied with heat resistive adhesive. Ceramic countertops shall include coved backsplash and bull nose tiles. Minimum backsplash height is 4 in. (102 mm).

4.4.14 Appliances. Provide the following equipment in accordance with specifications listed, one each per dwelling unit.

4.4.14.1 Refrigerators. Conform to Fed. Spec. AA-R-00211, Refrigerator, Mechanical, Household, Type V, Grade A, two-door, top freezer, with adjustable shelves, separate meat tender and vegetable crispers, and compartments for eggs, butter, and cheese/spreads.

	<u>Unit Type</u>			
	<u>2 Br</u>	<u>3 Br</u>	<u>4 Br</u>	<u>5 Br</u>
Required Ft ³ (nominal size)	16	16	19	19

4.4.14.2 Ranges. Ranges shall be 30-in. wide and provided with porcelain enamel cooktop, oven, clock/timer, oven light, and cooking surface light. Oven shall have black glass window door, broiler pan, and self-lock racks. Ranges for O-6 commanding officer and flag officer units shall be the double oven type, conforming to Fed. Spec. S-R-440044, Range, Gas, Domestic. Over-under microwave/conventional oven combinations will satisfy the double oven requirement. Use either gas or electric range, depending upon availability of natural or LP gas.

a) Gas ranges shall have two 6-in. and two 8-in. burners, a continuous cleaning oven surface and AGA-approved electronic ignition. Standing pilot flames are prohibited.

b) 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. Oven shall be equipped with one 2000-watt (minimum) tubular broil element and one 700-watt (minimum) bake element, oven

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indicating light, thermostatic heat control, utensil drawer, and one 400-watt grounding type appliance outlet conforming to NEMA WD 1, General Requirements for Wiring Devices, configuration 5-15R, and UL 858, Household Electric Ranges.

4.4.14.3 Range Hoods. Provide metal range hood, the same length and finish as range, with separately switched light and exhaust fan. Hood shall have a washable filter. Fan shall have a capacity of not less than 50 cfm per linear foot of range hood. Sound level shall not exceed 6 sones. Duct fan to the exterior.

4.4.14.4 Microwave Ovens. Oven shall conform to UL 923, Microwave Cooking Appliances, and be UL listed, minimum 1.5 ft³ (0.042 m³), stainless steel interior, automatic oven light, built-in browning element and temperature probe.

4.4.14.5 Garbage Disposals. Garbage disposals shall conform to Fed. Spec. OO-G-1513, Garbage Disposers, Household, Type 1 continuous feed, size 1, minimum 1/2 HP motor, stainless steel grinding elements, two 360-degree stainless steel swivel impellers, manual motor reset, and sound insulation. Plug connector is required.

4.4.14.6 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. The automatic controls shall cycle through the Wash, Rinse, Dry/Heat, and Stop phases, and shall be capable of manual setting to repeat or skip any phase. Unit shall contain instantaneous, or inline, water heater booster, with automatic thermostat set for 140 degrees F (60 degrees C). Plug connector is required.

4.4.14.7 Water Heater. Water Heaters shall be in accordance with Fed. Spec. W-H-196, Heater, Water, Electric, and Gas Fired Residential, Group B, (Gas Fired), (Electric), Water Heaters, Type IV, Glass Lined Tank (Round), with Service Efficiency (SE) of 0.613. Size water heaters according to Table 23.

Table 23
Water Heater Sizing

<u>UNIT TYPE</u>	<u>WATER HEATER SIZE (Gals)</u>	
	<u>Gas</u>	<u>Electric</u>
1 and 2 bedroom	30	40
3 bedroom	40 (or 30 with SE of 0.800)	60
4 and 5 bedroom	50	80

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4.4.14.8 Color and Manufacture. Appliances, except disposal, shall be of the same manufacture, and have matching finish, white or off-white in color.

4.4.15 Maintainability. 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. Avoid products that require continuing maintenance at high cost.

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Section 5: MOBILE HOME PARKS

5.1 GENERAL REQUIREMENTS. Mobile home parks may be provided for privately-owned and government-owned mobile homes where a need has been determined. The criteria contained in this section are intended to establish minimum standards of construction for new mobile home park facilities and, where applicable, to the improvement of existing facilities. Parks shall be complete with roads, parking areas and all required utility systems. Where cost limitations allow, projects should include such desirable elements as a laundry/community building and individual storage units.

