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THE SUITABILITY OF WESTERN LARCH (TAMARACK) FOR USE AS SHAKES IN AREAS HAVING A LOW DECAY POTENTIAL

BY

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Portland, Oregon

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SUMMARY

The durability of western larch shake roofs was investigated in northwestern Montana and in Oregon and Washington east of the Cascade Mountains. Over 50 shake roofs which range in age from 11 to about 100 years were inspected. Some of the roofs turned out to be western red cedar. In the areas investigated, the larch shakes appeared to be equal to cedar in decay resistance.

In areas having a low decay potential, weathering resistance (to sun, wind, rain, blowing sands, snow loads, etc.) appears to have a greater influence on service life of shakes than decay resistance. Larch shakes which were one-half inch or more in thickness showed significantly better weathering resistance than the thinner ones. They split and warped less and had less shake loss due to high winds and snow loads.

Observations made during this investigation indicate that western larch shakes have excellent service life in areas with a low decay potential. This essentially would include most of the western United States as shown on the enclosed map.

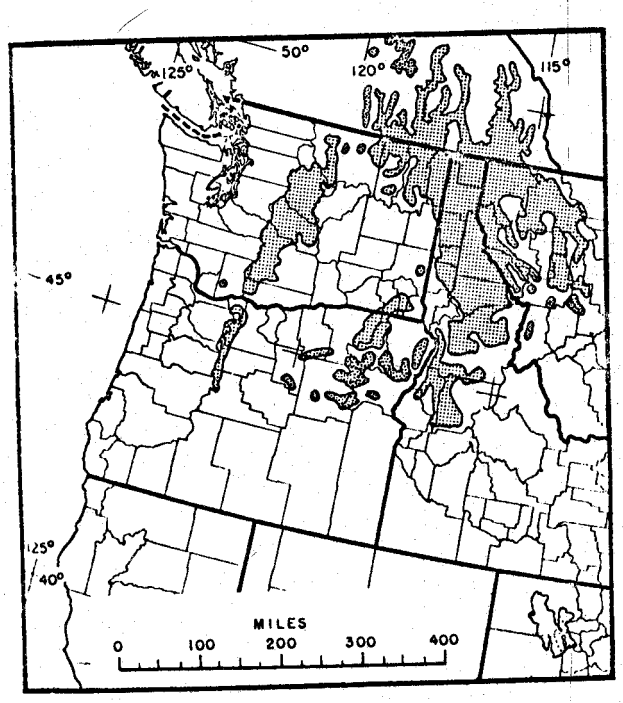
INTRODUCTION

Observations concerning the use of western larch shakes have generally been local. No extensive investigations have been made to compare the suitability and desirability of larch shakes in areas where they may have had long time use. This study was therefore undertaken to provide a more comprehensive analysis for those individuals or organizations which might be concerned with the potential use of larch for shakes on a commercial basis.

The geographic areas visited during this investigation are located within the growing area of western larch. Settlers and early residents used local woods for their structures and therefore the oldest use data would be found within the species growth range.

WESTERN LARCH (LARIX OCCIDENTALIS)

Western larch grows in eastern Oregon and Washington and in areas of Idaho and Montana, as shown in the figure below. It grows in a climatic zone having cool temperatures with an average annual precipitation of 28 inches. The minimum annual precipitation it tolerates is about 18 inches. Frequently 250-year-old stands average only 16 to 24 inches in diameter; and 400-year-old stands average about 30 inches.[1/]



Range of Western Larch

Larch lumber is usually graded and sold with Douglas-fir. Larch is used commercially as plywood, edge-grained flooring, roof decking, railroad ties, and poles.

1/ Silvics of the United States, Agriculture Handbook No. 271, 1965, Forest Service, U.S. Department of Agriculture.

The wood is straight grained, coarse textured, moderately heavy (specific gravity approximately 0.48), moderately high in shock resistance, splits easily, moderately high in nail holding capacity, and is intermediate in durability when exposed to conditions favorable to decay.2/

The catastrophic 1910 forest fires in Montana and Idaho left millions of dead larch trees. Forty years later most of these snags still had sapwood sound enough to give satisfactory service in poles, and the heartwood was invariably as sound as ever.3/ Thousands of these dead trees were seen during the course of this study.

2/ Commercial Timbers of the United States, 1940, Brown, H. P. and Panshin, A. J.

3/ Poles of Western Larch, 1950, The Rocky Mountain Pole and Treating Association.

DEFINITION OF LOW DECAY POTENTIAL AREAS

The low decay potential areas of the United States are defined by T. C. Scheffer* in his unpublished report, "Indexing the Potential of Climates to Promote Decay of Wood Above Ground." This report presently is on the editor's desk at the Forest Products Laboratory, Madison, Wisconsin, and is expected to be published in the Forest Products Journal some time in 1971.

Figure 1, which is taken from the above report, indexes the decay potential within the United States. Essentially, the index system is based on a formula employing mean monthly temperatures and amount and distribution of annual rainfall. A decay potential index (D.P.I.) range of 0-35 is considered low; 35-65 is classed as medium; and over 65 is high. The Western United States, except for western Oregon, Washington, and northwestern California is below the 35 D.P.I.

