DOCUMENT RESUME

05224 - [B0725641]

Savings Possible through Further Design Standardization of Bachelor Enlisted Quarters. LCD-78-311; B-133316. March 9, 1978. 30 pp. + 5 appendices (11 pp.).

Report to Sen. Gary Hart, Chairman, Senate Committee on Armed Services: Military Construction and Stockpiles Subcommittee; by Elmer B. Staats, Comptroller General.

Issue Area: Facilities and Material Management: Building, Buying, or Leasing Federal Facilities and Equipment (706); Facilities and Material Management: Design and Construction of Federal Facilities (707);Facilities and Material Management: Operation and Maintenance of Facilities (708).
Contact: Logistics and Communications Div.
Budget Function: General Government: General Property and Records Management (051); National Defense: Department of Defense - Military (except procurement & contracts) (804).
Organization Concerned: Department of the Air Force; Department of the Army; Department of the Navy; Department of Defense.
Congressional Relevance: House Committee on Armed Services; Senate Committee on Armed Services; Senate Committee on Armed Services: Military Construction and Stockpiles Subcommittee. Sen. Gary Hart.

Within statutory cost and Department of Defense (DOD) space limits, the military services generally have been free, and encouraged, to develop bachelor housing concepts and designs to suit their requirements and preferences. As a result, each service has developed one or more basic housing concepts to meet its needs, and there are seven basic concepts used today. Findings/Conclusions: Housing provided by the services is comparable in quality, but there are significant variations in costs for construction, architecture, and engineering, and differences in energy efficiency. The basic architecture was the chief factor affecting construction cost and energy efficiency. When standardized plans were used and adapted for local conditions, design costs generally were lower. Further standardization of designs could significantly reduce future housing costs. For every 2,500 spaces built, future construction costs could be reduced up to $1 million by use of the most economical design throughout the service. DOD opposes further standardization, maintaining that flexibility is needed to meet varying geographical and individual requirements. These objections could be met, and greater standardization is warranted. Present statutory limits on cost and space have not always been met, and controls have not all been sufficiently effective in promoting economy and efficiency. Recommendations: The Congress should consider three alternatives to strengthen controls over costs: to revert to a statutory cost limit per design occupant based on the cost actually needed to build the most economical designs or to restrict space per occupant--by

either a statutory or administrative limit. If the Congress chooses to restrict space per occupant, the present statutory cost limit should be restricted to the cost needed to construct the most economical designs. (Author/HTW)

3641

REPORT BY THE

Comptroller General

OF THE UNITED STATES

Savings Possible Through Further Design Standardization Of Bachelor Enlisted Quarters

The military services choose from several different designs when building new bachelor enlisted quarters. Although each design generally conforms to the Department of Defense's criteria, there are significant differences among them in construction cost, architectural and engineering cost, and energy efficiency. If the more economical and efficient designs were adopted for use servicewide, the cost of future bachelor housing programs could be greatly reduced.

The Congress could strengthen the controls over bachelor quarters costs by limiting gross square feet per occupant or total cost per occupant.

MARCH 9, 1978

LCD-78-311

COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

B-133316

The Honorable Gary Hart
Chairman, Subcommittee on Military
Construction and Stockpiles
Committee on Armed Services
United States Senate

Dear Mr. Chairman:

This report is in response to your request of August 8, 1977, that we examine the advisability of increased design standardization in military bachelor housing.

We reviewed all bachelor enlisted quarters projects approved by the Congress for the fiscal years 1975, 1976, and 1977 military construction programs. As agreed with your office, we excluded overseas, trainee, and bachelor officer quarters. At your request, we did not obtain written agency comments. However, the matters covered in the report were discussed with agency officials, and their comments are incorporated where appropriate.

Our review showed that there are significant cost differences among the designs used to construct new bachelor enlisted quarters. If the more economical and efficient designs were used servicewide, the cost of future bachelor housing programs could be greatly reduced. To achieve greater standardization and to control housing costs more effectively, we believe the Subcommittee should consider changing certain controls over bachelor housing. We have not included legislative language in this report; however, we will be available to assist the Subcommittee in drafting any legislation it believes is warranted.

As your office requested, we are not restricting distribution of this report. We are sending copies to the Chairmen, Senate and House Committees on Armed Services and Appropriations; the Secretaries of Defense, the Army, the Navy, and the Air Force; and the Acting Director, Office of Management and Budget.

Sincerely yours,

Comptroller General
of the United States

COMPTROLLER GENERAL'S
REPORT TO THE SUBCOMMITTEE ON
MILITARY CONSTRUCTION AND STOCKPILES
SENATE COMMITTEE ON ARMED SERVICES

SAVINGS POSSIBLE THROUGH FURTHER DESIGN STANDARDIZATION OF BACHELOR ENLISTED QUARTERS

D I G E S T

Within statutory cost and Department of Defense space limits, the military services generally have been free, and encouraged, to develop bachelor housing concepts and designs to suit their requirements and preferences. As a result, each service has developed one or more basic housing concepts to meet its needs, and there are seven basic concepts used today. (See pp. 4 and 5.)

However, the differences among them in construction cost, architectural and engineering cost, and energy efficiency are significant. Because of these differences, further standardization toward the more economical and efficient designs could substantially reduce future costs for constructing and operating bachelor housing.

Of the seven designs, the Air Force has one, the Army has two, and the Navy has four. They can be grouped into two categories: a cluster type featuring several bedrooms grouped around a lounge, and a motel type featuring individual bedrooms with one lounge on each floor. (See pp. 5 to 12.)

The relative habitability of the seven designs is primarily a subjective issue and cannot be directly quantified. Defense officials say each service is providing comparable housing. Service headquarters representatives generally agree and are satisfied with their designs. (See pp. 12 and 29.)

QUANTITATIVE ANALYSIS

GAO analyzed bachelor housing projects approved by the Congress between fiscal years 1975 and 1977 and found sizable differences in construction cost, architectural and engineering cost, and energy efficiency. For example:

--Average construction cost per occupant ranged from $5,250 to $6,650. (See p. 14.)

--Average architectural and engineering cost per occupant varied from $203 to $475. (See p. 17.)

--Estimated annual energy cost per occupant for the most efficient design was 41 percent less than for the least efficient. (See p. 20.)

Although many factors contribute to these differences, the basic architecture of each design was the primary influence on construction cost and energy efficiency. Differences in architectural and engineering cost per occupant appeared to depend primarily on the extent of redesign. When standardized plans were used and adapted for local conditions, design costs generally were lower. (See p. 20.)

Because of the cost differences, further standardization of bachelor housing designs could significantly reduce future housing costs. For every 2,500 spaces built, GAO estimated that future construction cost could be reduced up to $1 million if the most economical design were used servicewide. Actual savings will depend on the extent to which the more economical and efficient designs are used in lieu of the more costly and less efficient designs. In addition, greater standardization could reduce design and energy costs. (See p. 24.)

Defense opposes further standardization of bachelor housing designs. It contends that present designs provide the flexibility needed to meet varying requirements in geographical climatic conditions and in the services' desires to provide privacy to individuals. After analyzing these arguments and others presented by the services, GAO believes greater standardization is nevertheless warranted. For example:

--The argument for flexibility mainly allows for personal preference in selecting a design.

--Through site adaptation, any design can be modified to accommodate differing climatic conditions. (See ch. 4.)

EFFECTIVENESS OF CONTROLS

To promote savings in construction cost and to make sure that relatively equal facilities are provided to bachelors in all services, the Congress and Defense have imposed two limits on the design and construction of bachelor quarters:

--The congressional limit since fiscal year 1973 has been a maximum cost per gross square foot.

--Defense limits the net living area provided to each person, excluding space for baths, lounges, and corridors. This limit varies, depending on the occupant's paygrade. (See pp. 4 and 5.)

Of the 52 projects GAO reviewed, 11 (or 21 percent) exceeded their statutory cost limit and 4 (or 8 percent) exceeded Defense's net living area limit. (See pp. 25 and 26.)

GAO also found that these controls have not sufficiently promoted economy and efficiency in designing and constructing new bachelor housing. Since 1971, the average construction cost per occupant has increased more than inflation. The increase seems to relate primarily to an increased average number of gross square feet per occupant. (See pp. 27 and 28.)

The controls do not effectively limit a project's total gross square feet. Consequently, a project's total cost cannot be effectively controlled since total cost relates to both cost per square foot and total gross square feet. Before fiscal year 1973, the Congress limited the cost per occupant. Since then, the total gross square feet has increased. Although the old limit did not directly control gross square feet, it required that greater attention be given to total cost. (See pp. 26 to 28.)

GAO also compared the fiscal year 1977 statutory cost limit of $39 per square foot to actual construction cost and found the limit was apparently greater than needed. The projected average cost per square foot for the fiscal year 1977 housing projects was $5.07 (or 13 percent) below the $39 limit. (See p. 28.)

RECOMMENDATIONS

To promote greater standardization of bachelor enlisted quarter designs, the Congress should consider three alternatives to strengthen the controls over cost. One is to revert to a statutory cost limit per design occupant based on the cost actually needed to build the most economical designs. The others are to restrict gross square feet per occupant--by either a statutory or administrative limit, depending on the desires of the Congress. If the Congress chooses to restrict gross square feet per occupant, GAO believes the present statutory cost limit per gross square foot should be restricted to that cost actually needed to construct the most economical designs. (See p. 30.)