5.2 SITE. A major site planning objective is to assure an interesting, attractive, livable residential environment at an affordable construction cost. Planning shall take into consideration existing topography, trees, and natural characteristics of the environs to utilize potential site advantages.

5.2.1 Site Selection. A critical factor in providing an economically feasible mobile home project is the selection of the site. Each site should be evaluated to determine its suitability for the intended residential use as well as compatibility with adjacent land uses. The same factors used in selection of sites for conventional housing (i.e., hazards, noise, geotechnical considerations, etc.) must be considered in determining the suitability of a site for a Mobile Home Park. The condition of the site, the availability of utility systems and access to roadways have a direct impact on the cost of constructing Mobile Home Parks. Optimum site conditions include the following:

a) Lightly wooded or partially cleared. Selective tree trimming required to provide space for locating mobile homes while allowing some existing trees to remain to provide shade, wind screening and improve the aesthetics of the community.

b) Topography such that minimal earthwork is required to provide suitable locations for mobile homes, roads and drainageways.

c) Soils which provide adequate support for mobile homes and roadways without excessive undercutting and backfilling operations.

d) Minimum rock formation.

e) Direct access to existing roadway(s) not requiring lengthy entrances and having sufficient width and pavement strength to support moving mobile homes into and out of the site.

f) Existing utility systems (water, sanitary sewage, electric power, and storm drainage) located adjacent to or on the site with adequate capacity to support the project.

5.2.1.1 Location. Where possible new facilities should be located adjacent to existing on-base mobile home parks.

5.2.2 Site Planning. Planning for a mobile home park should include all initial and projected site improvements including patios, laundry and

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community buildings and landscaping. In developing layouts consider the following:

a) **Street Layout.** Because of the inherent differences in the appearance of mobile homes, street layout should be uniform to give the park a more orderly appearance. Streets should be two lanes and designed to minimize cut and fill.

b) **Landscape design** shall utilize existing trees and groups of trees where possible. Landscape plans should include that landscaping to be included as part of the basic park construction and any phased future landscaping. The basic planting scheme should place emphasis on creating a pleasant outdoor environment for park inhabitants while providing appropriate screening between adjacent sites.

c) **Parking.** Provide parking at the same ratio as for conventional family housing at military installations within the United States.

d) **Density.** Individual mobile home lots should average 4,000 to 4,500 ft² (372 to 418 m²) exclusive of allowances for roads, recreation areas, pedestrian paths and other common use facilities. Projects shall be planned to a density of approximately 6 units per gross acre.

e) **Clearances.** Clearances shall reflect the specified density while maintaining a minimum separation between units of not less than 15 ft (4.57 m).

f) **Accessibility for oversized emergency and service vehicles** (such as fire and rescue).

g) **Paved areas.** Paving should be minimized to maximize the green space in parks. Pads shall not be provided under mobile homes, however every precaution shall be taken to prevent the creation of ruts and other damage to soil by mobile home wheels during move in and move out. Foundations, tie-down, and skirting for mobile homes is the responsibility of individual owners.

h) **Sidewalks.** Asphalt concrete or concrete walks may be provided on one side of streets when funding permits.

i) **Patios, pedestrian access, parking and the base for the exterior storage units** will be incorporated in a 10-ft x 50-ft paved strip adjacent to mobile home unit locations. Paving may be asphaltic concrete or concrete as funds permit.

j) **Exterior storage.** Provide individual storage sheds not less than 30 ft² (2.79 m²) in area where funds permit.

