

Modern Application of the Traditional Log Construction Technique

Jari Heikkilä

University of Oulu, Department of Architecture, Oulu, Finland

ABSTRACT: The Finnish building tradition is based on log construction. Finnish log construction has been influenced by both the west and the east. Log construction has developed substantially over hundreds of years. Traditional log construction has been characterised by a simple box-type structure and advanced wood joining techniques. The log construction tradition diminished in the 1900s, but did not break entirely. Log construction has continued in leisure time housing and evolved from handwork to industrial activity. The architectural quality of new log construction has remained low. Wood studio of the University of Oulu has developed the architecture of industrial log construction. Modern log construction should still be characterised by a simple box-type structure. The industrial processing of logs and wood-gluing techniques enable solutions that avoid the technical problems of traditional log construction. The future of modern log construction is good in domestic construction as well as for export.

1 TRADITIONAL LOG CONSTRUCTION

1.1 Early history of log construction

Finland is located in the northern coniferous forest belt of the world. Wood has always been a natural building material in Finland because it has been available everywhere and has been easy to work. The first wooden dwellings were lightweight and movable. When people began living in permanent settlements, they began building fixed dwellings from tree trunks, i.e. logs. This way of building based on the corner joints of horizontal logs was adopted in the seventh century AD. This way of building came to Finland from abroad; influences came from the east as well as the west. Logs were formed into simple four-corner dwellings. The way of building was almost entirely single-material, as the other elements, such as doors and roofs, were also made of wood. The problem was in making the horizontal joint tight between the naturally shaped logs. At first the joints were sealed with clay. A revolutionary development step took place when a dual-spike marking tool was introduced to Finland in the 1100s. This made it possible to mark the shape of the top surface of the lower log unto the bottom of the upper log. When the upper log was hewn according to this tracing mark, the logs settled compactly on top of each other. The joint could furthermore be sealed with stuffing made of natural material such as moss. The log corners were hewn so that the crosswise logs were locked together by the extruding ends of the corners (Heikkilä 2001).

For a long time, log buildings were only single-room log frames, whose size was determined by the length of the log frame. The buildings had dirt floors and the interior was open all the way up to the roof. When there new needs for living arose, a new log frame was always built to fulfil the need. In fact, the Finnish tradition is characterised by a large number of buildings in the same courtyard area. The courtyard areas of the wealthiest households might have more than 30 log buildings. Although these buildings are simple and downright ascetic in their lack of

decoration, they nevertheless formed rich and diverse groups of buildings and villages (Heikkilä 2001).

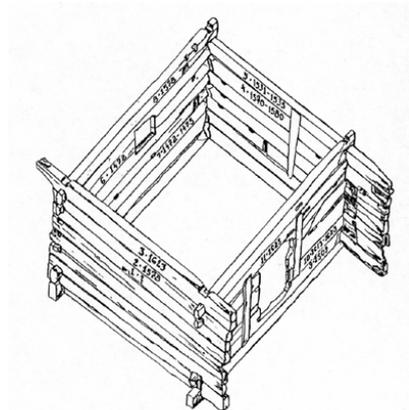


Figure 1: A simple four-corner log frame.

1.2 Development of traditional log construction in the 1700s

Later, the 1700s saw significant technical advancements in log construction. The dirt floor was replaced with a stone footing and a ventilated base floor, and the bottom side of the roof eventually evolved into a horizontal ceiling structure. Builders began to fill the horizontal floor and ceiling structures with insulation available from nature, such as turf or moss. The logs were now hewn straight, first inside, and later on the exterior as well. Builders learned to extend logs and were thus able to build larger buildings with more than one room. Log corners were made short without extruding log ends. This was desirable especially in town construction, where long corners were considered as a waste of space and rustic. To make the structures more air-tight, log walls were covered up with paperboard on the inside and with tarpaper and boarding. The boarding had a protective as well as decorative purpose, and made it possible to form the façade according to prevailing style ideals. The covering of log houses with boards became common slowly, and it was not until the 1800s that boarding became a common practice. In towns, log houses began to be painted with red ochre as early as the late 1600s. Painting spread from the towns into the countryside. Painting was often considered a luxury in the countryside, and the natural grey of wood remained the dominant colour. An essential part of log architecture was the porch, which was traditionally the only decoration of a log house. At its simplest, it was a pillared canopy in front of the door. In the 1800s the porch evolved into an enclosed structure and was furnished with several diamond-paned windows and was outright decorative (Heikkilä 2001).

