
UNITED STATES DEPARTMENT OF LABOR

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BUREAU OF LABOR STATISTICS

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Probable Volume
of
Postwar Construction



Bulletin No. 825

For sale by the Superintendent of Documents, U. S. Government Printing Office
Washington 25, D. C. Price 10 cents

Letter of Transmittal

UNITED STATES DEPARTMENT OF LABOR,
BUREAU OF LABOR STATISTICS,
Washington, D. C., May 14, 1945.

The SECRETARY OF LABOR:

I have the honor to transmit herewith a report on the probable volume of postwar construction, and on the estimated site employment in postwar new construction. The report on probable volume was published in the Monthly Labor Review for February, March, and April, 1945. Estimated site employment (part 4) of the bulletin is to be published in a later issue of the Review. These reports were prepared in the Bureau's Division of Construction and Public Employment by Alexander C. Findlay. The historical statistical data were developed by Henry F. Haase.

A. F. HINRICHS,
Acting Commissioner.

Hon. FRANCES PERKINS,
Secretary of Labor.

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*Bulletin No. 825 of the
United States Bureau of Labor Statistics*

[Reprinted from the MONTHLY LABOR REVIEW, February, March, and April, 1945, with additional data]

Probable Volume of Postwar Construction

Part 1.—General Forecast and Its Controlling Background

Summary

THE forecast of postwar construction here presented is necessarily conjectural, as, although some basic conditions are now rather clearly apparent, others are less so, and still others have yet to be established. Either turbulent economic conditions, such as those immediately following the First World War, or a period of severe industrial conflict would produce construction activities quite different from those here predicted. Neither such development is expected, but neither is impossible. A period of boom psychology such as that of the later 1920's would increase the total volume greatly and shift the pattern markedly toward ambitious commercial projects. It is believed that this will not occur, but this too is not impossible. Similarly, public construction has been predicted on the basis of the public policy which seems likely, according to assumptions which are later stated. Policies either of drastic retrenchment in public construction or of expansion for the primary purpose of stimulating employment would obviously change the volume of this work greatly, with considerable influence on private work as well.

The average volume of work started annually is expected to be about 10.9 billion dollars per year, at 1940 cost levels, in the 5-year period following the end of the war, for new construction, additions, modernization and alterations, and major repairs of the type for which building permits are usually issued. Such work will probably be started to the extent of about $4\frac{1}{2}$ billion dollars during the final phase of the war—i. e., against Japan only—which is assumed as 1 year. From this figure it is expected to increase to almost 8 billion dollars in the first postwar year, and to about 12 billion dollars in the fifth postwar year. In addition, maintenance and routine minor repairs are expected to amount to about 3.7 billion dollars in the last year before defeat of Japan, and to average about 4.4 billion dollars annually in the following 5-year period.

The largest single element in this volume of work will be nonfarm residential building, for which the expected average is about 900,000 new dwelling units per year with annual construction cost of 3.4 billion dollars.¹ Privately financed units will probably constitute about 95 percent of these. It is estimated that about 250,000 private units will be started during the final year of war against Japan only, although this number will be governed to a considerable degree by the time of year at which Germany is defeated. About 550,000 private

¹ Like all other construction value figures, except where otherwise noted, this has been converted to the 1940 level of costs. The estimate of an average volume of 900,000 dwelling units per year includes apartments, etc., as well as detached houses. This is to be distinguished from estimates of the construction rates required to meet housing needs within specified periods made by the National Housing Agency and other organizations.

units are expected to be started in the first year following defeat of Japan, and the number started will probably increase to about 1,040,000 in the fifth year.

Private industrial construction including alterations during this period will probably be almost 700 million dollars per year, which is somewhat under three-fourths of the previous peak, and commercial construction at 1.2 billion dollars per year will be within about 12 percent of its 1929 peak. This will be quite unlike pre-depression commercial construction, however, with new work overshadowed by modernization and with few if any of the monumental commercial buildings for which the previous period of active commercial construction is best known. The significant although minor field of construction for nonprofit and community organizations, such as churches and voluntary hospitals, will increase substantially, but probably not to its pre-1929 levels.

Utility construction will probably be almost 1.15 billion dollars with construction for railroads the largest single group, followed by that for communications companies and for light and power companies. Other utility work will be considerably smaller.

New public work, according to the assumptions later stated, will be somewhat over a third of private work. The principal type of work will be highways, roads, and streets, with related structures, for which preparations are well advanced and for which financing will be available irrespective of considerations of resulting employment. States and local government bodies have a great volume of other work which they would like to carry out, but actual working plans are completed or in preparation for a considerably smaller program than that which has been estimated, and grants or loans will be needed in many cases to permit this preparation. For the most part financial preparation is likewise somewhat poor, and there are numerous indications that Federal aid will be commonly expected. It is therefore of primary importance that a decision on public policy be reached at the earliest possible date, in order that programs may be adjusted as necessary and, particularly, that a relatively dormant period while waiting for favorable Federal legislation may be avoided.

It is assumed that the postwar period proper will be preceded by a period of war against Japan only. For the purposes of this forecast this is assumed to be a year, although there are indications that it may be longer. During this period some degree of reconversion is likely to occur in building-material establishments, there will probably be an early and extensive relaxation of restrictions on the use of metals, and establishments requiring no real physical reconversion will be able to build up depleted trade inventories if materials and manpower are available. Maintenance and repair work, using proportionately little new material, will be the first activity to get under way. New residential building will expand from its low wartime level, but the volume of such construction will depend on the time of year at which Germany is defeated, and may vary between 175,000 and 350,000 dwelling units started. Commercial construction, both new work and modernization, is likely to be little above its earlier level during this final stage of the war. There will be industrial alterations for reconversion purposes, but less than after the defeat of Japan, and probably little new industrial construction except that useful for war production.

Estimated construction volume during this year of Pacific war and during the 5 years after the defeat of Japan is given in table 1.

TABLE 1.—Estimated Value of Principal Types of Construction To Be Started During Final War Year and First 5 Years Thereafter¹

Type of construction and source of funds	Value (in millions of dollars)						
	Final war year ²	First 5 post-war years					
		1st	2nd	3rd	4th	5th	Average
<i>New construction</i>							
Total new construction; including additions, alterations, modernization, and major repairs ²	4,460	7,890	10,870	11,805	11,990	12,065	10,924
Private construction.....	3,045	5,765	8,015	8,560	8,545	8,595	7,896
Residential (nonfarm).....	1,250	2,850	3,900	4,250	4,300	4,450	3,950
New construction.....	1,000	2,300	3,100	3,400	3,500	3,700	3,200
Additions, alterations, modernization and major repairs.....	250	550	800	850	800	750	750
Nonresidential.....	780	1,530	2,400	2,550	2,550	2,450	2,296
Commercial.....	275	750	1,300	1,350	1,350	1,250	1,200
New construction.....	150	250	400	500	550	550	450
Additions, alterations, modernization, and major repairs.....	125	500	900	850	800	700	750
Industrial.....	375	500	700	750	750	750	690
New construction.....	175	300	400	450	500	550	440
Additions, alterations, modernization, and major repairs.....	200	200	300	300	250	200	250
Religious.....	50	100	150	175	175	175	155
Educational.....	25	60	75	80	80	80	75
Social and recreational.....	15	50	75	85	85	85	78
Hospital and institutional.....	30	50	75	85	85	85	78
Miscellaneous.....	10	20	25	25	25	25	24
Farm (residential and nonresidential).....	325	425	525	550	550	500	510
Utility ⁴	690	960	1,190	1,210	1,145	1,195	1,140
Railroad.....	300	350	400	350	350	350	380
Local transit.....	15	25	40	45	45	45	40
Pipe line.....	25	25	25	25	25	25	25
Electric light and power.....	150	250	300	300	300	350	300
Gas.....	50	60	75	90	75	75	75
Telephone and telegraph.....	150	250	350	400	350	350	340
Public construction.....	1,415	2,125	2,855	3,245	3,445	3,470	3,028
Highway, road, and street ⁴	500	900	1,200	1,400	1,500	1,500	1,300
Residential building.....	10	95	145	175	190	190	159
Nonresidential building.....	420	380	580	690	725	750	625
Educational.....	100	250	400	450	450	450	400
Hospital and institutional.....	35	45	70	80	90	90	75
Public administration.....	50	75	100	150	175	200	140
Commercial and industrial.....	225	0	0	0	0	0	0
Miscellaneous.....	10	10	10	10	10	10	10
Military and naval.....	200	100	75	50	40	40	61
Civil aviation.....	0	60	75	80	80	80	75
Reclamation, conservation, and development.....	100	275	325	350	400	400	350
Water supply.....	75	110	140	160	170	170	150
Sewage disposal.....	75	125	200	225	225	225	200
Social and recreational ⁶	15	50	75	75	75	75	70
All other Federal.....	5	10	15	15	15	15	14
Miscellaneous non-Federal.....	15	20	25	25	25	25	24
<i>Maintenance and minor repairs</i>							
Total maintenance and minor repair.....	3,680	5,070	4,725	4,265	4,015	4,015	4,418
Private construction.....	2,885	4,005	3,675	3,330	3,180	3,180	3,474
Residential buildings.....	1,000	1,500	1,400	1,300	1,300	1,300	1,360
Nonresidential buildings.....	500	750	600	500	500	500	570
Farm.....	300	400	350	350	300	300	340
Utility.....	1,085	1,355	1,325	1,180	1,080	1,080	1,204
Railroad.....	800	1,000	1,000	900	800	800	900
Local transit.....	50	75	70	60	60	60	65
Pipe line.....	15	20	20	15	15	15	17
Electric light and power.....	85	100	90	85	85	85	89
Gas.....	25	30	25	20	20	20	23
Telephone and telegraph.....	110	130	120	100	100	100	110

See footnotes at end of table.

TABLE 1.—*Estimated Value of Principal Types of Construction To Be Started During Final War Year and First 5 Years Thereafter*¹—Continued

Type of construction and source of funds	Value (in millions of dollars)						
	Final war year ²	First 5 post-war years					
		1st	2nd	3rd	4th	5th	Average
Public construction.....	795	1,065	1,050	935	835	835	944
Highway, road, and street.....	600	800	800	700	600	600	700
Building (residential and nonresidential).....	50	75	75	70	70	70	72
Reclamation, conservation, and development.....	50	75	70	65	65	65	68
Water supply.....	75	90	85	80	80	80	83
Sewage disposal.....	20	25	20	20	20	20	21

¹ Converted to 1940 cost levels.

² Between defeat of Germany and defeat of Japan.

³ Additions, alterations, modernization and major repairs of the type for which building permits are usually issued are included with new construction except where listed separately.

⁴ Includes municipal and other publicly owned utilities except those constructed in conjunction with reclamation, conservation and development program.

⁵ Includes culverts, bridges, grade separations, and other related work.

⁶ Includes buildings and nonbuilding construction.

Scope and Methods of the Study

This forecast covers construction of all types within the United States during the period of war against Japan only, which is assumed to be a year in duration, and the 5-year period following the end of the war. It includes additions, alterations, modernization, and major repairs of the type for which building permits are usually issued and, as a separate group, routine minor repairs and maintenance work.

It is essentially an informed opinion based on information from a wide variety of sources and on analysis of controlling social and economic conditions. Information on scheduled or contemplated construction programs has been obtained through personal interviews and in reports from utilities, professional associations, architects, trade associations in a number of fields, officials of Federal agencies, financing organizations, institutional investors, and the architectural, engineering, building and financial press. Compilations of contemplated work, budgets and published reports of actual appropriations for public work issued by Federal, State, and local government units have been used. Interviews have been had with consultants in the construction plans of nonprofit and community organizations, and with promotional builders. Consideration has been given recent developments in building materials, methods, and in the case of residential work to major recent trends in job organization and management procedures. The past record of major types of construction by year from 1920 has been studied, along with the financial record of the various types of structures which were built. Trends in distribution and merchandising methods have been given attention, along with changes in social customs such as those still developing from widespread use of automobiles.

For the most part, postwar construction programs are highly tentative, including those of certain utilities and other firms long noted for careful planning of their capital-expenditure programs. Programs have been prepared by a number of public bodies, but with few exceptions these are schedules of work regarded as desirable and are dependent upon appropriation of necessary funds. Thus, a compilation of contemplated construction work, were it feasible, would not in itself indicate the volume to be expected.

No attempt has been made to prepare a strictly mathematical forecast, with volume computed from conditions which can be expressed numerically, because neither the techniques that could be used nor available data are satisfactory.

For convenience in comparison, all values have been converted to 1940 cost levels. The indexes used are not fully satisfactory, especially for years prior to 1935, and will be revised when there is opportunity for the special study involved. It is believed, however, that these revisions will not be great enough to change the significance of comparisons of given types of construction with the records of past years.

Construction Volume in the Past

The volume of principal types of new construction, including additions and alterations and those major repairs for which building permits are usually issued, but not including maintenance and routine minor repairs, is shown in table 2, by years, from 1920 through 1943. These figures have been converted to the 1940 level of costs, within the limitations of the cost indexes used.

Prior to the war there were 5 years—1925 through 1929—in which the annual total of expenditure for construction exceeded 10 billion dollars. The peak for all types of construction came in 1927, but that for nonfarm residential building was reached in 1925, that for commercial 4 years later, and those for some of the utility classifications not until 1929 or 1930.

Although the pattern predicted for the postwar period differs substantially from that for the first few years in table 2, certain relationships will be the same. Of the large groups of new private construction, residential will rise fastest, just as it did about 25 years earlier. New commercial work will rise more slowly than residential building and also more slowly than it did in the past, but this will be outweighed by a rapid expansion of commercial modernization and major alterations, for which owners' plans are well advanced. Public work will increase rapidly, in contrast to its gradual increase for 11 years to its prewar peak reached in 1931. This important difference from the development following the previous war will be the result of two major factors—increased general recognition of the value of certain kinds of public construction, notably reclamation and conservation work, and widespread realization of the importance of construction to total economy.

TABLE 2.—*Estimated New-Construction Expenditures in the United*

[Millions of dollars]

Type of construction and source of funds	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931
New construction ¹	5,735	6,156	8,511	9,020	9,996	11,037	11,555	11,608	11,154	11,241	9,126	7,466
Private construction.....	4,729	4,780	6,854	7,642	8,385	9,137	9,626	9,438	8,863	8,983	6,407	4,641
Residential (nonfarm) ²	1,578	2,151	3,711	4,099	4,691	5,084	5,036	4,679	4,278	3,786	1,964	1,753
Nonresidential ²	1,809	1,662	1,811	1,735	1,694	2,182	2,609	2,654	2,603	2,987	2,356	1,501
Commercial.....	610	696	799	768	787	1,029	1,218	1,247	1,207	1,361	1,177	759
Industrial.....	967	603	506	510	422	487	637	632	682	942	590	247
Religious.....	59	94	147	136	149	195	210	211	197	182	158	124
Educational.....	24	43	86	96	105	128	127	124	124	147	151	141
Social and recreational.....	116	166	197	157	158	248	317	312	274	225	169	156
Hospital and institutional.....	33	60	76	68	73	95	100	128	119	130	111	74
Miscellaneous.....	0	0	0	0	0	0	0	0	0	0	0	0
Farm ²	589	390	458	545	604	512	497	560	526	552	393	281
Utility ²	753	577	874	1,263	1,396	1,359	1,484	1,545	1,456	1,658	1,694	1,106
Railroad.....	151	170	173	329	335	370	472	433	407	483	507	313
Local transit.....	67	54	84	67	51	49	49	72	85	78	83	74
Pipeline.....	41	29	51	60	74	61	40	91	62	112	35	94
Electric light and power.....	290	169	289	503	546	494	453	473	425	434	503	317
Gas.....	70	51	132	114	163	144	206	219	186	161	156	106
Telephone and telegraph.....	134	104	145	190	227	241	284	257	291	390	410	202
Public construction.....	1,006	1,376	1,657	1,378	1,611	1,900	1,929	2,170	2,291	2,258	2,719	2,825
Highway, road, and street ²	329	517	576	474	602	704	719	836	954	970	1,237	1,233
Residential building.....	0	0	0	0	0	0	0	0	0	0	0	0
Nonresidential building.....	277	472	629	526	540	635	662	650	689	682	710	710
Educational.....	193	341	456	392	403	460	454	417	421	410	395	328
Hospital and institutional.....	33	50	80	62	68	70	77	88	118	106	122	147
Public administration.....	39	65	73	50	45	64	79	94	94	119	158	204
Commercial ²	0	0	0	0	0	0	0	0	0	0	0	0
Industrial ²	0	0	0	0	0	0	0	0	0	0	0	0
Social and recreational.....	12	16	20	22	24	41	52	51	56	47	35	31
Miscellaneous.....	0	0	0	0	0	0	0	0	0	0	0	0
Military and naval.....	157	59	34	18	10	10	13	14	17	21	33	50
Reclamation, conservation, and development.....	54	62	68	74	88	86	71	74	84	100	132	180
Water supply.....	83	120	157	128	175	170	163	162	137	147	240	209
Sewage disposal.....	65	93	122	102	122	155	169	204	214	148	169	152
All other Federal.....	1	1	3	2	1	1	2	4	12	15	11	12
Miscellaneous non-Federal (public service enterprises).....	40	52	68	54	73	139	130	226	184	175	187	279

¹ Converted to 1940 cost levels; unless otherwise stated estimates include expenditures for new construction, and major additions and alterations, but exclude expenditures for repairs, maintenance, and work-relief construction. Estimates through 1938, except for farm construction, are from Bureau of Foreign and Domestic Commerce Series "Construction Activity in Continental United States."

² Includes repairs of the type for which building permits are usually issued, for 1929 and subsequent years.

Rate of Expansion

The rate of expansion indicated by table 1 may seem high, but is entirely feasible. The maximum increments of previous expansion and the peak annual expenditures for each of the major types of construction are shown in table 3. The maximum past increments did not occur simultaneously. They did, however, in many cases occur when total construction activity was at or near a peak. The postwar expansion predicted will start from a very low level of total construction, when the industry is prepared to undertake additional work of all types.

