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HOUSING COMPARISON TES (U) CONSTRUCTION ENGINEERING
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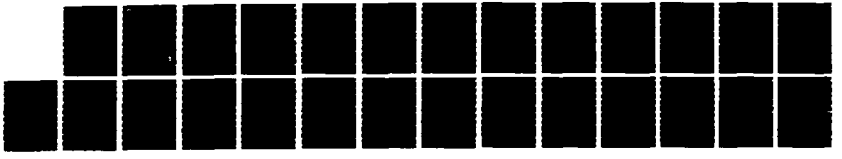

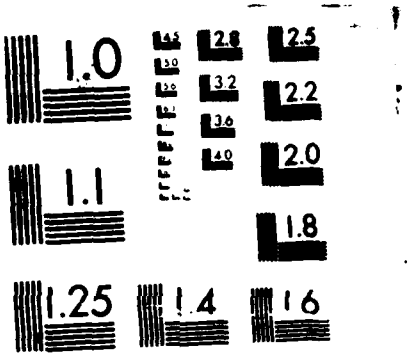

US Army Corps
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USA-CERL INTERIM REPORT P-87/10
April 1987

Three-Year Summary of Fort Irwin, CA, Family Housing Comparison Test: Operation and Maintenance Costs of Manufactured vs. Conventionally Built Units

by
Robert D. Neathammer

Congress directed the construction of 200 units of manufactured/factory-built housing at Fort Irwin, CA, in 1982 to see if this method of construction will cost less than conventional housing, yet still provide durable housing commensurate with contemporary housing standards.

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To compare these two types of construction properly, DOD must reliably identify O&M costs and user satisfaction. Differences in O&M costs must be identified and the reasons for those differences determined.

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No conclusions or inferences should be made as to which type of construction has the lowest O&M costs until the final 5-year summary is complete.

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SECURITY CLASSIFICATION OF THIS PAGE

AD-A180 991

REPORT DOCUMENTATION PAGE

Form Approved
OMB No 0704 0188
Exp Date Jun 30 1986

1a REPORT SECURITY CLASSIFICATION UNCLASSIFIED	1b RESTRICTIVE MARKINGS
2a SECURITY CLASSIFICATION AUTHORITY	3 DISTRIBUTION / AVAILABILITY OF REPORT Approved for public release; distribution is unlimited.
2b DECLASSIFICATION / DOWNGRADING SCHEDULE	
4 PERFORMING ORGANIZATION REPORT NUMBER(S) USA-CERL IR P-87/10	5 MONITORING ORGANIZATION REPORT NUMBER(S)
6a NAME OF PERFORMING ORGANIZATION U.S. Army Construction Engr Research Laboratory 6b OFFICE SYMBOL (If applicable) USA-CERL	7a NAME OF MONITORING ORGANIZATION
6c ADDRESS (City, State, and ZIP Code) P.O. Box 4005 Champaign, IL 61820-1305	7b ADDRESS (City, State, and ZIP Code)
8a NAME OF FUNDING / SPONSORING ORGANIZATION HQUSACE 8b OFFICE SYMBOL (If applicable) DAEN-ZCH-M	9 PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER IAO T016, dated 15 November 1985
8c ADDRESS (City, State, and ZIP Code) 20 Massachusetts Ave., N.W. Washington, DC 20314-1000	10 SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. / PROJECT NO / TASK NO / WORK UNIT ACCESSION NO

11 TITLE (Include Security Classification)
Three-Year Summary of Fort Irwin, CA, Family Housing Comparison Test: Operation and Maintenance Costs of Manufactured Vs. Conventionally Built Units

12 PERSONAL AUTHOR(S)
Neathammer, Robert D.

13a TYPE OF REPORT	13b TIME COVERED	14 DATE OF REPORT (Year, Month, Day)	15 PAGE COUNT
Interim	FROM _____ TO _____	4-87	22

16 SUPPLEMENTARY NOTATION
Copies are available from the National Technical Information Service
Springfield, VA 22161

17 COSATI CODES		
FIELD	GROUP	SUB-GROUP
15	05	

18 SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
Fort Irwin, CA
housing projects
operation and maintenance
cost analysis
prefabricated buildings

19 ABSTRACT (Continue on reverse if necessary and identify by block number)

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Congress directed the Department of Defense (DOD) to conduct a fair and reliable study that will compare the operation and maintenance (O&M) costs of manufactured housing to those of conventional housing. DOD will report to Congressional committees on the conditions and parameters under which this test was conducted and the results of the test after the housing has been in use for five years.