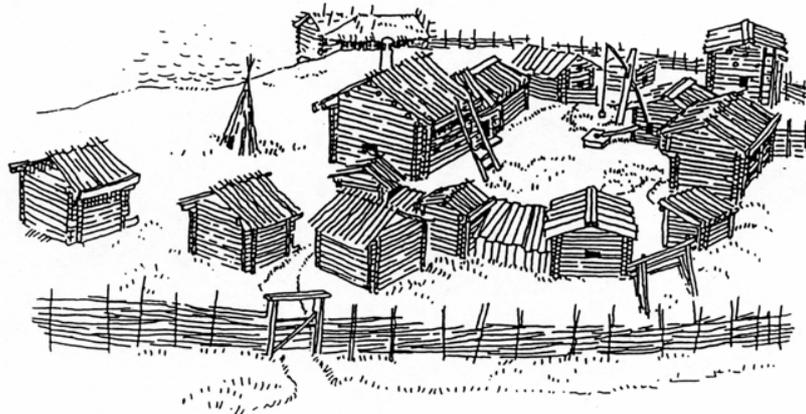


Figure 2 : Simple log buildings form a diverse group around a central courtyard. A traditional Finnish farmhouse.

All Finnish towns have been wooden towns, where the houses have been log buildings covered with boards. The buildings were essentially rectangular and the length of the log gave them a consistent scale. They were simple and uniform in shape. Also in town blocks there were numerous outbuildings. Finnish wooden towns can be considered unique and valuable world-wide (Heikkilä 2001). The best-preserved Finnish wooden town, Rauma, is on the UNESCO world heritage list. The same log building technique has also been used for Finland's oldest public buildings, such as churches, parsonages, schools, association houses and railway stations. In 1747 there were only 48 stone houses in total in Finnish towns. All other buildings were log-framed.

1.3 Duality of the log house tradition

Finland is situated along the border between the western and eastern log construction traditions. That's why log construction has evolved differently in different parts of the country. Most of Finnish builders have adhered to the log construction method described above, which has its roots in the west. It is characterized by a narrow building frame and a gently sloping roof. Corners were short and the log surface was hewn straight and painted. Later the houses were covered with boards. The most beautiful instances of the western tradition were the two-story Ostrobothnian houses. The boarded log houses of the towns were also based on this western influence. However, we must remember that the easterly parts of Finland were influenced by Russia. These areas had two-story Karelian houses, which had dominating roofs. The houses were made from round logs, had long corners and lacked surface treatment. The gable constitutes the most important façade of the Karelian house and is always richly decorated. The Karelian house is significant with regard to modern construction because it was the basis for the basic model of the Finnish cottage of the twentieth century (Heikkilä 2001).

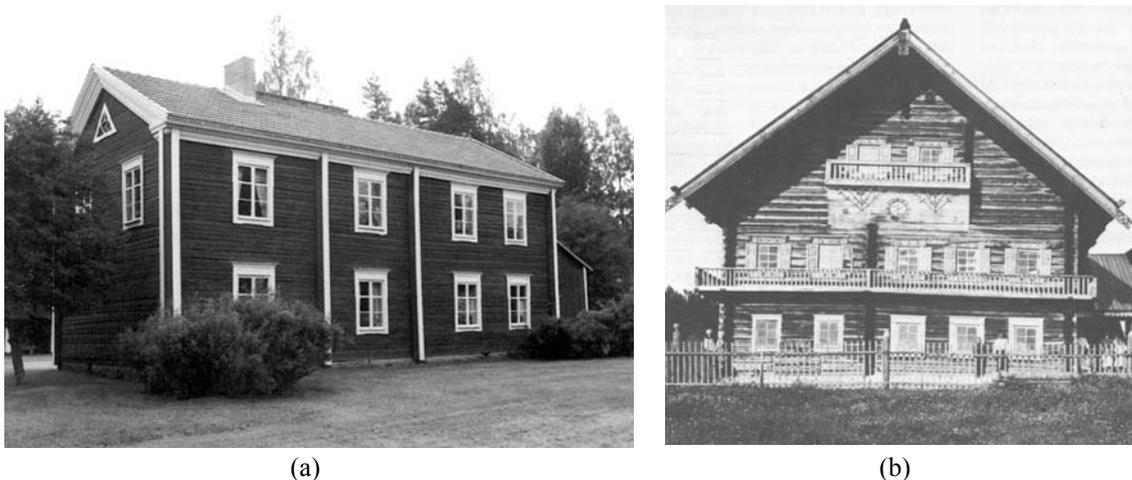


Figure 3 : The difference between the western and the eastern tradition; (a) an Ostrobothnian house; (b) a Karelian house.

