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SEASONING AND SURFACING DEGRADE
IN KILN-DRYING DOUGLAS-FIR
IN WESTERN OREGON

by

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This report presents the results of a study to determine the degrade--loss in volume and grade--of coast-type Douglas-fir lumber when kiln-dried and surfaced in accordance with commercial practice. The study measured (1) loss in volume due to culling and trimming of dry-surfaced lumber because of seasoning and surfacing defects, (2) reduction in grade due to seasoning and surfacing defects, and (3) reduction in grade due to incomplete manufacture or to the development of manufacturing defects. Degrade is expressed as a percentage of the green lumber volume and also as a loss in value per thousand board feet of lumber.

The study was made at the Willamette Valley Lumber Co.'s sawmill at Dallas, Oreg., in April 1957, using approximately 75,000 board feet of representative lumber. First the lumber was graded and tallied in the rough-green condition to establish its potential grade and value, and then it was kiln-dried according to industry practice. Finally, it was planed and regraded for shipment. Differences between the green volume and potential grade and the dry-surfaced volume and grade were used as a basis for determining the amount of degrade.

STUDY PROCEDURE

Initial Grading

The rough-green lumber was graded according to Standard Grading Rules No. 15 of the West Coast Lumber Inspection Bureau by grade supervisors of the Bureau. The grade was marked on each piece and, if trimming had not been completed in the sawmill, pencil trim was indicated. The lumber was then separated into groups for kiln-drying as follows: (1) 1-inch Finish, (2) 1-inch Flooring, (3) 1-5/8-inch Industrial Clears and Factory (V.G. Shop), and (4) 2-inch Dimension. These items were selected for the study since they represent the major part of kiln-dried lumber produced at this mill from Douglas-fir logs.

Kiln-Drying

The study lumber was dried in a battery of steam-heated, internal-fan, cross-circulation kilns about 100 feet long. Both single- and double-track kilns, arranged for end piling, were employed. The lumber was flat-piled with a mechanical stacker, and stickers were of standard 3/4-inch thickness. Kiln control instruments were calibrated before starting the test runs, and the plant's normal drying schedules were used (table 1). The kilns provided a rapid rate of air circulation through the lumber to maintain the desired schedules and operated satisfactorily during the study. No conditioning treatments were used on any of the charges to relieve casehardening.

The Finish, Flooring, and Industrial Clears and Factory lumber were dried to a moisture content of 8 to 10 percent; the Dimension was dried to 16 to 19 percent. This is commercial practice.

Planing

The dry lumber was pulled from the kiln and held in the roughdry shed for a day or two before unstacking. It was then sorted into planing units by size and grade, as originally graded and marked in the rough-green condition. Pieces of lumber that in the rough-green grading had been marked for pencil trimming were sent to the saw at this point to complete the trimming. Surfacing was done with conventional planing equipment by units of a single grade and size.

Following surfacing, the lumber was again graded by supervisors from the West Coast Lumber Inspection Bureau. Tallying of

ongrade, offgrade, and cull and trim was done by the authors. In tallying the offgrade and cull-and-trim pieces, notation also was made of the specific cause of degrade. This information was used in calculating the degrade values shown in tables 2, 3, 4, and 5.

RESULTS AND DISCUSSION

General

As is customary in the Douglas-fir lumber industry, all lumber was measured and tallied in terms of its nominal thickness, width, and length. These nominal dimensions remain the same, beginning with the rough-green lumber and continuing through the roughdry and surfaced-dry stages.

In grading the rough-green lumber, it was not always possible to judge the size of knots, presence of shake, pitch, wormholes, decay, felling breaks, and other characteristics in the wood as accurately as could be done after surfacing. It was obvious after surfacing that some lumber had been misgraded in the rough-green condition, and this misgraded lumber was therefore transferred to its correct category in the original tallies.

Grade Recovery

Tables 2 and 3 show the volume of rough-green lumber tested and the grade recovery after kiln-drying and surfacing for each of the items of lumber in the study. They show the amount of lumber that remained ongrade, the amount dropping to each of the lower grades, and the amount of cull and trim. For example, the item "B&Btr. V.G. Flooring" in table 2 shows that 88.1 percent remained ongrade, 5.5 percent dropped to C grade, and 6.1 percent dropped to D grade. Cull and trim amounted to 0.3 percent. In table 3 the 2x12 Construction grade showed 94.7 percent remaining ongrade, with 3.1 percent dropping to Standard, 1.9 percent to Utility, and 0.3 percent cull and trim. These recovery values show a relatively high percentage of the dry-surfaced lumber remaining ongrade and can be considered as representing good commercial kiln-drying practice.