The formula for deriving at this climate index is:

$$\text{Climate Index} = \frac{\sum_{\text{Jan.}}^{\text{Dec.}} \left[(T-35) \quad (D-3) \right]}{30}$$

where T is the mean monthly temperature (^{o}F), D is the mean number of days in the month with 0.01 inches or more of precipitation, and $\sum_{\text{Jan.}}^{\text{Dec.}}$ indicates the summation of products for the respective months, January through December. The sum of products is arbitrarily divided by 30 in order to make the index fall within the range 0-100.

Derivation of the climate index for Madison, Wisconsin, for example, would be as follows:

	Month of Year											
Data and: product	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
T-35 :	0	0	0	9	21	31	36	35	26	15	0	0
D-3 :	6	5	8	8	8	8	7	6	6	5	5	6
(T-35)(D-3):	0	0	0	72	168	248	252	210	156	75	0	0

$$\sum \frac{(T-35)\ (D-3)}{30} = \frac{1181}{30} = 39.$$

*The report was written while T. C. Scheffer was still employed at the Forest Products Laboratory, Madison, Wisconsin. He is now retired and, on a part time basis, is on the staff of the School of Forestry, Oregon State University, Corvallis, Oregon.

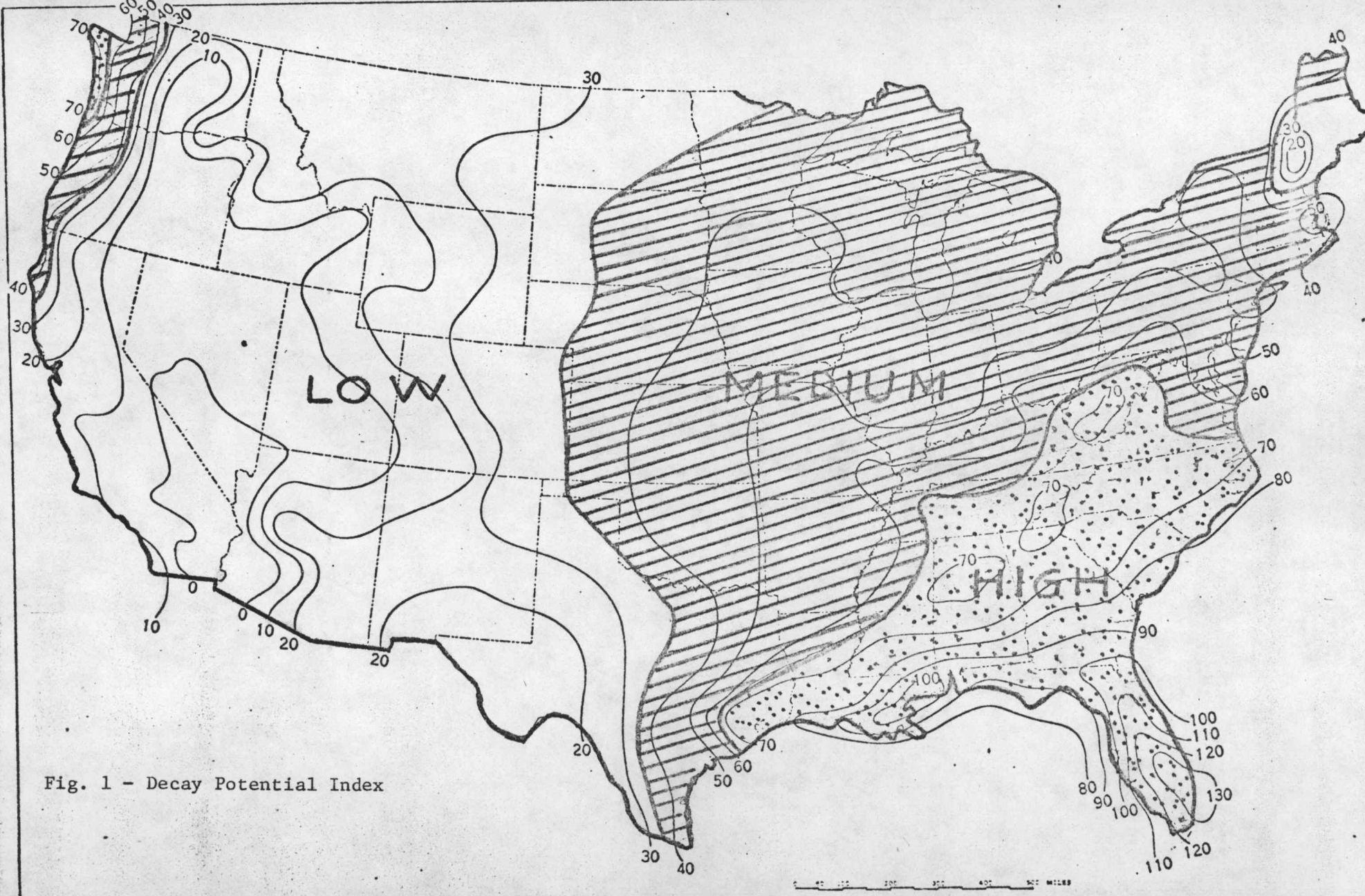


Fig. 1 - Decay Potential Index

DESCRIPTION OF AREAS VISITED

UKIAH AREA, OREGON--Ukiah is a small town located in the Blue Mountains of Oregon about 55 miles south of Pendleton. The area is generally timbered with interspersed pasture and range land. The primary tree species in the Blue Mountains are ponderosa pine, Douglas-fir, white fir, lodgepole pine, and western larch. Rainfall within the area varies from 20 to 30 inches per year.

