BOOK II

HOUSING DESIGN AND CONSTRUCTION

An Analysis of War and Pre-war Experience

Technical Division

National Housing Agency

November 1944

CONTENTS

Book I

THIS BOOK

APPENDIX ONE -ANALYSIS OF SOURCE MATERIAL

Note: For complete contents of this book see pages next following

Book III

Appendix Two - Source Material
Containing Comments and Tables from FHA Field Office Canvass and Abstracts of Reports on Public Housing Projects

CONTENTS - BOOK II

The accompanying report is based on information derived from a wide variety of sources. Information on private housing was secured chiefly through the issuance of a questionnaire to 24 representative FHA Field Offices (FHA Field Office Canvass). The questionnaire was prepared by the NHA Technical Division, with the assistance of the FHA Underwriting Division, and was intended to provide a consensus of opinion among FHA field personnel regarding probable practices after the war in private dwelling design and construction. Certain data on pre-war conditions were also secured through the FHA 6000-Case Sample Survey of 1939, and through FHA Operating Statistics.

Information on public housing was derived from an analysis of approximately 45 reports and articles by FPHA personnel, housing managers, and other specialists, and from about 35 "Technical Folders" prepared by the FPHA Regional Offices according to specifications suggested by the NHA Technical Division.

A list of sources is provided below:

PRIVATE HOUSING

Questionnaires were received from each of the following FHA Field Offices. Figures placed after each office represent estimated percentages of post-war residential construction attributed to that region.

Boston	3	Birmingham	3	Chicago	9
New York	12	Jacksonville	4	St. Louis	5
Buffalo	1	Memphis	3	Minneapolis	2
Philadelphia	7	Dallas	6	Denver	1
Pittsburgh	2	Houston	4	Salt Lake City	1
Washington, D. C.	2	New Orleans	3	Seattle	4
Richmond	2	Columbus	4	San Francisco	5
Greensboro	4	Detroit	5	Los Angeles	8

PUBLIC HOUSING

A Summary of reports, memoranda and magazine articles is given below, together with a list of projects on which Technical Folders were supplied by the FPHA. Figures placed in front of each item are arbitrary numerical designations for use as reference in connection with the abstracts contained in Appendix Two.

1. - ABSTRACT OF CASE STUDY, ELM HAVEN PROJECT, FPHA CENTRAL OFFICE & NEW HAVEN H.A., MAY 1944.

Contents: (a) explanation of design of project by architects, (b) summary of advantages and disadvantages of project by Director of Local Authority, (c) independent analysis and report by two consulting architects.

2. - DEVELOPMENT ITEMS REQUIRING SPECIAL CONSIDERATION FPHA REGION II, NEW YORK, N. Y. MAY 1943. 25 pp.

Summary and discussion by Regional Management Division of critical items of design, equipment, and construction as indicated by projects in operation in New York, New Jersey and Pennsylvania. (Used as agenda for conference referred to in Item 5 below).

3. - REVIEW OF PLANS & SPECIFICATIONS FOR SYDNEY, N. Y. PROJECT, FPHA CENTRAL OFFICE, WASHINGTON, D. C. NOV. 1943.

One of series of sample studies of individual existing projects by the FPHA Technical Division.

3A. - REPORT ON MEETING OF MANAGERS OF PHILADELPHIA HOUSING AUTHORITIES. (3 pp. Memo. JANUARY 1943).

Discussion of advantages and defects of past standards as indicated by Philadelphia projects.

4. - NOTES ON SITE PLANNING - GROUNDS MAINTENANCE REPORTS ON 13 PROJECTS IN N. Y., N. J., AND PA. - FPHA CENTRAL OFFICE, WASHINGTON, D. C. AUGUST 1943.

5. - COMMITTEE REPORTS - REGIONAL CONFERENCE ON MAINTENANCE AND OPERATIONS - FPHA REGION II N. Y. - JULY 1943 - 52 pp.

Summary of conference discussions and recommendations regarding advantages and defects of design, equipment and construction of present projects in New York, New Jersey and Pennsylvania.

6. - QUEEN STREET TRAILERS - FIELD REPORT ON TRAILER MAINTENANCE FPHA REGION III, WASHINGTON, D. C. SEPTEMBER 1943.

7. - LEWIS PARK, NORFOLK - SAME AS ABOVE - OCT. 1943.

8. - REVIEW OF PLANS AND SPECIFICATIONS FOR ABERDEEN, MD. PROJECTS, FPHA CENTRAL OFFICE JANUARY 1944.

One of a series of sample studies of individual existing projects by the FPHA Technical Division.

9. - NOTES ON SITE PLANNING - GROUNDS MAINTENANCE REPORTS ON 17 FLORIDA PROJECTS - FPHA CENTRAL OFFICE, WASHINGTON, D. C. AUGUST 1943.

10. - REPORT - CONFERENCE ON MAINTENANCE - FPHA REGION V, MARCH 1944.

Summary of discussions on management and maintenance methods, including information on advantages and defects of present design, equipment and construction standards based on projects in Kentucky, Michigan, Ohio and West Virginia.

11. - REVIEW OF PLANS AND SPECIFICATIONS FOR YPSILANTI, MICH. PROJECT FPHA CENTRAL OFFICE, WASHINGTON, D. C. DECEMBER 1943.

One of series of sample studies of individual existing projects by the FPHA Technical Division.

12. - GROUND MAINTENANCE REPORT - PROJECTS IN OHIO, KENTUCKY, W. VA. FPHA CENTRAL OFFICE. JULY 1943.

12A. - A SURVEY OF HOME CONDITIONS AT RAMONA GARDENS, H.A. CITY OF LOS ANGELES. OCTOBER 1942.

Tenant survey made primarily to improve management policy and techniques but containing information of value to planners.

13. - REPORTS ON HOUSING PROJECTS - MADE BY ALBERT MAYER FOR FWA. JANUARY - FEBRUARY 1942.

13A	Report on	SC-38025
13B	"	" SC-38023
13C	"	" CONN-6031
13D	"	" NC-31026
13E	"	" NC-31024
13F	"	" MD-18011
13G	"	" PA-36061
13H	"	" PA-36221
13I	"	" CONN-6051
13J	"	" NJ-28061

Reports by consulting specialist on adequacy of planning and construction. Similar to items 19 and 20.

14. - SUMMARY BY FPHA CENTRAL OFFICE OF REGIONAL REPLIES TO CIRCULAR MEMORANDUM BY LEE JOHNSON DATED 4/23/43. (COVERING HOUSING PROJECTS IN REGIONS I, II, IV, VIII,) FPHA CENTRAL OFFICE, WASHINGTON, D. C. SEPTEMBER 1943.

The opinion of from 5 to 10 Housing Managers in each Region was sought through the Regional offices as to whether certain projects met or exceeded minimum acceptable standards of design, equipment and construction. Replies from 8 Regions were received.

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Summary of three-day informal conference held by family interviewers upon conclusion of their work. Interviewers were retained by Pierce Foundation in connection with forthcoming report on space requirements in war housing. Project references follow:

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Project B - MD-18111,2 - Greenbelt
War Housing - Permanent
Project C - VA-44254.1 - Norfolk. Trailers
Project D - VA-44183 - Alexander Park, Norfolk. Demountable

Project E - ALA-1038 - Mobile - Trailers
Project F - ALA-1033 - James Place, Mobile - Permanent
Project G - TEX-8-4, TEX-41064 - La Armada, Corpus Christi - Permanent
Project H - CAL-4-5 - Aliso Village, Los Angeles - Permanent
Project I - CAL-4086 - Carquinez Heights, Vallejo - Demountable
Project J - KAN-14024 - Planeview, Wichita - Temporary
Project K - PA-36222 - Monongehela Heights, Pittsburgh, area. - Permanent
Project L - PA-36161 - Shalercrest, Pittsburgh area - Permanent
Project M - ME-17039 - Longcreek Terrace, South Portland - Temporary
Project N - ME-17031 - Red Bank Village, South Portland - Temporary

15A. - FINAL REPORT ON ITEM 15 ABOVE, DISTRIBUTED BY ROBERT L. DAVISON ASSOCIATES.

Note: In this Final Report, projects were re-lettered as follows: (See Prelim. Draft, Item 15, for further description of each project)

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16.- GUIDE IN EVALUATION OF PUBLIC HOUSING NAHO JULY 1943.

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18. - EDWARD LANGLEY FELLOWSHIP ARTICLES BY ELIZABETH COIT A.I.A. OCT. AND NOV. 1941 JOURNAL OF AM. INSTITUTE OF ARCHITECTS.

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20. - REPORT ON HOUSING PROJECTS MADE BY CATHERINE BAUER TO FWA FEBRUARY 1942. REPORT COVERS THE FOLLOWING 3 PROJECT LOCATIONS:

CAL-4092, San Diego
WASH-45044, WASH-45047, WASH-45048, Bremerton
CAL-4012, CAL-4833, Benecia

21. - REPORT ON DESIGN AND DEVELOPMENT ITEMS (PRELIM. DRAFT) ANNUAL LHA MAINTENANCE CONFERENCE - REGION II NEW YORK, N. Y. JULY 1944.

Summary of recommendations based on experience of housing managers in New York, New Jersey, and Pennsylvania. Similar report issued in 1943 (Item 5) - 36 pp. Final report listed as Item 23.

22. - COMMITTEE ON MANAGEMENT ASPECTS OF DESIGN - REPORT ON CONCRETE FLOORING. MAY 1944 - NAHO.

23. - FINAL VERSION OF ITEM 21 ABOVE.

30. - MEMO, DUANE TO GAYLORD, MAY 23, 1944 - "CONDENSATION IN DWELLING UNITS" 6 pp. REGION III FPHA.

31. - MEMO, GAYLORD TO RODIER UNDATED, TRANSMITTING "DEVELOPMENT ITEMS REQUIRING SPECIAL CONSIDERATION" 6 pp. REGION III FPHA.

Information derived from projects in Delaware, District of Columbia, Maryland, Virginia.

32. - MEMO LEVY TO RODIER, MARCH 18, 1944, TRANSMITTING "HEATING AND THERMAL QUALITIES OF PERMANENT DWELLINGS" ETC. 5 pp. REGION IV FPHA.

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Management experience in Illinois, Iddiana, Minnesota, South Dakota, Wisconsin.

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Report by consulting specialist.

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52. - ALUMINUM CITY TERRACE HOUSING - PITTSBURGH, ARCH. FORUM JULY 1944.

Includes tenant reactions regarding advantages and defects of modern architectural design.

TECHNICAL FOLDERS

Note: These folders were prepared by the FPHA Regional Offices during July, August and September 1944 as the result of a request by the NHA Technical Division to the FPHA Central Office. Each folder covers a single project and contains the following documents: A selection of the most important building and site plans; outline specifications; cost summary; management budget; summary of project statistics; an analysis of design defects and advantages by the Project Manager, etc.

The last-mentioned document is the source of much of the information contained in the Technical Division's report to the Administrator on design, material, and construction standards.

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103. - " " - ARK-3021 - Demountable

104. - " " - TEX-41373 - Temporary

105. - " " - TEX-41605 - Temporary

106. - " " - TEX-41632 - Trailers

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108. - " " - NC-3-1, NC-3-1A - Permanent

109. - " " - ALA-1101 - Demountable

110. - " " - FLA-8104A - Demountable

111. - " " - NC-31077 - Temporary

112. - " " - GA-9131 - Temporary

113. - " " - MISS-22024-28 - Trailers

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115. -	TECHNICAL FOLDER	-	WASH-45016	- Temporary
116. -	" "	-	WASH-45209	- Trailers
117. -	" "	-	ILL-5-1	- Permanent
118. -	" "	-	MINN-H-4201	- Permanent
119. -	" "	-	ILL-11094	- Demountable
120. -	" "	-	IND-12097	- Demountable
121. -	" "	-	ILL-11072	- Temporary
122. -	" "	-	WISC-47071	- Temporary
123. -	" "	-	IND-12175	- Trailers
124. -	" "	-	OHIO-5-2	- Permanent
125. -	" "	-	OHIO-33081	- Demountable
126. -	" "	-	WASH-45112	- Demountable
128 . -	" "	-	WASH-45217 (2 folders)	- Temporary
129. -	" "	-	ORE-35029	- Demountable
130. -	" "	-	WASH-5-2 WASH-45014	- Permanent
131. -	" "	-	WASH-45017	- Temporary
132. -	" "	-	MICH-20033	- Temporary
133. -	" "	-	MICH-20094	- Temporary
134. -	" "	-	W.VA-3-2	- Temporary
135. -	" "	-	OHIO-33044	- Temporary
136. -	" "	-	OHIO-33191	- Trailers
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137. -	" "	-	NJ-21-1	- Permanent

STATEMENT OF PROBLEM

Before the war about 90% of privately constructed single-family dwellings consisted of detached houses. Row houses and semi-detached houses constituted the remainder. Among single-family detached houses about 75% were one-story in height, the rest being two-story and one-and-one-half-story structures, in about equal proportions. For the most part, real estate sub-divisions, whether composed of single-family detached, semi-detached, or row houses, contained only one of these dwelling types.

Planning problems faced before the war by private developers of sale properties, therefore, largely centered around the design of the single family detached dwelling and its arrangement on a lot in proper relationship to other dwellings of a similar type. This general residential similarity was also emphasized in most developments by the fact that dwellings of the same story height were usually placed together.

The above mentioned types of single-family dwellings constituted about 90% of pre-war residential construction. Row housing for rent amounted to 1%, and multi-family flats and apartments to the remaining 9%.

No significant quantity of single-family detached or semi-detached houses was built for rent in any region.

REPORT MATERIAL

Information derived from the FHA Field Office Canvass indicates a trend in some localities away from single family houses towards multi-family flats and apartments. The prevailing proportions of different dwelling types within the single-family house classification, however, are expected to remain substantially the same. The pre-war composition of dwelling types is reported as follows:

Single family detached	- 79%
Single family semi- "	- 3%
Single family row	- 8%
Multi-family row (fental)	- 1%
Multi-family flats and apartments (rental)	- 9%
TOTAL	100%

1. Single family houses vs. multi-family flats and apartments:

Eight offices, representing 38% of the pre-war single family detached house construction anticipated a trend away from this type and nine offices, representing 34% of pre-war single family detached construction anticipated an increased trend towards multi-family flats and apartments. Nine offices representing 36% of pre-war single family detached construction anticipated no change in respect to the proportion of single family detached dwellings, and seven offices, representing 26% of this type pre-war anticipated an increased proportion of this type. The trend from single-family detached dwellings to multi-family flats and apartments may therefore be said to be sizeable, although some of the loss in the former type is expected to be taken up by increases in semi-detached and row houses.

Tabulation of proportion of multi-family flats and apartments in all offices.

(estimated average of 1940 and 41)

Estimated % of total single family post-war construction volume for each office	FHA Field Office	% of multi-family flats and apartments to total dwelling construction in each office	Trend anticipated post-war
2%	Washington, D. C.	72%	weak increase
5%	St. Louis	30%	weak increase
8%	Los Angeles	25%	weak increase
4%	Columbus	20%	weak decrease
4%	Greensboro	15%	no change
3%	Hartford	10%	no change
6%	Dallas	9%	no change
5%	San Francisco	8%	weak decrease

3%	Birmingham	8%	Weak decrease
2%	Richmond	5%	weak increase
4%	Houston	5%	no change
1%	Denver	5%	weak decrease
2%	Pittsburgh	4%	strong increase
12%	New York	3%	no change
4%	Jacksonville	3%	no change
2%	Minneapolis	3%	weak decrease
1%	Salt Lake City	3%	no change
4%	Seattle	2%	weak increase
3%	New Orleans	1%	no change
5%	Detroit	1%	weak increase
1%	Buffalo	none	no change
7%	Philadelphia	none	no change
3%	Memphis	none	strong increase
9%	Chicago	none	weak increase
100%			

2. Single family detached houses vs. single family semi-detached and row houses. The preponderance of single-family detached house construction is illustrated by the fact that only 12 out of 24 offices reported any significant amount of either single-family semi-detached or row houses in the last two years before the war.

As an illustration of this fact, the following table provides a cross-section through privately constructed dwellings of medium floor area before the war throughout the entire country:

Single family detached	- 88%
" " semi- "	- 3%
" " row "	- 9%
	100%

In houses of reduced room area, the proportion of single-family detached houses constructed before the war was 97% and in the larger room area it was over 98%.

The distribution of semi-detached house construction is shown in the following table.

Tabulation of all offices reporting single family semi-detached house construction: (estimated average for 1940 and 41)

Estimated % of total single family post-war construction volume for each office	FHA Field Office	% of single-family semi-detached houses to total single-family houses in medium sized class	Trend anticipated post-war
4%	Columbus	35%	strong decrease
2%	Minneapolis	6%	no change
3%	Memphis	5%	no change
6%	Dallas	5%	weak decrease
1%	Denver	4%	strong decrease
1%	Salt Lake City	4%	no change
7%	Philadelphia	3%	no change
2%	Pittsburgh	2%	weak decrease
2%	Richmond	2%	no change
2%	Washington, D. C.	1%	no change
5%	St. Louis	1%	weak decrease
9%	Chicago	0.5%	weak increase
44%	TOTAL		

In semi-detached houses with small room areas, the same offices indicate pre-war construction activity, except that Philadelphia and Chicago are omitted and Birmingham and Detroit are added. The percentages within this smaller area group are generally less than those in the medium class, with Columbus (25%) Dallas (15%) and Detroit (10%) the only offices indicating a volume of 10% or over. Offices generally expect no change or a decrease of this type after the war, except Detroit which expects a weak increase.

It is interesting to note that although Chicago built no small semi-detached houses before the war, and very few medium sized houses of this type, the local office expects a weak increase in these two sizes of semi-detached houses. This trend is explained as being due to the influence of wartime construction which demonstrated the economies possible through the use of this dwelling type. This same set of circumstances has prevailed in respect to row houses in Chicago, and the same post-war tendency is expected.

Only 3 offices showed a significant volume of semi-detached houses before the war in the larger floor area classification, as follows:

Columbus - 35% - (strong decrease anticipated)
Minneapolis - 4% - (no change anticipated)
Washington, D.C. - 1% (weak decrease anticipated)

Only 6 out of 24 offices reported a significant amount of single-family row housing constructed in their regions in the last two years before the war. In these localities, however, the development of this type of dwelling for the medium and lower portions of the market is generally expected to continue at the same rate after the war.

The distribution of single-family row house construction is shown in the following table:

Tabulation of all offices reporting single-family row house construction in medium class: (average of 1940 and 41)

Estimated % of total single family post-war construction volume for each office	FHA Field Office	% of single family row houses constructed to total single-family houses constructed in medium sized class	Trend anticipated post-war
7%	Philadelphia	60%	no change
12%	New York	35%	no change
2%	Pittsburgh	6	strong increase
2%	Washington, D. C.	6%	no change
4%	Columbus	5%	strong decrease
9%	Chicago	0.5%	weak increase
36% TOTAL			

Only 2 out of 24 offices indicated that a significant number of row houses with reduced room areas had been constructed in their regions. These offices, Pittsburgh and Washington, D. C., showed a volume of construction of these houses amounting to 8 and 9 percent respectively of their total volume of single-family dwelling construction within this reduced area class. The former expected a strong increase, and the latter a weak increase, in dwellings of this type and size after the war.

Only Washington, D. C. and Columbus indicated that a substantial number

lf larger-sized row houses had been constructed in the pre-war period. This variety represented only 2% and 5% respectively of the offices' total single-family construction within the large floor area class. Both expected a decrease after the war.

3. Use of one dwelling type vs. several different dwelling types within the same development. The Field Office Canvass provided widely varying local opinions as to the desirability of including different dwelling types within the same real estate development after the war. Of the nineteen offices which commented ten, representing 39% of the estimated post-war single-family volume, believed that the mixture of dwelling types would be definitely undesirable. Seven offices, representing a post-war volume of 34%, believed that certain types of dwellings could be combined in a sound development if proper planning and landscaping were used and if the development were sufficiently large. Two offices, St. Louis and Washington, D. C., representing together a post-war single-family volume of 7%, expressed a strong belief that the proper mixing of different dwelling types results in a sounder and more livable development. Four large St. Louis sub-divisions and the Ford Foundation in Dearborn, Michigan, were mentioned as being notably successful mixed developments. Five offices representing 20% of the estimated post-war volume did not comment. Offices reporting favorably covered, among other cities, New York, Philadelphia, Chicago and Detroit. Los Angeles did not comment.

CONCLUSIONS

It is obvious from the FHA Field Office Canvass that private residential construction after the war will continue to be primarily concerned with the single family detached house, although a trend towards multi-family flats and apartments is reported in 9 out of 24 field offices, representing

40% of the estimated volume of post-war single-family construction.

There is a slight trend towards a greater proportion of single family row houses in those regions in which significant amounts of this type were constructed before the war, as well as in one other region where wartime construction of row houses is believed to have laid the basis for a post-war demand. Although this trend appears to apply to only 5 regions, representing 32% of the total estimated post-war single-family volume, none of these regions expects a decrease in row house construction, and two expect an increase. It is significant to note, however, that in 20 regions, representing 77% of estimated post-war single-family construction, no important amount of row housing was constructed in the pre-war period.

A trend is also apparent in some localities towards the incorporation of different dwelling types within the same development. Sometimes this trend applies only to different types of single-family dwellings but frequently both single-family and multi-family accommodations are included. Field office opinion is apparently unanimous, however, in recognizing the necessity of having all types designed and developed together in a single neighborhood unit, and in precluding the mixing of dwelling types in any other manner.

DISTRIBUTION

STATEMENT OF PROBLEM

Privately constructed single family dwellings generally ranged from two-bedroom to four-or-more bedroom units before the war. Except in dwellings with reduced room areas, no significant amount of one-bedroom units was constructed. Even in these smaller dwellings only 6% were of the single bedroom type.

Generally speaking, the two-bedroom house was typical of the house with small rooms. Houses with medium-sized rooms usually contained either 2 or 3 bedrooms and houses with large rooms usually contained 3 bedrooms or more.

REPORT MATERIAL

The FHA Field Office Canvass indicates that the following distribution of single-family houses was typical for the last two pre-war years:

	% of houses built in each house size		
	House with Small Rooms	House with Medium-sized Rooms	House with Large Rooms
One-bedroom houses	6%	.4%	none
Two-bedroom houses	91.5%	53.1%	8.2%
Three-bedroom houses	2.5%	45.4%	65.2%
Four or more bedroom houses	none	1.1%	26.6%
	100 %	100 %	100 %

Eleven out of 18 offices predict an increase in 3 bedroom houses (one says 3 and 4; one says 3 minimum) mostly in medium and more in large than small classes, due to the war lag in this larger type of construction. These eleven offices represent 44% of the estimated volume of post-war single family construction while the 7 remaining offices anticipating no change represent 32%. The Detroit office, for example, states that, "Due to the fact that war housing was all smaller dwellings and predominantly two-bedroom type, the post-war construction will be mostly medium and large size dwellings of which the three-bedroom type will predominate". According to the Buffalo office, 3 bed-

rooms will be minimum for all classes even though one of the bedrooms may, at some period of occupancy, be used for other purposes.

These statements are strengthened by the schedule sheets sent in by the FHA offices which show the greatest increasing trend towards 3 and more bedrooms in all three house classes and conversely a decrease in 1 and 2 bedrooms even in the small class house. The estimated increase is especially strong in the small class group (62%), whereas in the medium class group 14 offices representing 42% of the estimated post-war single family construction volume reported an increasing trend. This was topped by an anticipated increasing trend towards 4-bedroom units reported by offices representing 75% of the estimated post-war single family volume. The three-bedroom unit is again most popular in the large class house group with offices representing 36% of estimated post-war single-family construction volume reporting an increasing trend. However, such figures are tempered by high predictions of no change in all three groups. For example, in the medium class alone where offices representing 42% of estimated postwar single family volume anticipate an increase of 3-bedroom units, no change is anticipated by offices representing 47% of this type of post-war construction.

Strong decreasing trends are anticipated for 1-bedroom units in the small and medium class groups and for two-bedroom units in the medium class group.

CONCLUSIONS

A summary of available information points to an increase in number of bedrooms for all three classes, with the greatest amount of change taking place in the small and medium classes and decidedly less in the large class.

The figures reported show the total number of bedrooms in any complete typical cross-section of 100 single-family dwellings to be 195 in houses of small-sized rooms, 246 in houses of medium-sized rooms, and 317 in houses with large rooms. The average for the larger class is therefore 3.1, for the intermediate 2.4, and for the smaller class 1.9. It is noteworthy that the largest number of bedrooms is provided in the larger and more expensive houses, and that presumably the families in the smaller dwellings are equal or superior in size to those living in the larger ones. The importance of this condition is demonstrated by the fact that 12 offices representing 47% of anticipated post-war single family construction reported that almost 55% of pre-war small class houses failed to provide sufficient bedrooms for the families housed, Pittsburgh reporting 95% deficiency, Buffalo, Greensboro, Columbus and Chicago each reporting 75%. On the other hand, within the large house class only one office reported a deficiency of bedrooms of 10%. Such figures suggest a more accurate study of average family size as related to income groups. The 1930 census shows an American average of 4.1 persons per family while the 1940 census shows a decrease to 3.8. This decrease is expected to continue. At what income level this decrease is occurring (if at any) might prove of interest.

Whereas the figures show an anticipated increase in the proportion of 3-bedroom units, the comments of FHA field offices indicate that a large portion of post-war construction is expected to take place not in the dwelling class with small room sizes at all, but in the medium class and, to a lesser extent in the large class house. Private builders quite naturally intend to concentrate on dwellings in the medium and large class because these larger sizes were not constructed during the war.

The proportion of small class dwellings to total existing house construction has increased enormously during this war period, but since these dwellings were usually constructed with one or two-bedrooms, the emphatic pre-war deficiency of bedrooms in the small class house still exists. The obvious conclusion is that this deficiency will not be met unless the government can offer inducements to bring the private builders into this small class field, or unless building costs are sufficiently reduced to make the 3-bedroom medium class house an attractive field to operative builders.

STATEMENT OF PROBLEM

The single-family house varies widely in area, and has, for the convenience of the report, been separated into 3 classes of small, medium and large, based on expedient divisions of this area range. These divisions originated in the mimeographed questionnaire which was sent to the twenty-four FHA Field Offices. For the purpose of securing information from these offices, small class was defined as a house having an area of 900 sq. ft. or less, the medium class as between 900 and 1600 sq. ft., and large class as over 1600 sq. ft. The Canvass showed that 21% of all houses fall within the small class, thus defined, 67% within the medium class, and 7% within the large class. Bedroom distribution and number of stories are factors in determining the total size of the dwelling, but it is the variation of individual room sizes that is most responsible for placing a dwelling in any one of the three classifications. The dwelling arrangement is apparently less varied among the three classifications according to the report material, though arrangement does undoubtedly vary somewhat between the small class house which is close to minimum and the large class house in which space is more generous.

The problem of size and arrangement in the single-family dwelling, as in any dwelling, involves the determination of how much space is necessary to accommodate the family living pattern, and in what relationship this space should be. Because the report material is somewhat scanty and evaluation of war and prewar practices infrequent, it is difficult to say to what extent privately constructed single-family dwellings have met the demands of the family living patterns. But it is at least possible to form an idea of practices followed to date and, where trends are indicated, to discover what has so far been satisfactory and where changes are imperative or desirable.

REPORT MATERIAL

A national weighted average gives to the small class house an area of 806 sq. ft. and ranges from 600 sq. ft., as reported by four offices representing 16% anticipated post-war construction, to 900 sq. ft., as reported by 12 offices representing 42% anticipated post-war construction. The medium class, with a low of 900, as reported by 17 offices representing 70% anticipated post-war construction, and a high of 1600 sq. ft., as peported by 15 offices representing 63% anticipated post-war construction, has a national weighted average of 1240 sq. ft. This figure comes very close to the national weighted average of 1200 sq. ft. for all houses in all classes, which is not surprising since 67% of all FHA Sale houses are built in this, the medium, class. The large class house averages around 1920 sq. ft., with a low of 1600 sq. ft., as reported by 17 offices representing 85% anticipated post-war construction, and a high of 3700 sq. ft., as reported by only one office representing 2% anticipated post-war construction. While the average number of bedrooms increases from the small through medium to large class, an "evening-up" of bedroom distribution among the three classes would not destroy the classifications i.e. to give a third bedroom to a small class house would not put it above the 900 limit. Actually, the majority of both small and medium class houses contain two bedrooms, while 65.2% of large class houses contain only three bedrooms. While these weighted averages show a wide difference in total dwelling areas between the small and medium class, it is important to notice that the greatest number of dwellings in both classes occur in the same range of areas, which centers around 900 sq. ft. It is also apparent from the FHA Canvass that dwelling size varies with geographic location. Taking the medium class only, if the country is divided roughly into four geographic areas of Northeast, South, Middlewest and West, it is apparent from the FHA Canvass that the smallest prevailing dwelling areas are found in the northeast,

while the largest are found in the south and west. Average areas for both one and more than one story dwellings are consistently smallest in the northeast, while the largest average areas for both types are found in the south. The difference between the two extremes is over 200 sq. ft. for the one story house, and over 350 sq. ft. for the dwelling with more than one story. In the case of maximum areas, the northeast again reports the lowest figure for both one and more than one story dwellings, while the west reports the largest areas for one story dwellings, the area reported being more than 375 sq. ft. larger than that reported by the northeast. The maximum area for dwellings with more than one story was reported by the south, the increase in size over the northeast areas being more than 350 sq. ft. Minimum areas reported for the one story dwelling vary less than 75 sq. ft. among the four geographic divisions, and the same is true for the house with more than one story, except for the south, which is over 175 sq. ft. larger than the greatest average minimum area reported by any of the other regions.

Average room sizes in the small class are fairly close to those recommended in public housing standards. The living room averaging 175 sq. ft. is 25 sq. ft. larger than required by FHA rental housing standards, and the kitchen averaging 83 sq. ft. is 23 sq. ft. larger than the minimum required by the same standard, but this increase in size may be partially accounted for by the fact that dining space may have been included in some of the calculations. The first and second bedrooms average 152 and 107 sq. ft., respectively, while the third bedroom averages 71 sq. ft. Only five offices, however, representing 21% anticipated post-war construction, reported any third bedrooms, and only one office, Detroit, representing 5%, reported third bedrooms adequate in size for two persons, such bedrooms being located in the attic. Increases in room sizes as indicated by anticipated trends are all minor, no increase being anticipated by more than

a 6% representation of post-war construction. Offices representing from 92 to 95% of anticipated post-war construction indicate no change for all room sizes, save the third bedroom for which no change is anticipated by offices representing only 18% post-war construction, due to the fact that most offices did not report any third bedroom.

The weighted average areas for all rooms in the medium class are considerably larger than those in the small class, the greatest increase being an additional 60 sq. ft. for the living room, bringing it to 235 sq. ft. A 59 sq. ft. increase for dining space indicates the more general inclusion of separate dining rooms for this class, and this implication is strengthened by the fact that the slightest increase is 15 sq. ft. for the kitchen, indicating that this space is less frequently used for dining. The average increase for all room areas in the middle class over those in the small class is approximately 40 sq. ft. Within this class no decreasing trends are anticipated. Three offices, representing 6% anticipated post-war construction, predict an increase in area for all rooms, while no change is expected by offices representing 92% post-war construction.

The increase in average room areas in the large class over the medium class is even more pronounced than is the increase of medium over small, the average increase being approximately 50 sq. ft. The living room again receives the largest increase, one of 97 sq. ft., and the kitchen the smallest of 22 sq. ft. The Buffalo office which reported all the minimum areas except for one in both medium and large classes, anticipated an increase in area for all rooms. But in the large class practically no other increase is expected, offices representing 97% anticipated post-war construction predicting no change.

Answers to the FHA Canvass of Field offices show that most small class houses are one-story and most large class houses are two stories, while the medium

class is fairly evenly divided between the two types. For the small class, 87% of which is one-story, offices representing 75% anticipated postwar construction predict no change, and offices representing 20% anticipate a decrease in one-story structures. An increase in two-story dwellings in the medium class is expected by offices representing 19% anticipated post-war construction, 55.5% being the proportion to date of one-story dwellings. For the large class, which has to date had only 25.7% of one-story dwellings, an increase in this type is expected by offices representing 15% anticipated post-war construction, while offices representing 82% expect no change. There is also an apparent geographic influence on the number of stories. Of single-family houses, less than 15 percent in the northeast are one story, while in the west only 20% and in the south 15% are more than one story. For the middle-west, dwellings are about equally divided between a one and more than one story arrangement.

The most noticeable difference in arrangement between the small and large class dwelling is the location of dining facilities. In the small class the most frequent location is the living room or alcove, as reported for 40.6% of all houses in this class; the kitchen following with 33.6%, and a separate dining room last with 25.8%. Offices representing 38% anticipated post-war construction report a complete absence of separate dining rooms, whereas in the middle class one office, representing only 1% anticipated post-war construction, reports this lack.

In the medium class separate dining rooms were reported for 80.3% of all houses in this group, 17.3% providing dining space in living room or alcove, and 2.4% in the kitchen. In the large class, the provision of a separate dining room is almost universal, the minimum percentage of dining rooms reported by any office being 76% as reported by one office representing 5% anticipated post-war

construction, and the maximum 100% provision of separate dining rooms being reported by 21 offices representing 89% anticipated post-war construction. The only other location found in this class is the living room or alcove, and that very rarely.