States, by Type of Construction and Source of Funds, 1920-43¹

[Millions of dollars]

1932	1933	1934	1935	1936	1937	1938	1939	1940	1941	1942	1943	Type of construction and source of funds
4,947	3,235	3,617	4,297	5,995	6,293	5,827	7,019	7,602	10,627	12,625	7,196	New construction. ²
2,562	1,824	2,108	2,724	3,710	4,302	3,721	4,425	5,053	5,819	3,223	1,990	Private construction.
919	567	719	1,117	1,614	1,715	1,820	2,478	2,659	2,973	1,344	674	Residential (nonfarm). ³
874	706	765	799	1,185	1,461	930	901	1,159	1,444	817	477	Nonresidential. ³
406	224	260	323	391	483	375	366	394	424	161	55	Commercial. ³
106	301	301	279	464	730	250	276	499	758	500	340	Industrial.
81	44	39	43	53	58	65	58	67	63	40	5	Religious.
105	47	60	64	98	55	55	41	62	48	21	26	Educational.
52	26	26	20	32	37	46	37	40	47	28	27	Social and recreational.
43	34	26	21	19	16	26	20	24	32	28	14	Hospital and institutional.
170	236	263	413	433	485	454	539	570	643	485	405	Miscellaneous.
599	315	358	395	528	641	517	507	665	759	577	434	Farm. ³
174	115	150	136	168	212	127	146	167	176	168	138	Utility. ⁴
36	26	35	47	51	42	44	37	34	19	9	10	Railroad.
50	10	14	23	48	69	22	52	78	62	43	32	Local transit.
159	68	66	85	122	153	179	130	193	239	150	102	Pipeline.
47	37	37	42	63	60	49	45	70	80	62	46	Electric light and power.
113	59	56	62	76	105	96	97	123	183	145	56	Gas.
												Telephone and telegraph.
2,385	1,411	1,611	1,573	2,285	1,991	2,106	2,594	2,549	4,808	9,402	5,206	Public construction.
1,075	652	699	553	757	766	824	780	819	691	442	231	Highway, road and street. ⁵
0	0	1	11	72	96	36	67	199	413	495	622	Residential building.
588	262	252	319	645	483	587	858	519	1,512	3,487	1,824	Nonresidential building.
192	60	100	136	339	233	290	436	133	127	55	61	Educational.
109	48	41	37	71	65	81	121	56	28	20	32	Hospital and institutional.
258	136	52	89	152	116	130	181	100	49	26	9	Public administration.
0	0	12	10	15	18	22	27	28	15	7	4	Commercial. ⁶
0	0	11	5	4	4	14	23	164	1,264	3,366	1,705	Industrial. ⁶
29	18	26	31	53	41	41	48	17	15	6	4	Social and recreational.
0	0	10	11	11	6	9	22	21	14	7	9	Miscellaneous.
51	50	57	46	34	38	64	138	385	1,537	4,467	2,110	Military and naval.
214	239	300	392	395	315	301	317	311	353	306	204	Reclamation, conservation, and development.
134	67	76	85	109	81	92	123	62	47	32	54	Water supply.
106	48	66	84	135	98	91	138	87	64	51	25	Sewage disposal.
9	6	10	10	8	10	15	20	35	42	46	0	All other Federal.
208	87	50	73	130	104	96	153	132	149	76	136	Miscellaneous non-Federal (public service enterprises).

¹ Farm construction estimated by Bureau of Agricultural Economics, U. S. Department of Agriculture; includes maintenance and minor repairs.

² Privately owned utilities only.

³ Includes culverts, bridges, grade separations and other related work.

⁴ Included with privately financed commercial and industrial construction up to 1934.

The grand totals shown in this table establish a limit for what may reasonably be expected. They would be the maxima for the past if the greatest rate of increase had occurred simultaneously for all types of construction, and if greatest volume had been reached in the same year for all types.

In almost every respect the United States is better prepared for sound expansion than after the previous war and in the 1920's. The construction industry itself is more mature. The home-mortgage system is incomparably more satisfactory from the standpoint of both borrowers and lenders, and has provided useful minimum standards of construction and environment. Promotional builders following accepted business-management practices are much more prominent in the field than 25 years ago, and are likely to increase in prominence

with the passage of time. Although the financing machinery for shoestring rental operations was destroyed by the depression, financing for responsible operators in certain classes of rental housing has since been provided and rental housing is now recognized as a field for direct institutional investment. Financing of large commercial projects is more difficult, but should not prevent construction for which there is sound economic need.

Planning of postwar work, except for highways, is not so far advanced as it should be to assure a maximum rate of expansion. It is nevertheless well ahead of the situation at the end of the previous war, and seems likely to be improved materially before this war is over.

TABLE 3.—Greatest Year-to-Year Increment and Maximum Annual Expenditure for Specific Types of New Construction, 1920–40¹

Type of construction and source of funds	Greatest year-to-year increment		Maximum annual expenditure	
	Amount (in millions of dollars)	Years	Amount (in millions of dollars)	Years
Total new construction ²	4, 603	(³)	14, 947	(³)
Private construction.....	3, 081	(³)	10, 713	(³)
Residential (nonfarm).....	1, 560	1921-22	5, 084	1925
Nonresidential.....	732	(³)	3, 180	(³)
Commercial.....	242	1924-25	1, 361	1929
Industrial.....	266	1936-37	967	1920
Religious.....	53	1921-22	211	1927
Educational.....	43	1921-22	151	1930
Social and recreational.....	90	1924-25	317	1926
Hospital and institutional.....	28	1926-27	130	1929
Miscellaneous.....	10	1937-38	43	1932
Farm.....	150	1934-35	570	1940
Residential.....	60	1934-35	250	1940
Nonresidential.....	90	1934-35	320	1940
Utility.....	639	(³)	1, 879	(³)
Railroad.....	156	1922-23	507	1930
Local transit.....	30	1921-22	85	1928
Pipeline.....	59	1930-31	112	1929
Electric light and power.....	214	1922-23	546	1924
Gas.....	81	1921-22	219	1927
Telephone and telegraph.....	99	1928-29	410	1930
Public construction.....	1, 522	(³)	4, 234	(³)
Highway, road, and street.....	309	(³)	1, 329	(³)
State.....	155	1929-30	647	1931
County.....	88	1920-21	259	1931
Municipal.....	66	1924-25	423	1930
Residential building.....	132	1939-40	199	1940
Nonresidential building.....	487	(³)	1, 135	(³)
Educational.....	203	1935-36	460	1925
Hospital and institutional.....	40	1938-39	147	1931
Public administration.....	63	1935-36	253	1932
Commercial.....	5	{ 1935-36 1938-39 }	28	1940
Industrial.....	141	1939-40	164	1940
Social and recreational.....	22	1935-36	56	1928
Miscellaneous.....	13	1938-39	22	1939
Military and naval.....	247	1939-40	385	1940
Reclamation, conservation, and development.....	92	1934-35	413	(³)
Bureau of Reclamation.....	15	1934-35	74	1939-40
Corps of Engineers.....	45	1934-35	226	1936
Tennessee Valley Authority.....	14	{ 1933-34 1934-35 }	88	1936-40
Other.....	18	1934-35	80	1935
Water supply.....	93	1929-30	240	1930
Sewage disposal.....	51	1935-36	214	1928
All other Federal.....	15	1939-40	35	1940
Miscellaneous non-Federal.....	96	1926-27	279	1931

¹ Converted to 1940 cost levels.

² Includes additions, alterations, modernization, and major repairs of the type for which building permits are usually issued.

³ Year-to-year increments or annual expenditures making up this total were not simultaneous.

Basic Conditions Governing Postwar Construction

The postwar construction program will be conducted in an environment of economic, social, and technical conditions by which its character will be largely determined. Some of these can be predicted with a rather high degree of certainty because of their intrinsic nature, and others can be predicted with reasonable confidence because of the unmistakable direction of the forces active. Still others must be more or less arbitrarily assumed, to establish a frame of reference; these are presented in the section on pages 12 and 13.

DESIGN AND PHYSICAL ENVIRONMENT

It cannot be emphasized too strongly that in design and construction postwar structures will resemble very closely the prewar structures for the same purposes. Development is occurring, and some experimental or pioneering operations will influence designers, but this has been the case in the past and has led to varying rates of evolution in design. "Miracle houses" and miracle structures of other types are not to be expected.

Functional requirements for structures of various types will be unchanged, although recognition of their relative importance is changing in some instances. An example is the greater emphasis being given to facilities for customer circulation in retail stores, which is changing the details of design but having slight effect on the basic structures. Family living habits, housekeeping operations, and social customs may change somewhat, but not sufficiently to have a material effect on space requirements in proportion to family size. Trailers and other extremely compact dwelling units have filled a useful place under emergency conditions, and no doubt will be useful under similar conditions in the future. No indications are apparent as yet, however, that units of this type are generally regarded as satisfactory for permanent occupancy. Instead, recent market studies show a widespread desire on the part of potential home buyers for more space than has been provided in wartime houses. Replies in these studies have emphasized a strong desire for larger rooms.

Structures of any type, including dwelling units, require an environment of community services and facilities. Where density of population is great, this environment must be fairly complex. Health requires public water supply and sewage systems, hospitals, and clinics; convenience requires electric service and probably gas, paving, and local retail and service establishments; elementary social standards require schools, churches, park and recreation areas and organizations, etc. All of these requirements mean that some stable system of community organization is necessary, plus some stable relationship between dwelling units and community. That entails permanent attachment of dwelling units to land. Purchase of dwelling units which can be moved with any change of employment will no doubt continue to some degree, but such units are most unlikely to constitute more than a trifling percentage of the total.

MATERIALS AND CONSTRUCTION METHODS

Materials likewise will be essentially the same as before the war, though development has occurred and is continuing. Greater use

may be expected of certain materials introduced within recent years, and there are strong indications that other new materials will be introduced. Specifically, it seems almost certain that panel boards (plywood, panels made from various fibrous materials, and those made from inorganic materials) will be more prominent, and it is quite probable that war-expanded capacity for production of light metals may lead to considerable increase in their use in construction. These developments, however, are minor in relation to the pattern of materials as a whole and are altogether comparable to past evolution in the field. Costs of materials and of equipment for processing, as well as other considerations, make unlikely the actual realization of the quite common prediction that walls, partitions, and other major elements will be molded from plastics or that other such drastic changes will occur. Plastics will fill a useful place, more prominent than in the past but still minor. They will be employed as ornamental elements, as a thin coating to improve appearance and wear-resistance of plywood and other panel boards, and in other supplementary applications. At the same time, metals will replace them for many of the wartime uses in which they were emergency substitutes. Ultimately their range of usefulness in construction may be increased considerably by technical developments, but it is difficult to picture conditions under which they would become important load-bearing materials. In the latter field, changes are to be expected from development work in treated wood, rather than in plastics.

For at least a generation, the trend in buildings of all types has been toward more extensive use of mechanical equipment and a higher degree of its development. This trend will certainly continue, but will continue to be limited by considerations of cost. Almost without exception mechanical items introduced at prices limiting their use to the luxury market have been progressively reduced in price. A long-time downward trend may be expected, compared to the prices for other parts of the buildings, for such equipment items as air-conditioning systems. Nevertheless, it must be recognized that such highly fabricated items of equipment represent many man-hours of manufacturing labor under any circumstances, in addition to the labor of installation. They must therefore constitute an appreciable element of the cost of those buildings in which they are used, and will not be used within the near future in mass-market houses or similar buildings.

Construction methods have also undergone a long and gradual evolution. Off-site processing has increased, with site work consisting less of fabrication and more of installation. Fabrication at the site has been segregated to an increasing degree; cutting and other processing are carried out at temporary shops and followed commonly by installation by another group of workmen. Greater attention has been given to scheduling of materials and of material flow, to timing of operations, and to organization of the work between specialized gangs to reduce waste motion and lost time. Machinery for site processing of materials, especially lumber, has been improved greatly within recent years, with the result of much more widespread adoption. All of these developments may be expected to continue.

Off-site fabrication of processed materials into panels for floors, walls and other major elements of houses, although known for many years, was quite limited in extent prior to the war. Wartime conditions expanded this division of the construction industry tremendously.

Numerous firms have pursued programs of design and development work, and have made concrete plans for postwar operation. Other firms having existing plants which could be used have entered the field only on the basis of contracts for individual housing projects, and on the whole have made little preparation for continuance under postwar conditions.

A considerable increase over prewar volume may be expected for these operations, but here again drastic changes in the general pattern of the industry seem unlikely. Transportation of panels or sections of houses is both more difficult and more expensive than that of bulk building materials. Manufacturing economies are reduced when great variety must be provided for a large number of individual purchasers. Panels and sections are not well suited to extensive inventory storage, and their manufacture must therefore be dovetailed quite closely with erection. A study now in progress is sufficiently advanced to indicate that most of the prefabricators have operated quite successfully with ingenious but simple and inexpensive plant facilities, and that it is exceedingly doubtful whether the additional advantages of an elaborate plant outweigh the additional complications. Problems of site acquisition, site planning, and project planning are enormous for Nation-wide operation of any firm, on a scale sufficient for erection of thousands of structures a month. Consequently forecasts of such operations, with production concentrated in enormous plants for distribution throughout the country, must be accepted with great reservation. It is much more likely that production on a moderate scale and with fairly extensive variety will occur, probably with some of the firms operating or licensing a number of such plants in different parts of the country, and with distribution to promotional builders as well as individual buyers.

A less striking but highly important development is that of the more extensive off-site processing of materials, including assembly in some cases. Among the many steps in this direction may be cited the manufacture of shower stalls which need only to be fastened in place and connected to supply and waste lines (introduced about 20 years ago), the factory fitting of doors (including mortising for locks and routing for hinges when desired), and the factory finishing of wood flooring to eliminate sanding, filling, and varnishing after laying. Further developments having the same purpose of reducing site operations, and a more widespread adoption of the new products, may be expected.

The rate of change will be irregular, however, and in many cases specific changes are likely to require agreements between contractors and the building-trades unions affected.

Productivity of workers will increase somewhat from prewar and also from wartime levels. The elements of increased mechanization and better planning of work have been mentioned. Availability of materials will remove the difficulties and delays occasioned by use of some of the wartime substitutes. Ending of wartime labor shortages will mean higher average competence, when it is no longer necessary to employ those seriously lacking in skill.

It can certainly be expected that overtime work will be greatly reduced. Overtime is likely to be important mainly for such rush work as commercial modernization which is commonly performed during operation of an establishment. At the same time, it seems

almost certain that the wartime modifications of overtime premiums will be terminated. Total overtime work will be small, but the cost for that which is necessary will be high.

FINANCING OF CONSTRUCTION

The Federal Housing Administration procedure for residential mortgage lending will certainly be continued, probably with some minor changes. The advantages of this system to borrowers, promotional builders, and lenders have been generally recognized, and there is every indication that attempts to abolish it will be unsuccessful. No significant change in interest rate seems likely in the period here considered. Although the long-range trend is unquestionably downward as risk is reduced with greater stability of neighborhoods and higher construction standards, this is not expected to be effective in the early postwar years. Inquiry among institutional investors indicates that they are unlikely in the near future to lower the return of about 3½ percent currently regarded as the minimum acceptable on direct investment in construction projects.

URBAN REHABILITATION

Although urban rehabilitation is an urgent need, no extensive start can be expected for a number of years. There will be numerous specific projects fitting into master city plans—housing, civic and community facilities, and other—including a few projects constructed with private funds; these must be regarded as individual undertakings only. Urban rehabilitation as generally understood, and as it is likely to occur ultimately, means work of an altogether different order of magnitude—demolition, rearrangement of streets and utilities, and changes in land use, on a scale sufficient to produce major changes in the patterns of whole cities.

Obviously the problems to be solved before any real start can be made on such efforts are tremendous. Ultimate solution requires new financial mechanisms, new legislation, and changes in basic attitudes toward relationships between individual properties and integrated neighborhoods. Numerous procedures have been proposed for dealing with the problems, which cannot be discussed here. Although some of these have high merit, a fairly long period must be expected before any can attain the widespread public acceptance necessary for general adoption. Hence, within the next few years only limited progress can be anticipated including, probably, a few small-scale demonstration projects.

Basic Assumptions of Forecast

The conditions stated below are assumed as a basis for the estimates here given, and are not in any sense either recommendations or forecasts. Should they not be met, actual construction volume will be affected correspondingly.

It is assumed herein—

1. That construction wage rates will be not less than current rates, and not more than 5 percent above current rates, except for those workers included in annual wage agreements, and that differentials in

wage rates between housing and other building, and between maintenance work and new construction, will be the same in amount and in geographical coverage as at the start of the war.

2. That no substantial changes will be made in the normal work week and in overtime premiums from those in effect at the start of the war.

3. That no substantial price increase will take place for any major building material, but that, rather, the price level for building materials as a whole will be reduced by about 5 percent within 2 years from the end of the war. These assumptions are based on strong indications of active competition between established producers and new producers for many of the fabricated metal products, and between producers of different types of products serving the same ultimate purpose.

4. (a) That Federal construction policy will be to proceed with projects desired for the value of the completed facilities, but not to proceed with any projects for the primary purpose of providing employment. (b) That Federal grants for State and local projects will be made where the purposes to be served, exclusive of the provision of employment, are accepted as contributing to national welfare. (c) That there will be no grants for projects the benefits of which are almost exclusively local or for the production of revenue, but that a procedure will be established for Federal loans for approved revenue-producing projects, such as improvements to water facilities, municipal transit systems, etc.

5. That FHA underwriting will not be provided for commercial construction, and that Federal grants will not be provided for private construction of any type.

6. That corporation income tax will be reduced by half and excess-profits taxes eliminated on the completion of the war, and that the individual income tax will be reduced by a third, with this latter reduction consisting in part of reduction in the higher surtax rates, and in part of increases in personal and family exemptions.