Driving through the country, one is impressed by the many miles of very old split-rail western larch fencing and by the many old barns, log cabins, and homesteads. Very few homes less than 20 to 30 years old were seen.

The area was permanently homesteaded around the turn of the century although many pioneers settled much earlier than that. Western larch was used for roofing and fencing by these early pioneers probably because it split easily. It is believed that both live and dead wood were used. Probably more rails and shakes were cut from the dead, dry trees because of the reduced weight and somewhat easier splitting of the wood. There is a noticeable absence of rail fencing and old log structures soon after one leaves the timbered area. Apparently the early settlers were not inclined to transport the rough logs of wood very far. Only one handsplit larch shake roof was found in this area which was less than 40 years old. This is probably due to the fact that the availability of commercial cedar shingles made laborious handsplitting of shakes unattractive.

YAKIMA - ELLENSBURG AREA, WASHINGTON--Western larch is found on the eastern slopes of the Cascade Range along with western red cedar, Douglas-fir, and other associated species. Because of the proximity to western red cedar, most of the older homesteads and buildings that are left in the area are roofed with manufactured shingles. Three very old log cabins located in the hills about twenty miles north of Ellensburg were inspected. On two of the buildings, the shake roofs were almost completely deteriorated. Inspection of the shake showed them to be pine. The third cabin, called the Nanum Cabin, and probably not as old as the first two, had a larch shake roof which showed no decay.

At Naches, about 15 miles northwest of Yakima, a retired airline pilot used handsplit larch shakes on two residential buildings. Both roofs (built in 1946 and 1959) are in sound condition. A barn with four-foot-long larch shakes, built in 1941-42 by a relative of a Forest Service employee, was also inspected. The shakes showed no decay. The buildings inspected are located in timbered country but not far from range and agricultural land.

COLVILLE-REPUBLIC AREA, WASHINGTON--Northwestern Washington has a history of forest fires. Fire blackened dead larch snags can still be seen standing in the area from the 1929 fires. The area is timbered with relatively little commercial farming. Local contact and assistance in the Republic area was provided by a local Forest Service employee. The larch shake roofs inspected were all in good serviceable condition with very little noticeable decay.

NORTHWESTERN MONTANA AREA--The area investigated is bounded on the west by the Idaho border and on the east by the west boundary of Glacier Park. Many fire-killed larch snags are still standing from the 1910-1917 forest fires which ravished much of the area. The fires coincided with the influx of settlers and exceptionally dry summers. It is poor farming country and many of the areas which were heavily settled 50 years ago now have few permanent residents.

Background information and local records for the North Fork of the Flathead River Valley were obtained from Mr. Ralph Thayer who homesteaded in the area in 1914 and now lives in Kalispell. He still has his homestead near Trailcreek which is shown on most road maps. In reality, Trailcreek is only an abandoned residential building (for a time used as a post office) and a barn.

COMMERCIAL MANUFACTURE OF WESTERN LARCH SHAKES

Shake bolts at a commercial operation in Ukiah, Oregon are cut from dead trees. These trees are not suitable for lumber because of radial seasoning splits, but make excellent shake bolts. Wood scientists are all in agreement that sound wood, dried "on the stump", is equal to wood cut from live trees and then dried in the form of lumber. Therefore, the utilization of this dead wood is not contrary to any accepted practices of good uses of wood. It is a step towards better utilization of our forest resources.

The use of this "on the stump" seasoned larch has distinct advantages in the manufacture of shakes: (1) The wood is dry, lighter to handle and easier to split (2) The split shake blanks can be easily resawn (with band saws) into two tapered shakes. Galactan gum in green western larch fouls up the fine teeth of the band saw thus creating manufacturing problems (3) Various degrees of shrinkage have already taken place because of "on the stump" seasoning. The dead trees are extremely durable and, therefore, the wood generally has been air-seasoned over the years. It might be noted here that there are large but unknown volumes of dead western larch throughout its range. Expanded commercial larch shake production could utilize this significant but unused volume.

Shake bolts, cut from dead trees, as delivered by the loggers (as shown below), were examined at the Ukiah plant. The bolts were 24 inches long and averaged 18-24 inches in diameter. The narrow bands of sapwood (1/2 - 3/4 inches) were generally in various stages of decay. Some sapwood had insect holes but these holes do not penetrate the heartwood to any extent. Some of the bolts contained ring shake and all contained radial seasoning splits.

The clear wood in the bolts is split radially to produce edge-grain shake blanks. Edge-grain shakes have better use characteristics than flat grain. It might be mentioned that this is most fortunate in that it is difficult to split larch (or any species) tangentially (flat grain) and get a controlled thickness. The blanks are then band sawn into two tapered edge-grain shakes 1/2 to 3/4 inches thick at the thick end. No sapwood, split, ring shake, decay, or pith is permitted in the shakes. Because of the relatively small diameters (as compared to western red cedar) of the bolts and after removal of all the unusable portions, few larch shakes need splitting to reduce excessive widths.