Whereas offices representing from 60-80% anticipated post-war construction predict no change in the location of dining facilities in the small class house, offices representing 35% anticipate an increase in separate dining rooms. The Hartford office states that although in the pre-war period there seemed to be a trend away from dining rooms, tenants in a number of war-constructed dwellings where no dining room was provided use a first floor bedroom for this purpose. In the medium class the greatest increasing trend is towards the living room or alcove, as reported by offices representing 41% anticipated post-war construction. In both the small and medium classes, the greatest decreases are expected in the use of the kitchen for dining. For the large class, with practically 100% separate dining rooms, no change is anticipated.

Other elements of Dwelling Arrangement have been dealt with in other reports and will here be only briefly summarized. Such elements include basements, laundry facilities, garages, storage, bathrooms and porches.

The provision of basements depends largely on geographie location. They are found almost universally in regions from Richmond, Va., north, but are very infrequent south of this line. Basements, where provided, give space to a rather miscellaneous group of activities including laundry and laundry drying, storage, heating equipment and the storage of fuel, workshop and play space. According to FHA Field offices, basements seem to be the most economical way of providing for these elments where lot sizes are small and floor space at grade level is at a premium. Other reasons given for the provision of basements are

the avoidance of dampness and cold floors, elimination of termites, and the desire to conform to local custom. The Buffalo office, however, states that all basement activities could be cared for more conveniently elsewhere if sufficient space were provided.

Laundry facilities are usually located in the basement in northern regions where basements are prevalent, except in some large class houses where they appear on the first floor adjacent to the kitchen. In the south, however, laundry facilities are often provided outdoors, a garage or kitchen porch being the most usual location. Many dwellings in the south were not provided with any laundry facilities prior to the war period, but their inclusion became imperative with the war and the advent of the servant problem. Laundries will be included in these localities from now on, but otherwise few departures from past practices are anticipated by the field offices. Richmond does, however, want to move the laundry from the back porch, where it is now located, to the basement, while the Washington, D. C. office predicts the removal of the laundry, now in the basement, to the first floor level.

Storage is similar to the laundry in that if often seems to be put any place that there is room for it. The basement is the most popular location in northern regions. Other frequent location are the attic, the garage or the back porch, the last two being southern solutions. A certain amount of dissatisfaction with present storage locations is apparent. The Washington and Buffalo offices both report the basement as a ppor location, stating that greater dryness and convenience would be achieved by storage above grade. Several offices state a simple need for more storage space and other references are made to the desirability of utility storage, generally adjacent to the kitchen but occasionally at each floor level.

Sitting porches are appreciated where provided and are desired where

omitted. Kitchen porches are frequently desired in the south as an extension of kitchen work space, as well as to shelter storage and laundry facilities. A few comments were received on the location of the kitchen which appears usually to be located at the rear of the dwelling, though this is less true of the large class than of the small class house. The Dallas office for example reports the kitchen at the rear for 60% of small houses, 67% of the medium class, and 75% of the large class. There is, however, insufficient data to draw any real conclusions on this matter.

Additional toilets are mentioned for servants, especially in the south, usually in the basement or a garage extension. Servants in the south also seem to make necessary the provision of two dining spaces.

CONCLUSIONS

One factor made very clear by the report material is the importance of local climate in the determination of dwelling arrangement. This influence is a logical and powerful one and has been used to good advantage. An example is the kitchen porch in southern localities, which functions efficiently as an addition to the kitchen work space without requiring the added cost of extending enclosing walls. There is also an interesting correlation between dwelling size and geographic location already mentioned in the report material. Figures from the FHA Canvass make it apparent that prevailing dwelling areas are smallest in the northeast, larger in the west, and greatest in the south. Heating costs, the prevalence of basements and the possibility of smaller lot sizes in the north are some of the probable causes.

A significant fact concerning floor area not immediately apparent from figures produced by the FHA Canvass is brought to light by an inspection of an FHA Sample Survey, compiled in 1939 on the basis of 6000 case studies. This survey, dealing with 6000 FHA insured dwellings, demonstrates in general terms that areas

in the largest portion of both small and medium class dwellings, as defined by the FHA Canvass, are within approximately the same range of areas in spite of the fact that the average areas of each of these two classes differ by more than 400 sq. ft. For example, 1451 or more than 1/6 of these dwellings were built with an area of between 860 and 1059 sq. ft., whereas at no point in the rest of the survey is such a large proportion of the total field concentrated within such a small range of areas. To highlight these figures, it can be stated that in the area range of 1060 to 1259 sq. ft., 1088 dwellings were built, and in the area range of between 660 and 859 sq. ft., only 712 dwellings were built.

The advantage of discovering weighted averages for each class and for the whole field is that a weighted average gives a hypothetical area which may not be represented by any actual house but which is based upon all actual areas within each class and the number of times which each occurs. Viewed alone, this figure gives no indication of the individual cases upon which it is based. Viewed in combination with the mode or most frequently occurring item (in this case, floor area), the average gives an indication of the spread of total building construction over all possible floor areas. In other words, it is necessary to know not only the average area of all houses within each class, but also in what floor area range the bulk of these dwellings are built. A knowledge of this factor makes clear that while the weighted average area of the house with small size rooms is 806 sq. ft., more houses in this class are built with areas between 860 and 910 sq. ft. than in any other area range. Similarly, among houses with medium size rooms, the major portion of all such houses are built with an area of between 910 and 959 sq. ft., although the average total area for this class is 1240 sq. ft. The greatest number of houses in the large class are built with an area of between 1610 and 1659 sq. ft. (though the average of this group is 1920 sq. ft.) and from here on the

number of houses built decreases rapidly as the area increases. It seems apparent, therefore, that the 900 sq. ft. figure represents an approximate area below which the sales value of a house becomes questionable and above which it is not necessary to go to insure saleability.

The responses to the FHA Canvass indicate that operative builders, as interpreted by FHA field offices, are in general, satisfied with present practices in the size and arrangement of dwellings and anticipate few changes. This conclusion is implied by the relatively large number of "no change" answers appearing on the schedule sheets under anticipated postwar trends and by separate comments made by the field offices. That certain changes would, however, be desirable becomes evident upon analysis of the various schedule sheets in conjunction with one another.

It is surprising that practically no increase in size is expected in the third bedroom of the small class house which averages 71 sq. ft. and this in spite of the fact that 12 offices representing 47% anticipated post-war construction, reported that 55% of pre-war small class houses were deficient in number of bedrooms, the deficiencies reported by some offices being as high as 75 and 95%. An increase of 30 or 40 sq. ft. would make a third bedroom adequate for 2-person occupancy and at least partially relieve this situation, especially in combination with the marked increase in 3-bedroom dwellings expected by offices representing 62% anticipated post-war construction.

The basement seems to be a catchall for various household functions for which no adequate space provision has been made in the main body of the house. Some of the functions are no doubt well cared for in the basement (i.e. storage of large articles rarely used, heating equipment and fuel storage) but it seems possible that many other activities habitually cared for in the basement might

be better and more conveniently located elsewhere. Most storage, for example, could be better arranged in more direct relation to the place of use and would be kept drier and in better condition at a first or second story level. Laundry might be better located at a first floor level thereby gaining a better working light, a better relation to outdoor drying and the avoidance of many trips over the stairs with heavy laundry hampers. A basement is undoubtedly a good solution in some cases but its provision should be determined through a consideration of land costs, lot size, cost of excavation and the most convenient relation between the different areas within the dwelling.

Storage and laundry seem both to be rather incidental considerations, their locations being largely determined by building areas provided for other purposes. If there is a basement, laundry and storage go there. If there is an attic, storage goes there. In other words, these components of the total dwelling are not considered as separate elements requiring certain conditions for their proper functioning, but are lumped together as miscellaneous odds and ends that can adjust themselves to any available location. The brevity of the report material makes it difficult to realize to what extent the results of this approach cause discomfort or inconvenience to tenants of FHA Sale dwellings. Moreover, it seems to be true that, as one manager of a public project remarked, "It has been general management experience that tenants become accustomed to certain inconveniences after they have put up with them for a period of years." It seems possible that dwelling arrangement might be improved by considering these elements once more as important departments of the household deserving careful attention and by analyzing the special circumstances which will promote their efficient functioning.

LAUNDRY FACILITIES

STATEMENT OF PROBLEM

The laundry process includes the activities of washing, rinsing, wringing, drying and ironing. To facilitate this process space for work, equipment and storage of equipment are necessary. The problem differs somewhat from the provision of laundry facilities in federally aided projects by virtue of a somewhat different living pattern among higher income families. Laundry is not, for example, so exclusively done in the home and when done there is sometimes done by a servant. The quantity of things to be washed is often less because of the different type of employment of this group, i.e. more white collar workers. Moreover, more generous space provisions in FHA sale as compared with federally aided dwellings automatically reduces the problem of congestion in the service portion of the house. Beyond these qualifications, however, the problem remains one of proper space provision and relationship between work area equipment and storage. The most commonly owned equipment includes tubs, washer, mangle and drying ropes in addition to many minor articles which have to be stored.

Provisions for laundry facilities in FHA Sale Houses vary with building types, local custom and climatic conditions. There are therefore three fairly distinct ways in which these facilities are cared for; basements in the north where they are already provided for other reasons, such as furnace, storage and the avoidance of dampness. A first floor location in or adjacent to the kitchen is found in both north and south. Kitchen porches, outdoor shelters and garages are popular in the south where climatic conditions make such a location possible.

REPORT MATERIAL

Because the report material is somewhat scanty, it is difficult

to form any valid statement on facilities in FHA sale houses, but on the whole it seems apparent that practices up to date will be continued except in portions of the south where formerly such facilities were completely omitted.

Reports were received for this matter from 16 offices representing 69% of anticipated postwar single family construction. Six of these offices, however, representing 29% anticipated construction stated simply that there would be no change, without describing their present methods. The Chicago office representing 9% anticipated postwar construction likewise stated that no change is expected but went on to describe the present practice of locating laundry facilities in the basement.

The figures received show that 2 offices representing 11% of postwar building locate laundry facilities in the basement, 1 office representing 2% have kitchen locations, and another office with 2% utilizes the kitchen porch.

The regional offices are more articulate about laundry location in postwar building, 5 offices representing 23% of anticipated construction recommend a basement location, While 3 of these offices are in the north and 2 are in the south, the fact that 100% of the northern cities reporting (unlike these of the south) on this subject advocate a basement location seems to indicate that this preference is more peculiar to the north than the south. Southern offices representing 6% of anticipated postwar construction advocate garage locations, those representing 9% recommending the kitchen porch, and a 3% representation recommending the kitchen. Space adjacent to the kitchen is recommended by 3 offices, 2 in the south, the

other in D. C. representing 13% postwar construction. These figures illustrate the importance of regional conditions in the solution of this problem, not only as to average mean temperatures but also as to local custom. It is interesting to note that whereas laundry in federally aided projects is most often done in the kitchen, this location is rarely mentioned as a present practice or a future possible solution in FHA sale dwellings.

Several reports from the south indicate that the provision of laundry facilities is a relatively new problem with them. For example, the Memphis office states that laundry facilities were almost completely lacking until the advent of the war and its attendant servant problem. Only two offices, however, advocate a definite change from past practices. One of them, Washington, D. C. wants to move the laundry from the basement to the first floor and the other, Richmond, Va., wants to change the location from the first floor to the basement. Perhaps there is logical reasoning behind such recommendations but they seem arbitrary on the surface at least. 3 offices do, however, indicate the need for further consideration of this problem, though without specifying the proposed solution.

CONCLUSIONS

There is a rather surprising contrast between the controversy centering around the provision of laundry facilities in federally aided projects, and the apparent equanimity with which the problem is met by the operative builders, as reflected by FHA offices. It is difficult to tell because of the insufficiency of the report material, whether this problem has in reality been satisfactorily solved in FHA single family houses or whether a problem exists which has not been recognized as such by builders. To a large extent it is clear that laundry facilities are not looked upon as a separate problem in private residential construction, but

are considered as a part of the basement, kitchen, porch or garage space provisions customary in each locality.

STORAGE

STATEMENT OF PROBLEM

The problem of providing storage facilities is basically the same in any dwelling, whether public, private, high or low rental or sale. In each case space of proper size, shape, location and accessibility must be provided for articles and possessions necessary for the household activities of a particular number of occupants. The extent to which space is provided will, of course, vary. Minimum standards governing FHA and public housing will differ, and within FHA itself provision for storage varies in lower, middle and upper price ranges. Building types and construction features such as basements, attics, utility rooms and porches, determine storage areas and locations as well. So closely identified are bulk storage areas and laundry facilities with basements and utility rooms for example, that it is difficult to separate these two subjects in the report material, and as basements and porches are found in northern and southern states respectively, storage areas will be found to vary indirectly with geographical location.

This report can be no more exact than the material as received from the field offices. Whereas statements might more accurately be made upon analysis of necessary and recommended storage requirements and the activities they serve, reports are in some cases vague, recommendations sometimes arbitrary, and qualifying references too small, intermediate and large dwellings are frequently lacking.

REPORT MATERIAL

In every case where size or amount of storage space was mentioned, comprising about 50% of all reports, the complaint was one of inadequacy. This was particularly true of small and medium class houses of pre-war con-

struction, regardless of region. One comment indicated inadequacy of the basement for general storage, several that attic space was inadequate and others that specific closets were either lacking or too small. As to the location of general storage, there are very definite reports and recommendations. General storage is usually provided in basements, attics, utility rooms, porches. Basements were found to be in wide use and were proposed for continued use in the more northern regions. This is substantiated by the comments from Buffalo, Richmond, Philadelphia, Chicago and Washington field offices. Particular importance was given to the provision of basements for small and medium class dwellings. For these classes, usually found on the minimum size lot, ground floor space is at a premium and too valuable to devote to the larger storage areas. Other reasons for basements are that cold and damp floors can thus be eliminated, that little added expense is necessary since deep footings are already required in these northern states, and that strong local preference or custom supports the use of basements.

For general storage, attics were preferred in Memphis, Greensboro, Philadelphia and Richmond; porches, garages or a ground floor room were preferred in Birmingham and New Orleans. Reasons given for not having basements in these cases were that they were damp, and that certain activities, including storage, usually carried on there were provided for on porches in that region. Basements a half story below grade were sometimes found.

Very few reports described or proposed smaller decentralized spaces for the storage of particular articles. Mention is made of the importance of more storage adjacent to the kitchen for house cleaning articles, more kitchen cabinets, larger living room, bedroom and linen closets for minimum FHA dwellings.

CONCLUSIONS

The report material indicates that general storage space is always correlated with basement, attic, utility closet, garage or porch space in the privately built single family house. The presence and character of these individual elements of the house depend on local circumstances and they, in turn, determine the location of storage space, regardless of any better location which might be designated as a result of a closer analysis of human activity and habit. Repeated suggestions are made for large storage spaces, and more basement and attic space is frequently requested in instances where basements or attics are provided. There is, however, no feeling of assurance that there will be any substantial change in the manner of providing storage facilities when building recommences after the war. It is here recommended that a more careful analysis be made of the storage problem: of the separate household activities requiring storage, of the controlling conditions of region and site and accompanying factors of economy, in order that minimum and optimum storage facilities and accurate locations may be more clearly stated.

STATEMENT OF PROBLEM

The typical single-family lot with which the private builder is concerned is about 7,000 sq. ft. in area and cost about $600 as indicated by the FHA. 6,000 Case Sample Survey for 1939 - This lot contained a house with its facade set back 25 ft. from the street boundary. There was usually a one-car detached garage and some planting added by the owner after the purchase was made.

Before the war, the construction of houses for sale was generally a small scale operation. According to a study by the Bureau of Labor Statistics, the average number of houses built by all builders was 2.2 per year; while two-thirds of all builders constructed only one house per year. To the ordinary private builder, therefore, land improvement was merely the improvement of individual lots.

An indication of the proportion of builders who developed subdivisions, as contrasted with those who built houses on individual lots scattered throughout the city, can be seen in the BLS survey of 72 cities in 1938. Assuming that developers of fifty or more lots per year are operating on a subdivision scale, their number compared to that of all builders was 20.5%. Like the smaller builder, the large subdivider develops lots, but in this case lots are constituent subdivision units which are accompanied by other land improvements such as streets, drives, walks, parking, and in some cases recreational and commercial facilities. The problem of planning the large subdivision that will be financially successful, efficient and attractive, has become one of complexity; a problem requiring a good deal of technical knowledge. The larger builder can usually obtain the services of technicians. Many of them have had the advantage of an actual participation in the building of completely planned communities of the war housing program. The developer of a small tract or individual lot is free of the responsibility of planning a functioning and appealing neighborhood; the plan of such

a tract or lot being to a greater degree determined by existing and uncontrollable surroundings.

REPORT MATERIAL

Lot Size and Cost: According to the 6,000 Case Sample Survey of FHA mortgages in 1939, the bulk of approved mortgages covered lots varying in size from 4,000 sq. ft. to 15,000 sq. ft. with the greatest number from 6,000 to 8,000 sq. ft.

The bulk of approved mortgages were for lots less than $1250 in cost. Above this price, the number of mortgages decreases rapidly and from $2500 to $5,000, comprising the upper half of the price range, the number of mortgages is only .72% of the total. That portion of the cost graph showing more mortgage approvals than any other was the segment between $500 and $750.

The question of building types seems to relate closely with the size and cost of the plot. For the detached house, having most likely the largest plot the average cost is given at $810; for the semi-detached house an average cost of $975; and for the row house naturally having the smallest lot, the average cost is about $1,000. This would indicate a correct use of building type according to land costs.

Porches: Beyond the actual dwelling upon the plot, are accessory structures and other plot developments. In the FHA Canvass of twenty-four offices, porches and garages are most frequently mentioned. Living porches in Memphis, Dallas and Chicago are recommended. Memphis states that there will be an increase in their use among small and large sized dwellings regardless of added construction cost because of greater appeal, comfort, convenience and sales value. Working porches are especially important in the south, of generous size, screened, for laundry and kitchen activities and storage. Chicago reports that the elimination of porches during the war demonstrates that subsequently this feature will be in demand.

Garages: The 6,000 Case Sample Survey of FHA indicates that garages were found lacking among 20% of all dwellings reported. Of the 80% of the dwellings having garages, 54% had one-car garages, 24% two-car, and 2% three-or-more car garages. Of all garages regardless of number of cars housed, 54% were detached, 24% were attached and 22% were built in as a part of the house structure and mass. Among specific comments of the FHA canvass of twenty-four offices, New Orleans states a demand for multi-purpose garages serving as laundry, workshops and storage. Houston predicts the increased use of attached garages for medium and large class dwellings, and of the carport as serviceable and inexpensive for smaller dwellings. Buffalo expects no change in present practice but states a preference for attached garages facing and at short distance from street. Reports from Chicago insist that garages are necessary, that many occupants of war housing have subsequently built them, and that there will be a strong trend toward accommodations for one car among the smaller dwellings, and for two-cars among medium and larger.

Planting: Considered more and more as an integral part of the job, builders have shown a tendency to include seeding, sodding and planting with the more fundamental measures taken in site development. Chicago states that valuations for war housing have reflected expenditure allowances for landscaping. These cost allowances were specific requirements in those cases where a subdivision analysis was made by the FHA and in a great many individual cases where analyses were not made, these same requirements were enforced, and suitable allowances set up for the costs involved. The Chicago office expects that this practice will continue after the war.

Streets and Walks: In land improvement on a scale larger than the individual plot, two-thirds of those offices reporting expect no change from the present practice. Reporting on specific item of land improvement, the Chicago

office states that upon the experience of war housing projects, public rear alleys and service driveways are not feasible and are expected to go into disuse after the war. The numerous attractive war projects using curvilinear street patterns have demonstrated to builders the economies and desirable effects that can be achieved. It is expected both by the Chicago and Houston offices that the curvilinear pattern will be still more extensively used in coming years. They further state that planting strips separating street and walk will replace the integral curb and sidewalk of wartime practice; that trees will be more extensively planted where they are not found as natural amenities of the site. The FHA Chicago office, the only office which has reported attempts to increase lot widths, has not been entirely successful due to high acquisition cost, however, some progress in this respect was made during the war period. Reversion to narrow lots is expected, especially in those projects receiving no FHA assistance, though the general trend toward wider lots will be continued. This is confirmed by reports from Birmingham and Chicago.

Since a large proportion of available land for small and medium-sized houses within the principal city limits of chicago has been built upon by war housing, such post-war building will be carried on in suburban areas and this trend will be offset only by the extent of Chicago slum clearance programs. Houston expects that houses of this size will be built whenever possible near parks and playgrounds. It is felt that importance of light, air and recreational areas necessary to mental and physical health have come to popular attention, and demand for such sites will develop after the war. Influence of planned communities of the war housing program has led to a decrease in amount of land set aside for street, and more for residential use, public parks, playgrounds, schools; and in larger projects, for commercial purposes and parking. All these influences the

Chicago office feels will be permanent.

Protective Covenants: Trends toward volume building in the Chicago area will be accompanied by increased coverage by protective covenants to sections and entire tracts. Chicago was the only office reporting on this subject. It is believed also that the example set by war housing of low and medium cost will be followed in more expensive building; that volume building and covenants will be adopted whenever practicable. Usually in cases where covenants have been enforced, FHA standards were established as the basis. Architectural control, the most commonly exercised feature of protective covenants, is perhaps less needed with expected increase of volume building and its intrinsic uniformity. However, architectural control will definitely be more extensive. Easements for utilities have and will increase with the elimination of alleys. Subdivision review by FHA accepted by local government, has been employed to a great extent in war housing. Benefits of this practice have been very evident, and in the post-war building of small and medium houses, where too little attention was paid previously to subdivision requirements, the results are expected to be most successful.

Besides these measures, the revitalized city planning commissions active in drawing up master plans, are expected to direct the wise use, development and improvement of land both in the rebuilding of blighted areas and in suburban extensions. Recommendations were received that subdivision land planning be improved by assistance in procedure and design from the local FHA offices, public education through the activity of interested groups, the publicizing of recent and most successful developments, and through FHA publicity. Another office has made the suggestion that closer cooperation between FHA local office, lending agencies, city planning commission, and Public Works Department will make for more successful results in land planning.

CONCLUSIONS

Whether for an individual lot or large subdivision, land improvement should be based upon the greatest usefulness of the land with its inherent amenities, and upon its most effective and economical development. Relationship to surrounding development, existing or anticipated, landscaping and accessory structures on the individual lot, division of lots to be usable in size and shape, the arrangement of streets, walks, utilities and other improvements for safety, convenience, attractiveness and economy, are the fundamental concerns of the builder. The complexity of this job has required the services and guidance of the FHA field offices. To assure certain conformity to standards of health, safety, livability and permanence, public service, enforced zoning, subdivision regulations and restrictive covenants are usually exercised. However, to the technical ability and judgement of the developer is left the ultimate success of land planning.

Much of the restrictive measures such as that for "set backs" and zoning prevent chaotic placement of buildings. Nevertheless such measures have not been able to prevent both in separately developed lots and large subdivisions monotony, lack of interest and the unintelligent use of land. It is evident in view of the inadequacy of restrictive measures alone, of the complexity of the planning problem and of the responsibility involved in the housing for human need, that further positive guidance and services such as those extended by the FHA is needed. It is distinctly apparent that the FHA field offices feel this need; it is safe to say that could home owners better speak and discriminate they would endorce such a service, and to this may be added the recommendations of this office.

DISTRIBUTION

STATEMENT OF PROBLEM

Distribution means the proportionate number of dwelling sizes in a project to fit the anticipated market: tenant families to be housed. It is generally based on a market analysis of the income group brackets intended for the project or on the experience and knowledge gained from operating the existing projects.

It may be determined, where the market is large, to build for specific size families only. In the case of public-aided housing, it may be decided by policy, to house the larger size families, those with children. Thus a determination is made of the number of each size to be developed, generally in terms of number of bedrooms.

The average size of the dwelling unit establishes in a large measure the development costs, which, in both private and public housing, is reflected in monthly payments and affects project income.

In the case of public-aided housing, there are statutory cost limitations and Federal annual contributions to be considered.

The trend of the average urban size family is downward and since amortization of the capital cost of the project is of some duration, this trend must also be considered in the determination of distribution. The average number of persons per occupied unit was 3.97 in 1930, 3.61 in 1940, and may be 3.3 or 3.4 in 1950. The average size family is perhaps 0.2 less than these averages. The average size dwelling unit is about 0.6 rooms larger than the family count.

REPORT MATERIAL

More 3-bedroom units are needed and less one-bedroom units.

One and two-room, and one-bedroom units are good only for old couples and work particularly well when on ground floor with direct access.

Large units should not be placed together as it concentrates child population. 3-bedroom twins bring too many children together.

There is little call for one-bedroom units in war housing, especially for rural immigrant families who are unwilling to accept war space standards.

There should not be any 0-bedroom units in graded rents. (The principle of graded rents is charging according to ability to pay.)

More 4-bedroom units are needed, about 2% of the total.

If construction cost limitations do not permit some 4-bedroom units, then the bedrooms should be planned to enable the bedroom of the adjacent unit to be made available for the larger family.

Comparative and suggested distributions in percentages are tabulated on the following page.

Certain specific suggestions have been made regarding appropriate percentages of different-sized dwelling units in various types of projects. Some of these suggestions are tabulated below:

	Per Cent of Total Dwelling Units in Project				
Bedrooms	BR	BR	BR	BR	BR
Number	0	1	2	3	4
Per Cent	%	%	%	%	%
War Housing	0	40	40	20	0
Revised to	10	30	40	20	0
And later to	0	25	50	25	0
F.W.A. Perm. Proj. N.C. (Proj. Mngt. suggests increase in the 1 & 3 BR.)	0	15	66	19	0
F.W.A. 500 D.U. Perm. Proj. (LHA based this on 1,000 enlisted personnel families.)	0	33.6	49.6	13.6	3.2
F.W.A. 600 Perm. Proj. S.C. (Mngr. wants some 4-BR units.)	0	32	44	24	0
F.W.A. 100 D.U. Perm. Proj. Pa.	0	16	60	24	0
(Mngr. - should be	0	36	50	14	0
(Specialist disagrees, more 1-BR only, young couples will have children.)					
F.W.A. 450 D.U. Perm. Proj. Pa. (Specialist suggests more 3-BR & some 4-BR or borrow bedroom from adjacent unit.)	0	16.5	59	24.5	0
F.W.A. 300 D.U. Perm. Proj. Md. (No demand for change. Good - present conditions - can take lodgers.)	0	0	76.6	23.4	0
F.W.A. 350 D.U. Dem. Proj. S.C. (Desirable some - 1-BR)	0	0	70	30	0
FPHA Region II recommends (This makes an average of about 4.5 rooms per. D.U.	0	20	50	30	0

The average size dwelling unit in Federal-aided permanent projects is probably between 4 and 4.25 rooms.

CONCLUSIONS

Since the recommendations made were based on project manager's experience or on the appraiser's evaluation of the moment, these must be weighted in terms of the useful life of the project. It is obvious that this determination must be made locally.

The greatest need seems to be for some 4-bedroom units. Efforts should be directed toward reducing costs so that their construction will be possible in all parts of the country under statutory limitations. Policy should be formulated with the recognition of this need.

A flexible plan devised to enable the use of a bedroom by either of two adjacent dwellings is advisable.

The desirability of no-bedroom units should be re-evaluated in terms of flexibility of use, continued occupancy, and tenant satisfaction.

Location of specific size units as related to each other and elements of the site plan will be discussed elsewhere.

DWELLING SIZE AND ARRANGEMENT

STATEMENT OF THE PROBLEM

The success of the Federally financed project dwelling unit depends upon the adequacy with which the requirements of the low income tenant are met. The first step in the solution of this problem is an analysis of this particular living pattern in terms of activity. There are numerous ways in which such a pattern differs from other ways of living. These ways of doing things must be recognized before any dwelling plan can be formed. Such habit patterns emanate from family size and make-up, family possessions, method of earning a living and general social conditioning. Next the conditions essential to the smooth functioning of these activities should be investigated. Such essentials include comfort, convenience, avoidance of activity conflicts, ease and economy of maintenance and adequate space for furniture and equipment and space for their use. Such conditions which are a consideration in the planning of any house, must receive greater attention in the Federally financed dwelling because of its carefully limited size, and when plans are standardized, consideration should be given to local custom and usage so that the tenant will not feel forced into an unfamiliar living pattern. And finally there are the important considerations of capital cost and site plan layout.

In Federally financed projects the various family activities have been allocated to conventional room areas. Room choice is usually limited to kitchen, bedrooms, bath, and living room. Dining is taken care of usually in the kitchen, occasionally in the living room. Sometimes a utility room is included to accommodate, either singly or in

combination, laundry equipment, laundry drying, heating equipment and general storage. A basement is occasionally provided for similar purposes. Sometimes there is a combination heater-storage room. Otherwise (unless central heat is provided) the heating equipment is placed in a separate heater room or is left free standing. Storage is cared for by coat, linen, clothes and general storage space, the areas defined by standards. Room sizes are likewise in accordance with standards set up by FPHA (and its preceding counterparts) and qualified during the war by WPB. To some extent, room relationships have also been defined by standards. For example, "the bathroom should be accessible from each bedroom and the living room without passing through a bedroom or the living room."

REPORT MATERIAL

The following comments on dwelling sizes and arrangement are considered in order of importance as indicated by frequency of appearance in the report material.

The most recurring complaint is simple discontent with insufficient space. Such comments receive an occasional qualification that room areas are considered adequate where the dwelling is felt to be temporary by the tenant. Inadequate space is particularly mentioned in reference to child play, dining, furniture and equipment placement, storage and laundry. Often when dwelling space is adequate, it is because the inmigrant war workers have little furniture.

Inadequate ventilation comes next in apparent importance. Windows in row house end walls, sills at or below bed level, cross or corner ventilation, and consideration of the prevailing breeze are recommended.

A definite separation between living room and kitchen is usually desired or appreciated. A door is generally wanted to keep small children under parental supervision and to isolate soot and cooking odors.

Various comments indicate that the main dwelling entrance is the rear or kitchen entrance. The dwelling is usually entered here rather than at the front. It is recommended that the dwelling be arranged to give convenient access from this entrance to laundry drying and garbage and refuse disposal points. Tenants object to crossing the living room to drying yard and garbage cans.

Activity conflicts occur frequently, laundry, indoor drying, food preparation and dining contributing most to the congestion. But in spite of this conflict, the kitchen still appears to be the chosen spot for dining, reasons given being convenience, and the opportunity of shutting off from view, dirty dishes or the family while eating.

A few comments deal with the relation of dwelling arrangement to site. Such comments, include consideration of the kitchen-service yard relationship, the proper placement of bedrooms for quiet, and the height of window sills for privacy from passers by.

A few comments indicate the possibility of additional or different room choice. Utility rooms are desired occasionally and one or two requests for basements are made.

Other comments include safety measures, stair placement, bathroom-bedroom relationship and porch location. Such comments occur infrequently because the problem is either unusual or has in general been solved satisfactorily.

CONCLUSION

The single conclusion which can be drawn from the report material is as follows: The particular pattern of living of the low income tenant needs clarification before the Federally financed dwelling can be satisfactorily designed. Such a clarification should include an inventory of tenant activities, possessions and equipment, and a consideration of the conditions which will effectuate a pleasant and efficient life. Any formulation of standards should permit adaptability to local climate and custom.

LIVING ROOM

STATEMENT OF PROBLEM

To tenants in public housing projects the living room is, in many respects, the least important room in the house. This is illustrated by the fact that almost all the traditional functions of the living room can be performed elsewhere in the low-rent dwelling with an equal or greater degree of convenience, except the reception and entertainment of callers and guests. Family sitting, reading, conversing, child study, infant play and housewife sewing, all apparently can, and do, take place as frequently in the kitchen or the bedroom as in the living room. Living room use is also limited by the fact that the housewife has less cleaning and straightening to do if the living room is reserved for special activities and not used more than necessary.

As a result of these circumstances, and because a low-income family cannot afford the furniture to fill a large living room, government public housing agencies have permitted living room areas which are small in comparison with those provided in privately constructed dwellings.

Present and past standards generally range in area from the equivalent of a rectangle 10'-6" by 15'-0" to the equivalent of a rectangle 11'-0" by 16'-0". These sizes are based on a two-bedroom dwelling and would tend to increase slightly with each bedroom added.

REPORT MATERIAL

On the basis of recent surveys, the following tenant reactions to the design of living rooms in existing projects can be noted:

(a) Larger floor area is not generally desired because a small room is easier to keep clean and

requires less furniture.

(b) Usual location between kitchen and stairs to second floor, and between front entrance and kitchen, results in the living room being crossed and recrossed by circulation having no connection with the rooms itself. Paths are worn on carpets and additional cleaning is necessary.

(c) A definite separation is desired between kitchen and living room by means of a partition. A door-sized opening in the partition is preferred to a larger one because kitchen sights, noise, and odors can thus be better controlled. The door itself, however, is in most cases not used when provided.

(d) A davenport, or convertible couch-bed, is very frequently found in living rooms for the accommodation of overnight guests.