7. That the so-called "tax incentive plan" will be rejected. Under that plan, investment in certain proposed organizations or enterprises (particularly agencies to buy blighted properties and demolish the structures in preparation for rehabilitation, and agencies to construct low-rent housing on the vacated land) would be made an allowable deduction from the income of the investors before computation of their income taxes.

Effective Demand for Construction

Except possibly for a few months immediately after the end of the war, the volume of post-war construction will be established by the customary mechanism of effective demand. The capacity of the industry has been estimated at 11 billion dollars per year at 1940 prices, to be reached a year after defeat of Japan,² and thereafter is subject to such expansion as may be necessary. It may reasonably be expected that Government controls will be modified and then removed as severe shortages resulting from the war effort are overcome. Supply

² See Postwar Capacity and Characteristics of the Construction Industry, in *Monthly Labor Review*, May 1944; also published (with additional data) as Bulletin 779 of the Bureau of Labor Statistics.

considerations and capacity of the industry will therefore restrict volume for a few months only, if at all.

During the period under consideration, construction work of almost every type will be needed for a great variety of different uses. Much of this work will be carried out, but other parts will not be. In each individual case there will be opposing forces, some tending to cause the owner to proceed and others tending to cause him to postpone or cancel the undertaking. His decision will be governed as in the past by whether the expected advantages outweigh the disadvantages, in his individual circumstances and according to his own evaluation of the pertinent factors and of their relative importance.

Intangible, but of the greatest importance, are the complex psychological factors commonly grouped together under the phrase, "public confidence" or "business confidence." It has been a matter of common observation in the past that these had a great effect on the rate of construction and of other capital formation. No analysis of these factors is attempted. If they should move toward either marked optimism or marked pessimism during the period covered, the volume of work started would be changed accordingly.

PRIVATE RESIDENTIAL BUILDING

By far the greater part of private residential construction consists of houses built for sale. Initiation of such housing is governed mainly by whether there seems to be a profitable market. If it seems likely that houses are salable at a price yielding a satisfactory profit after meeting cost of land, construction and overhead expense, construction will proceed. The builders normally expect that their financial interest in the houses will end with their sale shortly after completion. Consequently, long-range considerations of future construction cost, probable developments in design or equipment, permanence of the local housing need, etc., usually receive little attention in themselves, apart from that given to their expected effect on selling conditions.

Families buying houses, or building for their own occupancy, are guided by different considerations. Ordinarily home ownership is regarded as a desirable end in itself, to be sought if family prospects of continued residence in a locality and continued income from employment or other sources make it seem feasible. In most cases purchase or construction of a house is the largest single commitment in a family's existence, for which payments must be spread over many years, and it is entered into with corresponding care. Each family has certain minimum requirements or expectations in a permanent home, which must be met if the purchase is to be made. There is some comparison of the costs of ownership with those of renting, and very careful attention to the down payment required. There is some interest in the trend of construction costs. When public expectations are high regarding new developments in building and home equipment, there is consideration of the likelihood of greater comforts and conveniences within the near future, proceeding in some cases to speculation about early obsolescence of houses without the new features. Finally, in a great many cases there is weighing of the choice between making a down payment on a house or purchasing other durable goods, such as an automobile, furniture, or household appliances.

Those building for investment are likewise guided by long-range considerations, but their thinking is much more financial in nature. The basic questions are whether probable net return exceeds the minimum acceptable rate, whether risks seem to be within an allowable limit, and whether available funds are sufficient for the equity investment needed. These questions mean consideration of expected trends in construction-cost levels and rental levels, and this latter of course necessitates consideration of local population and employment. Although investment-construction has characteristically been residential, a considerable part has been for commercial and other non-residential purposes.

INDUSTRIAL AND COMMERCIAL CONSTRUCTION

Companies erecting commercial, industrial, or utility structures for their own use ordinarily do so because they believe that increased operating profit made possible by new space will exceed all capital, maintenance, and operating costs. This profit may come from increased volume of business, or a new type of activity for which old space was unsuitable, or reduced operating cost. In some cases the investment in construction is for protective purposes—to insure continuance or permit rehabilitation of a going business for which the existing physical plant has become unsuitable. In any event, the level of construction and financing costs is of primary importance.

CONSTRUCTION BY NONPROFIT ORGANIZATIONS

For the various nonprofit and community organizations using physical plant—churches, voluntary (i. e., nonprofit private) hospitals, recreation agencies, and agencies offering institutional care—the problem of construction of desired facilities usually becomes that of raising the necessary funds and of being able to assume the additional annual obligation for debt service and for operation of the new plant. If the construction is to replace an obsolete building, there may be no increase in operating cost and in some cases there may even be a reduction because of a higher grade of structure better suited to the use. Since construction is usually financed by a special campaign for funds, ordinarily the decision to build or remodel is not complicated by considerations of other uses for the money. The conditions most favorable for such campaigns are a high level of business in combination with high income-tax rates, both of which are now present and seem likely to be maintained in the postwar period sufficiently to facilitate this type of undertaking.

PUBLIC CONSTRUCTION

Construction by public bodies financed by tax funds is largely a matter of public policy. The purpose sought is the better performance of some function accepted as a public responsibility. Decision to proceed with any specific project is governed therefore by the extent of recognition of its individual value and the numerous financial considerations present. Cash on hand, existing bonded debt, debt limit, effect of the project on the operating budget and the debt service budget, acceptability and collection prospects for special assessments and grants from a larger political unit all affect the decision.

The foregoing considerations are not by any means exhaustive, but are merely an indication of some of the principal factors present.

Part 2.—Demand for Private Construction

Summary

THE volume of construction (exclusive of maintenance and minor repairs) started during the final year of the war is expected to be 4½ billion dollars at 1940 cost levels, and for the first 5 years thereafter the average will be 10.9 billion dollars per year, starting at 7.8 billion dollars in the first year and increasing to 12.1 billion dollars in the fifth. This estimate assumes that no public construction will be undertaken mainly to provide employment or stimulate business. The rate of development in design of structures, materials, construction methods, and organization of the industry has been accelerated by the wartime program, but resemblances between postwar and prewar conditions will greatly outweigh the differences.

An average volume of 7.9 billion dollars per year at 1940 cost levels is expected for private construction started during the first 5 years following defeat of Japan, and a maximum volume of 8.6 billion dollars for such work started during the fifth year. Half of the total will be nonfarm residential building, about 30 percent nonfarm nonresidential building, about a seventh will be utility construction, and the remainder construction on farms. All major conditions are conducive to active sale of promotional houses, but apartment construction will be much below former peaks. The average for private nonfarm residential construction will be 850,000 dwelling units started per year. Commercial building of 1.2 billion dollars per year will consist of a substantial volume of new work, but an even greater volume of additions, alterations, and modernization. Industrial construction will be somewhat over half of commercial in volume, but will consist more largely of new structures and less of additions and alterations.

Residential-Building Situation

There is every indication of a large potential demand for residential building. As numerous estimates of the need for such construction have been made, it is sufficient here merely to mention briefly the pertinent factors usually grouped under this term. These may be divided between those apparent from the Housing Census of 1940, and those which have since developed.

HOUSING SITUATION IN 1940

In 1940 there was a relatively low vacancy ratio, extensive doubling up of families, appreciable occupancy of irregular units, and use of several million unfit dwelling units.

The Housing Census reported about 1,400,000 vacant nonfarm units for sale or rent, which gave a gross vacancy rate of 4.8 percent.

These included 290,000 seasonal units, however, as well as an unknown number of surplus units in areas of declining population and employment, and substandard or unfit units which, from information given, must have totaled at least 250,000. Adjustment for these would reduce the usable vacancy rate to not over 3 percent at the highest, and probably to not over 2½ percent, in comparison with the figure of 5 percent generally accepted as a necessary "cushion." This vacancy rate, although not alarming, indicates that no surplus for future needs was present.

About 1,345,000 "subfamilies" were reported as doubled up with other nonform families,¹ exclusive of other forms of doubling not reported in the Census. Almost 167,000 families were living in "other dwelling places"²—boats, tents, trailers, and units of other miscellaneous types.³ In some cases such arrangements were probably the result of personal preference, but it is likely that more commonly the motives were financial.

In addition, there were several million substandard units which could be brought to reasonable standards only at prohibitive expense. Any estimate of these is hindered by the absence of exact standards, but value provides a useful guide. More than 4,400,000 occupied nonfarm units were valued, with land, at less than \$1,000 or rented for less than \$10 per month. Although these included some entirely satisfactory units in localities of low real-estate prices and rent levels, there can be little doubt that they were greatly outnumbered by rudimentary and deteriorated and otherwise objectionable units elsewhere with value or rental above the limits used. Without attempt at further adjustments which would raise the figure, 4,400,000 may be taken as a minimum estimate of the number of substandard dwelling units for which improvement would not be practicable. On the basis of other criteria, the National Housing Agency has estimated the number of substandard units in 1940 as approximately 7 million.³

CHANGES SINCE 1940

Factors favorable to increased demand.—Since 1940 the number of families has been increasing rapidly, and this increase may be expected to continue. The Census Bureau has estimated an increase in all families from January 1, 1940, to January 1, 1955, of almost 7,300,000.⁴ While the estimated rate of increase varies considerably during this 15-year period, the average is about 485,000 per year. Continuance of the rural-to-urban population trend would mean an average annual increase in nonfarm families of perhaps 535,000. Many families are living for the duration in temporary or unsatisfactory accommodations, or are sharing quarters with others, because of wartime housing shortages. Many of the families recently formed have not yet been established as households, or have ceased that status temporarily. These conditions are of course temporary, and on conclusion of the war will be followed by a sharp increase in demand for normal house-keeping accommodations. The National Housing Agency has esti-

¹ 16th Decennial Census, Population and Housing, Families, General Characteristics, table 10.

² "Other dwelling places" were counted only when occupied by families having no other regular living quarters.

³ National Housing Bulletin 1: Housing Needs, A Preliminary Estimate (National Housing Agency, Washington, 1944), p. 15.

⁴ Series P-1943, No. 2: Estimated Number of Families in the United States, 1940 to 1960 (U. S. Bureau of the Census, September 30, 1943), table 4; medium estimate used.

mated that 1,400,000 servicemen's households will be established or reestablished following the war.⁶

The tremendous internal migrations to war centers which have occurred since 1940 will undoubtedly be reversed to a considerable degree, but probably with the net result of a major permanent shift in population to industrial centers, particularly in the West and South. Consequently, housing and population are unlikely to be as well fitted geographically as before the war. Total housing need may be affected only slightly by these shifts, but effective demand will be increased. In areas of declining population, there will seldom be an excess of units meeting reasonable standards, because substandard units will usually be greater in number than the reduction in number of families. At the same time, concentration of the increase in other areas will mean more acute local shortages, with intensified effect on rental levels and salability of houses.

Meanwhile there have been both additions to and deductions from the 1940 housing inventory. In the 4-year period 1940-43, a total of 1,870,000 dwelling units was constructed, exclusive of 313,000 temporary public units. Not all of these 1,870,000 units represent permanent additional accommodations, however. Considerable numbers were built in areas where reduction in employment after the war is likely to bring a housing surplus. Other new units, urban and rural, were essentially slum dwellings, accepted because of the financial circumstances of their occupants but not constituting a real housing asset. The number of these is unknown, but detailed study of building-permit records for certain periods and localities supplemented by additional information indicates that it was probably about 150,000. Additional increase in dwelling units came from conversion—some of it permanently useful, and some suited to emergency conditions only. The net effect of all these changes has been an increase, during the period, of probably not more than 1,700,000 dwelling units which can be regarded as a permanent housing resource.

Along with this increase, however, has come physical loss from fire and other disaster, demolition, abandonment, and conversion to non-dwelling use. A commonly accepted figure is 50,000 nonfarm units per year, of which about 20,000 are destroyed by disaster (in most cases, fire) and most of the remaining 30,000 are demolished. While data are much less satisfactory for such losses than for new construction, such checks as have been made indicate that the figures are at least roughly accurate.

Numerous estimates have been made, ordinarily on the basis of age, of the replacement rate necessary to offset deterioration. It is seldom because of age alone, however, that buildings reach a stage at which they cannot be brought to accepted standards of health, safety, and decency without prohibitive expense. Rather it is because of other conditions accompanying the passage of time—neglected maintenance, abuse, change of neighborhood environment, change of accepted standards affecting the basic structure, etc. Units rendered unfit by these developments up to 1940 are already included in the estimate of those needing replacement. By the end of the war, probably at least 500,000 additional pre-1940 units will have deteriorated to such a state that necessary repairs plus additional work to overcome initial inadequacy will cost more than their value justifies.

⁶National Housing Bulletin 1, p. 9.

The average construction rate needed during the first 10 years following the war has been estimated by the National Housing Agency at 1,150,000 to 1,610,000 nonfarm dwelling units per year, depending on the period over which replacement of substandard dwelling units is to be extended.⁷ These rates provide for the estimated increase in the number of families, for establishment or reestablishment of servicemen's households, for reduction in the extent of doubling, for replacement of units currently deteriorating beyond economical restoration, and for replacement over periods ranging from 10 to 30 years of units already substandard by the end of the war. Discussion is concentrated somewhat on a replacement period of 20 years, requiring an annual construction rate of 1,260,000 dwelling units.

These estimates of social need are obviously not intended to represent effective demand. Need and effective demand have not coincided in the past, and can be expected to coincide for an appreciable period only through the intervention of some type of control mechanism.

For those wishing to purchase or construct a house, financing terms are far more favorable than during previous periods of active construction. Under current FHA terms, a down payment of 10 percent of the appraised value brings ownership with a single mortgage, for a house selling for \$6,000 or less.⁸ Thus, purchase of a \$6,000 house requires a down payment of \$600 plus closing charges, and monthly payments averaging \$35.48 during the period for interest, mortgage insurance, and amortization over a period of 20 years. Under the former system of first and junior mortgages, this monthly payment on such a purchase would ordinarily have been little if any more than sufficient to pay interest and to provide for the commissions or bonuses charged for periodical renewal of the short-term junior financing.

In addition, the "G. I. Bill of Rights" provides for Federal guaranty of loans to war veterans. These will enable an indefinite (but probably large) number of veterans without accumulated funds for an equity payment to purchase houses. Under section 505 of this bill, the entire purchase price can be borrowed through an FHA first mortgage for 80 percent of the appraised value, plus a federally guaranteed second mortgage for 20 percent, but not over \$2,000. These loans will affect the market to some degree for houses selling for as much as \$10,000.

Factors unfavorable to increased demand.—These factors favorable to construction will be partially offset by other considerations, however. Although noncorporate savings are now at an all-time high and postwar incomes also may be expected to be reasonably high, not all families wishing a new home will be able to obtain it. More than half of the nonfarm families receiving income from salaries and wages only⁹ had incomes under \$1,500, and more than a third had incomes under \$1,000 in 1939. Even for 1942, it is estimated on the basis of earnings in the first quarter that 15 percent of all city families of two or more persons had incomes under \$1,000 during the year, and that another 12 percent had incomes ranging from \$1,000 to \$1,500.¹⁰

⁷ National Housing Bulletin 1, pp. 18-19.

⁸ Under present terms, mortgages are insured up to 90 percent of the first \$6,000 plus 80 percent of the next \$4,000 of appraised value of house and land, where this is \$10,000 or less, and up to 80 percent of appraised value where this is over \$10,000 but not over \$20,000. In practice, selling prices of FHA-financed promotional houses have ordinarily been the appraised values.

⁹ Individual incomes of less than \$50 during the year from other sources were disregarded. Data based upon Sixteenth Decennial Census, Population and Housing, Families, General Characteristics, table 17.

¹⁰ See Income and Spending and Saving of City Families in Wartime, in Monthly Labor Review, September 1942.

While postwar incomes may be higher, there is no likelihood that family incomes below \$1,500 and below \$1,000 will be eliminated. Few nonfarm families with such incomes will be able to assume purchase or rental obligations for unsubsidized new units. Other families will be hesitant to undertake home purchase because of uncertainty regarding future location and future employment. Unquestionably there will be many families well able to undertake home purchase, but preferring to use their money otherwise—for automobiles, household appliances, furniture, and in some cases probably for travel. Sales efforts for all of these items will be active.

Another offsetting factor is the unrealistic picture of postwar houses which has become somewhat prevalent. Postwar market surveys made by manufacturers of building materials, by other firms related to construction, and by trade associations show two fairly common misconceptions—a somewhat vague expectation of new materials and basically new design resulting in houses of fundamentally different character from those of the past, and quite concrete expectation of luxury-grade mechanical equipment, such as true air conditioning,¹¹ in inexpensive mass-market houses. An active effort to correct these impressions has been started through advertisements of materials manufacturers and others, and is likely to have some success. It will be reinforced strongly by the postwar houses themselves, which will be their own demonstration that the numerous irresponsible promises made by those outside the industry cannot be met at the present stage of development. Although misunderstanding of what is feasible will probably hinder purchase of homes for a time, it is likely to diminish fairly rapidly in influence.

Probable Volume of Postwar Residential Construction

PRIVATE HOUSING

Under these conditions, it is estimated that the average volume of new private housing will be about 850,000 nonfarm dwelling units started per year during the 5 years following defeat of Japan, and of private plus public housing, about 900,000 units. Although this average of 900,000 units is only about 3 percent above the highest previous 5-year average of 872,000 nonfarm dwelling units per year, realized from 1923 through 1927, and is below the record of 937,000 attained in 1925, it is associated with an increasing rather than a decreasing level of activity. The 1925 peak was followed by successive annual reductions until a low point of 93,000 was reached in 1932. The postwar estimate, in contrast, will start from a relatively low level during the final year of war against Japan only. Volume during this year will be governed to a large degree by the time of year when Germany is defeated. If this occurs in late winter, so that plans for expansion can be ready early in the period of normal spring expansion, as many as 350,000 units may be started during the following 12 months. If the defeat occurs in midsummer or late summer, the effect during the remainder of the calendar year will probably be slight, and as few as 175,000 units may be started during the first 12 months. From this range, housing built by private activity is expected to increase to 550,000 units started in the first postwar year, to reach 900,000

¹¹ Providing cooling as well as heating, control of humidity, ventilation, and air filtration.

started in the third postwar year, and to reach 1,040,000 in the fifth year. The average construction cost of these is expected to be at a maximum of \$4,200 each, at the 1940 cost level, for the units started during the first postwar year and then to decline gradually to about \$3,550 for those started in the fifth year as simpler and cheaper houses become a larger part of the total. Estimates of number of dwelling units started, average construction cost, and total construction cost are given in the accompanying table.