5.2.3 **Utilities.** In general, the requirements for utilities are about the same for a mobile home park as for a conventional housing development. Unless there are overriding considerations (e.g., bedrock, etc.), secondary electric services shall be underground. All utility connections with the exception of electrical should terminate within the rear one-third of the

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mobile home space. Electrical connections should terminate 65 ft (19.8 m) from the front and 15 ft (4.6 m) from the curb side of each mobile home space. Except as stipulated herein, systems shall be designed to conform to applicable engineering criteria.

a) Electric service. Electrical service to each mobile home space shall be 150 A and individually metered.

b) Water. The water connection shall consist of a riser terminating above ground surface with two 3/4-in. valved outlets. One outlet shall serve as a connection to the mobile home piping system and the other as an exterior hose bib. Protection against freezing shall be provided in cold regions. Sizing of secondary waterlines shall be based upon the supply normally provided to family housing.

c) Sanitary sewer. The sewer shall be cast iron, PVC or ABS pipe. The sewer connection shall consist of a 4-in. inside diameter riser terminating above ground surface and include provisions for a clean-out. Proper separation from waterlines shall be maintained.

d) Storm sewer. To the maximum extent possible. Storm drainage shall be controlled by surface grading, ditches, and swales. In larger parks, improved road ditches and laterals may be required to prevent low spots and accumulation of standing water. Systems shall conform to state and local storm water management regulations where required.

e) Natural gas. Do not provide a gas piping system; owner shall provide individual bottled gas system, when required.

f) Master TV Antenna. Master TV antenna outlet may be provided for each mobile home unit, if adequate reception of the nearest stations cannot be obtained on the most efficient indoor antenna. Outlets will be weatherproof and located on rigid supports near the mobile home power receptacle. Design and specifications of the antenna system will be coordinated with the base Public Works Officer/Post Engineer.

g) Telephone. Provisions for telephone connections shall be included in the basic design.

h) Street Lighting. Follow the practice and criteria used for conventional housing projects.

i) Due to the requirement for individual charges to occupants for utilities, consideration should be given to individual meter installation for each utility provided.

5.2.4 Recreational Areas. A recreational area should be included in the basic design, in accordance with criteria in Section 4 of this handbook.

5.2.5 Laundry/Community Building. A laundry/community building should be included in the basic design. Its inclusion and scope shall be dependent upon funding limitations, the number of mobile home spaces supported and the non-availability of existing facilities at nearby on-base locations or off-base commercial establishments. Where applicable, expansion of existing facilities

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will receive maximum consideration. Buildings shall be sized on the basis of providing one washer and one dryer for each four mobile home spaces.

5.2.6 Fire Protection. Mobile home parks shall comply with the applicable requirements of NFPA 501A Manufactured Home Installations and NFPA 501D Recreational Parks and Campgrounds. Fire hydrants shall supply water at a rate of at least 500 gpm (1892.5 L/min) for 1-1/2 hours with a minimum residual pressure of 20 psi (138 kPa).

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Section 6: FAMILY HOUSING COMMUNITY CENTERS

6.1 GENERAL. This section stipulates the basic criteria to be used in the design of Family Housing Community Centers (FHCC).

6.1.1 Determination of Need. Normally, construction of FHCC's should not be considered when:

- a) Housing projects or complexes have less than 250 family units.
- b) Base or community recreational facilities are convenient to and sufficient to support the housing project.

FHCC projects may be considered for isolated locations having fewer than 200 family units.

6.2 BUILDING SIZE. Building size shall be based on user needs, however, the size normally shall not exceed 5000 gross ft² (464.5 m²). A determination that a larger facility will be required shall be supported by detailed justification and headquarters approval prior to programming or proceeding with planning and design.

6.3 FUNCTIONAL DESIGN. The building design shall meet the functional needs identified early in the planning and programming cycle. Room sizes and configurations will vary to be responsive to end use, however, consideration should be given to multipurpose spaces divisible by movable partitions where overlapping or similar functions can be accommodated. Planning of a FHCC should consider the inclusion of the following functional spaces:

- a) Arts and crafts.
- b) Assembly space and meeting rooms
- c) Kitchen sized and equipped for small groups.
- d) Studio and lecture space.
- e) Game rooms
- f) Locker space
- g) Appropriate support spaces (i.e., toilets, lobby, etc.)

6.4 DESIGN FOR PHYSICALLY HANDICAPPED. Design of FHCC's shall provide for the physically handicapped. As a minimum, toilet facilities, building access and parking shall be provided for the handicapped, conforming with the Uniform Federal Accessibility Standards and ANSI A117.1.