To compare these two types of construction properly, DOD must reliable identify O&M costs and user satisfaction. Differences in O&M costs must be identified and the reasons for those differences determined.

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20 DISTRIBUTION / AVAILABILITY OF ABSTRACT	21 ABSTRACT SECURITY CLASSIFICATION
☐ UNCLASSIFIED/UNLIMITED ☒ SAME AS RPT ☐ DTIC USERS	UNCLASSIFIED
22a NAME OF RESPONSIBLE INDIVIDUAL D. P. Mann	22b TELEPHONE (Include Area Code) (217) 373-7223 22c OFFICE SYMBOL Chief-IMT

DD FORM 1473, 84 MAR

83 APR edition may be used until exhausted
All other editions are obsolete

SECURITY CLASSIFICATION OF THIS PAGE

UNCLASSIFIED

BLOCK 19 (Cont'd)

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FOREWORD

This research was conducted for the Assistant Chief of Engineers, Headquarters, U.S. Army Corps of Engineers (HQUSACE) under Inter Army Orders (IAOs) from Fort Irwin and Headquarters, U.S. Army Forces Command, dated 22 Aug 83, 19 Sep 83, 14 May 84, 15 Jan 85, and 15 Nov 85. The HQUSACE Technical Monitor is Mr. Alex Houtzager, DAEN-ZCH-M.

The work was performed by the Facility Systems Division (FS), U.S. Army Construction Engineering Research Laboratory (USA-CERL). The Principal Investigator was Mr. Robert Neathammer. Assistance was provided by Mr. Robert Doerr, Mr. Thomas Napier, Ms. Mary Chionis, Mr. William Dolan, Mr. John Shonder, Mr. Victor Storm, and Ms. Darcy Weber. Mr. E. A. Lotz is Chief of USA-CERL-FS.

COL Norman C. Hintz is Commander and Director of USA-CERL, and Dr. L. R. Shaffer is Technical Director.

CONTENTS

THREE-YEAR SUMMARY OF FORT IRWIN, CA, FAMILY HOUSING COMPARISON TEST: OPERATION AND MAINTENANCE COSTS OF MANUFACTURED VS. CONVENTIONALLY BUILT UNITS

1 INTRODUCTION

Background

Congress believes that use of manufactured (factory built) military housing, rather than conventionally built units, will result in lower overall costs, but still provide durable housing that meets contemporary housing standards. To verify this belief, Congress directed the Department of Defense (DOD) to construct 200 units of manufactured housing at Fort Irwin, CA, for comparison with conventionally built housing.[1]

The manufactured units were to be constructed to meet DOD standards and criteria for essential space, structural durability, energy efficiency, material quality, and life safety. These standards and criteria are compatible with, and complementary to, the Federal Manufactured Housing Construction and Safety Standards (FMHCSS). The Fort Irwin study will compare the impact of the FMHCSS versus standard DOD criteria, except for the essential criteria listed above.

The study is being conducted during the first 5 years the housing units are occupied with initial occupancy on some units starting in February 1983. The study compares 200 two-bedroom manufactured units to 144 two-bedroom, conventionally built units. DOD has presented the conditions and parameters of this test to Congress and will report the study results at the end of the test.

To properly compare manufactured versus conventional housing, the study addresses operation and maintenance (O&M) costs and user satisfaction for both types of housing. The study identifies not only the differences, if any, in O&M costs, but also the reasons for the differences and their importance for future construction criteria, construction methods, and occupant satisfaction.

Objective

This report's objective is to summarize the O&M costs and the occupant satisfaction data for both conventionally built and manufactured housing from construction through September 1986. First year data were reported in USA-CERL Interim Report (IR) P-85/14,[2] and second year data in USA-CERL IR P-86/06.[3]

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[1] Report No. 97-44, *Military Construction Authorization Act* (House of Representatives Committee on Armed Services, 1982), pp 8-9.

[2] R. D. Neathammer, *Fort Irwin, CA, Family Housing Comparison Test: Operation and Maintenance Costs of Manufactured vs. Conventionally Built Units*, IR P-85/14/ADA159740 (USA-CERL, 1985).

[3] R. D. Neathammer, *Fort Irwin, CA, Family Housing Comparison Test: Operation and Maintenance Costs of Manufactured vs. Conventionally Built Units*, IR P-86/06/ADA175995 (USA-CERL, 1986).