Grade recoveries shown in tables 2 and 3 are based on Rule 15 for the West Coast Lumber Inspection Bureau. In addition, a grade of E for Finish and Flooring is shown in order to include degrade from D and higher grades that, although small in volume, is marketed by the company.

Seasoning and Surfacing Degrade

The types of defects that caused degrade are shown in tables 4 and 5. Seasoning and surfacing degrade primarily results from those defects which are caused by unequal shrinkage of the wood as it dries, and which therefore generally can be controlled in the kiln-drying process. For example, a principal seasoning defect is surface checking, which affected both Finish and Dimension grades in some items. Several items showed as much as 4-percent degrade due to this defect. Season checking usually develops in the early stages of drying and is reduced by the use of higher relative humidities.

Warping is another seasoning defect that developed in this study, but only to a minor extent. When kiln-drying Douglas-fir, good piling practice minimizes warping by holding the lumber flat and straight as it dries.

Another serious defect, planer splitting, results when lumber that has cupped in drying is surfaced. The cupped board is flattened by the feed rolls of the planer and splits. Cupping can be minimized by using more stickers to provide closer spacing when piling. It also can be minimized by terminating the drying at a higher moisture content, which results in less cupping and also leaves the board more flexible at the planer. Planer splitting caused degrade in only the 10- and 12-inch flat-grain Finish lumber, which was dried to a moisture content of 10 percent or less. Since Finish lumber must be dried to this level, closer spacing of stickers and final conditioning treatment to reduce casehardening stresses afford good opportunities for reducing this degrade. Dimension lumber was free from planer-splitting degrade because drying was terminated at about 18-percent moisture content.

Degrade resulting from damage to knots varied with the grade of lumber. In Finish grades, knots are admitted only in very small sizes and limited amounts, and they may be intergrown or encased. Knots shrink appreciably in lumber dried to 10-percent moisture content or less, and many loosen and drop out. Others, however, are sufficiently fixed by growth to hold their position, even after drying and surfacing. Although drying such lumber to a higher moisture content would be expected to result in less shrinkage of the knots, thereby retaining a greater number of them in place, it is generally necessary to dry Finish lumber to a moisture content of less than 10 percent because of its intended use. Hence, in this study the amount

of degrade shown in Finish due to the dropping out of knots must be considered as unavoidable. For example, D Finish shows a degrade due to knotholes of 8.3 to 10.9 percent in 6-, 8-, and 10-inch widths, whereas if the knots had stayed in place the boards would have remained in the D grade. Since shrinkage is unavoidable, it might be considered that these boards never actually qualified in the D grade, and the knotholes should not therefore be interpreted as contributing to degrade.

Torn grain and broken edges contributed to degrade in Flooring and Finish items. Although these defects develop in surfacing the dry lumber, they may be aggravated by exceptional dryness of the lumber as well as by the operation of the surfacing equipment. There is no evidence that improved machine adjustment or setup over that used in this study could substantially reduce this degrading. Torn grain and broken edges are often related to the grain of the wood, and in that case may be unavoidable. Torn grain did not develop in Dimension lumber.

Cull and trim result from end checks and splits that require the board to be cut back, and from excessive warp and other defects that make it necessary to discard the board. The amount of cull and trim was relatively small in the Finish grades and was negligible in the Dimension grades.

As Dimension lumber in this study was dried to an average moisture content of 16 to 19 percent, total degrade after surfacing was small.

Manufacturing Degrade

Another type of defect that reduced the grade given pieces of rough-green lumber was caused by inadequate manufacture in the sawmill and by breakage due to rough handling. Typical examples of the former were pieces cut too narrow or too thin to surface to the required size. Actually such pieces had not suffered degrade in seasoning or machining; rather the loss in value resulted from mis-manufacture in sawing. Improved sawing practice could have increased realization.

Loss in Value

Reductions in lumber sales value due to seasoning, surfacing, and manufacturing degrade are shown in tables 6 and 7. These losses are based on average prices for the various items (dry surfaced) at the mill. Losses in value were greater in the higher priced items--Finish, Flooring, and Industrial Clears and Factory--than in Dimension.