An important period of time for the advancement of Finnish log architecture was the end of the 1800s and beginning of the 1900s. In that time the ideals of national romanticism emerged in architecture. Designers had got bored with international repetition styles. They began to seek roots for a new architecture from the country's own history. Finland, too, wanted to create wood architecture that was expressly Finnish. Thus began a search for the roots of Finnish architecture from among its own folk architecture, the national epoch Kalevala and the area of the Karelian region lying behind the Eastern border. Finnish architects and artists explored villages in Russian Karelia. They found grey, untreated log surfaces. The most beautiful place for the realisation of national romantic log architecture was in the wilderness studios of artists, which were based on visible log surfaces. National romanticism broke the long tradition of boarded log houses and gave the visible log surface a Finnish image. The era of national romanticism was not significant in terms of quantity, but it has substantially influenced the later development of

the log architecture of the 1900s and the image of log construction that continues to prevail (Heikkilä 2001).

1.4 Structural principle of traditional log construction

The traditional Finnish way of building log houses has been characterized by a simple, rectangular floor plan whose dimensions are determined by the length of the tree trunks. The log frame is a stiff box-type structure if its door and window openings are reasonably small. The joints of the logs are advanced wood joints. Overlapping logs are fitted tightly to each other and the joint is sealed with stuffing. Short log corners in particular require advanced woodworking skills in order for the indentations of the joints to tightly lock the intersecting logs to each other. Because they used fresh tree trunks for construction, the drying of the wood caused substantial technical problems. Logs in this kind of structure shrink, crack and twist as they dry. The drying of the logs makes a completed log wall settle. Builders learned this through experience and knew how to prepare for it. The time it took to build a building was inevitably long because finishing work could not be done until the log wall had settled after two or three warming periods. Weathering action erodes the soft surface wood of a natural log, especially on the sunny side of a building. As a result, builders began protect walls with boards. The boarding and paperboard layers used guaranteed the air-tightness of the log structure (Jokelainen 2005). Houses from the era of national romanticism, which left the log surface visible, strongly convey the richness of vivid natural material.

2 MODERN LOG CONSTRUCTION

2.1 Log construction tradition diminishes in the 1900s

The tradition of log houses covered with boards continued in Finland to the 1930s, when it was replaced by the American style lightweight timber-framed construction. The reason was the growing emphasis on the speed and affordability of construction. Lightweight timber-framed houses could be completed at once without having to wait for the log frame to settle before covering and finishing the walls. People began to think the log structure was outmoded and difficult. The saving of wood and the better thermal insulating quality of the lightweight timber frame also contributed to the displacement of log construction (Heikkilä 2001).

Although the tradition of log construction in Finland diminished, it was never entirely broken. Log construction continued even after the 1930s. There was an acute shortage of materials for the post-World War II reconstruction period of Finland; especially the nails needed for building the lightweight timber-framed houses were in short supply. Log construction, which was based on wooden joints, was once again an affordable way to build since wood and skills were still available. In the late stage of the war and after the war, log houses were made in a way reminiscent of serial production especially for the eastern border regions (Heikkilä 2001).

The log regained substantial status in the years following World War II, this time in leisure time construction. After the turmoil of war, people wanted peace and relaxation in the great outdoors. At the same time, the period of time after the war emphasised national heritage. The Finnish sauna gained status and the log, which was associated with Finnishness, was linked to the image of nature. Finns began to use logs to build first sauna buildings and later summer cottages. The style that has become the most popular is the architectural heritage of the eastern uncovered log, following the models from the era of national romanticism, because it is perceived to be Finnish in a special way. Leisure time log construction was initially handwork, but in the early 1950s logs began to be made industrially. At first, prefabrication was small in scale and modest. Log manufacturers began to create log cottage models to create a base for industrial production. Professional designers were not used in these plans, resulting in log cottages with low architectural level. Industrial production initially made use of natural wood, but logs were later also made of smaller timbers glued together (Heikkilä 2001).