Shakes could also be manufactured from live trees, but first some method needs to be developed to prevent the fouling of the fine teeth of the band saw with Galactan gum. Sawmills producing western larch lumber use water spray on the blades. This has not proven successful on the fine-toothed band saws used for resawing the shake blanks. Western red cedar shakes and shingles are generally dried before shipment to reduce shipping weight and to reduce shrinkage of the product in use. This would also need to be done for western larch shakes manufactured from green wood.

EVALUATION OF WESTERN LARCH DURABILITY

The larch shake roofs inspected during the course of the investigation had relatively little decay even though they were 11 to about 100 years old. Roofs of some unused buildings would require very little work to repair the storm damage which has occurred over the years.

The older shakes were generally 28 to 32 inches long and averaged only 3/8 inches in thickness. Construction details can be seen on several of the enclosed photographs. A double layer of shakes was laid with only a four to five inch lap between courses. Nearly all of the roofs were face nailed. This method of construction and the thinness of the shakes would not be acceptable today for residential construction. The newer residential larch shake roofs were constructed using present acceptable practices. Shake thickness for these generally was about 1/2 inch.

On several of the roofs in the Ukiah area, the south exposure had lost a significant number of shakes while the north exposure had no loss and little or no noticeable decay. Shake loss apparently is due to the fact that the rains and winter storms come from the south. In the other areas, shake loss also appeared to be related to prevailing storm direction.

The observations indicate that resistance to weathering and not to decay appears to be the critical factor determining service life of larch shakes. Blowing sands in open or semi-desert areas can have a very abrasive effect on dry soft woods. The result of this abrasive action was evident on several of the structures inspected. As a side note -- a four-year-old residence in Golden, Colorado with redwood plywood siding and a cedar shake roof, inspected July 1970, showed significant wear (to siding and shake) due to blowing sands.

In the North Fork of the Flathead River area (Montana), a good comparison was made between two homesteads about one mile apart. A Tom Peterson filed for a homestead patent in 1924 and built his house and outbuildings in 1925-26. Larch logs and shakes were used. The shakes are 3/8 to 5/8 inch thick. Buildings and roofs are in excellent condition and the place is still used for vacations.

A mile down the road, F. H. "Bignose" Johnson filed claim to his land on December 30, 1911, and built his house the following year using larch shakes which were only 1/4 inch thick. Although there is very little decay in the shakes, they are twisted, warped and broken. Many are missing. There is an apparent 14 year age difference between the two places. The two extreme roof conditions, are believed to be primarily due to differences in shake thickness and not age.

Several of the roofs inspected turned out to be cedar shakes. These did not appear to be in any better condition than larch roofs of the same apparent age. Actually, the cedar roofs appeared to have more decay. The St. Paul Mission building near Colville, Washington, which was built with larch logs in 1847 and reroofed in 1940, had a fair amount of decay in the cedar shakes.

An abandoned residence in the Libby Dam (under construction) flood area in Montana was inspected. It was roofed with cedar shakes which were severely weathered and had significant decay. Age of the building is unknown but it is estimated to be about 40 to 50 years old. It did have a "cinder block" type of chimney.

All observations made during this investigation indicate that larch shakes are durable and serviceable in the areas investigated. Good serviceability appears to range from 30 to 50 years or more. Observations also indicate that the shakes should be 1/2 inch or more in thickness to minimize damage due to weathering. There appears to be no reason why western larch shakes cannot be used throughout the United States in areas with low decay potential.

The following letter was written by Mr. Theo. C. Scheffer who is retired from the U.S. Forest Products Laboratory, Madison, Wisconsin and presently on the Forestry Staff at Oregon State University. It expresses his opinions concerning the use of western larch for shakes.

SUBJECT: Suitability of Western larch for shakes.

TO WHOM IT MAY CONCERN:

Interest has been expressed recently in the possible use of western larch (Larix occidentalis) for shakes. I have been asked to comment on this from my considerable background of investigations at the U. S. Forest Products Laboratory into the natural decay resistance of woods.

Comparative tests that have been made, and general experience, indicate that the decay resistance of western larch heartwood is equal or possibly somewhat superior to that of Douglas-fir. Both woods are protected by the same natural preservative. I refer to Douglas-fir because it has been more extensively tested for durability than larch, and has been shown to be capable of giving long service in exposed situations above ground. For example, in field experiments lasting 15 years in western, northern, and southern United States, Douglas-fir exposure units consisting of small panels of flooring and of joint structures simulating such as formed in rail-to-post construction were in generally good condition at the end. Serious deterioration occurred only in flooring units in the dampest and warmest climate (annual days of rain - 124, average temperature - 55° winter, 80° summer).

Direct evidence that shakes of western larch can give excellent service was found in recent surveys by Mr. Ralph Peter of the U. S. Forest Service. Peter observed shake roofs east of the Cascade Mts. that were still comparatively sound several decades after installation.