Contents

		Page
DIGEST		i
CHAPTER		
1	INTRODUCTION	1
	Size of bachelor housing program	2
	Scope of review	3
2	BACHELOR HOUSING CONCEPTS AND DESIGNS DIFFER AMONG THE SERVICES	4
	Bachelor housing criteria	4
	Basic designs used today	5
	Qualitative comparison of basic designs	12
3	COSTS VARY CONSIDERABLY AMONG DESIGNS	13
	Construction cost analysis	13
	Design cost analysis	16
	Energy analysis	18
	Conclusions	20
4	INCREASED DESIGN STANDARDIZATION WOULD BE FEASIBLE AND COST BENEFICIAL	21
	Arguments against further standardization	21
	Potential savings through standardization	23
	Conclusions	24
5	BETTER CONTROLS NEEDED TO RESTRAIN BACHELOR HOUSING COST	25
	Extent of compliance with present controls	25
	Effectiveness of statutory limit in controlling costs	26
	Conclusions	28
6	CONCLUSIONS AND RECOMMENDATIONS	29
	Overall conclusions	29
	Recommendations	30
APPENDIX		
I	Locations visited and bachelor enlisted quarter projects reviewed	31
II	List of BEQ projects used in energy analysis	35

APPENDIX		Page
III	Summary of BEQ design analyses	36
IV	Letter dated August 8, 1977, from the Chairman, Subcommittee on Military Construction and Stockpiles, Committee on Armed Services, United States Senate	37
V	Principal officials responsible for administering activities discussed in this report	39

ABBREVIATIONS

BEQ	bachelor enlisted quarter
Btu	British thermal unit
DOD	Department of Defense
GAO	General Accounting Office

CHAPTER 1

INTRODUCTION

The Senate Armed Services Committee, in a report on the fiscal year 1977 Military Construction Authorization Bill, 1/ expressed concern over the designs used to construct military bachelor enlisted quarters (BEQs). The Committee noted that the services are using many different designs and that the cost per design occupant has ranged from $4,500 to $7,700. The report stated:

> "The committee is concerned that the criteria currently used to constrain Service designs are not sufficiently restrictive to prevent incongruities between the Services. The committee is not suggesting or requiring that the Services all build the same, architecturally sterile facility, but it appears that more standardization might be cost effective and eliminate the inconsistencies that now exist between the Services."

Because of its concern, the Committee asked the Department of Defense (DOD) to study the advisability of increased BEQ design standardization.

In July 1977, DOD reported the results of its study on BEQ designs, which concluded that no further efforts should be undertaken to reduce the number of designs used by the services. Although no quantitative analyses or other support was provided, DOD concluded that further design standardization would not result in any savings but could result in reduced service flexibility.

The Chairman of the Subcommittee on Military Construction and Stockpiles, Senate Committee on Armed Services, stated in an August 8, 1977, letter, that the DOD study was unresponsive and asked us to undertake the same study. (See app. IV.) The Committee specifically asked that we:

--Compare the cost and gross square feet per occupant for the different BEQ designs currently used by the services.

--Evaluate the relative energy efficiency of the various designs.

1/Report no. 94-856.

--Assess the desirability of increased design standardization.

--Estimate potential savings of increased design standardization.

--Recommend changes to existing law which may be needed to achieve greater standardization.

SIZE OF BACHELOR HOUSING PROGRAM

The military services have long considered the quality of housing an important factor in recruiting and retaining personnel. Emphasis on upgrading the quality of on-base housing increased greatly as the military moved to an all-volunteer force. Since fiscal year 1974, over $1 billion has been appropriated for constructing 99,500 new BEQ spaces and supporting facilities.

In February 1977, DOD estimated that facilities requirements for all enlisted bachelors totaled 1,060,000 spaces. After considering the fiscal year 1978 program approval, the deficit is 241,000 spaces. This deficit is listed by service below.

Bachelor Enlisted Housing Summary
After the Fiscal Year 1978 Program
(number of spaces)

	Total requirements	Total usable spaces	Deficit	Percent of total requirements satisfied
Army	500,000	391,000	109,000	78
Navy	226,000	149,000	77,000	66
Marine Corps	118,000	87,000	31,000	74
Air Force	216,000	192,000	24,000	89
Total	1,060,000	819,000	241,000	77

To help ensure that the services do not overbuild bachelor housing, DOD's policy is to construct no more than 90 percent of an installation's total projected requirements. Applying this criterion to the services' total requirements, the deficit is approximately 135,000 spaces. This deficit, however, includes space for recruits and for bachelors located overseas. These personnel are not housed in the types of

BEQs discussed in this report. DOD was unable to provide accurate requirements and usable spaces for non-recruit bachelors assigned to the continental United States for all the services.

SCOPE OF REVIEW

We reviewed DOD's and the services' policies and procedures for designing and constructing BEQs to determine if further standardization of housing designs is possible and cost beneficial. We discussed bachelor housing philosophies and policies with service representatives and obtained their opinions on design standardization.

We examined and analyzed design and construction costs for the 52 BEQ projects in the continental United States approved by the Congress during fiscal years 1975-77 and placed under construction contract by November 1, 1977. The funds appropriated for these projects exceeded $225 million. We tested each project for compliance with congressional cost criteria and DOD space criteria. Bachelor officers quarters and trainee barracks were excluded from our review because of their small future construction requirement.

To help us analyze technical matters, including the relative energy efficiency of the basic BEQ designs used by the services, we retained two professional engineers. The energy analysis performed by the engineers was aided by a computer model developed by the Trane Company, La Crosse, Wisconsin.

Appendix I lists the offices visited and the BEQ projects included in the review.

CHAPTER 2

BACHELOR HOUSING CONCEPTS AND DESIGNS DIFFER AMONG THE SERVICES

The type of quarters provided to military personnel has been of continuing interest and concern to the Congress and the military departments. In particular, the Congress has long expressed concern over the lack of bachelor housing design standardization among and even within the services. For example, in 1952 a subcommittee of the House Appropriations Committee reported the following after an investigation of military construction spending:

> "It was noted that throughout all the Services there was a repeated need for certain buildings which serve the same essential purposes. This circumstance gave a clear opportunity to save building time and money, and to reduce confusion by the expedient of standardizing plans. For example, the Army, the Navy, and the Air Force all needed barracks, mess halls, bachelor officer quarters, warehouses, and similar repetitive structures, and they needed them for similar purposes. The committee and staff, however, found a wide variation in the design, cost, and accommodations offered by such buildings as were erected during the period of study. The variation existed not only between Services, but the variation existed within the Services themselves."

Most of the concerns expressed by that committee are as valid today as they were 25 years ago. Although the services have made sizable gains in standardizing quarters designs, significant variations continue to exist.

BACHELOR HOUSING CRITERIA

To promote economy in construction costs and to help ensure that relatively equal facilities are provided to bachelor personnel in all services, the Congress and DOD impose two limits on the design and construction of bachelor quarters. The Congress establishes a statutory cost limit, and DOD limits the living area for each occupant.

Each year since fiscal year 1973, the Congress has legislated a maximum cost per gross square foot for BEQ projects. This limit can be adjusted for known differences in geographic area construction costs. For example, the statutory limit for fiscal year 1978 projects is $42 per gross square foot. However, after applying area adjusting factors to this, the actual limits for projects in the continental United States range from $34.86 to $50.40, depending on location. DOD currently plans to request a $45 limit for the fiscal year 1979 BEQ construction program.

The other major limitation placed on bachelor housing designs is DOD's limit on the net living area provided to each occupant. Net living area includes the area in the sleeping room allocated for an individual's bed, locker, and circulation, and excludes lounges, bathrooms, and corridor space. The current DOD space criteria require that each occupant in paygrades E-2 through E-4 receive 85 to 90 square feet; E-5 and E-6 receive 127.5 to 135 square feet; and E-7 through E-9 receive 255 to 270 square feet.

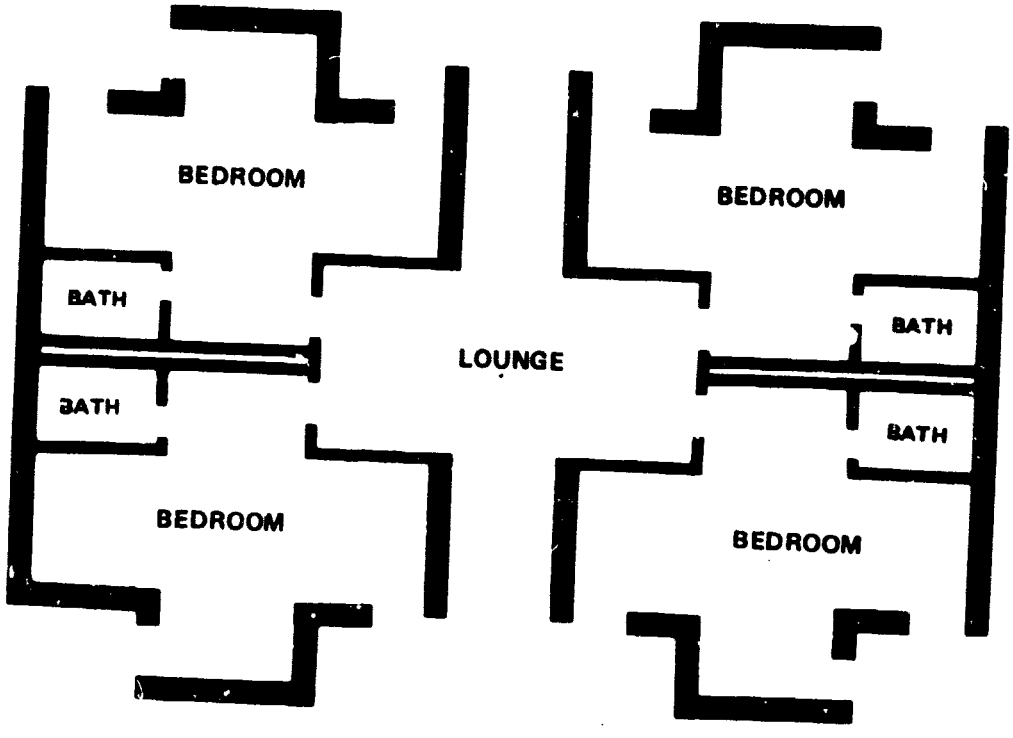
BASIC DESIGNS USED TODAY

Within the statutory cost limit and the DOD space criteria, the services have generally been free and actually encouraged to develop bachelor housing concepts and designs which suit their requirements and preferences. As a result, each service has developed one or more different concepts to meet its BEQ needs. Overall, there are seven different concepts used today--the Army has two, the Navy has four, and the Air Force has one.