6.5 TYPE OF CONSTRUCTION. Construction shall be permanent type conforming to the requirements for assembly occupancy.

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Section 7: SUPPORT FACILITIES

7.1 GENERAL. Concurrent with the planning of new housing projects, consider the need for support facilities such as child care centers, schools, and a housing office.

7.2 SCHOOL FACILITIES. Concurrent with the planning of new housing projects, consideration should be given to the resulting increased demand placed on existing education facilities. For housing projects within the United States it is important that representatives of the Military Department concerned, including the installation commander, work closely with local, State and Federal authorities to determine:

- a) Whether additional school facilities are needed.
- b) Whether Federal assistance is required.
- c) Whether needed facilities should be located on or off Federal property.
- d) Environmental considerations.

7.2.1 Coordination and Scheduling. In those instances where additional school facilities are determined to be required, the necessary actions, including site selection and required application to State and/or Federal agencies, should be made at the earliest possible date to ensure the availability of adequate facilities at the time of beneficial occupancy of the new housing units. For overseas projects, the proper Military Department representative should consult with the school area superintendent regarding the need for additional educational facilities.

7.4 PROJECT HOUSING OFFICES. When housing offices are authorized to support Military family housing projects they 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. Designs should be based on a work station utilization rate of 135 ft² (12.5 m²) for the housing manager and 122 ft² (11.3 m²) for each support and staff member. Appropriate support spaces are to be added. Support spaces should be based on the following:

- a) Files, standard letter: 6 ft² (0.6 m²); legal: 7 ft² (0.7 m²).
- b) Special equipment (such as computers, reproduction equipment etc.): To be based on size and required operating space.
- c) Waiting room with service counter designed to seat and serve 15 people: 400 ft² (37.2 m²) maximum.
- d) Other support space (i.e., mechanical, electrical, and bulk storage): 250 ft² (23.2 m²).

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REFERENCES

Unless otherwise specified in the text, users of this handbook should use the latest revisions of the documents cited herein.

FEDERAL/MILITARY SPECIFICATIONS, STANDARDS, BULLETINS, HANDBOOKS, AND NAVFAC GUIDE SPECIFICATIONS

The following specifications, standards, bulletins and handbooks form a part of this document to the extent specified herein. Unless otherwise indicated, copies are available from Commanding Officer, Naval Publications and Forms Center, ATTENTION: NPODS, 5801 Tabor Avenue, Philadelphia, PA 19120-5099.

SPECIFICATIONS

FEDERAL

L-F-475	Floor Covering Vinyl, Surface (Tile and Roll) with Backing
S-R-440044	Ranges, Gas (Domestic)
AA-R-00211	Refrigerator, Mechanical, Household (Electrical, self-contained)
OO-G-1513	Garbage Disposers, Household
TT-E-489	Enamel, Alkyd, Gloss, (For Exterior and Interior Surfaces)
TT-E-509	Enamel, Odorless, Alkyd, Interior Semigloss, White and Tints
TT-P-19	Paint, Latex (Acrylic Emulsion, Exterior Wood and Masonry)
TT-P-29	Paint, Latex Base, Interior, Flat, White and Tints
TT-P-102	Paint, Oil, Alkyd Modified, Exterior, White and Tints
TT-P-645	Primer, Paint, Zinc-chromate, Alkyd Type
TT-P-650	Primer Coating, Latex Base, Interior, White, (For Gypsum Wallboard)
TT-P-1511	Paint, Latex (Gloss and Semigloss, Tints and White) (For Interior Use)

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TT-S-179	Sealer, Surface, Pigmented Oil for Plaster and Wallboard.
TT-S-708	Stain, Oil, Semitransparent, Wood, Exterior
W-H-196	Heater, Water, Electric, and Gas Fired Residential
WW-P-541	Plumbing Fixtures (Lavatories) (Detail Specification)
DDD-C-0095	Carpets and Rugs, Wool, Nylon, Acrylic, Modacrylic Polyester, Polypropylene
DDD-C-001023	Cushion, Carpet and Rug (Hair Felt and Rubber coated Jute and Animal Hair or Fiber)