The total evidence in comparative experiments and in service experience indicates, in my opinion, that shakes of western larch heartwood generally should last more than 20 years in areas with low to moderate rainfall. Such areas prevail in the wide expanse of country east of the Mississippi River except for the Pacific Northwest. I have prepared a "Climate Index" formula and map that should be useful for determining - if necessary - whether larch shakes might be used in a particular locality without concern about their lasting quality. It would be conservative at present to limit their use to places in which the climate index does not exceed 35. Near-maximum decay potential in U. S. climates is indicated by an index of 100.

It should be emphasized that the preceding comments pertain only to heartwood. Sapwood should be strictly excluded for roofing generally, because it has little decay resistance.

Redacted for privacy

Theo. C. Scheffer
Research Associate

PHOTOGRAPHS OF STRUCTURES

WITH WESTERN LARCH SHAKE ROOFS

Photo Locations

Ukiah, Oregon

1. Ebb Hughes cabin
2. The Pete Able place
3. Willie Briggs place
4. Meengs homestead
5. Pioneer cabin
6. Western larch rail fence
7. Collapsed shed

Naches - Ellensburg, Washington Area

8. Sprick residence
9. Nanum cabin
10. Dutch settlement cabin

Republic, Washington Area

11. Konz place
12. Young ranch
13. Forest Service shelter

Montana Area

14. Tom Peterson homestead
15. F. H. "Bignose" Johnson homestead
16. Axel Peterson homestead
17. Mark's place
18. Hugh Williams place

EBB HUGHES CABIN

This hunting cabin was built in the early 1930's. It is still furnished and in use.

The cabin is located in a narrow, wooded canyon within 50 feet of a fair sized trout stream. The location can be considered a relatively high decay hazard area. The pine foundation logs are severely decayed.

This roof is an excellent example of severe neglect. Moss, pine needles and dirt have been accumulating, apparently for years. In spite of this, the larch shakes are in excellent condition. Average thickness is one-half inch.

The right edge of the roof in the upper photo was damaged by a falling tree.

In the colored photo, reference the shake with the hunting knife. The left edge of this shake contains a narrow strip of sapwood. This is soft from decay. The heartwood is completely sound. No heartwood decay was found in any of the shakes except perhaps for about one-eighth inch of the exposed end-grain. Note the growth of moisture-loving moss.

Average annual precipitation -- 30 inches

Ebb Hugh's
Cabin

"The Pete Able Place"

This barn was built by Tom Able, Sr., about 65 years ago. Foundation logs have decayed into the ground. Shakes are in excellent condition. Relatively little light can be seen through the roof from the inside. Pitch of roof appears to be shallower than normal. Even though it was raining, there was no indication of leakage.

Average annual precipitation -- 25 inches

"WILLIE BRIGGS PLACE"
AT
STARKEY FLATS

According to Mrs. Robena Yohn of Portland, Oregon, her father, Willie Briggs, homesteaded at Starkey Flats about 1895. Mrs. Yohn (age 69) does not remember when the "long shed" (Photo No. 1) was built. The "big barn" (Photo No. 2) was built about 1914. Mrs. Yohn thinks her father cut the larch shakes from dead trees, "because they split easier."

Photo No. 1 - Larch shakes are in poor condition. Some are spongy because of decay. Back side of roof has lost about one-third of the shakes.

Photo No. 2 - Larch shakes on barn are in very sound condition. Very few shakes have been lost to the winds. Only minor repair needed.

Photo No. 3 - Western red cedar shingles on left building are almost gone.

Photo No. 4 - General view of area.

Photo No. 1

Average annual precipitation -- 25 inches

"WILLIE BRIGGS PLACE"
AT
STARKEY FLATS

Photo No. 2

Photo No. 3

Photo No. 4

MEENGS HOMESTEAD

Mr. Raymond Meengs was interviewed at his present residence in Ukiah, Oregon.

Mr. Meengs stated that he homesteaded at Bridge Creek Flats in 1910 and built the barn about 1920-21 using larch shakes. He moved away about 1925 and for a few years had the place rented. It has been more or less abandoned since then. Mr. Meengs stated he used manufactured shingles on the main house because he did not have time to split shake. He was working at a local sawmill and wanted to move into the house as soon as possible.

The cedar shingle roof of the residence (no photo taken) is gone and the building is in very poor condition. The remains of the front door panels were deeply etched by the sandblasting effect of blowing sands.

The larch shake roof of the barn is in very good condition and would require only minor repair to seal the few cracks. (See lower photo).

Average annual precipitation -- 22 inches

MEENGS HOMESTEAD

PIONEER CABIN

This cabin is believed to be more than 100 years old. Scribed into a siding shake above the door on the far side is: "Wayne Chapman 10/19/08."

Western larch shake in relatively good condition considering age. Back side has more shake loss. Resistance to weathering (wind, sand, sun, snow) and not decay appears to be the critical factor determining service life.

The foundation logs have decayed into the ground and the cabin is resting on the second course of logs.

Average annual precipitation -- 30 inches

Base of post decayed.
Meandering stream,
over the years,
washed out base.

Rail completely
sound under
weathered surface.
Note heavy lichen
growth.

WESTERN LARCH RAIL FENCE AT UKIAH, OREGON

This fence illustrates the durability of western larch for off-ground use. A Mr. Faye Metty who would be about 90 years old and who drove stagecoach, was quoted as saying that he played on this fence as a boy.

