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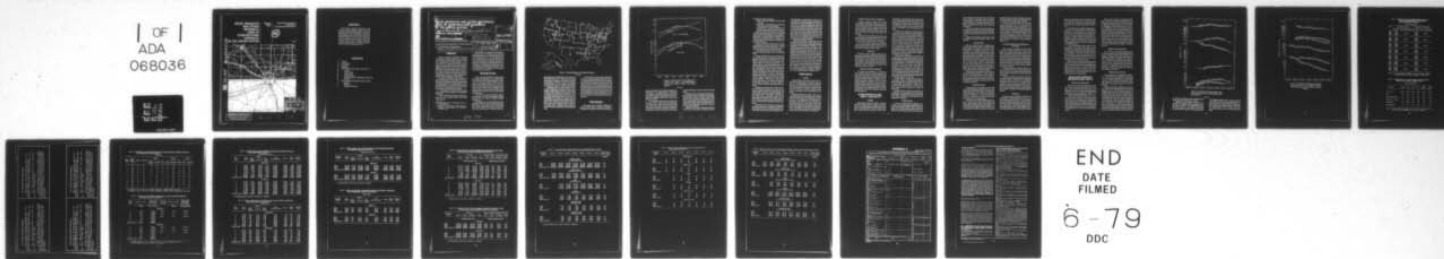
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WOOD PRODUCTS AND OTHER MATERIALS USED IN CONSTRUCTING HIGHWAYS--ETC(U)
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WOOD PRODUCTS AND OTHER MATERIALS USED IN CONSTRUCTING HIGHWAYS IN THE UNITED STATES

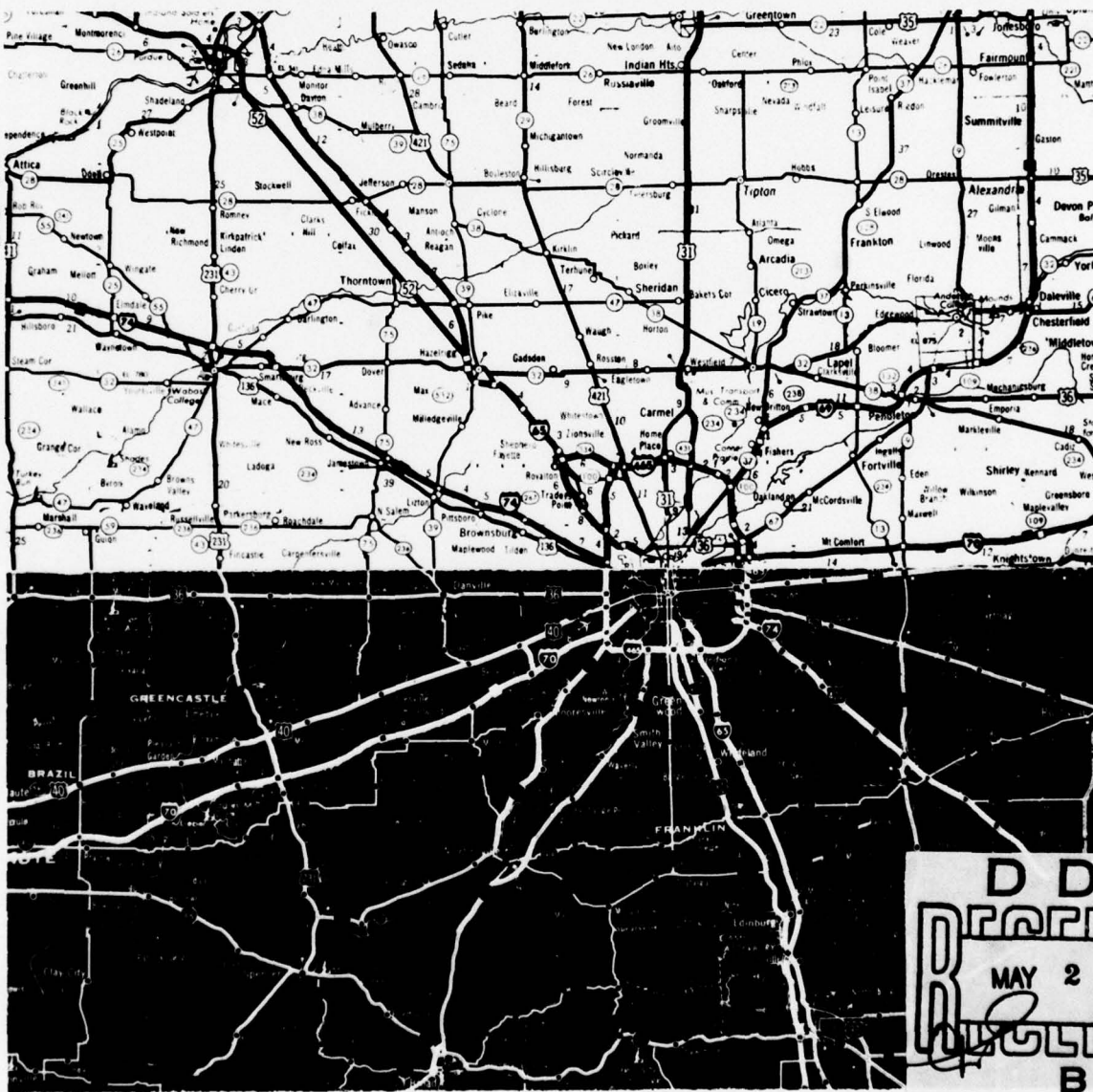
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ABSTRACT

This report presents estimates of the amounts of lumber, plywood, piling, and posts (rights-of-way and guardrail) used in constructing highways in the United States. Amounts of these materials used are shown by regions for the years 1969-1971 and 1973-1975. Combined lumber and plywood use is shown by 3-year periods from 1955 to 1975. In addition, estimates of timber piling, cement, bitumens, structural steel, and reinforcing steel are shown.

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WOOD PRODUCTS AND OTHER MATERIALS USED IN CONSTRUCTING HIGHWAYS IN THE UNITED STATES.

By William H. Reid, ~~Director~~

David B. McKeever, ~~Director~~

Forest Products Laboratory, Forest Service
U.S. Department of Agriculture

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PREFACE

Data for this report are based on highway construction material usage factors reported by the Federal Highway Administration of the U.S. Department of Transportation, a telephone survey of Regional and State highway personnel concerning wood products usage in highway construction, and values of highway construction as reported by the Bureau of Census. Data concerning linear feet of rights-of-way fencing and guardrail were obtained from unpublished records of the Highway Statistics Division, Federal Highway Administration.

This report, intended for use by market research organizations, both public and private, and others interested in evaluating the demand for these products, has been prepared under the authorization of the Resources Planning Act of 1974, as amended, which directs in part, the Secretary of Agriculture to prepare:

1. An analysis of present and anticipated uses; demand for and supply of the renewable resources.
2. And, to utilize information and data available from other Federal, State, and private organizations.

¹Maintained at Madison, Wis., in cooperation with the University of Wisconsin.

²U.S. Department of Transportation, Federal Highway Administration. Highway Statistics 1974. Washington, D.C. 260 p. 1976.

Appreciation is expressed to employees of the Department of Transportation, Federal Highway Administration, Highway Statistics Division, Washington, D.C. for providing access to unpublished data concerning rights-of-way fencing and guardrails. Appreciation is also expressed to employees of Federal Highway Administration (FHA) Regional Offices and material engineers at State Highway Offices, for providing information concerning wood products use in highway construction.

INTRODUCTION

There are approximately 3.8 million miles of streets and highways² in the United States. Since 1960 the total mileage has been increasing at an average of about 20,000 miles annually. Rural mileage makes up over three-fourths of the total quantity of streets and highways and municipal or urban mileage the balance. However, during the past 15 years, urban mileage has accounted for over three-fourths of the increase.

The nine FHA numerical highway regions are grouped into three geographical regions (North, South, and West), to expedite analysis of data (fig. 1).