Approach

The first step was to develop data collection and data analysis procedures. The cost comparisons and analyses being done in this study were established in USA-CERL Special Report (SR) P-140, *Fort Irwin Housing Comparison Test.*[4] The data will be collected, summarized, and reported yearly.

[4]M. J. O'Connor, *Fort Irwin Housing Comparison Test*, SR P-140/ADA130349 (USA-CERL, 1983).

2 REVIEW OF TEST PLAN

As this is the midpoint of the project, a short review of the test plan and the final data analyses is in order. Data is being collected in two areas: O&M costs and occupant satisfaction.

USA-CERL SR P-140 detailed the cost data collection plan and analysis methods. Four basic questions on costs will be answered:

1. Are the average annual O&M costs significantly different?
2. If different, where are they significantly different?
3. Why do the costs differ?
4. What criteria, design features, etc., need to be changed as a result?

Overall maintenance costs and utility costs will be compared separately. If significant differences are found, it will be important to determine their causes.

In addition to the overall cost comparison, the maintenance costs for major building components will be compared. These comparisons will provide more detail about where and why cost differences occur.

Costs to restore each unit to a comparable level of "new plus fair wear and tear" will be determined at the end of the test period. This will be done under the guidance of the Fort Irwin DEH and the Los Angeles District Office of the Corps of Engineers.

In addition to cost comparisons, occupant satisfaction with the overall apartments and each physical part of the unit will also be compared for the two types of construction. The questions used to determine this factor are given in USA-CERL IR P-85/14, Appendix F. When occupant satisfaction differs for a building component, that component will be evaluated to determine the reason for the difference.

However, there are two maintenance practices which may affect the test results and will have to be accounted for in the final evaluation. First, no "routine" or "preventive" maintenance has been performed, although it was originally planned. That is, no seasonal maintenance on the heating/cooling systems has been done--no periodic filter changes, etc. This may impact the breakdown repairs of these systems. However, the effect should not bias the test, as both type of units are treated the same. The only real "preventive" maintenance is done when occupants move out: then a team inspects the unit and either performs minor maintenance or writes a work order to have work done. Second, gutters are not being replaced as they become loose. This may have a minor effect on the maintenance costs, but will be accounted for in the final data analysis.

3 DESCRIPTION OF THE FAMILY HOUSING UNITS

Manufactured Housing Units (MHU)

These 200 units consist of 50 two-story fourplexes. Each upper unit has a balcony-porch and each lower one has a patio with privacy fencing. Each unit has a refrigerator, gas range, gas water heater, garbage disposal, central air conditioning, and gas-fired forced-air furnace. Each unit has two bedrooms, a kitchen, living-dining area, family room, one bathroom, utility room, and a one-car garage. There are two units on each level.

Initial occupancy was:

61 units	Dec 83
7 units	Jan 84
64 units	Feb 84
57 units	Apr 84
9 units	May 84
2 units	Jun 84

Conventionally Built Units (CBU)

The 144 units consist of 13 sixplexes, 6 fiveplexes, and 9 fourplexes, all two-story buildings. Each unit has two bedrooms, a kitchen, living-dining area, family-room, one bathroom, utility room, and a one-car garage. The fourplexes have two units on each level. There are two units on the second story in the five- and sixplexes with the additional unit(s) on the first level. The CBU also have a one-car garage, refrigerator, gas range, gas water heater, garbage disposal, central air conditioning, and gas-fired forced-air furnace.

A detailed description of all units can be found in the Los Angeles District Office report.[5]

Initial occupancy was:

8 units	Feb 83
28 units	Mar 83
38 units	Apr 83
31 units	May 83
23 units	Jun 83
14 units	Jul 83
2 units	Aug 83

[5] *Fort Irwin Family Housing Study—A Report on Manufactured/Factory-Built Housing and Site-Built Housing, Fort Irwin, CA* (U.S. Army Corps of Engineers, Los Angeles District, September 1984).

4 DATA COLLECTION PROCEDURES

Data collected in this study and their level of detail were discussed in USA-CERL SR P-140. That report requires that data be collected at such a level of detail that any differences found between the two types of construction can be explained. Appendix A in IR P-85/14 lists the housing units and their identification numbers used in the data collection.