CONCLUSIONS

The ideal living room of the low-income family would appear to be a relatively small space, perhaps no larger than 160 square feet for a 2-bedroom unit, which is easy to keep clean and attractive and which is so located that it can serve conveniently, upon occasion, as an extra bedroom.

If these requirements are important and are to be completely satisfied, the standard unit plan in which the stair runs perpendicularly to the point of the house along the wall between two adjacent dwelling

units will be less and less utilized in projects in the future. This plan, which is probably the most frequently used in American housing, requires the living room to be crossed diagonally in each trip between front entrance and kitchen and between kitchen and second floor, and to be crossed longitudinally in each trip between front entrance and coat closet.

Since the living room's only special uses are those of receiving and entertaining visitors and of providing additional sleeping space, more attention should apparently be paid to the design of the living room around these two special uses, and to the subordination of efforts to satisfy secondary uses which can be met by other rooms in the dwelling.

BEDROOMS

STATEMENT OF PROBLEM

Bedrooms in public projects are shaped according to the minimum sizes recommended in the FPHA Standards, 120 sq. ft. for the principal bedroom, 100 sq. ft. for secondary bedrooms and 70 sq. ft. for single person bedrooms. A minimum dimension of 7 ft. is recommended and a suggested list of necessary furniture is given together with suggested design sizes. The principal bedroom should accommodate twin beds and a child's crib. Standard closets are recommended for each bedroom. There are other factors in bedroom design which should also be given consideration. Quiet and privacy should be achieved in relating the bedroom to the rest of the dwelling and to the outside. Ventilation should be planned to give comfort and allow for proper placement of beds.

REPORT MATERIAL

Most objections to bedrooms are made on a basis of size. Even though inadequate space for the placement of beds can sometimes be blamed on poor placement of doors, windows and closets, still the situation is often undoubtedly the result of inadequate size. The extensive possession of double beds as indicated by several surveys does not necessarily represent a general preference for this kind of sleeping accommodation among low-income tenants. It may simply be the reflection of space provisions too limited to accommodate twin beds or of economy in the purchase of furniture. Space is wanted also for dressing, for other furniture and for a baby's crib.

Several comments indicate that though the bedroom is generally

designed to accomplish the purpose of its label, project tenants have found other uses for this space using it as a workshop, hobby and play room study, and sewing room.

A number of comments show up poor arrangement both within the bedroom itself and in its relation to the dwelling as a whole. Poor ventilation is the basis for much of this criticism. Sometimes such comments mean simply not enough windows but often the fault lies with poor window placement, with poor orientation for the prevailing breeze, or with lack of cross ventilation in the dwelling as a whole. Other comments show that bedrooms have not been designed for privacy and quiet. Such comments are based on the relation of the bedroom to other parts of the dwelling and to adjacent outdoor spaces.

CONCLUSIONS

The fact that tenants often use bedrooms for activities other than sleeping and dressing illustrates the possibility of actually designing this room for other uses. When used only for these two activities of sleeping and dressing, the bedroom remains unoccupied a large part of the day while other parts of the dwelling are congested by many activities.

The inadequacy in size of many bedrooms suggest a re-study of the space needed, such a study to be based not only on usual bedroom use, but also on other activities that might be satisfactorily accommodated here. An increase in size alone, however, without reference to proper placement of windows, spacing of beds, etc. will not insure good bedroom design. Some new method of presenting the standards should be found which covers arrangement considerations as well as sizes.

BATHROOM

STATEMENT OF PROBLEM

The bathroom has been generally fixed in size by the fixtures it holds. The five-foot bathtub fixes the width and the lavatory, water closet and width of the bathtub the other dimension which is approximately 7'-0". This area is satisfactory for usual uses. When other activities are introduced, such as child bathing, clothes washing and drying, soiled linen, etc., greater area is required. These desires are legitimate and should be considered in relation to the market served and to the benefits derived.

REPORT MATERIAL

The location of the bathroom at the head of the stair which starts at the front door is considered less desirable by some than the cross stair which starts between the kitchen and the living room and terminates on the second floor between the bathroom and the front bedroom, because of less danger to children and more privacy. Location is considered satisfactory from the standpoint of morning toilet and other activities in both schemes. The most desirable location in reference to the stair is not too apparent from comments received. The cross stair involves special structural framing for the stair well. It does create added privacy for the housewife in the kitchen and the activities on the second floor, but it also means crossing the living room from the front door to reach the stair. The direct stair from the front door to the second floor forms a stair well parallel to the usual construction framing methods, but the housewife must cross the living room to go from kitchen to the second floor.

Noise was objectionable where bathroom was located to back up the kitchen due to sound transmission to living room. Sound insulation for piping and walls and for medicine cabinets that back up to each other is desirable.

Size 5'x7', the usual minimum size in permanent, public-aided projects was somewhat reduced in war housing projects, depending on the equipment used, with approximately 24 sq. ft. as the smallest area. More floor area is desired by some than 35 sq. ft. in order to accommodate child bathing, baby dressing table and a clothes hamper.

Arrangement of toilet fixtures with the tub under the window which evolved through economical use of space and consolidation of plumbing lines along a single wall is objected to because of difficult access by short persons for window adjustment.

Showers are generally preferred by men: in the summer by some women. Tubs are generally preferred by women and mothers with young children. This involves a consideration of added cost of shower, a satisfactory tub hanger and type of wall construction and finish.

Details for technicians consist of items of good practice, some of which follow: (not all suggestions are listed as some are not considered practical)

Accessories

Curtain rod for showers should be provided because of water damage to floor.

Shelving is desired.

Water closet seats and covers should be supplied.

Flush tanks are preferred to flush valves on water closets because of noise.

Grab bars should be provided in showers, breast high because of danger of slipping

Bathtubs with flat tops for seat space (sits bath for older people) should be selected.

Grips of metal instead of glass, due to danger from breakage.

Locks on bathroom door should be placed out of reach of children or be self-unlocking.

Soap dish should drain to conserve soap and for ease of cleaning.

Towel rails should be non-slip, to hold towels.

Toilet paper holders should accommodate the largest size roll.

Accessories should be project installed by contractor in order to avoid patching due to lack of tenant skill.

Medicine cabinet should be larger.

Finishes - (more complete discussion under finishes)

Ceramic or mastic tile preferred for floors. Good oil or enamel two-coat paint job will stand up under bathroom activities.

CONCLUSIONS

Any reduction of the bathroom area from pre-war minimum standards induced by war limitations was found unsatisfactory, in fact, an increase is desired by some tenants.

Noise insulation is desirable and should be explored to find the most effective and inexpensive methods. Recommend study sound-proofing of partitions for specific uses and functions.

Size increase affects capital costs or a reduction of ad-

jacent room areas. In reference to the market for public housing, the bathroom minimum size in permanent projects is relatively satisfactory and no important changes appear justified.

Arrangement of fixtures to avoid the tub under the window would very likely result in a greater floor area and less efficient plumbing layout with either increased capital cost or a reduction of adjacent rooms. However, it should be done wherever possible without increasing capital costs.

Showers - tub-shower combination should be installed, the bath shower concealed combination spout type. Research and study for simplified and lower cost bathroom fixture assemblies should be conducted. As a long range program, in cooperation with industry, the design and investigation of a fixture combining all or part of the fixtures into a simplified low cost product might be a desirable objective, accompanied by acceptable adjustments of codes, trades, and others.

Details for technicians are self-evident and their acceptance rest on judgment, good practice, cost limitations, and local habits and usage.

KITCHEN

STATEMENT OF PROBLEM

For tenants of public low-rent housing projects, the kitchen is the center of family life. The housewife spends most of her time there, and many activities not ordinarily associated with the kitchen take place there. Practically all families prefer dining in the kitchen to dining in the living room, and a large percentage are believed to prefer kitchen dining to any other dining arrangement at all. Clothes washing, drying and ironing usually take place in the kitchen because the combination sink and laundry tray (with removable drainboard) has, for years, been the standard laundry fixture associated with minimum dwelling cost.

Besides the major functions of cooking, dining and laundering, the kitchen also frequently accommodates children's homework, infants' indoor play, and housewives' sewing. A large percentage of mothers apparently bathe their babies in the combination sink and tray fixture.

Since most projects have no basement, and since the kitchen has the advantages of good lighting, easily cleanable floor, direct access to out-of-doors, and nearness to storage space, the room also serves more frequently than other rooms in the house as a workshop for the husband and as a center of children's hobbies.

The size and shape of the kitchens which planners have provided to accommodate these many activities vary quite widely with different types of dwellings, with different sections of the country, and with the different agencies of the Government through whom the projects were developed. In general, however, the floor area allo-

cated to food preparation, dishwashing and laundering is equivalent to a space 10 feet long by 6 feet wide, and is usually supplemented by from 40 to 70 sq. ft. of additional area if the room is arranged for dining. The above measurements would apply generally to 2-bedroom units and would increase with the number of bedrooms.

Kitchen equipment and finish throughout publicly-aided projects have been more uniform than kitchen size and shape. In addition to the sink and tray combination fixture, equipment usually consists of a mechanical refrigerator, gas or electric range, work table, base cabinet, and shelves over the fixtures for dishes and foods. Generally in housing constructed during the emergency, ice boxes were installed instead of mechanical refrigerators, and ranges using coal instead of those using gas or electricity. In permanently built dwellings, a portion of the shelves are supplied with doors. A large closet or small utility room is usually adjacent. Floors are either linoleum or asphalt tile. Walls are smooth plaster with three coats of lead-in-oil paint.

REPORT MATERIAL

Preliminary information from project managers and others would appear to indicate the following in regard to the adequacy of past standards of kitchen design:

a. Except in projects located in the Southern states, in large city apartment projects and in one-bedroom accommodations, housewives find that the combination sink and tray fixture is inconvenient for laundry washing, and the adjacent kitchen space is inadequate for drying and ironing. The reasons for this general

tenant reaction (and for the exceptions to it) are discussed elsewhere under LAUNDRY FACILITIES.

b. Dining in the kitchen, if enough space is allowed, appears never to be seriously criticized by tenants.

c. More storage and shelf space is usually requested, especially for objects and equipment connected with laundry work. Frequently more shelving is desired enclosed with doors.

CONCLUSIONS

Inadequacies in present standards, when they occur, are due most often to the fact that the kitchen is used for more different kinds of activities than any other room in the dwelling, and is consequently more susceptible than other rooms to inconvenience and congestion. Tenant surveys show that laundry work accommodates itself very poorly to present kitchen space and equipment provisions and, ideally speaking, should be assigned elsewhere in future projects. Therefore, if methods can be developed to accomplish this objective within a minimum construction budget, one of the major causes of present difficulties will be removed. Most of the remaining activities, such as dining, child study, infant play, and housewife sewing, have more or less harmonious space and equipment requirements, and can apparently be accommodated together with very little change in present standards.

LAUNDRY

STATEMENT OF PROBLEM

To tenants in publicly-aided housing developments, the cost of sending soiled clothes to commercial laundries generally is prohibitive. In any case, where there are small children, washing usually must be done daily, or at least several times a week. For these reasons, provision for clothes washing and drying and ironing is important in dwelling and site design.

In both pre-war and war housing, these functions have been provided for, - either on an individual family or group basis, - with varying degrees of satisfaction - depending on the dwelling type, the particular plan, the characteristics of the tenants, and climate.

In apartment houses, group laundries generally are provided. They contain laundry trays, usually ironing boards, sometimes washing machines, and occasionally hot plates for boiling clothes. Indoor drying facilities often are included, occasionally with special heating. There may be exterior drying space as well, or exterior drying space only.

Often apartment units are also provided with individual facilities consisting of a sink and small laundry tray combination in the kitchen. These facilities are usual, without group laundries, in houses and flats. Very occasionally an individual family utility room (which is fairly usual, without running water) contains running water and laundry trays. Laundry trays in individual basements (which themselves are unusual in public housing developments) are still more infrequent. Outside drying may be individual or group. Indoor drying must be taken care of in laundry space or other rooms within the dwelling unit.

The importance of the effect of climate and atmospheric conditions on the laundry function apparently has not been given adequate consideration in many cases. In planning both group and individual facilities, there often has been lack of understanding of the relationship of the laundry functions to other household functions: In the case of group facilities, for example, facilities have not usually been such that laundry functions and child care can be satisfactorily carried on together. In the case of individual facilities, with the laundry tray in the kitchen, there has been conflict with other kitchen functions - not only cooking, but also other household activities such as dining, study, children's play, hobbies, and social activities. In those few cases where utility room laundries have been provided, satisfaction has usually been greater; but here too, improvements have been asked for, especially with regard to provision of adequate facilities for both laundry and general storage needs.

There sometimes has been an unsatisfactory relationship between individual laundry space and other parts of the dwelling unit, as well as between laundry space and exterior drying yards and recreation space.

Design problems in connection with drying include: interior vs. exterior space: individual vs. group space; location and surfacing of yards; type of lines; fencing.

Laundry facilities provided in war housing are similar to those of pre-war practice. However, problems have been intensified somewhat because probably even more clothes washing than formerly has been done by housewives, as a result of the burdening of commercial facilities; and normal schedules for group washing and/or drying often have broken down

because more women have been working. Occasionally equipment in war housing developments, has been less adequate, than in pre-war developments, due to wartime restrictions or economy; and sometimes less individual drying space has been available because of restricted site layout, resulting from economy in utilities.

The most significant comments in the reports gathered are summarized below.

REPORT MATERIAL

Group Laundry and Indoor Drying

In some developments where group laundries are found generally satisfactory, the carrying of heavy clothes, especially up and down stairs, is objected to. (A dumb waiter to the basement laundry and from the laundry to a drying roof, is a suggested remedy).

Group laundries in basements are reported well placed in one 200-unit development, where there are 6 laundries with 4 tubs and 3 dryers in each. It is suggested that one additional laundry with 2 sets of trays is needed.

Group laundries are reported difficult to supervise, especially when they must be open at night, since children like to play in them. Although they are a problem to management, one specialist believes group laundries would be popular with tenants everywhere, and particularly where indoor drying facilities are important. It is stated, however, that adequate individual utility rooms supplied with water would be an acceptable substitute.

Basements are reported inadequate for drying unless they are provided with fan ventilation and special heating in summer. In one apartment project, overhead heating in a basement laundry does not dry clothes - but

heats the apartment above.

There are suggestions for modified group laundries - one specialist suggesting a combination laundry-drying-storage space for use by 2 dwelling units; and one manager suggesting that every building containing more than 4 families be provided with a laundry to be used by the whole building (to the end that better laundry facilities be provided than would be feasible for each individual family and the total space allocated to each dwelling unit reduced).

Individual Laundry Equipment

In one survey, 28 out of 30 tenants preferred individual laundry equipment because (among other reasons already mentioned above) they can't leave the baby alone to go to a group laundry, and in the group laundry they have to clean up after someone else. However, laundry done in the kitchen causes vapor, wet floors, contamination of food by spray, clutter and interference with other kitchen activities. Furthermore, one laundry tray is not enough even for a small wash, and the size of kitchens and utility rooms is reported as unsatisfactory with relation to provision for laundry. The need for more space is emphasized where tenants own washing machines, (which in any case, they object to storing in plain view in the kitchen), and where climate or atmospheric conditions make indoor drying a necessity. (For example, in one area only about 100 days out of the year are satisfactory for clothes drying out of doors; in others, the air is smoky; in still others, project incinerators cause objectionable soot.) In many USHA-aided developments, tenants dry clothes over the tub in the bathroom rather than in their kitchens. In some of the war projects with smaller bathrooms, other rooms besides the kitchen and bathrooms are used. Drying in the kitchen is considered objectionable.

(diapers are especially mentioned in this respect), since there is no other place to use as a center for housework or for hobbies.

One specialist states that the general preference for dining in the kitchen makes a new solution to the laundry problem imperative. The possibility of a utility room with running water and space for drying already has been mentioned. It is suggested that such a room open outdoors and into the kitchen or hall. (Location of utility rooms in existing developments - usually without running water, and generally with inadequate space for drying - is reported as varying from unsatisfactory to fairly good). Another suggested solution is a "bathroom-laundry". For indoor drying, ceiling racks are suggested, as well as whirligig dryers (apparently for use in utility rooms).

Storage of soiled clothes sometimes is a problem. One report indicates that the utility closet occasionally is used for this.

Ironing

Although ironing boards are provided in group laundry rooms, most women prefer to iron at home, and with layouts as they are at present, in the kitchen. Space is needed for second drying of clothes after ironing.

Need for Consistency in Planning

The necessity for adequate ventilation and heating of basement drying spaces, mentioned above, is one example of the need for carrying through the details which will make a given plan workable. Thus, another report speaks of basement laundries which are not used because of lack of drains. In one project, an individual "washhouse" is provided for each family, on the entrance porch, with a separate entrance from the yard. But it is not large enough for a washing machine, there is no drain, and the

hot water has to be turned on outside. As a result, this "washhouse" generally is used for storage of wheeled toys, etc. Although it is satisfactory for this, it is a source of irritation, since it does not serve the purpose for which it was intended. in this way, small economies or careless planning can completely nullify far larger initial expenditure.

Drying Yards - Location and Type

One Report from a Region with moderate climate, recommends that all projects be provided with outdoor drying facilities, stating that this would save on indoor drying equipment. Separated individual drying lines are reported as the best solution. Laundry yards placed in generally central positions are reported as unsatisfactory because of their prominence, and unfenced yards are used as playgrounds by children. (Fenced yards with a minimum number of gates are recommended, although certain types of fencing are objected to by tenants because they make the yard "seem" shady - even though clotheslines do get the sun). If group lines are used, they should be adequate to permit a reasonable schedule, probably with leeway for disruption caused by personal emergencies or unusual weather conditions: Lines are reported as insufficient in one project where for each building of 8 units, there are only 4 lines, eadh 24' long. In one trailer project, group yards adjacent to the trailers were so inadequate that they have been abolished, and posts set every 50' between the trailer rows with cross-arms for 2 lines. These are fairly satisfactory. One specialist recommends posts with arms, and lines from these to hooks on the house. Lines should not be so close as to prevent clothes from drying (8' is reported as too close), or so long as to sag, (35' lines are reported as sagging). Posts set too near service drives frequently are damaggd.

Drying Yards - Surfacing

Not only general and local atmospheric conditions, but unsatisfactory surfacing, grading and drainage or drying yards cause soiling of clothes on the lines. In one project, mud and dirt (as well as soot) force tenants to dry clothes indoors. Grass-surfaced yards are reported as unsatisfactory: Gravel surface or duck-walks are suggested. Where lines are too close to street, clothes are splattered by passing vehicles.

Relation of Dwelling Layout to Site Plan

The relation of indoor to outdoor circulation frequently is unsatisfactory. For example, where dwellings have theoretical laundry yards at the "back", but kitchen and utility rooms are on the front, either housewives hang out clothes on that side, or else wet clothes must be carried across the living room.

CONCLUSIONS

A fresh approach is required which recognizes that clothes washing is usually a major household function for the low and medium income family, and that reasonably comfortable provision for this function cannot be considered a "frill". Such provision may, in fact, allow overall economy - as for example, in making the dining-kitchen a satisfactory plan solution. Furthermore, it must be recognized that a large proportion of low-income public housing tenants are very likely to own washing machines. On the other hand, this does not mean that they will be of the "under-the-counter, streamlined,-X-day" variety featured in magazine advertisements, which can be satisfactorily stowed in the kitchen.

All of the solutions suggested in the report material should be given careful consideration. They may require further opinion-surveys or plan studies. The possibilities of the fully equipped utility room should be explored, in connection with a study of storage needs. The bathroom-laundry should also be investigated, perhaps with special reference to apartment units. On the other hand the possibilities of the group laundry should not be neglected. Experience shows that the group laundry is not likely to be a success unless it furnishes more complete facilities than can be provided for the individual family; but this might well be done with costs under those required to supply satisfactory individual laundries. For example, an adequate number of washing machines and heated dryers would accelerate the use schedule. It seems likely that if there are definite advantages to the tenant in the group laundry facilities, there will be less difficulty in relation to their maintenance by the tenants. However, as with other group facilities, it is probable that not only is management attitude important, but that such facilities have to be ready for use by the tenants as soon as they move into the project as a cooperative extension of the individual dwelling unit.

Included in a study of group laundries, should be that of the possible provision of play space nearby (interior and exterior, supervised or unsupervised). The use of dumb-waiters to carry laundry should be studied, as well as the possibility of some kind of carrying service for clothes - possibly on a tenant cooperative basis.

It is noteworthy that the laundry tray in the kitchen seems to have proved generally satisfactory only in the three types of units mentioned below. (These are not reported on in the survey material

gathered). One is the large-city apartment. In this case the satisfaction may result from the fact that group facilities often are provided, as well: or else it may be that commercial facilities are more widely used here than elsewhere. Possibly, also, there is a larger proportion of white-collar workers in the large-city developments than elsewhere, and therefore there are fewer heavy work-clothes to be washed. The second dwelling type for which the laundry-tray seems adequate also, is 0-bedroom and 1-bedroom unit, in all parts of the country. In general, the 2-person families which use these units do not include a child, and have less laundry than families with children. In the third instance, in the South, very often the laundry-tray arrangement simply is ignored, in favor of the time-honored custom of a pot over a fire in the backyard. Here, local customs have not been sufficiently studied. It may have been thought that the laundry-tray offered a preferable alternative. But since its inadequacy has been shown up in other parts of the country, it would be well either to accept the possibilities of economy offered by the customary way of washing clothes, or else be sure that the substitute provided is preferable to those for whom it is intended.

To sum up: Provision for clothes washing, drying, and ironing is exceedingly important in housing for low and medium income groups; and in relation to this as well as other planning factors, we must work on the basis of the specific needs of the families to be served. Meeting these needs in ways which make use of economically feasible present-day possibilities should not mean interference with the living patterns these families prefer to follow.

STORAGE

STATEMENT OF PROBLEM

The storage problem starts with an investigation of those articles to be provided for. First to be considered are those articles that we can predict are in the possession of all tenants, and a further allowance should be made for other articles of more specialized use. In this statement, whether made by designer, builder, or agency, lies the first responsibility toward a successful solution. Next there is the determination of storage spaces - size, shape, location, accessibility, provision for specific articles, combination or conflict with other household activities.

REPORT MATERIAL

One of the most frequent reports of inadequacy within the dwelling unit is that of storage; and space for general storage, (i.e. trunks, washing, cleaning and maintenance and garden equipment, toys, perambulators, extra clothes and blanket storage.) Such comments comprise nearly 75% of all those received on this subject. Of these comments, about 48% are complaints of inadequate size. Prewar, war permanent and demountable housing standards state with minor qualifications for general storage 30 sq. ft., bedroom closets 4 sq. ft. per person, and linen closets 14"x20". Where these standards were met, there was less dissatisfaction, but the limited space of temporary standards and its almost complete lack in trailers was endured by tenants only as a wartime necessity.

Recommendations have been made for storage under buildings, located near entrances, or for some provision for outdoor articles. This has been strongly stated. Some suggestions were made that space

be provided to accommodate separate articles where they are needed, others, compromising on one centrally located space. Accessibility has also come to be an important consideration: The depth and shape of closets, outfitting with shelves, hooks and doors in certain cases and avoidance of conflict with kitchen, laundry and heating equipment and activities involved.

CONCLUSIONS

Nearly all these diverse comments and suggestions may be resolved in the statement: That storage is successfully handled when adequate space for indispensible articles is provided with protection, accessibility and within a reasonable distance from the place of use. There has been little contribution made by war housing to the solution of storage problems, certainly not in its decrease of space; but on the basis of these complaints and suggestions, renewed study and re-analysis will be profitable. One procedure followed in a few projects which may be considered an advance is the provision of utility closets for inside and outside use.

SITE SELECTION

STATEMENT OF PROBLEM

All proposed sites are analyzed and compared on the basis of the following factors. These relate to the characteristics of the site itself, those of the surrounding areas, and the relation of the site to other areas and facilities of the city as a whole--both existing and future:

Physical characteristics of the site - desirable and undesirable - both existing and potential.

Advantages and hazards of immediate surroundings

Character and availability of utilities, streets and city services, and/or cost of making them available.

Continuity, stability and diversity of available accessible employment.

Accessibility and adequacy of existing and potential civic, social and commercial facilities - including commercial and community recreation, schools, shopping, etc. (Consideration of accessibility must include not only actual distance and topographical and physical barriers, but also social - e.g. racial, economic - barriers.

Potential facilities must of course be considered in terms of <u>when</u> they will be supplied. Consideration of facilities that are not available or likely to be supplied off the site must include possible provision on the site.

- - See Site Development, Playgrounds)

Conformance with and effect on city development (including existing and probably future city and regional pattern, land use, building codes, population characteristics).

Determination of amount of land required for optimum density for the site - with consideration of physical features of site and character of surroundings.

Need and possibility of relocation of families living on the site.

Ease of land acquisition, length of time required for acquisition.

The urgent need for war housing often intensified divergent objectives, such as: - proximity to employment vs. safety from hazard (bombing); and, in the case of plants in the field, proximity of employment vs. availability of utilities and civic, social and commercial facilities (while costs in time, men and materials required to supply them whre of especial importance). Furthermore, the swelling of population in war centers due to in-migrant families overburdened facilities and municipal services.

REPORT MATERIAL

Projects should not be adjacent to city dumps, raillines or spurs, dangerous highways, oil refineries or chemical plants.

Poor soil condition; excessive ground settlement.

Smells, soot, slaughter-pen nuisance, etc.

Topography: if grade is steep, objection to climbing with small children and packages.

No apparent relation of site to work, shopping and schools.

Schools overcrowded: discrimination by other children against project children.

Site selection excellent - all community facilities within 1-mile radius.

Transportation poor.

Site is limited by existing street pattern.

Adjacent areas should be protected from encroachment of undesirable uses.

Bombing hazard: site too close to plant.

Basically bad choice of site and site design has resulted in an antagonistic attitude on the part of tenants and lowering of their morale.

No community facilities: Probably not feasible for such a small project (100 units), and probably not necessary in this location - mile from center of town of 12,000.

CONCLUSION

In general, the objections reported do not apply to permanent USHA aided projects. The considerations for site selection apparently cover all important factors. However when sites are confirmed for purchase limitations are known and all possible devices, both legal and planning are utilized for their circumvention.

City and regional patterns are often difficult to ascertain because of the lack of a qualified or implemented planning agency. Land use and building laws and codes are generally obsolete and restrictive, and hamper application of advanced, economical planning techniques, especially with respect to large scale development or redevelopment.

A legislative research program which would assist in keeping

municipal codes abreast of technical advances is desirable. This might include development of techniques for determining and establishing satisfactory and desirable land use patterns for municipalities and their regions, and related fiscal studies, as well as studies directed specifically toward the development and application of modern standards of planning and construction. Such research should result in benefit both to municipal bodies and to the building industry as a whole.

It may be impossible to approach such desirable patterns based on a proper proportioning of open spaces (for public use), buildings, (densities, coverages and types) traffic and parking in relatively high land cost areas without assistance, Federal, State or local. Such desirable open spaces imply buffer green belts or strips along a heavy traffic artery, the decreasing of the number of families per acre, the reservation or addition to public and semi-public buildings and land used for safety belts for human circulation. Such a method of land use would admit sunshine, air and planting, permit residential character and scale, give much greater flexibility to planning and assure appreciation and the permanence of the neighborhood.

A study of the degree of assistance as related to various levels of land costs would be most desirable to cities of all sizes in order to examine the cost factors entering into the stabilization of the decentralization movement from cities.

DWELLING TYPES AND PLACEMENT

STATEMENT OF PROBLEM

A list of dwellings used in public housing includes the following types: one and two-story single, double and row houses; 2-story flats; and apartments - usually three but occasionally six, eight or more stories in height. Also in use were dormitories and trailers. In some cases there were types combining flats with row house units; four-leaf clover schemes where dwelling units radiated from centralized utilities for kitchens and baths.

Each of the above dwelling types has, by its characteristics, particular advantages, and is used when its advantages coincide with the conditions and requirements of a certain project. Such a condition determining the use of dwelling types and their placement might be density, i.e. number of families per acre. High land costs dictate high densities and coverage and row, three-story flats and apartment buildings may be selected; low land costs will allow low density and low coverage, limited only by utility and site improvement costs. In these cases, row, double and single houses, often one-story, may be expected. Another condition determining the use of types is the prevalence of certain existing type in a locality or neighborhood. Row houses are acceptable in some eastern cities by precedent, city code and existing pattern but may be foreign to other sections of the country, restricting its use to zones of multiple family dwelling or only as temporary housing. Still other factors may be topography, soil conditions, tree growth, and perhaps the type of characteristics of the families to be housed. In dealing in the placement of buildings alone, there are the additional considerations of orientation to sun, wind and view; the

site plan as a whole as a functional and comprehensible unit, and pleasant effect of building masses.

REPORT MATERIAL

From the body of material received, in most cases from management, there is little comment on the subject of building types. The strongest feeling among tenants is their preference for individual houses. Semi-detached or double houses where generously used were liked. Row houses in many cases resembled barracks, their length usually offensive, and it has been suggested that row houses be limited to four units in length. In one case, however, tenants who first were forced into row houses due to housing shortage, have stated they now prefer them.

On the matter of building placement, most dissatisfaction was felt from regularity and parallelism, "boxy and choppy effect", monotony of too often repeated building types, buildings aligning with "gridiron" street patterns. In support of these same statements, on the other hand, are comments in appreciation of the variation in size and placement of buildings, the practical and pleasant manner in which houses follow natural land contours, and the recommendation that mixed building types be encouraged. Projects have, though, been laid out with such variety in building type and placement as to have no recognizable order whatsoever.

From project managers comes dissatisfaction with low densities and coverage. The point made is that large open spaces are wasteful, raise maintenance costs, and give projects the appearance of disorganization. In most cases, low densities have definitely been a pleasant feature of the project. The feeling of spaciousness

can and has been achieved by skillful placement of buildings.

Good reports have been received on the use of buildings facing inward or a protective device for the project against disagreeable surrounding conditions. Generally, favorable comments on orientations for sun, wind, and view were included; adverse criticism of buildings located near side to front side, with disagreeable aspects (that side devoted to deliveries, disposal, laundry) facing the street; and for the safety of children, houses too near to streets of heavier traffic.

CONCLUSIONS

The preference for certain building types must be received with some reservation. The desire for individual houses among American people is legitimate and sincere, though in many cases it has been a misinterpretation of the security and individuality they had hoped for. Where land costs are high and detached dwellings are impracticable, these desires cannot be satisfied. The problem then is transferred to one of lowering land costs or more thoughtful design of those necessary building types. An insistance on detached dwellings in such a case would simply mean the sacrifice of other amenities under a limited development cost budget. The balance of dwelling and site amenities is a delicate thing to work out. Although it will be a problem of constant investigation and research, it is believed that existing housing standards have met this problem fairly well.

It may be found that certain dwelling types are more suited to families of particular size and composition. Once this correlation

of building and family types is established, the matter of building placement comes to be affected by the sociological desirability. Families, for example, with children should be provided with safe and direct access to schools and play areas. In apartment buildings where proximity among tenants is necessarily greater and more continuous than in row, double and single houses, older people are often annoyed by the noise and disorder which children may create. A great many dissatisfactions with the building types and their placement, if not dealt with by providing other types or more land, can perhaps be solved by better design. The comments mentioned in the report material such as: buildings too near streets for childrens' safety, placement of buildings front to back or disagreeable side to street, can and perhaps must be solved by proper planning of these outside areas.

It is recommended in housing standards that dwelling types be chosen to conform to those already existing in that neighborhood. In view of certain failures in this regard, its importance is here emphasized with the further suggestion that future developments be integrated with any master plan and the developments therein anticipated. Furthermore, that comprehensive studies be made including both surveys and design research; that codes governing dwelling types, their combinations, net and gross densities and coverage be reinvestigated so that in the continuation of housing, building types may be used more intelligently and to greater advantage.

It may be impossible to approach such desirable patterns based on a proper proportioning of open spaces (for public use), buildings, (densities, coverages and types) traffic and parking in relatively

high land cost areas without assistance, Federal, State or local. Such desirable open spaces imply buffer green belts or strips along a heavy traffic artery, the decreasing of the number of families per acre, the reservation or addition to public and semi-public buildings and land used for safety belts for human circulation. Such a method of land use would admit sunshine, air and planting, permit residential character and scale, give much greater flexibility to planning and assure appreciation and the permanence of the neighborhood.

A study of the degree of assistance as related to various levels of land costs would be most desirable to cities of all sizes in order to examine the cost factors entering into the stabilization of the decentralization movement from cities.

ORIENTATION FOR INSOLATION, GLARE, DAYLIGHT AND THERMAL PROTECTION

STATEMENT OF PROBLEM

In recent years, more interest has been displayed on the part of pioneer planners in orientation for insolation. Companion considerations are daylight, glare and thermal protection. The variation of solar radiation due to the declination of the earth's axis effects life and living through its relation to the dwelling unit. The problem then is planning with these considerations in mind in addition to the other factors that determine the placement and design of dwellings.

REPORT MATERIAL

Only one report suggested comprehensive investigation of planning techniques in this field of orientation relative to improvement of future housing. This report recommends that the findings should be embodied in rather comprehensive guide material calculated to promote the best practices considering the structure, the thermal qualities of boundary surfaces, and the heating system, all in their combined effect. It calls for concerted efforts in mechanical, structural, architectural, engineering and site planning and advice from public health and management sources. Operating conditions and methods should be considered as well as design.