For example, the 1x6-inch C&Btr. Finish price was \$170 per thousand board feet. For this item, the loss due to degrade from season checking amounted to \$1.89 per thousand; from planer splitting, \$0.40 per thousand; from torn grain, \$0.79 per thousand; and from cull and trim, \$1.07 per thousand--a total of \$4.15 per thousand board feet for all seasoning and surfacing degrade. The manufacturing losses from thin lumber amounted to \$1.55 per thousand; from narrow lumber, \$7.74 per thousand; from mechanical damage, \$0.19 per thousand; and from cull and trim loss, \$1.22 per thousand. Altogether, manufacturing degrade represented a loss of \$10.70 per thousand board feet. In this item, the combination of seasoning, surfacing, and manufacturing degrade accounted for a total loss of \$14.85 per thousand board feet.

In Dimension grades, losses due to seasoning, surfacing, and manufacturing degrade generally ranged from \$0.50 to \$1.50 per thousand board feet.

It should be recognized that it is not practical to saw, kiln-dry, and surface lumber so well that degrade would be avoided entirely. The results of this study, however, indicate the opportunities for profiting from improved practices to capture more of the potential lumber value in the log.

Table 1.--Kiln-drying schedules for Douglas-fir,
Willamette Valley Lumber Co., 1957

Grade and thickness	Time from start of drying (hours)	Temperature (degrees F.)	
		Dry bulb	Wet bulb
Flooring, 1x4	0	172	166
	12	180	166
	24	185	170
	38	195	170
	62	200	175
	72	Out	--
Finish, 1x6	0	170	163
	18	180	168
	27	190	172
	42	195	172
	67	200	180
	72	Out	--
Finish 1x8 and wider	0	163	150
	24	170	158
	38	182	164
	48	190	170
	64	192	176
	88	Out	--
V.G. Shop, 1-5/8x5 and 1-5/8x10	0	160	155
	18	168	155
	24	170	155
	42	182	166
	48	192	172
	66	195	170
	162	Out	--
Dimension, 2x4	0	130	115
	30	140	132
	48	150	132
	68	155	132
	74	Out	--
	Dimension, 2x8 and wider	0	130
24		140	120
48		150	120
76		150	135
80		Out	--

Table 2.--Grade recovery of Douglas-fir lumber following kiln-drying
and surfacing; 1957 study at Willamette Valley Lumber Co.:

Flooring, Finish, and Shop

(In percent)

Green lumber			Kiln-dried and surfaced lumber									
Thickness and grade	Width (inches)	Volume tested (board feet)	B&Btr.	C	D	E	Fac. Sel.	No. 1 Shop	No. 2 Shop	No. 3 Shop	Cull and trim loss	Total degrade
4/4:												
V.G. Flooring:												
B&Btr.	4	2,349	88.1	5.5	6.1	--	--	--	--	--	0.3	11.9
C	4	2,369	--	90.1	7.8	1.9	--	--	--	--	.2	9.9
D	4	1,566	--	--	98.6	1.2	--	--	--	--	.2	1.4
F.G. Finish:												
C&Btr.	6	4,468	--	80.8	14.8	3.1	--	--	--	--	1.3	19.2
	8	2,226	--	91.1	4.8	1.8	--	--	--	--	2.3	8.9
	10	1,283	--	86.6	7.0	.9	--	--	--	--	5.5	13.4
	12	1,324	--	86.2	3.4	7.4	--	--	--	--	3.0	13.8
D	6	1,590	--	--	86.9	12.3	--	--	--	--	.8	13.1
	8	860	--	--	88.2	11.7	--	--	--	--	.1	11.8
	10	552	--	--	83.8	14.5	--	--	--	--	1.7	16.2
	12	530	--	--	98.5	--	--	--	--	--	1.5	1.5
1-5/8:												
V.G. Shop:												
B&Btr.	5	254	87.8	--	--	--	7.8	4.4	--	--	0	12.2
	10	236	90.7	--	--	--	9.3	--	--	--	0	9.3
C	5	252	--	96.0	--	--	4.0	--	--	--	0	4.0
	10	238	--	97.9	--	--	--	--	--	--	2.1	2.1
Factory												
Select	5	550	--	--	--	--	94.9	1.8	3.3	--	0	5.1
	10	1,035	--	--	--	--	94.2	5.8	--	--	0	5.8
No. 1 Shop												
	5	1,388	--	--	--	--	--	86.9	13.1	--	0	13.1
	10	1,514	--	--	--	--	--	83.7	15.1	--	1.2	16.3
No. 2 Shop												
	5	2,363	--	--	--	--	--	--	94.1	3.0	2.9	5.9
	10	639	--	--	--	--	--	--	100.0	--	0	0
No. 3 Shop												
	5	181	--	--	--	--	--	--	--	100.0	0	0
	10	22	--	--	--	--	--	--	--	100.0	0	0