Data Collection

Discussions were held with the technical monitor, Facilities Engineering Support Agency (FESA) representatives, the FORSCOM HQ representative, Fort Irwin personnel, and representatives of the base operations contractor, Boeing Services International (BSI), to establish the best methods of collecting the data. For O&M data, USA-CERL designed report forms (Appendix B of IR P-85/14). BSI was contracted to segregate all service orders for maintenance for the test units and report cost data to USA-CERL through the Fort Irwin Directorate of Engineering and Housing (DEH) on a monthly basis.

BSI was contracted to read gas and electric meters at the end of each month and report similarly.

Self-help data reports* and occupancy data were to be forwarded quarterly.

An occupant satisfaction questionnaire was to be given to each vacating family with a mail-back envelope to USA-CERL.

A new contractor, Dynalectron, became the base operations contractor effective 1 Oct 86. They will perform the same services described above.

Data Verification

USA-CERL is verifying the reported data several ways. Each work order is checked against the reported data forwarded by BSI. Discrepancies are resolved on verification visits to Fort Irwin. Additionally, BSI has set up separate accounting codes for the two groups of units and the total billed is compared to the total obtained from summing over all the individual work order data.

On meter readings, USA-CERL developed a computer program to compare monthly readings. When apparently erroneous data occurs, BSI is notified and corrections are made.

*Self help is a program whereby occupants obtain supplies and materials from a central warehouse to make minor repairs themselves.

Data Analysis

Maintenance Costs

These costs are reported on a unit-month basis and yearly basis. The data are also summarized by building component to determine if one or more components for one of the types of units is the cause of large maintenance costs. If so, an effort will be made to determine why these costs occur, i.e., what criteria or design features should be reviewed/changed.

Cost differences will probably be caused by material quality, installation, differences inherent to manufactured or conventional construction and possible errors in specifications for the two projects.

Warranty work referred to the construction contractor was not included in the cost comparison since no cost data are available or applicable, as it is not a cost to the government.

Energy Consumption

Gas and electricity consumption are reported on a unit-month basis and a yearly basis. Since most of the MHU were not completed until May 1984, prior energy consumption data for the CBU will not be used in comparisons. (Energy consumption comparisons are only valid for the same time frame because of varying weather conditions.)

Occupancy Effects

Occupancy data are also being collected. These data will be analyzed to ensure that both types of units have a similar distribution of occupants during the 5 years (ages, numbers). If required, these data will be correlated with O&M costs to help explain differences in costs.

Self-Help Data

These data will be summarized to see if maintenance costs are affected.

Occupant Satisfaction Survey

Data from the questionnaires will be analyzed to determine any differences in satisfaction with the two types of units.

5 WHOLE HOUSE ENERGY TESTS

Three whole house energy tests were performed immediately upon completion of construction on a sample of units from each type of construction. Appendices C and D of IR P-85/14 give details.

House Tightness

The number of air changes per hour were measured with the following results:

Type	No. Units	Average Air Change Per Hour	Standard Deviation
CBU	15	13.0	1.06
MHU	12	10.9	2.67

There is a statistically significant difference between the two types of construction, with the MHU being more airtight, on the average.

Furnace Efficiency

The furnace efficiency results were as follows:

Type	No. Units	Average Efficiency	Standard Deviation
CBU	13	66.2%	6.24%
MHU	16	79.3%	3.36%

The furnace efficiencies of the MHU were significantly higher than those of the CBU.

Wall Heat Transfer Characteristics

This parameter was not measured for the CBU because of unfavorable weather. This parameter was *calculated* for both types of construction using the designed wall construction. These data are given in Appendices C and D of IR P-85/14 and are summarized below:

Type	No. Units	Average Heat Loss (Btu/hr-°F)	Standard Deviation (Btu/hr-°F)
CBU	16	310	51
MHU	15	237	58

6 O&M COSTS

Overall Costs

The total housing unit-months and maintenance costs through September 1986 are shown below. (Maintenance includes all types of repairs and "preventive maintenance" performed.)

Type	No. Months	Total Cost ($)	Cost/Unit/ Month ($)	Cost/Unit/ Year ($)
MHU	6220	104,599	16.82	202
CBU	5983	107,685	18.00	216

Frequencies of Maintenance Per Housing Unit

For the MHU the number of work orders for a housing unit ranges from 0 to 59. For the CBU the range is 1 to 68. Table 1 lists the frequencies.