CONCLUSIONS

It is proposed to study and report on the foregoing with collaboration of all interested personnel and organizations. Some of the bulletins may suggest devices for the measure of daylight in relation to glass areas and the effect of their proportions on rooms of different sizes. Glare and the mechanical methods of control, etc. would also be considered. Orientation for insolation should be analyzed giving an

explanation of the phenonemon of the variation of the path and angle of the sun and a description of methods of estimation for all latitudes and longitudes. The technical application of these considerations to planning problems, the spacing of buildings and the site plan in general should be made clear.

Such information will give to planners a sound basis of knowledge to use as a tool in site and dwelling design.

STREETS

STATEMENT OF PROBLEM

Streets are one of the primary design components of which the site plan is formed. The character of the street pattern is influenced by many considerations: building placement, topography, proposed method of dwelling servicing, utility systems, fire protection, parking and the maneuverability of the automobile itself. Beyond this there is the important relationship of project to offsite neighborhood. Many of these influences are considered in the FPHA Standards. Maximum distance from dwelling to street, minimum widths for streets of different purposes, fire protection and project access are dealt with and recommendations made. The super-block system of street design is suggested for use wherever practicable.

Public projects have in general been based on these standards. Super-blocks are often used, with narrow roads "loop" streets and cul-de-sacs as minor streets or service drives. Service drives have sometimes been omitted as an economy measure. The trend on the whole has been away from direct motor access from street to dwelling.

REPORT MATERIAL

Comments pertaining to width form the most frequent criticism of streets. When street widths are not correct it is usually because the actual use of the street has not been anticipated. Thus 9-foot service drives, though intended for one way traffic only, are inefficient. Cars are parked, leaving no room for passage. Inadequate street width encourages driving on lawns which means the ruin of grass and planting and the resulting maintenance problems. On the other hand, streets that are too wide attract fast and off-project traffic.

Lack of service drives is a point against which much criticism is aimed. It is difficult to service the dwelling, particularly where coal is used, but also for deliveries of ice, milk and furniture. In addition to the inconvenience involved, lawns and planting are sure to be damaged.

Several comments are concerned with safety. Avoidance of surplus width and the use of the super-block are recommended as means of discouraging fast traffic. The elimination of sharp curves that cut off vision is proposed.

Complication of the circulation makes it difficult to find the way around the project, for tenants as well as visitors and should be avoided.

CONCLUSIONS

Conditions in the report material show the necessity for a careful analysis of intended use before determining street widths. It is inefficient and expensive to attempt to remedy such mistakes by signs or management policing. The omission of service drives, as an economy measure has not proved successful. The standards seem adequate as far as they go. Standards, in any case, cannot insure a good solution because they cannot anticipate all the varying conditions and purposes involved in the design of any particular project. Standards should however bring into focus these factors and clarify the conditions for their successful relationship.

Beyond the obvious purpose of streets of providing convenient motor circulation, there is a further and important function, that of giving integration and clarity to the project. To a large extent, it is the street pattern by which the project, with its various parts, is ultimately understood.

WALKS

STATEMENT OF PROBLEM

The problem of project walks is necessarily subordinate to general site design, the placement of buildings and roads and the proposed system of dwelling servicing. Once these elements have been established, the walks are designed to provide circulation between dwellings and between dwellings and streets, parking areas and community facilities. Protection to lawns and planting with the resulting benefits of reduced maintenance cost are included in this main purpose.

Walks in most public projects have been based upon standards formulated by FPHA and its predecessors. These standards recommend a 4-5 foot minimum width for public walks. Both front and rear walks are suggested for row houses, with a 2-foot minimum width. Walks on both sides of the street are usually recommended, and general principles involving servicing of dwellings, and tenant comfort are outlined.

Systems naturally vary with each site plan. In general, however, they follow the recommendations made in the standards. Walks at the rear, parallel to the dwelling are sometimes placed at the end of tenant yards and sometimes close to the building wall. During the War, walks at various points have been omitted due to cost limitations, especially walks occurring on the side of the dwelling opposite to the direction of motor access.

REPORT MATERIAL

The report comments on walks are fairly evenly divided between those which deal with the circulation pattern and those which deal with the design of the walks themselves.

Circulation should be anticipated and the route of paths made as direct as possible. Omitted or indirect walks mean the destruction of lawns and planting and a resulting maintenance problem, especially where service drives are omitted or are far away from the dwellings. Walks are also a favorite play space for wheel toys. When omitted children will play in the street. Walks are recommended on both sides of the street and at both front and rear of the dwelling unit.

Comments on the design of the walks themselves are also directed toward ease of circulation and the protection of lawns and planting. Inadequate width is a frequent criticism. A minimum width of 5 feet is usually suggested, to allow for passage of people, baby carriages and bicycles. Several reports recommend that intersections should be curved or at a 45° angle. Raising walks above lawn level is a further means of lawn protection.

CONCLUSIONS

Where the design of walks has been based upon the requisites of direct circulation and lawn protection, solutions have been satisfactory. It is only where an arbitrary pattern has been imposed, where attention to details has been neglected and where walks have been omitted that difficulties arise. The standards in general seem adequate. The omission of walks as an economy measure is a fallacy. Maintenance costs go up and the walks generally have to be installed in the end.

Several comments indicate the possibility that walks can go beyond these primary functions and help give the project a sense of space, unity of design and comprehensibility.

Although the report material shows unanimous agreement on the desirability of walks along streets, this subject has in general been considered from the point of view of grounds maintenance. Additional study should be done to determine whether or not safety is also encouraged by the inclusion of street sidewalks.

PARKING

STATEMENT OF PROBLEM

The first step in the solution of the parking problem is the determination of the number of cars to be parked. Car ownership has increased rapidly over the past decade and will most probably continue to do so, so that it may be advisable to anticipate 100% eventual car possession though that may not be the case at the time the project is designed. Such a recommendation is made in the FPHA Standards. Parking provisions should also be made for visitors and dwelling servicing.

Next the choice of parking system must be made, keeping in mind the relation of parking areas to dwellings, tenant yards and street pattern. In public projects the choice is often shaped by a compromise between considerations of convenience and capital cost. The systems most frequently used are as follows:

1. On-street parking is cheap and sometimes convenient but has the disadvantages of street congestion, unsightliness, inconvenience of car washing and repair, and the increased possibility of theft. Not recommended by FPHA Standards.
2. Centralized parking lots are also cheap but are inconvenient in a project of any size. Not recommended by FPHA Standards.
3. Off-Street parking bays are more expensive because of added street length and curbing but are satisfactory where adequately proportioned and not too distant from the dwellings they serve. They are recommended by FPHA for use with row and apartment houses, to accommodate

no more than 10 cars.

4. Stub parking in or adjacent to each tenant yard is the most expensive and the most desirable system. It is recommended by FPHA, particularly for use with single or twin houses.

FPHA also recommended at one time that provision be made for the future construction of garages. People on the whole seem convinced that cars are unsightly. Therefore, whatever system is used, the cars should be in some way shielded from dwellings. Parking bays should not be parallel to row houses.

REPORT MATERIAL

Parking lots are often criticized for inadequate size. This is due largely to faulty estimates of car ownership. 60%, 90% and 100% are variously estimated as the number of tenant families owning cars for which parking should be provided.

The report material shows definitely that tenants like to park their cars near the dwelling. Several comments state that even where adequate parking is provided tenants often ignore these facilities preferring to park close to their dwellings. This is not only for the sake of convenience but also to discourage theft. This has been particularly true during the war period when automobiles and parts are unusually valuable. For this reason as well as protection from weather garages are frequently requested. The suggestion is made that where it is impossible to build garages at the start, provision should be made for their future installation.

Centralized parking seems to be disliked, but smaller parking lots scattered throughout the project are not objected to when adequate in size

and not too distant from dwellings. Distances from 200 to 300 feet are variously recommended as the maximum. Tenants refuse to walk long distances. Where parking is too far away they simply park by their dwellings often creating a maintenance problem by the destruction of lawns.

Several comments point to the fact that parking has not always been considered in determining street widths. This seems to indicate that even where off-street parking is adequate, streets should be wide enough at least in places, for parking of tenants, guests and delivery wagons.

Other comments point out the danger to lawns and planting of insufficient definition of parking areas. Curbs should be provided.

CONCLUSIONS

Considering the standards and report material together it seems evident that most dissatisfaction arises when the standards are not adhered to. The distance that tenants will walk to and from parking spaces is still undefined. While a large number of comments imply that tenants insist on having their cars on or adjacent to their yards, this may be due largely to the increased valuation put on their cars, as stimulated by war shortages. This feeling may be diminished or disappear when cars and parts are once more available.

Further study should also be undertaken to determine best widths for parked cars, size and shape required for getting in and out of a parking space, and the relation of parking to streets, walks, dwellings and tenant yards.

PLAYGROUNDS

STATEMENT OF PROBLEM

The inclusion of playgrounds and children's play space is particularly necessary in the public project because of limited dwelling size with little space for child play. Playgrounds can supplement this home space and thus help relieve the tensions which are apt to arise when a family lives together in a very small space. Playgrounds concentrate noise and minimize the burden on maintenance.

The space given to playgrounds should be considered in determining the proposed density of any project. In aportioning this space over the project area, consideration should be given to the different age groups and the amount and kind of space necessary for each. For older children, a large and unencumbered space is desirable to accommodate field games such as baseball. For younger children, small spaces closer to the dwelling and furnished with play equipment are needed. Small children cannot walk so far and must have more parental supervision.

While the primary function of playgrounds is to provide play space, these relatively large areas can be very useful in opening up the project and creating a sense of spaciousness.

Playgrounds are expensive, particularly where land costs are high and have, therefore, been omitted in a number of public projects. This is, however, feasible only where adequate outside play space is already provided by the city and is not too distant from the project site.

The FPHA standards recommend a central recreation area for each project sized according to the number of dwelling units. Area sizes

are also recommended to accommodate water play, court games, fixed apparatus, etc. A location near the maintenance building is suggested and other recommendations are made pertaining to special types of play, shade, surfacing, etc. The FPHA standards state also that space provided for outdoor recreation should be "well correlated with the rest of the site arrangement".

REPORT MATERIAL

A number of requests are made for the inclusion or enlargement of playground area. Playgrounds concentrate noise and keep children under control. The character of the area desired, varies. Requests are made for large playgrounds, sometimes in preference to many small ones. About an equal number of requests are made for small playgrounds but these are generally desired for smaller children and would not be considered as replacing the large playgrounds used by older children. Such comments stem out only from a desire to eliminate friction between different age groups but also from the rather different needs for the younger child.

The frequency of comments on equipment gives an indication of its importance to the success of a playground. Several recommendations are made that all equipment be placed not in large, but in small playgrounds. This leaves the large playgrounds free for the space requiring games of the older children and eliminates the possibility of conflicts between the older and younger groups. A roller skating surface, and spray pools which can be used for winter skating are advocated. Wading pools are questioned because of their dubious hygenic condition. The elimination of sand boxes is suggested because they also are insanitary and put a work load on maintenance.

Several comments point out that playgrounds are little used when poorly planned. Traffic loaded streets separating playground from dwellings,

poor surfacing and drainage, too great distance from dwellings, lack of shade trees are all conditions that cut down on the success of playgrounds.

Other comments recommend that playgrounds be kept away from management and maintenance buildings, planting, garbage disposal areas, laundry drying yards, etc. to prevent destruction and untidyness.

CONCLUSIONS

Existing outdoor play facilities should be carefully enumerated before any decisions regarding the inclusion or exclusion of playgrounds are made. Considerations of capital cost have to be recognized, but the omission of play space where it is really needed can come very close to destroying the success with which the project meets its primary purpose, that of providing for the low income tenant a pleasant, efficient place to live. Tenant yards may provide adequate play space for the very small child, but larger spaces are necessary to accommodate the play and group games of the older ages. This is particularly true of the public project where dwellings are scaled down to a minimum and supplementary space outside the home is almost a basic necessity.

Study should be done to determine how play areas should be divided up between large and small playgrounds. Maximum and minimum distances from dwelling to playground should be established. Observation of children at play may produce information on the conditions that produce a good child play atmosphere.

YARDS, PORCHES AND IMMEDIATE OUTDOOR AREAS

Statement of the Problem

Because yards, porches and other immediate outdoor developments are designed to accommodate the same general group of household activities, they are discussed together in the same section of this report. This group of activities which are commonly carried on at or near the front and rear entrance of the dwelling, include: pedestrian and auto access, parking, garages, deliveries, disposal, clothes drying, sitting, dining, gardening, storage, child and adult recreation. Certain of these activities which present particular problems are treated separately and more completely elsewhere in this report.

The typical yard in public housing is difficult to define. The ground area prescribed to each dwelling unit may be considered as a strip the width of the dwelling unit extending on both sides half way to the face of the next building or to walks or streets that run midway between buildings. The width of the dwelling is usually 16 to 18 feet for two-story units and from 20 to 30 feet for one-story units, depending on the number of bedrooms. Yard areas on the street side vary from about 340 to 500 square feet and at the rear from 450 to 700 square feet. Very seldom are yards defined or enclosed by fencing or planting. Very often concrete paths cut these areas, running close and parallel to the houses. Walks to the entrances of adjacent dwellings are sometimes combined for economy's sake. Coal boxes, (if coal is used), clothes lines, garbage and refuse facilities, and entrance platforms are items usually contained in the yard area. The planting of flowers is sometimes encouraged. Shrubsplanting and fencing for yard division and screening purposes are used very rarely in permanent, and never in temporary housing. Yards are, generally speaking, relatively undefined and useless areas.

YARDS, PORCHES AND IMMEDIATE OUTDOOR AREAS

Careful location and relationship of yard activities is important. In many cases there is not enough space provided. In other cases, space which is ample may be located so as to cause conflict of activities such as main approach and garden development in conflict with the disagreeable aspects of coal delivery and garbage removal. Beyond these considerations are the devices by which the activities can more successfully be accommodated such as porches, shelters, paths, paving, fencing, planting, coal boxes, storage sheds, etc. It is all these developments and the activities which prompt their use, which must be mentioned both in the statement of the problem or in the judgement of its solution.

Report Material

Of complaints received, the majority have to do with the conflict of activities due to mistaken assignment to front or rear yards and each of screening and other devices mentioned above which can separate, confine and promote good maintenance. Some tenants have spoken of the confusion of back yards because of undefined use of space. Exterior drying facilities and no enclosures of yards at ends of row houses were mentioned as causes. Front yards of one row house facing the back yards of another was a common annoyance. This, if not solved by the reorientation of the buildings, can still be solved by the confinement by segregation and barriers of fencing or planting, but apparently was not in many cases. The use of row housesyards by nearby apartment tenants is another indication that ground use should be better defined. It is known that tenants to confine childrens play and sometimes the maintenance division of lower maintenance costs have added fencing after completion of the project. Clothes lines have disrupted the use of yards for other purposes, have been offensive when not enclosed from view and have not in all cases been

protected from the splash of passing cars nor from coal dust during delivery. The extensive use of individual coal-fired space heaters has been a characteristic war time practice and will presumably be largely discontinued in peace time. During the emergency, however, problems due to poor design of storage receptacles, unreasonable distances for delivery and other factors, have marked this as a major consideration in the planning of the yard and approaches to the war-time dwelling.

The porch is a structure which is said to have accommodated successfully many activities, especially in the south. Those in connection with the kitchen have served for clothes drying in bad weather, food preparation, storage, sitting, child play, play and sleeping. Porches off living rooms have been appreciated for sitting or resting in privacy though with view of street activity (a difficult conflict of requirements for the designer). Where porches are not provided, it is felt some area should be developed for sitting out of doors.

Privacy and yard division have been achieved by spaced walls and by outdoor storage sheds, and aside from their functional contribution, have enhanced the appearance, especially of row houses.

Conclusions

An amusing, though serious, fact is that tenants, managers, designers, and housing officials disagree as to which is the front and which is the rear side of a public low-rent dwelling. The same confusion exists in regard to front entrances, porches and yards. The term "front" usually indicates the side of main vehicular approach and this side usually receives the greater development for appearance and livability. But in this there is often a conflict. Private and pleasant outdoor areas are frequently compromised by servicing requirements which naturally belong on the street side of the dwelling and which involve disposal of garbage, delivery of fuel, auto traffic and parking.

YARDS, PORCHES AND IMMEDIATE OUTDOOR AREAS

Conflicts are progressively agravated as plots diminish in size. For detached dwellings, there is the possibility of access from four sides. For end row units and double houses access from three; and for row houses, from two or one.

This confusion is to be explained and solved by a determination of what activities are to be performed; their location and groupings. It is recommended that study be given to plots and yards of different sizes in connection with the various building types they serve, so that more intelligent and efficient use can be made of the land which is at such a premium in minimum planning.

GARBAGE AND REFUSE COLLECTION

STATEMENT OF PROBLEM

Several systems and their variations have been in use, each evolving from a group of determining factors or conditions particular to that project locality. These systems of a combination of them are: incineration, individual pickup and group collection stations.

Some of the problems of garbage and refuse collection may be due to the undefined responsibility for or the failure of any of the following participants, singly or in combination:

1. Technicians. Inflexible or poor method inherent in the site plan layout.
2. Municipal Agency or Contractor. Municipal service (rules and methods - separation of types of refuse - distance from truck to pickup, frequency, etc.).
3. Project Manager. Managerial skill (Project policy - Janitor Service).
4. Tenant. Tenant lack of cooperation.

This divided responsibility results in poor service and dissatisfaction. Therefore, Management has been attempting to eliminate those parts of the system which are hard to control. The trend is toward incineration where project management controls the entire process of garbage and rubbish disposal.

There are three schemes of incineration:

1. Household incinerator accessible on the same floor level which serves one or more families.
2. Group incinerator which serves families that carry refuse from their homes to the incinerator hopper at the

ground level (may also serve families on the upper floors adjacent to the incinerator stack).

3. Central incinerator which serves the project and means collection and hauling of garbage. A combination of the first two has been installed or converted to on some projects in conjunction with apartments and row houses.

REPORT MATERIAL

The material reviewed disclosed that the systems are more or less successful in various parts of the country, depending on the cooperation of the various participants involved. The systems vary from one of individual household pickup which influences the type and pattern of the interior road system of the project to group collection stations. The systems conceived and planned in the original site plan in some cases, involved extra site improvement costs which on the one hand gave service to each family but on the other hand sacrificed advantages of safety zones, green areas, etc. by interlacing the project with service lanes.

Many carefully considered collection arrangements, varying from the simple to the complex, continue to provide major management problems and dissatisfaction in spite of original site plan considerations. In low density projects where collections are made at the service door, the housewife sets her own standard (or Project Management) of cleanliness and in a measure that of the collector. The problem becomes more complex and aggravated with increasing site densities as specific demarcation of responsibility is lost. When relays are established from kitchen to group collection station,

pickup to truck, truck to other stations within the project and thence from the project, it is not surprising that spillage is frequent and a follow cleanup crew is needed.

The general consensus of project information discloses the following criticism and preferences:

Incineration, where practicable, by one or a combination of methods.

Incinerators should be gas-fired (This may be due to paper shortage).

Sunken cans are not satisfactory in some areas due to freezing of the cans in the containers and the impossibility of emptying them, and refuse lodging between can and container.

Wall receptacles for cans are satisfactory when they are large enough.

Cans at dwelling units should be sheltered and screened from view.

Stations should not serve more than 25 families. They should have concrete platforms and rectangular or circular masonry sides with sufficient opening for operation. Water (hot if possible) and a drain should be provided for flushing and washing after each collection. Visual screening of collection stations of masonry are preferred to deciduous shrub screening or trellises. Deciduous shrubs are broken and do not screen in the winter and trellises are too frail. The space should be designed to accommodate cans arranged around the wall in single row.

Location of stations, should be readily accessible to both

Tenants and collecting trucks with 200 feet as the maximal distance from doorstep to station. (This distance should be further checked by FPHA. It may be excessive.)

Rules and methods of the collection agency should be strictly adhered to.

A supplementary incinerator in maintenance building is suggested.

Parking spaces at city collection pickup garbage stations should be avoided.

CONCLUSIONS

No one system can be recommended since the determination must be made locally. This determination coupled with consideration of other services, particularly fuel, should be based on experience with existing projects and on a thorough analysis of the methods, rules and customs of the usual services. Moreover, capital costs and, in the case of public housing, Federal annual contributions involved in relation to the long term program with its comparative advantages should be given consideration in the final solution.

A system may be said to be successful, when, in the planning phase, the statement of determining factors in conditions is thorough, accurate, and followed by good design and good initial cost balance; and when put into operation, functions with efficiency and cooperation among those who participate without too much policing.

Individual pickup at each door seems to be satisfactory and is the useful accepted method in most cities. It may include costs of service drives or lanes for access if these are not needed for other services such as coal or oil delivery.

Group collection stations serving a number of families, concentrates the collection pickup at these points but also aggravates all the unpleasantness. This method is considered the least satisfactory but introduces many advantages in site planning, such as elimination of all but the essential service drives and thus creates more green areas for outdoor living and safety zones for children and gives the planner much more flexibility in arrangement of dwellings. Group incinerators have been found very satisfactory to management and involve only the initial capital costs of building the incinerators. This scheme has the freedom of open planning that group collection stations allow without the unhygienic conditions. It gives complete control to management of the whole operation and lowers service costs to the city. Disadvantage may be soot and ashes from incinerator chimneys falling on drying yards, noise from hoppers clanging, and spillage on route by children.

A program of instruction in self-education and self-policing by project tenants should be encouraged as a community activity for pride of tenancy.

FOUNDATIONS

STATEMENT OF THE PROBLEM

Without a durable foundation or support no dwelling will be satisfactory. Principal factors to be considered are (1) topography (2) character and bearing power of the soil at the footing depth, (3) the effect of heaving soil whether due to frost or to other unstable conditions encountered in certain South and Western States, such as Texas, Colorado and California. With no basement there may be the problem of enclosing and draining the crawl space and protecting under-floor piping. In pier construction or walls retaining fill, allowable height, thickness and reinforcing of the foundation is determined by expected lateral forces.

REPORT MATERIAL - PRIVATE

The FHA field office canvass did not cover the subject of foundation directly and therefore furnished little information on this subject. In the absence of indication of significant trends in foundations or in type of waterproofing of foundation walls it must be assumed that complaints if any are few and of little consequence.

REPORT MATERIAL - PUBLIC

Because it is usually not difficult to find suitable soil at required distances below grade for the light loads associated with dwellings report material seldom indicates settlement. Frost at one New England project has lifted the especially light frame structures of temporary war housing up away from the footings, where deep crawl spaces and moisture retaining soil were present.

Drainage must be provided for crawl spaces below grade and for basements unless natural drainage is exceptionally favorable. Reports also indicate the need for more attention to the waterproofing operations of basement walls and its adequate protection during back-filling. It is also pointed out that the waterproofing of basement walls on hillside sites is especially important.

Generally unanimity of opinion is expressed that continuous masonry walls around the building are preferable to pier construction with skirtings of highly perishable materials such as asbestos-cement board, granular surfaced fiber board, or gypsum board. Low maintenance, availability of masonry materials, practically the same initial cost, protection to under-floor piping and generally warmer crawl spaces are among the advantages of masonry foundation walls. Ventilation to under floor spaces is treated elsewhere.

Reports do not cover the so called "Raft" or "Floating Slab" foundation sometimes used in Southern states that require special site and drainage conditions as well as reinforcement for successful use.

Conclusions

Some economies may be achieved on large projects by more precise study of actual soil characteristics, imposed loads, construction methods and costs for alternate foundation methods. Determination is an engineering problem which can be solved by other than the usual "rule of thumb" and "good practice" assumptions where projects are large enough to warrant specialized consideration and where governing standards and codes permit. Under such conditions, for example, a "Raft" or "Floating Slab" foundation

may provide adequate performance characteristics at less cost than a conventional wall, footing, floor slab and other incidentals now generally required by standards and codes for the light loads of one and two story dwellings.

A typical illustration of special treatment is a temporary housing project in a New England State. Here the foundation consists of a concrete block on its face for the footing and a single concrete block on edge for the wall, all above natural grade on a compacted gravel fill. Satisfactory, economical construction under adverse conditions was thus obtained. Inspection after thirteen months revealed no settlement or other movement.

Crawl spaces when necessary are best enclosed by masonry walls. Drainage and waterproofing are generally required for occupied basements, and drainage is a necessity for crawl spaces.

CRAWL SPACES

STATEMENT OF PROBLEM

Unoccupied spaces under structural first floors, known as crawl spaces, are common in both private and public housing, to provide access to mechanical installations and, in wood framing, for termite and decay control. Where floors are of wood or certain perishable items such as insulation and where a floor furnance is installed, these spaces must be dry and of adequate height to allow space for inspection for termite and vermin control and mechanical installations. Enclosure of the spaces is almost mandatory for sanitary and appearance considerations. Crawl space ventilation increases heat transmission and in most areas necessitates thermal insulation and vapor barriers in the floor construction above.

REPORT MATERIAL - PRIVATE

The FHA Field Office canvass points out definitely that in areas such as Chicago, Buffalo, and Detroit, crawl spaces should not be used, as the full basement with its added area and facility for laundry work, storage, play space and heating of the dwelling is practically demanded. It is also brought out that in many places lots are not large enough to allow sufficient extra space outside of the living areas for the storage, laundry, heating and play space required by the larger class house.

Where crawl spaces with improper drainage have been used, dampness has often been experienced. Offices in the Northern areas report the use of insulation in floors over crawl spaces and a trend toward greater use of such insulation is indicated by other regions. However, the information was spotty and it is not considered practicable to attempt to list specific data on insulation in floors over

crawl spaces.

REPORT MATERIAL - PUBLIC

One of the most frequent complaints on crawl spaces is that they are damp and wet, resulting in detrimental effect on adjacent materials and discomfort within the dwelling. Reports indicate quite generally that one or a combination of the following listed conditions is responsible, (1) the floor of the crawl space is below the surrounding grade; (2) inadequate or no ventilation to crawl spaces; (3) openings direct from the crawl space, usually for piping, into the living areas; (4) lack of drainage from the crawl space area; (5) omission of surfacing for the crawl space floor; (6) lack of sufficient insulation and vapor barrier in the floor construction above the crawl space.

Reports were general in their complaint that the usual 12 or 18 inches of clearance provided is inadequate. Paving or earth stabilization of some sort is also generally recommended to facilitate working conditions. In many northern areas freeze-ups of piping in crawl spaces, especially those with asbestos cement skirting are reported. Continued maintenance cost always accompanies the use of skirting. Where access doors are not placed in outside walls or in walls of public spaces maintenance problems increase.

CONCLUSION

Crawl spaces should be eliminated wherever possible. In Northern areas full basements are indicated if floors on the grade are not practicable. In Southern areas slabs on the grade are indicated, with special attention to items such as drainage, capillarity of sub-soil, finished surfaces, and access to piping and mechanical equipment.

Where crawl spaces cannot be eliminated the items listed below are considered essential:

a. The floor of the crawl space should be above surrounding grade or be drained.

b. Clearance of at least 4' 0" to the bottom of first floor framing except in individual houses when it could be reduced to 2' 0".

c. Covenient access.

d. Ventilation with a free area not less than .5% of the floor area plus .5 sq. ft. for every 25 lin. ft. of wall arranged for cross ventilation and placed as high up as possible.

e. Insulation in floors as required by outside design temperatures.

f. Adequate properly placed vapor barriers.

g. Suitable surfacing of crawl space floor.

FLOORS AND FLOOR FINISHES

STATEMENT OF THE PROBLEM

Any study of floors starts with the requirements or the conditions to be satisfied. A floor to be satisfactory is something more than a flat surface to walk on. Among physical properties required for an acceptable dwelling floor are, (1) strength, (2) stiffness, (3) warmth (4) resiliency (5) ability to resist abrasion and indentation (6) ability to resist water vapor and moisture penetration if exposed (7) resistance to termite and vermin infestation (8) permanence of appearance, color and surface, (9) durability of structure and finish (10) easy to clean, (11) adaptability to receiving mechanical installations, (12) resistance to sound transmission when necessary.

Economy of first cost must be balanced against performance characteristics desired including ease and cost of maintenance. Limitations on construction of temporary housing since 1941 have imposed other requirements which often precluded a desirable solution.

REPORT MATERIAL - PRIVATE

Analysis of the FHA Field Office canvass shows that although the bulk of pre-war houses were built with conventional wood floors, there is a weak trend toward more concrete floors in the post-war period. One office in the Great Lakes area reports that although, when not insulated, concrete floors over unoccupied spaces are cold, they are not objectionable to the extent of discontinuing their use. This office also reports that concrete floors on the grade are satisfactory and compare favorably in cost with wood frame floors.

In the Texas area concrete slabs of the floating, or raft, type are quite extensively used and are liked both from cost, suitability and structural considerations.

During the war period the wood sub-floor so extensively used in pre-war housing was omitted. Reports indicate a strong trend toward the return of wood sub flooring for all floors.

Bathroom floor finish in houses of the small class were about equally divided between linoleum and tile. As the house increases in size the trend is toward more tile bathroom floors.

For kitchens linoleum is by far the preferred finish material and the trend is toward linoleum in the few instances where the finished wood floor served as the wearing surface.

In other living areas, as is to be expected, hardwood floors are preferred over soft wood in all classes of houses. In the small class the offices indicating soft wood generally reported a trend toward decrease in its use. Large class houses use practically 100% hardwood finish floors and indicate no tendency for a change.

REPORT MATERIAL - PUBLIC

Reports indicating tenant and management complaints against uncovered concrete floor surfaces run into large numbers. According to numerous reports, plain cement floors (1) are hard on the feet (2) are cold and unhealthy especially for children, (3) are damp in certain instances (4) dust badly, (5) stain easily (6) crack frequently (7) are usually unattractive and (8) are hard to clean. When these cement surfaces are covered with asphalt tile, or in some cases parquet wood flooring or linoleum, complaints are not nearly as numerous. Linoleum put down with waterproof cement is preferred for kitchens and baths.

Painting of concrete floor surfaces is reported as not satisfactory since (1) the paint peels and wears off (2) leaves a slippery surface and (3) produces a surface on which condensation easily forms.

Report material also points out that where concrete upper floors and roof slabs rest on masonry walls, cracks in the walls at floor level, at roof level, and at corners are quite common.

Wood floors properly filled and shellacked were generally preferred by Housing Managers and tenants for living areas except baths and kitchens. Complaints are numerous where wood flooring is of too low a grade; is less than 25/32 inch thick, and is finished with only a coat of filler and a coat of wax. Scattered reports to the effect that joints opened up; flooring buckled; walls pushed out and single oak floors were cold, apparently resulted to a large degree from lack of ordinary care in application and lack of protection to the finished work.

Reports are quite general in pointing out that the omission of wood sub-floors, which were prohibited in temporary housing by the War Production Board regulations, add greatly to the difficulty of construction, especially with masonry walls. Plywood for finished floors, according to reports covering this material, does not give satisfaction unless (1) it is especially prepared with a factory treatment of a water repellent sealer, (2) care is used in laying and (3) adequate protection is furnished it at all times during construction.

Report material did not indicate complaints on the strength and rigidity of floor constructions used in temporary housing, where, for dwellings an assumed live loading of 25 lbs. per sq. ft. was used in

lieu of the usual 40 lb. per sq. ft. a reduction of 37½ per cent.

CONCLUSIONS

There are very few if any, of the items brought out in the report material which cannot be rectified thru proper selection of design, materials and application. Concrete floors can be made warm dry, healthy, durable, comfortable and pleasing in appearance. Good workmanship, reinforcing materials, membrane waterproofing for floors on grade and more attention to adequate thermal insulation are among the items not always associated with some of the housing projects where concrete floors gave trouble. Wood floors should present no problems in post-war housing when materials of good quality are available and when they are treated and handled properly.

New materials and new uses of old materials in different form aided by developments in plastics overlays and impregnations and in other treatments are expected to assist in the search for an ideal floor covering material.

Among the items requiring further study on floors and floor finishes are (1) to what extent, if any, can the former design live load of 40# p.s.f. be modified to more nearly represent expected loading conditions for dwellings? (2) What are the physical performance requirements such as deflection under load, strength, resistance to impact and resistance to vibration, of a floor system, which will reasonably determine the general utility characteristic known as "Comfort" (3) the development of performance requirements for items such as resistance to abrasion, resistance to indentation, resiliency and permanence of color and finish. (4) The development of uniform testing proceedures for determination of all required properties of floors and floor finishes.

EXTERIOR WALLS

STATEMENT OF PROBLEM

Here, as with floors, the simplest way of stating the problem is to enumerate the major properties, qualities or performance characteristics a suitable wall must have. They are (1) strength and stability against all live, dead and lateral loads (2) resistance to penetration and absorption of water (3) resistance to heat transmission (4) resistance to sound transmission where applicable, (5) durability (6) fire resistivity (7) vermin resistance (8) vapor resistance when applicable (9) low cost of maintenance (10) correlation or adaptability to receive and accomodate items such as mechanical installations, doors and windows, flashings and other architectural treatment. Location, site conditions and arrangement of course dictate the extent to which these properties apply in the particular structure.

