LARCH IN RUSSIA

Introduction

Larch *(Larix)* is the main wood species in Russia. It occupies nearly half of the coniferous forests. The main stocks of larch wood are in East Siberia and in the Far-East.

In the Middle Ages, larch wood was widely used in the construction of buildings, ships, bridges, etc. Wooden buildings and churches more than 300 years old can be found in Russia. Before 1862, in Arkhangelsk, 500 military ships were built of larch wood. Larch was widely used for many buildings and roads too.

Larch has some positive properties which make it possible to use as a structural material. This wood is characterized by very high mechanical properties, which are 30-60% higher than those of pine. Larch heartwood has a high decay resistance, due to its density and large natural resins content.

Despite its growing stocks, high mechanical properties, and decay resistance, the logging of larch does not exceed 5% of the total volume of logging and industrial use in Russia. One of the reasons for larch wood's limited industrial use is the difficulty connected with its treatment, which is a result of the wood's structure.

Larix sibirica Ldb and *Larix daurica tursz* are two larch wood species which are widely grown in Russia. Of the many positive properties they share, the main advantage is their natural decay resistance. Such high decay resistance and perfect mechanical properties make it possible to use this wood in different fields.

It's widely known that the European larch wood, *L deciduas mill,* also has a high natural decay resistance. However, Siberian and Daurican larch still exceed European larch in this respect, thanks to those subspecies' greater density.

Historical data about larch wood's decay resistance

P.Pallas (1741-1811), a Russian academician, was one of the first scientists to notice the perfect decay and fungus resistance of larch wood. After some traveling in Siberia, he came to the following conclusion, "Larch wood doesn't decay, and that is why it is used for dams, bridges, piles, pipes for water moving, mills and barrels".

Contemporary historical literature gives us many examples of buildings, and both hand-made and manufactured articles, which were made in the 17th and 18th centuries. These constructions remain intact despite very harsh conditions. Some examples are as follows: the wooden towers in Jakutsk and Ilimsk, which were built in the 17th and

18th centuries; the remains of the Mangaseisk defenses (dated 1601); a dam on the Iset river in Yekaterinburg, which worked 240 years; several different buildings in Perm, Solikamsk, Cherdyn, Verkhoturie, and in many other cities and towns; etc.

Archived data shows that larch wood was the main building material used by the Russian navy in the 18th and 19th centuries. Larch proved a better choice than oak for those conditions.

It is very difficult to find wood in archaeological excavations. Specialists pay close attention to every find. Some perfectly preserved larch wood articles and constructions of Pazyryk barrows have been found in Russia, in the Altai Republic (180 km from Teletskoe Lake). These articles belonged to Scythian tribes, who lived there in the first thousand years A.D.

Growth of larch stock

The full stock of larch wood is more then 28 billion cubic meters. However, the distribution of larch forest in Russia is irregular, as shown in Table 1.

Table 1

Larch Stock Growth

Region	Forest Percentage	Stock Growth Percentage	Average growing stock, m^3 per ha
Vologda, Arkhangelsk, Komi, and Central Region	0.16%	0.2%	106
Ural	0.04%	0.05%	159
Western Siberia	1.9%	2.15%	131
Eastern Siberia	78.5%	77.0%	102
Far-East	19.4%	20.6%	110

More than 95% of the total growing stock of larch is in Eastern Siberia and in the Far-East. There are more than 10 species of larch in Russia (*L siberica, L decidua, L. dahurica, L sucachevii, L lubarskogo, L. primorskaja, L olchinskaja,* and others). But the quantity of these subspecies of larch wood differs. *L. daurica* occupies about 86% of total Russian forests. Nearly 13% is *L sibirica*. And only 1% is occupied by other subspecies.

Structure of larch wood, and its physical and mechanical properties

Larch trees can be 30-45 meters high and up to 1 meter in diameter. The average diameter of larch wood for industrial use is 30-40 cm. Some data about larch trees is given in table 2.

Table 2

Relative Volumes of Different Parts of Tree

Wood species	Volume of different parts of tree,%		
	trunk	branches	roots
Larch spp.	77-82	6-8	12-15
Pine spp.	65-77	8-10	15-25
Birch spp.	78-90	5-10	5-12
Beech spp.	55-70	5-10	20-25

There are some specific characteristics of larch wood structure. It has a very thin layer of sapwood which is about 8-20 mm in total diameter. The width of the annual ring is 0.4-2.2 mm and depends on growing conditions and the age of the tree. The width of late wood can be from 0.07 to 0.76 mm, to 20-30% of the full width of the annual ring. The quantity of late wood can reach 39% for larch, 31% for silver fir (Siberian), and 27% for Siberian pine. This characteristic is the main reason for the mechanical properties of larch.

The main component of coniferous wood is its tracheids. Tracheids are more than 90% of the volume of the wood. The sizes of tracheids of some coniferous species of wood are shown in table 3.