MILITARY

MIL-P-28582	Primer Coating, Exterior, Lead Pigment-free (Undercoat for Wood)
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HANDBOOKS

MIL-HDBK-1190	Facility Planning and Design Guide
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STANDARDS

FED-STD-795	Uniform Federal Accessibility Standards
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NAVY MANUALS, DRAWINGS, P-PUBLICATIONS, AND MAINTENANCE OPERATING MANUALS

Available from Commanding Officer, Naval Publications and Forms Center, (NPFC), 5801 Tabor Avenue, Philadelphia, PA 19120-5099. To order these documents: Government agencies must use the Military Standard Requisitioning and Issue Procedure (MILSTRIP); the private sector must write to NPFC, ATTENTION: Cash Sales, Code 1051, 5801 Tabor Avenue, Philadelphia, PA 19120-5099.

NAVFAC P-80.3	Facility Planning Factor Criteria for Navy and Marine Corps Shore Installations
NAVFAC P-971 (AFR 86-14 and TM-5-803-7)	Airfield and Heliport Planning Criteria
NAVFAC P-930	Navy Family Housing Manual

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NAVY DEPARTMENTAL INSTRUCTIONS Available from Commanding Officer, Naval Publications and Forms Center, ATTENTION: Code 3015, 5801 Tabor Avenue, Philadelphia, PA 19120-5099.

OPNAVINST 11010.36	Air Installations Compatible Use Zones (AICUZ)
NAVFACINST 11101.63	Planning Services for Navy and Marine Corps Activities
NAVFACINST 1101.85	Navy Family Housing Projects, Turnkey Standards

OTHER GOVERNMENT DOCUMENTS AND PUBLICATIONS

The following Government documents and publications form a part of this document to the extent specified herein.

ARMY

AR 210-20	Master Planning for Army Installations
AR 210-50	Family Housing Management
AR 415-15	Military Construction, Army (MCA) Program Development
DAEN-ECC-A	Procurement Procedure Manual for Army Family Housing
TM 5-803-1	Installation Master Planning

(Unless otherwise indicated, copies are available from U. S. Army Adjutant General, Publications Center, 1655 Woodson Rd., St. Louis, MO 63114.)

Army Corps of Engineers Architectural and Engineering Instructions
-- Design Criteria

Available on-line through the PAXMAIL program under DCIS. Information on the program is available from U.S. Army Corps of Engineers, Headquarters, 20 Massachusetts Avenue, N.W., Washington, DC 20314-1000 / (commercial) (202) 272-0577 or (Autovon) 285-0577.

SOLFEAS Solar Feasibility Program

Available from the BLAST Support Office, University of Illinois, 30 Mechanical Engineering Building, 1206 West Green Street, Urbana, IL 61801 (217) 333-3977, (800)-UIBLAST or (800) 842-5278.

CONSUMER PRODUCT SAFETY COMMISSION

CFR 16-1630	Standard for the Surface Flammability of Carpets and Rugs
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(Unless otherwise indicated, copies are available from Consumer Product Safety Commission, Directorate for Compliance and Administrative Litigation, Department of Regulatory Development, Washington, DC 20207 / (301) 492-6400.)

DEPARTMENT OF DEFENSE

DOD Instruction 4165.57 Air Installations Compatible Use Zones

DOD Directive 6050.1 Environmental Effects in the United States of DOD Actions

Available from Commanding Officer, Naval Publications and Forms Center, (NPFC), 5801 Tabor Avenue, Philadelphia, PA 19120-5099. To order these documents: Government agencies must use the Military Standard Requisitioning and Issue Procedure (MILSTRIP); the private sector must write to NPFC, ATTENTION: Cash Sales, Code 1051, 5801 Tabor Avenue, Philadelphia, PA 19120-5099.

FEDERAL EMERGENCY MANAGEMENT AGENCY

Maps of flood-prone areas and information on regional offices are available from the Federal Emergency Management Agency, Federal Insurance Administration, 500 C Street, S.W., Washington, D.C. 20472. In Maryland call 1-(800)-492-6605. Elsewhere in the continental United States, call 1-(800)-638-6620. In Alaska, Guam, Hawaii, Puerto Rico, and the Virgin Islands, call 1-(800) 638-6831.