REPORT MATERIAL - PRIVATE

In the FHA field office canvass six offices, namely, Buffalo, Richmond, Houston, Chicago, Dallas and New Orleans, representing an estimated 25% of the national volume indicate anticipated trends toward changes of exterior wall construction. In the absence of data from the other offices it is assumed that there are no indications of change or major problems.

For those offices reporting, there is a strong trend toward an increase in brick veneer or wood frame construction, especially in the middle and large class dwellings. There is also a trend toward increased use of furred masonry walls with a decreased use of unfurred masonry walls.

The increase in masonry and masonry faced walls is offset by a reported decreasing trend in the use of frame walls with wood or asbestos cement siding and shingles. Only one office reported an indicated change in stucco faced walls and that was toward a weak decrease in use.

As to be expected the reports indicate that as the size of the house increases there is a greater use of masonry and masonry faced walls with a corresponding decrease in the use of wood or asbestos cement facing over wood frame. For the six offices reporting and representing approximately 25% of pre-war volume, brick-veneer construction was used on 3% of the small class houses, 15% of the medium class houses and on 33% of the large class houses. For the furred all masonry walls pre-war volume for the three classes was 21%, 29% and 27% respectively. Wood frame with other than brick facing accounted for 76% of small house volume, for 54% of medium house volume and for 38% of large house volume in pre-war days.

One office, Denver, Colorado, definitely expressed a desire for extended use of brick veneer on wood frame construction within the city where solid masonry walls are almost exclusively required under the present building code.

Although the field office canvass did not indicate the use of new materials for exposed siding it did reveal a trend on wall sheathing. In the pre-war period wood sheathing was more common than other types especially in the larger houses. The performance of gypsum board and fiber board sheathing during the war period has apparently been satisfactory as offices representing approximately 20% of the national volume indicate greater use of these boards for wall sheathing in the post-war period.

REPORT MATERIAL - PUBLIC

With the exception of a few comments on the unsatisfactory performance of synthetic wall coverings used in temporary housing practically all major adverse criticism was directed at masonry walls. Masonry walls in public housing have leaked and still are leaking badly in many areas where they are exposed to heavy rainfall and high winds. Among report comments on this item are (1) parapets of brick crack (2) discontinue use of patented masonry cements (3) furr all masonry walls (4) masonry walls plastered direct do not prove satisfactory (5) condensation occurs on columns and spandrels when they are not furred (6) many leaks are due to improper type or placing of spandrel waterproofing (7) wall leaks are due to floor slab expansion(8) wall leaks in masonry are serious (9) proper design is the only solution.

Several reports on projects in the Richmond, Virginia area where the true cavity wall has been used indicated no trouble. Brick veneer construction over a wood frame wall, according to the reports received, is generally satisfactory with proper details of flashing, especially at the base of sheathing and an unobstructed, air space.

In temporary war housing where gypsum board sheathing and granular surfaced fiber board sheathing were used extensively reports indicate excessive maintenance costs, especially for the former.

Reports on the satisfaction of plywood for exterior siding vary. When used in shop fabricated construction application of this material and protection of edges have been given more consideration than in field assembled structures where considerable maintenance is indicated. The reports do not indicate to what extent plywood siding on field built structure was restricted to the "Exterior" or resin bonded type as re-

commended for all exposed use by the sponsors.

Comments regarding unsatisfactory experience with conventional wood sidings were few in number and of such nature that the use of well seasoned lumber and ordinary care in detailing and erection would no doubt have resulted in satisfaction. Condensation, heat and sound transmission are covered in another section of this report.

CONCLUSION

Major changes in the design and construction of masonry exterior walls of public housing are necessary. Good materials and good details cannot produce the required results under poor workmanship conditions. Poor details and inferior materials will not produce satisfactory results, even if the workmanship is far above that usually obtained on public housing projects.

It is believed that there is a fair unanimity of opinion among engineers familiar with brick masonry that in severe areas excellent workmanship must be obtained to warrant reasonable assurance that the usual four inch face brick course will serve as a "barrier" to keep blowing rains, of extended duration, out of the interior of the wall. It is not reasonable to hope to obtain this kind of workmanship without excessive inspection costs. Assuming for a moment that such workmanship is obtained, we must go farther and consider the effects of the cracks which occur so frequently in many of the wall-bearing concrete slab projects associated with public housing. The solid wall-bearing concrete slab type of construction is claimed by many to be the most economical for three story row fireproof buildings about 27 ft. wide and has been used extensively in the past.

With cracks in walls whether from settlement, differential movement between walls and slabs, thin masonry surfacing of columns and spandrels,

or just plain shrinkage it is apparent that excellent workmanship in laying up the brick work cannot be expected to do the whole job. The design then should be worked out so that satisfactory walls will be reasonably assured with job conditions as we find them or as they can be modified without excessive supervision and expense.

The cavity wall where two wythes are separated by a two inch air space and bonded together with non-corroding special metal ties is proposed for thorough studied consideration. Advantages are (1) is effective with average commercial workmanship (2) does not require continuous spandrel flashing (3) does not require furring or even need plastering (4) can be built with low heat transmission factors (5) provides for differential movement between slab and walls (6) the cost compares favorably with that of a 12" furred brick faced masonry wall.

When the standard brick faced masonry construction is used and when it will be subjected to severe exposures, moisture penetration beyond the face brick should be anticipated and provision made to take care of it. Items requiring major consideration in this respect are (1) inclusion of furring with free standing furring highly preferable (2) effective spandrel flashing with its back edge away from the inside face of the masonry and turned up at least four inches (3) inclusion of weep holes or other provision to lead permeated water back to the outside face of the wall (4) more adequate inspection and enforcement of contract provisions to assure reasonable compliance in the field.

Substitute materials for conventional wood drop or beveled siding and wood or asbestos cement shingles must be perfected to a greater degree before extensive use can be made of them in post-war housing.

Although no serious problems in wall construction of private housing is indicated by the FHA field office canvass it is to be pointed out that

the report material referred mostly to detached dwellings and did not request specific trouble items. It is believed that a survey of multiple apartment buildings (privately financed) primarily concerned with construction items causing management problems, would reveal some trouble also.

ROOFS AND ROOF COVERING

STATEMENT OF THE PROBLEM

Selection of the roof and its covering requires planning beyond the mere matter of keeping rain and snow out of the building. In industrial areas where coal dust and soot covers roof areas drainage and overhangs must be worked out so that wall surfaces are kept clean. Items such as ventilation in the attic space, adequate insulation, vapor seal, protection to plumbing pipes in the attic space, and the extent to which the attic space will be used require planning consideration closely integrated with the architectural result desired.

Selection of the structural system for multiple dwellings and row housing assumes importance to a far greater degree today than it did when roofs were generally of wood rafters supported by wood frame or solid brick walls. The roof system must be adapted to the wall construction to the end that relative movement of these two elements of the structure is kept at a minimum. Roof slab movement should not crack the walls.

Among the structural requirements for a suitable roof are (1) ability to safely support all snow loads (2) ability to support a normal operating load of not less than 20# p.sf. uniformly distributed or a concentrated load of approximately 150 lbs. in any one square foot of flat roofs whichever is the more severe, (3) ability to resist the forces of the wind including pressure on the windward side, suction on the leeward side, suction on both slopes when the wind is

parallel to the ridge and built-up pressure when there are windows between the top floor or ceiling and the roof.

Roof coverings to be acceptable and durable over a period of years are determined by factors sueh as (1) location of the building, that is, whether in an industrial area where chemical change is rapid with certain coverings or in an area where there is little or no adverse effect (2) slope of the roof (3) the base to which roofing is attached (4) the period during which the roofing is to be effective (5) relation between first cost and expected maintenance expense and (6) to what degree the roofing will be subjected to traffic or exposure other than to the elements.

When dwellings are closely spaced, the matter of fire resistivity of the roof covering assumes importance and selection of material is influenced by items such as insurance rates, expected useful life of the roof and the possibility of spreading conflagration.

There are many obvious reasons why a good roof is of major importance during the life of the dwelling.

REPORT MATERIAL - PRIVATE

Five field offices representing 20% of the national volume indicated probable changes in roofing practice in the post war period. The balance of the offices, all reporting no change, apparently have no roofing problems of magnitude. It is interesting to note that choices of roofing materials for sloping roofs vary considerably with the region and it is difficult to note any specific trend. Where an office like Dallas indicates a trend toward increased use of wood shingles, decreased

use of asphalt shingles, and an increase in the use of asbestos cement shingles for the small, medium and large classes respectively, another office, Richmond, indicates a decreased use of wood and asphalt shingles and an increased use of asbestos cement shingles for the three classes of dwellings.

With offices representing 81% of the national volume indicating no change in the use of gutters and downspouts it is believed that here again no major problem presents itself. Four offices; Richmond, Birmingham, Dallas and Los Angeles representing 19% of the national volume were consistent in indicating a strong trend toward the use of gutters and downspouts where they had previously been omitted and also a strong trend toward preference for metal over wood for gutters and downspouts. In fact, some offices state that gutters will probably be mandatory in the postwar period. Reports also indicate a trend toward better roofing materials especially for the medium and large class dwellings. As to be expected, this canvass did not reveal any changes in roofing over flat roofs, as FHA has always required built up roofing of high quality.

REPORT MATERIAL - PUBLIC

Considering design items first, it is interesting to note that a large proportion of comments had to do with the overhang of the roof proper. In the majority of cases complaints arose when the overhang was not approximately 12 inches. In warm regions preference for a wider overhang as protection from the direct rays of the sun was expressed. In other areas (not industrial) comment indicated a 6" overhang might be enough.

A few reports indicated there had been a lack of proper roof protection at entrances. Here gutters were too short, where there were any; and extending main roofs or pent roofs were too small.

On the item of drainage, report material indicates that (1) sloping roofs without gutters are not satisfactory (2) downspouts connected to french drains or depositing on splash blocks are generally unsatisfactory (3) hanging gutters on flat roofs are unsatisfactory (4) when built up roofs do not have slag stops high enough to prevent water from flowing over them, walls and trim are marred (5) built up roofing should have interior downspouts.

Lack of adverse reports on the adequacy of the roofs of temporary war housing where designs were based on 20# p.s. ft. live loads in all sections of the country and much lumber was saved by using clear-span trusses, indicate general satisfaction with this economical design. In this connection, pre-war practice has been to design for live loads as high as 40# per sq. ft. in extreme northern areas.

Sheathing gave very little trouble in housing built before the war, due to the availability of lumber. For temporary war housing, however, War Production Board's regulations generally prohibiting solid wood sheathing forced the use of gypsum and fiber board sheathing. Report data indicates some trouble with these materials in adapting them to the type of roofing selected. Comment such as (1) shingles blown off (2) asphalt shingles 3 tab blow off (3) asbestos cement shingles blow off (4) shingles have become loose (5) shingles lifted (6) roof carried off in wind, all must be interpreted to indicate improper means of attaching shingles to the sheathing.

Single thickness roll roofing was not satisfactory. The lack of adverse report data on double thickness or 19" salvage edge roofing indicates it to have been satisfactory for temporary housing. Comment that roll roofing buckles is believed to be directed at single thickness material or to double thickness when laid with cold bitumens. Field inspections have revealed hot applications are preferable to cold applications.

Sloping roofs are preferred in most northern areas according to report material, as they allow (1) for better ventilation and thus less trouble with condensation (2) promote better public relations (3) it is believed the slightly higher first cost is more than balanced by less maintenance.

CONCLUSIONS

Among the design requirements for satisfactory roofs are (1) more precise determination of necessary design loads (2) at least a 12" overhang for wood frame buildings (3) slopes of 5 inches or more in 12 inches (4) selection of a system that will work well with the wall construction selected (5) adequate provision for ventilation, insulation, drainage and protection of piping in the loft space.

Single thickness roll roofing is not satisfactory. Double thickness roll roofing laid in hot bitumen is satisfactory for short term duration. Individual or strip shingles require secure attachment to a sheathing which does not have excessive movement during the life of the structure. Where the roof pitch is 3 inches or less in 12 inches a built-up asphalt roof should be used; drains should be connected to conductors inside the building; and gravel stops should be high enough to prevent overflow.

War housing experience (Public) with light wood clear span trusses for a 5" in 12" slope indicates that this design slightly modified can be adapted to post war housing where the attic space is not to be occupied. Saving approximately 45% of the lumber generally used for ceiling and roof framing, the design with its simple nailed connections and details which facilitates application of mass production methods have been shown by test to have ample strength and stiffness, for post war housing. Cost studies in the field have indicated substantial economy in both assembly and erection resulting in a construction suitable for ready application of any roof sheathing or ceiling finish. Another advantage is that with no bearing partitions flexibility of room layout by moving of partitions is provided. This is a desirable feature of post war housing according to recent surveys. This truss construction should be thoroughly studied and developed to the end that it contributes its full share in reducing costs in dwellings not requiring attic occupancy.

Moreover, the use of lighter design loads which was a correlary to the development of the truss, should be studied to determine the extent to which existing practice can be modified to reduce costs without sacrificing essential strength.

Gutters and downspouts will be more generally used in both private and public housing. Better roofing materials are expected with wood and fire resistive shingles tending to supplement composition shingles.

DOORS, WINDOWS and HARDWARE

STATEMENT OF THE PROBLEM

Consideration of requirements for doors and windows first brings to mind three major items; namely, light, ventilation and means of entrance and egress, with hardware facilitating operation of these functions. A further study, however, shows that such openings are called on to (1) keep out wind and rain (2) prevent loss of heat (3) keep out sunshine when called upon to do so (4) be properly located to allow placing of furniture and equipment (5) provide for normal functional operation (6) be architectually attractive and (7) to continue to perform all required functions satisfactorily with a minimum of maintenance cost.

REPORT MATERIAL - PRIVATE

The FHA field office canvass revealed that six offices; namely Richmond, Birmingham, Dallas, Washington, Chicago and Los Angeles, representing an estimated 30% of the national volume expect changes in the type of windows used. A decline in the use of wood double hung sash although weak in the small class house is rather strong in the medium and large classes. The same trend for less use of wood casement sash is also indicated. The decrease in wood sash use is offset by an expected increase in steel casement sash. Although not much change is expected in the small house class trends toward greater use of steel sash in the medium and larger classes is quite strong. Although double hung steel sash apparently have not been used extensively in dwelling construction other than in multiple apartments, the meager information indicates satisfaction.

The FHA canvass did not directly cover hardware or information on doors so there is of little value in the reports pertaining to these items.

An item of window insulation in the canvass revealed that in private housing the advantages of reducing heat loss thru windows and doors is being increasingly appreciated by five offices, Pittsburgh, Chicago, Richmond, Dallas and Birmingham representing 22% of the national volume indicate a strong trend toward increased use of storm sash in all three classes of houses. A similarly strong trend toward increased use of weatherstripping is also reported.

Double glazing, although not used to a great extent in small houses in the past, is expected to show increases in use in the middle and large class houses and no doubt, cost allowing, will find its way into the smaller houses in the colder areas.

Prefabricated or fully assembled windows have been used in some ing areas and lack of adverse criticism indicate general satisfaction.

REPORT MATERIAL - PUBLIC

Report material on this subject matter is quite extensive indicating many considerations and changes are necessary for post war public housing. Sixty three percent of the comments are directed at the design used, 7% at workmanship obtained, and 30% at materials used. Assembling report data another way it is found that 35% of the comments relate to doors, 41% relate to windows and 24% refer to hardware applicable to either doors or windows.

Reports on doors indicate that from a maintenance viewpoint particularly, combination storm and screen doors with good hardware are desirable. Advantages are warmth, lower cost of handling and changing over

as seasons require and general higher durability. Comments on weather stripping of doors indicate necessity for it in most areas with caution that it be of substantial weight and under no circumstances attempt to use the spring type weatherstripping at the bottom of doors. Improper details and lack of projection of the face of the door over the sill allows water to drive into the buildings in some instances.

Poor workmanship in fitting doors as well as in applying weather-stripping is mentioned as contributing to uncomfortable conditions in a few cases. Other reports indicate that inadequate hardware on screen doors is responsible for considerable damage. In one instance from 40% to 50% of the screen doors blew off.

One common complaint is that the space between screen and door is not deep enough to receive packages or milk bottles. Screen doors are therefore left open and, not being latched, blow open and are ripped off the hinges. Stay chains or door closers are proposed to rectify this condition.

Other scattered miscellaneous comments on doors are (1) provide locks for doors from stair halls to roofs (2) veneered exterior doors are not satisfactory (3) paint exterior doors dark colors (4) equip doors with interviewers and numbers (5) push-button stop works are not satisfactory on front door hardware.

Reports on windows are quite in agreement on two things (1) that wood sash are far more satisfactory than steel casement sash and (2) that wood double hung sash are not satisfactory when "Jiffy" or spring clips are substituted for sash balances. Steel casement sash allow more air passage; are generally associated with more condensation; require venetian blinds; are difficult to weatherstrip or fit with screens and storm sash;

and deteriorate faster than wood sash. Double hung metal windows did not receive adverse criticism. On the operation of double hung sash, weights with cord or chain and spring spiral balances are preferred. Difficulty of adjustment as well as the hazard to children created by sill operators projecting into the room are other reported disadvantages of steel casement sash.

Storm sash or double-glazing with weather stripping are generally required in northern areas. On insect screens, full length screens are preferred to half length due to better ventilation and less breakage in handling, installing, and operating.

Venetian blinds, according to reports, are needed when steel sash are used due to excessive air infiltration. Shades hung on ordinary shade brackets are a source of continuing trouble. Combination shade and over drape curtain brackets give less trouble.

Other scattered comments on windows include the following (1) Protect basement windows with heavy metal guards. (2) Use ripple glass where it is likely to get dirty. (3) Use sloping window sills to prevent milk bottle storage. (4) Use shutters when it is important to keep out sun glare and street noises.

Hardware is adversely criticised, and severely too, in many reports. The comments may be summed up in the two statements. (1) Hardware is, in many instances, of too low a grade and (2) there was not enough hardware used, in many instances, to result in satisfactory operation and low maintenance. Typical comments are (1) cheap hardware causes high maintenance costs (2) hardware should be of better quality, cheap stuff results in high maintenance (3) poor quality hardware makes endless problems (4) use better hardware (5) cheap hardware doubles its original cost in repairs (6) cheap hardware is a problem (7) advisable to standardise hardware.

Other scattered comments criticised (1) the lack of three butts on the outside doors (2) the lack of proper catches on screen and storm doors (3) inappropriate locks for exterior doors and (4) the lack of proper hardware on scuttle doors to attic spaces.

CONCLUSIONS

It is realized that since 1941 restriction on and shortage of many materials have been partly responsible for complaint pertaining to hardware and openings in public housing. It is, however, believed that in many instances economies in first cost have developed into major maintenance problems.

Experience shows that in the planning of the dwelling, window, doors and hardware should be given more consideration and that details be determined according to the requirements by other elements of the structure. Only high grade hardware should be used and it should be used in quantities sufficient for satisfactory long term operation.

Steel casement sash in public housing generally are not satisfactory and to date, the double hung type of wood sash with proper hardware are preferred. This is contrary to private housing experience where the trend apparently is to wider use of steel sash at the expense of wood sash. Storm sash or double glazing is almost mandatory in northern areas. Full screens are preferred to half screens from a maintenance standpoint.

Combination storm and screen doors are almost a must for low cost public housing. Outside doors should be of solid material, having three butts, be properly detailed for weather resistance when not protected by roofs. In multiple apartment house construction front doors opening from vestibules inside the building are recommended.

WALL AND CEILING FINISH

STATEMENT OF THE PROBLEM

This subject includes the covering of walls and ceiling such as plaster or dry-wall finish and their painting as well as the finish of wood work and trim. Various parts of the dwelling as (1) entrance hall (2) bath room (3) kitchen (4) living and bed rooms and (5) service or storage spaces serve different functions; are subjected to different usage; require different treatment and therefore finishes acceptable for any one may not be acceptable for another.

Among the requirements for an acceptable interior wall and ceiling covering are (1) it must give a feeling of permanence and solidarity (2) it must not crack excessively (3) it must be rigid (4) it must be durable when subjected to normal occupancy usage (5) it must form a suitable base to receive the plaster or paint (6) it must be subject to ready repair by the maintenance crew in case of abuse (7) where fire protection is required it must have the proper resistivity (8) it must have low dimensional change when subjected to moisture or temperature change.

In certain instances selection of wall and ceiling covering may be governed by requirements for sound proofing and control of vapor migration.

Finishing of walls and ceilings including trim and other woodwork, to be satisfactory, must have the following properties.

(1) Durability of surface under normal usage.

(2) Resistence to normal cleaning operations.

(3) Ease of redecoration.

(4) Adequate covering capacity.

REPORT MATERIAL - PRIVATE

The FHA field office canvass did not reveal much of interest on this subject. In the absence of the reporting of specific trends it must be assumed that no major problems exist. The reports did not cover either the painting of walls and ceilings or the finishing of wood work.

Trends for past war housing as indicated by the four offices Birmingham, Chicago, Dallas and Houston representing 22% of the national volume for wall and ceiling covering in living and bedrooms are as follows: In the small and medium class houses it is expected slightly less plaster will be used with an increase in the use of dry wall finish such as gypsum board, composition board and plywood. No change is indicated in the large house class where it is reasonable to assume the majority were plastered prior to the war.

Specific comments are (1) Chicago - Drywall finish is expected to be used more in the post war period (2) Richmond - There is a trend toward wider use of tile for walls and floors of baths. (3) Richmond- the trend is toward better wall covering materials with tile used for baths of large class houses. (4) Houston - Drywall finish is liked and will replace the board and canvass finish used so extensively before the war (5) Philadelphia - tile walls and floors are preferred in baths.

REPORT MATERIAL - PUBLIC

The majority of report material indicates smooth finished plaster to be the most acceptable wall and ceiling covering. Sand finish plaster received much adverse comment especially when it was used in public halls, bathrooms and kitchens. The following remarks are typical (1) sand finish sheds (2) sand finish is expensive to maintain (3) sand finish plaster is

not satisfactory (4) sand finish is not liked as it is hard to clean (5) never use sand finish plaster in halls, baths or kitchens.

Next to plastered surfaces, receged edge gypsum board with joints taped and filled is preferred. Square edge gypsum board without tape or filler is hard to maintain.

Fiber boards and composition boards used quite extensively in temporary housing and trailers, according to reports often caused high maintenance charges. Factory painted wall boards are hard to clean. Plywood and tempered hard boards apparently worked out fairly well for trailers, demountables and temporary housing although reports on them are few in number.

Report material on finishes is quite specific and positive. Lead and oil paint, at least two coats is by far the preferred material for all surfaces and a definite requirement for public halls, bathrooms and kitchens.

Reports on Casein paint were practically unanimous against its use. Among adverse comments are (1) Casein paint is not satisfactory (2) there is a universal objection to casein paint (3) casein paint cannot be cleaned (4) with casein paint it is difficult to change to lead and oil.

On Resin Emulsion paints, reports were divided. The majority of them offered similar objections to those presented for Casein paint. Namely, it was hard to clean and was generally unsatisfactory. Other reports, however, indicated better success, stating that it could be cleaned and had been satisfactory in living areas except baths and kitchens.

On finishes for woodwork, the reports indicated that in some

instances economy had allowed stain and wax or other sub-standard finishes to be used. A stain and wax finish is hard to clean and does not stand up without continued attention. A preference for dark colors or shades is expressed for all items such as doors, cabinets and other mill work receiving heavy usage.

Other scattered comments indicate that (1) ordinary wall paper is not satisfactory (2) glazed tile wainscots are preferred in public halls (3) management problems arise when the tenants are allowed to redecorate under other than a well organized plan.

CONCLUSIONS

Plastered walls and ceilings are at the top of the recommended coverings. Recessed edge gypsum board, properly applied is next. Sand finished plaster should never be used in public halls, bathrooms or kitchens and generally is not as acceptable as hard finished plaster for living areas. Where not ruled out by cost considerations, ceramic tile wainscot for public halls, baths and kitchens is the best. Linoleum and washable wall papers such as Sanitas are satisfactory for baths and kitchens cost allowing.

At least two coats of lead and oil paint with gloss finish in halls, baths and kichens has given the best service. With better control over, and advancement in the development of synthetic resin paints they should prove more satisfactory. Casein paints are not recommended for long term satisfaction. All woodwork should receive three coats of lead and oil paint or stain (filler when required) and at least two coats of shellac or varnish.

THERMAL INSULATION AND CONDENSATION

STATEMENT OF THE PROBLEM

In recent years insulation of the dwelling against loss of heat during cold weather and against entrance of heat during warm weather has been given more and more attention. With future developments in cooling of dwellings during warm weather this problem will commend even greater consideration.

Referring to heat loss in cold weather, it, of course, is desirable to insulate, as a whole, to a point where there is the most economical balancing of capital costs and operating costs. However, insulation should be distributed to the extent that comfort in locations such as the living room, the outside edges of concrete slabs, the space up to 5 ft. above the floor line, and the spaces adjacent to large glass areas will be adequately taken care of.

When a wall, ceiling, or floor contains insulation all parts of the element under consideration on the cold side of the insulation are usually at lower temperatures than the inside surface. The warm air in the dwelling may have a high relative humidity resulting in vapor pressure outward in all directions. If this vapor diffuses thru the insulation and comes in contact with the cold parts beyond it, condensation may occur within the element whether it be wall, floor, ceiling or roof. Free water in these areas adversely affects the efficiency of the insulation and may result in deterioration of structural members and finishes and invite fungus growth within the construction.

In cold areas this has happened in some instances. The problem then is to prevent such condensation and still provide sufficient insulation to effect comfort and efficient heating in the living areas.

REPORT MATERIAL - PRIVATE

The FHA field office canvass reveals considerable constructive progress on this subject. Reports show that in the prewar period not over 25 percent of new dwelling construction had insulated ceilings, and only about 10 percent had wall insulation. Only a negligible number had insulation in critical places such as floors, over unheated spaces. If these figures appear low it is to be noted that much of the construction was in the South and West where insulation was not generally used at all. War Production Board requirements limiting heat loss in construction built during the war as a conservation measure to reduce the amount of critical materials consumed for heating equipment, resulted in wide use of insulation in walls, ceilings and floors. The effect of this war usage is revealed by the reports.

Eight field offices representing 37 percent of the national volume are unanimous in reporting trends toward increased use of insulating materials in post-war construction. Overall trends are strong toward additional insulation in ceilings and walls of all size classes of houses. The trends are not as well defined for more insulation in walls of masonry or for floors over unheated spaces; however, they are slightly toward increased use her also.

The few reports indicating the amount and trends in the use of vapor barriers are not sufficient to justify comment other than to say that apparently the problem of vapor migration into the construction with the resulting condensation under adverse conditions has not, up to this time, been given the consideration it deserves.

Typical comments received from the field offices are (1) HOUSTON: the war has sold insulation for coolness. It will be used more and

sors. (2) DALLAS: The war has shown the way for insulation in walls and ceilings. (3) CHICAGO: Insulation is expected to be used in all classes of houses. Vapor barriers are required with insulation. (4) PITTSBURGH: The trend is toward more insulation. Lack of reports indicating condensation troubles in private housing is understandable since relatively complete insulation was not used before the war and where it was used sufficient time has not elapsed for serious trouble to appear.

REPORT MATERIAL - PUBLIC

One of the most common complaints is, that with the use of steel casement sash condensation is general during winter months with water running down to the sills and in some instances off these to the floor. Lack of adverse comment on this subject when wood sash are used and even a few comments to the effect that, with wood double hung windows, there is no condensation, indicates better performance by wood sash.

Report material also indicates that in areas as far South as Washington, D.C., condensation on the inside face of solid exterior masonry walls where furring has been omitted and on the inside face of concrete columns and spandrel beams which have no furring has been a source of trouble. The seriousness of this is demonstrated by the fact that investigation in some cases has determined that what were called leaky walls were actually walls on which excess condensation had formed.

The outside edges of concrete floors on the ground in some instances have caused condensation when not properly insulated to prevent direct heat transmission through unobstructed masonry to the outside. Failure to insulate structural first floor slabs over ventilated crawl spaces often results in condensation on the surface of the concrete floor under adverse humidity and temperature conditions.

Spaces between ceilings and roofs, especially in temporary war housing, are reported to be critical locations giving condensation troubles. Here the sloping roofs generally provided better conditions than the flat roofs with their reduction in space between roof and ceiling. Typical comments are (1) poor roof ventilation (2) condensation appears with flat roofs where laundry work and cooking is done in the apartment (3) the problem of venting the space between the roof and the ceiling needs further study (4) unventilated spaces between the roof and the ceiling result in trouble (5) inadequate ventilation of the space between the roof and the ceiling causes condensation, wet insulation, and the plaster falls. Inspection in some instances, however, has indicated that through improper details or construction oversights or lack of understanding of the problem, the required ventilation and vapor seals were not obtained.

Because condensation within walls and floors is more difficult to detect visually, specific reports on trouble here are not numerous. In the northern part of the country, especially around the Great Lakes, however, considerable condensation, inside of walls containing insulation, has already been observed. Here insulation, on removal of the wall covering, has been found to be well saturated and wall surfaces have become disfigured. Special field investigations are now in progress to determine the causes for this apparent excessive condensation and to recommend design and construction procedure to prevent recurrence.

Reports state that some dwellings are excessively air tight with their weatherstripping, lack of ventilation from the kitchen, and no access to a second story or basement. In some cases it was necessary to drill holes in door panels in an attempt to provide ventilation to re-

lieve the situation. Other scattered reports point to excessive use of gas fired appliances in the dwelling; excessive laundry work within and the complete closing up of the dwelling for long periods of time as major contributing factors to condensation trouble.

Insulation for fire resistivity in connection with heating plants, space heaters and chimneys is discussed in another section.

CONCLUSIONS

This subject of insulating against heat transmission and preventing condensation is one that is deserving of thorough study and research to determine steps to be taken in the design and application of insulating materials together with the required vapor resistance and/or ventilation. Among the items requiring consideration as they occur in the particular structure involved are (1) regions of the country as it is divided into belts of equal design temperatures; (2) the range of outside relative humidity expected in these areas; (3) the effect of tight construction obtained with weatherstripping, and with the use of walls, floors or ceilings which restrict normal air infiltration; (4) the effect of, and to what degree, gas fired appliances, laundry work, cooking, bathing and other operations known to add water vapor to the air within the dwelling have on relative humidities; (this is especially important in small dwellings); (5) the accurate and uniform determination of the vapor resistance of various materials used for inside and outside wall covering, and finish, and for the wrapping of insulation or used separately as vapor barriers; (6) the determination of the reduction in effectiveness of these materials when assembled or applied in various ways; (7) the effect of various methods of ventilating spaces on the cold side of the insulation as an independent means of preventing condensation or in correlation with the use of vapor barriers.

Study is also required to determine the degree to which various living areas such as living or sitting rooms and studies or bedrooms should be insulated so that the dwelling as a whole has a low heat transmission loss with resulting suitability of comfort for these areas. To date consideration has been generally confined to floors, walls and ceilings and over-all heat loss with little thought to special insulation in those parts of the dwelling which are used most and therefore might deserve special treatment for both comfort and economy of operation for various types of heating equipment.

Investigation is now under way to determine the actual heat transmission of floors on the ground and of floors having crawl spaces under them and what effect the closing of the crawl space may have when it is practicable to close it. This should be continued to the end that computations on heat transmission can be reasonably assumed to represent that experienced in actual construction.

Pending development of more complete data on this subject, it is not wise to attempt to recommend definite requirements and procedures. However, it is necessary to realize that as thermal resistance is increased by the addition of insulation, resistance to vapor migration and/or increases in ventilation are necessary.

SOUND INSULATION

STATEMENT OF THE PROBLEM

In the past, insulation against sound transmission was not given much thought due to the capacity of the heavy masonry construction or the plastered frame construction for absorption of noise and to resist vibration. Temporary war, demountable, and shop fabricated dwellings with their thin light walls and floors have demonstrated the necessity for insulation against sound transmission particularly between dwelling units in row or twin houses. In single houses the necessity is not so great although in certain instances such as partitions dividing living areas from sleeping areas sound insulation may be needed.

With the determination of sound intensity expected in various parts of the dwelling and intensity of sound which will disturb occupants of other parts of the dwelling, standards for required sound absorption can be set up. With tests of complete assemblies and possibly the development of formulae to calculate expected sound absorption it will be possible to select construction which will be suitable.

In order to adequately handle this problem we must:

(1) Determine expected intensities of sound at its origin within the dwelling or outside of it.

(2) Make such study as is necessary to determine the intensity of sound that is likely to annoy occupants of other rooms or other apartments.

(3) Develop standard techniques of determining sound transmission resistances of various constructions.

(4) Develop data on sound transmission properties of various constructions most generally used.

(5) Adapt the data developed to practical construction at a minimum of expense commensurate with the results required or obtained.

REPORT MATERIAL - PRIVATE

The FHA field office canvass revealed little information on this subject. It is believed the comments received referred to single detached dwellings where little trouble is experienced when all inside sound is controlled within the one dwelling. It is known that complaints have been made on the unsatisfactory sound absorptive properties of partitions in private multiple apartment houses.

Reports indicate only that there is no serious problem in detached houses and no change from past practice is expected in the smaller close ones. In the medium and large close houses a slight tendency toward better sound insulation is revealed.