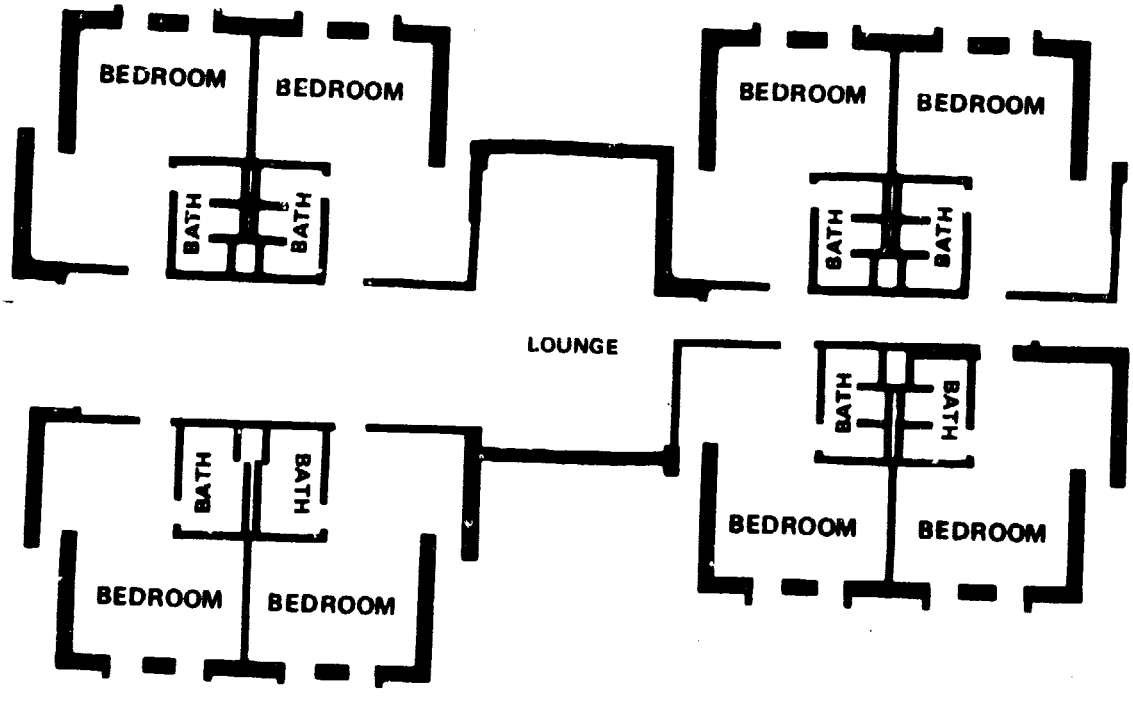
Army designs

Since fiscal year 1973, the Army has used two BEQ designs. Both are the cluster type, in which several bedrooms are grouped around a lounge. The bedrooms of both designs have approximately 270 square feet of net living area and a bath. Using DOD space criteria, this allows each room to be occupied by three persons in paygrades E-2 through E-4; two persons in paygrades E-5 or E-6; or one person in paygrades E-7 through E-9. Both designs are usually built as three-story structures.

The Army designates these designs, which are illustrated on page 6, as the LBC&W and the BB&A. The LBC&W design features four bedrooms clustered around a lounge. Access is from the exterior and there are no corridors. The BB&A design has eight bedrooms grouped around a lounge, and access is from covered stairways and interior corridors.



L B C & W DESIGN



B B & A DESIGN

According to the Army, the LBC&W and BB&A designs are well suited to maintaining unit integrity. Under this concept, groups of rooms are allocated to an organizational unit, and personnel are housed within their unit's allocated space. The Army considers it essential to maintain unit integrity in its bachelor housing to promote esprit de corps.

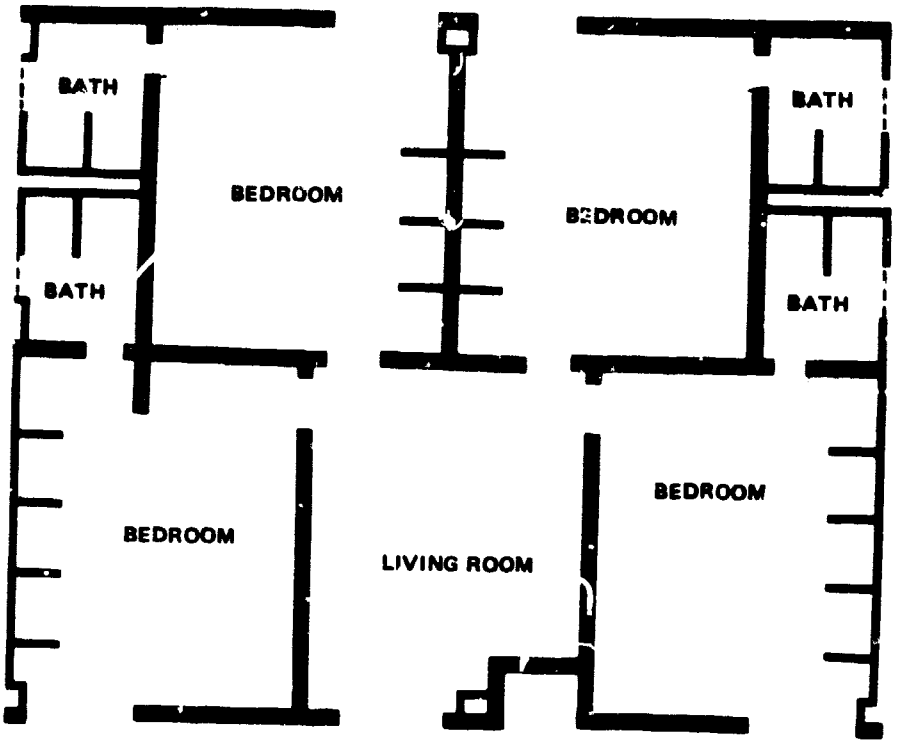
The Army's BEQ designs are more standardized than the other services' designs. We were told that detailed working drawings have been prepared for both designs, which, with some modification, can be site adapted for each new project. After an installation commander chooses a design, an architectural and engineering firm is usually retained to adapt the standard plans to the project's location. This process includes adapting the plans to climate, soil, seismic conditions, and the size or planned capacity of the project.

Navy designs

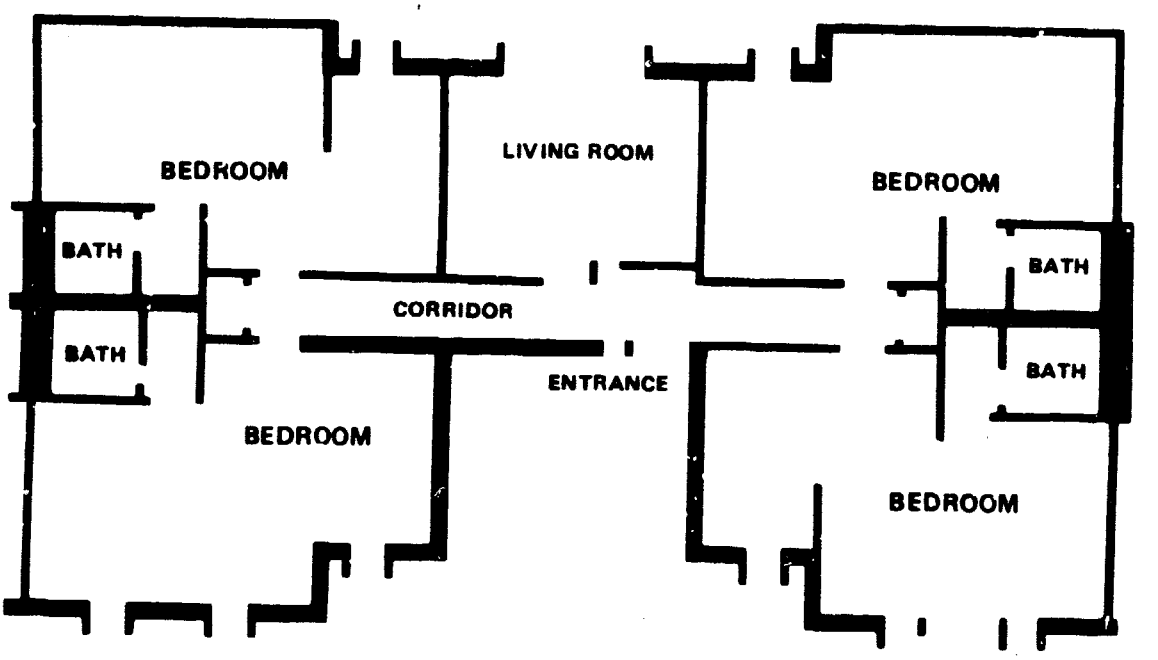
In its July 1977 study on bachelor housing design, DOD commented that the Navy found that no single BEQ was ideal for its needs because of varying climatic conditions and occupant life styles. For this reason, the Navy developed four BEQ designs to provide a choice for any specific project. The bedroom in each design has 270 square feet of net living area and a bath, which allows for occupancy by one, two, or three persons depending upon paygrade.

Two of the Navy's designs, designated the Welton-Becket and the FY 1975 Definitive (both shown on p. 8), are cluster types. The Welton-Becket features four bedrooms located around a lounge. Each module is entered from a covered exterior walkway or balcony. This design is very similar to the Army's LBC&W. The FY 1975 Definitive also has four bedrooms grouped around a lounge but is accessed from exterior stairways and interior corridors.

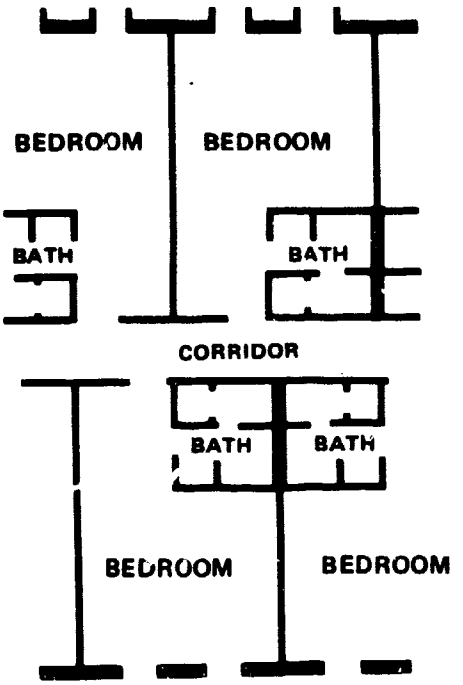
The other two designs used by the Navy feature motel-type bedrooms. In one, called the Interior Corridor design, bedrooms are accessed from an interior corridor. In the other, usually referred to as the Marine Corps design, bedrooms are accessed from an exterior corridor. Both designs have one lounge on each floor. The Interior Corridor design can be used as a three-story building or a high-rise. The Marine Corps design has been primarily used by that service since 1971. These designs are shown on page 9.