NATIONAL BUREAU OF STANDARDS (NBS)

See NATIONAL INSTITUTE OF SCIENCE AND TECHNOLOGY

NATIONAL INSTITUTE OF SCIENCE AND TECHNOLOGY
(formerly National Bureau of Standards)

NBS Handbook 135 Life-Cycle Costing Manual for the Federal Energy Management Program

Available from National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161 (703) 487-4650. Document order number is PB88-138227.

U. S. GEOLOGICAL SURVEY

Unless otherwise indicated, topographic maps, maps of flood-prone areas, engineering hazards maps, and streamflow data are available from the U. S. Geological Survey National Center, Reston, VA 22092 / (703) 648-4000. For information on maps or local information resources such as Water Resources Division Field Offices or State geological surveys, contact the Public Affairs Office at (703) 648-4000; to order maps and publications, contact the National Cartographic Information Center at (703) 648-6045.

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FEDERAL LAWS

Code of Federal Regulations

10 CFR 436A

10 CFR 435, Subpart A

Federal Manufactured Housing Construction and Safety Standards Act of 1974, 42 USC Section 5401-5426

Public Law 97-214, Title 10 U.S.C., Section 2826

Public Law 93-383, Title 24, Chapter xx amended (1977, 1978, 1979, and 1980)

Public Law 98-407, August 28, 1984

Public Law 98-115

Noise Control Act of 1972, 42 U.S.C. Section 4901-4918 (1976) and 49 U.S.C. Section 1431 (1976)

National Environmental Policy Act (NEPA) 42 U.S.C. Section 4321-4361

(Unless otherwise indicated, copies are available from Superintendent of Documents, Government Printing Office, Washington, DC 20402-9325 / (201) 783-3238.)

NON-GOVERNMENT PUBLICATIONS

The following publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the Department of Defense Index of Specifications & Standards (DODISS).

AMERICAN ASSOCIATION OF HEATING, REFRIGERATION, AND AIR-CONDITIONING ENGINEERS (ASHRAE)

Air Distribution Manual

(Unless otherwise indicated, copies are available from the American Association of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE), 1791 Tullie Circle, N.E., Atlanta, GA 30329 / (404) 636-8400.)

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 101 Voluntary Specification for Aluminum Prime Windows and Sliding Glass Doors (DOD adopted)

AAMA 101V Voluntary Specification for Poly (Vinyl chloride) (PVC) Prime Windows and Sliding

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AAMA 1002.10 Glass Doors
Voluntary Specifications for Aluminum
Insulating Storm Products for Windows and
Sliding Glass Doors

AAMA 1402 Standard Specifications for Aluminum
Siding, Soffit, and Fascia

(Unless otherwise indicated, copies are available from the American
Architectural Manufacturers Association (AAMA), 2700 River Road, Suite 118,
Des Plaines, IL 60018 / (312) 699-7310.)

AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS

AATCC 134 Electrostatic Propensity of Carpets

(Unless otherwise indicated, copies are available from the American
Association of Textile Chemists and Colorists, P.O. Box 12215, Research
Triangle Park, NC 27709 / (919) 549-8141.)

AMERICAN GAS ASSOCIATION (AGA)

(Unless otherwise indicated, standards and specifications are
available from the American Gas Association (AGA), 1515 Wilson Boulevard,
Arlington, VA 22209 / (703) 841-8400.

AIR MOVEMENT AND CONTROL ASSOCIATION, INC. (AMCA)

AMCA 210 Laboratory Methods of Testing Fans For
Rating

(Unless otherwise indicated, copies are available from Air Movement
and Control Association, Inc. (AMCA), 30 West University Drive, Arlington
Heights, IL 60004 / (312) 394-0150.)