Number and Construction Cost¹ of Nonfarm Dwelling Units to be Started During Final Year of the War and First 5 Years Thereafter

Year	Total number of units	Privately financed units			Publicly financed units		
		Number	Average construction cost per unit	Total construction cost (in millions of dollars)	Number	Average construction cost per unit	Total construction cost (in millions of dollars)
Final year of war.....	254,000	250,000	\$4,000	1,000	4,000	\$2,500	10
First 5 post-war years: Average per year.....	900,000	850,000	3,750	3,200	50,000	3,200	159
1st year.....	680,000	550,000	4,200	2,300	30,000	3,200	95
2d year.....	825,000	780,000	4,000	3,100	45,000	3,200	145
3d year.....	955,000	900,000	3,800	3,400	55,000	3,200	175
4th year.....	1,040,000	980,000	3,600	3,500	60,000	3,200	190
5th year.....	1,100,000	1,040,000	3,550	3,700	60,000	3,200	190

¹ Converted to 1940 cost levels. Multiplication of number of dwelling units by average construction cost in most cases gives a total construction cost slightly different from that shown, because of rounding of figures.

These operations will be facilitated by experience gained in the war housing program, in which both builders and general contractors built projects of several hundred units. With few exceptions, these projects were marked by more thorough planning of operations, more careful timing and control of materials, and greater use of power-operated tools than were general in prewar promotional building. Numerous larger contractors accustomed to management procedures were introduced to the field of residential work, and many residential builders learned the possibilities present in large-scale operations. On some of the largest projects, materials were bought directly from manufacturers. In these respects, and others, the housebuilding industry matured substantially.

The result of this development will be projects of larger average size than before the war. Small operators who build a house or two at a time are likely to retain a place in the industry almost indefinitely, but an increasing part of total volume will probably be in projects of 25 to 50 units, and to some degree in projects up to about 100 units. It is likely that the largest projects of a few hundred units up to a thousand or more, which became somewhat common under war conditions, will be quite unusual when these special circumstances are no longer present.

The major expansion will come first in the moderately high-priced group of houses to be sold (with land) for \$7,500 up to about \$10,000, and in the considerably smaller field of even higher-priced houses, both promotional and built on contract, costing up to about \$25,000. Current activity of residential architects indicates, however, that few mansions are likely to be built.

The moderately expensive group offers in many respects the most inviting field for early expansion. It will meet general public expectations best, because the prices will permit more extensive use of mechanical equipment and of the more-expensive newer materials than will the prices of the cheaper houses. These differences—in plumbing, heating, electrical installations, lighting, electrical appliances, closets and cabinets, glass blocks, tile and other ornamental treatment—are the features most effective in selling. Competition for the early market is likely to be primarily on the basis of design, finish, and equipment rather than price, with percent of gross profit higher than for cheaper houses.

This expansion will start as soon as metal products for the mechanical trades and also domestic appliances are available to the extent needed for this market—probably about 6 months after the end of the war—and will continue as the variety of mechanical, metal, and appliance items reaches its prewar state.

While the field described will lead the expansion, it is not sufficient to bring the expected total volume, nor can it sustain its own volume for more than a few years. Only a minority of those desiring to purchase can pay \$7,500 or more. Operations at lower prices mean lower gross profit per unit and will require more thorough planning of operations, but offer large rewards for those able to satisfy customer demand within allowable cost limits.

As in the past, the moderately large projects will commonly be in outlying locations where large tracts of land are available. Because of problems already mentioned, little progress can be expected during early postwar years in use of urban sites which have passed through a sequence of blight followed by demolition for rehabilitation. Increasing attention has recently been given, however, to the land resource provided in most cities by sparsely built subdivisions of the 1920's. Although some of these tracts are unsuitable, many of them are potentially good residential areas, well located, already provided with sewer and water lines and, not infrequently, provided also with sidewalks and paving. Unless another wave of speculation in vacant land develops, it will be cheaper to buy such lots even in those cases in which purchase and demolition of a few shacks is necessary to improve environment than to install utilities in raw land. It seems likely, therefore, that there will be a significant start on a new type of development, in which fairly large projects are built on scattered sites in a general neighborhood, with some existing houses interspersed between groups of new houses.

Private rental units will probably form a considerably smaller part of the total than in the past, and will be mainly in apartment buildings. Units in 2-family buildings reached their peak both in number and in percentage in 1923, when 175,000 were built, and have since declined greatly in importance. It seems unlikely that their average during the first 5 postwar years will exceed 50,000.

The building of apartments will be more active, but these are unlikely to approach either their prewar peak of 257,000 or the prominence they are likely to attain some years after the period under consideration. In the early postwar period, not much over 100,000 apartment units per year seems likely. In accordance with a long-time trend, average size will probably decline. Most of the units are likely to consist of 3 rooms or less, suitable for families without

children or for temporary households consisting of groups of employed men or employed women. Many of these small units will be supplied with furnishings.

The apartment-house type of enterprise is now in a transitional stage. Although a substantial volume of apartments was built for permanent investment by individuals or organizations, for about two decades ending with the depression, the basic pattern was established to an increasing degree by speculative builders whose intention was to sell the property at the capitalized value of imputed earning power—that is, a price at which there would be a stated percentage yield to the owner annually if expected or assumed rental income and ownership expense were maintained. These operations were dependent almost solely on availability of sufficient financing, which during the height of this development was commonly obtained by means of appraisals also based on capitalization of imputed earning power. The opportunity for abuses given by this procedure have been so generally recognized, and the resulting losses have been so widespread and so severe, that it is unlikely to be revived on an extensive scale.

Instead, apartment construction will be motivated primarily by investment considerations. That means change toward much larger projects than were formerly customary, both to facilitate management and maintenance and to protect the investment through unified control of a development large enough to establish its own neighborhood characteristics. While there will be a rental market for such projects in the moderately high rental range of \$15 monthly per room and over, the great market is for housing at lower rates. Demand for apartments is based partly on the freedom of the occupants from maintenance responsibilities and partly on the locations of the buildings, but in the case of families with children, mainly on lower rents than are necessary for detached houses providing comparable accommodations. As the monthly rental for acceptable units in acceptable locations falls, the number of possible tenants increases very rapidly, with probably the majority of all possible tenants not able to pay more than \$8 monthly per room including heat. The market for 5- and 6-room apartments at higher rentals will probably be reduced through home purchase by many families able to pay these higher rentals. This reduction in market will be least in the largest cities, and will occur over a fairly long period, but may be expected to have at least latent influence at all times.

Through FHA, loans are available up to 80 percent of appraised value for responsible operators planning on permanent ownership. These will be used for construction of numerous projects of the "village" type, commonly in outlying or suburban locations. As in existing projects of this type, rentals will be suitable primarily for families with income considerably above average, families without children, and temporary housekeeping groups. The risks of luxury-grade apartments, with monthly rentals of \$25 per room and over, are such that mortgages will be available only in unusually favorable circumstances. There have been several notable instances of direct investment in apartment projects by insurance companies, several such projects are scheduled for the early postwar period, and it seems likely that housing will ultimately become an accepted major field for institutional investment. Before that occurs, however, legislation

permitting such use of fiduciary funds, as well as certain other developments, will be necessary in most States.¹² Recent inquiry indicates that few if any insurance companies other than those which have already constructed housing projects as investments are planning to do so in the near future.

To fill the potential demand for low-rental apartments will require a lower yield to owners and mortgage holders than has been customary for apartment investment, availability of suitably located land, and the utmost economy in construction through skillful design and carefully planned operations. Ultimate meeting of this last condition will probably be accompanied by some reorganization of this part of the construction industry, resulting in greater integration of operations between the different kinds of site work and more direct procurement of materials. It will also require a more uniform pattern of annual operation to reduce the traditional lost time from seasonal unemployment of construction workers—possibly from encouragement of off-season work by annual wage agreements, possibly through some mechanism for seasonal variation in wage rates and material prices, possibly through other means. It seems very likely that in the 5 years immediately after the war these conditions may be met somewhat better than in the past, but not yet sufficiently well to make new apartments available to any substantial number of industrial workers or persons of similar incomes.

Full development of apartment construction must be mainly in projects suitable for average-income workers, who cannot afford expensive commuting and who will ordinarily prefer to live fairly close to places of employment. It is thus tied directly to the cities' problem of salvaging their deteriorated areas, which for the most part are well located for housing use and would ordinarily provide large areas suitable for efficient and attractive housing developments. Maturity of this potentially important part of the private housing field is therefore not to be expected until substantial progress has been made in solving the exceedingly complex problems of urban rehabilitation.

PUBLIC HOUSING

Public housing will be discussed in part 3 of this series in somewhat more detail, with other types of public construction. It is expected to be at a very low rate during the final year of the war, with perhaps about 4,000 dwelling units started, and to reach an average level of about 50,000 units started per year during the 5 years following defeat of Japan.

ADDITIONS, ALTERATIONS, AND REPAIRS

There will be heavy demand for work on existing structures. Owners will want to obtain rooms in attics or other unfinished space, to add complete or partial baths, to replace obsolete plumbing, heating and wiring, in some cases to obtain additional space, and to make numerous other improvements. Owners of sound but old-fashioned apartments will want to modernize them. Both owners' funds and

¹² California, New Jersey, New York, and Virginia are the only States in which legislation has specifically permitted insurance companies to invest in ownership of rental housing, and the only States in which such investment has occurred (other than through foreclosure). Legislation has been enacted in Massachusetts, but has not yet gone into effect. In a number of other States such investment is not expressly forbidden, but its legality is regarded by some as not entirely clear. In the remaining States such investment is definitely illegal.

credit machinery will be available, and an average volume of \$750,000,000 per year may be expected in alterations, modernization and improvements. In most cases, this work is likely to be postponed a few months until shortages of materials are relieved, but then will expand rapidly. It is expected to reach \$800,000,000 during the second year after defeat of Japan, reach a peak of \$850,000,000 the next year, and then fall off slowly as the accumulated demand is met.

It will be necessary for owners, whether occupants or landlords, to proceed with maintenance operations which have been curtailed during the war. This work—decorating, exterior painting and other protective treatment, nonemergency repairs postponed from the war period, and emergency repairs—is estimated at an average of about \$40 annually per existing dwelling unit, or approximately \$1,400,000,000 per year. Since it requires less materials proportionately than other types of work it will probably increase very rapidly, but will nevertheless be spread over a considerable period. Such maintenance work is expected to reach a peak of 1½ billion dollars in the first year after the end of the war, and then to fall off quite slowly.

Nonresidential-Building Situation

COMMERCIAL BUILDING

There will be a very large volume of commercial-building work—probably an average of \$1,200,000,000 annually for the first 5 postwar years, and a peak of \$1,350,000,000 during the third and also the fourth of those years. For comparison, the greatest previous peak at the same 1940 level of costs was \$1,361,000,000 reached in 1929, and the greatest 5-year annual average was \$1,242,000,000 maintained from 1926 through 1930.

Although very close to these earlier peak periods in total volume, postwar commercial construction will be quite different in its composition. New work will be little more than a third of the total, and will consist characteristically of much smaller projects. Much more important will be modernization and alterations, which will expand to an early peak in the second year following the end of the war, and then fall off somewhat slowly as new work reaches a sustained level.

New Construction

Additional commercial space will be needed, but under conditions bringing a different type of activity from that of the 1920's, and specifically with comparatively few of the multi-million-dollar projects of the type which commemorate the excesses of that period of commercial building.

Retail space will be needed because of general and local growth in population, changes in distribution methods, and obsolescence of existing buildings. In growing localities, neighborhood shopping facilities will be needed. This need will be acute wherever intensive housing development occurs in vacant or sparsely settled areas, which necessarily will be the areas used for most of the larger housing projects. To a noticeable degree these will be unified shopping centers with off-the-street parking space, of the type which began to attain prominence shortly before the war, and it is likely that many of these

will be built in conjunction with the larger promotional housing and village-type apartment projects.

Changed distribution methods will also bring about some construction. Food stores particularly will want additional building designed for so-called "supermarket" type of operation, to replace older quarters less suitable for this use. Department stores in the major cities will continue their shift toward outlying and suburban localities, with construction of additional branch stores. Little expansion of downtown department-store space may be expected except in those cities having permanent and substantial gains in population. There will, however, be continued replacement of obsolete nonfireproof buildings, although in the larger cities this process is already well advanced. Likewise, there will be construction of new commercial buildings, either company-owned or built on lease, for department store, dry goods, and apparel chains, to replace the unsatisfactory rented quarters occupied by some of their outlets.

There will be a wide variety of other commercial construction, but probably no individual projects comparable to the largest of those built before the depression. Overbuilding of office space has been so great that even now there are vacancies in prominent buildings in some cities, and except for war requirements there would be extensive vacancy in most of the larger cities. Therefore, some office-building construction may be expected in cities showing net growth after the war, and some elsewhere under special circumstances, but only a small fraction of former peaks. Firms needing store or office space for their own use are likely to be much more cautious than in the past regarding construction of additional stories for rental as offices. Obsolete buildings on high-value land will ordinarily be replaced, if at all, with comparatively cheap "taxpayer" type buildings, with stores at the street level and not more than a single floor of office space above.

The current shortage of hotel accommodations is largely temporary, resulting from wartime conditions. In some cities there is permanent need for additional hotel facilities and, in fact, a small volume is currently under construction. There will be some replacement of old-fashioned buildings by well-known hotels having established clienteles for which their buildings are no longer suitable, but the greater part of this replacement has already been carried out. There will also be gradual replacement of less prominent older hotels in many cities. In a few localities there is a potential market for additional luxury-grade hotels, primarily for residential rather than transient occupancy, and this will no doubt be supplied wherever the demand seems to be permanent. Uncritical building of elaborate hotels from considerations of civic prestige, or as an indefinitely expansible field for investment, will be curtailed by the disastrous financial record of the hotel business. Except for the largest cities, restoration of automobile travel will have an adverse effect on patronage, by diverting travelers to motor courts, especially since these are likely to increase in number and to improve as regards the average grade of accommodations offered.

Small buildings, although no longer the dominant pattern for neighborhood retailing, will be built containing one or a few stores suitable for almost any kind of business. The trend toward estab-

lishments for "drive-in" patronage by city motorists has been apparent for some years and is likely to be accelerated. Thus far, this has been most notable for restaurants and food stores, but it has already been extended to laundries and other service establishments. There will also be active construction of establishments, particularly motor courts, for tourists' patronage. Although "tourist cabins" in many parts of the country have often been little more than shacks, substantial and comfortable accommodations with private baths have already spread extensively since they were introduced in the Far West some 15 to 20 years ago. These are likely to make up a very large part of the new construction for motorists' occupancy. In addition, there will be new roadside restaurants, and fairly extensive replacement of gasoline stations in both urban and rural locations.

Modernization

In the commercial field, new construction will be exceeded by modernization for which an average volume of \$750,000,000 per year is expected. Older office buildings, hotels, department stores, and smaller commercial buildings in cities of all sizes will require this treatment. Many such buildings are well located, structurally sound, fire-resistive, and in general well suited to their purposes, but at a serious competitive disadvantage because of inconvenient or inefficient room arrangement, obsolete plumbing, heating, and other mechanical equipment, poor arrangements for internal traffic, or unattractive appearance of public spaces such as entrance or lobby. Modernization of these buildings, for which the cost will be only a small fraction of the cost of new construction, will represent a real economic necessity to their owners. The cost of individual projects will in some cases be several hundred thousand dollars, and perhaps occasionally a million dollars or more, although ordinarily it will be much less.

All types of work will be included, but special emphasis will be on those using metals. The prewar trend to installation of escalators for concentrated passenger movement of a few stories will certainly be resumed. Elevator machinery and controlling mechanisms will be replaced, in order to increase hourly passenger capacity and reduce maintenance; cabs, doors, and enclosures will be replaced to improve appearance. Heating facilities in large buildings will be modernized to save fuel. Modernization of lighting will be widespread and will be accompanied by replacement of wiring not meeting modern standards. In some buildings there will be augmentation of plumbing installations. Installation of air-conditioning systems in retail establishments of all types, in amusement buildings, and in certain public parts of hotels will be extensive.

Nonmechanical work will be largely that affecting appearance and, in retail establishments, the display of goods and internal traffic. It will be concentrated on exteriors, show windows, entrances, and wall treatment for lobbies and other public spaces. Where room arrangement is poor or room sizes inefficient, partitions will be moved.

For smaller store buildings the need will be principally for refurbishing with new lighting, new store fronts and entrances, in some cases new finish floors or building exteriors, and other work bringing modernization of appearance. A great number of these smaller establishments will likewise install air-conditioning systems or, perhaps more

commonly, air-cooling systems without the humidity-control feature of true air conditioning. A special commercial group will be the establishments intended for patronage by highway users—gasoline stations, restaurants, motor courts, etc.—whose owners will be anxious to prepare them for restored traffic volume as soon as relaxation of restrictions permits.

An appreciable volume of commercial alteration and modernization work will be carried out by those chain stores which operate principally in downtown and other high-rental locations. To an increasing degree these companies have adopted their own standardized store designs, which not only identify their outlets but also meet the special requirements of their methods of operation. This results in some alteration work at all times, for opening of new units and changes of location. In addition, however, a number of these firms contemplate modernization of their exteriors and other distinctive features in accordance with trends in retail operations and in commercial architecture since their designs were originally adopted. It is also likely that standard designs will be adopted by additional companies.