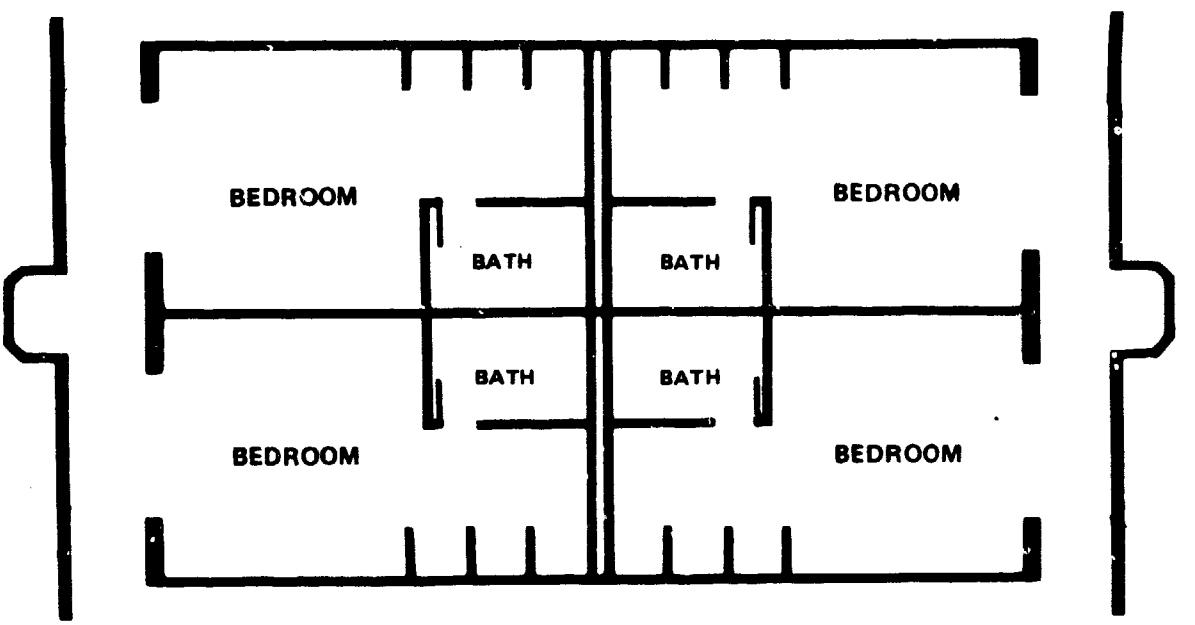
WELTON-BECKET DESIGN



FY 75 NAVY DEFINITIVE DESIGN



INTERIOR CORRIDOR DESIGN



MARINE CORPS DESIGN

The Marine Corps and Welton-Becket designs are standardized and generally can be site adapted for each project. The FY 1975 Definitive and Interior Corridor designs, however, are not as standardized. Using the Navy's definitive plans for the latter designs, an architectural and engineering firm has to prepare detailed working drawings, and then site adapt the plans to a project's location. Sometimes the definitive plans are modified slightly to better fit local conditions or preferences.

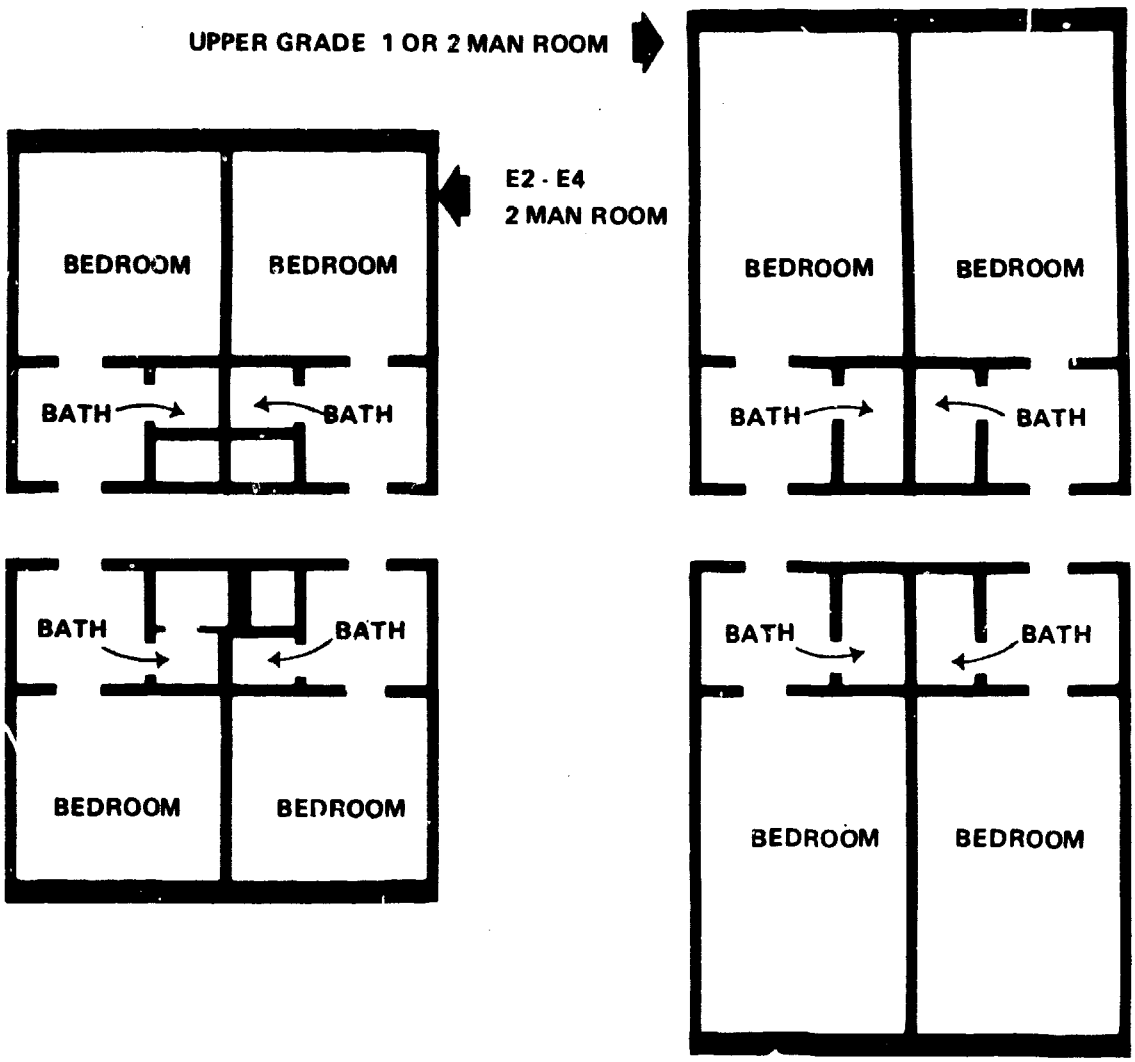
A Navy official told us the Navy plans to discontinue the two cluster-type designs, because the Welton-Becket has had security problems and the FY 1975 Definitive is too expensive to build.

Air Force design

Since the early 1950s, the Air Force has stressed that occupant privacy should be considered in bachelor housing designs. When the other services were building mostly open-bay barracks, the Air Force was building dormitories with three-person bedrooms, allocating 72 net square feet of space per occupant. When DOD increased the net living area standard to 90 square feet in fiscal year 1971, the capacity of these rooms was lowered to two persons.

Recognizing this two-person configuration for existing housing, DOD has allowed the Air Force, since fiscal year 1971, to design and build new BEQs, with no more than two occupants per bedroom. However, the Air Force has been required to comply with the statutory cost limit and DOD's net living area criteria.

Today the Air Force uses one basic BEQ design concept which reflects its desire for individual privacy. This design, called the Air Force design, is a motel-type design with one lounge on each floor. Bedrooms are entered from a covered exterior walkway or an interior corridor. In order to provide two-person rooms and still comply with DOD space criteria, two room sizes are used. One is used for paygrades E-2 through E-4 and provides 180 square feet of net living area with a private or a semi-private bath. The other provides 270 net square feet with a private bath for two E-5 or E-6 persons or one E-7 through E-9 person. (See the diagram on p. 11.)



AIR FORCE DESIGN

The Air Force has only developed detailed working drawings for a 1,000-person BEQ. For other projects, an architectural and engineering firm designs the BEQ for the location and designed capacity using the Air Force design concept.

QUALITATIVE COMPARISON OF BASIC DESIGNS

The BEQ designs used by the services today can be grouped into two categories. One is the cluster type reflected in the LBC&W, BB&A, Welton-Becket, and FY 1975 Definitive designs. The other is the motel type reflected in the Marine Corps, Interior Corridor, and Air Force designs. Each of these seven designs was developed to provide quality housing for bachelors. All of them have a maximum of three persons per room with each person having at least 85 to 90 square feet of net living area.

According to DOD officials, each service is providing comparable quality housing. Service headquarters representatives we talked with generally agreed and were satisfied with their designs. Also, officials from most engineering field offices we visited stated that each service offered comparable quality bachelor housing.

CHAPTER 3

COSTS VARY CONSIDERABLY AMONG DESIGNS

Further standardization would be of questionable value if costs did not vary among the different BEQ designs used by the services. But our analysis of actual design and construction costs for housing projects approved for the fiscal years 1975-77 programs showed considerable differences among the basic designs. For example, we found that the average construction cost per occupant ranged from $5,250 to $6,650, and there was a $272 difference in the average design cost per occupant.