Table 3.--Grade recovery of Douglas-fir lumber following kiln-drying
and surfacing; 1957 study at Willamette Valley Lumber Co.:

Dimension

(In percent)

Green lumber			Kiln-dried and surfaced lumber						
Thickness and grade	Width (inches)	Volume tested (board feet)	Sel. Str.	Const.	Stand.	Utility	Econ.	Cull and trim loss	Total degrade
Dimension:									
Select									
Structural	4	1,415	94.1	2.8	1.6	1.5	--	0	5.9
	8	3,547	86.2	6.3	2.9	4.3	--	0.3	13.8
	12	6,104	94.0	4.5	.8	--	--	.7	6.0
Construc- tion									
	4	2,697	--	93.7	3.5	2.2	0.4	.2	6.3
	8	4,288	--	93.0	4.2	2.5	--	.3	7.0
	12	5,660	--	94.7	3.1	1.9	--	.3	5.3
Standard									
	4	1,696	--	--	96.1	3.0	.5	.4	3.9
	8	4,016	--	--	99.6	.4	--	0	.4
	12	3,568	--	--	98.0	.8	.9	.3	2.0
Utility									
	4	2,280	--	--	--	98.8	.8	.4	1.2
	8	4,275	--	--	--	99.8	--	.2	.2
	12	3,876	--	--	--	97.1	2.9	0	2.9
Economy									
	4	819	--	--	--	--	99.5	.5	.5
	8	1,264	--	--	--	--	99.6	.4	.4
	12	956	--	--	--	--	100.0	0	0

Table 4.--Seasoning, surfacing, and manufacturing degrade in kiln-dried Douglas-fir lumber, by defect;

1957 study at Willamette Valley Lumber Co.: Flooring, Finish, and Shop

(In percent)

Green lumber			Kiln-dried and surfaced lumber													
Thickness and grade	Width (inches)	Volume tested (bd. ft.)	Seasoning and surfacing defect							Manufacturing defect					Total degrade	
			Season check	Planer split	Warp	Torn grain	Broken edge	Knot-holes	Cull and trim loss	Total	Thin	Narrow	Mechanical damage	Cull and trim loss		Total
4/4:																
V.G. Flooring:																
B&Btr.	4	2,349	--	--	0.2	2.7	0.8	--	0.2	3.9	1.8	3.3	^{1/} 2.8	0.1	8.0	11.9
C	4	2,369	--	--	--	1.5	.8	0.2	.1	2.6	3.1	3.6	.5	.1	7.3	9.9
D	4	1,566	--	--	.3	--	--	--	.1	.4	.3	--	.6	.1	1.0	1.4
F.G. Finish:																
C&Btr.	6	4,468	1.9	0.3	--	1.3	--	--	.6	4.1	2.0	12.2	.2	.7	15.1	19.2
	8	2,226	1.6	--	--	.1	--	--	1.4	3.1	1.0	3.0	.9	.9	5.8	8.9
	10	1,283	4.0	.9	--	2.0	--	--	4.1	11.0	--	1.0	--	1.4	2.4	13.4
	12	1,324	.9	4.3	--	--	--	--	2.1	7.3	3.3	--	2.3	.4	6.0	13.3
D	6	1,590	.4	--	--	--	--	10.9	.4	11.7	1.0	--	--	.4	1.4	13.1
	8	860	3.4	--	--	--	--	8.3	.1	11.8	--	--	--	0	0	11.8
	10	552	4.2	--	--	--	--	8.5	1.3	14.0	1.8	--	--	.4	2.2	16.2
	12	530	--	--	--	--	--	--	2.2	2.2	--	--	--	.4	.4	2.6
1-5/8:																
V.G. Shop:																
B&Btr.	5	254	3.9	--	--	--	--	--	0	3.9	3.9	--	4.4	0	8.3	12.2
	10	236	--	--	--	--	--	--	0	0	9.3	--	--	0	9.3	9.3
C	5	252	--	--	--	--	--	--	0	0	4.0	--	--	0	4.0	4.0
	10	238	--	--	--	--	--	--	2.1	2.1	--	--	--	0	0	2.1
Factory Select	5	550	--	--	--	--	--	--	0	0	5.1	--	--	0	5.1	5.1
	10	1,035	--	--	--	--	--	--	0	0	4.0	--	1.8	0	5.8	5.8
No. 1 Shop	5	1,388	--	--	.6	--	--	--	0	.6	12.5	--	--	0	12.5	13.1
	10	1,514	1.3	--	--	--	--	--	0	1.3	13.8	--	--	1.2	15.0	16.3
No. 2 Shop	5	2,363	--	--	--	--	--	--	0	0	1.3	1.7	--	2.9	5.9	5.9
	10	639	--	--	--	--	--	--	0	0	--	--	--	0	0	0
No. 3 Shop	5	181	--	--	--	--	--	--	0	0	--	--	--	0	0	0
	10	22	--	--	--	--	--	--	0	0	--	--	--	0	0	0