2.2 Development of industrial log construction

After a modest start, the industrial production of logs has expanded. Companies specialised in log houses developed their production technology in the 1970s and 1980s. The modern log is a high-quality, accurately dimensioned and technically functioning product. The industrial log has almost entirely displaced handwork from log construction. As a result of the harsh economic recession that hit Finland in the early 1990s, the domestic leisure time construction came to a stop at that time. The log industry began to seek substitutive markets from exports, and was in fact successful. The export of log cottages began to go forward and as a result, the companies in that branch grew, the quality of production improved and technical solutions evolved. However, the architectural quality of log houses continued to be low. Industrial log cottages became assembly line products whose appearance was based on commercial nature romanticism and often on the round log of the eastern tradition (Heikkilä 2001). The cottage models were foreign to the Finnish tradition and often even to the structural principle of log construction. Therefore, technical problems appeared. The log frames might have too many openings, resulting in poorer stiffness. Solutions alien to the structural principle of log construction were also used in cottages, such as mixing the use of settling and non-settling structures. This resulted in opening joints and air leaks. To resolve these structural problems, builders had to add a lot of steel into log structures.



Figure 4 : A typical industrially manufactured log cottage.

In the mid-1990s Finnish state authorities launched several programmes to enhance the use of wood. These programmes aimed at increasing the use of wood, especially in construction, raising the level of know-how and degree of processing in the wood industry, and speeding up exports. From the basis of these efforts, Finland has indeed seen a renaissance in wood construction. New know-how in wood construction and new types of wooden buildings have emerged in Finland. The focus in the development work was on lightweight timber frame construction, but the improved image of wood also raised the appreciation of log construction. Finland has, almost unnoticed, grown into the world's leading manufacturer of industrial log houses. Over half of Finland's current log house production is exported to more than 60 different countries. The industrial log has become the most important export product of Finland's mechanical forest industry. The world's largest log companies and largest production facilities are located in Finland (Heikkilä 2001).

The demand for log construction has expanded from leisure time construction to permanent house building, from cottages to single-family homes. An increasing number of Finnish people building a single-family home would also like to build their permanent home from logs. According to a market survey, about 20% of builders of single-family homes are interested in the log as a building material. The background behind the wishes is appreciation for nature, Finnishness and heritage. The health effects of construction also contribute to these values because there is a continual debate in Finland about the effect of impervious vapour barriers on the quality of the interior air of wooden houses. Today about 8% of new single-family homes are log houses. The log has been the prevailing material used in leisure time living, as much as 70% of new leisure time buildings are made of logs. The low architectural quality of log buildings in

domestic residential construction has kept logs from becoming more popular. The log house models on the market are large summer cottages that don't meet the standards of construction supervision and planning authorities in towns and population centres. Log houses have been restricted to rural sparsely populated areas (Heikkilä 2001, Kuusisto 2002).

2.3 *Wood studio of the University of Oulu – developing modern log architecture*

It was in these circumstances that Wood studio, a wood construction research group from the Department of Architecture at the University of Oulu, became interested in developing log construction. There was a clear need to enhance the architectural quality of log construction so that log houses would also be accepted in population centres and towns. The underlying idea was that there is an honourable tradition of log construction in Finland and that Finnish towns have traditionally been log house towns. Why couldn't this still be possible? Wood studio launched research and development work that soon revealed that the technology required for log construction already existed. The issue was the development of architecture. It was apparent in the work that the ways to create modern log architecture could be found in the Finnish tradition. A modern log house can be created by modernising the tradition. The eastern round log heritage, which was characteristic of nearly all of the 1900s, should be discarded. Builders should learn from the western tradition, which the entire old town construction was based on (Heikkilä 2004, Riikola 2003).

Wood studio arranged design competitions for architecture students to create ideas for a modern log house. Model construction was carried out on the basis of these ideas, and the ideas were demonstrated to be possible by means of real practical projects. The result was a modern neutral town house that nevertheless has the strength of massive wood. The log surface in new houses can be left visible. It is not necessary to cover it with boards for protection as it was in earlier centuries. This kind of house follows the same shape as the traditional town house, but it does it with modern details. The houses are simple and lack decoration. Their floor design is rectangular and realises the traditional box-type shape, which is functional and appropriate in terms of structural technique. The houses are based on a new industrial way of building (Heikkilä 2004, Riikola 2003). The development work of Wood studio has also looked at building types that are larger than single-family houses.