In addition, an analysis of the energy efficiency of the designs revealed significant differences. Using 1976 as a base, these differences could result in an average annual energy cost per occupant ranging from $48 to $82.

Projects included in the analyses are listed in appendix I.

CONSTRUCTION COST ANALYSIS

We reviewed all of the 52 continental United States projects approved by the Congress for fiscal years 1975-77 and placed under a construction contract by November 1, 1977, to see if there were differences in the average construction cost per occupant among the seven basic designs.

When a project included supporting facilities such as a dining hall or an administrative building, we included only the contractor's estimated construction cost of the BEQ portion of the project. In addition, we adjusted the original contract price or the contractor's estimated construction cost by doing the following.

- --Subtracted the cost of any unusual features such as pile foundations or seismic construction.
- --Included the cost of any change orders to the basic construction contract and used the services' estimates of the cost of such change orders.
- --Added the cost of contract supervision and inspections.
- --Normalized the cost to one geographic location expressed in 1977 dollars.

--Divided the normalized cost by the BEQ's capacity to obtain the cost per occupant. For consistency, we rated the capacity of each BEQ according to DOD's space criteria for E-2 through E-4 occupants.

--Averaged the cost per occupant for projects built using the same design.

As shown in the following table, construction costs varied about $1,400 per occupant.

Rank	Design	Average construction cost per occupant	Projects reviewed	Type
1	Marine Corps	$5,250	14	motel
2	Interior Corridor	5,550	4	motel
3	LBC&W	5,650	11	cluster
4	Welton-Becket	5,650	5	cluster
5	Air Force	a/5,800	10	motel
6	FY 1975 Definitive	6,250	4	cluster
7	BB&A	6,650	4	cluster

a/The cost per occupant for the Air Force design would have been about $6,000 if the capacity of the Air Force projects had been rated on its two-person per room criteria instead of DOD's space criteria for E-2 through E-4 personnel.

The cost per occupant varied considerably for projects of the same design. For example, costs for the Marine Corps projects ranged from about $4,900 to $5,800. Similarly, there was a $4,400 to $8,100 range for the Welton-Becket projects. For all 52 projects, the average cost per occupant was $5,650.

Several factors account for the differences in the average cost per occupant among the seven designs. One, according to our consultants, is architectural differences. Each design uses different architecture which can result in construction cost differences. Also, since corridor and lounge space varies among the designs, average gross square feet per occupant also varies. This statistic, shown on page 15, also provides some measure of the relative design efficiency obtained in meeting the military's bachelor housing needs.

Rank	Design	Average gross square feet per occupant	Type
1	Welton-Becket	155	cluster
2	Marine Corps	158	motel
3	LBC&W	161	cluster
4	Interior Corridor	163	motel
5	FY 1975 Definitive	164	cluster
6	BB&A	167	cluster
7	Air Force	169	motel

Other factors affecting cost differences cannot be so easily quantified. For instance, a favorable or unfavorable bid climate when the construction contract was awarded can have a significant impact on a project's cost, although the actual dollar amount would be difficult to measure. Another factor is whether the BEQ was part of a larger project with other facilities. BEQ cost is determined by the contractor's estimate on the BEQ portion of the total contract price. It is possible that this estimate could differ from the cost of the BEQ, had it been bid and awarded separately.

For example, the fiscal year 1976 Fort Polk BEQ for 2,304 persons was part of a large complex which included administrative buildings, classrooms, storage facilities, a dining area, a chapel, and a gymnasium. The successful contractor bid $27,027,000 for the entire complex, including an estimated $11,400,000 for the BEQ portion. The next lowest bidder submitted a bid of $27,248,000 for the whole project, including an estimated $13,062,000 for the BEQ portion. Although the bids varied only $221,000, there was a $1,662,000 difference in the BEQ estimate. Obviously, with this much difference, cost per occupant can be greatly influenced by the contractor's bid estimate on the BEQ portion of a complex.

The following table shows, by design, the number of BEQ projects reviewed which were part of a much larger construction project.

Design	BEQ projects reviewed	Number that were part of a larger complex
LBC&W	11	9
FY 1975 Definitive	4	3
BB&A	4	2
Marine Corps	14	1
Air Force	10	0
Welton-Becket	5	0
Interior Corridor	4	0
Total	52	15

Two other factors which can affect the cost per occupant are project size and quality of construction. Usually some economies of scale are achieved as a project's size increases. For the projects we reviewed, capacity ranged from 60 to 2,448 persons and averaged 767. In addition, varied project costs can result from differences in the quality of construction and the materials used, which are difficult to detect.

DESIGN COST ANALYSIS

We also reviewed the architectural and engineering cost for each project to see if average design cost per occupant differed. As in the construction cost analysis, when a project had supporting facilities such as a dining hall or administrative buildings, we included only the estimated design cost of the BEQ portion. To compute the average design cost per occupant, we also did the following.

--Calculated each project's cost for all design work including site costs by totaling the cost of (1) the basic architectural and engineering contract, (2) contract changes applicable to the BEQ, and (3) internal design effort expended by the cognizant field office of the service's engineering command. For the projects designed using standard drawings, we did not try to determine the costs of initially preparing the standard drawings.

--Normalized the total design cost to an equivalent expressed in 1977 dollars.

--Divided the normalized cost by the BEQ capacity to obtain the design cost per occupant. Each BEQ's capacity was rated according to DOD's space criteria for E-2 through E-4 personnel.

--Averaged the design cost per occupant for projects using the same design.

--Calculated design cost as a percentage of BEQ construction costs.

The results of our computations are shown in the following table.

Design	Projects reviewed	Average design cost per occupant Rank	Cost	Design cost as a percentage of construction cost Rank	Percentage
LBC&W	11	1	$203	1	3.6
Welton-Becket	5	2	239	3	4.2
Air Force	10	3	247	2	4.2
FY 1975 Definitive	4	4	286	4	4.6
Marine Corps	14	5	314	5	6.0
BB&A	4	6	417	6	6.2
Interior Corridor	4	7	475	7	8.5

By statute, a project's design cost cannot exceed 6 percent of total construction cost. When the services calculate this percentage, they are permitted to exclude internal design cost and to adjust for the cost of lost design effort. Lost design effort occurs when a change is made to a project's original size or location which necessitates redesigning all or portions of the completed design work. When we calculated this percentage, we did not exclude internal design cost. In addition, we did not adjust for lost design effort because we were not able to identify these costs in all instances. Thus, our computation resulted in higher percentages than those obtained by the services. This does not mean, although the design cost for two designs exceeded 6 percent, that the services exceeded the statutory limit on design cost.

As in the construction cost analysis, sizable variances occurred among projects within each design. For example, the design cost per occupant ranged from $117 to $831 for the Marine Corps projects and from $129 to $790 for the Welton-Becket projects. The average design cost per occupant for all 52 projects was $257.

Several factors influence the design cost per occupant and the design cost as a percentage of construction cost.

One significant factor, though difficult to quantify, is the degree of design standardization. Generally, design cost decreases as detailed plans become more standardized and require only site adaptation. Conversely, design cost is usually higher when a building is designed from scratch or from only a suggested floor plan configuration. Of course, the savings achieved from using standard plans and drawings are to some extent offset by the cost of initially preparing the standard plans and drawings.

Army officials claim that the Army has a high degree of standardization in its LBC&W design. When the Army selects this design, standard plans are usually used which require only adaptation for local conditions and the project's planned size. We were told that most projects in the other services are designed individually using a basic design for guidance, or are at least partially redesigned from standard plans.

According to our consultants, another factor influencing design cost is the size of the projects. Generally, as the size or dollar value of a construction project increases, the design cost percentage decreases. The construction cost and capacity of the BEQs we reviewed varied considerably. For instance, the 11 LBC&W projects averaged 1,678 occupants, with an average project cost of over $9.4 million. In contrast, the 4 Interior Corridor projects averaged 222 occupants, with an average cost of $1.2 million.

Another factor influencing design cost is lost design effort. Some projects' originally planned design, size, or cost were changed after design work had been started, so some design work had to be redone. As an illustration, the design contract for one project reviewed called for a 561-person BEQ. Eight months after the $119,300 design contract was awarded, the project was reduced to 273 persons. As a result, $11,400 was added to the contract for necessary redesign.

ENERGY ANALYSIS

Over the last several years, increasing emphasis has been placed on energy conservation. New construction offers special opportunities for energy conservation by using efficient designs, materials, and mechanical equipment.

DOD and the services have not analyzed the relative energy efficiency of the seven basic BEQ designs. However, a few projects have been analyzed to identify ways to reduce energy consumption. Of the 52 projects we reviewed, such analysis had been performed on 7. We were told by the

services' headquarters officials that studies will be made on most future Air Force and Navy BEQ projects to identify cost-effective ways to conserve energy. The Army is also developing a system to analyze energy efficiency called Building Load and System Thermodynamics. DOD is planning to implement more stringent conservation requirements, which should result in improved energy efficiency in all military construction projects.

Our consultants analyzed and ranked the BEQ designs according to their energy efficiency. For this analysis, we selected one project built according to each of the basic designs. We selected two Interior Corridor projects, since they are built as a three-story building or a high-rise. Except for the two Interior Corridor projects, which were located in northern States, each selected project was located in the southeastern United States. (See app. II.)

A computer program developed by the Trane Company in La Crosse, Wisconsin, was used in the energy analysis. In addition to performing other analyses, this program simulates a building's typical operating conditions to estimate annual energy consumption. To be consistent and to obtain a better measure of energy differences caused only by architectural differences, the computer simulated each projects's operation as though it

--was located in Augusta, Georgia;

--had the same orientation to the sun;

--maintained the same internal temperature and humidity; and

--used steam for heating and a reciprocating chiller for cooling.

To obtain a relative measure of energy efficiency, we divided each project's estimated annual energy consumption by its capacity. Using the national average cost of electricity, we estimated the annual energy cost per occupant based on the premise that all energy requirements were supplied by electricity. (See table on p. 20.)