^{1/} Includes 1.6 percent due to machine burn.

Table 5.--Seasoning, surfacing, and manufacturing degrade in kiln-dried Douglas-fir lumber, by defect;

1957 study at Willamette Valley Lumber Co.: Dimension

(In percent)

Green lumber			Kiln-dried and surfaced lumber										
			Seasoning and surfacing defect					Manufacturing defect					
Thickness and grade	Width (inches)	Volume tested (bd. ft.)	Season	Warp	Knot-holes	Cull and trim loss	Total	Thin	Narrow	Mechanical damage	Cull and trim loss	Total	Total degrade
			check										
8/4:													
Dimension:													
Select													
Structural	4	1,415	0.8	--	2.8	0	3.6	--	1.5	0.8	0	2.3	5.9
	8	3,547	--	--	4.3	0.2	4.5	1.4	7.8	--	0.1	9.3	13.8
	12	6,104	2.6	--	.9	.6	4.1	1.0	.4	.4	.1	1.9	6.0
Construction													
	4	2,697	.3	1.0	1.5	0	2.8	.3	2.6	.4	.2	3.5	6.3
	8	4,288	.9	1.3	2.5	.1	4.8	1.6	.4	--	.2	2.2	7.0
	12	5,660	4.0	--	.6	.2	4.8	--	.4	--	.1	.5	5.3
Standard													
	4	1,696	.5	1.0	1.0	.1	2.6	--	1.0	--	.3	1.3	3.9
	8	4,016	--	--	.4	0	.4	--	--	--	0	0	.4
	12	3,568	.9	.8	--	.2	1.9	--	--	--	.1	.1	2.0
Utility													
	4	2,280	--	.8	--	0	.8	--	--	--	.4	.4	1.2
	8	4,275	--	--	--	0	0	--	--	--	.2	.2	.2
	12	3,876	2.9	--	--	0	2.9	--	--	--	0	0	2.9
Economy													
	4	819	--	--	--	0	0	--	--	--	.5	.5	.5
	8	1,264	--	--	--	0	0	--	--	--	.4	.4	.4
	12	956	--	--	--	0	0	--	--	--	0	0	0

Table 6.--Loss in value of kiln-dried Douglas-fir lumber caused by seasoning, surfacing, and manufacturing degrade, by defect;
 1957 study at Willamette Valley Lumber Co.: Flooring, Finish, and Shop
 (In dollars per M b.m.)