Expenditures in current dollars for new highway construction put in place amounted to \$8.6 billion during 1967 and approximately \$12.6 billion during 1975 (table 1, fig. 2). Construction expenditures (in constant 1967 dol-

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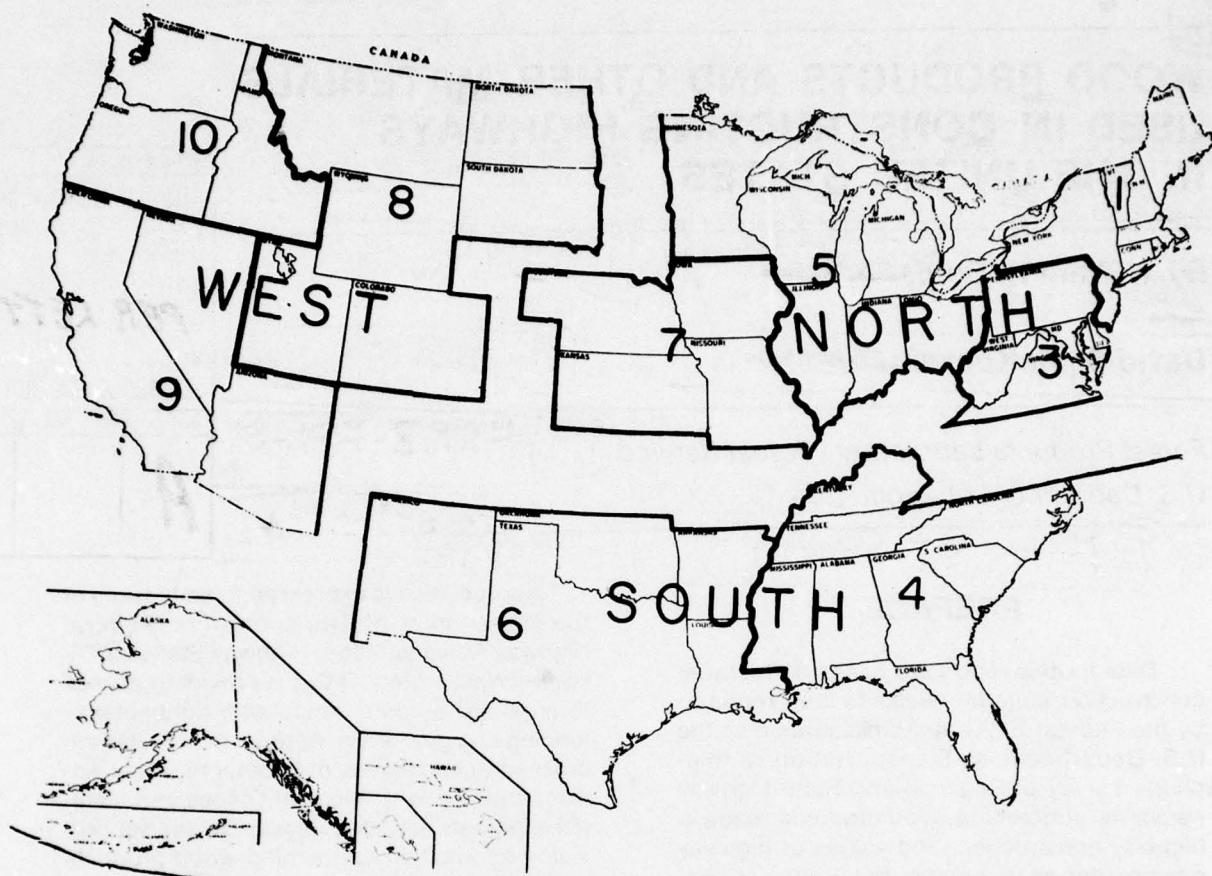


Figure 1.—Federal Highway Administration Regions

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lars) amounted to \$8.8 billion during 1967 and \$6.2 billion during 1975. Although the average annual rate of change in construction expenditures between 1967 and 1975 was an increase of 4.9 percent in current dollars, it decreased 4.3 percent annually in constant (1967) dollars.

Estimated cost (in current dollars) of construction materials and supplies used in public highway construction amounted to \$3.6 billion in 1967 and \$4.9 billion in 1975 (table 2). This is an average annual increase of 3.5 percent. The combined costs of steel, cement and concrete, aggregates, and petroleum products account for over three-fourths of the materials and supplies used in highway construction (table 2). Wood products, including lumber, plywood, and piling, used in highway construction account for about 2 percent of the total materials cost.

The first section of this report presents national and regional estimates of wood products, i.e., lumber, plywood, piling, fence, and guard-rail posts used in highway construction during 1969-71 and 1974-75. The second section provides estimates of wood and selected nonwood materials used during the seven 3-year periods starting 1955-57 and ending 1973-75. The wood materials are lumber/plywood and piling, and the selected nonwood materials are cement, bitumens, structural steel, and reinforcing steel.

PROCEDURE

This study was to develop estimates of wood products used in highway construction. Estimates are adapted from factors of materials

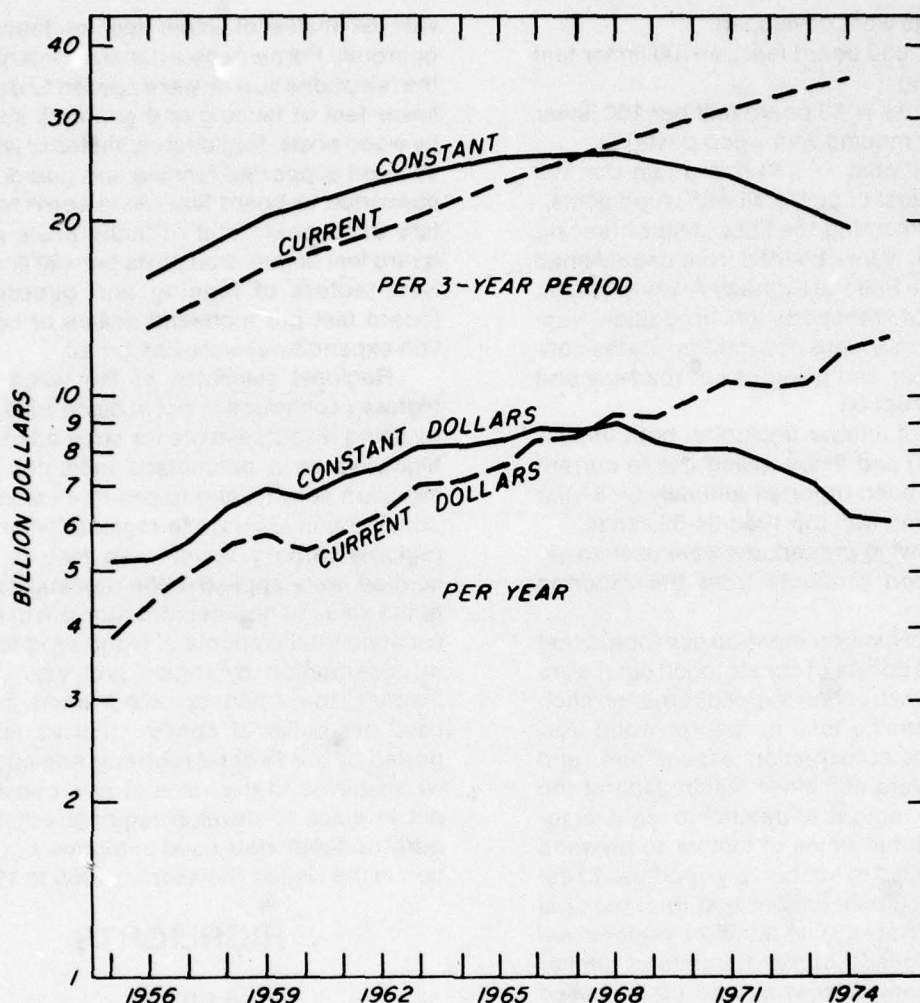


Figure 2.—Expenditures for new highway construction put in place in the United States in current and constant (1967 = 100) dollars 1955-75.

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used, as reported by the Federal Highway Administration, U.S. Department of Transportation, based on reports by highway contractors. Contractors prepare these reports upon completion of a highway construction contract (appendix A, PR-47).

The materials reported include wood products and units in which they are measured: (1) lumber, board feet; (2) timber piling, linear feet; (3) fencing, linear feet; and (4) guardrail, linear feet. The material reported as lumber includes both lumber and plywood; fencing and

guardrail includes concrete, metal, and wood posts.

A telephone survey of highway material engineers was made to determine where lumber and plywood is used in highway construction and the ratio of lumber to plywood use. In addition, an estimate of the percentage of fencing supported by wood posts was determined, including the percentage of guardrail supported by wood posts (table 3).

Based on information obtained during the survey as to size, length, and spacing, the fol-

lowing factors were developed:

Piling = 630 board feet per 100 linear feet of piling

Fence post = 63 board feet per 100 linear feet of fencing with wood posts

Guardrail post = 430 board feet per 100 linear feet of guardrail with wood posts.

Data concerning the linear feet of fencing and guardrail were obtained from unpublished records of the Federal Highway Administration, Department of Transportation. In addition, from this source, data were obtained by States concerning lumber and piling use in roadway and bridge construction.