Average annual precipitation -- 25 inches

WESTERN LARCH SHAKE ROOF OF A COLLAPSED SHED
ALONG HIGHWAY 395 NORTH OF UKIAH

Shed collapsed because of decayed pine pole supports. Age is unknown.

Relatively little decay of shakes was noted. It was raining as this photo was taken. Several shakes were removed for inspection. Even though the under course shakes were wet from the rain, little or no decay was found. Greatest deterioration is due to weathering. Average shake thickness is only three-eighths of an inch.

Note the small amount of overlapping between courses. Also note the face nailing. The use of extruded nails indicates construction some time after the turn of the century - a good guess might be 1915-1930.

Average annual precipitation -- 30 inches

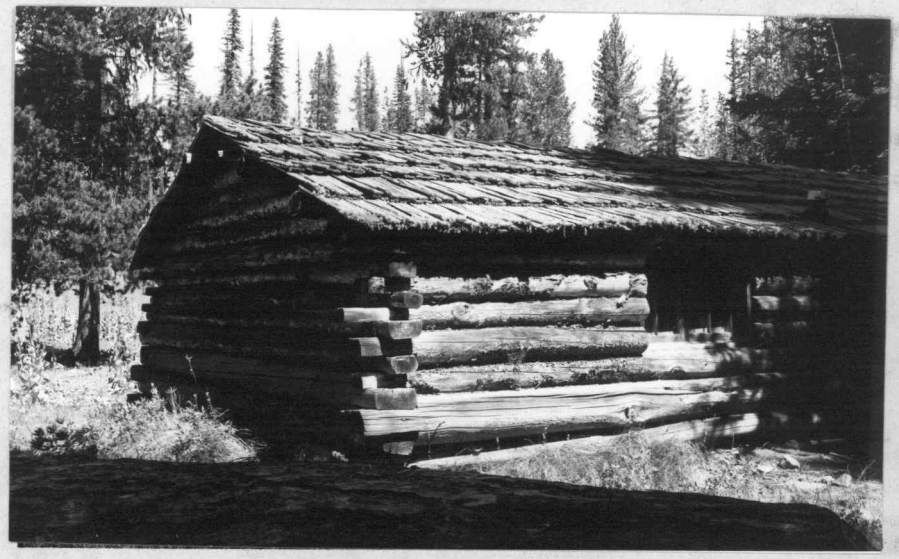
SPRICK RESIDENCE, NACHES, WASHINGTON

This small residence was built in 1946. The shakes are 3/8" to 1/2" thick, 30" long with 14" to the weather. Larch shakes are in excellent condition.

Back side of roof of above building. This face is 60% cedar and 40% larch.

Average annual precipitation -- 15-20 inches

AREA NORTH OF ELLENSBURG, WASHINGTON



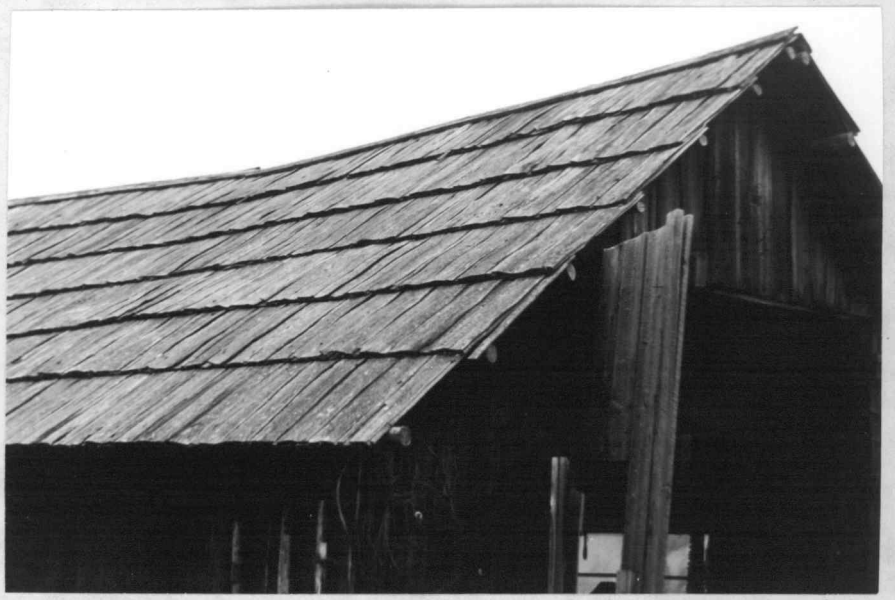
Nanum cabin, 17 miles N. of Ellensburg. This cabin is known to be at least 50 years old. The 3/8" to 1/2" larch shakes are in good condition with only little decay noted. Cabin is open and used by hunters for shelter.

This cabin is part of an old Dutch settlement and believed to have been built in the 1880's. It has been reroofed at least once. The shakes are pine.