AMERICAN NATIONAL STANDARDS INSTITUTE, INC. (ANSI)

ANSI A112.19.1 Enameled Cast Iron Plumbing Fixtures

ANSI A112.19.2 Vitreous China Plumbing Fixtures (DOD
adopted)

ANSI A112.19.3 Stainless Steel Plumbing Fixtures
(Designed for Residential Use)

ANSI A112.19.4 Porcelain Enameled Formed Steel Plumbing
Fixtures (DOD adopted)

ANSI A112.19.5 Trim for Water-Closet Bowls, Tanks, and
Urinals (Dimensional Standards) (DOD
adopted)

ANSI A117.1 Buildings and Facilities -- Providing
Accessibility and Usability for Physically

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ANSI A135.6	Handicapped People Hardboard Siding
ANSI A161.1	Recommended Construction and Performance Standards for Kitchen and Vanity Cabinets
ANSI B16.5	Steel Pipe Flanges and Flanged Fittings (DOD adopted)
ANSI B16.22	Wrought Copper and Copper Alloy Solder Joint Pressure Fittings (DOD adopted)
ANSI B16.26	Cast Copper Alloy Fittings for Flared Copper Tubes (DOD adopted)
ANSI B31.8	Gas Transmission and Distribution Piping Systems
ANSI C2	National Electrical Safety Code
ANSI Z21.45	Flexible Connectors of Other Than All- Metal Construction for Gas Appliances.
ANSI Z124.1	Plastic Bathtub Units
ANSI Z124.2	Plastic Shower Receptors and Shower Stalls

(Unless otherwise indicated, copies are available from the American National Standards Institute, Inc. (ANSI), 1430 Broadway, New York, N.Y. 10018 / (212) 354-3300.)

AMERICAN PLYWOOD ASSOCIATION

APA B840-K-88 303 Siding Manufacturing Specifications

(Unless otherwise indicated, copies are available from American Plywood Association, P.O. Box 11700, Tacoma, WA 98411 / (206) 565-6600.)

AIR-CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

Directory of Certified Unitary Air Conditioners, Unitary Heat Pumps
and Sound Rated Outdoor Unitary Equipment

ARI 210/240 Unitary Air Conditioning and Air-Source
Heat Pump Equipment

(Unless otherwise indicated, copies are available from the Air-Conditioning and refrigeration Institute (ARI), 1501 Wilson Boulevard, Suite 600, Arlington, VA 22209 / (703) 524-8800.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A526 Specification for Steel Sheet, Zinc-Coated
(Galvanized) by the Hot-Dip Process,
Commercial Quality (DOD adopted)

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ASTM B117	Method of Salt Spray (Fog) Testing (DOD adopted)
ASTM C90	Specification for Hollow Load-Bearing Concrete Masonry Units (DOD adopted)
ASTM C216	Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale) (DOD adopted)
ASTM D1785	Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 (DOD adopted)
ASTM D2513	Standard Specification for Thermoplastic Gas Pressure Piping Systems (DOD adopted)
ASTM D2683	Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing (DOD adopted)
ASTM D2846	Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems (DOD adopted)
ASTM D3018	Specification for Class A Asphalt Shingles Surfaced with Mineral Granules (DOD adopted)
ASTM D3679	Specification for Rigid Poly (Vinyl Chloride) (PVC) Siding
ASTM E84	Standard Test Method for Surface Burning Characteristics of Building Materials (DOD adopted)
ASTM E90	Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions (DOD adopted)
ASTM E108	Standard Methods of Fire Tests of Roof Coverings
ASTM E119	Standard Methods of Fire Tests of Building Construction and Materials
ASTM E162	Standard Test Method for Surface Flammability of Materials Using A Radiant Heat Energy Source (DOD adopted)
ASTM E336	Standard Test Method for Measurement of Airborne Sound Insulation in Buildings

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

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

(Unless otherwise indicated, copies are available from the American
Society for Testing and Materials (ASTM), 1916 Race Street, Philadelphia, PA
19103 / (215) 299-5400.)

AMERICAN WATER WORKS ASSOCIATION, INC. (AWWA)

AWWA C500 Gate Valves for Water and Sewerage Systems
(DOD adopted)

AWWA C502 Dry-Barrel Fire Hydrants

AWWA C503 Wet-Barrel Fire Hydrants

(Unless otherwise indicated, copies are available from the American
Water Works Association, 6666 Quincy Ave., Denver, CO 80235 / (303) 794-7711.)