Factors of lumber (including both lumber and plywood) and timber piling use in current dollars have been reported annually by 3-year periods starting with the 1953-54-55 series.

The following procedures were used to extrapolate wood products from the reported data:

Factors of lumber/plywood use (board feet per thousand dollars of construction cost) were applied to construction expenditures for each State to determine total lumber/plywood use. These values, construction expenditure, and lumber use were combined within each of the nine highway regions to determine regional totals. The regional ratios of lumber to plywood use were applied to lumber/plywood use to estimate total regional lumber and total regional plywood use (table 3). In addition, regional estimates were made of the amounts of lumber used as timbers, falsework, and other, based on percentages. In like manner, regional estimates were made of the amounts of plywood used as signs, falsework, and other. New factors of lumber and plywood use were then computed.

Similarly, piling use factors (linear feet per thousand dollars of construction cost) were applied to state construction expenditures and consolidated regionally. Regional estimates of total linear feet of piling were converted to board feet using a conversion factor of 630 board feet per 100 linear feet of piling. New factors of piling use (board feet per thousand dollars of construction expenditures) were computed.

Total linear feet of fencing and guardrail erected by contractors in highway construction were obtained from the Federal Highway Administration. State data were combined to pro-

vide estimates of linear feet of fencing and guardrail. Percentage estimates determined in the telephone survey were applied to determine linear feet of fencing and guardrail supported by wood posts. Regional estimates of linear feet of wood supported fencing and guardrail were converted to board feet using conversion factors of 63 board feet of fence posts and 430 board feet of guardrail posts per 100 linear feet. New factors of fencing and guardrail use (board feet per thousand dollars of construction expenditure) were computed.

Regional estimates of the value of new highway construction put in place were derived by using disbursements for state-administered highways as a percentage indicator of construction activity, and to pro-rate value of new construction among the regions (table 4). The regional wood products use factors, as described, were applied to the regional estimates of the value of new construction put in place to estimate total amounts of wood products used in construction by region and years. In like manner, the amounts of nonwood materials used per dollar of construction value, as reported by the Federal Highway Administration, were applied to the value of new construction put in place to develop regional estimates of nonwood materials used in highway construction in the United States from 1955 to 1975.

HIGHLIGHTS

Lumber

Approximately 200 million board feet of lumber is used annually for highway construction in the United States. Most of the lumber, 80 percent, is used for falsework in the forming of concrete, 8 percent is used for bridge timbers, and the remaining 12 percent is used for sign posts, barricades, and miscellaneous purposes.

Regional differences exist in the use of lumber per dollar of construction cost. Lumber use in the West region is the highest. About 50 percent of the expenditure for highway construction is in the North but only 40 percent of the lumber used is in this region. About one third of the expenditure and lumber use is in the South. Only about 18 percent of the expenditure is in the West but about 25 percent of the lumber used in construction is in this region.

Timbers, Piling, Posts, Falsework

Timbers, falsework, piling, fence posts, and guardrail posts used in highway construction amount to about 325 million board feet annually. Between the two study periods the amounts used in timbers, falsework, and other uses increased while the amounts used in piling, fence posts, and guardrail posts decreased.

The annual use of timber piling, fence, and guardrail posts decreased from about 160 million board feet during the 1969-71 period to 117 million board feet during the 1973-75 period.

The use of these products per thousand dollars of construction value amounted to 34.7 board feet during the 1969-71 period and 27.6 board feet during the 1973-75 period.

Plywood

Plywood used in highway construction amounts to about 500 million square feet ($\frac{1}{8}$ -in. basis). About 85 percent of the plywood used is for falsework. The remaining 15 percent is about equally divided between signs and other construction. Over twice as much plywood is used per \$1,000 of construction value in the West as is used in the North.

Wood and Other Materials

The amounts of materials, i.e., lumber/plywood, cement, bitumens, reinforcing steel, and structural steel used in highway construction have shown general upward trends since 1958. The use of timber piling, in contrast, has decreased. Between 1958 and 1975, the South had the greatest increases in the amounts of materials used in highway construction. For example, in the South, the use of reinforcing steel increased at an average annual rate of 4.2 percent annually, over twice the rates of the North and West regions.

WOOD PRODUCTS USE, 1969-71, and 1973-75

Lumber

During the 3-year period, 1969-71, the total amount of lumber used in highway construction in the United States was 558 million board feet, or an average of about 186 million board feet annually. During the period 1973-75, the

total amount used was 620 million board feet, or 207 million board feet annually (table 5). Approximately 81 percent of the lumber was used as falsework for the forming of concrete, 8 percent as bridge timbers, and 12 percent as sign posts, barricades, and miscellaneous purposes.

Lumber use in highway construction averaged 18.67 board feet per thousand dollars of construction value during the period 1969-71, and 17.62 board feet during the period 1973-75 (table 6). Substantial differences in regional use per dollar of construction value occurred within and between survey periods. Within the 1969-71 period, lumber use in highway construction among the regions varied from a low of 12 board feet in Region 8 to a high of 36 board feet in Region 10. During the more recent period 1973-75, lumber use among the regions varied from a low of 11 board feet in Region 5 to 32 board feet in Region 9.

During the 1973-75 period, 51 percent of the total value for highway construction in the United States was in the North region, although only 41 percent of the total lumber used was in this region (table 7). The South accounted for 32 percent of the construction value and 33 percent of the lumber used. The West accounted for only 18 percent of the value, but almost 25 percent of the total lumber used. Similar relationships existed during the 1969-71 period; for example, 20 percent of the total value for highway construction and 30 percent of the total lumber use was in the West.

During 1969-71, lumber use per dollar of construction value in the North and South regions averaged about 16 board feet per \$1,000 of construction value (table 8). Lumber use in the West exceeded that used in the North and South regions and amounted to almost 28 board feet.

During 1973-75, lumber use per \$1,000 of construction value amounted to 14 board feet in the North, 19 board feet in the South, and 25 board feet in the West. Over 80 percent of the usage was in falsework.

Timber Piling

The use of timber piling in highway construction in the United States declined from 134 million board feet during the 1969-71 period to less than 97 million board feet during 1973-75 (table 7). Approximately 50 percent of the piling

used in highway construction was in the North during 1969-71, 30 percent was in the South, and 20 percent in the West. During 1973-75, about 64 percent of the piling was used in the North, 21 percent in the South, and 15 percent in the West.

The use of piling per \$1,000 of construction value for all regions in the United States decreased from about five board feet during 1969-71 to about three board feet during 1973-75 (table 8).

Piling use per \$1,000 of construction value decreased in all regions between 1969-71 and 1973-75.

Fence Posts

The use of fence posts in highway construction also declined from 43 million board feet in 1969-71 to 33 million board feet in 1973-75 (table 5). An average of about 14 million board feet, or about 2 million fence posts, were used annually in fencing right-of-ways in highway construction during 1969-71. About half of the fence posts were used in Regions 4 and 5. During the 1973-75 period, the average annual use of fence posts in highway construction was 11 million board feet or approximately 1.4 million posts with 45 percent of the use in Region 4. During both periods the quantity of fence posts used in the South exceeded that used in either the North and West regions.

Fence post use in highway construction in the United States averaged 1.5 board feet per \$1,000 of construction value during 1969-71 and 1.0 board feet during 1973-75 (table 6). During both 3-year periods, Regions 4 and 8 exceeded all other regions in post use per \$1,000 of construction value.

Guardrail Posts

Guardrail post use in highway construction in the United States decreased from over 300 million board feet during 1969-71 to 220 million board feet during 1973-75 (table 5). Guardrail post use in Regions 4, 5, and 9 amounted to over half of the total use in the United States during each of the 3-year periods.

Although the use of guardrail post per dollar of construction value varied among the three regions (North, South, and West), the amounts of guardrail posts used were fairly uniform among the regions. During 1969-71, approximately 100 million board feet of guardrail

posts were used in each of the regions and during 1973-75 approximately 70 million board feet were used in each of the regions (table 7).

The use of guardrail posts in the United States decreased from 10.1 board feet per \$1,000 of construction value during 1969-71, to 6.3 board feet during 1973-75 (table 8). During 1969-71, the use of guardrail posts ranged from a low in Region 1 of 3.0 board feet per \$1,000 of construction value to a high in Region 10 of 19.0 board feet (table 6). By 1973-75, the use of guardrail posts ranged from a low of 1.8 board feet in Region 1 to a high of 14.9 board feet in Region 10.