Frequencies of Maintenance Per Component

Table 2 lists the frequencies of work orders per building component, where the frequency or cost is at least 2 percent of the total number of work orders or total cost respectively.

Self-Help Repairs

Total self-help costs to date (not included in the overall costs shown above) are $467 for an MHU and $370 for a CBU. (The self-help program was discontinued at the end of FY85.)

Table 1

Frequency of Maintenance Actions Since Units were Occupied

Conventionally Built Units		Manufactured Housing Units	
No. of Work Orders	No. of Units With These Totals	No. of Work Orders	No. of Units With These Totals
50-68	4	50-59	4
40-49	10	40-49	5
30-39	29	30-39	19
20-29	50	20-29	70
10-19	43	10-19	71
9	2	9	7
8	1	8	7
7	2	7	6
6	1	6	3
5	1	5	2
4	3[1]	4	4[5]
3	1[2]	3	11[6]
2	6[3]	2	23[7]
1	13[4]	1	17[8]
		0	1

[1] Two were for the building as a whole, not an apartment.
[2] This one was for the building as a whole, not an apartment.
[3] All six were for the building as a whole, not an apartment.
[4] All 13 were for the building as a whole, not an apartment.
[5] Two were for the building as a whole, not an apartment.
[6] Ten were for the building as a whole, not an apartment.
[7] Twenty-one were for the building as a whole, not an apartment.
[8] All 17 were for the building as a whole, not an apartment.

Table 2

Maintenance Actions Performed Per Component
(Percent of Work Orders by Component)

Component No.	Description	Conventional Housing Units	Manufactured Housing Units	Cost ($) CBU	Cost ($) MHU
		(N=3603)*	(N=4063)	(Total= 107,685)	(Total= 104,599)
0101	Roofing Surface	36 (1%)	89 (2%)	2205 (2%)	6034 (6%)
0104	Gutters and Downspouts	124 (3%)	100 (2%)	1717 (2%)	1360 (1%)
0206	Exterior Doors and Frames	164 (5%)	242 (6%)	3434 (3%)	5945 (6%)
0207	Storm and Screen Doors	93 (3%)	----**	2239 (2%)	----
0208	Windows and Frames	57 (2%)	64 (2%)	1205 (1%)	1357 (1%)
0209	Stormwindows and Screens	55 (2%)	----	1187 (1%)	----
0212	Interior Drywalls	52 (1%)	----	1711 (2%)	----
0214	Interior Doors	266 (7%)	207 (5%)	6467 (6%)	3888 (4%)
0220	Garage Door	160 (4%)	98 (2%)	4220 (4%)	1791 (2%)
0301	Resilient Flooring	----	98 (2%)	----	2273 (2%)
0401	Paint, Walls and Ceilings	55 (2%)	36 (1%)	8753 (8%)	4593 (4%)
0601	Heating Plant	76 (2%)	----	2037 (2%)	----
0602	Heating Motors, Blwrs, Pumps	28 (1%)	38 (1%)	2072 (2%)	3007 (3%)
0607	Heating Controls	89 (2%)	----	3883 (4%)	----
0608	Other Heating	102 (3%)	100 (2%)	1979 (2%)	1467 (1%)
0701	A/C Coils, Comp., Cond.	16 (.4%)	----	3935 (4%)	----
0702	A/C Motors, Blowers, Pumps	40 (1%)	42 (1%)	3196 (3%)	1858 (2%)
0704	A/C Refrigerant	219 (6%)	114 (3%)	9250 (9%)	5078 (5%)
0706	A/C Controls	41 (1%)	45 (1%)	2247 (2%)	2025 (2%)
0707	Other Cooling	100 (3%)	119 (3%)	1893 (2%)	2185 (2%)
0801	Water Heater	92 (3%)	119 (3%)	2666 (2%)	5000 (5%)
0803	Piping, Supply	69 (2%)	132 (3%)	2188 (2%)	5215 (5%)
0804	Faucets and Shower Heads	102 (3%)	208 (5%)	2495 (2%)	4080 (4%)
0805	Lavatories	114 (3%)	156 (4%)	1775 (2%)	3805 (4%)
0806	Water Closets	241 (7%)	264 (7%)	5327 (5%)	6231 (6%)
0807	Bathtub/Shower Unit	----	92 (2%)	----	1646 (2%)
0902	Panel Box	----	63 (2%)	----	1664 (2%)
0904	Wall Receptacles	72 (2%)	105 (3%)	937 (1%)	1508 (1%)
0906	Light Fixtures	150 (4%)	91 (2%)	3398 (3%)	1576 (2%)
1001	Garbage Disposal	119 (3%)	153 (4%)	2614 (2%)	2615 (3%)
1002	Dishwasher	116 (3%)	179 (4%)	4545 (4%)	4318 (4%)
1003	Range	225 (6%)	341 (8%)	6901 (6%)	7744 (7%)
1202	Gas Supply	----	53 (1%)	----	1824 (2%)

*N = Number of Work Orders
**---- = Less than 2%.