In general, financing of commercial construction and modernization of the types mentioned should present no difficulties. The new construction and modernization will provide special advantages to the occupants, and in most cases the space provided will be rentable without difficulty to other tenants should occasion for such action arise. The chain stores and other firms wishing to rent specially constructed new buildings in general will be regarded as a preferred group of tenants with financial stability much above that of retailers as a whole. The cost level of building work, and the price levels for various materials, will of course affect volume and in specific modernization projects will affect the extent of the work. Relatively high land prices in good commercial locations and the high rent levels which such locations can support mean, however, that building costs are less important than for residential construction.

INDUSTRIAL CONSTRUCTION

Industrial construction will be needed, but the extent of the need is more uncertain than for other types. On the basis of available information, an average volume of \$690,000,000 annually is estimated for the first 5 postwar years. It is expected that new construction will rise to a peak of \$550,000,000 in work started during the fifth year, with an annual average of \$440,000,000 for the period, and that additions, alterations, and modernization will reach a maximum level of \$300,000,000 started per year during the second and third years, with a 5-year average of \$250,000,000 per year. The volume of work for which architects or engineers have already been engaged is still small, but near the end of 1944 was about 6 times as great as at the beginning of the year. Further acceleration in the rate of preparation seems likely.

Private industrial construction was within or somewhat below the range of 500 million to 700 million dollars annually from 1921 through 1928, but this period was preceded by a peak of 967 million dollars in 1920 and followed by a secondary peak of 942 million dollars in 1929. No such rapid expansion, with the peak reached so soon after the end of the war, seems likely. The greatest period of industrial construction in the history of the United States is nearing its end, but there is ex-

tensive doubt about the peacetime usefulness of many plants which have been constructed. Some are suitable only for the manufacture of products for which peacetime demand will probably be small; some were built in isolated localities for military reasons, and are badly situated for civilian use; some are so large and so closely fitted to a specific pattern of operations that it is doubtful whether they can be used efficiently for postwar manufacturing. The remaining plants are presumably suitable for postwar production, but the availability of the large number built with Government funds will not be known until policies for their disposal are adopted. Until such policies are announced, many decisions on private industrial construction will remain tentative. Quite understandably there is a tendency to reticence on the part of many firms having concrete plans for new postwar products, with accompanying plans for necessary construction.

Even so, volume is likely to be substantial. There are indications of expansion in the food and textile fields. Geographical shift is likely for some industries. Expansion of paper making and other wood-pulp industries in the South is almost certain, because of the rapid growth rate of suitable trees. Some expansion of metal-using industries above prewar level is also likely in the South, and rather considerable expansion in the Far West. Aluminum fabrication may expand in the Northwest, but this development is dependent on conditions beyond local control. Other geographical expansions are likely, to varying degree; in general, it seems likely that there will be an appreciable growth of manufacturing in the less-industrialized regions of the country.

In addition, there will be many expansions for which war-built plants cannot be used. Some new products, particularly chemicals, require highly specialized facilities which cannot be obtained economically by conversion of existing structures. In some cases expansion or the addition of specific facilities to existing plants will be needed to bring balance between different parts for postwar production. Another somewhat similar type of need, is that for replacement at existing plants of obsolete and unsatisfactory buildings, particularly older buildings which are no longer suitable for newer products and improved production methods. There is at all times a certain amount of alteration and addition to industrial plants as a whole, and this will certainly be increased substantially by preparations for postwar competition.

Financing is of primary importance, and will present widely varying problems to individual firms. Some have liquid assets sufficient for their contemplated capital expenditures, and those which have issued good securities to the public in the past or which make products well known to the general public will probably have little difficulty in marketing any necessary securities. There are definite indications, however, that firms without existing underwriting connections and not recognized by the general public will have serious difficulty in obtaining funds for plant expansion. This will be the case especially for those requiring specialized structures which cannot be used readily for the manufacture of other products.

OTHER PRIVATE BUILDING CONSTRUCTION

Other private nonfarm building construction will be largely that of nonprofit organizations—churches, schools and colleges, hospitals, and so forth. For all of these, the primary questions are availability of construction funds and ability to assume responsibility for maintenance and operation of the new facilities. Conditions for fund raising are more favorable than they have been for 15 years, and are expected to continue so. As a result, organizations of most of these types throughout the country are in differing stages of preparation for contemplated postwar construction. This work is unlikely to increase greatly from its reduced wartime level until Japan is defeated, except that church buildings seem likely to be started in fair volume during the final year of war against Japan only. Thereafter the entire group will expand rapidly, to an annual average of about \$380,000,000 during the ensuing 5 years.

Articles in the architectural magazines and reports from other sources indicate a larger volume of religious buildings at the stage of plan preparation than for many years. A compilation of the tentative building schedule of more than 15 major denominations indicates a probable 5-year average of \$155,000,000 for all religious groups. Some of this is for new church buildings, some for replacement of temporary or outworn buildings, some for additions to existing buildings including those left unfinished when first built, with the intention of completion at a later date, and some for improvements and modernization.

Private-school work is also reaching the stage of architectural design. A considerable part of this is for endowed or church-sponsored colleges, some for church-sponsored lower schools, and a certain amount for academies and other schools operated as business enterprises.

Preliminary tabulation of a questionnaire circulated by a committee of the American Hospital Association among member and nonmember hospitals indicated the likelihood of an extensive program of hospital construction. The report issued to date is provisional, but supports other indications. The increasing use of hospital facilities for conditions once treated at home is facilitated by widespread adoption of the "Blue Cross" hospital-insurance plans operated jointly by the hospitals themselves, which tends to smooth out occupancy and at the same time alleviate the great operating problem of collection losses. It is estimated that average annual volume will be about \$75,000,000 for construction alone.

Since most of the nonpublic hospital space is provided by nonprofit organizations, the question of whether funds can be raised is important. The preliminary report of the Hospital Association's committee indicated fairly widespread concern regarding this particular problem on the part of hospital officials, and also indicated some wish for Federal grants. However, the favorable conditions for fund raising by other nonprofit organizations will apply to hospitals also, and should permit the volume estimated.

The construction work will include additions as well as new buildings, but comparatively little alteration and modernization work. The purpose of the latter obviously must be that of making the hospital plant more suitable for its specialized and highly technical

functions, which is sometimes exceedingly difficult. Lack of balance can often be overcome by addition of specific facilities, and localized faults in arrangement overcome by alterations, but more general shortcomings are not ordinarily subject to such correction. Where buildings are not fire-resistive or were designed without appreciation of the requirements of efficient operation, the improvement to be obtained through alterations will commonly not be worth the cost. The modernization project likely to be most widely carried out will be installation of air conditioning for operating rooms, delivery rooms, preparation rooms, and in some cases, nurseries.

Institutional care for the able-bodied aged and, except for rather brief periods, for dependent children is now generally regarded as obsolete, and existing facilities in many localities are more than adequate by current standards. Future construction is likely to be small.

There will be an expansion of construction by those nonprofit recreational and cultural agencies which conduct their activities largely in central buildings. The best known of these are the Y. M. C. A. and Y. W. C. A., but this group includes other federated organizations and a great number of strictly local organizations. Preliminary architectural steps have been taken in numerous cases, and some progress has been made in raising funds. The program will consist largely of replacement and modernization of existing buildings. Because of the financial burden of maintaining and operating additional space, new construction other than for replacement is expected to be concentrated on facilities which will increase membership and thus increase operating income, and on buildings in areas where the agencies have been poorly developed in the past. There will also be some construction of buildings of fraternal organizations, but this will probably be limited by the foreclosures during the depression on property of even some of the best-known lodges.

Public-Utility Situation

The estimates in the utility field are based primarily on past records of construction expenditures, in conjunction with such additional information as could be obtained from trade associations and the headquarters offices of national utility companies. No attempt was made to canvass the individual operating companies. Postwar plans are still rather uncertain in this field, although it includes companies long noted for their careful planning of capital expenditure programs. There has been extensive study of possible improvement programs and fair progress in planning specific projects, but for the most part final decisions on the scale of expenditures remain to be made. Furthermore, in some cases decisions between alternative ways of accomplishing a given purpose will probably be postponed until the postwar period, especially in the communications field. This will permit comparison of the various tentative plans on the basis of current cost levels, and in the light of the latest technical developments which might affect the decisions.

Subject to these qualifications, it is expected that average volume of utility construction started in the first 5 postwar years will be about \$1,140,000,000.

A substantial part of utility construction at any time consists of extension of distribution facilities to additional customers. Another

substantial part consists of improvements to the general plant, in most cases individually rather small, to bring it into better balance with the load upon it. Some large projects are contemplated, but utility construction as a whole is not synonymous with large undertakings.

For the most part, financing will not be a serious problem. The earning record in most parts of the field has been good, and a fairly large volume of refunding to obtain lower interest rates has occurred within recent months. In the weakest part of the general field, that of railroads, a number of companies enjoy high credit and some have improved their credit by debt reduction from wartime earnings, but others will have great difficulty in borrowing money for construction purposes. Most of the last group, although their long-time financial condition is poor, will have on hand depreciation and other reserves which can be used for minor construction work.

RAILROADS

Railroad construction is estimated at an average of \$360,000,000 per year, made up for the most part of fairly small jobs. Most of this will be nonbuilding work carried out on the roadway, on bridges, and on signal and other communication and control facilities. Its purpose will be to facilitate operation, correct causes of delay or congestion, improve safety, and reduce maintenance costs. There may be some replacement of outgrown smaller stations and probably will be some degree of modernization of other stations, in accordance with recent trends in design. Replacement of obsolete stations is needed in a number of cities, including some of the largest metropolitan centers. Those familiar with the field believe that the larger projects will not be undertaken until a later period. It is very likely that there will be some construction of shops and service pits especially designed for Diesel locomotives and other new-type equipment, but this work will be a small part of the construction program.

LOCAL TRANSIT

There is every indication of a large capital improvement program for local transit systems, but in most localities this will consist almost exclusively of purchase of new busses and streetcars, and construction will be limited principally to shops, garages, and other supplementary facilities. No instances are known in which major extensions of car tracks are contemplated. It is likely, however, that there will be cases of major track reconstruction or relocation in conjunction with improvement of principal urban traffic routes, to fit the streetcar routes into the master traffic plans being carried out. There will also be fairly extensive overhead construction for trolley busses in a number of localities, but this type of work is relatively minor in proportion to mileage provided.

The only major construction projects in prospect are in New York and Chicago, where the work will be financed with public funds. The program of the New York City Planning Commission includes capital expenditures of somewhat over \$125,000,000 for local transportation, of which roughly \$100,000,000 is for construction. Although city appropriations for this program are some \$65,000,000

to date, execution as proposed is dependent on Federal grants of about \$45,000,000 as well as on additional city appropriations. It is therefore uncertain how much of this program will be carried out. The construction work contemplated consists of miscellaneous improvements to present plant, a number of connecting links to join portions of the city-owned subway and elevated system, and one major extension to that system. The Chicago program is completion of the initial part of the west-side subway which had been under construction as a PWA project until work was stopped by the war. Subways have been proposed or are under discussion in several other cities, but it seems somewhat unlikely that any of these will be started within the period covered by the estimate.

COMMUNICATIONS

A large construction program in the communications field is scheduled, estimated tentatively at an average of \$350,000,000 per year for the first 5 years after the war. Because of the highly technical nature of the field, the active program of engineering development in progress at all times, and the many assumptions which must be made regarding future technical and economic conditions, plans of the major companies are undergoing continued study. The upward trend in public use is shown by the fact that, at their lowest depression point in 1933, long-distance telephone conversations were only a quarter in number below their 1930 peak, and in 1937 exceeded this previous peak. This trend will be stimulated to some degree by new types of service in the postwar period. The consolidation of the telegraph companies which occurred late in 1943 will result in ultimate integration of physical facilities, and may be expected to accelerate the program of capital improvements.

Additional message capacity, service to additional users, and facilities for new types of service will be obtained in part by additional equipment and in part by construction, of which the largest single element is likely to be overhead and underground cable lines. Although buildings of several types will be needed, they will constitute a minor part of total construction.

GAS, ELECTRIC SERVICE, AND PIPELINES

No compilations are available on proposed construction by gas companies, but there are indications that it will be fairly substantial. A considerable part of the new residential building will be on sites already having gas service, but much of it will not be. In addition, gas service will be wanted for some war-built housing projects now using bottled gas. Where there is retained population growth or increase in industrial use, the additional consumption will in some cases necessitate additional generating and storage facilities, and additional capacity for the mains. Construction cost of this work is estimated at \$75,000,000 per year.

Electric light and power expansion was at its highest level during the 8 years from 1923 through 1930. During each of these years construction exceeded \$400,000,000 and during 3 of the years it exceeded \$500,000,000 for the private utility companies alone. Construction has declined since 1941, being limited by scarcities of the

critical materials needed. After the war there will be need for service to new areas and growing areas, as well as increased service to older areas with increasing levels of consumption, and some replacement of obsolete plant. The extent to which additional generating plant will be needed is not known. Recently, current consumption has declined somewhat from its earlier wartime peak, but the long-range trend is consistently upward. In the absence of more concrete information, volume is estimated at \$300,000,000 per year.

Pipeline construction is estimated at only about \$25,000,000 per year, in the absence of other information. This would consist primarily of extensions to existing lines, and construction of collecting lines in oil- or gas-producing areas. Financial success of the "big inch" line has been so very much greater than was expected that it would seem to presage construction of other interregional lines, but this may not be the case. Continuous operation at full capacity will be considerably more difficult to maintain than under wartime controls, and a larger fleet of tankers than ever before will be available. Consequently, no lines of this type have been included in the estimate.

Part 3.—Demand for Public Construction

Summary

THE average annual volume of construction started (exclusive of maintenance and minor repairs) during the first 5 years following defeat of Japan is expected to be 10.9 billion dollars at 1940 cost levels, with a maximum of 12.1 billion dollars in the fifth year. Publicly financed construction will make up about 3 billion dollars of this average figure, increasing from about 2.1 billion dollars in the first postwar year to almost 3.5 billion dollars in the fifth. The largest single item will be private residential building, which with alterations and modernization will comprise more than a third of total construction, and which will consist primarily of detached houses built for sale. Apartment construction will be active, but will not approach its pre-depression rate until a number of developments occur at a later time. The volume of commercial construction will be close to that of the 1920's, but will consist more of modernization than of new buildings.

Preparation for public construction varies extensively among the different government bodies. Although still unsatisfactory, it has improved substantially during the past year and is likely to improve further. On the whole, non-Federal bodies are basing their programs on expectation of Federal aid or new sources of tax revenue. The largest element of public construction will be highway work, estimated at 1.3 billion dollars per year plus \$600,000,000 in maintenance. A fairly extensive program of reclamation, conservation, and development is likely, for which both the U. S. Corps of Engineers and the Interior Department have working plans ready. Schools will be the largest item of building construction, considerably larger than all other types of public buildings combined. Sewer and water projects seem to be the most strongly felt need of local government units, as indicated by the advanced state of preparation of working plans.

Public-Construction Situation

The types and extent of public construction at any time are a reflection of current public policy. This construction is carried out by or for thousands of different bodies—the Federal Government, the State governments, counties, townships, municipalities, boards of education and park boards, sanitary and water districts, government corporations, and various others.

Although traditionally a project is financed by the body by which it is to be maintained or operated, there have been exceptions. The earliest of these were the national roads constructed by the Federal Government, well over a century ago, because they were regarded as having national rather than merely local value. The recent grants to States and local bodies made under the Federal Works program, in

large part to stimulate employment and raise the level of business activity, were intended also to improve the national welfare through providing improved facilities for public services. This latter consideration was one influence in the choice of activities for employment-producing expenditures.

What any State or local government unit spends for construction will be governed in part by its financial condition, but unquestionably will be influenced by the extent to which grants or nonlocal tax revenues are available. The current financial condition of local government units on the whole is very good, but this is principally the result of wartime conditions—unusually good tax collections because of wartime business and employment levels, combined with suspension of all but the most urgent capital expenditures. With few new bond issues to offset retirement of maturing bonds, a substantial margin of borrowing power has been built up, and in many cases liquid assets have been accumulated as well. This condition will permit an active start on postwar construction, but is regarded as merely temporary by numerous authorities on public administration and municipal finances. Preliminary schedules of postwar improvement programs presented by States and municipalities have in a large number of cases included the direct or implied statement that execution of the proposed work was dependent on some form of Federal grant. This viewpoint was expressed with the greatest frankness by Robert Moses in a memorandum, dated February 1, 1944, which he issued as chairman of the Triborough Bridge Authority of the City of New York.¹

Obviously the volume of public construction which will actually take place will be governed by broad decisions on public policy which have not yet been made. If projects are to be constructed because of a recognized immediate need for the physical facilities to be provided, the volume during this period will be less than if projects which would otherwise have been postponed to a later date are advanced in order to provide employment. It has been assumed for the purpose of the estimate that the former of these policies will be adopted, but this assumption may be incorrect. As a result, the estimates of specific types of public construction may be regarded as conservative and in most cases are below the potential programs of public bodies.

Similarly it has been assumed that Federal grants will be provided for those State and local projects recognized as valuable to the Nation as a whole. This assumption would include grants for projects such as highways, schools or hospitals, and other institutions, but not for projects of primarily local benefit such as construction of public administration buildings or paving of purely local streets. If this assumption is not met and there are no grants other than those for the Federal-aid highway system, the local construction program will be delayed and the volume during the early postwar years will be substantially below that estimated. Conversely, appropriations to stimulate employment will bring an increase.

It has also been assumed that some effective procedure of Federal loans will be established for revenue-producing local improvements, consisting largely of municipally owned utilities. These loans would be in the form of revenue bonds, secured by the operating revenue from

¹ Function and Degree of Participation of the Federal Government in the Construction of Postwar Federal, State and Local Public Works (published by City of New York with a transmittal letter addressed to Hon. Fritz G. Lanham, Chairman of the Committee on Public Buildings and Grounds of the House of Representatives).

the improvements. This procedure will be important for those government units whose bonds are not yet reapproved for fiduciary investment, because of defaults which occurred during the depression. It may be even more important for other government units in permitting them to segregate the financing of these improvements in bonds secured only by operating revenue, which are distinct from the general bonds secured by the full faith and credit of the municipality and are exempt from the debt limit existing for these general bonds.