Design	Relative energy efficiency ranking	Annual energy consumption per occupant in Btus (note a)	Estimated annual energy cost per occupant
		(000,000 omitted)	
Marine Corps	1	6.98	$48
Interior Corridor (high-rise)	2	7.40	50
Interior Corridor (3-story)	3	8.61	59
FY 1975 Definitive	4	8.75	60
LBC&W	5	8.86	61
Welton-Becket	6	9.25	67
BB&A	7	10.35	71
Air Force	8	11.90	82

a/One British thermal unit (Btu) is the amount of heat required to raise the temperature of 1 pound of water 1 degree Fahrenheit.

The analysis showed that the Marine Corps design was the most energy efficient. Using our estimates, the annual energy cost per occupant in that design would be $34 (or 41-percent) less than the Air Force design, which was the least efficient.

The differences in energy utilization among the projects analyzed were primarily the result of architectural differences in the designs. For example, they used different types of walls, roofs, and relative amounts of window glass. According to our consultants, the ranking of the designs would probably not change for any location in the continental United States. They also said the efficiency of any of the designs could be improved by using modern energy conservation techniques.

CONCLUSIONS

Overall, the Marine Corps design had the lowest construction cost per occupant and the best energy efficiency rating. We believe that differences in the basic architecture of each design was the primary influence on the construction cost and energy efficiency rankings. The design-cost ranking appeared to be caused mainly by differences in the extent of site adaptation versus redesign. Appendix III shows the more significant information we analyzed.

CHAPTER 4

INCREASED DESIGN STANDARDIZATION WOULD BE FEASIBLE AND COST BENEFICIAL

Basic BEQ design and construction costs and energy efficiency differ considerably. Therefore, the more economical and efficient designs should be used servicewide unless other barriers preclude further standardization.

The military departments have raised several arguments against further standardization. However, we believe they can be overcome, and if the most economical housing design were adopted servicewide, future bachelor housing construction costs could be reduced by up to $1 million for every 2,500 spaces built.

In addition, further standardization toward the more economical and efficient designs could result in significant savings in design and energy costs. Actual savings will depend on the extent to which the more economical and efficient designs are used in lieu of the more expensive and less efficient designs.

ARGUMENTS AGAINST FURTHER STANDARDIZATION

DOD stated in its July 1977 report that the services need flexibility in selecting from current designs to meet varying requirements in climate and in providing privacy for the individual. Concerning privacy, DOD cited the Army's preference for cluster-type designs used for unit integrity, and the Air Force's preference for two-person rooms even for lower rank enlisted bachelors. DOD concluded that an effort to reduce the available designs would reduce the services' flexibility in meeting such requirements to an inadequately low level.

We do not agree with DOD in this conclusion. We believe the flexibility argument is basically one which results in allowing installation commanders or services to express their preference in selecting a BEQ design, rather than one which results in real functional or cost considerations. Further, this seems to disagree with DOD's and one service's actions. To illustrate, in 1970 DOD developed a single BEQ design and directed each service to use it for all new BEQs. The Marine Corps, but no other service, adopted that design for use at all installations. Also, as mentioned in chapter 2, the Navy plans to reduce its BEQ designs from four to two--apparently without any significant loss of flexibility.

Climate differences

DOD contends that geographical climatic variations prevent use of a single BEQ design servicewide. According to our consultants, however, any of the basic designs can be site adapted for climatic conditions anywhere in the continental United States. Currently, the services are doing just this. Each service allows an installation commander to select a design from those available in the service. An architectural and engineering firm then adapts the selected design to local conditions, including climate. For example, among the projects we reviewed, the Marine Corps design was used at installations in California, North Carolina, Virginia, and Washington. The BB&A design was used in Alabama, Colorado, Georgia, and Missouri.

The concept of adapting standard plans to local conditions is not new. In a previous report, 1/ we noted that some private sector organizations were successfully using standard designs to construct similar buildings in different parts of the country. The report discussed the experience of an engineering and building firm engaged to design and construct 200 high-rise motels. Representatives from the firm said they developed a standard plan for the motels which would be site adapted as necessary for climate and other local conditions.

Unit integrity

According to DOD, the need to maintain unit integrity in Army bachelor housing presents another barrier to BEQ design standardization. DOD contends that the cluster designs used by the Army advance the group consciousness and esprit de corps necessary for fighting units.

In another report, 2/ we discussed the practice of maintaining unit integrity in bachelor quarters and suggested that it be changed. We agreed with DOD that if officers and enlisted personnel work and live together, a common bond of esprit de corps will probably develop. However, we found that although unit personnel worked together, the majority of the people did not live with the unit. Officers, married personnel, women, and senior enlisted personnel usually lived in separate quarters or off base--not with their unit in a BEQ.

1/"Benefits Could Be Realized Through Reuse of Designs for Public Housing Projects," B-114863, December 2, 1971.

2/ Savings Possible Through Better Management of Quarters for Enlisted Personnel," LCD-76-327, June 28, 1976.

Overall, we found that only 38 percent of a typical Army unit's personnel were assigned to a BEQ by unit affiliation.

Air Force exception

As discussed in chapter 2, DOD has allowed the Air Force to construct BEQs with bedrooms designed for no more than two people. The Air Force feels this feature is needed to provide privacy for its personnel. Almost 90 percent of the Air Force's total BEQ requirements have been satisfied using this criteria.

DOD contends that Air Force criteria obstructs further design standardization throughout DOD. However, the Air Force's programmable deficit for new BEQ spaces is extremely small--only 2,160 spaces. Therefore, we believe that such a small requirement, even if the design requirement were valid, should not influence a decision on standardizing the designs used by the other services.

POTENTIAL SAVINGS THROUGH STANDARDIZATION

We estimated potential savings in future BEQ construction costs assuming that the most economical design--the Marine Corps design--would be used servicewide.

Because DOD was unable to provide accurate data on the deficit of non-recruit bachelors in the continental United States (see p. 3), we were unable to estimate the total potential construction cost savings. However, as shown in the following table, we estimate that up to $1 million in construction costs could be saved for every 2,500 spaces constructed, if the most economical design were used rather than the varied designs used by DOD in fiscal years 1975-77.

Average construction cost per occupant for all designs used in fiscal years 1975-77	$ 5,650
Average construction cost per occupant for Marine Corps design	5,250
Potential savings per occupant	$ 400
Potential construction cost savings (2,500 spaces built multiplied by $400)	$1,000,000

Because of the many variables involved such as the amount of site adaptation required and the future costs and availability of several types of energy, we did not try to quantify the potential design costs and energy savings from further standardization. However, based on our analysis presented in chapter 3 and the opinion of our consultants, potential savings are significant.

CONCLUSIONS

We believe further standardization of BEQ designs is feasible and should be actively pursued to reduce future BEQ costs. We do not agree with DOD's and the services' arguments against standardization. For example, through site adaptation, any of the standard designs can be adapted to differing climatic conditions. Also, since true unit integrity is not maintained in BEQs, this argument lacks validity. Even if all unit personnel lived together, we see no advantage in using a cluster design over a motel design. In both, personnel are assigned to one-, two-, or three-person bedrooms depending on paygrade.

We believe the flexibility argument is basically one which results in allowing installation commanders or services to express their preference in selecting a BEQ design, rather than one which results in real functional or cost considerations. Finally, since the Air Forces's programmable deficit is so small, we do not consider its two-person-per-room criteria to be a significant barrier.

For every 2,500 BEQ spaces constructed, we estimate that up to $1 million could be saved if the most economical design--the Marine Corps design--were adopted for use service-wide. Actual savings will depend on the extent to which the more economical and efficient designs are used in lieu of the more expensive and less efficient ones. In addition, we believe greater BEQ design standardization could result in reduced BEQ design and energy costs. Because of the many variables involved, we did not attempt to estimate these savings.

CHAPTER 5

BETTER CONTROLS NEEDED TO RESTRAIN BACHELOR HOUSING COST

As discussed in chapter 2, the Congress and DOD have imposed two controls on the design and construction of BEQs. One is the annual statutory cost limit per gross square foot established by the Congress. The other is DOD's net living area space criteria. However, these controls have not sufficiently promoted economy and efficiency in the design and construction of BEQs.

Since 1971, the average BEQ construction cost per occupant has increased much more than inflation. We believe this was caused by a sizeable growth in the average gross square feet per occupant. In addition, our tests of the projects showed that 21 percent exceeded their statutory cost limit. We believe that new controls are needed to see that more economical, standardized BEQ designs are used servicewide in the future.

EXTENT OF COMPLIANCE WITH PRESENT CONTROLS

We tested the 52 projects in our review for compliance with the statutory cost limit and DOD's space criteria. To test for statutory compliance, we compared a project's applicable limit with its actual cost per gross square foot. We used the actual costs as reported by DOD and did not verify their accuracy. The statutory limit was $31 in fiscal year 1975, $35 in 1976, and $39 in 1977. As discussed in chapter 2, these limits are adjusted for geographical differences. When calculating actual cost per gross square foot, design cost and the cost of special features such as pile foundations or seismic construction were excluded. As summarized on the next page, 11 of the projects reviewed (or 21 percent) exceeded their statutory cost limit. All of these 11 projects were approved for either fiscal year 1975 or 1976 construction programs.

Design	Projects reviewed	Projects exceeding statutory limit	No. that received waiver to exceed limit
BB&A	4	4	a/4
LBC&W	11	2	2
Welton-Becket	5	2	2
FY 1975 Definitive	4	1	1
Air Force	10	1	0
Marine Corps	14	1	0
Interior Corridor	4	0	0
Total	52	11	9

a/For one of these projects, final project costs exceeded the authorized waiver amount.

The Congress has given DOD the authority to grant waivers from the statutory limit in unusual situations, such as for exceptionally high project costs caused by an unfavorable bid climate. Since fiscal year 1975, DOD has not refused any requests for waivers to exceed the limit.

Waivers had not been requested for the two projects that exceeded their limit without a waiver. In one case, the responsible agency officials used the wrong geographic location factor when computing the statutory limit which gave the project the appearance of being within its limit. In the other case, agency officials were unaware that the project had exceeded its limit, and therefore did not request a waiver.