Table 3

Tracheid Sizes in Some Coniferous Species of Wood

Species of wood	The sizes of the cross section of tracheids, mkm						The length of the tracheids, mm
	radial		tangential		The thickness of the wall		
	early wood	late wood	early wood	late wood	early wood	late wood	
Larch[1] spp.	52,4	21,8	32,0	27,4	3,3	6,6	2,6
Pine[2] spp.	40,0	20,0			2,0	5,5	2,8
Pine[3] spp.	40,9	19,7	29,4	32,5	1,5	5,9	
Spruce[4] spp.	35,0	13,0			2,2	3,9	
Spruce[5] spp.	45,0	22,0			3,0	5,0	

*Note: data presented by: 'Vikhrov V. E.; z Perelygin L. M.; 3 Moskaleva V. E.; 4Gartman A. N.; 5 Melekhova T. A.

There are big differences between early and Late wood. As a result, the physical and mechanical properties of early and late wood differ too (table 4).

Table 4

Physical and Mechanical Properties of Larch Wood's Annual Ring

Name of the property	Average meaning of:	
	early wood	late wood
Density, kg/m^3		
at: moisture content = 0	362(383*)	863
moisture content A max	1030	1090
Max moisture content%	206	80
Shrinkage,%		
full	13.43	22,8
tangential	7.87	13,9
radial	1.57	7,1
Quantity of pores,%	66(75.3*)	21(46,7*)
Tensile strength along o/grain, MPa	44.2*	151,0*
Bending strength, MPa		
at: moisture content = 9%	48.3*	259,0*
moisture content >=30%	25.8*	104,7*

*Note: data presented by Vikhrov V. E.

Results of investigations of larch

Investigations of natural larch wood decay resistance were carried out during the 1960s by scientists of the USSR Academy of Science (Institute of Forest and Wood), and the Siberian Technological Institute. Telegraph poles were used for this research work. These investigations showed that the average duration of natural larch wood pillars is 19-23 years in the Abakan region, and 24 years in the Krasnojarsk region. The first sign of dilapidation was visible after 4 years of exploitation. During 4-15 years of work nearly 10-20% of the telegraph poles were destroyed. After 25 years of exploitation, nearly 50% of the poles were still intact. It was noted that fungus attacks the sap of the wood. High heartwood resistance is what explains the wood's chemical structure and very low penetration ability for liquid and gas. As a result, the investigations concluded that wood resistance is dependant on the different types of soil where this wood is located.

More than a few thousand pillars were observed during these investigations, thus accounting for highly accurate data.

Samples for the tests were made from parts of a 230-year-old larch wood building in the city of Krasnojarsk. The results of the tests showed that the durability of this wood is 15-30% less when compared with the average data of larch wood in this region.

Larch use

Despite great growing stock, high mechanical properties and decay resistance, the logging of larch does not exceed 5% of the total volume of logging and industrial use in Russia. In the last 5 years, wood logging in Russia was reduced from 380 million m3 to 150 million m3 per year. From these 150 million m3, larch accounts for nearly 7 million m3. Most of this larch wood is exported, especially to Japan.

One of the reasons for the limited industrial use of larch wood is the difficulty connected with its treatment which results from the wood's structure. Some properties have negative effects on treatment. The main ones are as follows:

- high density, and the large difference between sapwood and heartwood density and the density of late and early wood;
- large differences between the physical and mechanical properties of the heart wood and sapwood, and the early and late wood;
- high content of- natural resins and gum (about 22.6% in *L.daurica*);
- lowest vapour and gas penetrating ability.

Some results of these properties are:

- fast obstruction (pitching) of tools. During sawing, for example, resins and gum get stuck between the teeth of the saw and this makes sawing impossible;
- big internal stress and deformation during drying and pressing, which results in contraction cracks;
- low surface activity in finishing, resulting in glue bonds which are weaker than those of other wood species.

These are the reasons why larch wood requires special methods of treatment during sawing, rotary cutting, drying, gluing, and finishing.

Lumber production is described in detail, and the schedule of plywood manufacture is given.

Laminated veneer lumber (LVL) is one of the most progressive ways of structural lumber production, because the gluing makes it possible to get material of any length, width, and thickness.

Besides the fact that the strength of LVL is greater than that of lumber (sawn beam and sawn board), due to the even the spreading of natural defects - especially knots - laminated veneer lumber has fewer anisotropic properties than usual as a result of its structure.

Experimental work to produce LVL has been carried out on a large scale in the St. Petersburg Forest Technical Academy and the Bratsk plywood factory.

The main mechanical properties of the laminated veneer lumber from larch veneer are higher than those of pine veneer. Larch wood LVL has perfect mechanical properties (1.2-1.6 times higher than those of structural lumber), and it has less anisotropic properties due to the fact that some internal sheets of veneer have a perpendicular direction of grain in relation to those of outside sheets.

Source: LesPromInform.