Combined Board Foot Measured Products

Use in highway construction of the wood products—timbers, falsework, piling, fence posts, and guardrail posts—amounted to 1,038 million board feet during 1969-71 and 970 million board feet during 1973-75. Material used in falsework and guardrail posts amounted to about three-fourths of the total use during both periods. Slightly over 40 percent of these materials were used in the North and the remaining portion was fairly evenly divided between the South and West.

The total amounts of lumber used in timbers, falsework, and other uses increased between the two study periods while the amounts used in piling, fence posts, and guardrail posts decreased.

The use of these products per \$1,000 of construction value amounted to 34.7 board feet during the 1969-71 period and 27.6 board feet during the 1973-75 period. The use of timbers, falsework, and other uses per \$1,000 of construction value decreased about 6 percent between the two periods, while the use of piling, fence posts, and guardrail posts decreased 38 percent.

Plywood

Plywood used in highway construction amounted to 1,329 billion square feet ($\frac{3}{4}$ -in. basis) during the period 1969-71, or an average of about 443 million square feet annually. During the period 1973-75 plywood used in construction amounted to 1,497 million square feet or 500 million square feet annually (table 9). Approximately 85 percent of the plywood used in

highway construction was for falsework used for forming concrete and other temporary structures. The remaining 15 percent of plywood was used in signs and other construction.

Plywood used per \$1,000 of highway construction in the United States during 1969-71 averaged 44.5 square feet ($\frac{3}{4}$ -in. basis) and during 1973-75 averaged 42.5 square feet (table 10). The use of plywood per \$1,000 of expenditure averaged about 36 square feet in falsework, about 3 square feet in signs, and about 3.5 square feet in other uses. Among the FHA Regions the use of plywood varied widely during both periods.

In the United States during 1973-75, approximately 51 percent of the value of new highway construction was in the North region—accounting for 39 percent of the plywood used in construction. The South, with 32 percent of the construction value, accounted for 33 percent of the plywood used, and the West, with 17 percent of the construction value, accounted for 28 percent of the plywood used.

Over twice as much plywood was used per \$1,000 of construction value in the West as was used in the North (table 10). If plywood used in highway construction in the United States had been at the rate used in the West, 2,377 million square feet ($\frac{3}{4}$ -in. basis) would have been used during the 1973-75 period instead of the estimated 1,497 million square feet.

WOOD AND NONWOOD MATERIALS USE, 1955-75

National Consumption

Since the late 1950's the quantities of lumber/plywood, cement, bitumens, structural steel, and reinforcing steel consumed in new highway construction in the United States have increased, while the quantity of timber piling consumed has decreased (table 11, fig. 3).

Lumber/plywood use moved from 1.14 billion board feet in 1955-57 to 1.38 billion board feet in 1973-75. This represents an average annual rate of growth of 0.9 percent. However, the use of timber piling has steadily dropped, from 272.3 million board feet in 1955-57 to only 96.5 million board feet in 1973-75, or an average annual decrease of 4.9 percent over the 20-year period.

Most of the increase in consumption has been in the use of nonwood materials. The use of reinforcing steel rose from 3.55 million tons in 1958-60 to a high of 6.22 million tons in 1970-72, dropping to 5.24 million tons in 1973-75. From 1958-60 to 1973-75, the use of reinforcing steel grew faster than any other material, an average 2.3 percent increase per year. The use of structural steel grew second fastest at 1.9 percent per year with some 4.87 million tons being consumed in 1973-75. The use of bitumens increased nearly as fast at an average annual rate of 1.8 percent to 25.7 million tons in 1973-75. The quantity of cement consumed changed very little, increasing an average 0.1 percent per year.

Regional Consumption

Consumption of all types of materials used in highway construction has traditionally been largest in the North with over 50 percent of all materials, except for bitumens, during the period 1958-60 being consumed there (table 12, fig. 4). In 1973-75, consumption of all materials, except bitumens, was still largest in the North, although no longer being over half of total consumption. Consumption in the South was second largest, and consumption of all materials was smallest in the West.

Material Use Factors

Expenditures for new highway construction in the United States, based on current dollars, have steadily increased since 1955 (table 1, fig. 2). In 1955, \$3.8 billion was spent on highway construction while in 1975, \$12.6 billion was spent, an average increase of 6.2 percent per year.

Material use factors, based on current dollars, have shown a downward trend since 1955 (table 13, fig. 4). Timber piling use per dollar dropped faster than for all other materials. In 1955-57, 20.1 board feet per thousand dollars of expenditure were used. By 1973-75 only 2.7 board feet were used, an average decrease of 9.5 percent per year. The use of cement fell over a half, from 15.2 barrels per thousand dollars in 1958-60 to 7.4 in 1973-75, a 4.2 percent per year reduction. Lumber/plywood use declined 3.9 percent per year, from 87 to 39 board feet per thousand dollars. Bitumens, structural steel, and reinforcing steel use declined 2.6,

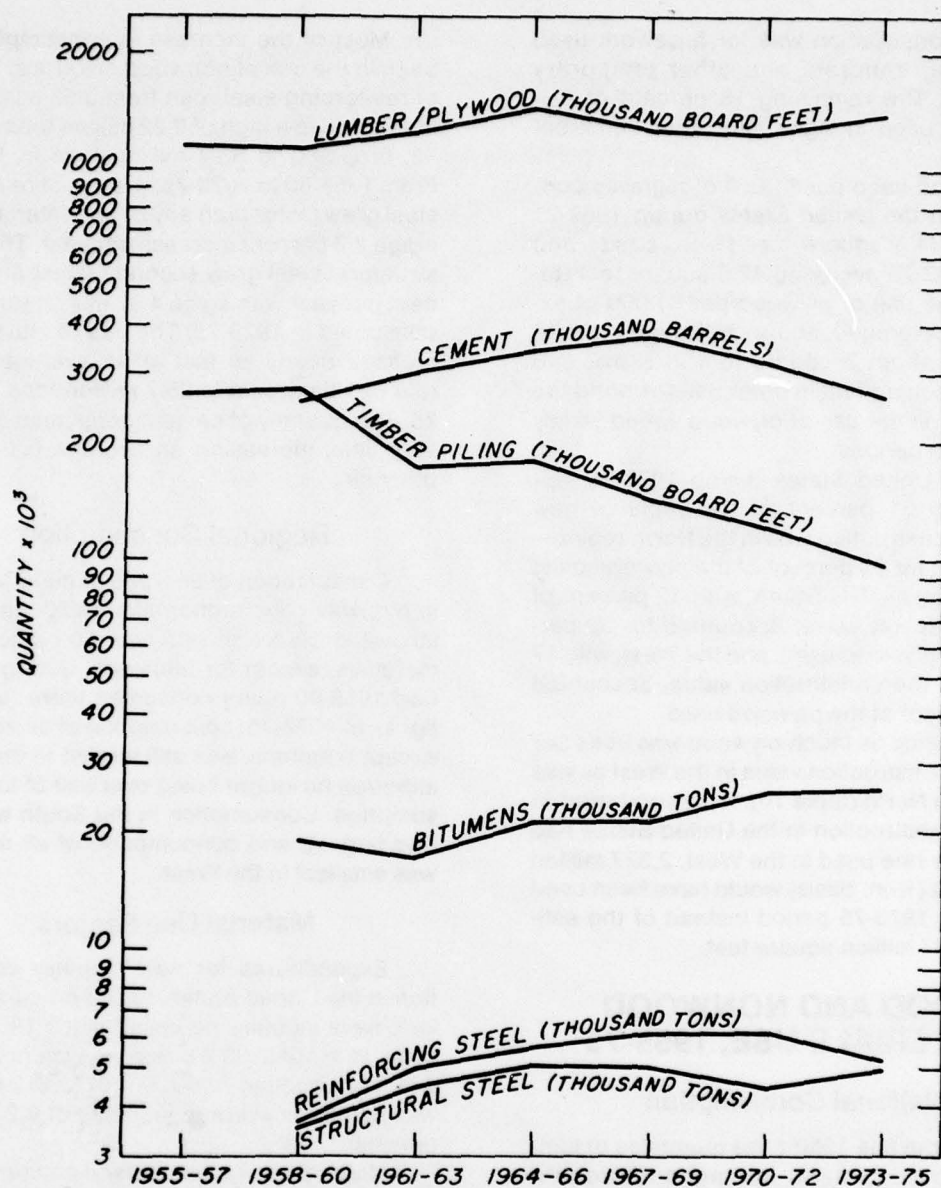


Figure 3.—Quantities of materials used in highway construction during 3-year periods, 1955-57 to 1973-75.