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION, INC. (BHMA)

BHMA 101 Butts and Hinges (formerly ANSI A156.1)
(DOD adopted)

BHMA 301 Door Controls, Closers (formerly ANSI
A156.4) (DOD adopted)

BHMA 501 Auxiliary Locks and Associated Products
(formerly ANSI A156.5) (DOD adopted)

BHMA 601 Bored and Preassembled Locks and Latches
(formerly ANSI A156.2) (DOD adopted)

BHMA 611 Interconnected Locks and Latches (formerly
ANSI A256.12-86) (DOD adopted)

(Unless otherwise indicated, copies are available from Builders
Hardware Manufacturers Association, Inc. (BHMA), 60 East 42nd Street, Room
511, New York, NY 10165 / (212) 661-4261.)

INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS (IAMPO)

Uniform Plumbing Code

(Unless otherwise indicated, copies are available from the

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International Association of Plumbing and Mechanical Officials (IAMPO)
5032 Alhambra Avenue, Los Angeles, CA 90032 / (213) 223-1471.)

INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS (ICBO)

Uniform Building Code

(Unless otherwise indicated, copies are available from the
International Conference of Building Officials (ICBO), 5360 South Workman Mill
Road, Whittier, CA 90601 (213) 699-0541.)

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS ASSOCIATION (NAAMA)

Metal Finishes Manual

(Unless otherwise indicated, copies are available from National
Association of Architectural Metal Manufacturers Association (NAAMA), 600
South Federal Street, Chicago, IL 60605-1842 / (312) 922-6222.)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA DC 3 Wall-Mounted Room Thermostats

NEMA WD 1 General Requirements for Wiring Devices

(Unless otherwise indicated, copies are available from National
Electrical Manufacturers Association (NEMA), 2101 L Street N.W., Washington,
D.C. 20037 / (202) 457-8400.)

NATIONAL FIRE PROTECTION ASSOCIATION, INC. (NFPA)

NFPA 70 National Electrical Code DOD adopted)

NFPA 74 Household Fire Warning Equipment

NFPA 101 Life Safety Code

NFPA 101M Alternative Approaches to Life Safety

NFPA 255 Method of Test of Surface Burning
Characteristics of Building Materials

NFPA 501A Manufactured Home Installations

NFPA 501D Recreational Vehicle Parks and Campgrounds

NFPA 701 Standard Methods of Fire Tests for Flame
Resistant Textiles and Films

(Unless otherwise indicated, copies are available from National
Fire Protection Association, Inc. (NFPA), Battery March Park, Quincy, MA
02269 / (617) 770-3000.)

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NATIONAL SANITATION FOUNDATION, 3475 Plymouth Road, P.O. Box 1468, Ann Arbor, MI 48106 / (313) 769-8010.

NATIONAL WOOD WINDOW AND DOOR ASSOCIATION

NWWDA I.S.2

Standard for Wood Window Units

(Unless otherwise indicated, copies are available from National Wood Window and Door Association (NWWDA), 205 Touhy ave., Des Plaines, IL 60018 / (312) 299-5200.)

SOUTHERN BUILDING CODE CONGRESS INTERNATIONAL, INC. (SBCC)

Uniform Mechanical Code

(Unless otherwise indicated, copies are available from Southern Building Code Congress International, INC. (SBCC), 900 Montclair Road, Birmingham, AL 35213-1206 / (205) 591-1853 or (800) 633-3876.)

UNDERWRITERS LABORATORIES, INC. (UL)

UL 749

Household Electric Dishwashers

UL 858

Household Electric Ranges (DOD adopted)

UL 923

Microwave Cooking Appliances (DOD adopted)

(Unless otherwise indicated, copies are available from Underwriters Laboratories, Inc. (UL), 333 Pfingston Road, Northbrook, IL 60062 / (312) 272-8800.)

CUSTODIAN

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ARMY - CE

PREPARING ACTIVITY

NAVY - YD

PROJECT NO.

FACR 0272

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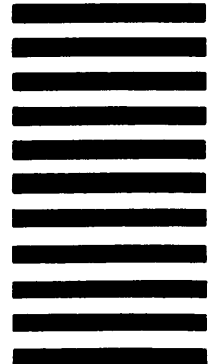
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