Figure 5 : A modern log house has a simple four-corner log frame like the traditional houses.

2.4 *Structural principle of modern log construction*

The new log construction observes a new industrial way of building. However, the shape of the building has to be a traditional, simple rectangle. The log frame must still be a stiff box-like structure. The developed joints of new log construction can be made with new computer-controlled woodworking machines. The logs are tightly superimposed with tongue-and-groove in such a manner that sealing material can be placed into the joint. Corner joints are made tight, and it's even possible to make a modern short corner that locks the logs. The logs are made industrially

from dried wood and they are assembled by gluing together several laminated sections. This reduces warping. The logs don't crack and twist, and completed wall structures hardly settle at all. Wall structures are air-tight and have few structural problems. The log is also made weather-resistant when the laminated sections are placed in such a manner that the heartwood is on the exterior surface of the log. Thanks to their weather resistance and imperviousness, logs can be left visible without using cladding as a protector or sealant. Architecturally this enables a strong wood architecture in which a visible wood surface, perceived as Finnish, creates mood for interior spaces and honestly shows the structure outward. The overly uniform quality of structures can sometimes be considered an architectural problem. The effect of the surface is industrial flawlessness, since the logs lack the roughness and imperfections of natural wood.

Although new log construction is based on industrial manufacturing, traditional craftsmanship is also needed. Handwork is essential for the maintenance and repair of old log building stock. In this regard we are living in a critical time because there are fewer and fewer people proficient in old log working skills, and this expertise should be transferred to a new generation. Furthermore, it should also be possible to store information related to traditional log construction and use it to benefit the development of industrial log construction. Everyone probably understands that the only way to make large volumes is through an industrial way of building.

3 OUTLOOK FOR LOG CONSTRUCTION

Log construction is still a sensible and feasible way of building. The notion of the 1930s, that log construction is a difficult and obsolete way of building, has turned out to be incorrect. Log construction has been given a new industrial form that avoids the difficulties of traditional handwork. Experience demonstrates that sufficient thermal insulation and air-tightness can be achieved in the modern way of building. The method of building introduces a more massive wood alternative to frame construction, in which visible natural wood is the key architectural strength. There appears to be strong demand for this kind of natural, simple wood construction based on local tradition. The new neutral massive wood architecture is also accepted by authorities. The goal should be to create a modern log town. It looks like new log construction has new possibilities in Finland as well as the export market. The 1,400-year-old method of construction is alive and well in a new industrial version that nevertheless realises a structural form that is based on a long-lasting tradition.

REFERENCES

- Heikkilä, J. 2001. *Hirsi kaupunkiympäristössä – hirsiarkkitehtuurin kehittämishankkeen raportti*. Logs in Town Setting – Report on Log Architecture Development Project, Oulu University Press, Oulu. (in Finnish)
- Heikkilä, J. 2004. In *Search of Urban Log Architecture*. Proceedings of the 8th World Conference on Timber Engineering, WCTE 2004, June 14-17, 2004, Lahti, Finland. vol.3, p. 33-38
- Jokelainen J. 2005. *Hirsirakenteiden merkitys asema-arkkitehtuurille 1860-1950*. Significance of Log Constructions to the Architecture of Railway Stations 1860-1950. Oulu University Press. Oulu. (in Finnish)
- Kuusisto, R. 2002. *Teollinen hirsitalo – mielikuvien vanki? Tutkielma teollisen hirren materiaalimielikuvasta ja soveltuvuudesta nykyaikaiseen rakentamiseen*. The Industrial Log House – A Prisoner of Notions? A Thesis of the Material Notions of the Industrial Log and its Suitability for Modern Construction, Department of Architecture, University of Oulu, Oulu. (in Finnish)
- Riikola, P. 2003. *Moderni kaupunkihirsitalo – korttelisuunnitelma Jylkynkankaalle*, Oulun yliopisto Arkkitehtuurin osasto, The Modern Urban Log House – A Town Block Plan for Jylkynkangas, Department of Architecture, University of Oulu, Oulu. (in Finnish)