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2.4, and 2.1 percent per year respectively between the years 1958-60 and 1973-75.

Material use per dollar of highway construction has declined for all materials in all regions since 1955-57. The largest decline was for timber piling use per dollar in the South, where use fell at a rate of 11.8 percent per year.

The smallest decline was in reinforcing steel use in the South where use declined at only 1.2 percent per year. Lumber/plywood use per dollar has been traditionally highest in the West, 60.7 board feet in 1973-75—nearly twice the use in the North and 1.5 times the use in the South.

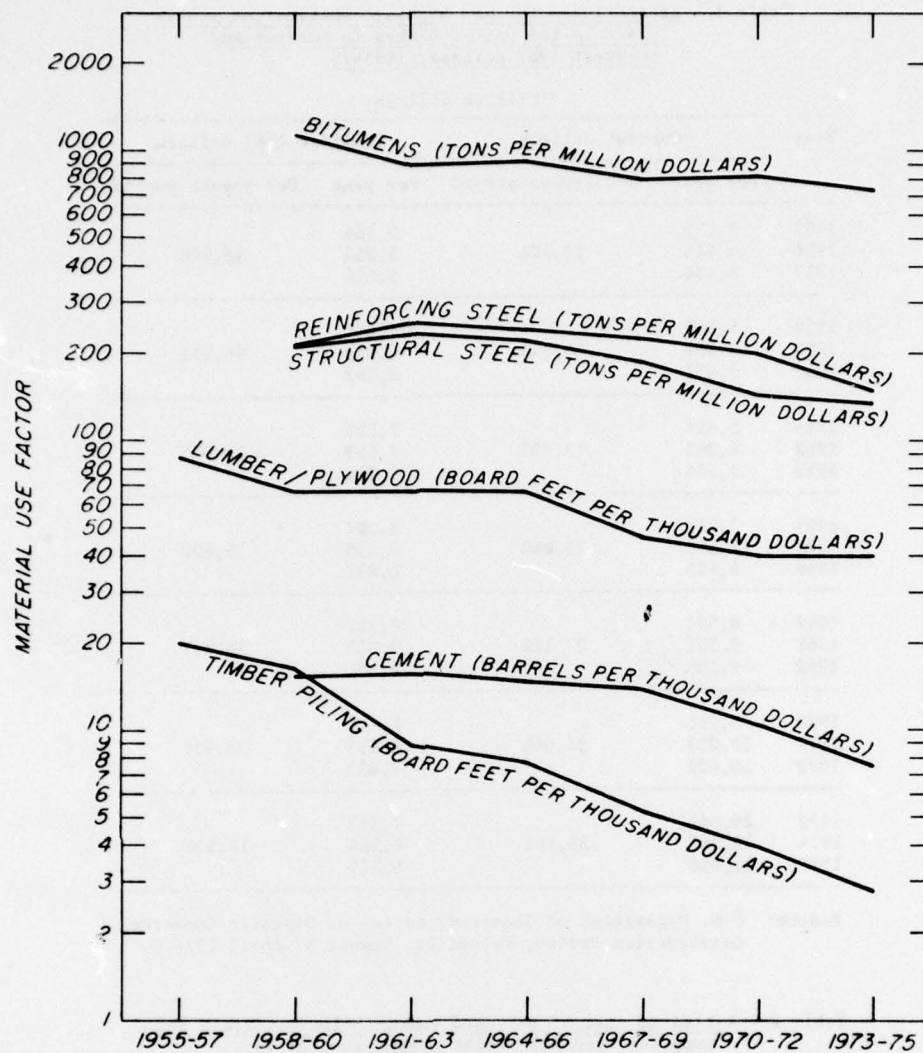


Figure 4.—Quantities of materials used per dollar of construction value in highway construction during 3-year periods, 1955-57 to 1973-75.

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Table 1.--Expenditures for new highway construction put in place in the United States in current and constant 1967 dollars, 1955-75

[Million dollars]				
Year	Current dollars		Constant 1967 dollars	
	Per year	Per 3-year period	Per year	Per 3-year period
1955	3,852		5,184	
1956	4,415	13,201	5,256	16,066
1957	4,934		5,626	
1958	5,545		6,476	
1959	5,761	16,743	6,953	20,211
1960	5,437		6,782	
1961	5,854		7,264	
1962	6,365	19,303	7,593	23,075
1963	7,084		8,218	
1964	7,133		8,207	
1965	7,550	23,088	8,390	25,428
1966	8,405		8,831	
1967	8,591		8,767	
1968	9,321	27,162	9,043	26,191
1969	9,250		8,381	
1970	9,981		8,170	
1971	10,658	31,068	8,133	23,936
1972	10,429		7,633	
1973	10,505		7,153	
1974	12,069	35,194	6,284	19,598
1975	12,620		6,161	

Source: U.S. Department of Commerce, Bureau of Domestic Commerce. Construction Review, Volume 22, Number 3, April 1976.

Table 2.--Estimated cost of selected construction materials and supplies used for public highways, 1967-75

[Million dollars]						
Material	1967	1970	1972	1973	1974 (prel.)	1975 (prel.)
Total cost	3,593	4,156	4,425	4,326	4,894	4,905
Steel	783	859	969	943	1,224	1,109
Petroleum products	731	850	891	914	1,073	1,109
Cement and concrete	731	803	764	690	687	729
Aggregates	738	813	822	788	751	854
Wood products	53	74	69	88	97	87

Source: U.S. Department of Commerce, Bureau of the Census, Statistical Abstract of the United States: 1976 (97th edition).

U.S. Forest Products Laboratory.

Wood products and other materials used in constructing highways in the United States, by William H. Reid and David B. McKeever, Madison, Wis.

19 p. (Resource Bulletin FPL 5, For. Prod. Lab., For. Serv., U.S. Dept. Agr.)

Presents estimates of amounts of lumber, plywood, piling, and posts (rights-of-way and guardrail) used in building highways in the United States for 1969-71 and 1973-1975. Estimates of non-wood materials are also shown.

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Table 3.--Percentages of lumber and plywood use and product type use in highway construction by FHA regions in the United States

[Percent]

FHA region	Lumber and plywood	Lumber	Plywood ^{1/}	Lumber			Plywood			Posts ^{2/}	
				Bridge timbers	Falsework	Other	Signs	Falsework	Other	Fence	Guardrail
1	100	42	58	6	82	12	13	80	7	2	14
3	100	47	53	8	78	14	10	81	9	18	17
4	100	53	47	10	72	18	4	83	13	50	60
5	100	54	46	11	74	15	3	85	12	28	64
6	100	34	66	1	90	9	10	84	6	32	55
7	100	46	54	7	87	6	1	86	13	15	74
8	100	47	53	4	90	6	7	87	6	30	76
9	100	41	59	1	89	10	1	94	5	32	97
10	100	47	53	8	87	5	13	85	2	2	85

^{1/} Plywood (3/4 by 12 by 12 in.) assumed equivalent to lumber (1 by 12 by 12 in.).

^{2/} Percent of total linear feet of fence or guardrail installed that is supported by wood posts.

Table 4.--Value of new U.S. highway construction put in place classified by FHA and geographic regions for two periods

FHA region	Portion of total	Value of new construction put in place	Geographic region ^{1/}	Portion of total	Value of new construction put in place
	Percent	Million dollars		Percent	Million dollars
<u>1969-70-71</u>					
1	16.0	4,792.0	North	54.0	16,116.6
3	15.2	4,536.1			
4	15.2	4,540.5	South	25.9	7,745.3
5	17.1	5,097.5			
6	10.7	3,204.8	West	20.1	6,027.2
7	5.7	1,691.0			
8	4.6	1,385.8			
9	11.2	3,336.5			
10	4.4	1,304.9			
United States ^{2/}	100.0	29,889.0			
<u>1973-74-75</u>					
1	13.3	4,692.0	North	50.9	17,931.6
3	15.6	5,483.5			
4	19.7	6,937.8	South	31.6	11,132.8
5	16.0	5,636.6			
6	11.9	4,195.0	West	17.5	6,129.4
7	6.0	2,119.5			
8	4.2	1,465.2			
9	8.7	3,062.0			
10	4.6	1,602.2			
United States ^{2/}	100.0	35,194.0			

^{1/} North = Regions 1, 3, 5, 7; South = Regions 4, 6; West = Regions 8, 9, 10.

^{2/} United States totals may not add due to rounding.