Starting of public work is dependent not only on accessibility of funds and of land but also on availability of detailed working drawings with specifications. Obtaining needed land can be a time-consuming process, but in most cases need not be. If there is definite decision on the property needed, and if the purpose of the project is accepted as unquestionably a public use, in most States possession can be obtained with slight delay by condemnation, even though legal determination of the price to be paid may be in process and may, indeed, continue over a long period. Acquisition in this manner is likely to be more expensive than by negotiation in advance, because there is no opportunity to choose among a number of suitable sites on the basis of negotiations with their respective owners. It is, however, an alternative to prolonged delay when site purchase has not been undertaken sufficiently in advance. Furthermore, information from a considerable number of government bodies indicates that a rather substantial part of the total land needed for contemplated public construction is already publicly owned.

For preparation of drawings and specifications there are few short-cuts, except for certain kinds of work. The time required varies with the type, size, and complexity of the project, but for a project of any magnitude is likely to be at least several months. Basic designs for some types of work are fairly well standardized, but other types require preliminary surveys and careful study of alternative designs before work on the final drawings can be started.

Design preparation is somewhat meager, but has advanced during the past year and shows signs of further acceleration. Preparation has gone farthest for State highway work. For other work, it is improved but still spotty. Early in 1944, architectural sources reported that little public work had reached the design stage, except that in and near New York City and Los Angeles. Since then, architects have been engaged for projects in many other parts of the country, but still there are some extensive areas and a great number of local political bodies for which this step has not yet been taken. The report on the subject,² published jointly by the Federal Works Agency and the Bureau of the Census in September 1944, notes that there were 29,270 projects (other than Federal-aid and State highways) having a total estimated cost exclusive of land of \$5,969,000,000, which were in at least a preliminary stage of preparation on July 1, 1944.³ Of these, plans were completed for not quite a fourth, having about a sixth of total cost; design was in progress for somewhat over a fourth, both in

² Report of Proposed Post-War Public Works: Volume and Status of the Plan Preparation of Post-War Public Works Proposed by State and Local Governments, prepared at the request of the Special Committee on Post-War Economic Policy and Planning, House of Representatives, by the Federal Works Agency in collaboration with the Bureau of the Census.

³ That report summarizes data obtained from 1,480 government units—44 States, 731 counties, 593 cities, and 112 special districts. All information given is for those 1,480 units exclusively, rather than an estimate for all State and local government units in continental United States. Estimated expenditures are, in general, at the cost levels expected by the various units when the work is carried out.

number and in cost; and the remainder were in a preliminary stage only. In addition, 27,513 projects with estimated cost excluding land of \$5,665,000,000 were in what was termed the "idea stage" (i. e., being contemplated as possibilities).

The seriousness of this situation is indicated by the concentration of plans in limited areas. New York City alone reported 29 percent of all completed plans, in terms of value, while the other 4 cities having populations over 1,000,000—Chicago, Philadelphia, Detroit, and Los Angeles—reported 9 percent of the total. These 5 cities reported almost 42 percent of all work currently in the design stage. Furthermore, almost a sixth of the 1,480 public bodies reporting—237—had no plans in any stage of preparation. Of the remaining 1,243, only 600 had completed plans for any of their projects at the time of submitting their reports. Reports on ability to complete plans for their projects in the design, preliminary, and idea stage showed that 535 units would be able to carry plans to completion, while 689 would not. For this latter group there were two principal reasons—lack of funds, and legal restrictions which prevent numerous government bodies from spending money on plans for any project until its construction is officially authorized.

With respect to construction funds, the current state of preparation is likewise incomplete. According to the same report, for the projects having completed plans, 31.4 percent of necessary funds were on hand or arranged for; for those on which design was in progress, 14.8 percent; for those in preliminary stages, 7.2 percent; and for those in the "idea stage," 5.5 percent. Negotiations were currently under way for about 5 percent of necessary funds for the first 3 of these groups, and for about 3 percent of funds for the projects in the "idea stage." Even for those projects for which plans were complete, little more than a third of the necessary funds was on hand, arranged for, or under negotiation.

It is apparent that, with respect to both planning and financing, much remains to be done if public construction is to be started as early as needed. There are indications that this situation is being increasingly recognized.

Probable Volume of Postwar Public Construction

HIGHWAYS, ROADS, AND STREETS

The most important single element of public construction will be highway, road, and street work. It will be necessary ultimately to bring the entire street and highway system into conformity with traffic requirements, including, of course, the provision of access to new localities. This will mean work to improve the traffic flow and reduce the accident hazard on primary highways, extension of the all-weather mileage of minor roads, and relief for urban traffic congestion. In many cases work will consist of improvements to existing highways, such as construction of additional lanes or replacement of sharp curves, excessive grades, and other localized defects. In other cases it will be necessary to replace outworn pavement, while in some cases it will be more satisfactory to construct new highway on new right of way, for the heaviest concentrations of traffic. Work on structures will also be important—new bridges and culverts, re-

placement of bridges and culverts not meeting modern traffic requirements, and grade separations.

Work within cities is likely to emphasize the arterial-street system and access portion of intercity highways to a greater extent than formerly. In some cases satisfactory treatment will require widening or relocation of right-of-way, which may necessitate demolition of buildings. This procedure involves large expenditures for purposes other than construction, and thus will take place over a fairly long period. Other city paving is likely to be fairly small in volume, except for repairs and replacement and for work in new areas actually undergoing development. Difficulties in collecting special assessments during the last 15 years have made city officials cautious about provision of improvements in undeveloped areas.

The Federal Works Agency and Census Bureau report above cited shows that of Federal aid and State highway projects to cost almost \$2,200,000,000, plans had been completed for 10 percent by July 1, 1944, and were in preparation for another 43½ percent. It commented on the rapid progress in preparation of plans, and expressed the opinion that plans would probably be available for at least the volume of work that could be financed for the first 3 postwar years. State highway revenues, balances in the various State highway funds, and probable Federal aid would permit expenditures of approximately \$1,000,000,000 per year during this period, for construction plus engineering and land acquisition.

Highway, street, and road projects not in the State and Federal-aid systems, which were in the preliminary planning stage or beyond, reported somewhat over \$1,500,000,000 in estimated cost exclusive of land, of which plans had been completed for about 15 percent and were in progress for another 25 percent. These figures include bridges, viaducts, and grade separations, as well as grading and paving.

The total of all new highway and related construction may be estimated at an average of \$1,300,000,000 per year, at 1940 price levels.

In addition, there will be a large volume of maintenance. Definitions of maintenance vary somewhat between State highway departments and other bodies carrying on road work, but in general it is regarded as meaning prevention and correction of deterioration by repairs, patching, and routine operations such as periodical scraping of gravel surfaces. Even during the curtailments of war years such maintenance has been above \$400,000,000 in value per year. It is likely that an average annual expenditure will be \$600,000,000 in the first 5 postwar years, in part for current needs and in part to overcome the deterioration resulting from past curtailments and from heavy concentration of wartime traffic.

PUBLIC HOUSING

The construction rate for wartime public housing has been falling rapidly for almost 2 years, and it seems unlikely that any substantial number of dwelling units will be started during the final year before defeat of Japan. The number during that year is estimated at about 4,000, although this may be increased somewhat by unforeseen requirements of war production.

When the war is over, a fairly rapid increase may be expected in construction of permanent slum-clearance projects by local housing authorities, with an average of 50,000 dwelling units started annually during the first 5 years. It is estimated that about 30,000 units will be started during the first year, most of these during the latter part of the year when difficulties of material supply are alleviated, and that the annual construction rate will increase to about 60,000 during the fourth and fifth years. Average construction cost during the period is estimated at about \$160,000,000, at 1940 cost levels.

It is recognized that public housing has been subjected to detailed criticism, and to some degree of attack. There is a widespread desire to give every opportunity, and in fact every reasonable assistance, to private operators to meet as much of the housing need as is possible. Nevertheless there is fairly general recognition that an acute need exists for housing of families unable to meet full commercial charges for decent accommodations, whether new or used. There is accompanying recognition that slum-clearance housing projects provided for such families have been civic assets, both in the physical facilities provided and in the accompanying removal of what was often the worst of the slum buildings. It is therefore believed that public housing will be constructed on a moderate scale, but with close observation of the results being achieved.

In New York State approximately 18,000 public dwelling units are scheduled for construction within the early postwar period, most of these within New York City. Drawings and specifications are completed for many of these and well advanced for others, and numerous sites have been acquired. Because of State legislation, financing is not dependent on actions or available funds of the National Housing Agency. Elsewhere, preparations have been made through the stage of signed loan contracts between local housing authorities and National Housing Agency or its predecessors for some 25,500 dwelling units in slum-clearance projects still postponed because of the war. It seems likely that many of these will be built, although the increase in building costs since 1941 introduces financial and legal problems. It is also possible that a few local housing authorities having sufficiently high credit will construct additional projects even without grants from other bodies. Apart from these, it is thought, from proposed legislation and published but unofficial expressions of legislative opinion, that sufficient Federal financing will be provided to permit a total program of the size estimated.

SCHOOL BUILDINGS

Schools are the public buildings most urgently needed. One educational authority has estimated that there is extremely urgent need for capital expenditure of at least \$3,000,000,000 within the first 5 years after the war for public schools and colleges, and that additional capital expenditure of \$4,000,000,000 during this period would be highly desirable. About two-thirds of each figure is for construction proper, the remainder being for equipment, architectural services, and in some cases, land. The estimate includes rural schools, urban schools below college level, and public colleges and universities.

Plans to date are not commensurate with such a program, but the situation in this respect is likely to be improved materially. Al-

though school design has been undergoing fairly extensive development for more than a decade, this is an architectural field in which requirements are rather widely understood, and in which certain basic designs are applicable with minor modification to different localities of similar composition and similar climate. In fact, a few cases are known in which architects specializing in school work have retained their staffs during dull periods to prepare tentative drawings for schools of common types and sizes in order to have plans ready, when needed, for modification and completion to fit individual requirements.

An average volume of \$400,000,000 per year is estimated for new work, additions, alterations, and improvements. This is expected to begin with \$250,000,000 in work started during the first postwar year, and to amount to \$450,000,000 annually during the third, fourth, and fifth years. Annual expenditure was above \$400,000,000 at 1940 cost levels for 6 successive years ending with 1929, and was somewhat above \$450,000,000 in 1925 and 1926, but this pre-depression period was marked by a combination of stimulating factors—spread of the junior-high-school system with its need for new buildings, movement of urban population from older residential areas to outlying and suburban areas, widespread realization that nonfireproof urban schools needed replacement, and of course the viewpoint of the period favorable to physical improvements of almost all kinds.

HOSPITALS AND INSTITUTIONS

Hospitals and institutional buildings, including sanatoria and mental hospitals, will probably be built to the extent of about \$75,000,000 per year. The Veterans Administration plans an annual expenditure of \$20,000,000 per year for veterans' hospitals alone—probably replacement of temporary hospitals built during the war, for the most part. This figure includes equipment and other nonconstruction costs, and the remainder must be deflated to about \$12,000,000 annually at 1940 price levels. In addition, States and local government units have projects in various stages of preparation for general hospitals, mental and other specialized hospitals, sanatoria, training and custodial institutions for the handicapped, institutions for the aged,⁵ and establishments of numerous minor types. In part this proposed work will provide increased capacity in accordance with greater public recognition of the need present, and in part will replace existing buildings which—in some classifications especially—are badly suited to their purposes.

Because of the greatly increased recognition of the value of hospitals especially, and of other public institutions to a lesser degree, it is expected that funds will be available for the volume of construction estimated. The present state of plan preparation indicates readiness for this volume.

PUBLIC ADMINISTRATION BUILDINGS

The Federal building program is directed by the Public Buildings Administration, which submits to Congress the building programs proposed. After Congressional approval and accompanying authori-

⁵ While old-age assistance and social-security benefits are supplanting institutional care for the able-bodied aged, they do not affect the need for such care for the infirm, chronically sick, or handicapped.

zation of funds, a committee representing PBA and the executive agencies selects specific projects from the approved list, after which land is purchased, drawings are prepared, and contracts are awarded.

This activity is divided between work in the District of Columbia and work elsewhere. For the former, a study of space requirements has been made by PBA on the basis of expected reductions in personnel, return of some agencies transferred from Washington, release and demolition of unsuitable buildings, and restoration of the space per employee to the figure found from experience to permit best efficiency. The proposed program based on this study calls for demolition of temporary and obsolete buildings with about 6,000,000 square feet of space, release of about 3,400,000 square feet of rented space, and construction of new permanent buildings with about 6,000,000 square feet. Construction cost of this program would be about \$15,000,000 per year for 5 years at 1940 levels of prices.

For buildings outside of Washington, a tentative program consisting of 3,000 buildings throughout the country has been prepared by PBA for submission to Congress. In accordance with established procedure, this list will be approved with or without modification, and then annual or biennial appropriations will be made establishing the construction rate. Past appropriations suggest a rate somewhat over \$50,000,000 per year at 1940 cost levels.

These buildings will be of all types and sizes. Some will be simple, single-purpose buildings such as border-patrol stations or small post offices, while a few will be comparable to metropolitan office buildings. For a number of years it has been the policy, in designing custom-houses, post-office buildings, and other specialized buildings, to provide space for those other Federal offices in the same cities which could use this space advantageously. This policy has been followed in preparation of the tentative program.

If land is not already owned it can be obtained within 30 days if necessary, by a declaration of seizure. For smaller buildings needed in quantity, mainly small post offices, numerous standard designs have been in use for some years, which can be modified within 30 to 45 days to fit individual requirements. This could not be done, of course, in the case of larger buildings or those for less-standardized uses, for which preparation of drawings ordinarily requires 6 months to a year or more, depending on the size and characteristics of the building wanted.

State and local government units are planning for buildings of many types. No comprehensive tabulation by type is available, but reports from individual government bodies indicate that most projects will be for operating departments—fire stations, shops for public-work activities, and other strictly utilitarian structures. There will also, however, be both additions and new buildings for city halls, courthouses, and public offices, to overcome crowding and to replace obsolete buildings.

Publicly financed industrial buildings have been important only under war conditions or when war was imminent, and commercial buildings have been minor at all times. It is expected that these will be few in number and small, limited to those built in conjunction with other types of work.

MILITARY AND NAVAL CONSTRUCTION

Military and naval construction in continental United States will probably be fairly small—about \$60,000,000 per year—since curtailment rather than expansion of the total military and naval establishment is expected. This work is likely to consist largely of improvement to existing establishments to make them better suited for postwar operation.

AIRPORT CONSTRUCTION

There will certainly be a large public construction program for aviation facilities, for which a tentative estimate is \$75,000,000 per year. Large expansion of commercial aviation over prewar levels may be expected, as well as some expansion of private flying. The wartime construction has been enormous, but with some exceptions military requirements meant location of new fields where they will have but limited value for postwar civilian use.

The principal agency in this field is the Civil Aeronautics Administration, but numerous States, counties, and municipalities have also carried out varying degrees of planning. Although no formal program will exist until Congressional authority is given, the subject is being studied carefully and rather detailed programs have been prepared for submission to Congress.

Whatever the extent of the program authorized, it seems likely to consist of two principal types of facilities: (1) Metropolitan airports capable of accommodating the largest planes and the heaviest traffic volume, to be built close to the center of the city. Average construction cost will be about \$20,000,000 each. Because of the area required, these can be built only in cities located on suitable bodies of water where land can be created by filling in. The cost of buying a sufficient area of improved property near the downtown section, on which it would be necessary to demolish all buildings, would obviously be prohibitive. (2) Smaller airports on natural land, in several size groups intended for corresponding classes of expected traffic volume. Preliminary estimate of construction cost for these is from \$80,000 to \$360,000 each, depending on size.

It is expected that land will be provided and supplementary expenses (such as those for legal services) will be paid by local sponsors, ordinarily municipalities. This preparation has lagged thus far and start of work will in many cases be delayed unless planning is accelerated. The preparation time required, including that for design, ranges from 9 months for the smallest airports up to 2 years for the metropolitan airports to be built on filled-in land.

RECLAMATION, CONSERVATION, AND DEVELOPMENT

Comprehensive plans for reclamation, conservation, and development work have been prepared by the Corps of Engineers and by the Interior Department, and construction can therefore be started on short notice. Proposals affecting the contemplated programs of both of these agencies have been made for unified development, of the TVA type, for six major river systems. Other proposed projects

include the St. Lawrence Seaway, for which a large part of the construction would be performed in Canada.

The purposes to be served include improvement of navigation; flood control, erosion control, and soil improvement; irrigation; the generation, transmission, and distribution of electric power; and the provision of recreational areas. Some projects will serve a single purpose, particularly improvement of navigation, while others will contribute to most if not all of those listed. All this work is heavy engineering, but includes a variety of types of construction, of which dredging, rock removal, moving of earth, and construction of dams, locks, piers, and facilities for generation and distribution of electricity will be the most important.

Public policy on expenditures will affect the volume of work on projects within this general classification more than that on most others. There is seldom the immediate urgency that there is, for example, for relief of overcrowded schools or hospitals. Results of earlier development work, and particularly the value of many of the completed projects to the war production program, have been an effective demonstration that these undertakings augment the Nation's resources and productive capacity. Hence there seems to be little chance that they will be regarded merely as means of creating employment and stimulating business. An average volume of \$350,000,000 annually during the first 5 postwar years is estimated, with a range from \$275,000,000 in the first year to \$400,000,000 in the fourth and also in the fifth year.

SEWER AND WATER FACILITIES

Sewer, sanitation, and water-supply projects are local undertakings, except that in metropolitan areas they are not uncommonly constructed and operated by special districts for several municipalities and the intervening unincorporated territory. Their importance, particularly as regards sewage-treatment facilities, is considerably more than local because of the effect on other localities.