We also tested each project for compliance with DOD space criteria. This criteria requires new BEQs to provide each E-2 through E-4 occupant with 85 to 90 square feet of net living area. Our tests showed that four projects (or 8 percent) had exceeded this by over 1 square foot. Three of these were FY 1975 Definitive designs, and the other was an Air Force design. Agency officials responsible for three of these projects said they were unaware that DOD's space criteria was not to be exceeded. In the Air Force design, the responsible official provided no explanation for not complying.

EFFECTIVENESS OF STATUTORY LIMIT IN CONTROLLING COSTS

Prior to fiscal year 1973, the statutory limit on new BEQ construction was expressed as a cost per occupant. In its budget submission for that year, DOD requested that the

statutory limit be changed to a cost per gross square foot. The change was requested for two reasons. First, since most approved projects in the 3 preceding years had been designed for E-2 through E-4 occupants, DOD believed that the services could not construct BEQs for higher-grade personnel within the cost limit per occupant. The proposed solution would not be affected by capacity.

The second reason for requesting this change was that other DOD facilities were programmed by the cost per gross square foot.

The Congress approved the requested change and established the statutory cost limit for fiscal year 1973 at $27 per gross square foot. Since then, DOD has annually requested and obtained an increase to cover inflation in construction costs.

We believe that the current limit is deficient in that it does not control a project's total gross square feet. The net living area per occupant is controlled by DOD's space criteria, but DOD only provides a target amount of gross area per occupant. Thus, there is no control over the amount of space devoted to such areas as bathrooms, lounges, lobbies, and corridors. Without this, a project's total cost cannot be effectively controlled since total cost depends on both cost per gross square foot and total gross square feet. The old criteria, the cost-per-occupant limit, did not directly control gross square feet but required that greater attention be given to a project's total cost.

To demonstrate the effect of the statutory criteria change, we compared the average cost and gross square feet per occupant for the 52 BEQs in our review with those constructed in fiscal years 1971 and 1972. In fiscal years 1971-72, the statutory cost limit per occupant was $3,200, and, according to DOD, the average gross square feet per occupant was 148. This equals a $21.62 cost-per-square-foot limit. Normalizing these costs to 1977 dollars, i.e., applying a factor for inflation in construction costs, yields an equivalent $5,203 per occupant and $35.15 per gross square foot.

The projects we reviewed, also normalized to 1977 dollars, had an average cost per occupant of $5,662 and an average cost per gross square foot of $34.98. Although the more recent projects compare favorably with the adjusted fiscal year 1971-72 projects on a cost-per-gross-square-foot basis ($35.15 to $34.98), the more recent projects cost $459 more per occupant.

As shown in the following table, this difference can be accounted for by the increase in the gross square feet. The 1971-72 projects averaged 148 gross square feet per occupant, and the projects in our review averaged 162. This difference of 14 square feet per occupant at an average cost of $35 per square foot equals $490--not too much more than the $459 difference in cost per occupant considering the normalizing and averaging procedures used in our computations. Or stated another way, the projects we reviewed cost about 9 percent more per occupant and averaged about 9 percent more gross square feet per occupant than the normalized 1971-72 projects.

	Fiscal years 1971-72 projects	Fiscal years 1971-72 normalized to 1977 costs	Fiscal years 1975-77 projects reviewed normalized to 1977 costs	Difference
Average cost per occupant	$3,200	$5,203	$5,662	$459
Average cost per gross square foot	$21.62	$35.15	$34.98	$0.17
Average gross square feet per occupant	148	148	162	14

We also compared the fiscal year 1977 statutory cost limit of $39 per gross square foot to actual construction cost and found the limit was apparently greater than needed. As shown above, the average cost per gross square foot for all projects reviewed was only $34.98 after costs were normalized to 1977 dollars. In addition, the projected average cost per gross square foot for the seven fiscal year 1977 BEQs reviewed was $5.07 (or 13 percent) below the $39 limit. The fiscal year 1978 statutory cost limit is $42. DOD plans to request a $45 limit for fiscal year 1979.

CONCLUSIONS

We believe that more effective controls are needed to promote economy in designing and constructing new BEQs. The current statutory and administrative controls have not sufficiently restrained total cost or cost per occupant because they fail to adequately control the gross square feet. In addition, the $39 statutory limit for fiscal year 1977 was apparently greater than needed.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

OVERALL CONCLUSIONS

We believe the relative habitability of the seven basic BEQ designs is a subjective issue and cannot be directly quantified. For instance, we could not measure the difference in the quality of living in the cluster design as opposed to the motel design, or in a smaller two-person bedroom as opposed to a larger three-person bedroom. An attempt to quantify such differences usually results in a subjective discussion of personal preferences.

However, there are significant differences among the designs in construction cost, design cost, and energy efficiency. If the more economical and efficient designs, such as the Marine Corps and Interior Corridor, were used to satisfy all future requirements, construction costs could be significantly reduced. Additional savings could be achieved in design and energy costs. Also, even if the energy efficiency of all designs were improved, the more economical ones we identified should continue to be relatively more economical. For these reasons, and since the services' arguments against standardization generally lack validity and significance, we believe that BEQ designs should be more standardized.

Although we are not recommending that all the military services use one particular design, we believe that present controls allow too much flexibility in designing and building BEQs. As a result, construction cost per design occupant varies considerably among the current designs, while the quality of housing for all designs, according to DOD, is comparable.

We feel that if more stringent controls were mandated, reflecting only the actual cost needed to construct the most economical designs, the services would then be limited to selecting the most economical and efficient designs with no apparent loss in quality of housing. Since all of the fiscal year 1977 BEQ projects are estimated to be below the statutory limit of $39 per gross square foot, there is not enough of an incentive to select the most economical designs at present. The fiscal years 1978-79 limits may similarly be greater than required for such a purpose.

In addition, we believe the statutory cost-per-gross-square-foot limit is deficient since it does not control a project's total gross square feet. Although DOD controls net living area per occupant, it only provides a target amount of gross square feet per occupant. Consequently, there is no control over the amount of space used for areas such as bathrooms, lounges, lobbies, and corridors. The projects we reviewed cost about 9-percent more per occupant than did projects in fiscal years 1971-72--at least partly because they averaged about 9-percent more gross square feet per occupant than did the 1971-72 projects.

Since a project's total cost depends on both cost per gross square foot and the total amount of square feet, Congressional oversight of this factor would be enhanced if gross square feet per occupant were specifically controlled. Alternatively, a cost per design occupant limitation based on the cost actually needed to construct the most economical designs could be used to promote greater standardization.

RECOMMENDATIONS

To promote greater standardization of BEQ designs, we recommend that the Congress consider three alternatives to strengthen the controls over BEQ costs. One is to revert to a statutory cost limit per design occupant based on the cost actually needed to build the most economical designs. Under this approach, the capacity of proposed projects should be determined using DOD space criteria for E-2 through E-4 personnel, since the space criteria and number of occupants would change for other paygrades.

The other alternatives would be to limit gross square feet per occupant in addition to the present limitation on cost per gross square foot. This could be a statutory or administrative limit, depending on the desires of the Congress. If either of these alternatives are used, it would be necessary to restrict the existing statutory cost limit per gross square foot to the cost actually needed to construct the most economical designs.

APPENDIX I

LOCATIONS VISITED AND BACHELOR ENLISTED QUARTER PROJECTS REVIEWED

Headquarters level

Office of the Assistant Secretary of Defense (Manpower, Reserve Affairs, and Logistics), Washington, D.C.

Department of the Army, U.S. Army Corps of Engineers, Washington, D.C.

Department of the Navy, U.S. Naval Facilities Engineering Command, Washington, D.C.

Department of the Air Force, Directorate of Engineering and Services, Washington, D.C.

Field Offices, Army Corps of Engineers

Fort Worth, Texas
- Fort Hood, Texas, fiscal year 1975, 288 capacity
- Fort Hood, Texas, fiscal year 1975, 1,668 capacity
- Fort Hood, Texas, fiscal year 1976, 2,448 capacity
- Fort Polk, Louisiana, fiscal year 1976, 2,304 capacity
- Fort Polk, Louisiana, fiscal year 1977, 1,692 capacity
- Sheppard Air Force Base, Texas, fiscal year 1975, 1,000 capacity

Mobile, Alabama
- Fort Rucker, Alabama, fiscal year 1975, 177 capacity
- Tyndall Air Force Base, Florida, fiscal year 1975, 180 capacity
- Tyndall Air Force Base, Florida, fiscal year 1976, 606 capacity

New York, New York

Omaha, Nebraska
- Fort Carson, Colorado, fiscal year 1975, 1,269 capacity
- Fort Leonard Wood, Missouri, fiscal year 1975, 210 capacity
- Lowry Air Force Base, Colorado, fiscal year 1975, 1,000 capacity
- Lowry Air Force Base, Colorado, fiscal year 1976, 1,000 capacity
- Chanute Air Force Base, Illinois, fiscal year 1975, 904 capacity

Field Offices, Army Corps of Engineers (continued)

Sacramento, California
Fort Lewis, Washington, fiscal year 1976, 1,620 capacity
George Air Force Base, California, fiscal year 1975, 396 capacity
Mountain Home Air Force Base, Idaho, fiscal year 1976, 251 capacity

Savannah, Georgia
Fort Gordon, Georgia, fiscal year 1975, 771 capacity
Fort Stewart, Georgia, fiscal year 1975, 2,097 capacity
Fort Stewart, Georgia, fiscal year 1976, 2,172 capacity
Fort Stewart, Georgia, fiscal year 1977, 1,860 capacity
Fort Bragg, North Carolina, fiscal year 1976, 417 capacity
Fort Bragg, North Carolina, fiscal year 1977, 1,896 capacity

Divisions, Naval Facilities Engineering Command

Atlantic Division, Norfolk, Virginia
Marine Corps Base, Camp Lejeune, North Ca[illegible] fiscal year 1975, 654 capacity
Marine Corps Base, Camp Lejeune, North Car[illegible], fiscal year 1975, 537 capacity
Marine Corps Base, Camp Lejeune, North [illegible]lina, fiscal year 1975, 480 capacity
Marine Corps Base, Camp Lejeune, North [illegible]olina, fiscal year 1976, 1,290 capacity
Marine Corps Base, Camp Lejeune, Nort[illegible] Carolina, fiscal year 1977, 1,626 capacity
Fleet Combat Direction System Training Center--Atlantic, Dam Neck, Virginia, fiscal year 1976, 540 capacity