Table 5.--Lumber, piling, fence, and guardrail posts used in highway construction
by FHA regions for two periods

[Thousand board feet]

FHA region	Total lumber	Lumber			Total piling and posts	Piling	Fence posts	Guardrail posts
		Bridge timbers	Falsework	Other lumber				
<u>1969-70-71</u>								
1	66,421	3,985	54,465	7,971	32,951	18,099	234	14,618
3	66,212	5,297	51,645	9,270	29,224	3,442	3,588	22,194
4	90,848	9,085	65,411	16,353	107,873	26,289	13,361	68,223
5	95,739	10,531	70,847	14,361	78,399	24,762	7,663	45,974
6	39,975	400	35,977	3,598	56,034	14,868	5,216	35,950
7	30,269	2,119	26,334	1,816	44,028	19,739	1,347	22,942
8	16,579	663	14,921	995	32,651	4,980	5,643	22,028
9	105,355	1,054	93,766	10,536	56,395	5,101	6,034	45,260
10	46,668	3,733	40,601	2,333	42,102	16,868	156	25,078
United States ^{1/}	558,066	36,867	453,968	67,231	479,657	134,148	43,242	302,267
<u>1973-74-75</u>								
1	80,564	4,834	66,062	9,668	19,929	11,414	158	8,357
3	71,615	5,729	55,859	10,026	34,621	20,702	2,605	11,314
4	145,578	14,558	104,816	26,204	89,424	9,459	14,852	65,113
5	64,108	7,052	47,440	9,616	56,956	14,531	4,213	38,212
6	61,213	612	55,091	5,509	28,028	11,094	4,103	12,831
7	40,138	2,810	34,920	2,408	30,856	14,624	859	15,373
8	34,218	1,369	30,796	2,053	23,455	3,303	2,900	17,252
9	96,783	968	86,137	9,678	33,160	1,951	3,471	27,738
10	25,855	2,068	22,494	1,293	33,591	9,431	151	24,009
United States ^{1/}	620,070	39,999	503,615	76,455	350,020	96,509	33,312	220,198

^{1/} United States totals may not add due to rounding.

Table 6.--Lumber, piling, fence, and guardrail posts use per \$1,000 of construction
value by FHA regions for two periods

[Board feet]

FHA region	Total lumber	Lumber			Total piling and posts	Piling	Fence posts	Guardrail posts
		Bridge timbers	Falsework	Other lumber				
<u>1969-70-71</u>								
1	13.86	0.83	11.37	1.66	6.83	3.78	0.01	3.05
3	14.60	1.17	11.39	2.04	5.77	.76	.12	4.89
4	20.01	2.00	14.41	3.60	21.24	5.79	.43	15.03
5	18.78	2.07	13.90	2.82	14.10	4.86	.22	9.02
6	12.47	.12	11.23	1.12	16.09	4.64	.24	11.22
7	17.90	1.25	15.57	1.07	25.36	11.67	.12	13.57
8	11.96	.48	10.77	.72	20.08	3.59	.59	15.90
9	31.58	.32	28.10	3.16	15.36	1.53	.26	13.57
10	35.76	2.86	31.11	1.79	32.16	12.93	.02	19.22
United States	18.67	1.23	15.19	2.25	14.81	4.49	0.21	10.11
<u>1973-74-75</u>								
1	17.17	1.03	14.08	2.06	4.22	2.43	0.01	1.78
3	13.06	1.04	10.19	1.83	5.91	3.78	.07	2.06
4	20.98	2.10	15.11	3.78	11.06	1.36	.31	9.39
5	11.37	1.25	8.42	1.71	9.47	2.58	.11	6.78
6	14.59	.15	13.13	1.31	5.85	2.64	.14	3.06
7	18.94	1.33	16.48	1.14	14.21	6.90	.06	7.25
8	23.35	.93	21.02	1.40	14.36	2.25	.29	11.77
9	31.61	.32	28.13	3.16	9.86	.64	.17	9.06
10	16.14	1.29	14.04	.81	20.89	5.89	.01	14.99
United States	17.62	1.14	14.31	2.17	9.14	2.74	0.14	6.26

Table 7.--Lumber, piling, fence, and guardrail posts used in highway construction
by geographic regions for two periods

[Thousand board feet]

Geographic region	Total lumber	Lumber			Total piling and posts	Piling	Fence posts	Guardrail posts
		Bridge timbers	Falsework	Other lumber				
<u>1969-70-71</u>								
North	258,642	21,932	203,292	33,417	184,602	6,042	12,832	105,728
South	130,823	9,485	101,388	19,950	163,907	41,457	18,577	104,173
West	168,602	5,450	149,288	13,864	131,149	26,950	11,833	92,366
United States ^{1/}	558,066	36,867	453,968	67,231	479,658	134,149	43,242	302,267
 <u>1973-74-75</u>								
North	256,424	20,425	204,282	31,718	142,362	61,271	7,835	73,256
South	206,791	15,170	159,908	31,713	117,452	20,553	18,955	77,944
West	156,855	4,405	139,426	13,024	90,206	14,685	6,522	68,999
United States ^{1/}	620,070	39,999	503,615	76,455	350,020	96,509	33,312	220,199

^{1/} United States totals may not add due to rounding.

Table 8.--Lumber, piling, fence, and guardrail posts use per \$1,000 of construction
value by geographic regions for two periods

[Board feet]

Geographic region	Total lumber	Lumber			Total piling and posts	Piling	Fence posts	Guardrail posts
		Bridge timbers	Falsework	Other lumber				
<u>1969-70-71</u>								
North	16.05	1.36	12.61	2.07	11.45	4.10	0.80	6.56
South	16.89	1.22	13.09	2.58	21.16	5.31	2.40	13.45
West	27.97	.90	24.77	2.30	21.76	4.47	1.96	15.32
United States	18.67	1.23	15.19	2.25	16.05	4.49	1.45	10.11
<u>1973-74-75</u>								
North	14.30	1.14	11.39	1.77	7.94	3.42	0.44	4.09
South	18.57	1.36	14.36	2.85	10.55	1.85	1.70	7.00
West	25.59	.72	22.75	2.13	14.72	2.40	1.06	11.26
United States	17.62	1.14	14.31	2.17	9.95	2.74	0.95	6.26

Table 9.--Plywood use (3/8 in. basis) in highway construction and use per \$1,000 of construction value by FMA regions for two periods

FMA region	Total use				Use per \$1,000 of construction value			
	Total	Signs	Falsework	Other	Total	Signs	Falsework	Other
----- -Thousand square feet----- -Square feet per \$1,000-----								
1969-70-71								
1	183,449	23,848	146,759	12,841	38.28	4.98	30.63	2.68
3	149,329	14,933	120,956	13,440	32.92	3.29	26.67	2.96
4	161,127	6,445	133,736	20,947	35.49	1.42	29.45	4.61
5	163,112	4,893	138,645	19,573	32.00	.96	27.20	3.84
6	155,196	15,520	130,365	9,312	48.43	4.84	40.67	2.91
7	71,066	711	61,117	9,239	42.03	.42	36.14	5.46
8	37,390	2,617	32,530	2,243	26.98	1.89	23.47	1.62
9	303,218	3,032	285,025	15,161	90.88	.91	85.43	4.54
10	105,250	13,683	89,463	2,105	80.66	10.49	68.56	1.61
United States ^{1/}	1,329,138	85,682	1,138,595	104,861	44.47	2.87	38.09	3.51
1973-74-75								
1	222,510	28,926	178,008	15,576	47.42	6.17	37.94	3.32
3	161,514	16,151	130,826	14,536	29.45	2.95	23.86	2.65
4	258,955	10,328	214,302	33,565	37.22	1.49	30.89	4.84
5	109,220	3,277	92,837	13,106	19.38	.58	16.47	2.33
6	237,649	23,765	199,625	14,259	56.65	5.67	47.59	3.40
7	94,238	942	81,044	12,251	44.46	.44	38.24	5.78
8	77,171	5,402	67,139	4,630	52.67	3.69	45.82	3.16
9	278,545	2,785	261,832	13,927	90.97	.97	85.51	4.55
10	58,311	7,580	49,564	1,166	36.40	4.73	30.94	.73
United States ^{1/}	1,497,353	99,157	1,275,178	123,017	42.55	2.82	36.23	3.50

^{1/} United States totals may not add due to rounding.