After the war there will be extension of service to growing neighborhoods, both those formerly dormant and those entirely new, and provision of public facilities—especially for sewage—in smaller municipalities formerly lacking such improvement. In cities already providing water and sewage service there will be development of new sources of water supply, increase of capacity for pumping stations and primary distribution mains, construction of water-treatment plants, and construction or enlargement of sewage-treatment plants. Considerably greater attention than in the past is likely to be given treatment of industrial wastes, with provision made in part through public plants and in part through private facilities at industrial establishments producing objectionable liquids.

As might be surmised, sustained level for sewer and water construction was greatest during the pre-depression period when residential and other building was at its height and when urban subdivisions were being marketed in greatest number. From 1925 through 1929, average annual volume was about \$180,000,000 for sewer construction and about \$155,000,000 for water.

The estimated averages during the first 5 years after the war are, respectively, \$200,000,000 for sewage facilities and \$150,000,000 for

water. Widespread public recognition of the importance of such projects is indicated by the fact that they lead all other types of work reported to the Federal Works Agency by local government units, as regards estimated cost of work for which plans were completed on July 1, 1944, and also for which plans were in preparation on that date. There will of course be caution about proceeding in vacant new subdivisions and other vacant areas, but the influence of this factor is reflected in the estimate.

Financing should present no difficulties for any justified project. Water service is a revenue-producing utility, the rates for which include debt service as well as operating costs. A considerable part of the cost of sewer work will be paid from special assessments. Collection risks will commonly be avoided by requiring the property owners to pay the assessments prior to start of the work, when they desire construction in vacant areas or areas where property values are speculative. The several forms of "sewer rental" by which property owners or occupants are charged separately for sewage service have been adopted in relatively few cities, but in the course of time may become important as a source of funds for debt service.

PARKS AND RECREATIONAL FACILITIES

This work consists in part of buildings such as auditoriums, field houses, and shelters, and in part of grading, landscaping, construction of swimming pools and beaches, and other outdoor work. The expenditure level for buildings alone rose rather consistently during the 1920's to a peak of \$56,000,000 in 1928 and then, after depression curtailment, increased again with somewhat less regularity through 1939. Recent newspaper accounts show strong public support for some proposed projects. Nevertheless, this is one of the smaller classes of public construction and one likely to be subordinated to schools, hospitals, and other types of work which are generally regarded as more urgent. Volume is estimated at \$70,000,000 per year.

Part 4.—Site Employment in Postwar New Construction

Summary

EXECUTION of the postwar new-construction program will mean employment for an estimated average of 1,840,000 site workers during the first year following the end of the war, and for an estimated average of approximately 2,840,000 during the fourth and fifth years. These figures represent the estimated full-time jobs to be available, and not the total number of different people receiving employment; because of turnover in the labor force, including temporary entrance into it on the part of some, the latter figures would be perceptibly higher. During the first year the number of jobs will increase within the pattern of seasonal variation, so that employment early in the year will be below the estimated average, while during the latter part of the year it will be higher. By the fourth and fifth years employment will have reached virtual stability.

Slightly over half of these workers will be skilled, including foremen; the semiskilled group will be somewhat over 10 percent of the total; and the unskilled group will be almost three-eighths of the total. The remainder—about 2 percent—will consist of general and other superintendents, job clerks, and others doing administrative work.

Laborers will constitute the largest occupational group. Among the skilled workers, the most numerous will be carpenters, who will constitute about 45 percent of this group. The other occupations expected to make up 5 percent or more of the skilled group are masons, equipment operators, painters, and plumbers. Almost half of the semiskilled workers will be truck drivers, and about a sixth will be in the closely related occupations of bricklayers' and plasterers' helpers (hod carriers).

The estimated figures take account of expected changes in materials and methods affecting productivity, and are below estimates made on the basis of man-hour requirements in 1940 by about 2½ percent in the first year and by almost 9 percent in the third and subsequent years. These adjustments are based on observation of recent developments in the construction industry, and are necessarily approximate. These, and the estimate as a whole, are regarded as substantially accurate, but are subject to revision on the basis of additional data and after more detailed study.

This report is an estimate of the site employment necessary to perform the new construction¹ previously estimated for the first 5 years following defeat of Japan. It is valid only as related to that forecast and cannot be regarded as an estimate of the site employment resulting from any other volume of construction work which may be carried out. The forecast of construction work to be started assumed that authorization of publicly financed projects would be governed by immediate need for the completed facilities, without consideration for the resulting employment. Should this assumption not be met, the volume of employment would be changed substan-

¹ The employment estimated is for new construction including additions, alterations, modernization, and major repairs of the type for which building permits are usually issued, but excluding maintenance and minor repairs.

tially. Total site employment in new construction would be reduced by as much as 15 percent by a policy of drastic retrenchment in public expenditures, with postponement of all except the most urgently needed construction projects. Conversely, total site employment might be increased from the estimated figures by 25 percent or even more, if creation of employment were a major consideration in decisions on public expenditures for construction activity.

Scope and Method of the Study

The estimates here given are based on past studies relating construction volume to man-hours of site employment for the major types of projects, similar studies of the distribution of man-hours by occupations, and observation of recent trends in methods, machinery and materials which are expected to affect the number of site hours per unit of output in several important types of construction. Briefly, the estimate is derived as follows: The dollar volume of each major type of construction is first converted to man-hours, on the basis of former studies above mentioned; these are adjusted, where appropriate, for the lag between the start and the execution of work, to give timing of the employment represented; the adjusted man-hours are then converted to man-years (i. e., to the number of full-time jobs available); these man-years are distributed among the major construction occupations, to show the employment which would be available in each under 1940 conditions (used in the forecast of volume and the other studies on which this estimate is based); and finally this employment is adjusted downward to allow for the increased productivity which is expected to affect several important types of construction work.

These estimates cover only site employment in new construction, and not the total employment of construction workers. There will be additional employment, not included in the estimate, for more than a million workers in maintenance and minor repairs carried out on existing structures. This includes a wide range of work performed to overcome deterioration—painting and decorating, roof repairs, replacement of leaking pipes and rain gutters, patching of holes or breaks in highway pavement, etc. This employment will be supplied by contractors who undertake such work, by industrial and commercial establishments and public bodies employing regular maintenance crews, and by property owners who employ workers on an hourly or jobbing basis for these services. In addition, some construction workers will be employed in their own trades at nonconstruction work in manufacturing (such as wiring or sheet-metal work for specially designed machines), and an unknown but probably rather small part of the construction labor force will be employed in nonconstruction occupations during the less active parts of the year.

Relation of Construction Employment to Construction Volume

Site employment in construction is directly related to the volume of operations currently in progress, and is not in any sense an independent entity. Unlike manufacturing operations, construction offers no "cushion" of production for inventory or expected future orders.²

² Promotional building seems to be an exception, but the difference is more apparent than real; from the standpoint under consideration, a project for a given number of houses for which land has been purchased and financing arranged is altogether comparable to a contract for other construction.

Contractors hire mechanics, helpers, and laborers to perform work on specific construction projects, and have no effective use for their services in any other manner.

Employment at the site of construction can be estimated for the actual or expected construction volume during any period, on the basis of the value of work completed per man-hour. For any particular type of construction, there is a good deal of uniformity in the physical measure of work completed per man-hour between groups of projects, even though individual projects may vary from the average because of unique conditions. The value of a completed construction job is made up of the wage cost, the cost of the materials used, numerous overhead items, and profit. Since the physical measure under any given set of general conditions is uniform for a group of projects, the value is uniform also, subject of course to geographical differences in wage rates and material prices, and over a period of time subject to changes in price levels for these and other elements in the total value.

Table 1 shows estimates of the volume of new construction, by the principal major types, to be started during the final year of war against Japan only and during each of the first 5 years thereafter. The value figures in this table are based on 1940 construction costs, assuming the methods and working conditions as well as the material prices and wage rates of that year. It should be noted that the forecast refers to work started rather than work performed during each of the years shown.

TABLE 1.—Estimated Value of New Construction To Be Started During Final War Year and First 5 Years Thereafter¹

Type of construction and source of funds	Value (in millions of dollars)						
	Final war year ²	First 5 postwar years					
		First	Second	Third	Fourth	Fifth	Average
Total new construction ³	4, 460	7, 890	10, 870	11, 805	11, 990	12, 065	10, 924
Private construction.....	3, 045	5, 765	8, 015	8, 560	8, 545	8, 595	7, 896
Residential (nonfarm).....	1, 250	2, 850	3, 900	4, 250	4, 300	4, 450	3, 950
New construction.....	1, 000	2, 300	3, 100	3, 400	3, 500	3, 700	3, 200
Additions, alterations, modernization, and major repairs.....	250	550	800	850	800	750	750
Nonresidential.....	760	1, 530	2, 400	2, 550	2, 550	2, 450	2, 296
Commercial.....	275	750	1, 300	1, 350	1, 350	1, 250	1, 200
New construction.....	150	250	400	500	550	550	450
Additions, alterations, modernization, and major repairs.....	125	500	900	850	800	700	750
Industrial.....	375	500	700	750	750	750	690
New construction.....	175	300	400	450	500	550	440
Additions, alterations, modernization, and major repairs.....	200	200	300	300	250	200	250
Religious.....	50	100	150	175	175	175	155
Educational.....	25	60	75	80	80	80	75
Social and recreational.....	15	50	75	85	85	85	76
Hospital and institutional.....	30	50	75	85	85	85	76
Miscellaneous.....	10	20	25	25	25	25	24
Farm (residential and nonresidential).....	325	425	525	550	550	500	510
Utility ⁴	690	960	1, 190	1, 210	1, 145	1, 195	1, 140
Railroad.....	300	350	400	350	350	350	360
Local transit.....	15	25	40	45	45	45	40
Pipe line.....	25	25	25	25	25	25	25
Electric light and power.....	150	250	300	300	300	350	300
Gas.....	50	60	75	90	75	75	75
Telephone and telegraph.....	150	250	350	400	350	350	340

See footnotes at end of table.

TABLE 1.—*Estimated Value of New Construction To Be Started During Final War Year and First 5 Years Thereafter*¹—Continued

Type of construction and source of funds	Value (in millions of dollars)						
	Final war year ²	First 5 postwar years					
		First	Second	Third	Fourth	Fifth	Average
Public construction.....	1,415	2,125	2,855	3,245	3,445	3,470	3,028
Highway, road, and street ³	500	900	1,200	1,400	1,500	1,500	1,300
Residential building.....	10	95	145	175	190	190	159
Nonresidential building.....	420	380	580	690	725	750	625
Educational.....	100	250	400	450	450	450	400
Hospital and institutional.....	35	45	70	80	90	90	75
Public administration.....	50	75	100	150	175	200	140
Commercial and industrial.....	225	0	0	0	0	0	0
Miscellaneous.....	10	10	10	10	10	10	10
Military and naval.....	200	100	75	50	40	40	61
Civil aviation.....	0	60	75	80	80	80	75
Reclamation, conservation, and development.....	100	275	325	350	400	400	350
Water supply.....	75	110	140	160	170	170	150
Sewage disposal.....	75	125	200	225	225	225	200
Social and recreational ⁴	15	50	75	75	75	75	70
All other Federal.....	5	10	15	15	15	15	14
Miscellaneous non-Federal.....	15	20	25	25	25	25	24

¹ Converted to 1940 cost levels.² Between defeat of Germany and defeat of Japan.³ Additions, alterations, modernization, and major repairs of the type for which building permits are usually issued are included with new construction except where listed separately.⁴ Includes municipal and other publicly owned utilities except those constructed in conjunction with reclamation, conservation, and development program.⁵ Includes culverts, bridges, grade separations and other related work.⁶ Includes buildings and nonbuilding construction.

The value of work to be started as shown in table 1 was converted into man-hours requirements. After conversion, the detailed classification of projects used in table 1 was condensed into the 10 major categories shown in table 2. The estimated man-hours requirements were derived from the value figures by the use of data on the value of work put in place per man-hour, under 1940 conditions, for each major type of construction. These data were developed by the Bureau in its program of analyzing the labor and material consumption in the major types of construction projects.

TABLE 2.—*Site Man-Hours Required for Execution of Predicted Construction Started Within Each Year, ¹ under 1940 Conditions*

Type of work and source of funds	Site employment (in millions of man-hours)					
	Final war year	First 5 postwar years				
		First	Second	Third	Fourth	Fifth
Total new construction.....	1,548	2,862	3,964	4,303	4,356	4,362
Private.....	1,106	2,123	2,970	3,172	3,154	3,152
Residential building.....	475	1,080	1,485	1,615	1,625	1,670
Nonresidential building.....	301	596	944	996	988	940
Farm.....	98	128	158	165	165	150
Utility.....	232	319	383	396	376	392
Public.....	442	739	994	1,131	1,202	1,210
Residential building.....	3	32	49	59	64	64
Nonresidential building.....	134	129	198	235	246	254
Highway, road and street ²	150	338	450	525	563	563
Civil aviation ³	0	18	23	24	24	24
Sewer and water.....	45	71	103	117	120	120
All other public.....	110	151	171	171	185	185

¹ Man-hours required for execution of work started within each of the years shown, before adjustment for carry-over of work from year to year.² Includes culverts, bridges, grade separation and other related work.³ Includes structures.

An indication of the individual characteristics of specific types of construction may be obtained from comparison of the figures for farm construction in tables 1 and 2. Man-hours are somewhat low in proportion to the value of work to be started, despite low wage rates for rural workers and extensive use of lower-priced materials. The reason is that commonly a considerable part of the work is done by the farmers, family members, and farm employees, who help the workmen hired to perform the more skilled operations. It is only the work of this last group, and that of construction laborers hired as such, which can be regarded as construction employment.

Timing of Employment

The man-hours shown in table 2 are those estimated as necessary to construct the projects started within each of the several years. These figures are not the same as man-hour employment during those years. A certain part of the work started during any 12-month period is completed during the following period. The proportion thus carried over depends on the type of construction and the time of year at which the successive 12-month periods start.

If the volume of work started were uniform from year to year, no adjustment would be necessary, because the unfinished work at the end of the period would be equal to the previous year's unfinished work which was completed during the early part of the period. This condition is not present, however; the estimated volume of construction increases rapidly until the third year following defeat of Japan. During this period the rate at which projects are started is increasing continuously, subject to seasonal variations, and the amount of unfinished work at the end of any 12-month period exceeds the amount carried over from the preceding period. Since actual employment results from the execution rather than merely the start of work, the man-hours of employment during each of the postwar years must be adjusted for this lag. The adjusted employment figures, showing employment in man-hours actually available in each year, are presented in table 3.

TABLE 3.—*Man-Hours of Site Employment Available in Each Year¹ During Execution of Predicted Program, under 1940 Conditions*

Type of work and source of funds	Site employment (in millions of man-hours) in first 5 postwar years				
	First	Second	Third	Fourth	Fifth
Total new construction.....	2, 644	3, 762	4, 249	4, 352	4, 363
Private.....	1, 915	2, 791	3, 130	3, 156	3, 155
Residential building.....	959	1, 404	1, 589	1, 623	1, 661
Nonresidential building.....	523	857	983	990	952
Farm.....	123	153	164	165	152
Utility.....	310	377	394	378	390
Public.....	729	971	1, 119	1, 196	1, 208
Residential building.....	26	46	57	63	64
Nonresidential building.....	131	181	225	243	252
Highway, road and street ²	338	450	525	563	563
Civil aviation ³	18	23	24	24	24
Sewer and water.....	71	103	117	120	120
All other public.....	145	168	171	183	185

¹ Man-hours of employment provided during each of the years shown.

² Includes culverts, bridges, grade separations and related work.

³ Includes structures.

The amount of work to be performed, or of employment to be available, during the first postwar year is estimated under 1940 conditions at somewhat over 2.6 billion man-hours, or about 60 percent of the amount estimated for the fifth year. The greatest increment in construction activity during the postwar period occurs between the first and second years. As stability is approached, the rate of increase falls sharply. From the third to the fourth years construction man-hours increase by only about 3 percent, and from the fourth to the fifth years by less than 1 percent.

The distribution of construction over the first 5 postwar years for individual types of work differs from the general pattern in some respects. The principal feature to be noted is a reduction in the fifth year for man-hours in private nonresidential construction, the result of an expected reduction in modernization and alteration of commercial and industrial buildings.

Man-Years of Employment Under 1940 Conditions

There is less concrete information regarding the hours worked annually in construction than in most major fields of employment. A full week ordinarily consists of 40 hours,³ and a year might be regarded as consisting of 50 or 52 weeks. These figures omit consideration of the seasonal variation in the volume of construction work with resulting high seasonal unemployment, and of the time lost during the most active working season because of rain and other interruptions. Hence conversion of man-hours to man-years on the basis of 2,000 or 2,080 hours would give a theoretical figure for a year of full employment, but would understate the number of workers to be employed and overstate the average hours of paid employment.

The working season varies geographically with the climate and local custom, and in many localities is affected by the type of work being done. Some materials are damaged seriously by freezing, which may occur several days after they have been placed and, hence, whenever there is danger of freezing, can be used only under conditions permitting adequate protection without undue expense. Certain operations are entirely feasible in unfavorable weather, but only at greatly increased cost, and are therefore avoided whenever possible. Some types of indoor work, such as "roughing-in" of plumbing and electrical installations, are comparatively unaffected by weather but are nevertheless subject to seasonal reduction because of seasonal variations in the structural work on which they are performed. Although certain numbers of construction workers are employed continuously throughout the year, the available data indicate that these constitute a small proportion of the total. For many workers, especially the employees of the smaller special-trade contractors, it is believed that employment is divided between construction work proper and maintenance and repair work.

Hours worked per week are reduced by bad weather conditions, especially by rain. Some kinds of work can be resumed as soon as the rain stops, but others (such as outdoor painting) must be postponed until the exposed surfaces have dried. In addition, there are interruptions caused by variations in the work to be done, failure to obtain materials as needed, and miscellaneous causes. In these cases,

³ Shorter workweeks have been established in a few trades, in some cases nationally and in some cases locally. The commonest of these is 35 hours.

the workers involved are ordinarily laid off for a half day or whatever brief time may be involved, without pay for this time lost. Custom in this respect varies, particularly with current employment conditions, but when the lay-offs are quite brief workers usually accept them rather than undertake the trouble of moving their tools to another job.