Chesapeake Division, Washington, D.C.
Andrews Air Force Base, Maryland, fiscal year 1976, 438 capacity
Bolling Air Force Base, Virginia, fiscal year 1975, 250 capacity

APPENDIX I

Divisions, Naval Facilities Engineering Command (continued)

North Division, Philadelphia, Pennsylvania
- Naval Training Center, Great Lakes, Illinois, fiscal year 1975, 300 capacity
- Naval Submarine Base, New London, Connecticut, fiscal year 1975, 60 capacity
- Naval Submarine Base, New London, Connecticut, fiscal year 1976, 420 capacity

Southern Division, Charleston, South Carolina
- Naval Training Center, Orlando, Florida, fiscal year 1975, 828 capacity
- Naval Technical Training Center, Pensacola, Florida, fiscal year 1975, 708 capacity
- Naval Station, Mayport, Florida, fiscal year 1976, 336 capacity
- Naval Station, Charleston, South Carolina, fiscal year 1975, 96 capacity
- Naval Support Activity, New Orleans, Louisiana, fiscal year 1976, 252 capacity
- Naval Support Activity, New Orleans, Louisiana, fiscal year 1977, 108 capacity

Western Division, San Bruno, California
- Marine Corps Base, Camp Pendleton, California, fiscal year 1975, 588 capacity
- Marine Corps Base, Camp Pendleton, California, fiscal year 1976, 288 capacity
- Marine Corps Base, Camp Pendleton, California, fiscal year 1975, 309 capacity
- Marine Corps Base, Camp Pendleton, California, fiscal year 1976, 273 capacity
- Marine Corps Base, Camp Pendleton, California, fiscal year 1976, 273 capacity
- Marine Corps Base, Camp Pendleton, California, fiscal year 1977, 1,089 capacity
- Naval Weapon Station, Seal Beach, California, fiscal year 1975, 108 capacity
- Naval Air Station, Miramar, California, fiscal year 1976, 396 capacity

APPENDIX I

Officer in Charge of Construction, Trident, Bremerton, Washington

Naval Submarine Base, Bangor, Washington, fiscal year 1976, 468 capacity
Naval Submarine Base, Bangor, Washington, fiscal year 1975, 324 capacity
Naval Submarine Base, Bangor, Washington, fiscal year 1975, 198 capacity
Naval Submarine Base, Bangor, Washington, fiscal year 1977, 432 capacity

APPENDIX II

LIST OF BEQ PROJECTS USED IN ENERGY ANALYSIS

Location	Fiscal year approved	Maximum capacity	Design
Camp Lejeune, North Carolina	1976	1,290	Marine Corps
Naval Submarine Base, New London, Connecticut	1976	420	Interior Corridor (high-rise)
Naval Training Center, Great Lakes, Illinois	1975	300	Interior Corridor (3-story)
Naval Training Center, Orlando, Florida	1975	828	FY 1975 Definitive
Fort Stewart, Georgia	1977	1,860	LBC&W
Naval Technical Training Center, Pensacola, Florida	1975	708	Welton-Becket
Fort Gordon, Georgia	1975	771	BB&A
Tyndall Air Force Base, Florida	1976	606	Air Force

SUMMARY OF BEQ DESIGN ANALYSES

Design	Number reviewed	Type	Construction cost per occupant		Design cost per occupant		Design cost as a percentage of construction cost		Gross square feet per occupant		Energy efficiency		
			Rank	Cost	Rank	Cost	Rank	Percentage	Rank	Number	Rank	Required annual Btus per occupant (000,000 omitted)	Estimated annual energy cost per occupant
Marine Corps	14	motel	1	$5,250	5	$314	5	6.0	2	158	1	6.98	$48
Interior Corridor	4	motel	2	5,550	7	475	7	8.5	4	163	2	a/8.01	a/55
LBC&W	11	cluster	3	5,650	1	203	1	3.6	3	161	4	8.86	61
Welton-Becket	5	cluster	4	5,650	2	239	3	4.2	1	155	5	9.25	67
Air Force	10	motel	5	5,800	3	247	2	4.2	7	169	7	11.90	82
FY 1975 Definitive	4	cluster	6	6,250	4	286	4	4.6	5	164	3	8.75	60
BB&A	4	cluster	7	6,650	6	417	6	6.2	6	167	6	10.35	71

a/Average of the two Interior Corridor projects included in the energy analysis.

APPENDIX III

APPENDIX IV

United States Senate
COMMITTEE ON ARMED SERVICES
WASHINGTON, D.C. 20510

August 8, 1977

Honorable Elmer B. Staats
Comptroller General of
the United States
General Accounting Office
Washington, D.C. 20548

Dear Mr. Staats:

The Senate Committee on Armed Services in its Report No. 94-856 on the FY 1977 Military Construction Authorization Bill tasked the Department of Defense to review the many designs being used by the three Services for bachelor enlisted and officer quarters with a view toward possible economies by increased standardization. A copy of the Department of Defense study in response to that directive is attached.

I consider the Department of Defense study to be unresponsive and would request that you undertake the same study. If you could complete your work in time for the FY -1979 military construction authorization hearings, which will start about March 1, 1978, it would be most helpful.

Specifically, I would request that you:

(1) Compare the different designs currently being used in terms of cost per design occupant based on actual contracts over the past several years.

(2) Compare these same designs on the basis of gross square feet per design occupant to get some indication of the relative efficiency of each design.

(3) Develop recommendations for the Congress to consider regarding:

(a) The desirability of increased design standardization in bachelor quarters design,

(b) The potential dollar impact of increased standardization based on the backlog of bachelor quarters construction,

APPENDIX IV

Honorable Elmer B. Staats
Page 2
August 8, 1977

(c) Possible modifications to existing law which may be required to implement increased standardization.

The Armed Services Committee staff contact on this matter is Mr. Jim Smith, 224-3871.

Sincerely,

Gary Hart, Chairman
Subcommittee on Military
Construction and
Stockpiles

Enclosure

APPENDIX V

PRINCIPAL OFFICIALS RESPONSIBLE FOR ADMINISTERING ACTIVITIES DISCUSSED IN THIS REPORT

	Tenure of office	
	From	To
DEPARTMENT OF DEFENSE		
SECRETARY OF DEFENSE:		
Harold Brown	Jan. 1977	Present
Donald Rumsfeld	Nov. 1975	Jan. 1977
ASSISTANT SECRETARY OF DEFENSE (INSTALLATIONS AND LOGISTICS): (note a)		
Dale Babione (acting)	Jan. 1977	Apr. 1977
Frank A. Shrontz	Feb. 1976	Jan. 1977
Dr. John J. Bennett (acting)	Apr. 1975	Feb. 1976
ASSISTANT SECRETARY OF DEFENSE (MANPOWER, RESERVE AFFAIRS AND LOGISTICS): (note a)		
John P. White	May 1977	Present
Carl W. Clewlow (acting)	Jan. 1977	May 1977
DEPARTMENT OF THE ARMY		
SECRETARY OF THE ARMY:		
Clifford L. Alexander	Feb. 1977	Present
Martin R. Hoffman	Aug. 1975	Feb. 1977
ASSISTANT SECRETARY OF THE ARMY (INSTALLATIONS, LOGISTICS AND FINANCIAL MANAGEMENT):		
Alan J. Gibbs	Apr. 1977	Present
Edwin Griener (acting)	Jan. 1977	Apr. 1977
Harold L. Brownman	Oct. 1974	Jan. 1977

APPENDIX V

	Tenure of office	
	From	To
DEPARTMENT OF THE NAVY		
SECRETARY OF THE NAVY:		
Wm. Graham Claytor, Jr.	Feb. 1977	Present
Gary D. Penisten (acting)	Feb. 1977	Feb. 1977
Joseph T. McCullen, Jr.	Feb. 1977	Feb. 1977
David R. MacDonald	Jan. 1977	Feb. 1977
J. William Middendorf	June 1974	Jan. 1977
ASSISTANT SECRETARY OF THE NAVY (INSTALLATIONS AND LOGISTICS): (note b)		
Vacant	Jan. 1977	Apr. 1977
Jack L. Bowers	June 1973	Jan. 1977
ASSISTANT SECRETARY OF THE NAVY (MANPOWER AND RESERVE AFFAIRS): (note b)		
Vacant	Jan. 1977	Apr. 1977
Joseph T. McCullen, Jr.	Sept. 1973	Jan. 1977
ASSISTANT SECRETARY OF THE NAVY (MANPOWER, RESERVE AFFAIRS AND LOGISTICS):		
Edward Hidalgo	Apr. 1977	Present
COMMANDANT OF THE MARINE CORPS:		
Gen. Louis H. Wilson	July 1975	Present
DEPARTMENT OF THE AIR FORCE		
SECRETARY OF THE AIR FORCE:		
John C. Stetson	Apr. 1977	Present
John C. Stetson (acting)	Jan. 1977	Apr. 1977
Thomas C. Reed	Jan. 1976	Jan. 1977
ASSISTANT SECRETARY OF THE AIR FORCE (INSTALLATIONS AND LOGISTICS):		
Vacant	Apr. 1977	Present
Richard J. Keegan (acting)	Feb. 1977	Apr. 1977
J. Gordon Kapp	Mar. 1976	Jan. 1977
Frank A. Shrontz	Oct. 1973	Feb. 1976

a/The position of Assistant Secretary of Defense (Installations and Logistics) was abolished on April 20, 1977, and its functions were divided between the Office of the Assistant Secretary of Defense (Manpower and Reserve Affairs) and the Office of the Director of Defense Research and Engineering.

b/The Offices of the Assistant Secretary of the Navy, Installations and Logistics and Manpower and Reserve Affairs, were combined into Manpower, Reserve Affairs and Logistics on April 25, 1977.

(945433)