REPORT MATERIAL - PUBLIC

The reports are quite general in indicating that sound transmission, particularly in temporary war housing is too high. The lack of sound insulation in party walls and in walls between bath rooms and kitchens caused the majority of complaints. Other places receiving adverse comments were floors over heating rooms, boiler rooms or machine rooms, and second floors, particularly when the second story was occupied by children and the first story by a war worker on the night shift.

In a few instances where medicine cabinets were placed back to back they were found to offer practically no resistance to sound transmission. Single thickness stud partitions covered with dry-wall finish were criti-

cized severely. Among typical comments are (1) sound insulation is mandatory (2) many people are disturbed by noises from other apartments (3) sound transmission is bad with gypsum board walls (4) the partitions are not adequate for sound proofing (5) sound proofing is almost universally inadequate (6) sound proofing between units is inadequate (7) tenants complain of noise through party walls (8) interior partitions need more sound-proofing (9) sound transmission is too high.

At one project in California where a canvass of the tenants was made, it was found that 60% of them complained about high sound transmission of the partitions.

In another case where row dwellings were of shop fabricated construction, field investigation revealed that the plywood first floors carried sound horizontally so that noises such as radio music could be heard several apartments away. In later designs this was corrected by entirely separating floor units under party walls.

Reports indicate that the placing of a door between the chamber hall and the living room considerably lessens the sound transmission, thus allowing normal use of the living room while children or others sleep. Favorable comments on the sound transmission resistance of 4" masonry partitions and double frame partitions indicate that they are far more satisfactory than the single frame partitions.

CONCLUSIONS

The subject of sound insulation is one of growing importance in the design of dwellings. Noise has increased with the growth of the radio, traffic, and even aircraft, while we are tending toward less bulk and weight in the building, especially where dry wall finish, pre-fabrication or hollow unit masonry wall construction is involved.

Sound originating in a dwelling, as far as intensity and volume is concerned, maybe divided into two categories; namely (1) that from the living room or dining room and (2) the lesser noises which might come from the bed rooms or other areas not generally used for assembly and radio, piano or other musical instruments. It therefore, follows that insulation for sound transmission is more important for walls, floors and ceilings of the living and dining rooms than it is for these elements when they divide bedrooms, or separate bedrooms from unoccupied spaces.

Planned room arrangement with elements, both rooms and halls, separating the living rooms and bedrooms can in many cases aid in lowering sound transmission and should be employed where practicable. Where this is not possible sound insulation will be necessary for proper living conditions for a great many of the wall, partitions and floor constructions used in post-war housing.

The need for such insulation is readily apparent when it is realised that the intensity of sound in a room with radio playing may be in the order of 70 to 80 decibels while a thin single stud partition with dry wall covering may have a reduction capacity as low as 25 decibles and while a solid 9 inch brick wall plastered both sides may have an average reduction capacity of only 50 decibels. Openings in walls greatly reduce their capacity to absorb sound and will require special treatment to obtain the desired over all effect.

The above refers to "air-born" sound only. "Impact sounds" such as that in which the floor or wall itself is the source from direct impact presents another problem. Here insulation must be achieved by preventing the impact from vibrating the wall or floor.

In setting up performance standards for the various elements of a dwelling as they relate to "air-born" sound and to "impact" sound a decision will first have to be reached as to expected intensity and frequency at the source followed by determination of the required reduction and the means of obtaining it for suitable conditions.

FUELS

STATEMENT OF THE PROBLEM

The development of Public Housing has stressed the need for intelligent selection of the most economical combination of fuels and Power for heating of spaces and water, cooking, refrigeration, lighting and miscellaneous auxilliary functions of household use. The need for achievement of low operating expense coupled with the variation in costs of fuels and utility rate structures in various parts of the country usually requires a careful analysis of the problem before final designs are accepted.

Cost of fuels and power must include, not only the actual charges for fuel but the applicable expenses of all other items which are necessary adjuncts to the use of that fuel, such as interest and amortization, maintenance and repair of the fuel consuming equipment, cost of related fuel storage equipment, additional cost of structures by the equipment, etc.

Public Housing, generally, has pioneered the residential field in the selection of the most economical overall fuel and power combinations, but, during the emergency period, when restrictions had to be placed on critical fuels and electric power and on the accessory equipment for their utilization, many projects were constructed which were unable to utilize the best combinations and less desirable selections had to be made.

Pre-war construction used coal, oil or gas for heating and hot water; coal, oil, electricity or gas for cooking; gas electricity or ice for refrigeration and, of course, electricity for lighting

and auxilliary power.

War restrictions almost eliminated the use of oil and gas for heating and hot water to some extent for cooking. As a corollary, the use of coal was increased for these purposes. Mechanical refrigeration by gas or electric equipment was eliminated except for a few areas where ice deliveries were not available. Electricity demand was reduced to the greatest possible extent by elimination of fixtures and outlet connections. The results of this reduction of availibility of fuels have been; greater operating expense; increased tenant dissatisfaction and increased demand for improvement in the post-war period.

REPORT MATERIAL - PRIVATE

Reports from 42% of the FHA offices indicate that cooking equipment is preponderantly gas fired to the extent of approximately 90% of all the reporting offices. Nearly all the remaining units are electric, the percentage running higher in the Medium and Large classes of dwellings. These offices report a trend toward the use of more electric ranges and less use of gas ranges in future installations. Only a small percentage of coal, wood and oil ranges are reported while the trend is for decreased use of these fuels for cooking.

Reports from 40% of the FHA offices indicate that gas is used for heating fuel in approximately 42% of the pre-war construction with oil being used in 33% and coal in 25%. Of the coal fired units, about three quarters were manually fired and one quarter fired by automatic stokers. Trends reported by FHA offices indicate increased use of oil and gas and decreased use of coal.

No data was reported concerning selection of fuels for other purposes.

REPORT MATERIAL - PUBLIC

Approximately one half of the reports relating to fuels and power are in the form of objections to the use of some particular fuel or piece of equipment, the majority being objections to bituminous coal because of the increased maintenance, dirt and handling problems. Seventeen of thirty-five comments relate to this problem, eleven of them being concerned with the bituminous coal.

Objections to the total combination of fuels and power were raised but these objections were all from specialists, none being reported by project reports. There appears to be a tendency here to select fuels according to the utilization equipment regardless of the economic problems involved.

Some reports indicate poorly operating billing methods where master metering of gas and electricity is concerned. Pro-rata charges are high or unbalanced between various types of dwelling units. Tenants appear to be uninformed regarding the methods used.

A few comments refer to difficulties in arrangement of individual fuel storage facilities, access thereto, and to difficulties of fuel delivery.

In some cases the reports complain of misuse of fuels such as the heating of houses by means of the gas range, where the gas is master metered and flat rates charged the tenants. This, of course, is a function of individual heating systems where bulk purchase of gas and electricity exists.

CONCLUSIONS

The cost of fuels and the expense of the fuel utilization equipment represent a major item in the annual expense for operating any home. It is, therefore, incumbent upon the designer that he make careful selection among the various fuels, power and equipment which are available in most localities. Public Housing in particular, with larger projects than Private, has found it advantageous to observe this principle, usually with good results. Selection should be made on the overall cost of each combination of fuels and equipment covering all required services and the selection by first cost or by desirability of equipment, alone, should be eliminated.

Some very useful fuels, such as coal, are not utilized to their fullest extent in normal times due to popular objection to the equipment available for their use. It was shown, in the emergency period, that coal could be used without undue inconvenience, for cooking by persons who had never before done so and that there was very little objection to this service over the large number of installations. Sincere efforts should be made to remove the objections, which have been built up, by improving the appearance of the equipment, such as coal ranges and coal water heaters, so that they will gain more extended use in the post-war low cost housing field.

In Private construction, existing conditions of improperly selected fuels and the attendant burden of expensive operation and carrying charges, point up the need for the preparation and dissemination of technical information to make consumers, builders and architects concious of the need for considering total cost - interest and amortization plus operating expenses - in selecting fuels and equipment.

Attention should be given to the methods of billing, now in use, for gas and electric services where bulk purchases are made through master meters. Many of the problems could be solved by education of the tenants in the actual economies involved. While many tenants demand individual meters, it can usually be shown that the cost of such meters will actually increase their expenses since the cost of the meters, meter reading, maintenance, billing, etc., usually exceeds any normal wastage or misuse encountered on any project particularly where the project supplies heat and hot water. Where tenants use gas or electricity to heat their homes, in order to avoid the purchase of coal or oil individual heating fuel, it may be necessary to install check meters but many fair schemes have been arranged to avoid this situation. A thorough study of present billing methods should be made and a standard policy should be adopted for such practices.

HEATING

STATEMENT OF THE PROBLEM

Several systems, variations and combinations have been in use, each evolving from a set of enviromental conditions of weather, fuel availability, cost consider tions and personal comfort preferences particular to the project locality.

These systems can be roughly grouped as: War air heating; heating by radiation; and radiant heating. Each of these groupings may be broken down further according to the mechanism of heat distribution; gravity; mechanical; etc., and by the heat transfer medium: Air; Steam or Water.

The general problems arising in heating dwellings are attributable to: Lack of capacity of the heat generator; Inadequacy of the heat distribution method or mechanism; and inefficiency in the translation of heat to personal comfort by the heating elements.

Except in the most Southern areas of the country, heating is one of the most important single elements of the dwelling. Heat is necessary through approximately 50% of the year, in average localities, for comfort and health and as a protection to the structure against damage by cold and moisture.

Heating, in general, can be considered as no more than fair in its present applications but there appears to be a growing tendency toward improvement as relating to health conditions. The various unhealthy conditions created by over and underheating, drafts, vitiated air, etc., are now more widely understood by the industry and can eventually be overcome by perseverence in research and development of more adequate

methods, construction and equipment. The impetus caused by the WPB restrictions has greatly stimulated thinking along these lines and has, for example, advanced the use of thermal insulation which is a large factor in improved health conditions.

Present standards are rather loose considering the importance of this subject, the only really effective ones being those of the Federal groups which require certain inside temperatures to be obtainable. Local codes and ordinances are generally weak or omit any reference to heating.

There is a real need for the determination and application of healthful heating standards in the general field of house heating.

REPORT MATERIAL - PRIVATE

Complete reports from FHA field offices indicate that pre-war private housing utilized many types of heating system, principally warm air systems and the conventional radiator systems, both steam and hot water. For the small class house, the incidence showed about 45% air heating with "overflow" systems, 35% air heating by duct systems, both gravity and forced and about 18% radiator systems. The reports for the medium and large class houses show a decrease in the incidence of "overflow" air heating systems to 15% while the duct type air heating systems increase to about 50% and the radiator systems increase to about 33%. In all classes, a few cases were cited where panel or radiant heating was installed, principally in the large class where the incidence was 1½%.

The reports show that there is a trend toward the elimination of the "overflow" type system in favor of forced warm air systems with duct distribution. No change is indicated in the percentage of other types of heating in the post war period.

The figure given by the field offices indicate very little use of electric and other types of heating and there is no trend toward the increase of this type of system.

REPORT MATERIAL - PUBLIC

The major complaint, brought out by the report material, is of discomfort due to insufficient thermal insulation of the structure and inadequate heating equipment. The individual reports indicate that more or better weather stripping and storm sash is required in the Northern Areas in order to avoid drafts and excessive heat loss. Cold floors are complained of in several instances showing the need for proper insulation of the floors and for adequate treatment of crawl spaces. Some comments note the excessive heat loss from steel casements when compared to double hung wood sash. In many cases these complaints are due to faulty construction work rather than to poor design but they serve to emphasize the need for accurately following up the standards through construction to utilization and to indicate the need for proper design which may eliminate the problem.

The greatest number of reports discussed the choice and design of the heating system. The majority of the complaints were based on inadequate, uncomfortable heating by means of "space heaters". The location of the heating equipment was also discussed showing need for thoughtful planning.

The use of individually operated heaters located in the dwelling quarters, brought forther many objections due to dirty conditions and fire hazards, particularly in the case of coal fired space heaters.

Scattered reports mentioned improvements in design of group and central heating plants but these items are generally understood and the specific complaints arose due to omissions or deviations from recognized

practice.

CONCLUSIONS

No general recommendation can be made for any particular system of heating since the determination must be made locally and is dependent upon the availability of fuels, construction design and living habits of the proposed tenants and cost analysis. The system selected should combine the most effective equipment which will produce the most desirable results at the lowest compatible cost of installation and operation.

In order that this planning and selection may be accomplished, it becomes necessary that performance standards for heat distribution be established. Such standards must take into consideration air temperatures, quality of air and temperatures of enclosing surfaces, air movement and humidity before the optimism of comfort and health is achieved. Ventilation requirements for typical conditions of occupancy, heating systems and building heat loss should be included. While much of this data and information is available, it is by no means complete and many items are in need of careful revision before final standards may be set.

Information, concerning the best present knowledge of the health requirements of heating, should be placed in the hands of those who are to construct the buildings and to the prospective tenants so that their collaboration will produce more adequate and effective results.

There is a real need for specific planning and selection of the heating systems and in the related parts of the building structure such as thermal insulation and infiltration protection, to assure that the best principles of technical knowledge will be applied in the field. Additional capital, properly spent on correctly designed installations, in the long run will easily pay for itself many times over in the reduction of carrying

changes and in reduced maintenance and operating expense. The present practice of selecting heating systems for first cost considerations or sales pressure only, should be eliminated by education of the trades and the general public.

The impetus given to the increased use of thermal insulation, by the war time restrictions should be encouraged to continue through the post-war period. The increased interior surface temperatures, which are obtained by this construction, are conducive to greater comfort and health and result in savings in operating expense which are of a magnitude to amortize the increased first cost in a short period of time. It must be borne in mind, however, that proper ventilation must be considered in this type of construction, so that the completed structure will satisfy the best health requirements.

The use of individually fixed "space heaters" set in the living quarters, has proven to a poor substitute for the better types of heating, when health requirements are considered. Some measures should be taken to restrict the use of this equipment to that field where it is best suited, i.e. where first cost is the only consideration and where the heating season is mild and of short duration.

Forced warm air heating with complete return ducts, are preferable to the usual grevity type warm air systems without controlled return air. Uncontrolled return air creates unhealthy, drafty conditions and should not be used.

Radiant panel heating is being tried on an ever increasing scale and shows promise of coming into use. Every effort should be made to determine the characteristics of this type system and to further its use in the interest of improved heating health.

No recommendations are necessary concerning the radiated heating systems since these are well known. There is, however, a need for suppression of misleading information promulgated by competitive interests since this type of information leads generally to incorrect selection of equipment and system.

There is need for consideration of ventilation requirements in the design and installation of heating equipment. It has been shown that combustion equipment located in living spaces can increase the vitiation of the air, within the dwelling, to a point injurious to health. It would be well to restrict the use of such planning so that it will not be used in small houses. For such houses the addition of a basement or cellar will not only remove the problem of vitiation of air but will also improve the quality of the heating.

DOMESTIC HOT WATER

STATEMENT OF THE PROBLEM

This subject deals with the generation and distribution of adequate supplies of hot water, for domestic use, to all fixtures requiring it.

Normal practice has been to generate the heated water in individual water heaters or in group or central stations for project distribution. Fuels have been of all kinds - coal, oil, gas and electricity - which have all been successful in operation under proper design, selection and use.

Individual heaters are of the automatic, semi-automatic or manually operated types or consist of coils or water backs installed in the fire boxes of heating or cooking appliances. A small percentage are of the instantaneous type while the majority have integral or separate tanks for storage of heated water.

Group or central stations usually consist of storage tanks containing submerged steam coils or of coils built into the heating boilers and supplying storage tanks. In some cases separate boilers are installed to supply the hot water. Project distribution systems for hot water follow the heating distribution system and are equipped with return circulating lines to insure proper temperature at the outlying fixtures.

During the emergency, very few central or group types were constructed the majority of installations being individual and the greater proportion for public housing being storage tanks heated by the coal cooking ranges.

The pre-war pattern of private housing shows that the vast majority of dwelling units were equipped with individual water heaters completely independent of any other equipment. About 8% utilized heat exchangers and about 4% utilized firebox coils or water backs. Of these heaters, only 1 in 8 was insulated. Approximately 2/3 were automatic in operation, the majority being gas fired units.

REPORT MATERIAL-PRIVATE

Reports from 96% of the FHA offices indicate a trend to increase the percentage of automatic types of water heaters with a corresponding decrease in manual types.

A similar trend is shown indicating increased use of insulated hot water storage tanks in lieu of uninsulated types. This follows the shift which appears to be under way from coal and wood cooking ranges with heating coils or water backs, to automatic gas, oil or electric equipment.

REPORT MATERIAL-PUBLIC

Approximately one quarter of the reports are concerned with the storage capacity of the water heating apparatus. Some questimn the adequacy of the FPHA standards of 20 gallon storage for single bedroom units and 30 gallon storage for larger units. Some object to the use of 9 gallon semi-instantaneous heaters.

The reports carry conflicting recommendations but generally indicate a desire for increased hot water storage capacity.

Many complaints were received relative to materials used in the hot water systems. These indicate difficulties with tanks - because the materials or lining are not suited to the water condition or to shipping and erection hazards - difficulties with equipment furnished by the Mass Purchases Program, faulty relief valves which fail under operating conditions and omission of certain items, normally used, such as sediment faucets or drain cocks.

Complaints, of equal magnitude, were received about gas fired water heating installations. These report non-automatic apparatus without safety pilots, clogged or faulty thermostatic gas valves, etc. Some request more adequate specifications for heaters and one complains that the fuel is too expensive.

Several items refer to the design of the hot water systems. Some recommend improved location of apparatus in individual systems and others discuss the disadvantages of drainage from relief valves or tanks into the crawl spaces or living spaces. Some discuss problems arising from errors of design or construction in project operated systems.

A few reports request coils or water backs to be installed in heating or cooking apparatus for use in winter to affect economies by shutting down gas fired water heaters.

One comment was received stating that solar type water heating was satisfactory in that (Southern) project.

CONCLUSIONS

There appears to be a need for added research to develop optimum and minimum requirements for storage capacity and temperatures to be maintained in the individual types of water heating systems. The present standards of the FPHA, while generally adequate, fail to satisfy a large portion of the tenants and flexibility, according to local requirements, must be added to the standards.

It is apparent that considerable trouble was experienced when substitute materials and equipment were used during the emergency. Where non-ferrous or acid resisting tanks were normally called for by water conditions, it was necessary to substitute "glass lined" and cement lined tanks or ordinary steel tanks. These tanks gave uniformly poor service and cannot be considered as substitutes to be used after restrictions on critical materials have been removed, unless difficulties experienced during the war can be overcome.

Equipment such as valves and controls was also weakened by substitution of less critical materials which caused decreased operating life and efficiency. The use of these substitutes indicates that pre-war materials should be restored as soon as possible.

Considerable attention should be given to the design of the water heating system especially in the individual dwelling unit types. Unit plans do not usually provide much leeway in location of apparatus but there is generally one best solution which can be worked out provided sufficient time and study is devoted to the problem.

Such study will pay for itself in decreased maintenance and increased satisfaction. Piping problems can be simplified and dangerous or unhealthy conditions can be removed by applying good engineering principles to the individual designs. Present standard plans can be improved to encompass these points and efforts should be made to accomplish this work.

The objections to certain types of equipment or fuels and the selection of proper combinations of fuels have been discussed in another section of this report. Let us repeat, that best results will be attained when overall combinations are analyzed and selected, rather than when selection is based on equipment and first cost only.

Certain other equipment, for water heating, such as solar heaters and electric heaters, have good application in certain areas of the country. More data and information is needed concerning these devices and it is recommended that research be stimulated to determine the useful limitations of this apparatus.

SEWERAGE AND DRAINAGE

STATEMENT OF THE PROBLEM

The object of sewage and drainage systems is to carry away all soil and waste discharge from the buildings and where possible to collect and dispose of all surface drainage from the site. The systems include all sewerage underground storm water drainage and allied portions of the surface drainage systems.

Sewerage has been in use for a long period of time and a great deal is known about its design. This knowledge has been applied to the formation of standards for both public and privately financed housing and its use in conjunction with the usually adequate local sanitary regulations, has developed no great problem, except where, proper standards have not been observed.

On the other hand, the removal of surface and storm water, has posed a problem particularly in the development of the larger housing projects. While considerable data is available concerning rainfall and the hydraulic flow factors can be developed, this information has not been applied to the fullest possible extent, with the result that serious difficulties have been encountered in many projects and on many private properties.

Some of these difficulties are attributable to local requirements which regulate the disposal of storm water by prohibition of access to municipal sewerage systems, by the lack of municipal storm water systems or by the inadequacy of such systems when access is permitted.

REPORT MATERIAL - PRIVATE

REports from 30% of the FHA field offices indicate that pre-war construction allowed for storm drainage by underground storm sewers in

about one third of their cases, the remainder disposed of the storm water by surface or open channel drainage. These offices report a very strong trend toward the elimination of surface and open channel drainage in favor of underground drainage.

Reports from 40% of the FHA field offices indicate that pre-war construction included sewage disposal systems, 15% private septic tank, 5% private cesspool, 3% community sewerage and the remaining few with privy. The field offices report strong trends toward the use of public and community sewerage and decreasing trends in the use of private cesspool, septic tank and privy construction.

REPORT MATERIAL - PUBLIC

The major item reported was that of inadequacy or ineffectiveness of the surface drainage systems. Reports indicate severe erosion of terraces, banks and slopes, puddling of flat areas, and reversed drainage toward buildings. These reports indicate failure of the designers to gauge the grading properly and of the construction crews to conform to grades properly designed. In some cases the flat areas are of vast extent and storm sewers are unavailable or missing. The result is that the surface becomes swampy.

Many comments relate to poor drainage of roadways, particularly when heavy grades prevail. Loose packed gravel or chip surfacing has suffered from erosion and concrete curbs and gutters have been broken by undermining. Gutters and curbing have been omitted in some cases with bad results. Insufficient number of catch basins or clogged catch basins increased the flooding and erosion of the roadways.

In some instances the concrete walks are placed so as to carry surface water and reports indicate that such walks are unusable in

rainy weather.

Several complaints were reported regarding the design of the sewerage system, such as breakage of pipe, poor location or type of catch basins, equipment inadequate or of poor quality, etc.

Others report poor materials or poor design of equipment. Sewer pumps have given trouble by clogging and equipment has suffered through tampering by unauthorized persons.

While no reports were received discussing the various problems related to individual or group septic tank systems in public housing there have been many instances of serious trouble with this type of installation. The causes to which the troubles are traceable are usually found in poor elimination of the effluent due to faulty design or installation or both.

Another unreported source of trouble lies in the design, construction and operation of project sewage treatment plants. Few, if any, of the disposal plants erected for public housing projects, have performed in a continuously effective and adequate fashion and most of them are a constant problem to the project management.

As a general rule, it can be stated that the elimination of sewage, from both publicly and privately constructed houses, has been well done when public or community sewers were utilized and that the results have been contrastingly poor where individual or group septic tank systems were selected. One probable reason for this condition is the fact that where sewers were used, specialists were given the responsibility for the design or governing codes required certain performance and design standards, whereas insufficient thought and planning were devoted to the septic tank installations.

The selection of septic tank systems is dependent on many variables such as natural phenomena, topographic conditions, diet of residents, temperatures, etc. and cannot be considered as a precise science. Before it is determined that septic tanks will or can be used for any certain building, it is necessary that a survey be made to determine the individual conditions for that building. After it has been determined that the septic tank installation can be successful, there still remains the matter of correct design, of the system. As a request, it is apparent that it is necessary to engage the services of competent specialists to determine the method of sewage disposal and to assure compliance with the best principles of sanitary engineering, before any system is installed. There appears to be an urgent need to develope appreciation of these facts in the minds of the designers, builders, tenants and owners of homes to be constructed in the post war period.

In the matter of sewage treatment plants, which affects public housing more than private construction, it must be pointed out that the design of such plants is a highly specialized subject which should only be entrusted to those qualified in such matters.

There has been shown a need for a complete follow-through on drainage systems for storm water, beginning with an adequate, accurate design and continuing until the completion of construction. The principles are known and set forth in standards but the operation of projects indicate that somewhere, between design and completion, errors have been allowed to creep in with the usual grievous results. Strict inspection and supervision is necessary on this work

PLUMBING - INTERIOR

STATEMENT OF THE PROBLEM

The problem in plumbing is to achieve safe sanitary disposal of household sewage wates, to provide adequate supply of water and gas for family requirements and equipment and to secure drainage from all parts of the structure to avoid accumulation of rain and ground water.

It has been the usual practice in plumbing installations to follow local building codes where ever this was necessary and, as a result a wide variety of types of installation is to be found throughout the country. Since plumbing affects sanitary and health conditions, the local governments, rightly enough, created standards according to their individual understanding of the problem. Where such governing bodies had adequate resources the codes have been generally good, but in many cases, because of lack of understanding or because of the actions of political and sales pressure groups, inadequate or excessive requirements have been included. In many other cases there are no codes at all and installations are left in the hands of the mechanical trades.

Another problem of codes for plumbing arises from the type and quality of the enforcement agency charged with administration of the building codes. Several instances show that even though good codes are applicable, the administration is in the hands of inspectors, some of whom are incompetent to interpret the rulings of the code or who, for one reason or another, see fit to over-look basic code regulations. In many other cases the codes exist without any administration and are therefore largely ineffective as concerns the

welfare of the community.

During the emergency period the restrictions on materials caused the War Production Board to refuse certification to any construction which required materials in excess of the minimum requirements of the "Emergency Standards for Plumbing" a code developed by the Government in collaboration with the National Association of Master Plumbers of the United States, The United Association of Journeymen Plumbers and Steam Fitters of the United States and Canada, and others.

This ruling effectively reduced the design of plumbing in those areas where excessive code requirements had been in effect, but it did nothing toward the strengthening of plumbing design in those localities where sub-standard codes were followed or where no codes existed.

The FPHA remedied this situation by requiring the work done under its jurisdiction to be brought up to the minimum requirements as well. This had the effect of standerdization of plumbing design throughout public housing construction and, since local codes were voided in such work, it introduced the Emergency Standards for Plumbing, as a code, to many localities.

The promulgation of this code has had the effect of educating the various localities, trades and manufacturers in the advantages and possibilities of more uniform practice. The "Emergency Standards" was not accepted with open arms in all communities and there remains some objection to its use but many of the arguments produced against it have been proven false by the picture of its successful operation. Other communities, where no codes or code enforcement existed have undoubtedly been greatly benefited by the use of the "Emergency Standards".

REPORT MATERIAL - PRIVATE

Reports from 40% of the FHA field offices indicate that, in pre-war construction, approximately one quarter of the houses were constructed with extra half bathrooms although none of them were installed in the small class house. About 10% had extra shower and 10% had extra full bathrooms, the latter being totally confined to the large class house. The trend appears to be toward the use of more extra plumbing fixtures, particularly for full or half bathrooms, except that the trend for the small class house shows little or no change.

Reports indicate that pre-war houses were equipped with galvanized ferrous water pipe in 75% of the cases, most of the remainder having copper tubing while a very small number were fitted with brass pipe. The trend is strong toward increased use of copper tubing.

REPORT MATERIAL - PUBLIC

The report material indicates that a majority of complaints concern themselves with incorrect or inadequate piping design or with desires for improvements or additions to present piping systems. Chief among these reports was the desire for adequate and accessible clean outs on soil and waste lines. Another major complaint was with the type of fittings used in waste lines, requests being chiefly for the long radius smooth flow fittings, which are generally required by all good plumbing codes.

Second in importance, was the number of items concerning the drainage of crawl spaces, footings and basement areas below grade. These reports indicate the accumulation of surface and ground water and the general inadequacy of French or blind drains to handle such accumulations in some projects.

Many reports indicate that gutters and rain leaders are necessary from roof areas and that erosion is severe and crawl spaces, basements and lower parts of exterior walls are affected by dampness when roof dripping is allowed or when splash blocks are used. All request positive connection of leaders with storm sewer or with project sewerage although it should be pointed out that many localities prohibit such connections to soil sewerage and that cost economies may bar the addition of storm water drainage systems.

Some reports mention freezing of piping, generally located under the first floor in temporary projects. This of course, is a matter of design and installation and can be corrected by proper insulation and construction.

A few instances were noted which relate to equipment, of the need for uniform sizes of washers and of the venting of gas ranges, or of faulty equipment. These are of minor importance and can be solved by proper design.

CONCLUSIONS

There is but one major recommendation which can be made concerning plumbing and that is; to formulate and promulgate a National Code for Plumbing to be used as a guide for local jurisdictions and to assist those areas where local regulation does not exist. Such a code could be based upon the recommendations of BMS-66 plus any revisions found necessary through later experience and experimentation, and should have the approval of the trade associations and manufacturing interests involved in its requirements.

A basic code of this type plus intelligent and effective administration by local bodies would eliminate practically every plumbing problem.

PLUMBING FIXTURES

STATEMENT OF THE PROBLEM

The function of the plumbing fixtures is to furnish convenient, safe and comfortable facilities for the domestic necessities of cleanliness, health and hygiene and for the utilization of the hot and cold water supplies.

The average small home is usually equipped with single bathroom containing one water closet, one lavatory and either a bathtub or shower or combination of both, and with a kitchen sink and laundry tray, separate or in combination. Pre-war custom included bathtubs in all cases but during the emergency period, it was necessary to substitute shower stalls which contained considerably less critical material.

The kitchen and laundry fixtures were usually combined into a single sink and tray located in the kitchen except where central or project laundry rooms were available in public and multi-family rental private projects, or where basements or utility rooms were furnished in private projects. In these cases the sink was placed in the kitchen and the laundry tray usually was eliminated from the dwelling unit in multi-family projects and relocated in single family structures. In some cases where large families were housed, it was found necessary to provide double tray laundry facilities for each such dwelling unit.

Extra plumbing fixtures, in addition to the usual three fixture bath and kitchen sink, are rarely installed in public housing or in the small class of private housing. However, the medium class of privately constructed dwellings usually are fitted with an extra half bathroom with water closet and lavatory and sometimes with extra showers stalls, while the large class of privately built houses usually has a complete second bathroom plus an additional half bathroom or shower stall.

REPORT MATERIAL - PRIVATE

Reports from 40% of the FHA offices indicate a trend toward the installation of more plumbing fixtures over and above the minimum 3 fixture bathroom. This trend is almost negligible for the small class of houses but amounts to approximately ten percent for the medium and large classes with the heaviest expectancy being for additional full or half bathrooms.

The trend for additional odd fixtures, water closets, lavatories or showers, is very small except that the medium class indicates a ten percent expected increase in extra showers.

REPORT MATERIAL - PUBLIC

The major proportion of the reports refer to difficulties from the nature of the materials used in the fabrication of the fixtures and trim. Most of these references complain of the high breakage and maintenance costs of the tile or "pottery" type sinks, trays and lavatories, and of the unsatisfactory features of the "Victory" trim and substitute shower stall materials.

The Mass Purchase program receives criticism which is primarily caused by this fact.

Some reports discuss the locations of equipment and fixtures in the dwelling units, with various recommendations for improvements for space and handling efficiency.

Some criticism of design was received relative to the choice of fixtures such as the natural preference for bathtubs over showers, the advantages of stall showers over those built directly into the bathroom and shower trim locations.

A few reports indicate misuse of fixtures such as the use of the laundry tray for bath babies and the health hazards created by the accumulation of spilled garbage in unused laundry trays.

CONCLUSIONS

A return to pre-war materials, for fixtures and trim, should be arranged as soon as the restriction can be relaxed. This alone will solve most of the problems affecting fixtures. It is not likely that the war time substitutes can compete in the post-war market.

There is a strong possibility, however, that many new materials not used for fixtures because of critical supplies may be used in the future. Among these items are the various new plastics which may easily find wide acceptance in fixture fabrication. Considerable research and development is needed for this and every effort should be made to add these materials to the plumbing fixture field where they show promise of reducing costs.

It is very unlikely that any Mass Purchase program will be carried on into the post-war period. The program, carried on during the emergency, handled materials, which, because of the many restrictions, were necessarily of poor quality and appearance and which had low structural strength.

These features of the program, combined with poor shipping facilities and schedules, delayed production and inefficient organization, combined to defeat any economies which might have been effected by bulk purchase and also failed to speed up the construction by delays in delivery. The result was complete dissatisfaction with the fixtures and trim which might otherwise have received a more fair treatment on the jobs.

There appears to be a strong desire to return to the use of bath tubs rather than to depend on showers which are very inconvenient in the care of children and not suitable for the infirm, aged or sick. Private building has experienced extreme opposition to the omission of bath tubs in war housing construction and despite masculine preference for showers, new construction will always include a bath tub, probably with shower overhead.

The arrangement of fixtures and equipment in kitchens should be thoughly studied in the light of the complaints received. There is need for continued study and research to determine the best standards for arrangement and selection of equipment.

WATER SUPPLY

STATEMENT OF THE PROBLEM

Water supply is an important item in the development of healthy living standards in housing. Its function is to provide adequate quantities of water for fire protection and domestic use for drinking, food preparation, bathing, laundry, sanitary and maintenance purpose. The water supply for domestic use must be purified suitably so as to be potable and non-injurious to health.