7 ENERGY COSTS

Comparisons of gas and electricity consumption began in May 1984, since most MHU were not occupied before then.

Electricity Consumption

The average usage (kWh) per housing unit is shown in Table 3. For the 29-month period, an MHU used an average total of 23,119 kWh while a CBU used an average of 22,308 kWh. This is a difference of 811 kWh ÷ 29 months = 28.0 kWh/month. At the August 1985 rate of $0.0825/kWh an MHU cost $2.31 more than a CBU for electricity per month.

Table 3

Monthly Electricity Consumption (kWh)

Month	MHU	CBU
May 84	780	704
Jun 84	1007	959
Jul 84	1218	1170
Aug 84	1263	1132
Sep 84	1001	907
Oct 84	557	582
Nov 84	445	433
Dec 84	486	471
Jan 85	484	463
Feb 85	427	417
Mar 85	423	444
Apr 85	633	549
May 85	679	661
Jun 85	1179	1013
Jul 85	1451	1425
Aug 85	1420	1312
Sep 85	643	707
Oct 85	574	610
Nov 85	525	547
Dec 85	514	492
Jan 86	507	482
Feb 86	447	434
Mar 86	465	465
Apr 86	468	484
May 86	828	789
Jun 86	1148	1070
Jul 86	1280	1270
Aug 86	1520	1349
Sep 86	755	961

Gas Consumption

The type of gas used is liquid propane. The average monthly usage (cu ft) per housing unit is shown in Table 4.

Table 4

Monthly Gas Consumption (cu ft)

Month	MHU	CBU
May 84	900	710
Jun 84	680	640
Jul 84	570	530
Aug 84	620	590
Sep 84	580	530
Oct 84	1410	1110
Nov 84	2400	2070
Dec 84	3560	3180
Jan 85	3540	3220
Feb 85	2940	2780
Mar 85	2700	2390
Apr 85	1460	1270
May 85	960	820
Jun 85	610	570
Jul 85	650	580
Aug 85	660	670
Sep 85	700	650
Oct 85	1050	880
Nov 85	2670	2410
Dec 85	2840	2560
Jan 86	2540	2400
Feb 86	2260	2120
May 86	1700	1680
Apr 86	1380	1360
May 86	910	890
Jun 86	560	650
Jul 86	600	730
Aug 86	610	720
Sep 86	840	830

For the 29-month period, an MHU used an average total of 42,960 cu ft while a CBU used an average total of 39,670. This is a difference of 3290 cu ft ÷ 29 months = 113 cu ft/month. At the August 1985 cost of $0.0228/cu ft an MHU cost $2.59 more than a CBU for gas per month.

Cost Comparison Summary

For the two years ending in September 1986 the 2-year averages for dwelling unit energy consumption and cost were:

	MHU		CBU	
	Gas	**Electricity**	**Gas**	**Electricity**
Average Unit Consumption/Year	19750 cu ft	8929 kWh	18270 cu ft	8712 kWh
Average Unit Cost/Year	$450	$737	$417	$719

The MHU on the average have cost $51 more per year for gas and electricity.

Comments

The data in Chapter 5 (better air tightness and higher furnace efficiencies for the MHU) would indicate the MHU should use less energy than the CBU. However, detailed energy simulations currently being done indicate three design/construction features negate these two measured variables: the MHU have more window/door glass area; the MHU have single-pane glass while the CBU have thermal-pane; and the CBU are built on a slab (which modulates heating/cooling demands) while the MHU are built on a crawl space. The final report of this project will give complete details. Meanwhile, no conclusions should be drawn until the 5 year analysis is completed.

8 OCCUPANT SATISFACTION

One part of the study assesses occupants' satisfaction with their housing. Use of lower cost housing for Army personnel would be questionable if it created morale problems. A questionnaire developed at USA-CERL and approved by FORSCOM, FESA, and HQUSACE is given in Appendix F of IR P-85/14.