Table 10.--Plywood use (3/8-in. basis) in highway construction and use per \$1,000 of construction value by geographic regions for two periods

Geographic region	Total use				Use per \$1,000 of construction value			
	Total	Signs	Falsework	Other	Total	Signs	Falsework	Other
----- -Thousand square feet----- -Square feet per \$1,000-----								
1969-70-71								
North	566,956	44,385	467,478	55,093	35.18	2.75	29.01	3.42
South	316,324	21,965	264,101	30,258	40.84	2.84	34.10	3.91
West	445,858	19,332	407,017	19,509	73.98	3.21	67.53	3.24
United States ^{1/}	1,329,138	85,682	1,138,595	104,861	44.47	2.87	38.09	3.51
1973-74-75								
North	587,482	49,297	482,716	55,469	32.76	2.75	26.92	3.09
South	495,844	34,093	413,927	47,824	44.54	3.06	37.18	4.30
West	414,027	15,768	378,536	19,724	67.55	2.57	61.76	3.22
United States ^{1/}	1,497,353	99,157	1,275,178	123,017	42.55	2.82	36.23	3.50

^{1/} United States totals may not add due to rounding.

Table 11.--Materials used in highway construction in the United States, 1955-75

Geographic region	1955-57	1958-60	1961-63	1964-66	1967-69	1970-72	1973-75	Average annual rate of change
								Percent
LUMBER-PLYWOOD (Thousand board feet)								
North	628,826	546,387	546,300	643,934	547,342	533,355	555,060	-0.6
South	252,944	295,641	292,589	334,264	357,792	315,282	457,432	3.0
West	267,292	289,414	430,614	460,989	366,884	388,776	371,702	1.7
United States ^{1/}	1,149,063	1,131,442	1,269,503	1,439,186	1,272,018	1,237,412	1,384,194	0.9
TIMBER PILING (Thousand board feet)								
North	158,993	186,202	99,161	123,380	83,233	65,591	61,271	-4.7
South	62,726	41,106	35,213	22,439	32,914	28,367	20,553	-5.4
West	44,216	45,012	36,845	33,028	26,088	27,002	14,685	-5.4
United States ^{1/}	265,935	272,320	171,219	178,847	142,236	120,960	96,509	-4.9
CEMENT (Thousand barrels)								
North		158,106	167,965	184,905	211,889	164,852	129,340	-1.2
South		62,420	85,289	98,742	100,533	100,052	92,827	2.4
West		33,726	50,098	56,719	58,884	55,880	37,963	0.7
United States ^{1/}		254,252	303,352	340,367	371,306	320,784	260,130	0.1
BITUMENS (Thousand tons)								
North		8,742	6,372	7,952	8,076	8,714	7,564	0.1
South		7,045	6,080	7,591	7,692	9,517	11,119	2.7
West		4,550	4,751	5,783	5,691	6,865	7,029	2.6
United States ^{1/}		19,022	17,203	21,325	21,459	25,096	25,712	1.8
STRUCTURAL STEEL (Thousand tons)								
North		2,341	3,307	3,492	3,336	2,762	3,146	1.8
South		835	1,005	1,128	1,127	1,229	1,387	3.0
West		349	410	432	589	447	334	-0.3
United States ^{1/}		3,524	4,452	5,052	5,053	4,439	4,867	1.9
REINFORCING STEEL (Thousand tons)								
North		1,886	2,371	2,661	2,866	2,810	2,342	1.3
South		998	1,360	1,606	1,907	2,055	2,016	4.2
West		666	1,242	1,295	1,431	1,352	884	1.7
United States ^{1/}		3,550	4,972	5,562	6,203	6,217	5,241	2.3

^{1/} United States totals may not add due to rounding.

Table 12.--Materials used in highway construction, as a percent of the United States total, 1955-75

Geographic region	1955-57	1958-60	1961-63	1964-66	1967-69	1970-72	1973-75
LUMBER-PLYWOOD							
North	55	48	43	45	43	43	40
South	22	26	23	23	28	25	33
West	23	26	34	32	29	31	27
United States	100	100	100	100	100	100	100
TIMBER PILING							
North	60	68	58	69	59	54	69
South	24	15	21	13	23	23	19
West	17	17	22	18	18	22	13
United States	100	100	100	100	100	100	100
CEMENT							
North		62	55	54	57	51	50
South		25	28	29	27	31	36
West		13	17	17	16	17	15
United States		100	100	100	100	100	100
BITUMENS							
North		39	37	37	38	35	29
South		37	35	36	36	38	43
West		24	28	27	27	27	27
United States		100	100	100	100	100	100
STRUCTURAL STEEL							
North		66	68	69	66	62	65
South		24	23	22	22	28	29
West		10	9	9	12	10	7
United States		100	100	100	100	100	100
REINFORCING STEEL							
North		53	48	48	46	45	45
South		28	27	29	31	33	38
West		19	25	23	23	22	17
United States		100	100	100	100	100	100

Table 13.--Material use factors in current dollars for highway construction in the United States, 1955-75

Geographic region	1955-57	1958-60	1961-63	1964-66	1967-69	1970-72	1973-75	Average annual rate of change
								Percent
LUMBER-PLYWOOD								
(Board feet per thousand dollars)								
North	78.72	58.69	53.54	54.44	37.51	32.40	30.95	-3.9
South	85.70	66.05	56.90	54.95	50.81	37.38	41.10	-3.6
West	118.07	97.89	108.81	89.04	66.36	63.01	60.67	-3.3
United States	87.03	67.58	65.77	62.33	46.83	46.83	39.33	-3.9
TIMBER PILING								
(Board feet per thousand dollars)								
North	19.90	20.00	9.72	10.43	5.70	3.98	3.42	-8.4
South	21.25	9.18	6.85	3.69	4.67	3.36	1.85	-11.5
West	19.53	15.22	9.31	6.38	4.72	4.38	2.40	-10.0
United States	20.14	16.26	8.87	7.75	5.24	3.89	2.74	-9.5
CEMENT								
(Barrels per thousand dollars)								
North		16.98	16.46	15.63	14.52	10.01	7.21	-4.9
South		13.95	16.59	16.23	14.28	11.86	8.34	-3.0
West		11.41	12.66	10.96	10.65	9.06	6.20	-3.5
United States		15.19	15.72	14.74	13.67	10.33	7.39	-4.2
BITUMENS								
(Tons per million dollars)								
North		797.68	624.47	672.30	553.47	529.29	421.74	-3.7
South		1,573.96	1,182.29	1,247.76	1,092.30	1,128.42	998.90	-2.6
West		1,538.97	1,200.63	1,117.00	1,029.36	1,112.61	1,147.20	-1.7
United States		1,136.11	891.20	923.65	790.02	807.78	730.58	-2.6
STRUCTURAL STEEL								
(Tons per million dollars)								
North		251.39	297.61	295.28	228.65	167.76	175.38	-2.1
South		186.45	195.37	185.49	160.08	145.78	124.62	-2.3
West		117.90	103.71	83.38	106.53	72.48	54.51	-4.4
United States		210.45	230.62	218.83	186.02	142.87	138.28	-2.4
REINFORCING STEEL								
(Tons per million dollars)								
North		202.52	232.35	224.97	196.40	170.67	130.55	-2.6
South		223.02	264.46	263.98	270.77	243.71	181.09	-1.2
West		225.30	313.78	250.20	258.83	219.10	144.23	-2.6
United States		212.02	257.60	240.90	228.39	200.12	148.92	-2.1

APPENDIX A

FORM APPROVED RCS HHO-39-02
OMB NO. 04-R3274

U.S. DEPARTMENT OF TRANSPORTATION - FEDERAL HIGHWAY ADMINISTRATION														
STATEMENT OF MATERIALS AND LABOR USED BY CONTRACTORS ON HIGHWAY CONSTRUCTION INVOLVING FEDERAL FUNDS														
(PPM 20-2 and PPM 20-4)														
To be completed by Washington Headquarters Personnel														
PART A (To be completed by FHWA or State Highway Personnel (See instructions on reverse))														
STATE		COUNTY		FEDERAL PROJECT NO.				URBAN ()			RURAL ()			
ITEM	DESCRIPTION	UNIT	ROADWAY QUANTITY	BRIDGE QUANTITY (Over 20 ft.)		DATE STARTED								
CONSTRUCTION TYPE CODES														
20	FINAL CONSTRUCTION COST	DOL.				DATE COMPLETED								
21	LENGTH OF PROJECT	MILES				TOTAL NO. BRIDGES								
PART B (To be completed by contractor - See instructions on reverse) (REMARKS Attach plain sheet of paper)														
30	LABOR	TOTAL MAN HOURS		GROSS EARNINGS						CULVERT ITEMS				
										ITEM	SIZE (In.)	LGTH. (Lin. ft.)		
22	TOTAL COST OF ALL MATERIALS AND SUPPLIES	DOL.								6	CORRUGATED STEEL CULVERT			
9	PETROLEUM PRODUCTS	GAL.												
1	CEMENT	BBL.												
2	AGGREGATES PURCHASED	TON.												
92		CU. YD.												
3	BITUMINOUS MATERIAL	GAL.												
4	LUMBER	THSD BD. FT.												
5	TIMBER PILING	LIN. FT.								13	CONCRETE PIPE			
7	REINFORCING STEEL	LB.												
8	STRUCTURAL STEEL	LB.												
10	EXPLOSIVES	LB.												
11	READY-MIXED CONCRETE	CU. YD.												
12	PREMIXED BITUMINOUS PAVING MATERIALS	TON												
13	AGGREGATES PRODUCED	TON												
93		CU. YD.												
16	MISCELLANEOUS STEEL	LB.								14	CLAY PIPE AND DRAIN TILE			
17	FENCING	LIN. FT.												
18	GUARDRAIL	LIN. FT.								25	CORR. ALUMINUM CULVERT			
19	BRIDGE RAIL	LIN. FT.												
23	FINAL CONTRACT AMOUNT FOR SIGNS	DOL.												
24	FINAL CONTRACT AMOUNT FOR LIGHTING	DOL.								26	CAST IRON PIPE			
Blocks 48-70 to be completed by FHWA Washington Headquarters Personnel														
48	52	53	51	52	70									