Green lumber				Kiln-dried and surfaced lumber													
Thickness and grade	Width (in.)	Volume tested (bd. ft.)	Mill price (dol.)	Seasoning and surfacing defect							Manufacturing defect					Total degrade loss	
				Season check	Planer split	Warp	Torn grain	Broken edge	Knot holes	Cull and trim loss	Total	Thin	Narrow	Mechanical damage	Cull and trim loss		Total
4/4:																	
V.G. Flooring:																	
B&Btr.	4	2,349	173	--	--	0.15	0.45	0.50	--	0.37	1.47	1.24	2.22	1/0.62	0.07	4.15	5.62
C	4	2,369	160	--	--	--	.89	.48	0.25	.20	1.82	2.36	2.66	.28	.21	5.51	7.33
D	4	1,566	100	--	--	.19	--	--	--	.06	.25	.19	--	.33	.06	.58	.83
E	4	--	42	--	--	--	--	--	--	--	--	--	--	--	--	--	--
F.G. Finish:																	
C&Btr.	6	4,468	170	1.89	0.40	--	.79	--	--	1.07	4.15	1.55	7.74	.19	1.22	10.70	14.85
	8	2,226	170	1.22	--	--	.08	--	--	2.36	3.66	.57	2.13	1.02	1.53	5.25	8.91
	10	1,283	170	2.43	1.12	--	1.17	--	--	6.89	11.61	--	.61	--	2.39	3.00	14.61
	12	1,324	220	1.50	5.86	--	--	--	--	4.65	12.01	3.10	--	3.74	1.00	7.84	19.85
D	6	1,590	110	.26	--	--	--	--	6.57	.41	7.24	.60	--	--	.35	.95	8.19
	8	860	110	2.02	--	--	--	--	4.95	.13	7.10	--	--	--	0	0	7.10
	10	552	110	2.50	--	--	--	--	5.11	1.39	9.00	1.09	--	--	.40	1.49	10.49
	12	530	160	--	--	--	--	--	--	3.60	3.60	--	--	--	.61	.61	4.21
E	6, 8, 10	--	50	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12	--	55	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1-5/8:																	
V.G. Shop:																	
B&Btr.	5	254	180	1.77	--	--	--	--	--	0	1.77	1.77	--	3.03	0	4.80	6.57
	10	236	180	--	--	--	--	--	--	0	0	4.19	--	--	0	4.19	4.19
C	5	252	165	--	--	--	--	--	--	0	0	1.19	--	--	0	1.19	1.19
	10	238	165	--	--	--	--	--	--	3.45	3.45	--	--	--	0	0	3.45
Factory Select	5	550	135	--	--	--	--	--	--	0	0	2.25	--	--	0	2.25	2.25
	10	1,035	135	--	--	--	--	--	--	0	0	.99	--	.46	0	1.45	1.45
No. 1 Shop	5	1,388	110	--	--	.19	--	--	--	0	.19	3.74	--	--	0	3.74	3.93
	10	1,514	110	.38	--	--	--	--	--	0	.38	4.14	--	--	1.38	5.52	5.90
No. 2 Shop	5	2,363	80	--	--	--	--	--	--	0	0	.39	.50	--	2.33	3.22	3.22
	10	639	80	--	--	--	--	--	--	0	0	--	--	--	0	0	0
No. 3 Shop	5	181	50	--	--	--	--	--	--	0	0	--	--	--	0	0	0
	10	22	50	--	--	--	--	--	--	0	0	--	--	--	0	0	0

1/ Includes 0.20 due to machine burn.

Table 7.--Loss in value of kiln-dried Douglas-fir lumber caused by seasoning, surfacing, and manufacturing degrade,

by defect; 1957 study at Willamette Valley Lumber Co.: Dimension

(In dollars per M b.m.)

Green lumber			Kiln-dried and surfaced lumber											Total degrade loss	
Thickness and grade	Volume tested (bd. ft.)	Mill price (dol.)	Seasoning and surfacing defect					Manufacturing defect							
			Season check	Warp	Knot- holes	Cull and trim loss	Total	Thin	Narrow	Mechan- ical damage	Cull and trim loss	Total			
8/4:															
Dimension:															
Select															
Structural	4	1,415	105	0.23	--	0.58	0	0.81	--	0.78	0.23	0	1.01	1.82	
	8	3,547	105	--	--	.95	0.18	1.13	0.48	3.27	--	0.09	3.84	4.97	
	12	6,104	107	.61	--	.20	.63	1.44	.22	.11	.10	.07	.50	1.94	
Construction	4	2,697	84	.02	0.33	.22	0	.57	.02	.40	.28	.19	.89	1.46	
	8	4,288	83	.18	.33	.15	.10	.76	.34	.16	--	.12	.62	1.38	
	12	5,660	85	.97	--	.03	.18	1.18	--	.03	--	.12	.15	1.33	
Standard	4	1,696	76	.32	.24	.24	.05	.85	--	.24	--	.15	.39	1.24	
	8	4,016	77	--	--	.12	0	.12	--	--	--	0	0	.12	
	12	3,568	78	.57	.28	--	.17	1.02	--	--	--	.09	.09	1.11	
Utility	4	2,280	52	--	.30	--	0	.30	--	--	--	.18	.18	.48	
	8	4,275	47	--	--	--	0	0	--	--	--	.09	.09	.09	
	12	3,876	42	.77	--	--	0	.77	--	--	--	0	0	.77	
Economy	4	819	16	--	--	--	0	0	--	--	--	.07	.07	.07	
	8	1,264	16	--	--	--	0	0	--	--	--	.06	.06	.06	
	12	956	15	--	--	--	0	0	--	--	--	0	0	0	