Average annual precipitation -- about 20 inches

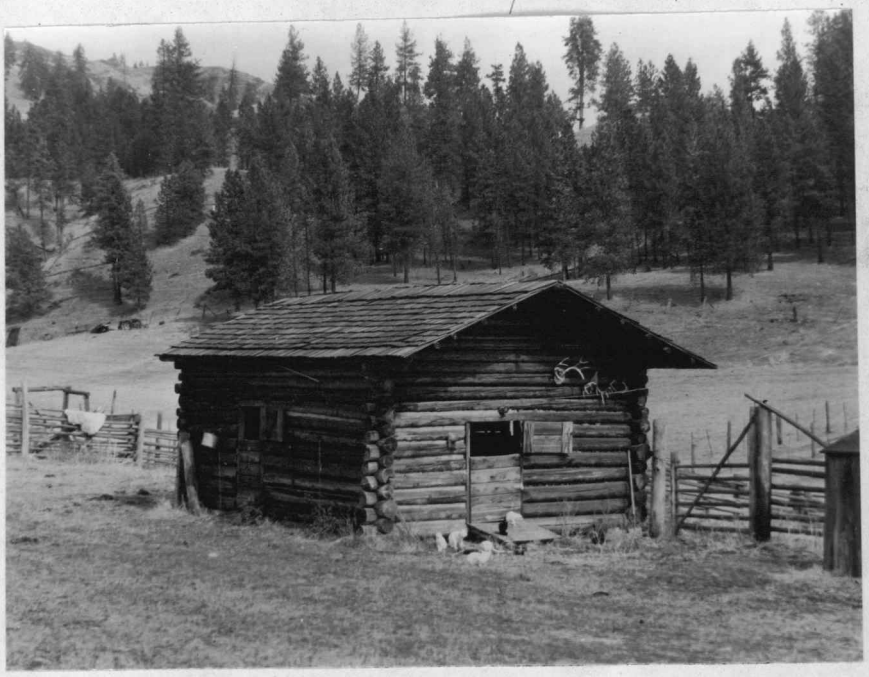
KONZ PLACE, REPUBLIC, WASHINGTON

Cabin built in 1932. Larch shakes are 1/4" - 3/8" thick, 28" long with a 4" lap between courses. Some shakes have spots of decay. Wood species of decayed ridge board is unknown.



Tool building constructed in 1938. Shakes are in very good condition. Shake thickness and roof construction is same as above.

Average annual precipitation -- about 20 inches



Young ranch at Republic, Washington. Fifteen year old larch roof is in excellent condition. Shakes average 1/2" thick and are 20" long with 5" lap between courses.

Average annual precipitation -- about 20 inches

Forest Service shelter with larch roof. Structure was built by C.C.C. crews in 1934. Shakes are 3/8" - 1/2" thick. A few decayed spots are noticeable. Structure is located at Swan Lake 16 miles south of Republic, Washington.

Average annual precipitation -- about 35 inches

NORTH FORK OF THE FLATHEAD RIVER VALLEY

MONTANA

Photo No. 1 - Tom Peterson place. Homestead patent filed 1924. Buildings were constructed 1925-26. Photo shows residence and some outbuildings. Logs and shakes are larch and in excellent condition with only very minor indication of decay. Shakes are 24" long, 3/8" to 1/2" thick, and 4" lap between courses. Residence is still used as a vacation home.

Photo No. 2 - Barn at Tom Peterson place. Shakes and logs in excellent condition.

Photo No. 3 - F. H. "Bignose" Johnson filed homestead patent December 30, 1911. Building was constructed 1912. This place is within one mile of the Tom Peterson homestead and only about 13 to 14 years older. The small age difference does not account for the two extreme roof conditions. The shakes on this roof are only 1/4 inch thick. This thinness greatly reduced the weathering resistance and probably was the major contributing factor to the poor condition. Hole at ridge of roof was caused by fire.

Average annual precipitation -- 30-40 inches

Photo No. 1

Photo No. 2

Photo No. 3

North Fork of the Flathead River Valley, Montana

NORTH FORK OF THE FLATHEAD RIVER VALLEY
MONTANA

Photo No. 1 - Homestead patent filed by Axel Peterson March 3, 1915. Cabin built the same year. Larch shakes are 1/2" thick, 22" long with a 5" lap between courses. This cabin is within 5 miles of the Tom Peterson and "Bignose" Johnson homesteads.

Note the dead larch on hillside still standing from the 1910 - 1917 forest fires. The heartwood of these snags is still sound.

Photo No. 2 - Roof detail of above cabin. Shakes are in good condition. Compare this roof with "Bignose" Johnson's homestead which was built in 1912. This cabin is still used for vacations.

Photo No. 3 - Roof detail of low outbuilding at Mark's place. Built about 1916-18. Larch roof has a few decay spots.

Average annual precipitation - 30-40 inches

Photo No. 1

Photo No. 2

Photo No. 3

North Fork of the Flathead River Valley, Montana

HUGH WILLIAMS PLACE, LOLO, MONTANA

This haybarn was old when the Williams family moved onto farm in 1919. Barn built with square nails. Larch shakes in good to very good condition. There has been no maintenance by the Williams family.

Building on left was constructed in 1930 and the one on the right in 1945. Both larch roofs are in excellent condition. The 1945 roof looks almost new.