A copy of the questionnaire with a mail-back envelope (to USA-CERL) was given to each vacating family by BSI approximately 2 weeks before vacating. BSI also checked with the family when they vacated to encourage completion and mail-back.

Through September 1986, only 168 of 532 vacating occupants (32 percent) returned questionnaires. This response rate is considered low. Special surveys were done in September 1984, April 1985, and June 1985 of all families who had lived in their quarters at least 1 year. Of these, 122 (52 percent) returned questionnaires.

For analysis purposes, only occupants who had lived in their quarters for at least 12 months were considered, since they would have been through both heating and cooling seasons.

The responses from occupants of the two types of units were compared by performing cross tabulations. The following paragraphs show results for key questions and for questions for which occupants of the two housing types differed significantly (95 percent confidence). There were 116 responses from occupants of CBU and 96 for MHU.

Q5. How would you rate the condition of your quarters?

	Excellent	Better than Average	Average	Below Average	Poor
CBU	25%	38	35	2	0
MHU	19	44	30	6	1

No statistically significant difference was found in responses between occupants of the two housing types.

Q6. In general, how satisfied have you been with these quarters?

	Very Satisfied	Satisfied	Dissatisfied	Very Dissatisfied
CBU	24%	62	11	3
MHU	26	58	16	0

No significant difference was found.

Q7E. In general, are you satisfied with your kitchen cabinets?

	Satisfied	Not Satisfied	No Opinion
CBU	74%	24	3
MHU	90	10	0

There was a difference between CBU and MHU occupants.

Q7J. In general, are you satisfied with living/dining room floors?

	Satisfied	Not Satisfied	No Opinion
CBU First Floor	58%	39	3
CBU Second Floor	86	11	3
MHU First Floor	64	34	2
MHU Second Floor	74	24	2

There was a statistically significant difference between first and second floor occupants of the two housing types. Second floor units have carpet while first floor units have tile/vinyl. Second floor occupants were more satisfied.

Q7J1. How would you rate cleanability of living/dining room floors?

	Hard to Clean	Easy to Clean	No Opinion
CBU First Floor	47%	51	2
CBU Second Floor	17	76	7
MHU First Floor	19	75	6
MHU Second Floor	20	63	17

There was a statistically significant difference between occupants of CBU and MHU for cleanability of living/dining room floors, caused by the CBU first floor occupants' responses.

Q7K. In general, are you satisfied with the bedroom floors?

	Satisfied	Not Satisfied	No Opinion
CBU First Floor	63%	37	0
CBU Second Floor	97	0	3
MHU First Floor	70	28	2
MHU Second Floor	79	19	2

There was a statistically significant difference: second floor (carpet) occupants were more satisfied.

Q7K1. How would you rate cleanability of bedroom floors?

	Hard to Clean	Easy to Clean	No Opinion
CBU First Floor	42%	58	0
CBU Second Floor	7	83	10
MHU First Floor	20	74	6
MHU Second Floor	9	70	21

There was a statistically significant difference between first floor and second floor occupants for cleanability of bedroom floors with more first floor occupants (vinyl/tile) rating it as hard to clean.

Q7M. In general, are you satisfied with the interior walls?

	Satisfied	Not Satisfied	No Opinion
CBU First Floor	45%	55	0
CBU Second Floor	75	22	3
MHU First Floor	70	28	2
MHU Second Floor	71	24	5

There was a statistically significant difference: more dissatisfaction was shown by CBU first floor occupants.

Q7M1. How would you rate the cleanability of the interior walls?

	Hard to Clean	Easy to Clean	No Opinion
CBU First Floor	58%	35	7
CBU Second Floor	36	52	12
MHU First Floor	23	65	12
MHU Second Floor	34	46	20

There was a statistically significant difference: the CBU first floor occupants rated walls as harder to clean.

Q7P1. How would you rate the cleanability of the windows?

	Hard to Clean	Easy to Clean	No Opinion
CBU First Floor	40%	52	8
CBU Second Floor	56	38	6
MHU First Floor	26	68	6
MHU Second Floor	31	49	20

Although overall satisfaction with windows was similar, there was a significant difference, with second floor CBU rating their windows harder to clean.

Q9-10. There was no difference between CBU and MHU for noise/odor annoyance from other quarters.