Most of the large communities provide municipal water supply but in rural and outlying developments, these facilities are unavailable and the supply must be drawn from well or spring sources. All of these sources have been successfully utilized in the housing developments prior to and during the emergency period.

Best practices dictate that analysis of the water be made (where source is other than from controlled municipal plants) to determine its suitability for the purpose intended and to assure treatment if required for health reasons.

Distribution systems, both interior and exterior to buildings, have been satisfactorily designed in all cases to provide adequate pressure and flows and no problems are apparent from this cause.

REPORT MATERIAL-PRIVATE

Reports from 40% of the F.H.A. field offices indicate that pre-war private housing drew about 90% of its water supply from public systems, about 6% from community sources and the remainder from individual wells, springs, etc. The larger classes of houses used less community supply sources than did the small class where nearly 12% were supplied by community systems. The reported trend is toward a slight increase in the use of

public and community systems and toward a decrease in private water supply arrangements.

For water piping inside the buildings, 42% of the FHA field offices report that about two thirds of the pre-war private housing was piped with galvanized steel or galvanized wrought iron pipe, about one third was piped with copper tubing while a fraction of a per cent used brass pipe. The reported trend indicates a very strong increase in the use of copper tubing and a correspondingly strong decrease in the use of galvanized ferrous materials.

While the report material carries no data on the subject of location of piping, it is known that more efficient locations for piping and equipment will produce greater operating economy. Privately constructed housing contains many examples of poor or inefficient design based on extreme economy in first cost, where as slight additional expenditures would result in savings which would offset such costs within a short period of time.

REPORT MATERIAL - PUBLIC

The majority of the reports indicate dissatisfaction with the valving arrangements. Although required by FPHA standards, the units shut off valve for each dwelling unit seems to have been omitted in many cases so that nearly 60% of the complaints request that an individual shut off valve be installed. Of these, the proportion is 3 to 1 in favor of the shut off valve being located inside the unit rather than outside in a service box.

Some reports request a greater number of hose bibbs for lawn maintenance or desire that such hose bibbs be located on the exterior building walls in preference to present location on lawns or in basement or laundry rooms.

A few cases are reported where the piping design or distribution system design is questioned. These deal with choice of materials, location or piping in the structure and lack of insulation.

During the emergency period, however, it was found that many substitute materials were not up to required standards and some difficulities are traceable to this source.

Interior piping and valving installations are the major problem, dependent as they are, on the experience of the designer and the ability of the installation mechanics.

CONCLUSIONS

The most important item for recommendation is that a careful study of conditions including the quality of the water supply and source, be made prior to the design of the system, and that the results of this study be applied to the design. It has been apparent that there is a tendency to neglect this in the selection of materials and the location of equipment and valving.

Each dwelling unit should be provided with an individual shut off valve, located within the unit at an accessible location and with every proper precaution taken to prevent freezing. In a few cases, the only safe precaution against freezing when dwelling is unoccupied in winter, is to locate the valve exterior to the building, underground in a service box, but this is not only more expensive but it is found that most such valves become inoperative in a short time thus causing increased maintenance and lack of accessibility, and it has been found that there are few localities apart from the extreme Northern areas where difficulties are experienced with properly located and installed interior shut-off valves. In all cases the interior piping must be capable of complete

drainage down to the valve.

In private construction there is a need for improved design in the matter of the piping systems and the location of equipment. Strong efforts should be made to improve the conditions created by treating these items in the usual off hand manner. The cost of careful planning would easily be repaid many times over by economies in construction and operation.

Both public and private construction require careful study regarding the placement of hydrants for fire protection to give adequate coverage without the necessity of having all mains sized for fire flow. Existing standards set up clear cut rules for the location of such equipment but these standards make no attempt to govern the piping design other than to require that certain pressure and quantities of water be available at the hydrants. The piping layout is up to the design Engineer and the efficiency of the installation is at his disposal. It is therefore desireable that those selected to make the designs should be carefully selected in order that both economy of first cost and operating efficiency may be obtained. This is true for municipal as well as private systems since municipal waste is reflected in increased costs to the home owner.

GAS SYSTEMS

STATEMENT OF THE PROBLEM

The function of the gas system is to take gas fuel from utility sources and distribute it to each appliance requiring such service.

Gas fuel is of many types, the most usual, in the housing field, being manufactured or city gas, natural gas, bottled gas (usually of the propane-butane series) and mixtures according to availabilities and selection.

Gas systems commonly used are of two general types: First the project distribution system where the utility company furnishes gas from main or tank locations and the project distributes the gas from a central point or points to the appliances; second, the individual system where the utility company furnishes service to the dwellings through mains and service or by means of individual bottle installations.

Installations, exterior to the buildings, made in conformance with the rules and regulations of the serving utility company or of the National Board of Fire Underwriters are generally well designed, but in many cases these regulations have been overlooked or over ruled and difficulties have arisen.

Interior piping is good or bad depending on the design and the ability of the installation mechanics. Many hazardous gas piping systems are known to exist because of disregard or lack of knowledge of the problems of gas distribution. These hazards cover explosion, asphyxiation and fire. Safe systems are frequently too costly because of over cautious design.

REPORT MATERIAL - PRIVATE

None reported.

REPORT MATERIAL-PUBLIC

About 50% of the reports complain of the metering system and show a preference for individual check with or without project purchase through master meters.

Many complaints refer to matters of system design such as, requets that master meters be housed inside buildings, lack of sleeves where pipes pass through walls and fluctuating pressures.

Other complaints refer to equipment problems such as lack of safety pilots, clogged or faulty controls, etc.

CONCLUSIONS

The lack of complaints by the project personnel regarding serious items such as poor gas pressures, leakage, etc., which are known to exist on many projects, indicates the lack of knowledge of the subject by the general field personel. A program of education is vitally needed to overcome the apparent indifference to the dangers of mishandling gas fuel.

The matter of metering has been discussed elsewhere under "Fuels and combustion" and needs no further comment except that it is shown that check meters cannot pay for themselves in fuel economy except under conditions of tenant abuse in projects where the tenant operates his own heating system and buys coal, wood or oil at retail rates.

System design should be most thoroughly studied so that the resultant service will be the ever flow of sufficient magnitude to operate the appliance satisfactorily. Fluctuating pressures are hazardous and should not be tolerated in good design. Strong standards should be set and no system should be permitted to be installed unless these standards are met. It is suggested that such standards be based upon the regulations

of some of the most reliable utility companies in order to take advantage of the years of experience of such concerns.

Mechanical devices using gas fuel can be considered safe and satisfactory when they have the approval of the American Gas Association. A return to the pre-war practice of requiring such approvals before acceptance for installation should eliminate any problems relative to equipment.

In private housing construction, the matter of the relationship of the location of the various appliances range-water heater-heating unit, etc, should be carefully studied for efficiency of use and ease and comfort in performance of the kitchen functions. The gas piping represents an insignificant cost in this respect and should be subordinated to the other requirements of the design.

LAUNDRY FACILITIES

STATEMENT OF THE PROBLEM

For each dwelling unit, it is necessary to provide suitable, convenient facilities for handling the family laundry work. These facilities consist of laundry tray or trays for soaking, washing and rinsing, space for operation and storage of a washing machine and space for drying clothes, both outside and inside the house in case of inclement weather.

The usual solution in public housing and low cost private rental projects, has been to provide a laundry tray in combination with the kitchen sink and to allow area in the storage or utility closet for the washing machine, but little or no provision has been made for drying inside the house.

In the case of larger projects, community laundry rooms have been added with the expectation that bulk laundry will be handled in such rooms thus relieving the load on the unit equipment. In some of these projects the combination sink and tray has been replaced by a kitchen sink but in others the combination has been retained as a convenience to the house wife in handling light washes, which are often desired several times a week in families with children and limited means.

Community laundry rooms usually contain mechanical drying equipment and the outside drying facilities are usually adequate but there remains a considerable drying load which is done in the dwellings.

REPORT MATERIAL - PRIVATE

None reported.

REPORT MATERIAL - PUBLIC

Over two-thirds of the reports discuss the adequacy of the combination sink and tray for the handling of its intended load. These discussions indicate that the feeling is equally divided between those who think the fixture is suitable and those who think that it is too small. Some are of the opinion that it is suitable for smaller families but unsuitable for three bedroom and larger dwellings.

Several reports complain of the inadequacy of the interior drying areas, all agreeing that the kitchen space is too small for this purpose.

Conflicting opinons are reported concerning the use or non-use of community laundry facilities when additional facilities are provided in the dwellings and one report suggests the substitution of a double tray for the sink and tray combination, with the ordinary kitchen sink work to be performed in one of the trays.

CONCLUSIONS

The amount of conflicting opinion, on this subject, points to a real need for accurate information relative to the habits and desires of typical occupants and to the capacities of loads to be handled by the equipment. Research and revision of present standards in the light of such research, is badly needed in this field.

Even though there is no report material to confirm it, the problem of drying clothes in inclement weather affects private, as well as public construction, where basements are not provided or where utility rooms are either too small or non-existant. Considerable study should be devoted

to the problem of providing sufficient drying space inside the dwelling units and to coordinate this usage to the known principles of ventilation to assure the removal of excess humidity caused by clothes drying.

The furnishing of laundry facilities in units when community facilities are provided, is debatable and there is need for research to resolve the conditions under which this type of installation is necessary.

VENTILATION

STATEMENT OF THE PROBLEM

Ventilation is defined as the process of supplying or removing air to or from any space. From the standpoint of comfort and health in the dwelling unit, we must add to this the necessity of supplying sufficient air of the proper quality and of removing sufficient air vitiated by breathing, by combustion and by the objectionable ordors of home use.

In ordinary dwellings with adequate cubic space allotments, no special provision is made for controlling the chemical purity of the air other than the removal of fumes from heating appliances and usually the removal of cooking odors by kitchen ventilators. No provision is made to remove physical impurities in the air except in the better designed air heating units employing fitters. Humidity control is not usually successful on a small scale and has not been in general use in dwelling construction.

The greatest portion of homes built prior to the war had sufficient leakage through structural surfaces and by infiltration, to provide a minimum of one complete air change, throughout the house, per hour. This was considered suitable for ordinary conditions but usually resulted in uncomfortable drafts.

However, the conservation of fuels, so necessary during the emergency, required the addition of weather stripping, storm sash and doors and added structural resistance to wall surfaces by the use of insulation and vapor barriers. This practice reduced the natural air supply to the dwelling to approximately one-quarter to one-third air change per hour. This

quantity is insufficient for proper health or control of condensation on windows and within walls and ceilings and the condition was further aggravated by the heating equipment, which was placed in the living spaces in many cases, thus adding a greatly increased demand on the already overburdened air supply. In several cases sickness developed because of this.

Ventilation can, of course, be augmented by the use of windows or doors and this has been necessary in most cases, but the use of storm sash prevents easy ventilation by this means, and the danger of vitiated or too humid air are always present, even if not noticeable.

During the non-heating seasons, adequate ventilation can be obtained by the use of windows and present standards appear to be successful at 5% of the floor space as a minimum for opening area except that a minimum of 7½% is maintained in the kitchens.

REPORT MATERIAL - PRIVATE

None reported.

REPORT MATERIAL - PUBLIC

Approximately one-third of the reports deal with problems of drafty conditions caused by infiltration, listing many items such as; omission of weather stripping; lack of storm doors or storm sash; badly fitted or poor quality of storm doors, sash and weather stripping; etc.

Many complaints describe conditions of condensation on inside surfaces of the dwelling, the greatest number ofcases being condensation on steel sash and auxilliay reports disclosed conditions of condensation, within walls and ceilings which caused paint failures, dry rot of structural members and sheathing and damage to insulation materials.

Several reports deal with inadequate ventilation of crawl spaces which causes bad conditions of dampness and condensation in these areas.

A few miscellaneous reports cite the lack of consideration of summer conditions and request apparatus for added ventilation during the hot seasons.

CONCLUSIONS

These conclusions are drawn as related to both private and public construction, since, while no report material was furnished for private housing there is no reason to believe that the same conditions do not exist where structures are similar.

There is much to be done in the field of winter ventilation of the home. Much data is available for the determination of optimum and minimum requirements but practically no use is being made of this data in present construction.

The present trend is in the construction of tighter houses which must decrease the natural ventilation. This leads to the necessity for introducing added equipment or [illegible] facilities for permitting adequate supplies of fresh air to enter. This equipment may function by gravity or by mechanical means but it appears to be necessary.

Research is needed to determine the amount of added ventilation needed for health and to recommend means for its addition. Education of builders, designers and tenants is required to assure the inclusion and use of ventilation methods. In this vein, it should be pointed out that British Standards exceed U.S. practice by a ratio of nearly 4 to 1 in the admission of fresh air to dwellings. U. S. Standards should be formulated and placed at the disposal of those concerned with this phase of building.

Another item of equal importance is the determination of the proper humidity conditions which should be maintained for health reasons and for the avoidance of interior condensation. Proper ventilation will naturally control condensation to a certain extent but the conditions must be thoroughly known for the design to be effective. More data on the household humidity conditions and their effect upon health, should be obtained by research and made available for use.

Humidity, as it effects health, is at present the subject of some research and preliminary data seems to indicate that a revision of certain existing standards may be due. The usual belief, that extremely low percentages of humidity are injurious to health, may be shown to be untrue, thus permitting the maintenance of lower humidities which in turn could reduce the condensation problem.

EXTERIOR ELECTRIC DISTRIBUTION

STATEMENT OF THE PROBLEM

In the development of housing projects, the distribution of electric power presents a problem additional to those described in the section on electricity in dwellings. The distribution systems take power from public utility sources and extend such service throughout the project to the various structures.

Power is generally taken at high voltage and reduced by project transformers. Distribution has been accomplished by overhead or underground systems, the former type being used principally during the emergency period for temporary projects.

Problems concerning substitute materials and equipment as mentioned in the section on electricity in dwellings are also encountered here. In addition, the critical position of lumber caused modifications in the use and design of pole structures and lead to some very unattractive patterns of overhead wiring.

In the field of private housing, there was no such problems except in the large rental projects. The shortage of materials prevented any extended use of underground service to dwellings, but the substitution of overhead service to the small number of houses, which would have used underground service, constitute no major problem.

REPORT MATERIAL - PRIVATE

Reports from 40% of the F.H.A field offices indicate that an approximately one quarter of the dwellings are served by overhead distribution from the street and that about three quarters are served by overhead distribution through rear easements. The percentage served by rear easement

is greater for the large class house than for the small class house.

Trends reported by these offices show a very strong tendency to increase the use of rear easement distribution and a corresponding decrease in the use of overhead distribution from the street.

REPORT MATERIAL - PUBLIC

The report material indicates that a majority of the complaints refer to design problems of electric distribution and to problems of street and project lighting, about 40% in each category.

Design problems include the old questions of overhead versus underground distribution, types of wiring system, overloading of circuits and troubles with water and breakage in underground conduits.

Street and project lighting complaints include problems related to master timing clocks, switches, and insufficient street lighting and requests for separate circuits for yard lighting and apartment hall and stair lighting and objections to widely spaced, high power street lights as compared with lower power lights spaced at lesser distances.

The remainder of the complaints deal with the question of check meters versus master meters and with billing which has been discussed elsewhere in this report.

CONCLUSIONS

There is only one major recommendation which can be offered concerning project electric distribution systems, that the selection of the system be placed in the hands of capable designers who will follow the principles of good safe practice to produce the most economical system for both first cost and for operating expense including carrying charges. It should be pointed out that efficient operation achieved through careful design, can pay for itself many times over in reduced maintenance costs.

ELECTRICITY IN DWELLINGS

STATEMENT OF THE PROBLEM

The function of the interior electric system is to supply adequate power and connection equipment to all parts of the dwelling as required for electric lighting and operation of electric powered equipment and to provide all necessary controls and accessories for convenience and safety.

Pre-war construction usually included adequate and safe electric systems, governed by the rules of the National Electric Code which were enforced by nearly all power companies and municipalities. Where municipalities lacked enforcing agencies or building codes, installations were either designed by or installed under the direction of equipment manufacturers and so had the benefit of the code requirements. Public housing specifications always required compliance and the results were uniformly good in operation, but were sometimes expensive where local codes carried excess requirements.

During the emergency period, many parts of the electric system suffered from substitution of materials and apparatus, chiefly because the materials used were usually of the most restricted types. Emergency changes were made in the codes to allow construction to proceed but it is not likely that any of these emergency measures will be carried into the post-war period, except that private construction will probably see the use of non-metallic sheathed cable extended into post-war use in installations where rigid conduit or BX was heretofor mandatory. Among the items, used during the emergency which fall in this class are the type E. I. (Emergency Insulation) insulation, the so called "bare neutral" and increased use of pull chain fixture switches and open type lighting.

Conservation also affected the electric systems by reducing the number of outlets and thus resulted in lowered standards of housing efficiency and increased fire and accident hazard occasioned by more numerous and lengthy extension cord, arrangements made by the tenants.

REPORT MATERIAL - PRIVATE

Reports, from one third of the FHA offices, indicate an increased use of non-metalic sheathed cable and rigid conduit or flexible B.X. at the expense of the knob and tube type installations. The pre-war ratio of the dwellings constructed under the reporting offices indicates that 25% used knob and tube types, 30% used rigid conduit or B.X. and 45% used non-metalic sheathed cable.

REPORT MATERIAL-PUBLIC

Most of the report material deals with problems of design affecting lighting and outlets.

Of these items, the outlet facilities are in the majority. The general complaint is because of an insufficient number of outlets, some suggest more study in placing outlets and requests are made for duplex outlets.

Lighting complaints are because of obstructions to light due to poor location of fixtures, lack of lighting facilities in crawl spaces and lack of ceiling fixtures in the living room.

Many reports relate to equipment. Among these are complaints about lack of standardization and quality of fixtures and discussions concerning

controversial items such as circuit breakers vs fuses, toggle switches vs pull chain switches and push button door bells vs knob type. One complaint referred to the overloading of the circuits by electric hot plates.

Some reports indicated dissatisfaction with the metering methods, the majority pointing to a desire for check or individual metering to avoid waste or tenant dissatisfaction where flat charges for electricity are included in the rent.

While no complaints or reports were received relative to the location of kitchen lighting fixtures and outlets, it is common knowledge that considerable trouble is traceable to this source. There should be lighting directly over sinks due to the shadows cast by center lights at ceiling while sinks are in use.

CONCLUSIONS

The report material clearly indicates that a return to pre-war practice will improve the lectric systems and remove most of the mechanical problems involved.

There is, however, a strong indication that further study should be given to the problem of the number and location of outlets. Present standards should be carefully restudied in the light of the report materials and investigation should be made to improve this item of the electric system.

More attention should be given to the location type and quality of electric fixtures selected for use and designers should avail themselves of present data on lighting. There is a need for insistance, on the part of the housing authorities, that this subject be treated in a more adequate manner in post-war construction.

There is an apparent need that accurate information, concerning the operation of competitive forms of equipment, be assembled and distributed so as to remove the selection of such items as circuit breakers, fuses, toggle switches, pull chains switches, etc., from the pressure sales class.

Consideration for post-war economies points to the need for further research in substitutions or alternates for pre-war items since nearly all emergency substitutes were tried and found wanting. Among the items which should be studied is the possibility of prefabrication of wiring systems, tried at least once on one project with considerable success. More should be known of this method.

LIGHTING

STATEMENT OF THE PROBLEM

Natural and Artificial Lighting must be provided in all domestic and project areas where required for the safe and healthy performance of household activities, recreation, maintenance and operation functions and for traffic and public safety.

Natural light is furnished through windows of areas determined by standards based upon the floor areas of the spaces involved. The usual practice being that the window glass area shall be at least ten percent of the floor area with a minimum of fifteen percent for kitchens.

Artificial light for many years has always been furnished by electric fixtures and has been based on standards set up by the controlling agencies. These standards were reduced during the emergency period to a point where safety and health were endangered. This is particularly true of the street and project lighting systems.

Interior lighting was affected by the reduction in the number of utility outlets and by the reduced quality of fixtures which were permitted by the material conservation controls.

In private construction particularly, the matter of kitchen lighting has been handled in a hap-hazard manner which has resulted in glare or shadows on work surfaces.

REPORT MATERIAL - PRIVATE

Report material from 31% of the FHA offices indicates that, of pre-war house construction, 50% were wired with non-metalic sheathed cable, 30% with rigid conduit, flexible B.X. and the remainder with the old knob and tube type wiring. The same offices report a strong downward

trend in the use of the outmoded knob and tube type in favor of the increased use of non-metallic sheathed cable and the metalic rigid and flexible conduit types of wiring.

Thirty per cent of the FHA offices report that in pre-war construction, an average of 33 lighting fixtures, switches and convenience outlets were installed in the two bed room house, this average varied from 26 in the small class house to 41 in the large class house. The reporting offices indicate a strong increase in the number of fixtures, switches and outlets in post-war construction, the probability being that most of this increase will be achieved through the use of additional convenience outlets.

REPORT MATERIAL - PUBLIC

There are no reports relative to natural lighting except one or two which recommend the use of blinds or awnings to eliminate intense glare during summer days.

The report data is divided between comments on artificial light intensity and on the design of the lighting systems.

Several reports complain of inadequate street lighting due to excessive distance between lights which causes dark corners dangerous to public and traffic safety.

The Pierce Foundation reports inadequate interior lighting systems in many units surveyed by their field staff.

Several reports concern the design of the lighting systems such as; the omission of the center ceiling light in living rooms; lack of any lighting in crawl spaces, obstructions to lights caused by interfering structures, piping, etc; and poor design or selection of fixtures causing undue glare and excessive power consumption.

CONCLUSIONS

War problems, due to insufficient outlets should for the most part desappear when restrictions are lifted.

It can be stated that, while the needs of natural lighting have been met adequately in nearly all cases, the requirements of artificial lighting have been handled in a contractingly poor manner.

A great deal of data is available on the subject of lighting intensities but very little of this knowledge has been applied to the design of household lighting systems.

There is a great need for the adoption and use of domestic lighting standards and for the development of an educational program aimed at increasing public appreciation of the advantages of adequate lighting. The designer can provide fixtures for proper systems but the selection of bulb sizes and the use of the fixtures remains in the hands of the tenants.

In private construction, there is an observable trend toward the increased use of greater glass area in the home, although this was not reported in the report material. This is bound to affect heat lose and glare unless effective counter measures are developed and used.

There appears to be a great need for placing information in the hands of the consumers and builders to focus attention on the benefits to be derived from proper and adequate artificial lighting. Comparisons should be developed to show how easily good results are obtained by the application of simple principles and the lighting industry should be stimulated to perform this educational work.

Street lighting systems undoubtly will be made safe as soon as the restrictions on critical materials are removed.

RANGES AND REFRIGERATORS

STATEMENT OF THE PROBLEM

The scope of this report, covers convenient and adequate equipment for cooking and refrigeration for household use.

Cook facilities usually consist of ranges using coal, gas kerosene or electricity but during the emergency, a great many electric hot plates were provided where the cooking load was estimated to be quite light. In many areas, fuel restrictions prevented or reduced the normal number of gas and electric ranges and increased the proportion of coal ranges, particularly in public projects.

Pre-war construction usually was planned for electric and sometimes gas refrigeration with a small percentage of ice refrigerators. The emergency period saw restrictions practically eliminate the gas and electric apparatus in favor of the ice equipment. Only where it was not possible to obtain ice, were any gas or electric boxes permitted.

Therefore it was necessary during the emergency to select equipment for which fuel could be obtained rather than by economic balance.

REPORT MATERIAL - PRIVATE

Reports from approximately 40-45% of the FHA field office indicate that cooking appliances in pre-war private housing were 90% gas fired and about 8% electric with a small percentage of coal, wood and oil ranges, chiefly in the small class houses. These offices report a decidedly strong trend towards increased use of electricity for cooking and a lesser downward trend in the use of gas ranges.

Reports from the same FHA offices indicate that pre-war refrigeration was about 80% electric, 15% gas, while the remainder used the ordinary ice box or ice regrigerator. Reported trends show fairly strong increases

in the use of mechanical refrigerator, both electric and gas, at the expense of the ice cooled types.

While no reports are available, through the field office canvas, to show the extent of various financing plans for equipment purchases, it is understood that a larger proportion of the smaller houses will be furnished with ranges and refrigerators financed under the house mortgage. Favorable experience with this type of transaction is leading the Producers Council to exert it influence to continue and accelerate this trend in post war financing.

REPORT MATERIAL - PUBLIC

About one third of the reports indicate a preference for equipment other than that which was installed. Some want gas ranges rather than coal ranges, others want kerosene ranges rather than butane ranges. Some merely state that the type installed is unsatisfactory. These reports are sometimes conflicting.

Many complaints contain objections to the selection and location of the equipment, and desire for extra items or report excess items such as unused ironing boards or hot plates.

Many reports request the adoption of standard specifications for gas ranges because of inferior equipment which has been installed. Others refer to the inferiority as being the result of the Mass Purchases Program.

Several complaints were received relating to inadequate storage capacity of refrigerators with one report approving 5 to 6 c.f. ice boxes.

Several reports deal with auxiliary items such as the necessity for drains from ice boxes, desireability or undesireability of providing

hoods and vents for gas ranges and the inadequacy of coal range fuels.

Some statements describe items of misuse of equipment such as heating the houses by means of gas ranges, tampering with electric reanges, explosions due to careless operations, etc.

CONCLUSIONS

The necessity for the selection of fuels and equipment from an analysis of all possible combinations has been discussed under "Fuels and Combustion" and the miscellany of conflicting comment received in the reports serves to emphasize the fact that more information, relative to proper slection, be presented to those whose duty is to supervise or operate the installations. An educational program would serve good purpose in removing many unfounded or biased objections to worthy types of equipment and fuels.

Here, again, there is shown to be a need for research and planning of areas of equipment use and consideration of the problems of the tenants and owners. Reports show that many tenants own refrigerators which must be sold or stored because the dwelling unit is already equipped with a refrigerator, yet no additional storage space is available. Others show that items such as built-in ironing boards or electric hot plates are not used, showing that these items could have been saved in the initial cost of the unit. More consideration of these problems could effect economies and increase satisfaction.

Complaints referring to gas range specifications and Mass Purchase defective materials can doubtless be charged off to war time experience with substitutes and reversion to pre-war standards should remove this criticisum.

The report data concerning the capacity of refrigerators is

important in that it indicates the need for more research into household functions of food storage and preparation. Some of the complaints may arise from the increased capacity required due to war time restrictions in food deliveries, especially milk.

Auxiliary devices such as ice box drains, hood and vents from gas ranges and coal range flues, are problems for the designer and should be carefully worked out prior to construction. The data needed for proper design is known and should definitely be applied.

The items of misuse indicate a need for educational programs to enable the tenants to understand the equipment and its problems and to make him aware of the dangers of misuse. Such programs should be undertaken in all projects where the tenant operates or has access to items of mechanical equipment.

While no report material was submitted to show statistics relative to range oven and refrigerator insulation, the advantages of proper application of insulation principles to appliance construction are well known. There is a real need for the dissemination of correct facts, covering the economies of well insulated equipment, to the general public in order that they may understand and eliminate the wasteful types from the market.

FLUES AND DRAFTS

STATEMENT OF THE PROBLEM

Flues must be provided to assure sufficient draft to support combustion and to eliminate the products of combustion, for all types of space heating, water heating and cooking appliances except those using electricity for fuel and for gas and kerosene burning ranges.

Normal practice prior to the war, generally included tile lined brick chimneys for this purpose and sometimes special materials such as transite pipe flues for gas burning appliances.

During the emergency, a type of flue and chimney combined, constructed of insulated porcelain coated sheet metal, was widely used where the space limitations and low buildings precluded satisfactory operation of brick chimneys, and was sometimes used as an economy measure in other cases.

The present trend appears to be toward a reversion to the use of the older, more reliable type of construction and most of the buildings now under way are being equipped with the brick chimneys. This may be that, despite its superior draft development, the metal chimneys are subject to errors of erection which make it possible for serious fire hazards to develop. The brick chimney has the advantage of being familiar to the building construction trades and as a result generally finds more satisfactory installation which, in turn, reduces the fire hazards.

In many of the privately constructed dwellings, especially in the Southwest Areas, it is common practice to permit the use of unvented natural gas fired heating appliances, usually with some kind

of limitation on the heat output. This practice results in low first cost due to the elimination of the chimney and flue but it also increases the hazards due to asphyxiation or explosion. There appears to be no strong indication of the willingness of the competitive builders, in these areas, to abandon this dangerous type of installation.

REPORT MATERIAL - PRIVATE

None Reported.

REPORT MATERIAL - PUBLIC

The majority of the reports deal with problems of insufficient draft attributed to insufficient chimney height, insufficient or excessive flue areas and design. Others report difficulty with metal chimneys and with broken flues due to settlement of the structures.

RECOMMENDATIONS

The report material indicates that, while a great deal is known about the requirements and operation of flues and drafts, there is still a problem because the principles have been overlooked. Chimneys are usually somewhat less in height than is required for best combustion efficiency, flue areas are sometimes smaller than required, causing choking, and sometimes larger than required, causing poor drafts, back drafts or sluggish operation. Local code requirements are often faulty and create conditions which are not conducive to best results, sometimes making no discrimination as to fuel and apparatus types which naturally require different flue areas and heights. It appears to be necessary to assure that sound engineering principles be used in the design of chimneys for household use.

One item of importance is the tendency and practice of architects and designers to permit the building height to determine the chimney height. While this method is generally satisfactory, it fails sadly when single story, flat roof structures are used with combustion equipment located on the first floor. The overall chimney height required in this case calls for a chimney to project five or six feet above the roof and if cut off for the sake of appearance, the combustion is bound to suffer.

This was one of the prime reasons for the development of the insulated metal chimney which, for a given height, can produce nearly 50% more draft than the brick chimney. The metal chimney, however, is subject to erection errors and to reactionary treatment which combines to produce fire hazards. The loss to the government on this item amounted to approximately $1,000,000 in the completion of the F.W.A. demountable housing program.

There is an apparent need for the application of more technical knowledge in the design and construction of chimneys in general and for the strengthening of FPHA standards in particular.

There is also need for the development of methods of erection of the metalic chimneys in order to remove the hazards created by poor installation. Such methods must be made absolutely fool proof and if they can be so made, will permit this equipment to offer its advantages of increased draft, light weight, and lower costs to the housing industry on a safe basis.

STRUCTURES RELATED TO MECHANICAL SYSTEMS

STATEMENT OF THE PROBLEM

The installation of mechanical systems for heating, plumbing and allied services, requires proper adaptation of the surrounding and supporting structures for the achievement of convenient, economical and efficient operation of the several mechanical systems, fuel storage and maintenance.

Usual practice is to squeeze such systems into spaces which are otherwise unused in the architectural development, whether or not the spaces so allowed, are sufficient or safe. The results have usually been overcrowded, inefficient and sometimes hazardous mechanical systems.

Public housing made some effort to produce efficient structural spaces for these systems but the tremendous stress on overall space limitation forced their standard plans into designs which were woefully weak regarding mechanical spaces.

REPORT MATERIAL - PRIVATE

None reported.

REPORT MATERIAL - PUBLIC

The majority of the reports are about evenly divided between comments on equipment arrangements and locations and structural details.

Those comments dealing with equipment layouts in most cases mention the kitchen layout, the problem being aggravated when domestic water heaters and tanks are included. Others comment on space heater locations and the lack of satisfactory location of these appliances.

The comments dealing with structural details mention problems of settlement and its effect on heaters or shower compartments, inadequate fire prevention clearance and insulation between structure and equipment,

lack of sufficient sound and heat insulation between mechanical spaces and dwelling or public spaces, or between back to back bathrooms, the problem of cold floors in pier construction and the lack of accessibility to crawl spaces.

There are also several reports relating to improperly arranged fuel storage spaces, inadequate fuel storage, insufficient operating space and problems of fuel delivery.

CONCLUSIONS:

This problem and the volume of comments received, points up the need for the expenditure of more time and energy in the planning of spaces and structures to accommodate the mechanical systems. It is not usually satisfactory to allow these systems to be fitted into left over spaces and, while the architectural design should not be built around the mechanical design, nevertheless, it is apparent that the overall problem must consider both plans equally in order to economize in operational effort and expense.

Present standard plans should be examined carefully to determine what changes can be made to improve the existing situation.

It is most important that the requirements for elimination of fire hazards should be given adequate consideration in the design and construction of dwellings. Proper clearance between combustible materials and hot surfaces of equipment must be maintained and adequate baffles or insulation installed to minimize dangers of fire. Sound codes or recommendation should be developed and furnished to those engaged in the design and construction and a program should be formulated to educate the tenants in the important features of fire safety in the home.

CENTRAL PROCUREMENT

STATEMENT OF THE PROBLEM

A problem that arose in the defense housing program and became particularly acute during the war program was that of procurement of plumbing, heating, refrigeration, and cooking equipment.

The normal process of procurement of such items is a flow of orders from contractor to jobber or wholesaler, thence to the manufacturer. The process of supply is in the reverse order, the manufacturer producing for anticipated annual demand, the wholesaler maintaining a stock for short term demand, and the contractor buying from the wholesaler in accordance with his construction needs. And the processes worked reasonably well in providing delivery of items as they were needed in normal peacetime construction.

However, the period under consideration had to deal with a different set of conditions.