FORM PB-4 PREVIOUS EDITIONS ARE OBSOLETE
(REV. 9-76)

INSTRUCTIONS FOR PREPARING AND TRANSMITTING FORM PM-47

GENERAL REQUIREMENTS

Form PR-47 should be transmitted for each highway construction project involving Federal funds except those that consist primarily of the installation of protective devices at railroad grade crossings, those that are constructed on a force account or direct labor basis, Federal aid Secondary system, highway work under the direct supervision of the Federal Highway Administration, and highway beautification projects financed with 319 b. funds.

Form PR-47 should be transmitted with or in advance of the Final Report required by Federal-Aid Highway Program Manual Vol. 6: Ch. 4; Sec. 2; Sub. Sec. 8.

A separate form should be transmitted for each contract except that data for two or more contracts on the same project may be combined when such contracts are completed at approximately the same time. In case of a combination, the earliest starting date and the latest completion date should be reported. Where a single contract covers more than one project, one form may be prepared, for each project or for the entire contract provided none of the data are duplicated. A Form PR-47 should not be prepared for a contract covering only the purchase of material but the quantity of material should be reported when subsequently included in a construction project. In all cases, only the original of Form PR-47, typed or clearly lettered, and no carbon or "fax" copies, should be transmitted to the Washington Office.

If nonparticipating work is included in the contract, all data should be combined with the Federal-aid data in preparing the form. Data for any subcontract may be combined by the State or the division office with that for the prime contract if not so combined by the prime contractor. It will be the State's responsibility to see that all prime contract and subcontract costs, material, and man hours have been reported for each contract, and no duplication of data are involved. Quantities of State-furnished materials should be included with contract quantities, and costs of State-furnished materials should be added to Item 20 "Final Construction Cost" and also to Item 22 "Total Cost of All Materials and Supplies". All quantities should be reported to the nearest whole unit and only in the units specified. All costs should be reported to the nearest dollar.

Check urban or rural to indicate whether the major cost is for work within an urban area, or in a rural location.

All figures should be verified for reasonableness by State highway department and Federal Highway Administration division office engineers. The total material cost and the total man-hours and gross earnings should bear reasonable relationships to the contract construction amount. Also the quantity of each material reported should be reasonable with respect to the size and nature of the contract and with respect to the quantities of other materials. For example, if a large quantity of reinforcing steel is reported with no cement or ready-mixed concrete, an error of omission in reporting would be indicated.

Generally, the total cost of materials, supplies, and labor should be substantially less than the final construction cost, as the latter also includes costs of equipment ownership, overhead, and profit which are not required to be reported. If the final construction cost is less or only a few percent more than the total cost of materials, supplies and labor, the indication is that the contractor suffered a loss on the project or that there is an error in reporting. In such case, if it is determined that the figures reported are correct, a statement should be made on plain sheet of paper marked "Remarks" to the effect that the contractor actually did suffer a loss.

PART A - INFORMATION TO BE SUPPLIED BY FEDERAL HIGHWAY ADMINISTRATION OR STATE HIGHWAY PERSONNEL (FEDERAL-AID HIGHWAY PROGRAM MANUAL, VOL. 6; CH. 4; SEC. 1; SUB. SEC. 9).

"Final Construction Cost" - Show best estimate of Federal and State costs incurred to date for contract items, extra work performed by contractor, and State-furnished materials.

"Length of Project" - Report official roadway mileage and official bridge mileage.

*Quantities of steel, concrete and lumber used in connection with Items 17, 18, 19, 23 and 24 should not be reported unless difficulties are encountered in segregating such quantities from total quantities.

PART B - INFORMATION TO BE SUPPLIED BY CONTRACTOR IMMEDIATELY UPON COMPLETION OF CONTRACT

Specific Instructions for the Following Numbered Items:

Item 1 - Report number of barrels of cement used on project. Do not report here the cement included in Item 11.

Items 2 and 92 - Report quantity of aggregates purchased from commercial producers, such as sand, gravel, crushed stone, etc. Do not report here aggregates included in Items 11 and 12. Aggregates produced by the contractor shall be reported as Item 15 or 95.

Item 3 - Report number of gallons of bitumens such as asphalt and tar. Do not report here bituminous materials included in Item 12.

Item 4 - Report all lumber products purchased for and used on the project, including plywood and pressed wood, but excluding timber miling, lumber in fencing, guardrail, and signs, and lumber purchased for or used on previous projects and previously reported. The quantity of lumber should be reported as the number of thousand board feet and not as the number of board feet.

Item 5 - Report timber piling in linear feet, regardless of size.

Item 6 - Report, by size, regardless of class, type, gauge or coating, number of linear feet of corrugated steel pipe, structural plate pipe, pipe arches and arches.

Item 7 - Report total number of pounds of reinforcement for both structures and pavement. Include estimated quantities of reinforcing and prestressing steel in purchased precast units, except concrete pipe reinforcement.

Item 8 - Report total number of pounds of all structural steel, steel H piling, and sheet piling.

Item 9 - Report total number of gallons of all gasoline, diesel oil, lubricating oil, and grease for equipment and trucks. For conversion purposes use factor of 8 pounds of grease per gallon.

Item 10 - Report total number of pounds of explosives, exclusive of caps and fuses.

Item 11 - Report total number of cubic yards of ready-mixed concrete plus estimated quantity of concrete in purchased precast units, excluding Item 13.

Item 12 - Report total number of tons of bituminous paving mixtures that are purchased in a prepared condition ready for placement as they reach the job.

Item 13 - Report, by size, regardless of class, type, gauge or coating, total number of linear feet of plain and reinforced concrete drain and culvert pipe.

Item 14 - Report, by size, total number of linear feet of clay pipe and drain tile.

Items 15 and 95 - Report total quantity of aggregates such as sand, gravel, crushed stone, etc., produced by the contractor.

Item 16 - Report estimated total weight of steel products not appropriate for Items 6, 7, and 8, such as joint devices, tubular piling, etc.

Items 17, 18 and 19 - Report total lengths, in linear feet, of all types of fencing, guardrail and bridge rail.

Item 22 - This should be the total cost, at the jobsite, of all construction materials and supplies purchased for and used on the project, including the cost of materials for signing and lighting and the cost of any materials and supplies not specifically listed hereon. Costs of equipment or equipment rental and the cost of operating the equipment, except the costs of fuel and lubricants, should not be included in this item. Small items of equipment such as jackhammers, handtools, repair parts, tires, etc., are not considered to be supplies. Costs of such items and also overhead costs should not be included. The amount included here for aggregates produced should be only the cost paid by the contractor for the aggregates and should not include the costs of excavating, processing, loading and hauling. Wages and man-hours for aggregates produced should, of course, be included with item 30.

Item 23 - Report final contract amount for all types of signs including foundations, posts, structural supports, etc. Do not include traffic signals.

Item 24 - Report final contract amount for highway and bridge lighting including foundations, conduits, standards, wiring, switches, luminaires, etc. Do not include traffic signals.

Item 25 - Report, by size, number of linear feet of corrugated aluminum culvert.

Item 26 - Report, by size, number of linear feet of cast iron pipe.

Item 30 - Report total man-hours worked by, and earnings of all contractor's employees on the project, including those on operation and maintenance of equipment.