9 RESULTS TO DATE

This interim report has presented results of the O&M and occupant satisfaction data collection for conventionally built and manufactured housing units at Fort Irwin, CA. The data cover a 3-year period from construction through September 1986. Through the first 3 years there is less than 7 percent ($14) difference per unit in yearly maintenance and repair costs between the two types of units; energy costs for the MHU are higher than for the CBU (about $50/year per unit); and occupants of the two types of units are equally satisfied with their apartments.

Through September 1986 the occupancy rates for the two groups are very similar: CBU, 98.4 percent; and MHU, 98.1 percent.

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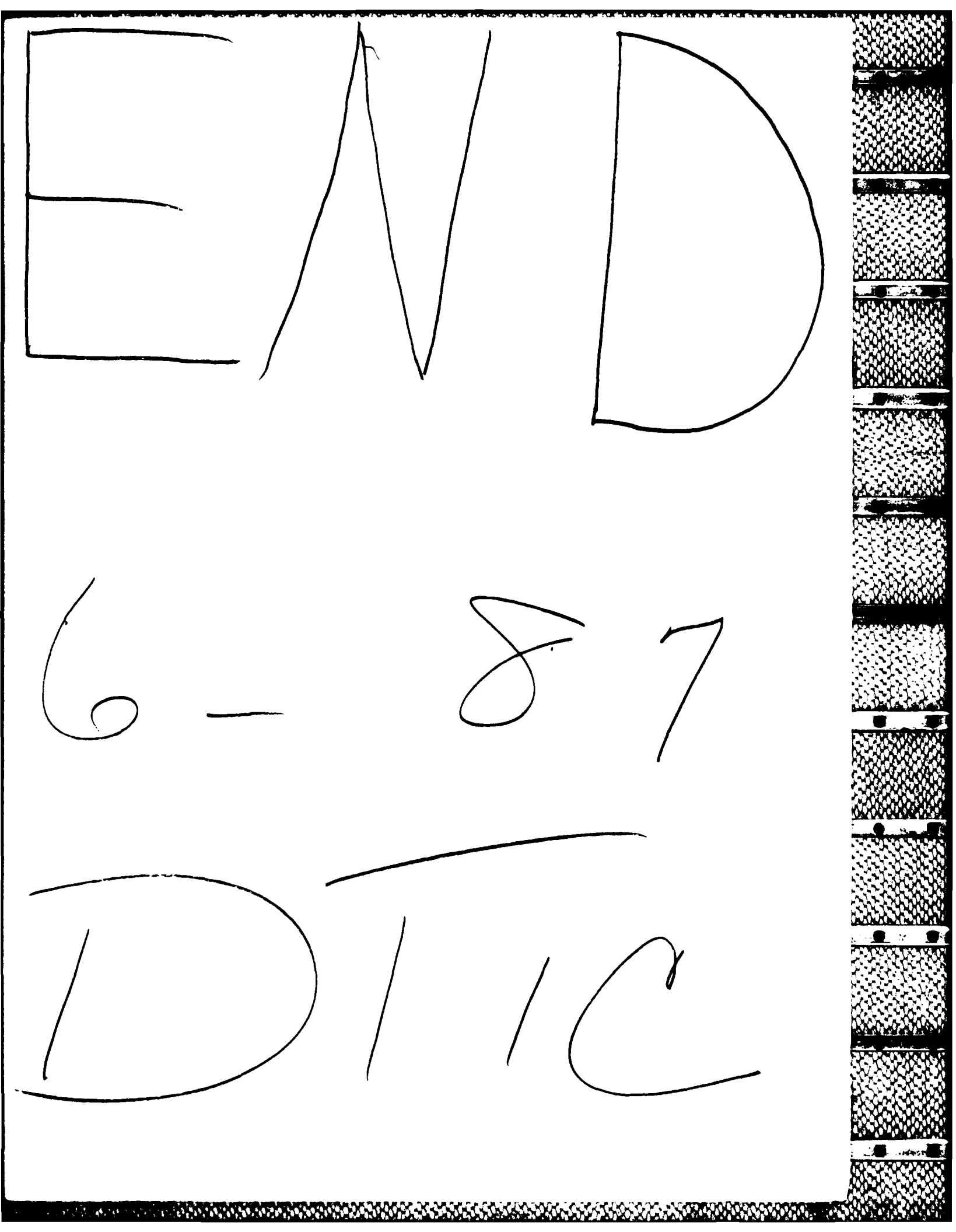
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