While the Nazi legions raced over Europe, the United States began to arm in earnest. The National Defense Bill was passed on June 22, 1940. The manufacture of war materials and equipment was accelerated and the provision of housing for the workers being drawn into war production centers received increasing attention.

The War and Navy Departments, the Maritime Commission, The Federal Works Agency (including USHA and FSA), all became active in the defense housing program. The Federal Housing Administration and the Federal Home Loan Bank System made every effort to stimulate private housing construction for war needs. As a consequence, housing

was being built at a pace far exceeding anything achieved during the depression but still not enough to satisfy the need.

At the same time the production of war equipment, ordnance, munitions, ships, planes, and tanks took ever increasing amounts of the same metals that were used in the manufacture of dwelling equipment.

Building materials were brought under partial priority control in September, 1941 with uneven results.

When Pearl Harbor came in December, 1941 the nation started its major conversion to war production. The War Production Board was created with full control of all the materials which were to be used for war purposes. In February, 1942 the National Housing Agency was established and consolidated the war housing activities of sixteen Government agencies.

When the armed services were building vast cantonments; as shipyards strove to build 50 times as many ships; when new plants were being erected and others expanded to produce planes, tanks, and guns in fantastic quantities; when whole new industries were being developed; when all possible industry was being converted to war production; when iron, steel, copper, zinc, aluminum, and lumber could ill be spared for other than weapons of war - how to provide the housing equipment, fixtures, and furnishings of minimal quality and amount but sufficient to provide for the 4,000,000 workers who were moving to the centers of war industry.

In summary we were faced with the following conditions:

1. Enormous amounts of critical materials had to be diverted from civilian use to direct military requirements.
2. Most American industry had converted all or a major part of their production to direct military requirements.
3. There was a huge demand for dwelling equipment, fixtures, and furnishings for the war housing construction program.
4. War housing had to be correlated to the war industries it was to serve and be completed in time to provide for the workers required in the industries.
5. Methods had to be developed in accordance with democratic traditions and with least disturbance to the vital roots of American economy.

REPORT MATERIAL

How were these conditions met by the central procurement of plumbing, heating, refrigeration, and cooking equipment, furniture and furnishings, and trailers?

Limitation and Conservation Orders of the War Production Board and its predecessors diverted from manufacturers for civilian use the critical materials needed for direct military requirements.

These set up maximum amounts of critical materials which could be used in the manufacture of designated items for civilian use. In some cases, the use of certain critical materials was prohibited. There was a continuous flow of these orders adding to, relaxing, strengthening, or eliminating provisions as necessary to meet changing strategic demands.

Equipment had to be redesigned to meet the limitations, or if not capable of redesign, could not be manufactured. Substitute designs and materials had to be developed and incorporated in the Victory models.

A system of priorities insured that such items went to the places where the war need was greatest.

Because so much of industry had converted to direct war production or because of unwillingness to manufacture Victory models, additional sources of supply had to be created and developed. Orders for standardised products in sufficiently large quantities to induce the setting up of production lines had to be issued.

Not only was sufficient plant production capacity to be found but it was necessary to program such production, see that it got to the right places at the right time in the proper quantity. Products had to be inspected at the plants, complaints at points of installation investigated and adjusted.

The magnitude of the operations involved is indicated in the following tabulation of items and sums expended.

Plumbing, Heating, Refrigeration, etc.		$48,000,000
Furniture, Furnishings		29,000,000
Kitchen & Cafeteria		3,000,000
Trailers		16,500,000
	Total	96,500,000

All this was done with due consideration to democratic traditions and with minimum disturbance to the vital roots of American economy. A joint Committee of the Procurement Policy Division of the War Production Board, Procurement Division of the Treasury Department, and the Federal Public Housing Authority held hearings at which representatives of the various industries and wholesalers affected presented their views. Policies were developed and placed in operation. There were periods of trial and error. Inventories were liquidated or reserved for private housing. There was opposition from some groups such as wholesalers who felt that they were denied a profit opportunity and some subcontractors who disliked the "inferior" equipment but on the whole there was substantial agreement on policy.

On September 15, 1942, the joint committee presented its recommendations to the Chairman of the War Production Board. This proposed that the Federal Public Housing Authority set up a Procurement Division which would have complete responsibility for all procurement activities for public housing.

This Division standardized specifications, revising them as necessary to meet limitations imposed from time to time by the War Production Board. It programmed and scheduled quantities and deliveries necessary to meet project completion dates. In collaboration with

specialists assigned from the WPB Procurement Policy Division, it determined detailed methods and procedures, prepared proposals, negotiated contracts, and prepared the papers for final closing of contracts by the Treasury Procurement Division. It investigated plant capacity, expedited deliveries, inspected products at the plant, accumulated stocks of equipment against sudden demands, and otherwise assumed responsibility for having materials available to meet construction schedules.

However, it was not until December 5, 1942, when Mr. Nelson, Chairman of the War Production Board approved, that this became the established policy. By February, 1943 contracts were being placed with manufacturers for plumbing and heating equipment and this marked the beginning of full scale production of Victory models.

Awards were made, wherever possible, on a geographical basis to facilitate deliveries and to cooperate with the Office of Defense Transportation. Industry was given an opportunity to requisition raw materials, schedule production on an orderly basis, and assure their employees steady employment. And most important, the finished products could be routed to the project when and as needed with assurance that construction schedules could be met.

Concurrently industry was assured that the policy was a temporary one only and that the Government would return to the normal distribution pattern as soon as production permitted. However, initial successes with space heaters, plumbing fixtures, and ice-boxes were followed by demands for additional items that would assure continued production and assured delivery of war housing to meet construction

schedules. Equipment for cafeterias, infirmaries, and clinics, recreation, child care and furniture were added. It was necessary to add furnishings - linens, drapes, dishes, medical supplies - for the community facilities provided for the housing projects.

In March, 1943 a thorough-going review of policy and operations was initiated and an industry-Government committee, headed by Mr. Tudor Bowen of the WPB Procurement Policy Division, was formed for this purpose. A number of meetings were held with industry representatives, several FPHA projects were visited to secure first-hand knowledge. On May 28, 1943, the conclusions of the committee were embodied in a letter to the American Institute of Plumbing and Heating Supply Associations. It confirmed the policy as the most practicable means of assuring delivery of war equipment at the time needed.

However, by April, 1944, in accordance with the announced policy of returning to the normal distribution pattern as production permitted, the Federal Public Housing Authority felt sufficiently assured that existing construction contracts would receive certain equipment purchased under central procurement when needed that it could revert to the usual requirements of construction contracts for furnishing of certain items. FPHA stated that such items as plumbing and heating equipment, and lighting fixtures, will be included again as they are under normal building conditions.

FPHA has begun to liquidate its central purchasing activities confining its efforts to administering contracts made under its

program. At this writing it seems assured that all items procured under this program will be used in war housing without appreciable surplus.

CONCLUSIONS

The first objective of any procurement policy under the War Production Board must be to deliver the war equipment at the time it is needed. All else must necessarily be subordinated to that prime objective.

In view of the necessity for diverting huge quantities of critical materials and for converting the major portion of American industry to direct war production but, at the same time, to provide the equally necessary war housing, it was understood that major changes might be necessary in the normal pattern of procurement and distribution of many items of equipment, fixtures, and furnishings. At the same time, it was felt that all efforts should be made to preserve the vital roots of American economy for new growth with the return of peace.

Some of the difficulties in making these changes and lessons learned for future application are indicated in the following paragraphs.

There was a determined opposition to the central procurement program from a segment of American Institute of Wholesale Plumbing and Heating Supply Association sparked by a small but influential group of plumbing distributors. They saw in the program the reduction of profits from the short-circuiting of their services by direct

distribution from manufacturer to project and they feared the effects of this practice on post-war patterns of distribution. From a strictly self-interested point of view their opposition was understandable, but from the larger view of waging a war most efficiently, business-as-usual should adjust to war demands of the whole nation, and the public interest rather than that of a small segment of industry becomes paramount.

There was sporadic opposition also from subcontractors and labor. They saw inferior material and equipment, compared to pre-war standards, being delivered to be installed by them under the central procurement program. Unfamiliarity with the substitute materials and the greater care needed in installation caused difficulties. They were not made properly aware of the effect of WPB Limitation Orders on construction materials and equipment and believed that they were money-saving in first-cost only and made at the expense of greater difficulty in installation.

These difficulties, although concentrated in the plumbing trades, were real and at times bitter. They could have been mitigated and perhaps eliminated by an adequate program to educate all segments of the industry beforehand to the necessities for making changes in materials and equipment, their distribution, and their installation so that their cooperation might have been assured before the program was put into effect.

There were difficulties in internal administration. There was the problem of coordinating construction requirements with deliveries. Field estimates for time of delivery were often based on

getting the material to the project "immediately", "as soon as possible" on the assumption that it was the best way of making sure that the material would be there when needed. Too often large deliveries arrived only to be stored in the open, unprotected from the elements, and obstructing construction operations. The consequences were large breakage, missing items, innumerable claims, unjust criticism, and an endless stream of correspondence from field offices to central office. This situation was not under control until a definite decision was taken by the central office to require all schedules to be justified against contract documents and reports of construction progress and to check the requests against independent reports from the field. Thorough education of field offices in the factors to be considered in making schedules and a closer integration of field offices with central office are indicated.

Perhaps the most basic difficulty was the lack of recognition by the War Production Board and its predecessors of the importance of providing housing for in-migrant war workers. Priorities assigned to war housing were inadequate to insure completion in the quantities and at the times needed to serve the war plants which they were to serve in the early stages of the war housing program. Only the logic of events forced belated recognition of the proper relationship of war housing to the war plants it is to serve and the necessity to grant such housing the same priority ratings as the plants. The remedy in the future is to establish at the beginning the relationship of war housing to the war plants and from that point determine priorities, allocations, etc. to hold that relationship constant.

Although it was planned primarily for the publicly-financed war housing program, it had secondary but important value to privately-financed war housing and to the Army and Navy. Time and again, private projects would reach substantial completion but could not be occupied because of lack of stoves, refrigerators, electric ranges, or water heaters. When such instances were called to the attention of NHA representatives in the field, it was frequently possible to obtain the needed equipment from FPHA through the sources of supply developed by the procurement program. Cantonments, hospitals, post exchanges, and officers' quarters were assisted similarly and prompt completion was often facilitated by drawing upon stocks built up by central procurement.

Despite the difficulties, the central procurement program proved its worth as a vital factor in the tremendous production of war housing.

CONSTRUCTION OPERATIONS AND METHODS

STATEMENT OF THE PROBLEM

Private housing construction projects before the war were generally small scale operations of predominantly one-family dwellings.

According to a study made by the Bureau of Labor Statistics for the year 1938, two thirds of the builders constructed but one house per year and the average for all builders was 2.2 houses per year. Even for the one-third of the builders constructing 2 or more houses per year and providing for 70 percent of the total housing produced the average was only 4.8 houses per year. Only 11 percent of the total volume was handled by operators who built more than 100 houses a year.

Operations on this scale precluded the employment of specialized skills and facilities in the production and erection of each part of a house. The builder had to be a jack of all trades - particularly the operative builder who had to acquire enough knowledge of market analysis, merchandising, planning, design, and construction methods - to meet the competition of others in the same class. Seasonal operations complicated his task. Few, if any, of the cost reducing and quality increasing techniques of standardized, large volume, sustained operations were feasible. Low output per manhour, intermittent employment, little or no quality control, and relatively high cost were the results.

The development of land, utilities and streets, the excavation of basements may frequently have made use of power machinery and the mixing of concrete was usually done in power mixers. But, by and large, the construction of private homes remained a handicraft industry. Hence, prior to the war, the nature of most private residential construction

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Typical housing construction projects before the war were generally small scale operations of predominantly one-family dwellings. According to a study made by the Bureau of Labor Statistics for the year 1938, two thirds of the builders constructed but one house per year and the average for all builders was 3.5 houses per year. Even for the one-third of the builders constructing 2 or more houses per year and accounting for 71 percent of the total housing produced the average was only 6.8 houses per year. Only 11 percent of the total volume was handled by operators who built more than 100 houses a year. Operations on this basis precluded the employment of specialized skills and facilities in the production and erection of each part of a house. The builder had to be a jack of all trades - particularly the smaller builder who had to acquire as much knowledge of market analysis, architectural planning, design and construction methods - to meet the capabilities of others in the same field. Seasonal operations complicated his task. Few, if any, of the cost reducing and quality improving economies of standardized, large volume, sustained operations were feasible. Low output per workman, inefficient employment, little or no quality control, and relatively high cost were the result.

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did not warrant the use of specialized equipment and methods, nor did competition from other builders and the skills and attitudes of construction labor encourage its use.

In the public housing field, however, construction operations and methods before the war already differed substantially from those of the typical private housing project. In contrast to the small number of units in the typical private project, the public housing project averaged 300 dwelling units. The units were grouped in larger buildings, heat was usually supplied from a central plant serving groups of buildings, and community facilities were provided in centralized spaces and buildings. The larger sums of money involved in each undertaking led to a greater degree of overall planning and management. Contractors who were engaged in the execution of the larger building operations, such as multi-story commercial buildings, were attracted to this field. Many of them had difficulty at first in adapting their practices based on vertical construction to those required for most efficient construction of a variety of small buildings spread over a large area. But with the characteristic ingenuity of American industry to adapt readily to new conditions they overcame these difficulties. As the improved techniques were developed and became the common knowledge of interested contractors, the results became evident in gradually lowering costs.

REPORT MATERIAL

For the purpose of this summary the NHA Field Office Canvass and the FPHA Survey material listed at the beginning of Appendix A has

been supplemented by the WPHA Summary of Prefabrication Experience and by interviews with officials of NHA, WPHA, and FHA connected with development and programming activities.

The defense program in 1940, succeeded immediately by the war program, accelerated trends which had begun to appear earlier, and created new conditions fraught with many possibilities for change in conventional methods of construction.

The unprecedented migration of workers to war centers created a tremendous demand for housing. In general, a new dwelling in any location would sell or rent. Prospects competed for houses. Under these circumstances, entrepreneurs were willing to venture larger private projects which placed a larger number of dwelling units on the market at one location within a short time. Contracts were let for huge public housing projects and prefabricators were encouraged to participate.

The requirements of the military and naval services for men and materials caused serious shortages in the construction field and ways and methods had to be devised to overcome these shortages.

The enormously increased size of projects, the short times which could be allotted for construction, and the difficulties in procuring labor and material called for tighter and more specialized overall planning and management.

A marked innovation in the public housing field was the central procurement of certain types of equipment and fixtures and is treated at some length in a separate summary.

When military construction was at its height, contractors had to be coaxed to build housing projects. As the defense program moved into the war period, the number of qualified contractors, who were willing to bid competitively in the face of material and labor shortages and rising costs, rapidly diminished. The cost-plus fixed fee or lump sum negotiated contract had to be used in the public field.

The military services and competition from other war industries drained off much of the qualified inspection personnel. The lack of trained and qualified inspection personnel, coupled with the pressure for completion to meet urgent needs and the realization that the major part of the publicly-financed construction was intended for temporary use only, made it necessary to exercise more latitude and tolerance in the type of workmanship which could be accepted. There was a realistic lowering of sights, but the Government's interests were protected by securing downward adjustments of contract prices wherever materials or workmanship, that fell below strict standards, but could give a reasonable measure of satisfactory use, had to be accepted in the exigencies of war.

Heavy volume of construction necessitated a change of policy in public projects to permit Government contracts to be assigned to banks as security for the large increases of operating capital that the contractors had to have.

While both public and private residential construction boomed, the volume of non-war heavy construction, such as roads, fell off. This

released for other fields the facilities and services of heavy construction contractors. The large scale of the war housing construction attracted these contractors for the work of clearing, grading, excavation and fill, sewers, roads, and water supply. In consequence, public projects and comparably sized private projects had the greatest show of earth-moving and excavating equipment ever seen in the residential field. Improvements in earth moving equipment which had developed in heavy construction prior to the war were adopted during the war by housing contractors where the size of the job warranted. Power shovels, cranes,, bulldozers, carryalls, trenchers, tractors, road mixers, and heavy trucks were a common sight.

Workmen developed techniques for the processing and assembling of new materials. The plumbers found that plastic, streamlined fittings had to be handled delicately, rather than with brawn, to made a water-tight connection. Methods of handling and installing finish wall boards of room size were developed. Workmen became familiar with mechanized equipment of all sorts that they had never operated before the war. Skills were developed in the handling, processing, assembling, and erection of materials to take advantage of highly-integrated and detailed construction systems.

Shop prefabrication, long dreamed of and much discussed before the war, was given its first real opportunity in public war housing. An assured market was presented. Buildings were built from standardized plans, necessitated by WPB regulations and the need for greater speed. Projects built in isolated spots where construction labor was

non-existent or highly critical required shop prefabrication of panels and sections at distant points of ample labor supply. Projects built at locations where the expected term of use was but a fraction of the war period were designed and built for ready demountability and transportation.

The principles of shop prefabrication were often applied in the field where individual private, as well as public, projects were of large size and where, in effect, prefabrication shops were set up in the field.

Finally, the production miracles and dramatic changes in processes being wrought in the new war industries provided a psychological stimulus that was conducive to conceiving and executing larger and speedier operations with new techniques in the residential construction field.

CONCLUSIONS

During the war the industry was geared to large projects. Organization and management for quantity production have been developed and tested. A large number of builders, contractors, superintendents, and workmen have experienced personally most for the first time the advantages, as well as the limitations, of handling repetitive operations with mechanized and specialized equipment. The shipyards and aircraft plants where techniques of prefabrication and sub-assemblies, not greatly different from the structural components of a dwelling were highly developed will be releasing workers skilled in these

techniques. The Army and Navy construction services, have developed similar techniques. The losses that the industry sustained when much of its trained personnel went into the armed services, the aircraft plants, and the shipyards, should turn out to be a deferred profit. The men have become acquainted with the mechanization of earth-moving, materials handling, prefabrication, and erection of sub-assemblies. The methods developed and the skills acquired will not be forgotten by the men that return to residential construction.

Power equipment was widely used during the war and its use should expand after the war on both private and public work. During the war the necessity for utilizing existing equipment to the maximum caused its use in many heretofore untried ways. Special purpose equipment and accessories for standard equipment were developed and used in the military and naval services. Great numbers of men became skilled in their operation. The production of equipment manufacturers was hugely accelerated during the war to supply the armed forces and that surplus capacity will be available for peacetime production.

Mass production techniques were encouraged by the war. Conditions were created for the extensive utilization of these techniques, including factory production, assembly line methods, and field prefabrication. All signs point to an increased use of such methods after the war. Exhaustive study is warranged to determine under what conditions and to what extent the newly-developed techniques will be most helpful to the industry as a whole after the war.

A larger proportion of the privately-financed business will

go to the larger operators who can take advantage of the economies of quantity purchases and mass production and merchandizing. The reports agree on a trend to larger scale operations. Ceiling prices and scarcity of materials and labor have taught builders a new economy of means and of operations. Few of the builders unable to gear their activities to the production of inexpensive houses have survived. The strong section of the residential construction industry that has weathered the war plus the additional companies that increased opportunities will attract will be keener, more imaginative, and more skilled in cost-cutting and quality-producing techniques.

A number of practices, necessary during the peak of war activity, will be substantially modified or dropped.

FPHA central procurement of supplies was basically an intrusion of the normal channel of distribution of plumbing, heating, refrigeration, kitchen and cafeteria equipment. That there were good and sufficient reasons for centralized procurementsfor certain items at the peak of war housing was generally recognized. But as the war housing demand was satisfied and the normal channels of supply and distribution became available, the central procurement program was dropped.

The cost-plus fixed fee and negotiated lump sum contract types became fewer in number as competition became keener due to the release of contractors from strictly military construction and the diminution of the war housing demand. In due course the contracting policy reverted to the advantages of open competitive bidding.

The downward adjustment of contract prices to permit acceptance of below-standard elements of construction was a temporary device only and will be dropped as soon as material and labor supply becomes normal.

The assignment by contractors to banks of their construction contracts as security proved satisfactory during the war and may continue after the war on projects requiring large amounts of operating capital.

Postwar objectives which are suggested by the war experience are increased output per manhour, steadier employment, quality control, and lower cost of the end product. These objectives will be greatly influenced by the kind of market that develops and the nature of the national housing and labor policy that is in effect at the time.

BUILDING CODES

STATEMENT OF THE PROBLEM

The problems pertaining to building codes are not new.

In America, the familiar cycle of needs and dangers arising out of unregulated construction, followed by scattered laws and ordinances seeking to correct conditions, and then eventually by codes, has repeated the experiences of older countries.

The American Colonists took what building materials were at hand and at first were content with hastily improvised shelters. Early accounts tell of fires originating in log chimneys imperfectly protected with a layer of mud which were followed by ordinances forbidding the dangerous practice. Wooden and plastered chimneys were forbidden in New York as early as 1648. A fire district was established in New York in 1766 in which all buildings "shall be made of Stone or Brick and roofed with tile or slate". So similarly through the years, repeated in each locality, local codes grew by successive accretions. Newer communities profited by the experiences of the older ones and frequently started their codes at advanced levels.

In the meantime developments in the scientific and professional fields affected the formulation of building codes. The founding of the American Society of Civil Engineers in 1852, of the American Society for Testing Materials in 1902, the development of the Building Officials' Conference of America in 1914 and of the Pacific Coast Building Officials'

Conference in 1922, and the formation of the American Standards Association in 1918, provided the means for ascertaining facts about building materials and for the evaluation of proposed construction methods through the meeting of many minds on a professional plane. The tests conducted at the Watertown, Mass., Arsenal in the 80's and more recent tests at university laboratories, the Underwriters' Laboratories, the National Bureau of Standards and other laboratories have supplied facts on many materials and practices without which rational determination of safety requirements would be difficult if not impossible. An examination of many modern codes will disclose the increasing frequency in which they include series of references to national standards of professional and technical organizations which were developed only after much testing and research carried out patiently over periods of years.

The building code derives its justification and legal enforceability from the police power of government. This is the inherent power of government to protect the people against harmful acts of individuals insofar as matters of safety, health, morals or the like are concerned. It is the basis for State acts and municipal ordinances dealing with these matters and is of indefinite extent, although certain limitations concerning its use are to be found in the Federal constitution, in the constitution of the State wherein the municipality is located, and in court decisions. Fundamentally, under our system of government, the power resides in the State and may be transmitted to local authorities through enabling acts, authorizing the adoption of building requirements or may be conferred upon municipalities when a charter is granted.

Generally speaking, building codes have tended to insure public health and safety by establishing a series of requirements for fire protection, strength of materials, light and ventilation, sanitation, exits, and the mechanical equipment with which the building is equipped.

Since the building code remains largely a local affair, there is almost as great a variety of provisions as there are codes. "Live load" requirements of dwellings have been found to vary from 25 to 100 pounds per square foot; minimum thicknesses of brick walls from 8 to 16 inches for the same height and load; working stresses in concrete from 500 to 1000 pounds per square inch, in steel from 16,000 to 20,000 pounds per square inch; and variations in pipe sizes of 150 percent. Floor area requirements for the same type of room vary from 60 to 120 square feet, and for ceiling height from 7 to 9 feet. An analysis of plumbing codes of a dozen cities selected at random shows that the community requiring the lowest amount of metal in a one-story house saves 100 pounds of cast iron or about 30 percent of the total required by the city with the maximum requirements. Similarly the minimum code saves 10 pounds of metals other than cast iron out of the 50 pounds required by the maximum code. Higher standards than are necessary for health and safety result in waste and increased costs without proportionate increase in value. But these are not the only ways in which increased costs are involved in current codes.

The manner in which code provisions are written often proves costly to the housing industry. Codes have in fact virtually become building specifications describing in great detail the methods and materials allowable in erecting framing, installing floors, building walls, etc.

Since the specification type of code unavoidably favors conventional methods of construction, it increases the resistance to new construction processes and materials. Procedures for obtaining exceptions are not only costly and difficult but provide opportunities for political corruption. Moreover, the detailed code specifications enable special interests to conceal insidious provisions to their greater profit.

Codes may be written in such a manner that they provide effective local monopolies for certain materials and manufacturers. Again building interests may force, through codes, the installation of excessive amounts of materials. This latter type of provision may be due to the pressure not only of manufacturers and dealers but also of labor unions. Labor may also secure provisions which make it difficult or impossible to introduce methods reducing the amount of labor or skill required in the erection of the house or installation of its equipment.

Many localities have no codes at all. The 2000 municipal codes estimated to be in effect in 1942 provide for about one-half of the communities of 2500 population or more. In addition, about 200 communities in this population group operated under state codes or had at least established fire limit regulations. Some communities of less than 2500 population also had some kind of codes. But construction in practically all rural areas and about 40 percent of urban localities was not subject to codes.

And many localities which had codes which once were good have failed to keep them abreast of the technological advances in methods and materials. It was estimated in 1938 that over 40 percent of existing codes were between ten and fifteen years old and almost 15 percent were over

twenty years old.

War has brought many innovations in building construction. Many communities, particularly in and near defense centers, are operating under a set of regulations in which many allowances and substitutions of an emergency nature had to be made if war housing was to go ahead. Under the spur of necessity methods have been improvised and materials used in ways not formerly believed possible. Some of these war-time changes have proven adequately safe and permitted reductions in construction costs. Others were no more than stop-gaps, decidedly sub-standard. In this nation-wide experimentation, some of these changes have been in effect long enough to prove their permanent merit. And the end of the war should see a flood of new or hitherto little-used materials making a bid to enter the building field. What should be done about our building codes to give new materials and improved methods a chance to help make possible better post-war homes at less cost?

REPORT MATERIAL

The 24 field offices of the Federal Housing Administration were requested, when significant trends or major changes were anticipated, to mark opposite each of the following codes -- building, sanitary, sewage disposal, plumbing, electrical, and heating -- the percent of houses to be built post-war to which the following adjectives -- none, inadequate, adequate, too restrictive -- would apply; and were asked to list important "inadequate" and "too restrictive" provisions and to state desirable changes.

They were also asked to comment on the following question:

"POST-WAR CONTROLS: Assuming a large volume of residential construction after the war, do you believe that adequate controls of development and construction exist through local public bodies, lending institutions, and government agencies to assure development and construction according to your ideas of sound practice? If not, state what minor or major modifications should take place."

Twenty-two of the offices commented in some way on the two questions.

Only Columbus and St. Louis reported that no change was recommended in local codes. All others were agreed that changes were desirable.

No codes of any kind applicable to outlying and unincorporated areas in their territories were reported by Houston, Chicago, and Los Angeles.

Inadequate provisions were reported by Chicago, Richmond, Greensboro, Houston, and Los Angeles and these included septic tank installations, plumbing, heating, electrical, and building provisions without detail.

Too restrictive codes were reported from Chicago, Houston, Denver, and Los Angeles. Electric wiring, interior finish, plumbing vents, thickness of masonry walls, heating equipment, excessive materials, and barring of new materials and methods were listed under this topic.

Desirable changes were listed by Chicago, Richmond, Greensboro, Houston, Dallas, Denver, and Los Angeles. These include provisions

for admission of new materials and methods, control by performance standards rather than by specification, revision to meet up-to-date conditions, state-wide codes, adequate inspection and enforcement, and less arbitrary one-man interpretation and enforcement.

There is general agreement that the mechanisms of control through codes, zoning laws, lending institutions, and government agencies (such as FHA through its Property Standards and Minimum Construction Requirements) are sufficient but most believe that all codes and standards should be examined critically and be brought into line with current developments in nationally recognized standards.

For instance, Philadelphia believes that "control should be very definite. It should attempt to keep the requirements constant with public needs, and be directional as a factor in keeping the standards of housing in step with progress; also in the use of materials, both as to their availability and adaptability."

Buffalo: ". . . modifications should be made in local codes toward a standardization of building development and construction requirements. Also supervision should be given greater consideration. That is, more frequent and thorough inspections made. Higher standard of architectural design."

Detroit: "Inadequate controls exist in rural and some suburban areas . . . housing standards could be improved by state and township (wide) . . . codes."

Chicago: "Zoning ordinances need a great deal of remodeling, and in some localities entirely new zoning legislation is required."

Houston: "Better sanitation, more light and air, greater attention to conveniences, both in the home and out, will be demanded by a more discerning public and the existing controls such as zoning laws, protective covenants, etc., will be made more effective by the education for home-mindedness generally being conducted throughout the nation by the press, radio, magazines, etc."

CONCLUSIONS

The problem of building codes is a three-fold one.

First, ideal provisions must be reconciled with practical, economic considerations. A code with elaborate requirements that brings cost to a point where only a few can pay for new housing defeats the purpose of public regulation and building.

Second, requirements must be so worded as not to exclude sound new building methods and materials. Performance requirements, not specifications, should be set up -- for example, not the thickness and materials for a wall but the strength, durability, fire resistance vapor resistance, et cetera required.

Third, special local circumstances should be provided for without impeding the industry on a wider basis. California construction requires special bracing for earthquakes. Florida buildings must satisfy hurricane protection requirements; and in northern cities the possibility of heavy snow loads must be considered.

A building code which properly takes these factors into account will be safe, fair, practical, economical, flexible, and recently revised.

Architects have said their freedom of design has been unnecessarily restricted. Engineers and builders have claimed that obsolete or ill-considered code provisions increased building construction costs without adding any compensating benefits in the way of increased public safety or health. Manufacturers of building materials have been compelled to run a gantlet of conflicting regulations and promising new materials and methods sometimes die in their struggle for recognition. Some authorities believe that any code over 10 years old should have a thorough investigation to determine if changes cannot be made in it that will reduce construction costs without detracting from safety standards. And it has been cited that over 55 percent of existing codes are over that age. The field offices of the Federal Housing Administration are in agreement that existing codes need modernization.

The interest is much broader than builders and the building industry; it affects the prosperity and living conditions of millions in towns and cities scattered throughout the country. Communities under the handicap of excessive building costs due to obsolete and unfair codes will not contribute the full share of national re-employment and post-war prosperity that can be created by the private building of their towns and cities. This breadth of interest points logically to increased nation-wide concern in the field of building codes.

Since local building codes are not isolated documents of purely local concern, there is a growing recognition of the need for increased activities at other levels of government in this field, cooperating closely with industry in order to facilitate local development of progressive building codes and better code administration. The federal government's interest in better housing at lower costs to expand the market that can be reached by private

enterprise without subsidy is so extensive that it cannot be indifferent to the local regulations that are wasteful or unduly restrictive.

In the public interest an expanded program of technical research and development on the part of the United States Government should be established as an aid to and in cooperation with the municipalities, and the home building and associate interests looking to

1. Development of adequate minimum performance standards and uniform testing methods for all elements of a dwelling and its site and services considering the health, safety and welfare of the occupants and their neighbors.

2. Dissemination of technical information interpreting significant developments in standards, tests, materials and methods for the guidance of code making and enforcing authorities and industry in order to promote local adoption of sound and workable performance standards and tests; to provide a practical scientific basis for local consideration of new or improved construction materials, subassemblies and methods; and to focus attention on technical research and development work currently needed by local code making and enforcing authorities to improve the physical character and economic well being of their communities.

STATEMENT OF PROBLEM

In attempting to determine what non-regulatory measures, if any, should be taken to guide the large anticipated volume of private postwar residential construction, the 24 FHA Field Offices were asked the following question:

"Non-Regulatory Action - Is there further action of a non-regulatory nature (i.e. publicity, information, research, education, etc.) needed to assure satisfactory planning, design, construction and equipment and lower costs in post-war residential construction? If so, what sort of action, and in your opinion by whom should it be performed?"

REPORT MATERIAL

Education & Publicity: Ten out of 24 offices, representing 45% of anticipated post-war single-family construction, stated that government agencies should direct a greater amount of publicity and educational work, covering improved design and construction practices, both towards the public and towards building firms and lending institutions. Two offices, in addition, representing 14% of anticipated volume, indicated that this type of action should be chiefly directed towards the general public. Three other offices, representing 6% of anticipated volume stressed the importance of directing this type of activity towards builders, lending institutions and local officials.

Research: Specific recommendations for the establishment or enlargement of government housing research departments were received from three offices, representing 12% of anticipated post-war single family volume. (Buffalo, Chicago, Minneapolis). More research by govern-

ment and industry together was advocated by two offices representing 3% of anticipated volume (Buffalo, Pittsburgh).

Architects: More participation by architects in the design of residential developments was advocated by 2 offices representing 7% of anticipated volume (Greensboro, New Orleans).

FHA Services: Extension of or enlargement of existing FHA services in planning and design to builders and developers was advocated by five offices representing 27% of anticipated volume (Hartford, Philadelphia, Houston, Columbus, Chicago).

One office, representing 4% of anticipated volume (Jacksonville) stated that no extension of present non-regulatory efforts was required.

One office (5%) did not reply to the question dealing with non-regulatory action.

CONCLUSIONS

Sentiment appears to be overwhelming for a wider dissemination by the government of information on better standards of design and construction, 18 offices, representing 73% of anticipated construction, stating that they consider such measures to be desirable. Emphasis is placed on the necessity for further government research by six of these offices, representing 27% of anticipated construction, and several additional offices mention the necessity for further research of this sort without spedifically stating that the government should do it. The remaining 12 offices appear to place chief emphasis on government educational and publicity work, rather than on further research, although the latter type of activity is not excluded.