Average annual precipitation -- 14-16 inches per year

APPENDIX

Decay Potential Indexes Derived by the Weather Bureau from the Climate Index Formula*

Station List

State	City	D.P.I.
Arizona		
	Flagstaff	19.2
	Phoenix	6.7
	Prescott	25.7
	Tucson	27.2
	Winslow	15.9
	Yuma	0.0
California		
	Bakersfield	9.2
	Bishop	0.1
	Blue Canyon	12.3
	Burbank	9.1
	Eureka	41.4
	Fresno	9.1
	Long Beach	3.8
	Los Angeles	8.0
	Mt. Shasta	13.2
	Oakland	19.9
	Pt. Arguello	21.9
	Red Bluff	23.5
	Sacramento	15.8
	Sandberg	3.8
	San Diego	13.6
	San Francisco	19.4
	Santa Maria	11.7
Colorado		
	Alamosa	17.9
	Colorado Springs	35.3
	Denver	33.3
	Grand Junction	17.4
	Pueblo	30.5
Idaho		
	Boise	16.7
	Idaho Falls	8.6
	Lewiston	24.8
	Pocatello	14.3
Iowa		
	Burlington	46.6
	Des Moines	44.8
	Dubuque	39.9
	Sioux City	43.2
	Waterloo	35.0
Kansas		
	Concordia	43.0
	Dodge City	39.7
	Goodland	32.8
	Topeka	48.4
	Wichita	44.7
Michigan		
	Alpena	36.9
	Detroit	46.2
	Flint	39.5
	Grand Rapids	38.5
	Lansing	40.9
	Marquette	39.8
	Muskegon	37.0
	Sault Ste. Marie	34.0
Minnesota		
	Duluth	37.0
	Int'l. Falls	36.4
	Minneapolis	41.7
	Rochester	43.2
	Saint Cloud	38.0
Montana		
	Billings	29.0
	Glasgow	27.5
	Great Falls	28.5
	Havre	24.6
	Helena	28.3
	Kalispell	26.2
	Miles City	30.9
	Missoula	26.9

*States not shown have an index generally over 35.

Station List (cont'd.)

State	City	D.P.I.
Nebraska		
	Grand Island	39.6
	Lincoln	48.6
	Norfolk	38.1
	North Platte	35.1
	Omaha	47.3
	Scottsbluff	34.1
	Valentine	34.6
Nevada		
	Elko	6.6
	Ely	9.3
	Las Vegas	0.0
	Reno	2.5
	Winnemucca	6.6
New Mexico		
	Albuquerque	24.7
	Clayton	31.0
	Raton	34.9
	Roswell	20.3
	Silver City	35.3
North Dakota		
	Bismarck	33.0
	Fargo	35.2
	Williston	29.7
Oregon		
	Astoria	71.1
	Burns	9.0
	Eugene	41.4
	Meacham	18.8
	Medford	23.7
	Pendleton	21.0
	Portland	50.2
	Roseburg	44.0
	Salem	46.7
South Dakota		
	Huron	37.3
	Rapid City	35.7
	Sioux Falls	37.2
Texas		
	Abilene	31.1
	Amarillo	33.5
	Austin	46.6
	Brownsville	43.0
	Corpus Christi	43.9
	Dallas	38.6
	El Paso	17.6
	Houston	76.5
	Loredo	28.0
	Lubbock	26.2
	Midland	19.8
	Port Arthur	76.5
	San Angelo	22.6
	San Antonio	43.4
	Victoria	41.1
	Waco	38.5
	Wichita Falls	34.1
Utah		
	Milford	7.1
	Salt Lake City	19.8
	Wendover	4.2
Washington		
	Olympia	49.4
	Seattle	49.7
	Spokane	19.9
	Stampede Pass	27.8
	Tatoosh Island	67.5
	Walla Walla	26.6
	Yakima	8.2
Wisconsin		
	Green Bay	37.3
	La Crosse	44.8
	Madison	39.5
	Milwaukee	35.6
Wyoming		
	Casper	22.0
	Cheyenne	34.9
	Lander	14.3
	Sheridan	29.4

Summer Temperature Data at Ukiah, Oregon*

Month	Temperature F°	
	Average Maximum	Maximum
June 1969	76.0	91
July 1969	81.1	92
August 1969	82.5	100
September 1969	74.6	95
October 1969	53.1	72
April 1970	47.2	66

*U.S. Forest Service, Ukiah Ranger District.

Ukiah, Ore.
June 10, 1970

To whom it may concern.

This is to certify that I built my main house on Bridge Cr. flats in 1910. It had a cedar shingle roof. The barn I built about 1920-1. It had a tamarak roof which I split from green logs.

I used tamarak because everybody in the area knew it to be durable. All the fences were made from tamarak and most of the early pioneer homes (roofs).

Nachos Wash
Aug 11, 1976

To Whom it May Concern:

I built a small one story residence in 1936 used primarily tamarack hand split shake; the back slope contains 60% cedar and 40% tamarack.

The two story building I built in 1954; the lower roof is tamarack and the upper roof is cedar.

Redacted for privacy

Ebb Hughes Cabin

The hunting cabin on my place was built in the early 1930's. The cabin is at the old A.L. Moore saw Mill site In resent years it is called Rot-Tail Lodge

Redacted for privacy

July 8, 1970

Mrs. Tom Able Sr. 82 yrs. moved to the Osker Coombs place when she was 17 yrs old. She said They built the main barn at that time.

Redacted for privacy