In addition, workers lose time moving between jobs. The different operations of an individual construction firm in most cases vary in magnitude and its total activities extend over a considerable area. Usually, a nucleus of "regular" workers is retained and transferred from project to project, and is supplemented by a relatively large number hired on a project basis. These latter are hired for the duration of their own work, and not of the project as a whole. In extreme cases (such as extra laborers for placing concrete) they may be hired for only a few hours, and then either rehired or replaced at a later date when similar work is again to be performed. Hence it is necessary for many construction workers to find new jobs at rather frequent intervals, even during periods of above-normal activity. Even when there is a scarcity of workers, this commonly means a short period of lost time for some of those affected.

In view of these conditions, 1,400 hours has been assumed as constituting a man-year of employment. This is equivalent to 40 weeks of 35 hours each. It is not regarded as an ideal work-year, but rather as a fairly realistic figure in view of the seasonal and other influences which have been effective to date.

An estimate of the full-time jobs to be filled, under 1940 conditions, is presented in table 4. It indicates an ultimate working force of about 3.1 million, almost attained in the third year and then fairly constant for the remainder of the period. As is also apparent in table 4, changes from year to year in the proportion of the workers to be employed on the publicly financed projects are relatively slight. This element of construction employment would of course be changed drastically should policy decisions regarding the public-construction program differ in major respects from those assumed in forecasting the volume of work to be started. These jobs are full time, in the sense

TABLE 4.—*Man-Years of Site Employment Provided During Execution of Predicted Program, by Years, under 1940 Conditions*

Type of work and source of funds	Site employment (in thousands of man-years of 1,400 man-hours) in specified postwar years				
	First	Second	Third	Fourth	Fifth
Total new construction.....	1,887	2,686	3,035	3,108	3,117
Private.....	1,367	1,993	2,236	2,254	2,254
Residential building.....	685	1,003	1,135	1,159	1,186
Nonresidential building.....	373	612	702	707	680
Farm.....	88	109	117	118	109
Utility.....	221	269	282	270	279
Public.....	520	693	799	854	863
Residential building.....	19	33	41	45	46
Nonresidential building.....	93	129	161	174	180
Highway, road and street ¹	241	321	375	402	402
Civil aviation ²	13	16	17	17	17
Sewer and water.....	51	74	83	86	86
All other public.....	103	120	122	130	132

¹ Includes culverts, bridges, grade separations, and related work.

² Includes structures.

that those who hold them are full-time members of the construction labor force,⁴ but not in the sense that all of these persons are employed continuously throughout the year or even throughout the construction season. The presence of so-called "frictional" unemployment between successive construction projects has already been mentioned. This will affect some workers slightly or not at all, but others to a considerable degree. At any given time, some part of the workers shown will be temporarily out of work, having been laid off at one project and not yet hired at another. This will of course be greatest during the dull construction season, which in general is the winter months. Adjustment for this situation has already been made by the use of an average figure of 1,400 hours as a year's employment.

Employment by Occupation

Occupational specialization is an outstanding feature of the construction industry. In part this is caused by the wide range of operations to be performed and of materials to be processed, and to a considerable degree it is the result of local customs, preferences, and other conditions. This separation of functions is most extensive in the larger urban places and in large projects, and is least pronounced in farm construction. For rural work, the local carpenters ordinarily do lathing and not infrequently install ready-made sheet-metal items and even electric wiring, while the local masons often do plastering as well. When the volume of work is sufficient to afford a living to workers in the less-common trades, the greater proficiency permitted by specialization has caused its general adoption.

The occupational pattern differs greatly with the type of work. For all types, laborers are the largest single group; for building construction, carpenters are the largest single group of skilled workers. In fire-resistive construction carpenters constitute one of the largest occupational groups, even though wood is used only incidentally in the basic structure, because they are needed for building the concrete forms and for installing the interior woodwork and hardware. Even in highway projects carpenters are quite commonly needed, to build forms for bridges and culverts being constructed in conjunction with the highway work, and for other related operations. Some occupations—such as those of high-tension linemen, blacksmiths, machinists, explosives workers (powder men)—are present on only a few types of work or on unusually large projects.

Table 5 gives an estimate of the employment, by occupation, during the first 5 postwar years, according to the methods and patterns of 1940. The more common occupations are shown, with a few combinations of those closely related. The rather uncommon trades, such as those mentioned above and a considerable number of other occupations which are fairly widespread but individually small (marble setters and helpers, elevator constructors and helpers, etc.), are grouped together under the classifications, "all other skilled," and "all other semiskilled." No attempt has been made to estimate employment in the specialties within standard crafts (such as hardwood-floor laying, stair building, etc., under carpentry), the skills of which are usually transferable to other operations.

⁴ Persons following other gainful occupations during dull seasons are ignored in this statement.

TABLE 5.—*Estimated Site Employment, by Occupation and Year, During Execution of Predicted Program, by 1940 Pattern of Operations and Productivity*

Occupation	Site employment (in thousands of workers) in specified occupations in postwar years				
	First	Second	Third	Fourth	Fifth
Total	1, 887. 0	2, 686. 0	3, 035. 0	3, 108. 0	3, 117. 0
Superintendents.....	23. 0	32. 5	36. 5	37. 5	37. 5
Foremen.....	139. 0	197. 0	222. 0	227. 0	229. 0
Clerks.....	16. 0	23. 0	26. 0	27. 0	27. 0
Skilled workers	805. 0	1, 164. 5	1, 317. 5	1, 346. 5	1, 348. 5
Bricklayers, masons.....	68. 5	101. 5	116. 0	119. 5	119. 5
Carpenters.....	370. 0	535. 5	604. 5	617. 0	617. 0
Electricians.....	34. 5	50. 5	57. 0	58. 0	58. 0
Equipment operators.....	53. 5	73. 0	82. 5	85. 0	85. 0
Lathers.....	10. 5	16. 5	19. 0	19. 5	19. 5
Painters.....	76. 0	111. 0	126. 0	129. 0	129. 5
Plasterers.....	37. 0	55. 0	62. 5	64. 0	64. 0
Plumbers.....	46. 5	68. 5	78. 0	79. 5	80. 5
Sheet-metal workers.....	13. 0	19. 0	22. 0	22. 5	22. 5
Steamfitters.....	8. 5	13. 0	15. 0	15. 5	15. 5
Structural, reinforcing, and ornamental iron-workers.....	26. 5	38. 0	43. 5	44. 5	44. 0
All other skilled workers.....	60. 5	83. 0	91. 5	92. 5	93. 5
Semiskilled workers	213. 0	263. 0	332. 0	343. 0	344. 0
Bricklayers', plasterer's helpers.....	30. 5	46. 0	53. 0	54. 5	54. 5
Electricians' helpers.....	9. 5	14. 0	16. 0	16. 5	16. 5
Plumbers' helpers.....	19. 0	28. 5	32. 5	33. 5	33. 5
Sheet-metal workers' helpers.....	3. 0	4. 5	5. 5	5. 5	5. 5
Truck drivers.....	98. 5	128. 5	145. 0	151. 0	152. 0
All other semiskilled workers.....	52. 5	71. 5	80. 0	82. 0	82. 0
Unskilled workers	691. 0	976. 0	1, 101. 0	1, 127. 0	1, 131. 0
Laborers.....	668. 5	944. 0	1, 064. 5	1, 089. 5	1, 093. 5
Watchmen, miscellaneous.....	22. 5	32. 0	36. 5	37. 5	37. 5

As is evident from table 5, skilled workers exclusive of foremen constitute three-sevenths of the total for all construction work, with only slight variation throughout the period. For private construction they make up very nearly half, while for public construction they are not greatly above a quarter of the total. This major difference arises from the fact that the predominant part of the private program will consist of buildings, which require the highest percentage of skilled workers, whereas the public program consists mainly of nonbuilding work and includes some large elements in which the percentage of skilled workers required is notably low.

Among the skilled trades the carpenters constitute the largest occupation, accounting for somewhat less than half of the skilled group. Painters are the next commonest trade, and about 90 percent of them will be employed on private work. Even for similar types of construction, such as multifamily residential buildings, there is proportionately more work for painters on the privately financed jobs, because of more extensive decorative treatment. In contrast, bricklayers will constitute about 8 percent of the skilled workers in the private program, but 13 to 14 percent in the public program, because the publicly financed buildings will be predominantly of masonry and in many cases will have partitions of structural tile or other materials installed by bricklayers. Equipment operators show an even greater contrast, accounting for 6 percent of the employees in the private program and 21 percent on public construction. This is caused primarily by differences in the types of construction; those types most extensively mechanized, of which grading and paving are

the commonest examples, are undertaken almost exclusively by public bodies. The semiskilled group is proportionately about 3 times as numerous on public as on private work, because of the large number of truck drivers employed in the nonbuilding types of construction.

In addition to the direct productive workers, an administrative and supervisory staff of superintendents, foremen, and clerks will be needed, making up somewhat less than 10 percent of total site employment. This group will be slightly larger, proportionately, on the publicly financed part of the total program, principally because of differences in the relative importance of the various types of projects and in the average size of projects. Roughly three-fourths of this group will be foremen, for whom the distribution by craft will approximate that for the workmen. Although most of the superintendents will be employed by general contractors and will have charge of complete projects, superintendents for specific trades will be employed on some of the larger projects. Clerks are employed only on projects of moderate or large size, usually to be responsible for maintaining time, pay-roll, and material records, and other somewhat similar work. In the largest projects a complete job office is established, having authority for many of the functions usually performed at a contractor's central office.

These estimates exclude employees of the contractors' central offices and job representatives of the owners, architects, and engineers.

Changes in Occupations and in Productivity

Changes in occupational patterns and in the work done by those in given occupations are taking place more or less continuously. In a few cases, such developments have led to the establishment of entirely new occupations on the initiation of new operations differing radically from those of established trades. Other changes have either expanded or curtailed the work of existing trades. Thus, metal lath is installed by the lathers who do wood lathing; plumbing was greatly changed through the replacement of lead pipe by steel pipe accompanied by the change from boxed-in fixtures with exposed pipe to "open" plumbing with concealed pipe; plastering has been simplified by a great curtailment in elaborate ornamental work; and carpentry has been changed in pattern by progressive reduction, over almost two generations, in the use of ornamental woodwork and complicated framing, accompanied by a great increase in the building of forms for concrete work during recent years. Some of these changes have meant that a lower level of skill is satisfactory for most work, but many have merely called for changes in the pattern of skills needed in the occupation.

Rather distinct from the changes described above is another group for which there is no exact starting date, but which has been accelerated greatly by the war. This may be termed industrialization, as applied to the construction of standardized structures or of structures which lend themselves to standardization. This development has been noted especially with respect to detached houses, which, however much they may differ in exterior appearance and in the details of ornamentation, when built in a fairly large promotional development usually follow a very few basic designs in floor plan and structure proper.

The wartime program of house construction has been marked by much more careful planning, greater specialization of operations, greater use of processing machinery at the site, and closer correlation between the different parts of the work than had formerly been practiced. Carpenters and workers in some other trades were provided with detailed schedules and dimensions of pieces to be cut. In a few of the largest projects, templates and other auxiliary devices were used, eliminating even the necessity for measuring. After cutting, the pieces were commonly delivered to the erection locations in sets, often marked with code numbers indicating where they were to be used.

This development (commonly known as pre-cutting) marks a basic change, in that it transfers the scheduling of material processing from a production function of foremen and skilled workmen to a management function. It affects employment both by increasing the productivity per worker and by reducing the range of skills necessary for capable performance of important operations. After the war these procedures will probably be used less intensively, because there will be few if any repetitive projects comparable in size to the largest of the wartime housing or barracks projects. At the same time, there is every indication that greater mechanization and rationalization in construction will be practiced than before the war.

Within recent years there has been notable improvement in some types of construction machinery. The pre-cutting development above mentioned was greatly facilitated by a comparatively recent type of machine, the radial saw. Important development has also occurred in some important types of highway machinery, primarily with respect to increased capacity rather than to the type of operations performed, but still increasing the productivity per worker. Other developments have been of less individual importance, but in combination have been appreciable. In addition, older equipment items such as electric handsaws have been coming into increasing use, and from time to time new uses are made of existing equipment.

Another progressive change has been in the almost continuous increase in the extent of off-site processing. Present indications are that this trend will continue and probably be accelerated. It affects building construction more than other types, but extends to the others to some degree.

These are all aspects of the general question of the postwar productivity per worker as compared to that in 1940. It is certain that there will be changes, but no exact measure of their extent is available. The presence of changed methods and practices in recent construction activities of numerous types has been noted, and estimates have been made of their expected effect on the different types of work.

Table 6 presents the estimated employment by occupations after the expected changes in productivity. It is recognized that the estimates for individual trades can be only rough approximations, but they are believed to give at least an indication of the distribution of the total changes. As is apparent from comparison with table 5, the ultimate effect is expected to be a reduction of somewhat less than 9 percent in the number of workers required to carry out a year's program. This is expected to occur progressively over a period of about 3 years, as the various developments progress and receive more general adoption.

The effects will differ among the various types of work, from a maximum in highway and other paving and in private residential building to a minimum (so small that no attempt at adjustment for it has been made) in farm construction. Almost all occupations will be affected to some extent, but with major differences between different types of work. Carpenters will be the group most affected in private residential building, whereas in both residential and non-residential modernization work carpentry methods are not likely to change significantly. In the larger paving and grading projects the number of construction machine operators will be reduced by the larger capacity and greater productivity of the more important machines, whereas in building work little net change in their scope of work seems likely. It is probable that there will also be geographical differences, with the changes in productivity greatest in those localities where the adoption of improved methods has lagged heretofore.

TABLE 6.—*Estimated Site Employment During Execution of Predicted Program, by Expected Pattern of Operations and Productivity*

Occupation	Site employment (in thousands of workers) in specified postwar years				
	First	Second	Third	Fourth	Fifth
Total.....	1,840.0	2,513.0	2,773.0	2,837.0	2,842.0
Superintendents.....	22.0	30.5	34.0	35.0	35.0
Foremen.....	135.0	183.5	201.5	206.0	207.0
Clerks.....	16.0	22.0	24.0	25.0	25.0
Skilled workers.....	789.0	1,090.0	1,203.5	1,229.0	1,229.0
Bricklayers, masons.....	67.0	95.0	107.0	110.0	110.0
Carpenters.....	360.0	501.5	550.0	562.0	560.0
Electricians.....	34.0	47.0	52.0	53.0	53.0
Equipment operators.....	53.5	68.0	75.5	77.5	78.0
Lathers.....	10.5	15.5	17.0	18.0	18.0
Painters.....	74.0	103.5	113.5	116.0	116.5
Plasterers.....	36.0	51.5	57.5	59.0	58.5
Plumbers.....	47.0	63.5	71.0	72.0	72.5
Sheet-metal workers.....	13.0	17.5	19.5	20.0	20.0
Steamfitters.....	8.5	12.5	14.0	14.5	14.5
Structural, reinforcing, and ornamental-iron workers.....	26.0	36.0	40.0	41.0	41.0
All other skilled workers.....	59.5	78.5	86.5	86.0	87.0
Semi-skilled workers.....	206.0	273.0	303.0	312.5	313.0
Bricklayers', plasterers' helpers.....	30.0	43.5	49.0	50.5	50.5
Electricians' helpers.....	9.0	13.5	15.0	15.0	15.0
Plumbers' helpers.....	18.5	26.5	30.0	30.5	30.5
Sheet-metal workers' helpers.....	3.0	4.5	5.0	5.0	5.0
Truck drivers.....	94.5	118.0	130.0	135.5	136.5
All other semiskilled workers.....	51.0	67.0	74.0	76.0	75.5
Unskilled workers.....	672.0	914.0	1,007.0	1,029.5	1,033.0
Laborers.....	650.0	883.5	973.5	995.5	998.5
Watchmen, miscellaneous.....	22.0	30.5	33.5	34.0	34.5

The increase in productivity will probably be slightly greater in private construction, because of the very large element of residential building for which an increase of 15 percent is expected. Little increase in productivity is expected for the small operators building a house or two at a time or for the builders of luxury-grade houses. For apartment construction the changes will also be well below those for residential construction as a whole, largely because the procedures applicable to frame houses are inappropriate. An increase of only 5 percent has been estimated for private nonresidential building. A

large part of the private nonresidential building will consist of alteration and modernization work, most of it unsuited by its nature to mass-production techniques. The new projects of a size sufficient to afford opportunity for time savings through careful planning will usually be performed by the contractors who have in the past been the leaders in the planning and coordination of their operations. Although some increase in productivity in farm construction is expected, it is likely to be quite small and has therefore been omitted in the estimate. For utility construction an increase of only 5 percent has been assumed, because this also is a field in which work has been carefully planned in the past and in which individual changes affecting output are likely to be minor.

Increased productivity in public construction is expected to be slightly less than that in private construction. Productivity in public residential building is expected to increase by 10 percent, in contrast to 15 percent in private residential building, because the public work is likely to consist predominantly of apartment-type buildings with masonry walls. At the same time, individual variations between and within structures and the extent of ornamental treatment will be much less in publicly than in privately financed apartments. For nonresidential buildings an increase of 5 percent has been estimated, the same as for privately financed buildings of the same group. The greatest increase, 15 percent, has been estimated for highway, road and street work, primarily because of recent developments in some of the basic machines. The same amount of increase has been assumed for airport work, the greater part of which is quite similar to highway work. No change has been estimated for sewer and water projects, already highly mechanized and standardized in the principal operations, although it is recognized that some small change is rather likely. For the "all other public" classification, consisting largely of heavy engineering work, an increase of 5 percent in productivity has been estimated. This work is usually done by contractors who give the most careful attention to their methods, and will be affected mainly by development of new equipment.